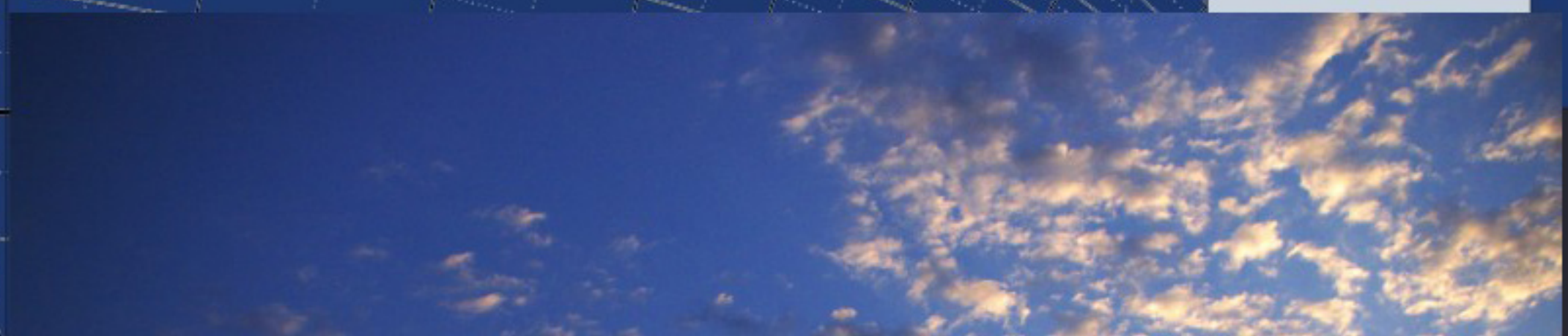
Usikov Institute
of Radiophysics and Electronics
NAS of Ukraine

VIII Kharkiv Young Scientist Conference "Radiophysics and Electronics, Biophysics"

November 25-27, 2008.



		Conference hall	Council room (2 floor)	Council room (3 floor)
Tuesday 25.11. 2008	8:00 - 9:00			**Registration of participants[1]**
	9:15 - 9:30	**Opening Ceremony**		
	9:30 - 11:30	**Plenary Session-1 (Prof. Rinkevich, Dr. Belov, Dr. Korsun)**		
	11:30-13:30	**Time for Lunch and Accommodation**		
	13:30-15:30	**Radars, Propagation & Remote Sensing (RPRS) -1**		**Solid-state Radiophysics (SSRM) -1 (Russian Session)**
	15:30-16:00	**Poster Session: RPRS +PME+SSRM/ Coffee break[2,3]**		
	16:00-18:00	**Radars, Propagation & Remote Sensing (RPRS) -2**		**Metamaterials(SSRM) -2 (Dr. Belov + English Session)**
	18:00-20:00		**Welcome party[3,4]**	
Wednesday 26.11. 2008	9:15 - 9:30			**III YSCD Workshop Opening**
	9:30 - 11:00			**Session I (Prof. Boeck, Dr. Vallecchi)**
	11:00-12:00			**Session II (Presentation IEEE, OSA, SPIE, LEOS)**
	12:00-13:00	**Time for Lunch**		**Chapters meeting / Coffee break[2,3]**
	13:00-15:00		**Biophysics (Bio) -1**	**Optics and Photonics (OP)-1 (Dr. Mergo + English Session)**
	15:00-15:30	**Chapters Poster Session +Bio Poster Sesion / Coffee break[2,3]**		
	15:30-17:00		**Biophysics (Bio) -2**	**Session III (Dr.Belov,Dr.Sakhnenko, Dr.Fesenko)**
	17:00-18:00			**Polish-Ukrainian Workshop**
	19:00-21:00	**Theatre of French Comedy [4]**		
Thurs Day 27.11. 2008	9:00-11:00	**Computational and experimental electromagnetics (CEE)-1**		**Optics and Photonics (OP)-2 (Russian Session)**
	11:00-11:30	**Poster Session: CEE+OP / Coffee break[2,3]**		
	11:30-13:30	**Computational and experimental electromagnetics (CEE)-2**		**Optics and Photonics (OP)-3 (Russian Session)**
	13:30-14:30	**Time for Lunch**		
	14:30-16:30	**Computational and experimental electromagnetics (CEE)-3**		**Optics and Photonics (OP)-4 (Dr. Mazikowski +English Session)**
	16:45-17:30	**Plenary Session–2 (Prof. Evstigneev)**		
	17:30-18:00	**Awards and Closing Ceremony**		

[1] *Participants registration is obligatory*

[2] *Lobby of the Council Room (3-rd floor of the Main Building)*

[3] *FREE for all registered participants of YSC'08*

[4] *Preliminary scheduled (can be modified later)*

90 РОКІВ

НАЦІОНАЛЬНА

АКАДЕМІЯ НАУК УКРАЇНИ

1918

Organizing Committee

Organizing committee co-chairmen:	*Yevginya Ermak,* e_ermak@ire.kharkov.ua
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Conference secretary	*Yevginya Minakova,* ysc08@ire.kharkov.ua

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Kuleshov Oleksii
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Ph.D. Shramkova Oksana
Ph.D. Shulika Oleksii (KNURE)
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D.Sc. Tarapov S.I.
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Brief information about IRE NAS Ukraine

Usikov Institute for Radiophysics and Electronics of the NAS of Ukraine (IRE NASU) is the first Academic Institute of Radiophysics in Ukraine, it was founded in September in 1955. The institute became the leading research centre with deep expertise in various fields, such as: millimeter and submillimeter wave radiophysics and electronics, interaction of electromagnetic waves with solid states and biological objects, radiowave propagation in the environment, radiophysics sensing of artificial and natural objects.

The most important achievements of the institute for last years are following:

- development of new methods of radiolocation used for designing of radiolocation systems for territories control, detection of alive people under ruins, subsurface remote sensing, monitoring of buildings condition
- designing of radiolocation monitoring from aerospace satellites used for monitoring and forecasting of floods, flowages and emergencies, and also for monitoring of vegetation, erosive processes and pollution of water surfaces.

The Institute is a founder of the following widely known scientific conferences: International Symposium „*Physics and Engineering of Millimeter and Submillimeter Waves*" (MSMW), International Conference „*Mathematical Methods in Electromagnetic Theory*" (MMET), and Annual Kharkiv Young Scientist Conference (YSC) which traditionally gather over 100 young scientists from different parts of Ukraine as well as from FSU and European Countries. All these conferences are aimed at development of favorable conditions of communication between Ukrainian scientist and the worldwide electromagnetic community. These events are traditionally supported by IEEE, OSA, SPIE, and URSI, EuMA societies.

Welcome note from the Organizing Committee

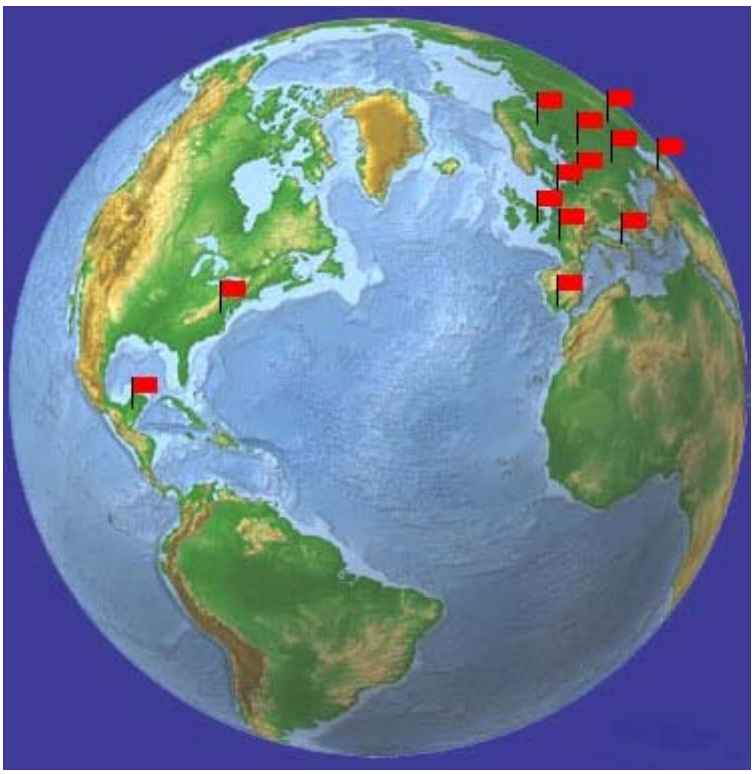
Dear Colleagues,

We are glad to welcome you at the VIII Kharkiv Young Scientist Conference "Radiophysics and Electronics, Biophysics" (YSC-08) held in IRE NASU, Kharkiv, Ukraine. This time our conference has traditionally attracted participants from many different institutions from Ukraine, Byelorussia, Russia, Armenia, European Community and USA.

We are very thankful to everybody for his/her interest to the YSC and believe that participation in the Conference will provide you with helpful experience and warm memories. We did our best to make the YSC not "just another conference" but a remarkable event in the life of each participant. We hope you will acknowledge and appreciate our efforts and will come back to us the next year.

YSC'08 Organizing Committee

Contents



	Conference and workshops/seminar geography - Country (city)	Number
1.	Ukraine *(Kharkov)*	68
2.	Ukraine *(Kharkov, Dniepropetrovsk, Donetsk, Lviv, Odessa, Sebastopol, Kherson, Chernivtzi, Uzhgorod, Yalta)*	43
3.	Byelorussia *(Minsk, Gomel)*	8
4.	Poland *(Lublin, Gdansk)*	7
5.	Russia *(Moscow,Tomsk, Novosibirsk, Ekaterinburg, Saratov, St.Petersburg)*	6
6.	Armenia *(Erevan)*	3
7.	Ukraine-Mexico	3
8.	Ukraine-USA	2
9.	England-Russia	2
10.	England-Portugal-Finland	1
11.	Armenia-France	1
12.	Germany *(Berlin)*	1
13.	Italy *(Florence)*	1
14.	USA	1
	Total :	147

Org Committee is grateful to the following for their support of the Conference: Institute of Radiophysics and Electronics NAS Ukraine (IRE NASU), OSA Student Chapter of Institute of Radiophysics and Electronics, SPIE Student Chapter of Institute of Radiophysics and Electronics, Joint OSA/SPIE Student Chapters of the Kharkiv National University, IEEE East Ukraine Joint Chapter, IEEE Student Branch "IRE-KHARKIV", IEEE MTT-S Student Chapter "IRE-KHARKIV-MTT", IEEE LEOS Stud. Chapter of Kharkiv National University of Radioelectronics

CONFERENCE PROGRAM

PLENARY SESSION - 1

Conference hall | Tuesday | 25.11.2008 | 9 :15– 11 :30

9:15 **OPENING CEREMONY**

ORGCOMMITTEE WELCOME NOTE

Ph.D. Ye.L.Ermak,

YSC-08 orgcommittee co-chairman

TOP ADMINISTRATION WELCOME NOTE:

Academician of NAS Ukraine V.M. Yakovenko,

Director of IRE NAS Ukraine

OSA/SPIE SEMINAR FOR YOUNG SCIENTISTS ON NANOPHOTONICS&METAMATERIALS

Conference hall | Tuesday | 25.11.2008 | 9 :30– 10 :30

9:30 10:00 **"INTERACTION OF ELECTROMAGNETIC WAVES WITH MAGNETIC METALLIC NANOSTRUCTURES"**

Prof., D.Sc., A.B. Rinkevich,

Head of the research laboratory, Institute of Metal Physics, Ural Division of Russian Academy of Sciences, Russia

SPIE VISITING LECTURER

10:00 10:30 **"EXTRAORDINARY PROPERTIES OF METAMATERIALS"**

Dr. Pavel Belov,

Post-doctoral Research Assistant, Dept. Electronic Engineering, Queen Mary University of London, England

OSA TRAVELLING LECTURER

STCU INVITED LECTURE

10:30 11:30 **" INTERNATIONAL TECHNOLOGY TRANSFER AND BUSINESS PLANNING"**

Dr. Vik Korsun,

STCU US Deputy Executive Director, USA

PLENARY SESSION - 2

Conference hall | Thursday | 27.11.2008 | 16 :45– 18 :00

16:45 17:30 **"MOLECULAR MECHANISMS OF REGULATION OF BIOLOGICAL ACTIVITY IN COMBINATION OF AROMATIC DRUGS"**

Prof. Maxim Evstigneev,

IEEE LEOS INVITED LECTURER

Associate professor, Department of Physics, Sevastopol National Technical University, Ukraine

17:30 18:00 **AWARDS AND CLOSING CEREMONY.**

SESSION:	**RADARS AND WAVE PROPAGATION & REMOTE SENSING 1**		
Conference hall		**Tuesday 25.11.2008**	**13:30 – 15:30**
1.	D.G. Vasiliev	JOINT CORRELATION PROCESSING OF THE SIGNAL INFORMATION RECEIVED BY SYSTEM OF SPACE DIVERSITY RADARS IN INTERESTS OF RECOGNITION	*Kharkiv Air Force University, Kharkiv. Ukraine*
2.	A.M. Gladishev	CONNECTION OF SPECTRAL-TIME CHARACTERISTICS OF THE CAR WITH THE DESIGN AND MODE OF WORK OF THE ENGINE	*Belarusian State University of Informatics and Radioelectronics*
3.	M.A. Durmanov	RADIATION FIELD OF COIL ANTENNA IN NEAR-FIELD	*Sevastopol National Technical University, Sevastopol, Ukraine*
4.	Yu.V. Levadnyi , V.K. Ivanov, V.N. Shalyapin	EFFECTS OF ROUGH SEA NON-GAUSSIANITY AND SHADOWING ON MICROWAVE PROPAGATION THROUGH EVAPORATION DUCT	*Institute for Radiophysics and Electronics of NASU , Kharkiv, Ukraine*
5.	I.V Lutsenko, V.I. Lutsenko	STUDYING OF TURBULENCE OF STORM CLOUDS WITH USE DOPPLER RADARS	*Institute for Radiophysics and Electronics of NASU , Kharkiv, Ukraine*
6.	I.V Lutsenko, V.I. Lutsenko, V.B. Sinitsky, E.V. Tarnavsky	USING OF GPS SATTELITE RADIATIONS FOR DIAGNOSTIC OF THE ATMOSPHERIC PROCESS	*Institute for Radiophysics and Electronics of NASU , Kharkiv, Ukraine*
7.	A.E. Mazgo, P.V. Petrov, D.V. Bobrov, N.N. Kolchevsky	REMOTE CONTROL SYSTEM FOR THE CALCULATION NUMBER OF THE STUDENT ON THE LECTURE WITH BLUETOOTH TECHNOLOGY	*Belarusian State University, Minsk, Belarus*
8.	S.A. Smirnov	RECONFIGURABLE WIDEBAND ANTENNA ARRAY OF CIRCULAR AND LINEAR POLARIZATION	*Dnipropetrovsk National University, Dnipropetrovsk, Ukraine*

SESSION:	**RADARS AND WAVE PROPAGATION & REMOTE SENSING 2**		
Conference hall		**Tuesday 25.11.2008**	**16:00 – 18:00**
9.	A.V. Sugak	USING THE PHASE STRUCTURE OF SIGNALS FOR ESTIMATING THE SOIL MOISTURE ALONG THE DEPTH IN GROUND PENETRATING RADAR APPLICATIONS	*Institute for Radiophysics and Electronics of NASU , Kharkiv, Ukraine*

10.	Cherniak Iu.V., Lysenko V.N.	THE OBSERVATION OF IONOSPHERE RESPONSE AT SOLAR ECLIPSE SOLAR ECLIPSE AUGUST 1 2008	*Institute for Radiophysics and Electronics of NASU , Kharkiv, Ukraine*

SESSION: SOLID-STATE RADIOPHYSICS -1

Conference hall (third floor) Tuesday 25.11.2008 13:30 – 15:30

1	A.A. Gorban S.A. Omelchenko M.F. Bulanyi V.A. Ogol	PHOTOLUMINESCENCE OF ZINC SULPHIDE CRYSTALS AT ACOUSTIC WAVES TRANSMISSION	*Oles Honchar Dnipropetrovsk national university*
2	M.V. Kirichenko R.V. Zaitsev V.R. Kopach	APPLICATION OF STEADY STATE PHOTOCONDUCTIVITY METHOD FOR CONTROL OF MINORITY CHARGE CARRIERS PARAMETERS IMPROVEMENT IN SINGLE CRYSTAL SILICON WAFERS	*National Technical University «Kharkiv Polytechnical Institute»*
3	Е.В. Кривенко[1], А.Я. Кириченко[1], В.И. Луценко[1], Г.В.Голубничая[1], Т.А. Жилякова[2]	РЕЗОНАНСНЫЙ МЕТОД ИЗМЕРЕНИЯ КОМПЛЕКСНОЙ ДИЭЛЕКТРИЧЕСКОЙ ПРОНИЦАЕМОСТИ ВИН	[1]*Институт радиофизики и электроники им. А.Я.Усикова НАН Украины* [2]*Национальный институт винограда и вина "Магарач" УААН*
4	K.S. Omelchenko M.D. Volnyansky	PHOTOLUMINESCENCE IN THE CRYSTALS OF LITHIUM-SODIUM TETRAGERMANAT DOPED BY MANGANESE	*Oles Honchar Dnipropetrovsk national university*
5	A.A. Stupka	MAGNETOHYDRODYNAMIC THEORY OF SOUND IN AMORPHOUS SOLID	*Oles Honchar Dnipropetrovsk national university*
6	K.I. Torokhtyi[1,2] A.A. Barannik[2]	QUASI-OPTICAL RING SAPPHIRE RESONATOR WITH CYLINDRICAL CONDUCTOR INSIDE	[1]*National Technical University "Kharkiv Polytechnical Institute"* [2] *Institute for Radiophysics and Electronics of NASU , Kharkiv, Ukraine*
7	P. S. Kharchenko	EIGEN FORWARD AND BACKWARD SURFACE WAVES IN THE PLANE-LAYERED STRUCTURE WITH METAMATERIALS	*Institute for Radiophysics and Electronics of NASU , Kharkiv, Ukraine*

8	O.V. Khmelenko S.A. Omelchenko	THE INCREASES OF THE ELECTRICAL CONDUCTIVITY OF THE ZnSe CRYSTALS, ENCOURAGED BY THE PLASTIC DEFORMATION	*Oles Honchar Dnipropetrovsk national university*

SESSION: METAMATERIALS

Conference hall (third floor) Tuesday 25.11.2008 16:00 – 18:00

1.	P.A. Belov[1] M.G. Silveirinha[2] Pekka Ikonen[3] Yan Zhao[1] C.R. Simovski[3] S.A. Tretyakov[3] Yang Hao[1] Clive Parini[1]	TRANSMISSION OF IMAGES WITH SUBWAVELENGTH RESOLUTION TO DISTANCES OF SEVERAL WAVELENGTHS IN MICROWAVE, TERAHERTZ, INFRARED AND VISIBLE FREQUENCY RANGES	[1] *Queen Mary University of London, UK* [2] *University of Coimbra, Portugal* [3] *Helsinki University of Technology, Finland*
2.	A.D. Arkhipov	ANALYTICAL METHOD OF INVESTIGATING A MEDIUM WITH ELECTRIC AND MAGNETIC ANISOTROPY UNDER AN OBLIQUE PLANE WAVE PROPAGATION	*Dnepropetrovsk National University*
3.	A.P. Balmakov I.V. Semchenko	POLARIZATION OF ELECTROMAGNETIC WAVES BY AN ARRAY OF DNA-LIKE HELICAL CONDUCTORS	*Francisk Skorina Gomel State University*
4.	S.P. Boruhovich A.V. Gribovsky	GEOMETRY OPTIMIZATION OF PERIODIC SCREEN CELL WITH TWO ORTHOGONAL RECTANGULAR WAVEGUIDES	*Institute of Radio Astronomy of NAS of Ukraine*
5.	O.V. Kostylyova A.A. Bulgakov	THE EXTERNAL MAGNETIC FIELD INFLUENCE ON THE PROPERTIES OF A FERRITE WAVEGUIDE LOCATED BETWEEN TWO LAYERED PERIODIC STRUCTURES	*Institute for Radiophysics and Electronics of NASU, Kharkiv*
6.	A.I. Pavlov	CONCEPTUAL MODEL OF A MAGNETODIELECTRIC SWITCH FOR GHz AND THz WAVEBANDS	*Kharkov National University of Radioelectronics*
7.	M.K. Khodzitskiy[1] A.V.Strashevskyi[2]	EXPERIMENTAL VERIFICATION OF LEFT-HANDED MEDIA PROPERTIES OF THE STRUCTURE (FERRITE/FLAT WIRES), PLACED INTO WAVEGUIDE AT THE FREQUENCY RANGE OF 21- 40 GHZ	[1]*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine* [2]*Karazin Kharkiv National University*
8.	Tomasz P. Warzocha	REVIEW ON MAGNETO-OPTICAL EFFECTS IN FERROFLUIDS	*Department of Theoretical Chemistry, Faculty of Chemistry Maria Curie-Sklodowska University*

POSTER SESSION:	**SOLID-STATE RADIOPHYSICS**		
Lobby		**Tuesday 25.11.2008**	**15:30 – 16:00**
1.	A.A. Bunyaeva	THE NONLINEARITY CONDITIONS IN THE MAGNETIC-RESONANCE EXPERIMENT	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
2.	R.V. Zaitsev M.V. Kirichenko V.R. Kopach	UNIVERSAL LIGHT SOURCE FOR COMPLEX SCIENTIFIC AND APPLIED RESEARCHES	*National Technical University «Kharkiv Polytechnical Institute»*
3.	T.V. Kalmykova	THE CELL OF MAGNETO-RESONANCE SPECTROMETER WITH BUILT IN REPER LABEL	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
4.	E.G. Plakhtiy V.O. Makarov O.V. Khmelenko S.A. Omelchenko A.G. Ivanitsa	THE RESEARCH OF THE PROPERTIES OF THE SODIUM-TUNGSTENBRONZES OBTAINED BY THE METHOD OF QUICK COOLING OF ALLOY	*Oles Honchar Dnepropetrovsk national university*
5.	A.J. Lyashko I.V.Gomilko T.M.Bulanaya	PROCESSING OF THE SIGNAL OF THE GAS SENSOR CONTROL BY MEANS OF THE METHOD OF CASCADE CORRELATION	*Oles Honchar Dnepropetrovsk national university*
6.	Yu.A. Tonkoshkur A.V. Degtyar'ov	MEASURING DEVICE OF POSISTORS' ELECTRIC TESTS ON THE BASIS OF THE MICROCONTROLLER	*Oles Honchar Dnepropetrovsk national university*
7.	E.A Yankovskaya[1] P.A. Belov[1,2] C.R. Simovski[1,3]	ESTIMATION OF MATERIAL PARAMETERS OF MULTILAYERED NANO-FISHNET METAMATERIALS	[1] *St.Petersburg State University of Information Technologies, Mechanics and Optics* [2] *Queen Mary University of London* [3] *Helsinki University of Technology*

POSTER SESSION:	**MICROWAVE AND SOLID-STATE ELECTRONICS**		
Lobby		**Tuesday 25.11.2008**	**15:30 – 16:00**
1.	A.V. Babich V.V. Pogosov	AN INFLUENCE OF BROADENING OF LEVELS AND ELECTRON OVERHEATING ON CURRENT-VOLTAGE CURVE OF TUNNELING STRUCTURES OF METALLIC CLUSTERS	*Zaporozhian national technical university*

2.	V.N. Varavin	PRINCIPLES OF CONSTRUCTION AND CALCULATION OF SUPPORTING SYNTHESIZER OF FREQUENCY	*National scientific center «Kharkov institute of physics and technology»*
3.	V. N. Zheltov A.I. Tsvyk	INVESTIGATION OF ELECTRON TRAJECTORIES IN OPEN RESONATOR OF DRO IN MM RANGE	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
4.	S.P. Repetsky[1], V.V. Lizunov[2], Yu.V. Karpenko[2]	SPIN TRANSPORT IN TRANSITION METAL ALLOYS	*[1]National Taras Shevchenko University of Kyiv* *[2]National Technical University of Ukraine "Kyiv Polytechnic Institute"*
5.	А.В.Федосов С.В. Луньов Д.А. Захарчук С.А. Федосов Л.І Панасюк.	ВИЗНАЧЕННЯ КОНСТАНТИ ЗСУВУ ДЕФОРМАЦІЙНОГО ПОТЕНЦІАЛУ В МОНОКРИСТАЛАХ n-Si ПРИ НАЯВНОСТІ РАДІАЦІЙНИХ ДЕФЕКТІВ	*Луцький національний технічний університет*
6.	D.G. Makarov V.G. Krizhanovskii V.A. Printsovskii	SIC MESFET CLASS E WIDEBAND POWER AMPLIFIER	*Donetsk National University*
7.	Yu. I. Gorobets S.A. Reshetnyak T.A. Khomenko	INFLUENCE OF NOT-IDEAL MAGNETIG PROPERTIES OF THE INTERFACE ON REFLECTION OF MAGNETOELASTIC WAVES IN THE FERROMAGNETICS	*National Technical University of Ukraine "Kiev Politechnical Institute"*
8.	Bulgakov A.A. Yefimov B.P. Kuleshov A. N. Khorunzhiy M.O. Khutoryan E. M	ELECTROPHYSICAL PROPERTIES OF DISCHARGE PROCESSES IN LIQUIDS	*A.Ya. Usikov Institute for Radiophysics and Electronics of NAS of Ukraine*

SESSION: OPTICS AND PHOTONICS -1

Conference hall (third floor) Wednesday 26.11.2008 13:00 – 15:00

1.	Paweł Mergo[1], Jan Wójcik[1]	FABRICATION AND CHARACTERIZATION OF SPECIALTY PHOTONIC CRYSTAL FIBERS	*[1]Department of Optical Fiber Technology, Faculty of Chemistry, Maria Curie-Skłodowska University,Lublin, Poland*

2.	V.O. Byelobrov	CHARACTERISTIC EQUATION OF THE LASING MODES OF INFINITE PERIODIC CHAIN OF QUANTUM WIRES	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
3.	Małgorzata Gil[1], Jan Rayss[1], Andrzej Gorgol[1], Wiesław Podkoscielny[1], Jan Widowski[1]	NEW POLYMER MATERIALS IN FIBRE TECHNOLOGY	*[1]Department of Optical Fibre Technology, Marie Curie Skłodowska University, Lublin, Poland*
4.	M.V. Klymenko	COHERENT ELECTRON TRANSPORT THROUGH INJECTORS IN THE QUANTUM-CASCADE STRUCTURES WITH VERTICAL TRANSITIONS	*Kharkov National University of Radio Electronics, Kharkiv, Ukraine*
5.	V.I. Lipkina[1], A.S. Gnatenko[1], I.V. Guryev[1], I.A. Sukhoivanov[1,2]	DISPERSION COMPENSATOR BASED ON 2D PHOTONIC CRYSTAL	*[1]Lab. "Photonics", KhNURE, Kharkiv, Ukraine [2]FIMEE, Universidad de Guanajuato, Salamanca, Mexico*
6.	K. Palanjyan, A. Zeytunyan, G. Yesayan, L. Mouradian	SELF-IMAGING OF NONLINEAR-DISPERSIVE SIMILARITON OF FIBER WITHOUT GAIN	*Ultrafast Optics Laboratory, Faculty of Physics, Yerevan State University*
7.	Elena I. Smotrova	LINEAR OPTICAL ANALYSIS OF MICRODISK LASERS CONCENTRICALLY COUPLED WITH MICRORINGS	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
8.	M.J. Vidil, S.L. Prosvirnin	ELECTROMAGNETIC EIGENWAVES OF PLANAR LAYERED METAL-DIELECTRIC STRUCTURE	*Institute of Radio Astronomy of NAS of Ukraine, Kharkiv, Ukraine*

SESSION: OPTICS AND PHOTONICS -2

Conference hall (third floor) Thursday 27.11.2008 09:00 – 11:00

9.	P.O. Angelsky, I.I. Mokhun	OPTICAL TRAPPING AND MANIPULATION MICRO OBJECTS WITH DIFFERENT OPTICAL CHARACTERISTICS	*Chernivtsy National University*

10.	R.A. Baskov[1, 2], O.O. Chumak[2]	THE EFFECT OF ATMOSPHERE TURBULENCE ON BROADENING OF LIGHT PULSES: LONG-DISTANCE PROPAGATION	*[1]National University of Kyiv-Mohyla Academy [2]Institute of Physics of the National Academy of Sciences*
11.	A.V. Burnashov	DETERMINTATION OF PARAMETERS OF THE LIGHT SCATTERED BY THE PARTICLES OF CIRRUS CLOUDS	*Institute of Atmospheric Optics*
12.	R.V. Golovashchenko	EXCITATION SYSTEM OF A DISK DIELECTRIC RESONATOR IN THE CRYODIELECTROMETER	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
13.	I.A. Kalinskiy, O.V. Martinov	DEVELOPMENT OF METHOD AND TECHNOLOGY OF SCATTERING MEASUREMENTS OF WATER IN SMALL-ANGLE RANGE	*Marine Hydrophysical Institute NAS Ukraine*
14.	Yu.V. Pilgun, E.N. Smirnov	SURFACE PROFILE RECONSTRUSTION FROM DIFFERENCE DATA FOR TWO-COORDINATE LASER SCANNING DIFFERENTIAL-PHASE MICROSCOPE	*National Taras Shevchenko University of Kyiv*
15.	I.S. Shelemba, S.A. Babin, M.A. Nikulin	METHODS OF ACCURACY IMPROVEMENT OF FIBER BRAGG GRATING SENSOR INTERROGATOR	*Institute of Automation and Electrometry SB RAS*
16.	D.V. Yakovleva[1], G.A. Tolkachenko[1], A.Smirnov[2],	COMPARATIVE ANALYSIS OF OPTICAL DESCRIPTIONS ABOVE BLACK SEA FROM DATA OF CIMEL AND MICROTOPS II	*[1]Marine Hydrophysical Institute NAS Ukraine [2] Biospheric Sciences Branch, NASA Goddard Space Flight Center, Greenbelt, Maryland, USA*

SESSION: OPTICS AND PHOTONICS -3

Conference hall (third floor) Thursday 27.11.2008 11:30 – 13:30

17.	G. Dovbeshko[1], O. Fesenko[1], V. Moiseyenko[2], V. Boyko[1]	SPECTROSCOPE FEATURES OF PHOTONIC CRYSTALS MODIFIED BY POLY-A	*[1] Institute of Physics of NASU [2] Dnipropetrovsk National University*

18.	A.A. Chernyshov	SINGULAR-OPTICAL SPECTRAL MODIFICATIONS OF THE SPECULARLY SCATTERED POLYCHROMATIC BEAMS	*Chernivtsi National University*
19.	A.V.Dubolazov, V.I.Istratiy	POLARIZATION METROLOGY OF MUELLER MATRICES IMAGES OF PHASE-INHOMOGENEOUS LAYERS	*Chernivtsi National University*
20.	A. O. Kovalchuk[1], V. V. Bobik[2], V. M. Solomaha[2], G. Yu. Rudko[1,3], S. A. Kovalenko[3], E. G. Gule[3]	ZINC OXIDE QUANTUM DOTS IN POROUS SILICA MATRICES	[1] *National University of Kyiv-Mohyla Academy* [2] *L. Pisarzhevskii Institute of Physical Chemistry* [3] *V. Lashkaryov Institute of Semiconductor Physics*
21.	S.N. Poperegay, D.L Kamenskiy, A.I. Kaplienko, V. I. Kutko	SPECTRUM OF LOW POWER EXCITATIONS Of CRYSTAL $KTm(MoO4)_2$	*B.I. Verkin Institute of Low Temperature Physics and Engineering, Kharkiv, Ukraine*
22.	K.P. Popovich	THERMOSTIMULATED LUMINESCENCE OF DOPED GLASSY LITHIUM TETRABORATE	*Institute of Electron Physics of NAS of Ukraine,*
23.	V.L. Derbov[1], N.I. Teper[2] ,	RESEARCH OF POPULATION DYNAMICS IN A HYDROGEN ATOM UNDER THE ACTION OF PULSE OF TI:SAPPHIRE LASER	[1] *Saratov State University,* [2] *Saratov State Socio-Economic University*
24.	D.A. Tsirkunov [1], S.Y. Prislopski[2]	INFLUENCE OF ANODIC ALUMINA PORES DIAMETER ON EUROPIUM LUMINESCENCE INDICATRIX	[1]*Belarusian State University of Informatics and Radioelectronics* [2] *B. I. Stepanov Institute of Physics of NAS of Belarus*

SESSION: OPTICS AND PHOTONICS -4

Conference hall (third floor) Thursday 27.11.2008 14:30 – 16:30

25.	A. Mazikowski	MULTIBAND SYSTEM FOR NON-CONTACT TEMPERATURE MEASUREMENT	[1]*Gdansk University of Technology, Poland*

26	A.A.Bolshakov, P.V. Petrov, N.N. Kolchevsky	CALCULATIONS OF THE OPTICAL CHARACTERISTICS OF THE X-RAY ADIABATIC MICROCAPILLARY LENS	*Belarusian State University*
27	V.O. Byelobrov	UNDERSTANDING THRESJOLDS OF MICROCAVITY LASERS THROUGH OVERLAP COEFICIENTS	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
28	Girich A.A.[1,2]	MODELLING OF SWITCHER WITH SEMICONDUCTOR ELEMENT CONTROLLED WITH STATIC MAGNETIC FIELD	[1] *Kharkov National University of Radioelectronics* [2] *Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
29	A.S. Gnatenko[1], V.I. Lipkina[1], I.V. Guryev[1], I.A. Sukhoivanov[2]	DEMULTIPLEXOR TO WAVE LENGTH BASED ON EFFECT OF THE SUPERPRISM	[1]*Lab. "Photonics", KhNURE* [2]*FIMEE, Universidad de Guanajuato, Salamanca, Mexico*
30	E. V. Goroshko, R. V. Golovashchenko	COUPLED DISK DIELECTRIC RESONATORS WITH WHISPERING GALLERY MODES IN THE MILLIMETER WAVE BAND	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
31	M. Kalashyan, K. Palanjyan, G. Yesayan, L. Mouradian	DISPERSIVE DELAY LINE VIA PHASE FOURIER SYNTHESIS	*Yerevan State University*
32	P.V. Petrov, A.A.Bolshakov, N.N. Kolchevsky	REFRACTIVE ADIABATIC MICROCAPILLARY LENS	*Belarusian State University*

POSTER SESSION: OPTICS AND PHOTONICS

Lobby **Thursday 27.11.2008 11:30 – 11:30**

1.	T.E. Remayeva[1], A.G. Nerukh[1]	CONSTRUCTION OF TIME - DOMAIN BASIS FOR SPHERICAL SYMMETRIC SOLUTIONS OF MAXWELLS EQUATIONS	[1]*Kharkov National University of Radio Electronics, Kharkiv, Ukraine*
2.	M. Kalashyan[1], T. Mansuryan[1], A. Zeytunyan[1], G. Yesayan[1], L. Mouradian[1], F. Louradour[2], A. Barthélémy[2]	SPECTRAL COMPRESSION AND SPECTRO-TEMPORAL IMAGING OF FEMTOSECOND PULSES BY SECOND HARMONIC GENERATION	[1]*Yerevan State University, Yerevan, Armenia* [2]*XLIM Institut de Recherche, Faculté des Sciences, Limoges, FranceF*

3.	K. Palanjyan, M. Kalashyan, G. Yesayan, and L. Mouradian	GENERATION OF FEMTOSECOND RECTANGULAR FOURIER TRANSFORM PULSES IN SPECTRAL COMPRESSOR	*Yerevan State University, Yerevan, Armenia*
4.	Skuratovskiy S.I., Kornienko Yu.V.	INVESTIGATION OF OBJECT IMAGE RESTORATION BY ITS SPECTRUM	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*

SESSION: BIOPHYSICS - 1

Conference hall (second floor) Wednesday 26.11.2008 13:00 – 15:00

1.	E.L. Usenko, V.A. Sorokin, V.A.Valeev	NATURE OF DIFFERENT EFECTS OF Mg^{2+} AND Ni^{2+} IONS ON AU→A2U (2→3) TRANSITION OBSERVED IN PHASE DIAGRAMS OF THESE ION COMPLEXES WITH POLYA·POLYU	*B.I. Verkin Institute for Low Temperature Physics and Engineering NAS of Ukraine, Kharkiv, Ukraine*
2.	K.V. Miroshnychenko	THE REPRESENTATION OF THE DNA DOUBLE HELICAL AXIS AS A BROKEN LINE WITH A MINIMUM NUMBER OF SEGMENTS	*Institute of Radiophysics and Electronics of NAS of Ukraine, Kharkiv, 61085, Ukraine*
3.	A.S. Khrebtova	SPECTROSCOPIC INVESTIGATIONS OF PROFLAVINE INTERACTION WITH DIFFERENT BASE COMPOSITION MATRIXES	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
4.	E.A.Minakova, E.B. Kruglova	INVESTIGATION OF ALKALI MONOVALENT IONS INFLUENCE ON THE LIGAND-DNA INTERACTION	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
5.	M.Yu. Tkachenko[1], O.P.Boryskina[1], M.Ye. Tolstorukov[2], A.V. Shestopalova[1]	INDIRECT MECHANISMS OF PROTEIN-NUCLEIC-ACID RECOGNITION: ANALYSIS OF PROTNA-ASA STRUCTURAL DATABASE	*[1] Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine* *[2] Harvard-Partners Center for Genetics and Genomics, Boston,USA*
6.	A.N.Zavilopulo[1], O.B.Shpenik[1], A.S.Agafonova[1]	IONIZATION OF GUANINE MOLECULES	*[1]Institute of Electron PhysicsNASU, Uzhgorod*
7.	Uljanov N.V.[1], Nechipurenko Yu.D.[1,2]	ANALYSIS OF LANGMUIR, SIPS, HILL ADSORPTION MODELS	*[1]Moscow State University of M.V. Lomonosov, Moscow, Russia* *[2] Engelhardt Institute of Molecular biology of RAS, Moscow, Russia*

8.	D.D. Andrejuk [1], A.A. Hernandez Santiago [2], M.P. Evstigneev[1]	INVESTIGATION OF THE HETERO-ASSOCIATION OF DIMETHYLXANTHINES WITH AROMATIC BIOLOGICALLY ACTIVE COMPOUNDS	[1] *Sevastopol National Technical University, Sevastopol, Ukraine* [2]*Autonomous University of Puebla, Mexico*

SESSION: BIOPHYSICS - 2

Conference hall (second floor) Wednesday 26.11.2008 15:30 – 17:00

9.	A.P. Balmakov, I.V. Semchenko	DNA AS A NATURAL SELECTOR OF POLARIZATION OF ULTRAVIOLET RADIATION	*Francisk Skorina Gomel State University, Gomel, Belarus*
10.	A.Y. Bordiuk, V.F. Kovalenko	RESEARCH INFLUENCE OF DECIMETRIC DIAPASON ELECTROMAGNETIC WAVES UPON STRUCTURAL FEATURES OF WATER	*Kherson National Technical University, Kherson, Ukraine*
11.	O.N. Zheryobkina, O.V. Kazanskiy	ELECTROMAGNETIC IMPULSE INTERACTION WITH BIOLOGICAL TISSUES ON THE FLATLAYERED DIELECTRIC AS EXAMPLE	*V.N.Karazin Kharkov National University, Kharkiv, Ukraine*
12.	V.G. Zobnina[1], E.N. Zhivotova[2], V.V. Chagovets[1], O.A. Boryak[1]	MASS SPECTROMETRIC STUDY OF INTERACTION OF AMINO ACID PROLINE WITH CRYOPROTECTORS BASED ON OXYETHYLATED GLYCEROL DERIVATIVES	[1] *B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine, Kharkiv,Ukraine,* [2] *National University of Pharmacy,Kharkiv, , Ukraine*

POSTER SESSION: BIOPHYSICS

Lobby Wednesday 27.11.2008 15:00 – 15:30

1.	S.V. Gorobets, O.Yu. Gorobets, O.N. Bylo, A.V. Medvedev	THE OBTAINING FUNCTIONAL COVERING OF HIGH GRADIENT FERROMAGNETTIC MATRIX (HGFM) FOR MAGNETIC SEPARATOR	*National Technical University of Ukraine "KPI", Kyiv, Ukraine*
2.	O.K. Zakharenko, V.M. Trusova, G.P. Gorbenko	SQ-1 AS A NEW MEMBRANE PROBE RESPONDING TO MODULATION OF PROTEIN-LIPID INTERACTIONS BY PHYSICAL FACTORS	*V.N. Karazin Kharkiv National University, Kharkiv, Ukraine*

3.	V.V. Kostjukov, N.M. Khomytova , M.P. Evstigneev	CONTRIBUTION OF CHANGE OF TRANSLATIONAL, ROTATIONAL AND VIBRATIONAL DEGREES OF FREEDOM TO ENERGY OF COMPLEXATION OF AROMATIC LIGANDS WITH DNA	*Sevastopol National Technical University, Sevastopol, Ukraine*
4.	Yu.I. Gorobets, M.M. Potyemkin, A.V. Sopina	APPLICATION OF MAGNETIC TWEEZERS IN MEDICINE FOR STUDYING AND TREATMENT OF ONCOLOGICAL FORMATIONS	*National Technical University of Ukraine "KPI", Kyiv, Ukraine*
5.	Gorobets S.V., Dvoynenko O.K., Mykhailenko N.O.	DETERMINATION OF THE MAGNETIC SUSPECTIBILITY OF A BIOSORBENT	*National Technical University of Ukraine "KPI", Kyiv, Ukraine*
6.	Gorobets O.Yu., Bondar I.A.	MODELLING OF TRAJECTORY ORIENTATION OF DIAMAGNETIC UNICELLULAR ORGANISMS IN STRONG MAGNETIC FIELDS	*National Technical University of Ukraine "KPI", Kyiv, Ukraine*
7.	O.P. Boryskina M.A. Semenov	MOBILITY OF NUCLEOBASES DURING DEHYDRATION OF DNA IN THIN FILMS	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*

SESSION: THEORETICAL AND EXPERIMENTAL ELECTRODYNAMICS - 1

Conference hall **Thursday 27.11.2008 9:00 – 11:00**

1.	M. Khruslov	COMPACT X-BAND COAXIAL MONOPOLE ANTENNA	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
2.	M.V. Balaban	EFFICIENT ANALYTICAL-NUMERICAL METHOD FOR THIN DISC SCATTERING PROBLEM	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
3.	O.Y. Galan	BASICS OF PARTICLE SWARM OPTIMIZATION ALGORITHM	*Karazin Kharkiv National University*
4.	Я.В. Дацко	ЧИСЛОВИЙ МЕТОД РОЗВ'ЯЗУВАННЯ ГІПЕРСИНГУЛЯРНОГО ІНТЕГРАЛЬНОГО РІВНЯННЯ ДЛЯ ЕЛЕКТРОМАГНІТНОГО ПОЛЯ У МЕТАЛІ З НЕСКІНЧЕННО ТОНКОЮ ТРІЩИНОЮ	*Фізико-механічний інститут ім. Г.В Карпенка НАН України, м. Львів*
5.	S.V. Dukhopelnykov	THE MATHEMATICAL MODEL OF SCATTERING WEAVES BY THE IDEALLY CONDUCTING CYLINDRICAL SURFACE WITH THE LONGITUDINAL SLITS ON THE DIELECTRICAL CYLINDER	*National Technical University «Kharkiv Politechnic Institute»*

6.	О.Л. Карпович, В.В. Кизименко	ЧИСЛЕННОЕ МОДЕЛИРОВАНИЕ РУПОРНОЙ АНТЕННЫ С ДИЭЛЕКТРИЧЕСКИМИ ВСТАВКАМИ	*Белорусский государственный университет информатики и радиоэлектроники*
7.	B.A. Kochetov A.Yu. Butrym	IMPULSE WAVE PROPAGATION IN RADIAL-INHOMOGENEOUS ASYMMETRICAL BICONICAL LINE	*Karazin Kharkov National University*
8.	M.N. Legenkiy A.Yu. Butrym	SOLUTION OF THE PROBLEM OF WAVEGUIDE OPEN END PULSE RADIATION BY METHOD OF MODE MATCHING IN TIME DOMAIN	*Karazin Kharkiv National University*

SESSION: THEORETICAL AND EXPERIMENTAL ELECTRODYNAMICS - 2

Conference hall **Thursday 27.11.2008 11:30 – 13:30**

9.	J.V. Mangushina A.V. Gribovskiy	THE ACTIVE PHASED ARRAY OF COAXIAL-SECTOR WAVEGUIDES	*Institute of Radio Astronomy of NAS of Ukraine*
10.	S.V. Nesteruk M.B. Protsenko	ELEMENT OF ANTENNA ARRAY WITH CONTROLLED RADIATION POLARIZATION	*Odessa National Academy of Telecommunications*
11.	A.Y. Popkov	SPECTRUM DESIGN OF ROTATIONAL SHAPED CAVITY RESONATORS	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
12.	S.A. Prikolotin	RESONANCE OF TOTAL REJECTION PRODUCED BY A THIN BAR IN RECTANGULAR WAVEGUIDE	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*
13.	I.Yu. Rozhnovskaya S.V. Nesteruk M.B. Protsenko	ELECTRODYNAMIC PROBLEMS OF MIMO TECHNOLOGY REALIZATION	*Odessa National Academy of Telecommunications*
14.	M.V. Rozhnovskiy A.M. Ivanitckiy	HOMOGENEOUS LINES WITH ARBITRARY LOSSES UNDER EXPOSINUSOIDAL EXCITATION	*Odessa National Academy of Telecommunications*
15.	S.S. Samoylyk V.P. Bondaryev	GOOD QUALITY OF THE RECTANGULAR FLOW RESONATOR WITH PARTIAL DIELECTRIC FILLING AT STRONG CONNECTION	*Zaporozhian national technical university*
16.	L.I. Stepanova S.V. Nesteruk M.B. Protsenko	SPATIO-TEMPORAL VARIATIONS OF THE POYNTING VECTOR IN THE NEAR ZONE OF TRANSMITTING ANTENNA	*Odessa National Academy of Telecommunications*

SESSION: THEORETICAL AND EXPERIMENTAL ELECTRODYNAMICS - 3

Conference hall **Thursday 27.11.2008 14:30 – 16:30**

17.	S.I. Taraban[1,2] A.I. Gubin[1]	REFLECTION FROM MATCHING SECTION LOADED BY INCLINED CONDUCTING SAMPLE IN REDUCED CROSS-SECTION RECTANGULAR WAVEGUIDE IN SECTION DECRISE WAVEGUIDE	[1]*Institute for Radiophysics and Electronics of NAS of Ukraine* [2]*Karazin Kharkiv National University*
18.	O. Trishchuk	CIRCULAR LOOP ANTENNA NEAR THE FINITE CONDUCTING CONE	*Karpenko Physico-Mechanical Institute of NAS of Ukraine*
19.	Shi He S.K. Katenev	MODELING OF A PERIODIC IRIS-LOADED CIRCULAR WAVEGUIDE H_{0I} – EIGENWAVES	*Karazin Kharkov National University*
20.	M.N.Maleyev	EXPERIMENTAL INVESTIGATION OF THE ELECTROMAGNETIC WAVE DIFFRACTION ON THE COMPLEX SHAPE ELEMENTS GRATING	*Karazin Kharkiv National University*
21.	R.E. Chernobrovkin	EFFECTIVE SMOOTH-WALLED SPLINE-PROFILE HORN FOR RADIO ASTRONOMY APPLICATION	*Institute for Radiophysics and Electronics of NASU, Kharkiv, Ukraine*

POSTER SESSION: THEORETICAL AND EXPERIMENTAL ELECTRODYNAMICS

Lobby **Thursday 27.11.2008 11:00 – 11:30**

1.	N.E. Gorokhovtsev S.V. Kuznetsov	THREE-AXIAL MEASURING INSTRUMENT OF THE MAGNETIC FIELD	*Sevastopol National Technical University*
2.	S.V. Kutsak, V. P. Bondaryev	H10 WAVE DIFFRACTION IN A RECTANGULAR WAVEGUIDE WITH IMPEDANCE NARROW WALLS PARTIALLY FILLED WITH DIELECTRIC	*Zaporizhzhya National Technical University*
3.	A.A. Stupka	NONLINEAR ELECTRODYNAMICS IN THE REDUSED DESCRIPTION METHOD	*Oles Honchar Dnipropetrovsk national university*
4.	E.S. Appazov	DEVELOPMENT OF THE TERMOPHOTOVOLTAIC AS AN ENERGY-SAVING TECHNOLOGY	*Kherson national technical university*

III Young Researcher Career Development Workshop :

bridging a gap between education and career in photonics and electromagnetics"

organized in the frame of YSC-2008, IRE NASU, Kharkiv, Ukraine

Dates & Venue: ***Wednesday, November 26, 2008, Institute of Radiophysics and Electronics***

Organized by :

Joint OSA/SPIE Student Chapter of Institute of Radiophysics and Electronics NAS Ukraine

Joint OSA/SPIE Student Chapter of V. Karazin Kharkiv National University

MTT-S Student Chapter "IRE-KHARKIV-MTT"

IEEE LEOS Stud. Chapter of Kharkiv National University of Radioelectronics

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OSA Advancing the Science of Light.

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Program of the Event

9:30 – 11:00 **Session I : Lectures on electromagnetics and photonics of IEEE Distinguished microwave lecturer and SPIE Visiting lecturer**

Design of integrated RF CMOS circuits.
Prof. Georg Boeck,

Technische Universitaet Chair, Microwave Engineering Lab Berlin, Germany

Planar designs based on tightly coupled scatterers for negative refractive index metamaterials.

Dr. Andrea Vallecchi,

Dept. of Electronics and Telecommunications, University of Florence, Italy

11:00 – 13:00 **Session II : IEEE / OSA / SPIE / LEOS Presentation**

11:00 – 12:00 *Presentation of societies benefits for students*

IEEE Benefits for Students: Dr. Konstantin Ilyenko, *Treasurer, IEEE East Ukraine Joint Chapter*

LEOS Benefits for Students: Sergei Gryshchenko, *President, IEEE-LEOS KNURE SC*

SPIE Benefits for Students: Katarzyna Koziel, *Representative, SPIE Gdansk SC*

OSA Benefits for Students: Anna Vozianova, *Representative, IRE-OSA SC*

12:00 – 13:00 *Presentation of Ukrainian/Polish/Russian OSA/SPIE/IEEE Student chapters in the format of "Round table"*

- OSA/SPIE Student Chapter of IRE NAS Ukraine / Kharkiv
  - Mikhail Khodzitskiy, President of IRE OSA Chapter
  - Maria Pashchenko, President of IRE SPIE Student Chapter

- OSA/SPIE Student Chapter of the Kharkiv National University / Kharkiv
  - Aleksii Galan, President of OSA Student Chapter
  - Alexey Simachov, Treasurer of OSA/SPIE Student Chapter

- IEEE IRE-KHARKIV MTT Student Chapter/Kharkiv
  - Maxim Khruslov, President of IEEE-MTT IRE Student Chapter

- IEEE LEOS Student Chapter of Kharkiv National University of Radioelectronics/Kharkiv
  - Sergey Gryshchenko, President of IEEE-LEOS KNURE Student Chapter

- OSA/ SPIE Student Chapter of Chernivtsi National University / Chernivtzi
  - Aleksiy Chernyshov, President of the CHU OSA/SPIE Student Chapter

- SPIE Student Chapter of Gdansk University of Technology/ Gdansk
  - Endward Marcin, President of Gdansk SPIE Student Chapter

- SPIE Student Chapter of Lublin University of Technology/ Lublin
  - Edyta Grzelak, Representative of Lublin SPIE Student Chapter

- OSA Student Chapter of St. Petersburg State University of Fine Mechanics & Optics
  - Elizaveta Yankovskaya, Representative of St. Petersburg OSA Student Chapter

Foods & Beverages from OSA/SPIE

15:30 – 17:00 **Session III: Career Development Masterclass**

Successful career in metamaterials

Dr. Pavel Belov,

Dept. Electronic Engineering, Queen Mary University of London, England

Successful career in optics and photonics

Dr. Natalie Sakhnenko,

Dept. High Mathematics, Kharkov National University of Radioelectronics, Ukraine

From student to professor

Dr. Vladimir Fesenko,

Lab. "Photonics", Kharkov National University of Radioelectronics, Ukraine

SPIE Polish-Ukrainian Workshop on «Photonics and Metamaterials»:

organized in the frame of YSC-2008, IRE NASU, Kharkiv, Ukraine

Dates & Venue: , November 25-27, 2008, Institute of Radiophysics and Electronics NASU

Organized by :

SPIE Student Chapter Institute of Radiophysics and Electronics

SPIE Student Chapter Lublin University of Technology

SPIE Student Chapter Gdansk University of Technology

LEOS Student Chapter Kharkov National University of Radio Electronics

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Program of the Event

25.11.2008 16:00 – 18:00 **Metamaterials Session** (*English Session*)

Transmission of images with subwavelength resolution to distances of several wavelength in microwave, terahertz, infrared and visible frequency ranges

Dr. Pavel Belov,

Dept. Electronic Engineering, Queen Mary University of London, England

26.11.2008 13:00 – 15:00 **Optics and Photonics – 1** (*English Session*)

Fabrication and characterization of specialty photonic crystal fibers

Dr. Pawel Mergo,

Dept. of Optical Fibre Technology, Marie Curie-Sklodowska University of Lublin, Poland

26.11.2008 17:00 – 18:00 **SPIE Polish-Ukrainian Chapter meeting**

Personal CV: "First step to success"

Sergey Mizrakhi, *Vice-President*, *IRE-OSA SC*

The various sources of funding available for projects in Poland

Artur Borkowski, *Treasurer, SPIE Lublin SC*

The possibilities of financing Polish-Ukraine scientific projects

Marcin Endward, *President, SPIE Gdansk SC*

The various sources of funding available for projects in Ukraine

Mikhail Khodzitskiy, *President, IRE-OSA SC*

27.11.2008 14:30 – 16:30 **Optics and Photonics – 4** (*English Session*)

Multiband system for non-contact temperature measurement

Dr. Adam Mazikowski,

Dept. of Optoelectronics and Electronics System, Gdansk University of Technology, Poland

OSA/SPIE SEMINAR FOR YOUNG SCIENTISTS AND STUDENTS ON NANOPHOTONICS & METAMATERIALS

INVITED LECTURES

III YOUNG RESEARCHER CAREER DEVELOPMENT WORKSHOP

SPIE POLISH-UKRAINIAN WORKSHOP ON «PHOTONICS AND METAMATERIALS»

RADARS AND WAVE PROPAGATION & REMOTE SENSING

SOLID STATE RADIOPHYSICS

METAMATERIALS

PLASMAS AND MICROWAVE ELECTRONICS

OPTICS AND PHOTONICS

COMPUTATIONAL AND EXPERIMENTAL ELECTROMAGNETICS

BIOPHYSICS

INTERACTION OF HIGH-FREQUENCY ELECTROMAGNETIC WAVES WITH MAGNETIC METALLIC NANOSTRUCTURES

A.B. Rinkevich, L.N. Romashev, V.V.Ustinov

Institute of Metal Physics Ural Division of RAS
18 S.Kovalevskaya Str., Ekaterinburg, 620041, Russia
e-mail: rin@imp.uran.ru

Microwave properties of magnetic metallic nanostructures with giant magnetoresistive effect are reported about. Two main physical reasons cause microwave variations, namely the microwave analog of giant magnetoimpedance effect and ferromagnetic resonance [1,2]. If the fields are lower than magnetic saturation field, the field dependence of the transmission coefficient is mostly due to the first mechanism. This dependence looks like the DC magnetoresistive one. There is approximately one-to-one correspondence between microwave and DC relative variations. The second mechanism is observed only under perpendicular pumping. The essential resonance variations are observed only at the frequencies of millimeter waveband. The resonance amplitude is the highest in those samples where the resonance falls in the magnetically saturated state of the nanostructure. Methods of microwave magnetoresistive effect measurement are presented. The experiments in the "current perpendicular-to-plane" geometry are specially considered, and the experiments carried out in the millimeter waveband are presented. The peculiarities of the joint observation of ferromagnetic resonance and microwave magnetoresistive effect are specified. The propagation of electromagnetic waves in a rectangular waveguide containing a gyrotropic plate made of a metallic-film nanostructure was studied. Changes in the propagation constant were calculated for the cases of in-plane and normal magnetizations. In the region of frequencies and fields that is far away from the condition of ferromagnetic resonance, the changes in the absolute value of the transmission coefficient are proportional to that in resistance. Expressions were obtained for the changes in complex reflection and transmission coefficients.

The lecture is subdivided into the following items.

Metallic nanostructures and their structure and preparation.

Exchange interaction and giant magnetoresistive effect.

Magnetic resonance in nanostructures.

Reflection and penetration of high frequency electromagnetic waves through metallic nanostructures.

Penetration in a wide frequency interval.

Realization of "current-perpendicular-to-plane" geometry at microwaves.

Measurement of giant magnetoresistive effect at the traveling waves.

Application of metallic nanostructures in nanoelectronics and spintronics.

Microwave methods give a unique opportunity to estimate the dynamic and relaxation parameters of nanostructures as well to study the spin - dependent transport. Application of the metallic magnetic nanostructures in microwave electronics is also discussed.

[1] J.Krebs, P.Lubitz, A.Chaiken, and G. A.Prinz, "Magnetoresistance origin for nonresonant microwave absorption in antiferromagnetically coupled epitaxial Fe/Cr/Fe(001) sandwiches", *J. Appl. Phys.,* vol.6, No.8, Part II, pp.4795-4797, 1991

[2] A.B.Rinkevich, L.N.Romashev, V.V.Ustinov, E.A.Kuznetsov, High frequency properties of magnetic multilayers, *JMMM*, vol. 254-255C , pp. 603-607, 2003

EXTRAORDINARY PROPERTIES OF METAMATERIALS

Pavel A. Belov[1,2], Constantin R. Simovski[2,3], Sergei A. Tretyakov[3]

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Metamaterials are artificial electromagnetic (multi-)functional materials engineered to satisfy the prescribed requirements. Superior properties as compared to what can be found in nature are often underlying in the spelling of metamaterial. These new properties emerge due to specific interactions with electromagnetic fields or due to external electrical control. The metamaterials provide a conceptually new range of radio, microwave, and optical technologies.

The overview lecture includes history of metamaterials, discussion of negative refraction and backward wave effects as well as possibility of subwavelength imaging. An emphasis is made on realization of mentioned effects with help of electromagnetic and photonic crystals.

OSA/SPIE SEMINAR FOR YOUNG SCIENTISTS AND STUDENTS ON NANOPHOTONICS & METAMATERIALS

INVITED LECTURES

III YOUNG RESEARCHER CAREER DEVELOPMENT WORKSHOP

SPIE POLISH-UKRAINIAN WORKSHOP ON «PHOTONICS AND METAMATERIALS»

RADARS AND WAVE PROPAGATION & REMOTE SENSING

SOLID STATE RADIOPHYSICS

METAMATERIALS

PLASMAS AND MICROWAVE ELECTRONICS

OPTICS AND PHOTONICS

COMPUTATIONAL AND EXPERIMENTAL ELECTROMAGNETICS

BIOPHYSICS

INTERNATIONAL TECHNOLOGY TRANSFER AND BUSINESS PLANNING

Dr. Vic Korsun,
Deputy Executive Director (USA)
Science and Technology Center in Ukraine

Mr. Korsun's talk addresses the competitiveness of Ukraine in the Global Economy of Knowledge; highlights several successful global companies and how they can be models for Ukrainian science and technology innovation; provides examples of how Ukraine can start its own Silicon Valleys based on the high level of Ukrainian science education and R&D; provides examples of how Ukraine can promote itself. All of this relates to developing successful Technology Transfer organizations in Ukraine to help universities and institutes commercialize their technology through start-up companies, and to be able to modernize their infrastructures to attract Ukrainian graduates to remain in Ukraine and develop Ukraine's high-tech product manufacturing base. Finally, the talk will try to motivate Young Ukrainian Scientists to take creative and effective action for scientific innovation in order to take control of their destiny while building a better economic future for themselves and the Ukrainian nation and people.

MOLECULAR MECHANISMS OF REGULATION OF BIOLOGICAL ACTIVITY IN COMBINATION OF AROMATIC DRUGS

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In the present work the results of investigation of molecular mechanisms of regulation of biological activity upon simultaneous administration of various combinations of aromatic biologically active compounds (BAC) are discussed. On the basis of structural and thermodynamical analysis of the interaction of different groups of aromatic BACs with a use of data from cell experiment it was shown that the effect of alteration of biological responce can, in part, be understood in terms of intermolecular interactions of the drugs (interceptor mechanism) and their competition on the bioreceptor binding sites (protector mechanism). The potential possibility to regulate the biological activity in combinations of aromatic drugs as well as the possibility to quantify the biological effect under the condition of domination of these mechanisms have been demonstrated.

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III Young Researcher Career Development Workshop :

bridging a gap between education and career in photonics and electromagnetics"

organized in the frame of YSC-2008, IRE NASU, Kharkiv, Ukraine

DESIGN OF INTERGRATED RF CMOS CIRCUITS

Georg Boeck

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The continuous progress of silicon technology has enabled the emergence of digital mobile broadband communication systems for voice, data and multimedia transmission with good quality of service. Data-rate and mobility trade-offs and different standards like 2G, 3G, Bluetooth, WLAN, GPS and digital multimedia broadcasting are leading to multimode requirements and issues relating to coexistence and inter-working of these different technologies must be solved. Single chip integration with digital part, high integration density and excellent RF performance, low power consumption and low cost under mass production aspects are further requirements. First system-on-chip (SoC) demonstrations show that today CMOS technologies seem to be able to fulfil all these requirements. This lecture will review current RF-CMOS technologies, RF-architectures and re-configurability studies, and circuit and system design aspects for mobile communication applications. It will consider special requirements on wafer processes like leakage and analogue and RF capabilities and will look to the world of system-level design. In this context, power-levels, form-factors and cost are key requirements for system-on-chip and system-in-package-solutions. Of course, new challenges for the future will be considered and explored, too.

PLANAR DESIGNS BASED ON TIGHTLY COUPLED SCATTERERS FOR NEGATIVE REFRACTIVE INDEX METAMATERIALS

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The possibility of achieving negative refraction, as a result of simultaneous negative permittivity and negative permeability over a certain frequency band, is one of the most attractive features of metamaterials (MMs). The first experimental demonstration of a negative refractive index (NRI) MM was conducted by using split-ring resonators (SRRs), providing negative permeability, and continuous wires, providing negative permittivity [1]. Since then, many research efforts have been dedicated, on the one side, to understand the behaviour of the SRR and wire materials so as to push upward their frequency range of operation from the initial microwaves range to millimeter and far-infrared frequencies, and, on the other side, to find alternative configurations more suitable for application in the visible range, such as, for instance, the strip pairs and related structures [2]. At any rate, also at microwave frequencies it is desirable to have a MM with unit cells simpler than those used in [1], that cannot be easily fabricated with a planar technology.

Some recent developments covering the aforementioned research trends in the field of NRI MMs are discussed in this presentation.

First, we will illustrate a type of composite MM which is constructed by combining SRRs and suitably-shaped finite strip wires arranged in a coplanar configuration. Indeed, by placing strip wires and the SRRs on the same side of the supporting dielectric board, one can avoid fabricating layers with metal printed on two faces, so that the related problem of the alignment between SRRs and strip wires would be eliminated. Furthermore, a fully coplanar configuration could be more easily fabricated at smaller scales. Since it has been shown that when SRRs and strip wires are combined into a single structure, their individual field patterns interfere with one another and this interference can even destroy the expected NRI response of the material, the developed MM unit cells are devised to minimize the interference between the two components and preserve the negative nature of their isolated behaviour.

Then, a class of fully printable MMs based on arrayed pairs of tightly coupled planar conductors with proper shapes (like dogbones, Jerusalem crosses, tripoles, etc.) will be introduced. These MMs generalize the concept of employing as constitutive particles for creating a NRI medium pairs of short strips, in substitution of SRRs and wires [2]. Analogously to short-strip pairs, such configurations of coupled conductors are shown to support both antisymmetric (magnetic) and symmetric (electric) resonance modes, whose interaction, if properly engineered, can reflect in simultaneous negative permittivity and permeability, and, accordingly, NRI behaviour. The use of metallic inclusions with more elaborated geometries than simple pairs of short strips offer the possibility to achieve enhanced control on the particle resonances, that can be tuned to the desired frequency by adjusting the shape and dimensions of the metallic inclusions, to reduce the size of the MM unit cell, and to realize MM structures optimized to provide a uniform NRI response to arbitrarily polarized incident waves.

[1] D. R. Smith, W. J. Padilla, D. C. Vier, S. C. Nemat-Nasser, and S. Schultz, "Composite medium with simultaneously negative permeability and permittivity," *Phys. Rev. Lett.*, vol. 84, pp. 4184–4187, 2000.

[2] V. M. Shalaev, W. Cai, U. K. Chettiar, H. Yuan, A. K. Sarychev, V. P. Drachev, and A. V. Kildishev, "Negative index of refraction in optical metamaterials," *Optics Lett.*, vol. 30, no. 24, pp. 3356-3358, Dec. 2005.

IEEE LEOS BENEFITS FOR STUDENTS

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Lasers and Electro-Optics Society (LEOS) of the Institute of Electrical and Electronics Engineers, Inc. (IEEE) has advanced the theory and practice of electrical and electronics engineering and of the allied arts and sciences. The field of interest of the Society is lasers, optical devices, optical fibers, and associated lightwave technology and their applications in systems and subsystems, in which the quantum electronic devices are key elements.

The goal of the LEOS society is to provide opportunities for information exchange, continuing education, and professional growth, publishing journals, sponsoring conferences, and supporting local chapter and student activities.

A lot of attention is given to the student members. LEOS provides a lot of special programs and contests in an order to increase interest to scientific activity. Also as many other IEEE societies LEOS supports many conferences with different type of grants. The idea of this talk is to carry to the listeners the major benefits of LEOS society and show plans on 2009th.

IEEE BENEFITS FOR STUDENTS

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What is IEEE from the students point of view?

Student life, along with it's many positive features, also contains a certain amount of chaos. IEEE has created a set of benefits specifically targeted for students in order to fill the void and increase the positive experience for students on their way to becoming an expert in their field. These benefits are, but not limited to:

1. Your Own Personal Subscription to IEEE Spectrum and Potentials

Winner of prestigious awards, IEEE Spectrum delivers, on a monthly basis, the latest technological information with behind-the-scenes stories to put the news in context. IEEE Potentials discusses career issues and other subjects of interest to those starting out in the electrical and computer engineering professions.

2. Enhanceing Your Career by Networking with Technical Experts

Participate in Student Branch activities, and in local, professional Section and Chapter meetings where members meet members and industry leaders to discuss technical and professional issues and career concerns.

3. Save with Low Member Prices on IEEE Products

Your membership gives you access to the world's most comprehensive source of electrical and electronics publications, specialized books, conference records and published standards. IEEE provides the best technical information in the world and your membership entitles you to low member prices on all of it.

4. Attend Top Technical Conferences at Low Member Rates

Accept invitations to attend and participate in numerous technical conferences in a variety of technical interest areas as well as educational seminars, technical and professional programs and courses.

5. Establish Yourself Early in the Profession's Premier Technical Organization

IEEE members are the technical and scientific professionals making the revolutionary engineering advances which are reshaping our world today. To enable young professionals who join IEEE as students to maintain their membership through the early years of their career, IEEE provides a graduated dues program. When you graduate with your first professional degree, with no interruption to your IEEE membership, you may be eligible for up to your years of reduced IEEE dues and assessments.

[1] http://ewh.ieee.org/reg/8/sac/index.php

SPIE BENEFITS FOR STUDENTS

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The subject of this paper are the benefits obtained by forming a SPIE students chapters at universities, and the criteria that need to be met before a chapter can be formed. The paper is a deep view into the first months after forming a chapter and the work that needs to be done at the beginning of the chapters life. The presentation also indicates the sources of ideas, training, and grants that are available for all of the chapters members and for the chapter officers.

The first part of the paper is a look at the benefits gained from forming a students chapter. This includes financial aid, free educational materials, lecture grants and more. Also one of the most important benefits a university obtains, is a group of students dedicated to scientific work. This is also looked into in this section of the paper. I include my personal experience from the first months after the chapter had been formed to show what did we gain just months after it's formation.

The second part of the presentation is a view into requirements for forming a students chapter[1]. There is also a brief instruction on how to begin the road to form an SPIE chapter.

[1] SPIE organization – www.spie.org

OSA BENEFITS FOR STUDENTS

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This talk is devoted to benefits obtained by Optical Society of America (OSA) student membership and forming a OSA students chapters at universities, and the criteria that need to formed a chapter. The presentation indicates the sources of ideas, training, and grants that are available for all of the chapter's members and for the chapter officers.

The first part of the talk is devoted to benefits of OSA Student member:

- Free online journal subscription
- Free optics & photonics news (opn) subscription
- Free *Physics Today* subscription
- Conference, meeting and subscription discounts
- Affiliation with a technical group
- Career Services - New Feature: OSA student members may now designate their student status allowing employers to quickly identify resumes of upcoming and recent graduates.

The second part of the talk is devoted to OSA Student chapter benefits:

- **Start-Up Fund** - Each new Student Chapter receives $500 USD in start-up funding. **Activity Grants** - All chapters in good standing have the opportunity to apply for an Activity Grant of up to $1,000 USD to help support chapter activities and events. **Youth Science Education Outreach Grants** - The OSA Foundation provides Education Outreach Grants to support the grassroots education efforts of OSA chapters.
- **Leadership Conference** - A representative from each chapter receives a travel grant to attend the annual Student Chapter Leadership Conference that is held in concert with OSA's Annual Meeting, "Frontiers in Optics."
- **Traveling Lecturer Program** - Student chapters are eligible to request a visit from a traveling speaker annually.
- **Excellence Award** - The Excellence Awards program was established to recognize the outstanding achievements of OSA's Student Chapters and Local Sections for advocacy and outreach efforts in their local communities as well as academic and professional development programming for members. Presented annually at Frontiers in Optics (FiO), two Student Chapters and two Local Sections receive an Excellence Award certificate and a $1000 USD award.
- **E-Newsletter** - Each chapter member receives *Focal Point* — a quarterly electronic newsletter written for and by OSA Local Section and Student Chapter members from around the world.

The second part of the presentation also is a view into requirements for the formation OSA student's chapter. There is also a brief instruction on how to begin the road to form an OSA chapter.

[1] OSA organization – www.osa.org
[2] http://www.osa.org/membership/studentservices/default.aspx

SUCCESSFUL CAREER IN METAMATERIALS

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Dr. Pavel Belov is Post-doctoral Research Assistant / EPSRC Advanced Research Fellow in the Department of Electronic Engineering, Queen Mary University of London, England. He received 1st PhD in Optics and radiophysics in 2003 and 2nd PhD in Radioengineering and electromagnetics in 2006. His current research interests are in metamaterials, nanostructures, photonic and electromagnetic crystals, artificial microwave periodic structures, composite materials and high impedance surfaces, with the emphasis on analytical and numerical (FDTD, FEM, MOM) modeling of electromagnetic properties. He received Nokia, SUMMA, IEEE MTTs, INTAS, SPIE Scholarship etc. He received IET Achievement Award, International Dennis Gabor Award, URSI Young Scientist Award. He has EPSRC Advanced Research Fellowship, Researcher Exchange Grant, British Council etc. He is IoP, IET, IEEE , AP-S , ED-S, MTT-S, LEO-S, URSI, EuMA, OSA, SPIE member.

Few advises, based on personal experience, for young scientists who would like to reach success in the area of metamaterials and not only.

FROM STUDENT TO PROFESSOR

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The point are given in this lecture designed to give you a broad sense of what is expected of you as a PhD student, tenure, assistant professor. Learning is a lifelong process, but it's form changes as we move from being educated to becoming educators and researchers ourselves. There comes a point in the process when we have gained reasonable insight into the state of our branch of science.

Studying for a Ph.D. will probably be the last, but the most decisive stage in the life of a young person who wants to devote him- or herself to the organised search for a greater understanding of the natural and social world. This includes the ability to produce, control and manipulate new phenomena, instruments and other artefacts. Most newly-minted PhDs are hired as assistant professors, promoted to associate upon achieving tenure, and go through an additional review, five to seven years later, for promotion to full professor. As an assistant professor your job consists of three components: teaching, research, and service to the institution.

The main goal of the talk is to show the opportunities and problems which people obtain in all listed above positions. Also some ideas of boosting your career have examined.

1. Matthias Tomczak, "Education for the Transition from Student to Scientist", Oceanography, Volume 17, Number 2, p 11-13.
2. Andrew Schwarz, Jason Thatcher, "Making the Transition from Doctoral Student to Assistant Professor", Decision Line, October 2008, p 24-28
3. "Survival Guide Handbook for Ph.D. Students at ETH Zurich", Printed by: RVA Druck und Medien AG, Altstatten/SG

SUCCESSFUL CAREER IN OPTICS AND PHOTONICS

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Dr. Nataliya K. Sakhnenko is Associate Professor in the Department of Higher Mathematics, Kharkov National University of Radio Electronics, Ukraine. She received her PhD in radio-physics in 2004. Her current research interests are in modelling of transient processes in active photonic components with time-dependent material properties.Dr. N. Sakhnenko received Royal Society/NATO Postdoctoral Fellowship and worked in the George Green Institute for Electromagnetics Research, University of Nottingham (GGIEMR) in 2004-2005. She has three-year NATO Reintegration grant (2005-2008) and Ukrainian Ministry of Education and Science grant (2005-2008).

She is IEEE member since 2002

Few advises, based on personal experience, for young scientists who would like to reach success in the area of optics and photonics.

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SPIE Polish-Ukrainian Workshop on «Photonics and Metamaterials»

*organized in the frame of YSC-2008**,** IRE NASU, Kharkiv, Ukraine*

CV: "FIRST STEP TO SUCCESS"

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If you are looking for a job, then it is very important that you understand how to offer yourself in the best way to an employer. This is done by writing a 'CV' (curriculum vitae - Latin for 'life story'), called in many cases as 'resume'.

How long will the average employer spend reading your CV or Resume? Minutes? Try a matter of seconds to make an impact. In sectors other than academic, medical or scientific, it is generally more appropriate to use a short "Resume" which is essentially a brief summary of your experience rather than a true Curriculum Vitae. It will not go into the detail of a CV, and is really a one to two page document that encapsulates your abilities, tantalizing the employer enough to find out more in the all-important interview stage.

So let's make a good CV follow the brief advices described in this report and make first step to successful carrier.

[1] How Make CV – www.google.com

THE VARIOUS SOURCES OF FUNDING AVAILABLE FOR PROJECTS IN POLAND

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There are many Funds Programmes which aid individual young scientists and research groups. Financial support can be obtain from various sources, for example: The European Union, The Foundation for Polish Science (FNP).

International PhD Projects Programme (MPD Programme) - in frame of this programme Foundation finances the scientific research of PhD students and covers expenses of international scientific cooperation.

TEAM Programme – helps to improve involvement of young scientists in projects involving grade students, PhD students and postdoctoral fellows carried out in the best research groups and laboratories in Poland. Projects may be implemented in three thematic areas described as *Bio*, *Info*, *Techno*.

FOCUS Programme – support the most active young scientists with achievements in a research area, it allows scientists to take up original and promising directions in research and provide assistance in the initial stage of building personal research teams.

INNOVATOR Programme – is directed to young scientists and research groups which dispose of new and innovate ideas or patents. The aim of this programme is financial assistance at the implementation level, training in business administration and couching provided to young scientists.

After accession to the European Union, Poland acquired to derive many funds. These are only examples of various programmes which allow to improve the quality of researches and the number of publication of polish scientists in international journals.

[1] http://www.fnp.org.pl/
[2] „Możliwości pozyskania środków finansowych dla młodych naukowców w ramach programów FNP oraz MNiSW" - Politechnika Opolska
[3] http://www.nauka.gov.pl/mn/index.jsp?place=Menu01&news_cat_id=-1&layout=0

THE POSSIBILITIES OF FINANCING POLISH-UKRAINE SCIENTIFIC PROJECTS

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The subject of this presentation are the possibilities of financing Polish-Ukraine scientific projects. The whole paper is a review of available sources of financing for the fore mentioned projects and a look at the possibilities and obstacles that researchers face in their work. The paper also briefly describes the Polish laws concerning international projects.

The first part of the paper is a look on the possible benefits from the joined Polish-Ukraine research. The important part of this process is to understand what common gains may we achieve by working together on new technologies and further development of old ones. This section also includes a look at the Polish Hi-Tech sector, the predictions of its growth and the fact that many of the regions are located around universities and scientific centers.

The second part of the paper is the description of sources of grants divided into main categories raging from government financing [1], [3] to university grants. The paper also shows that there are companies interested in financing scientific projects. The report looks into the possibilities of exchanging university staff between Ukraine and Poland [2][4]. The flow of personnel is one of the most important tasks to complete, for full scale joined projects to take place. This can be financed by a wide variety of grants sponsored by institutions connected to the specific field of research. This is also looked into in this presentation.

The last part of the paper is a summery of Polish law concerning rights to newly developed technologies and laws that protect the interests of scientists and their work. This is an important part of the joined scientific projects and as that it should be carefully examined.

[1] Polish Ministry of Education - http://www.men.gov.pl/
[2] Erasmus Programe-http://www.erasmus.org.pl/
[3] Polish Information and Foreign Investments Agency - http://www.paiz.gov.pl/
[4] Ministry of Science and High Education - http://www.nauka.gov.pl

THE VARIOUS SOURCES OF FUNDING AVAILABLE FOR PROJECTS IN UKRAINE

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This talk is devoted to various sources and forms of funding for young scientists projects in Ukraine. Funding sources in Ukraine are divided into local funds (regional state administration fund, private funds etc.), national funds (National Academy of Sciencies of Ukraine fund, Department of education and science fund, Ukrainian President's secretariat fund etc.) and foreign funds (societies funds of IEEE, OSA, SPIE, EuMA, URSI etc.). Funding forms are divided into State budget funding, target research projects/grants funding, fellowships, awards etc. Merits and demerits of each funding form and salary level for each funding form will be shown.

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JOINT CORRELATION PROCESSING OF THE SIGNAL INFORMATION RECEIVED BY SYSTEM OF SPACE DIVERSITY RADARS IN INTERESTS OF RECOGNITION

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Questions of analysis of information about geometrical characteristics of radar targets contained in reflected multifrequency signal which can be used as attributes of recognition of various classes of the air targets [1 – 4] are examined in the modern scientific and technical literature. But for reception of trustworthy information about geometrical characteristics of observable radar target it is necessary to contain more amount of frequency in the probing signal. That is connected with individual difficulties at formation, radiation, reception and processing of multifrequency signal. Investigation character of information accepted at joint processing of signals received by system of space diversity radars workings on different frequencies of one wave band allows to shorten the amount of used frequencies.

In our time exist radars with frequency separation partly for support of radio-electronic compatibility. Joint correlation processing of signal information about observable radar target received by system of space diversity radars at use of narrow-band signals of different frequencies of one wave band is examined in report. In result expression for calculation of coefficient of mutual correlation of envelope squares of amplitudes reflected from radar target signals with use of mathematical model of reflective characteristics radar target [3, 5] has been received. It is established that the coefficient of correlation depends on quantity of reflecting elements on radar target, frequencies of probing signals of radars, an angle of separation between radars and average on observation interval longitudinal and transverse sizes of radar targets. On the basis of received expression it is possible to develop of determination methods of geometrical characteristics observable radar targets at use of probing narrow-band signals in systems of space diversity radars. The received information on average geometrical sizes of radar targets allows to establish their distinction in sizes [3]. Received at joint correlation processing reflected from radar targets signals their geometrical characteristics can be used as additional attributes of recognition of air and ground objects of various classes.

[1] *Вишин Г.М.* Многочастотная радиолокация. – М.: Радио и связь, 1986. – 183 с.
[2] *Гьесинг Г.Т.* Радиолокация с адаптирующимся к цели согласованным подсветом: Принципы и приложения. Серия по электронным волнам института электрорадиоинженеров. Том 22. Великобритания: Лондон, 1986. – 103 с.
[3] *Казаков Е.Л. и др.* Радиолокационные признаки распознавания при многопозиционной локации / Под ред. Е.Л. Казакова. – Х.: АСЄ – 2005. – 188 с.
[4] *Казаков Е.Л. и др.* Распознавание целей при многочастотной радиолокации / Под ред. Е.Л. Казакова. – Х.: МОУ, ОНИИ ВС, 2007. – 188 с.
[5] *Казаков Е.Л.* Статистическая модель радиолокационной цели в сантиметровом диапазоне волн с учетом поляризационных свойств цели на многих частотах // Радиотехника. – 1976. - №4. – С.1-4.

CONNECTION OF SPECTRAL-TIME CHARACTERISTICS OF THE CAR WITH THE DESIGN AND MODE OF WORK OF THE ENGINE

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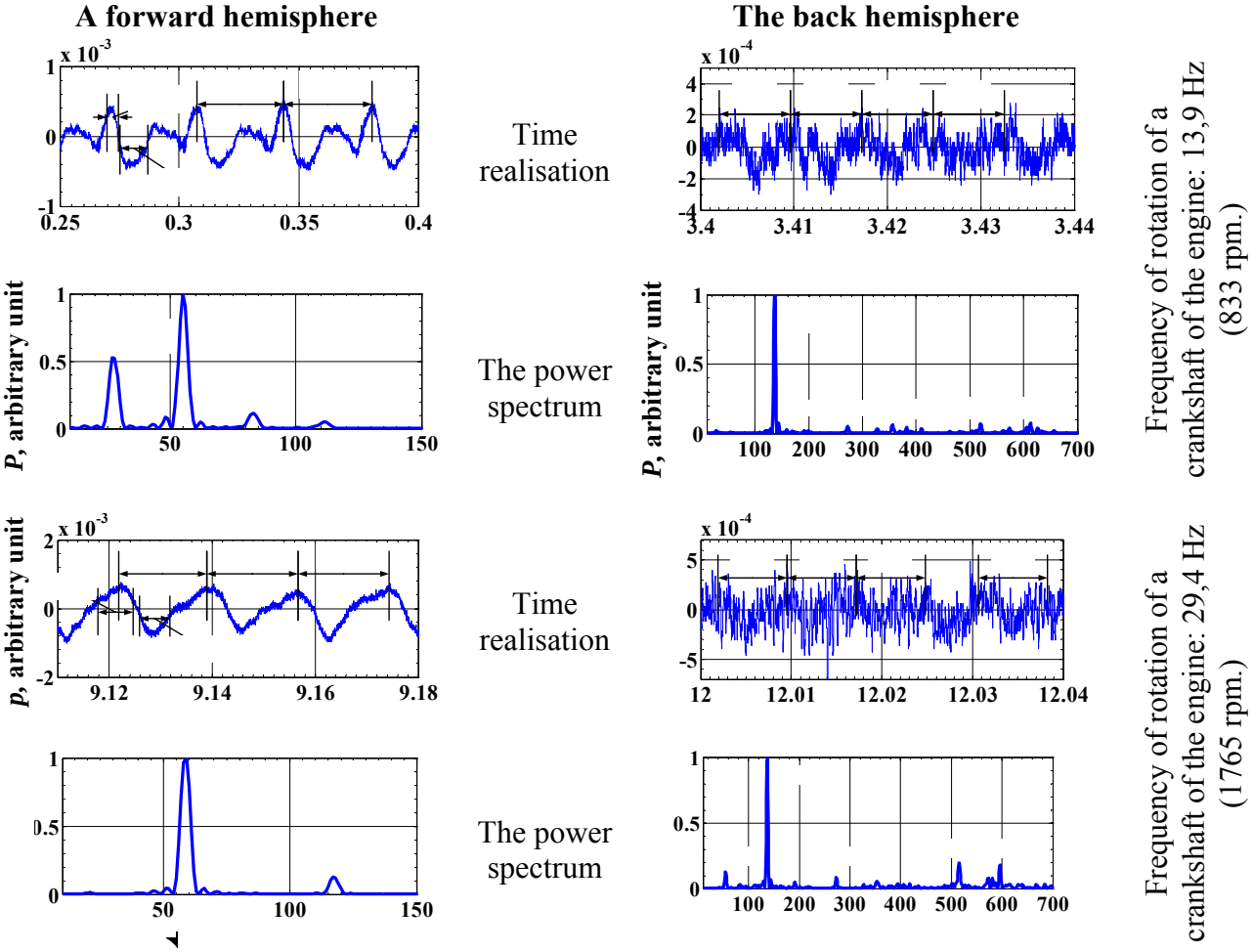
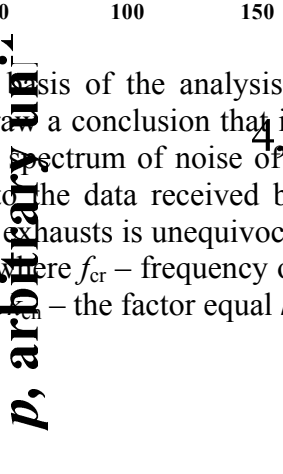
Vehicles are the basic method of penetration on territory reserves and other objects. Conducting monitoring of district a body television and thermovision means, and also radar-location means is limited to straight line conditions visibility and a difficult lay of land. Acoustic means of monitoring of district are substantially deprived the given lacks. Development of optimal algorithms of processing of acoustic signals demands knowledge of spectral-time characteristics of vehicles and their communication with a design of the car and an operating mode of the engine.

Now in open sources, as a rule, vehicles are considered only as sources of the noise influencing the person. Therefore experiment on record of an acoustic signal of car DAEWOO LANOS of 1997 has been made. Time realizations of an acoustic signal of the vehicle in neutral of the engine and the spectra corresponding to them resulted more low.





On the basis of the analysis time and spectral characteristics acoustic signal the car it is possible to draw a conclusion that in a back hemisphere at a motionless auto-mobile exhaust noise prevails. In a spectrum of noise of an exhaust the second harmonic of frequency of exhausts that corresponds to the data received by some authors, for example in ([1]) has the greatest capacity. Frequency of exhausts is unequivocally connected with parametres of engine a following parity: $f_{exh} = f_{cr} N_{cyl}/k_{en}$, where f_{cr} – frequency of rotation crankshaft the engine, Hz, N_{cyl} – number of cylinders of the engine, k_{en} – the factor equal $k_{en} = 1$ for duple and $k_{en} = 2$ for four-cycle engines.

RADIATION FIELD OF COIL ANTENNA IN NEAR-FIELD

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To this day the researches on the near-field long-wave (LW) diapason signal attenuation haven't been described enough in detail. It is explained by the fact that in the near-field zone the electromagnetic wave is only in the process of generating, which results in a set of time-varying (transient) processes. In this radio-wave diapason conduction currents dominate over displacement currents irrespective of the earth surface type. Due to this fact in case of surface wave propagation energy absorption is extremely low. Besides, long waves diffract well round the spherical surface of the Earth. These two factors set conditions for the possibility of propagation of long and superlong waves with the ground wave at the distances up to 3000 km. LW can also be used to communicate with people on board the dived submarines and for underground radiocommunication because they can penetrate the sea and the rock dozens of meters deep.

One of the important qualities of long waves is the fact that such signals don't suffer excessive absorption of the electric field energy by the conductive layer of the rock. Owing to this the results of the near-field long-wave radiation research can be used there where there are problems with the propagation of radio-waves, for example, in mines with the probability of rock collapse. If we know the field structure and pattern of change within the near-field zone we can determine the field magnitude at any given point of the restricted space. This can be used when looking for victims of rock collapse. In this case the working distances won't exceed 100 m. Judging by the strength of the beacon signal from the object of search we can determine its location. Thus, the aim of the work is studying the dependence of the field attenuation from the distance in the near-field radiation zone.

As mentioned above, the field structure in the near-field zone in very complex because in this zone there exists a so called bound transient electromagnetic field. This means that the near-field zone is characterized by the high level of electric and magnetic constituents, so that the radiation pattern of the antenna can't be defined. In the near-field zone, or in the induction zone, at the distance

$$r \le \frac{\lambda}{2\pi},$$

from the source, where λ is the wave-length of the transmitted signal, we can regard the electromagnetic field as quasi-static. In the near-field radiation zone the electromagnetic wave isn't shaping yet. To characterize the electromagnetic field (EMF) we measure the intensity of the alternating electric (E) and alternating magnetic (H) fields separately. The field in the induction zone serves to shape the traveling constituents of the fields (electromagnetic wave), which are responsible for signal transmitting and reception.

This work deals with the method of determining the variation of the magnetic constituent of the EMF in the near-field zone. This purpose in view we examined a system made up of two antenna coils with a ferrite core. This system permitted us to determine the dependence of the magnetic field intensity from the distance analytically. We also carried out experimental research, which as a whole confirmed the chosen calculation method.

EFFECTS OF ROUGH SEA NON-GAUSSIANITY AND SHADOWING ON MICROWAVE PROPAGATION THROUGH EVAPORATION DUCT

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The split-step parabolic equation (SSPE) method is widely used for prediction of microwave propagation over sea surface [1]. This method can simultaneously take into account surface inhomogeneity and height and distance refractivity dependence. The rough sea is one of the effects that sufficiently influence on the distribution of electromagnetic radiation. And the tangent plane method is used to account for this effect in the SSPE. According to this method effective reflection coefficient is calculated as multiplication of Frenel reflection coefficient and roughness reduction factor and full illumination of rough surface and Gaussian probability density function of sea surface elevation are assumed. But shadowing and non-gaussianity in real situation sufficiently influence on the microwave propagation. Evaporation duct amplify these effects because of multiply reflections.

Comparison of shadowing and non-gaussianity influences on the microwave propagation in evaporation duct based on the work of Fabro [2] and Hristov [3] are presented. The results of numerical experiments with shadowing and non-gausianity correction are shown and compared with theory and experiment.

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FOR STUDYING TURBULENCE OF STORM CLOUDS WITH USE DOPPLER RADARS

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Many atmospheric phenomena present danger for the air and sea transport. One of such dangerous phenomena is wind shear - change of the wind vector (velocity and direction of the wind) per unit of distance. Wind shear is instability characteristic of the atmosphere state, capable of cause bumpiness of the plane, create handicaps for the flights and for some its values - threaten safety of the flights. Determination of the vertical wind shear at aerodrome – is one of complicated problems of the aeronautical meteorology.

Determination of the wind velocities at a height by the accepted technique is impossible because of too low accuracies. Airborne equipment allows determining availability of the wind shear towards a glide path only qualitatively, without its accurate quantitative estimation. For accurate calculation of the vertical wind shear are used experimental dependences between velocity and wind direction at multiple levels under aerodrome conditions. In present report is offered use of sounding data of the storm clouds by coherent- pulse radar for determination of the wind shear parameter.

Experiments are carried out by coherent- pulse radar with radiation wavelength 2cm, beam width about 2° by azimuth and 5° - by angle of elevation. Spaces radiation and reception reflected signals were realized by vertical polarization. The moment characteristics of the scattered signal spectrums can be used for estimation of the air masses turbulences.

If spectrum of scatterers velocity $S(V,R,\theta,\beta)$ where velocity, recalculate via Doppler shift of frequencies $V=\frac{\lambda f}{2}$, then dependence m moment characteristics of the spectrum $l_m(R,\theta,\beta)$ on the spatial coordinates determines expression $l_m(R,\theta,\beta)=\int_0^\infty V^m S(V,R,\theta,\beta)dV$ on the ground its can be calculated mean intensity $I_0(R,\theta,\beta)$ velocity - $V_0(R,\theta,\beta)$ and dispersion of the scatterers velocity spread.

Determination of the wind velocities shift characteristics can be based on calculation of residual function between mean velocity for the concrete azimuth angle of the radiation and its moving average for chosen averaging window by azimuth on several scanning interval. Deviation of hydrometeors fraction velocity from average by the azimuth angles and periods permits to find the zones of the field heterogeneity of the wind velocities, which are danger for aviation. Simultaneous analysis of scattering intensity, path velocities of the air masses and root-mean-square value of the scatterer velocities turbulent pulsation permit to estimate thunderstorm activity areas, which are the most danger.

USING OF GPS SATTELITE RADIATIONS FOR DIAGNOSTIC OF THE ATMOSPHERIC PROCESS

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Efficiency of the different radio systems operation depends on conditions of the radiowave propagation are determined by atmospheric refraction state. For a long time the traditional approaches of the refraction coefficient determination were contact measurements of atmospheric parameters by means of meteorological sensors or direct refractometric measurements. In the last decades the atmosphere remote sensing methods such as radiometric, radar, radio raying and other methods are actively developed. These noncontact methods are advantageously differ from contact because of possibility of the more efficient observation of the spacious areas, velocity of the data reception and methodical comforts.

One of such methods is the radio raying method with the satellites radiation use. The method background is a relation between distortion of the signal parameters when source is moving and the atmospheric refraction measures. Series of works, carried out over the sea, has shown the high correlation of efficient gradients are obtained on the signal levels and positions of the setting point and minimums of field interference structure of the signal is radiated from GPS.

Diagnostics of the troposphere refraction over the land surface, which differs from sea surface by the most heterogeneity, as well as has the significant roughness, is the most complicated. At the sea dips of interference structure of the field are determined interaction of the direct signal, specular reflected from the sea surface and elevated inversion layers. Over land field in receiving point is formed, besides this and random - diffuse reflections from its roughness. By the satellite orbiting can occur a diffuse scatterer changing that complicates receiving interference pattern of the field and makes impossible to reconstruct the refraction coefficient profile by this pattern. In this connection the estimation method of the troposphere refraction over land, using radio settings of GPS navigational satellites is offered by us. The calculation expression which connect satellite viewing angles effective gradient of the refraction coefficient in the radio raying layer of the troposphere, made within the framework of the equivalent radius model of the Earth has been obtained. The calculation results have been compared with experimental data by the satellites setting angles. As reflections from the surface irregularity influence on the signal received from satellite analyzing satellites setting angles the attempt to take into account relief was made. Example of usage of the TV-center radiation and satellites for diagnostics of troposphere surface layer has been showed.

The method of radio raying of the atmosphere with usage of the satellites radiations provides measuring of troposphere parameter with period of satellites observation. Simultaneous use of the signals that are radiated from the TV-centers and satellites permits to performing the continuous inspection of troposphere conditions.

REMOTE CONTROL SYSTEM FOR THE CALCULATION NUMBER OF THE STUDENT ON THE LECTURE WITH BLUETOOTH TECHNOLOGY

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Bluetooth is technology for transferring data at low speed (<700 Kbit per sec). It is developed for mobile devises such as notebook, PDA, mobile phone etc. Mobile devices equipped with Bluetooth are appeared from 2000. Statistics show that 99% of students have mobile phones or notebook with Bluetooth radio device. Radio-modules Bluetooth works at radio frequencies from 2.4 to 2.48 GGz. This frequencies are free for using. Using Bluetooth device on the mobile phones is free-of-charge too. Therefore Bluetooth technology can be basis for improvement lecture process. Bluetooth technology can be used for creation dynamical network for data transfer.

The method of frequency jumps are used for the spectrum forming. The switching sequence between radio frequencies for each connection is pseudo-casual. The switching time is 625 microsec, that is enough for working several radio-modules Bluetooth. Without noise proof coding it provides data transfer with speed equals 723,2 Kbit/sec and the speed at the reverse channel is equal to 57,6 Kbit/sec. Or it provides 433,9 Kbit/sec in both directions. The radio signal Bluetooth is reliably distributed to distance about 10 - 100 m. The direct visibility for the radio-modules Bluetooth is not required contrary to IR technology. It is shown the Bluetooth technology is a basic for organization network for 50-100 users in an educational auditorium.

The main goal of the given research is to create Remote control system for the calculation number of the student on the lecture with Bluetooth technology. Appropriate software with ***Delphi*** programming ***language*** was developed. The developed software is compatible with BlueSoleil, Microsoft and WidComm drivers Bluetooth and is compatible to all versions Windows.

The program realizes the functions on detection and connection Bluetooth of devices. The program has a training mode for determination of conformity between a logic name of the telephone and surname of student. At start the program automatically establishes conformity the telephone - student and creates the text document about the students at the lecture. The opportunities of the developed system and opportunities of creation of dynamic interactive networks with computers and mobile devices are discussed.

RECONFIGURABLE WIDEBAND ANTENNA ARRAY OF CIRCULAR AND LINEAR POLARIZATION

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Presently large attention is spared to the reconfigurable aerial systems [1,2]. A reconfigurable disk-conical eightradial aerial array (AA) with capacity elements and electronic pattern control was exposed to research in this work.

The methods of research are based on preliminary estimation of insertion influencing of capacity elements in the radiation branches of vibrators by the close method of equivalent long line with subsequent estimation and optimization of parameters of the emitters AA by a strict electrodynamic method.

An optimum variant of the disk-conical AA is offered on results researches. It is represented on fig. 1. Dependense VSWR from frequency for disk-conical AA is shown on fig. 2.

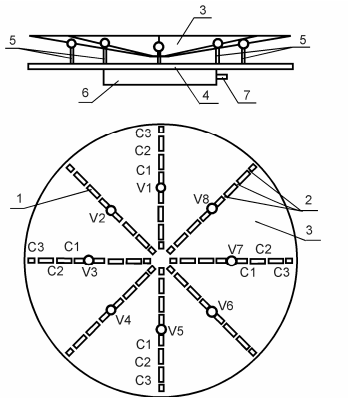

Fig. 1. Disk-conical ultra wideband AA:
1– vibrator; 2 – capacitive element; 3 – dielectric surface; 4 – conductive disk; 5 – support; 6 – feed and control device; 7 – input connector.

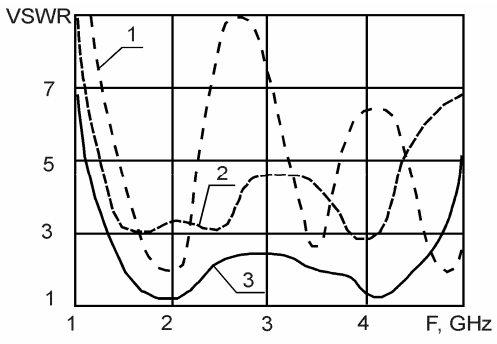

Fig. 2. Dependense VSWR from frequency for disk-conical AA:
1 – AA without inserted capacity elements; 2 – AA with capacity elements;
3 – AA with capacity elements and matching device.

The new reconfigurable disk-conical construction of AA provides the increase of term bandwidth – $\eta = \frac{f_h - f_l}{f_h + f_l}$ to 0.50, that allows to attain expansion bandwidth of the AA to 100 % at insertion of six capacity elements to every vibrator. By the device of AA feeding and control it is possible to involve not only eight vibrators but also any number with different phases and amplitudes of currents on vibrators, that makes AA a guided and universal.

Work is executed under direction of professor Ovsyanikov V. V.

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USING THE PHASE STRUCTURE OF SIGNALS FOR ESTIMATING THE SOIL MOISTURE ALONG THE DEPTH IN GROUND PENETRATING RADAR APPLICATIONS

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In modern ground penetrating systems that are used in engineering geology there are new mathematical signal processing algorithms needed to solve the problems of determining physical properties of soil layers and underground objects.

In this work the opportunity of using the phase structure of reflected signals to estimate the moisture depth distribution is considered by the example of penetrating the soil structure of dam nearby the city of Pavlograd (Ukraine). This opportunity is easily enough obtained by using the Stepped Frequency Continuous Wave (SFCW) Ground Penetrating Radar and by measuring quadrature components of reflected signals on an output of a georadar receiver phase detector.

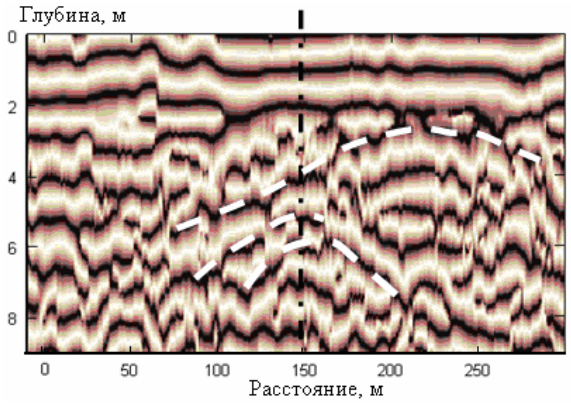
After applying the Fourier Transform to quadrature components of reflected signals we will write the equation for complex-valued spectral density: $\dot{S}(\Omega)=\left|S(\Omega)\right|\exp\left(\varphi(\Omega)\right)$, where $\left|\dot{S}(\Omega)\right|$ is a spectral density module and $\varphi(\Omega)$ is a phase spectrum of reflected signals.

In this equation phase spectrum characterizes dependence of spectral phase of the signals reflected from underground objects upon frequency (which in our case is proportional to depth)

It is shown that signals phase spectrum in our case can be written as:

$\varphi(d_p) \approx -j\frac{1}{\sqrt{2}}\sqrt{1+\left(\frac{\sigma(\omega)}{\omega\varepsilon_a(\omega)}\right)^2}\,d_p$, where d_p - discrete step of depth, $\sigma(\omega)$ - medium conductivity, $\varepsilon_a(\omega)$ - permittivity of medium, ω - angular frequency.

When presenting the information about phase spectrum on a display its isolines that correspond to maximum phase values $n2\pi$ where $n = 1\ldots N$ is showed as dark lines. Changeability of soil moisture along the depth and georadar movement trace can be judged by the distance between neighbor isolines and by their curvature. At picture 1 there is an image of signals phase structure depth distribution along the georadar movement down the dam. At picture 2 – changeability of soil moisture along the depth in the middle part of dam that is obtained by sequencing the iteration sum of its determining by the distance between neighbor isolines of phase spectrum and by computer modeling.



Picture 1. Signals phase structure.

Picture 2. Soil moisture distribution.

THE OBSERVATION OF IONOSPHERE RESPONSE AT SOLAR ECLIPSE SOLAR ECLIPSE AUGUST 1 2008

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The solar eclipses give us the unique opportunity to study the features of interactions of upper Earth atmosphere with solar radiation. The ionospheric processes occurred during solar eclipse are not investigated properly as powerful diagnostic means seldom situated at the regions with high level of solar disk covering during the quiet geomagnetic conditions. The incoherent scatter radars provide the potentiality to realize the most complete diagnostics of this phenomenon. At the ionosphere investigation by incoherent scatter method there are directly measured the power of incoherent scatter signal and it's spectrum (or autocorrelation function). With using of complex procedure of the receiving signal processing it is possible to estimate the majority of the ionospheric parameters – density and kinetic temperature of electron and ions, the plasma drift velocity and others.

The ionospheric effects of solar eclipse of 1 August 2008 at the Kharkiv radar were measured from the height of 100 km. For solving the problem of simultaneous electron density (N_e) determinations in E and F regions of the ionosphere it was used the dual-frequency measuring channel, which provided the obtaining of height power profiles and complex correlation function with altitude resolution 20 km.

The solar eclipse of 1 August 2008 over the point of observation was partial. The maximal percent of covering of visible solar disk was about 44.5%. The eclipse was observed from 9.12 (the first touch) till 11.21 UT (12.12 – 14.21 LT). The maximal phase of eclipse was registered at 10.15 UT (13.15 LT) with coefficient of Solar disk covering of about 0.45. The whole duration of this partial eclipse over Kharkiv was equal to 2 h 08 min. This eclipse took place during the low level of Solar activity and in quiet geomagnetic conditions (*Kp*=1, variations of *Dst* did not exceed 15 nT). The eclipse over Kharkiv took place after noon hours of LT, i.e. in the conditions of the formed stationary daytime F2 layer of the ionosphere. As covering the Solar disk the decrease of Solar radiation incident flux leads to the balance upset between processes of ionization, loss and transfer of the plasma.

The variations of N_e was found out in the form of decrease as the phase of Solar disk covering was increased up to the maximum phase of eclipse; after that with small temporal delay the concentration was practically restored. The maximal decreasing of N_e was registered at the maximum of layer and at the heights of 250 km and 300 km, it can be explained by predominance of the loss processes near the maximum of *F2* layer after the eclipse start. The electron density higher 400 km did not varied noticeably. At the height o the F2-layer maximum the electron temperature is decreased per 100-200 K, the changes of the ion temperature behavior was not observed. On the whole the ionosphere response is characterized by short-term change to the evening conditions.

The altitude dependences of electron density and plasma temperatures are presented. The comparisons with ionosphere response at recent solar eclipse 29March 2006 it is carried out.

OSA/SPIE SEMINAR FOR YOUNG SCIENTISTS AND STUDENTS ON NANOPHOTONICS & METAMATERIALS

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COMPUTATIONAL AND EXPERIMENTAL ELECTROMAGNETICS

BIOPHYSICS

PHOTOLUMINESCENCE OF ZINC SULPHIDE CRYSTALS AT ACOUSTIC WAVES TRANSMISSION

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Use of crystals of zinc sulfide as a sound-conducting environment a lot of problems related with finding-out of physics of processes of interaction of a sound wave with various defects. Studying of such interactions will be possible at use as defects natural or is artificial the inlet sondes (luminescence centres or paramagnetic ions)

In the given work the influence of ultrasonic oscillations on luminescent properties of zinc sulfide alloyed by the manganese, grown up of a melt under pressure of inertial gas is explored.

For making sign-variable mechanical loadings to the sample were put ultrasonic (US) oscillations. US oscillations were excited in a ceramic piezoelectric transducer from zirconate-titanate lead and by means of the aluminium concentrator were brought to the sample.

In spectrums of a photoluminescence of explored samples, at excitation by light with a wave length of 337 nanometers, it is observed two bands of a luminescence: blue (= 460 nanometers - the self-labilized luminescence caused by impurities and flaws in volume of a crystal) and orange (= 585 nanometers - an emission band of the impurity ions of manganese). The ultrasound does not render influence on breadth and the shape of a spectrum of radiation, dependences of intensity of a maximum of a luminescence on time of action of ultrasound therefore were measured. Intensity of a blue strip of a luminescence at activity US of oscillations exponentially decreases up to ~75 % from initiating value. After lockout of ultrasound the luminescent emission is recovered, but not up to initiating value (fig. 1b). It is known, that centres of a blue luminescence in zinc sulfide are centres of a sensitization, and are the basic energy sources for centres of an orange luminescence. It enables to guess, that changes of an orange luminescence at activity of ultrasound should be similar to changes of a blue strip. Such character of changes also is observed experimentally (fig. 1a).

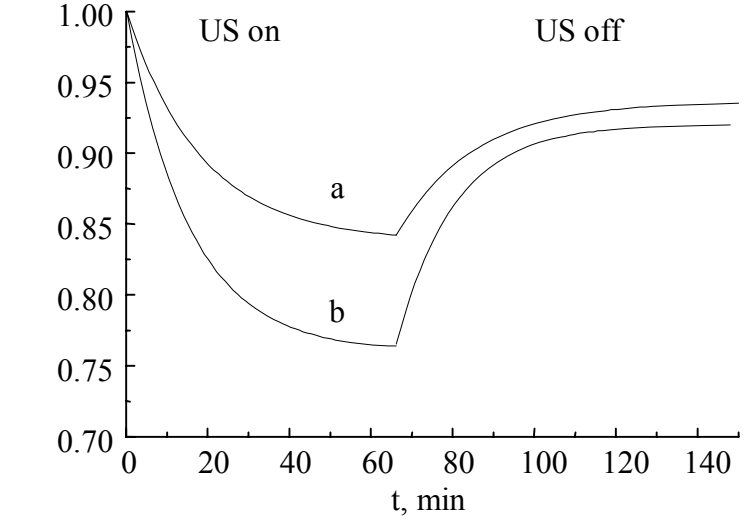

Fig. 1. Dependence of a luminescent emission on time of activity US (a - $\lambda_{макс}$=585 nm, b - $\lambda_{макс}$=585 nm).

At excitation of a photoluminescence by light with a wave length corresponding a maximum in a spectrum of excitation of manganese in sulfide of zinc (495 nm) the spectrum of a luminescence represents one band with a maximum - 585 nm. At action of ultrasound on a crystal of changes in spectrums of a luminescence it is not observed.

The analysis of the gained data allows to draw a deduction on a situation of centres of a luminescence in volume of a crystal and processes of resonant transmission of energy from centres of a sensitization to luminescence centres.

APPLICATION OF STEADY STATE PHOTOCONDUCTIVITY METHOD FOR CONTROL OF MINORITY CHARGE CARRIERS PARAMETERS IMPROVEMENT IN SINGLE CRYSTAL SILICON WAFERS

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Lifetime τ and diffusion length L of minority charge carriers (MCC) in the base crystals of photovoltaic converters (PVC) concerns to the main electronic parameters which determining the efficiency of PVC [1]. Earlier we carried out the research of abovementioned parameters at various optimization stages of Ukrainian PVC construction-technological solution [2] which showed that existing technological process led to appreciable reduction of MCC lifetime even when using silicon with initial $\tau \geq 100$ μs.

In connection with stated as well as taking into account the deficit and expensiveness of high-quality silicon the question of MCC lifetime control in the initial silicon wafers of different marks as well as the approbation of methods for increase τ in the silicon wafers initially possessing low MCC lifetime become topical.

The single crystal silicon wafers of SEP-4,5 and SHB-7,5 marks with n- and p-type of conductivity, accordingly, and area of 1 cm^2 were investigated. With the purpose of MCC parameters improvement the part of samples was exposed to annealing on air at the temperature of 900°C over a period of 3 hours and the part of them besides annealing was exposed to the deep chemical etching in boiling NaOH for thinning from initial 400 μm to the thicknesses in the range of 65-175 μm.

Determination of MCC parameters was carried out by the steady state photoconductivity method. As a source of light flow was used universal light-emitting diode illuminator [3], radiating monochromatic light in 370-960 nm wavelengths range.

It has been established that carrying out of such annealing at the temperature of 900° C over a period of 3 hours results in to growth of MCC life time from 12 up to 35 μs in the near-surface Si-wafers regions with thickness of 20÷40 μm. It can be explained by the intensive gettering of background impurity and intrinsic point defects from the specified regions into intrinsic silicon oxide forming on the surfaces of such wafers.

It has been shown that thinning of exposed to annealing silicon wafers by the deep chemical etching in NaOH promote to decay of τ in the near-surface regions to 70% from the bulk value, while in the non-thinned samples the values of τ in the near-surface regions does not exceed 5% from their values in a bulk. It can be explained by the deliverance of samples in the etching process from deep microcracks and other defects of initially mechanical treatment silicon wafers, which entered the significant quantity of recombination centers in the near-surface volume of single crystal wafer.

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РЕЗОНАНСНЫЙ МЕТОД ИЗМЕРЕНИЯ КОМПЛЕКСНОЙ ДИЭЛЕКТРИЧЕСКОЙ ПРОНИЦАЕМОСТИ ВИН.

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Среди методов измерения диэлектрических характеристик жидкостей в СВЧ и КВЧ диапазонах, использующих металлические волноводы, особое место занимает метод, основанный на резонансной измерительной ячейке, созданной в волноводе с капилляром, заполняемым жидкостью, получившей название капиллярно-волноводный резонатор [1]. Данная работа рассматривает возможность применения капиллярно-волноводного резонатора для измерения диэлектрических характеристик вин с малыми концентрациями спирта (от 10,7% до 11,6%), для которых стандартные волноводные методы обладают низкой эффективностью.

Экспериментальные исследования проводились с 12 образцами виноматериалов с различным содержанием спирта и сахара, а также несколькими образцами фальсификата вина. Изучались параметры резонансного поглощения электромагнитной энергии волноводной моды H_{10}(частота, добротность и максимальное затухание сигнала) винами и фальсификатом, которыми заполнялся капилляр в капиллярно-волноводном резонаторе. Полученные в результате эксперимента данные позволяют сделать вывод о высокой чувствительности используемой электродинамической структуры к малым изменениям концентраций спирта и примесям, что дает возможность использовать капиллярно – волноводный резонатор в качестве ячейки диэлектрометра. Сравнительный анализ экспериментально полученных характеристик вин и винофальсификата показал, что используемый метод перспективен для разработки датчиков измерения комплексной диэлектрической проницаемости вин, в том числе для оперативного контроля на этапе их производства.

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PROCESSING OF THE SIGNAL OF THE GAS SENSOR CONTROL BY MEANS OF THE METHOD OF CASCADE CORRELATION

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Gas sensor controls can be constructed on a basis as traditional semiconducting units (resistors, diodes), and in the form of primary converters as a part of hybrid structures (surface acoustic wave devices, optical sensor controls).

Sensor controls of resistive type are one of the most widespread. To sensor controls on a basis oxides metals as a sensitive material apply SnO_2, ZnO, Fe_2O_3, WO_3, Co_3O_4. On a surface of these semiconductors at chemical absorption of oxygen there is the local charge derivated captured electrons which leads near surface depletion to semiconductor area. According to its admittance in which a dominating role the surface component will play, had enough. When is adsorbed other gas which catalytically interact with chemical absorption of oxygen, conductivity near surface depletion to semiconductor areas essentially increases. Speed of these processes and their reflexivity depend on temperature which should be an order of several hundreds degrees.

Samples who were used in the given operation, were produced from powders ZnO and Ag_2O the submicronic size. Connections carefully mixed up in water. Contents of the additive of oxide of silver made 2 % on weight. Then stock it was pressed at pressure 100 МПа in the form of disks, and it was burnt out at temperature 900^{o}C in air atmosphere throughout 1 hour.

Time dependences of the electrical conductivity a material at its finding in atmosphere which study are in the important parametre for materials which are investigated for application as gas sensor controls. These dependences essentially differ for different spirits.

The developed model of processing of a signal of a gas sensor control studies time dependences of the electrical conductivity in a miscellaneous gas surrounded at different partial pressure. At the decision of problems of the signals of gas sensor controls connected with processing neural networks algorithms I allow to reduce considerably quantity of images which are necessary for writing down at training to a sensor control. Model of data processing on the basis of cascade correlation that most builds the topology, is under construction in such way. The data that arrive from sensor control elements, are consistently processed in following blocks of construction neural networks:

1. Cascade correlation begins from the minimum neural network which makes only of entrance and initial layers. Both layers - fully connected, i.e. exist all possible communications between all knots at the account of restrictions which are imposed on a network of direct distribution;
2. All communications which conduct to an initial layer study usual algorithm until the error does not cease to decrease;
3. So-called knots-candidates are created. Each knot-candidate connected with all entrance layers and with all existing latent knots. Between knots-candidates and initial knots of sheaves the absent;
4. Attempt to maximise correlation between attraction of knots-candidates and a residual error of a network is developed, learning communication which conduct to knots-candidates. Training occurs on the help of usual algorithms. Training stops, when correlation indicators cease to improve;
5. The knot-candidate with the maximum correlation gets out, scales of its entrance communications are fixed, and it increases in a network. For transformation of knot-candidate into the latent knot communications between it and initial knots are created. We come back to point 2.

Thus, was constructed neural networks which contained 3 neuron and the error of definition does not exceed 97,8 % that testifies to adequacy of model. The developed information technology allows to define unknown spirit as regards kinetic dependence.

PHOTOLUMINESCENCE IN THE CRYSTALS OF LITHIUM-SODIUM TETRAGERMANAT DOPED BY MANGANESE

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The purpose of this work was to obtain the spectroscopic data, which together with the results of the research of EPR would respond to questions about the charge status and possible locations of localization impurity of manganese ions in the crystal lattice of crystals $LiNaGe_4O_9$, grown from the alloy by using a method of Chohralskiy. It should be noted that such studies of these crystalls are conducted for the first time.

The photoluminescence (FL) of the studied crystals initiated at T = 300K and T = 77K in each of the two maximums set for luminescence excitation spectra (SVL). The nature of the spectra of FL, which were very difficult and consisted of at least seven clear lanes radiation, were guided by the selection of the wavelength of incident light. Figures 1 and 2 presents the typical spectra of FL manganese ions in conditions of the excitation by wavelengths of 385nm (Figure 1) and 471nm (Fig. 2)

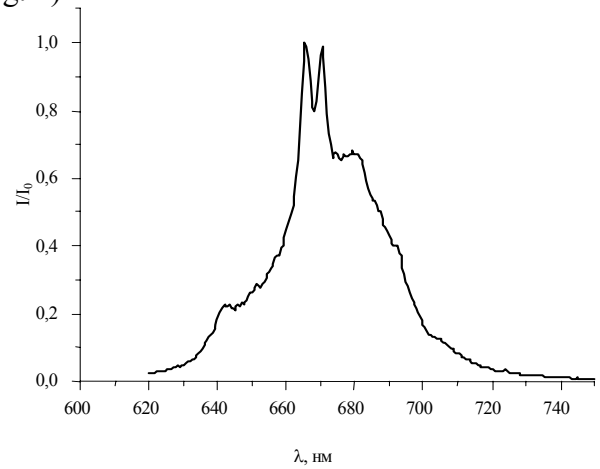

Fig. 1.

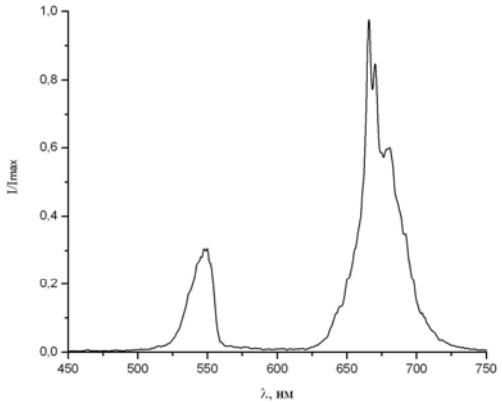

Fig. 2.

It was detected and investigated the dependence of the intensity of the bands of photoluminescence from the polarization of the incident light.

The paper shows and discusses evidence that under certain excitation energy, some bands in the spectrum of FL manganese split during action on the sample external magnetic field.

The experimental results, presented in this paper, indicate a presence of at least two different types of manganese centres of luminescence in the studied crystals.

MAGNETOHYDRODYNAMIC THEORY OF SOUND IN AMORPHOUS SOLID

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As known, in an amorphous (without structure) solid both longitudinal and transversal sound-waves are possible. The last have a displacement nature and tying up with oscillations of momentum [1]. For the origin of displacement wave an elastic body must obtain some initial momentum. The presence of momentum of the charged particles causes the presence of magnetic momentum. For simplicity we will study the pure matter (identical atoms). At sound frequencies we will consider effectively parted electrons and nucleuses. In a solid electrons form a quantum Fermi-liquid. Interaction is taken into account by introduction of effective mass of electron m_e^* in degenerated Fermi-gas. As on between atomic distances electromagnetic forces are operated only, naturally to assume that transversal waves have magnetoplasma nature. At what the constant magnetic field in the direction of wave distribution arises up due to a mechanism, that similar to the hydromagnetic dynamo. We will estimate the magnetic field through density of energy, as all power sizes in degenerated Fermi-gas have the order of Fermi energy [2]: $\frac{H_0^2}{8\pi} \cong \alpha \frac{3}{5}\varepsilon_{Fe} n_e = \alpha \frac{3}{10} m_e^* v_{Fe}^{*2} n_e$. It is now possible for description of acoustic oscillations to use equation of magnetic hydrodynamics [3]. At consideration of hydrodynamic processes it is comfortably to use to the concepts of pressure. Pressure of degenerated electronic gas on ionic (positive charges) component such as $P = (3\pi^2)^{2/3}\hbar^2 n_e^{5/3}/5m_e^*$. In future we need the gradient of pressure. In the truly hydrodynamic approaching of long waves $kr_D << 1$ the Poisson equation gives simple bond between densities $\delta n_i - \delta n_e = 0$, that allows to get rid of n_e ($n_i = Zn_p$). We will inculcate denotation $u_S = (3\pi^2)^{1/3}\hbar n_e^{1/3}/\sqrt{3m_e^* M_i} = v_{Fe}^*\sqrt{m_e^*/3M_i}$. As positive charges come forward the protons with effective mass $M_i \approx AM_p/Z,$ where A is amount of nucleons in a nucleus. It is possible, also, to apply direct electrodynamic (kinetic) consideration and already in dispersion equation to do the magnetohydrodynamic approximation. In the total we have spreading of three sound-waves. Longitudinal one, naturally, has speed u_S, from where we determine the effective mass, and two transversal (alfven and fast) ones determine the constant α - $u_\perp = u_A = H_0/\sqrt{4\pi n_i M} = v_{Fe}^*\sqrt{3\alpha m_e^*/5M_i}$. Experimental data give estimations for the inculcated parameters $m_e^* > 4m_e$, $\alpha < 0.9$. Knowing microscopic expressions for speeds easily to get, for example, expression for the Ung module $E = n_e M_i u_A^2 \frac{3u_S^2/u_A^2 - 4}{u_S^2/u_A^2 - 1}$. Optical frequencies will arise up at presence of a different effective mass of positive charges. There is obviously from the kinetic theory of plasma with magnetic field, that a longitudinal optical branch will be characterized by plasma frequency of light ion, and transversal – electronic cyclotron frequency.

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QUASI-OPTICAL RING SAPPHIRE RESONATOR WITH CYLINDRICAL CONDUCTOR INSIDE

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At present day the quasi-optical dielectric resonators begin to be used for surface resistance (Rs) measurements of the films and voluminous samples of high-temperature superconductors (HTS) [1]. However a necessity appears quite often for measuring R_s of test specimens with smaller linear dimensions, for example in case of synthesis of new superconductors. In our work the feasibility of the ring dielectric resonator, similar to the resonator in [2], in which "whispering gallery" modes are excited, is examined at R_s measuring in millimeter wave range. Here the sample in the form of the cylinder is disposed in a central part of the resonant tank.

Previously fundamental resonator's parameters such as resonant frequency (f_{res}) and quality factor (Q) were calculated depending on internal diameter of ring versus external diameter ratio. According to obtained data, optimal d_{in}/d_{out} ratio was determined. This relation is in an interval from 0.575 to 0.625.

For experimental investigation the ring anisotropic sapphire resonator ($\varepsilon_{\perp}$=9.8 a $\varepsilon_{\parallel}$=11.2) with outer diameter d_{out}=8.9mm, an inner diameter d_{in}=5.25mm and height H=3.63mm is fabricated. Both the ring open resonator and the resonator with conducting endplates (CEP) were studied. For electrodynamics properties determining of the resonator, the test specimens have been fabricated of conductors (copper and stainless steel) shaped the cylinder with a diameter d_{in}=5.25mm. The resonator was excited on $HE_{n.1.0}$ (n=6-9) mode by the image sapphire waveguides of a rectangular cross-section in frequency range 30-40 GHz.

The unloaded Q-factor of the resonator depending on conductivity of a metallic test specimen is investigated experimentally and numerically. It has the increasing character with achieving saturation which corresponds to a rod with perfect conductivity. At the same time a difference between Q_{OPEN} and Q_{CEP} is characterized by losses in CEP. It is shown, that on the basis of experimental data it is possible to estimate a resonator radiation Q-factor (Q_{rad}) and an inclusion coefficient (A_s) of the sample. Radiation losses fall considerably with index n growth. They were found unexpectedly independent, in limits of measuring errors, on CEP presence. Hence, for more precision R_s measurements it is necessary to use modes with larger azimuth indices. Such an approach will allow measuring R_s of HTS material with a high enough accuracy, but in a case of the resonator with CEP it is necessary to use endplates of superconductor with already known properties.

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EIGEN FORWARD AND BACKWARD SURFACE WAVES IN THE PLANE-LAYERED STRUCTURE WITH METAMATERIALS

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In this work, the spectral problem was solved for forward and backward surface eigen waves of TE-polarization. These waves can exist in the plane-layered structure with metamaterials, media possessing the negative permeability and permittivity [1]. The eigen surface waves satisfy homogeneous Maxwell's equations and meet the boundary value conditions and radiation condition. For the problem under consideration, we seek the surface waves in the following form:

$$\vec{E} = \vec{E}(z)e^{i(\gamma y-\omega t)},\ \vec{H} = \vec{H}(z)e^{i(\gamma y-\omega t)},$$

where $\vec{E}$ and $\vec{H}$ are electric and magnetic fields, correspondently; ω is a frequency, γ is a wave number. We suppose, that the permittivity of metamaterial possesses the frequency dispersion in the form [2]:

$$\varepsilon = 1-\frac{\omega_p^2}{\omega^2},$$

where ω_p is the plasma frequency [3] determined by the parameters of the elements composing the metamaterial.

Two types of the structures were considered: the first one is a magnetodielectric layer placed on the metamaterial half space, and the second type when the metamaterial layer is between magnetodielectric half spaces.

Analysis of the dispersive equations obtained reveals the existence of different types of eigen surface waves on the media interfaces. The constitutive parameters conditions, which permit backward surface waves in metamaterial structure, was defined. We carried out the numerical investigations of the wave numbers of the forward and backward surface waves as a function of a frequency, geometrical and constitutive parameters of the structure. In particular, the wave number dependence upon the plasma frequency was obtained.

The frequency ranges, which determine backward surface waves (the waves with the opposite phase and group velocities direction), were defined. These frequency ranges are guided with structure constitutive parameters. The whole energy flow of surface waves as a function of the frequency and structure parameters was studied. The special values of frequency, which give zero value to the group velocity and consequently to the energy flow, were determined.

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THE INCREASES OF THE ELECTRICAL CONDUCTIVITY OF THE ZnSe CRYSTALS, ENCOURAGED BY THE PLASTIC DEFORMATION

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The report presents the results of the studies of the nature of the increase effect (by 5-7 orders of magnitude) of isotropic electrical conductivity observed after the plastic deformation of some highom (10^{11}-10^{15} om·sm) crystals of the sulfid and zinc selenid.

For such crystals the value of activation energy of appr. 0,2 eV and the energy activation process of the electronic conductivity restoring (appr. 0,8 - 1,0 eV) is determined. Using the method of the original equilibrium conductance termostimulated depolarization (TSD), it was received an information about deformation changes of the the energy spectrum of small donors. It turned out that the plastic deformation results in the destruction of defects in depth of E = 0,2 eV and in the simultaneous emergence of small centers with depth E=0,018 eV.

It was found that for the existence in the studied samples of the sulfid and zinc selenid crystals the effect of deformation incentive conductivity, the presence of impurities aluminum is a necessary but not sufficient condition. It was found that the feature of samples in which electrical conductivity may increase after deformation, is the availability of EPR spectra of broad (up to 400 E) through acquisitions. Based on the analysis of complex experimental studies of the spectra of electron spin resonance (ESR) and electrical properties (VAH, TSD) crystals with stimulated deformation of conductivity, a model that adequately explains the physics of processes that make the electronic system of the deformed crystals go out of balance.

The basic assumption of the model, which in turn is confirmed by independent experiments, is that the growing deployment, shifting in the deformation from the starting positions, increasing their electrical activity. This occurs as a result of the areas surrounding space charge, formed by ionized impurities and other defects. Impurity atoms of aluminum, which, in the form of one-stop centers with high concentrations present in the atmosphere Kottrella (E ≈ 0,2 eV), as a result of interactions with strong electrical fields of dislocations rebuild their donor properties (E ≈ 0,018-0,02 eV) and under the condition of the dislocation fields activity irreversibly supply electrons into a zone of conductivity. When the temperature increases the efficiency of diffusion processes also increase, and the defects of the screening cloud, which had not moved along with the deployment, surround them in a new place (E_{act} ≈ 0,8 - 1,0 eV). As a result, the radius of the ridovskiy cylinders around the dislocations reduces again and the conductivity of crystals turns back to equilibrium.

The experimental data obtained in this work led to the assessment of the radius Kottrella atmospheres around dislocations of the impurity of aluminum (0.88 - 2.8) 10-5 cm, and the concentration of donor impurities necessary for the observed increase in conductivity (10^{-16} - 10^{-18} cm^{-3}).

THE NONLINEARITY CONDITIONS IN THE MAGNETIC-RESONANCE EXPERIMENT

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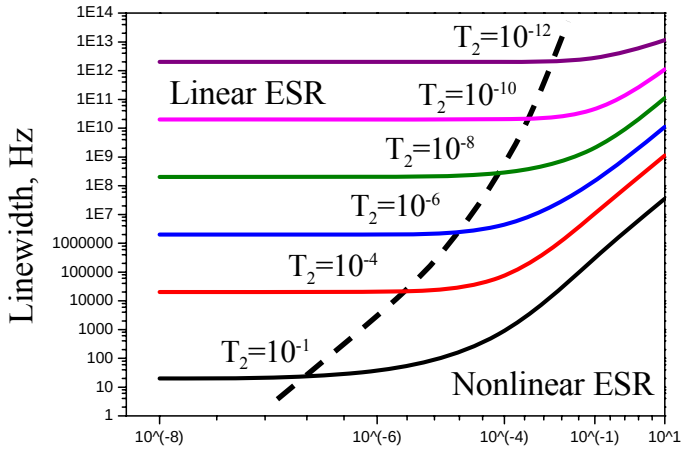
As is well known, the electronic spin resonance (ESR) is one of the most sensitive experimental methods for research of low-ordered magnetic phases in natural and artificial magnets. The mathematical method which is considered in [1], is reduced to the solving of the motion equation $d\vec{M}/dt = \gamma[\vec{M} \times \vec{B}_\Sigma] + \vec{R}$ of magnetic moment $\vec{M}$ of a microparticle, precessing in mutually orthogonal variable and constant magnetic fields $\vec{B}_\Sigma$. Here γ - gyromagnetic ratio, $\vec{R}$ - relaxation term which is responsible for the type of magnetic ordering in the structure. The solution of this equation is usually performed for a special "linear" case (the small intensity and small cross-relaxation times). Much more infrequent is a "nonlinear" case. The first case corresponds to the majority of known natural low-ordered magnets, the second one is more the general – it describes features more complex "composite magnets" (magnetic nanostructures) [2]. For the description of ESR -phenomenon in the first (traditional) case it is enough to receive the approximate solution of the linearized motion equations (see [1]). In the second case it is necessary to define the exact solution, because in magnetic nanostructures the wide dispersion of cross-relaxation times (at least from 10^{-1} to 10^{-12}) is observed. These dispersion interprets various types of low-ordered magnetic phases (superparamagnetism, asperomagnetism, spin glass, etc.).



In the given work the numerical solution of the motion equation is fulfilled, and areas of parameters (intensity of the microwave field and relaxation time) at which the «linear ESR» and «nonlinear ESR» are observed and defined. The dependence of half-width of the ESR-peak on intensity of the applied variable microwave field is given as an illustration here. One can see, that to the left of a dashed line the «linear ESR» effect takes place. The width of the ESR-response there does not depend on the intensity of the microwave field whereas on the right (the «nonlinear ESR» is observed), this dependence becomes quite noticeable and nonlinear.

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UNIVERSAL LIGHT SOURCE FOR COMPLEX SCIENTIFIC AND APPLIED RESEARCHES

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Light-emitting diode illuminator designing is initiated by the necessity to develop the universal and comparatively inexpensive device for express and complex parameters determination of both the semiconductor materials as well as the photovoltaic converters (PVC) on their basis.

Previously illuminators on the basis of tungsten incandescent lamps [1] and pulsed xenon lamps [2] were created for this purpose, but their key disadvantages such as significant mismatch of lamp spectrum to the solar one and limited possibility of the light flux time parameters control did not allow to create an really universal device. At the present time it became possible due to using of semiconductor light-emitting diodes which at the expense of quite small inertia and an enough low energy consumption allow to carry out express complex and energy saving researches, and by using the set of different radiation colors light-emitting diodes to imitate standard terrestrial and extra-atmospheric solar spectrums with the sufficient degree of accuracy.

Manufactured light-emitting diode illuminator (on which the patent of Ukraine [3] was obtained) at the using in structure of the appropriate measuring complex intended for solving of next problems. Measuring the loading illuminated current-voltage characteristics at the different illumination regimes, including the standard AM0 and AM1,5 regimes, for PVC on the basis of Si and GaAs single crystals and thin films heterojunctions (n-CdS/p-CdTe, for example). Determination of minority charge carriers lifetime in the PVC base layers on the stages of manufacturing, storage and exploitation of PVC. Other special purposes light actions on different solid-state, liquid-phase and biological objects.

The specified possibilities of the above mantioned illuminator reaches at the expense of using the unique radiating element in form of sphere segment, on the surface of which placed the semiconductor light-emitting diodes of seven colors, belongings to 380-960 nm wavelengths range. Light-emitting diodes in amount of 250-300 units are placed as the Archimedean spiral, which consists from in-series connected chains of light-emitting diodes each of seven colors. Such radiating element in a complex with the unit for separate control of each from seven colors light-emitting diodes illumination power and with the unit for the separate regulation of rectangular radiation impulses duration and pulse ratio allow to realize the different illumination regimes, expose the object to the illumination by the rectangular light pulses with the steepness of pulse edge no more than 1 μs at possibility to change duration and pulse ratio of impulses in the wide ranges.

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THE CELL OF MAGNETO-RESONANCE SPECTROMETER WITH BUILT IN REPER LABEL

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In this paper we consider the experiment's technique for researching the effect of an electronic spin resonance (ESR) in millimeter and sub-millimeter wavelengths in the field of low and ultralow temperatures. We have shown the results of the researches, allowed to create the resonator experimental cells of open type, which combining the basic advantages of the open resonator (OR) - high value of good quality and high value of filling factor. The cell №1 is made of a ruby in the form of DDR in modes of whispering gallery (MWG). These modes provide the values of good quality in 10 times exceeding values of good quality of two-mirror OR. On surface of DDR-ruby the investigated sample has been placed. Measurements were spent on a magnetic radio spectrometer "QUARK", intended for measurement of spectra of an electronic spin resonance (EPRFMR, etc.) in a range of frequencies of 25-30 GHz in the presence of magnetic fields to 1,4 T. The received spectrum of a ferromagnetic resonance for DDR with the investigated sample is presented in Fig.1.

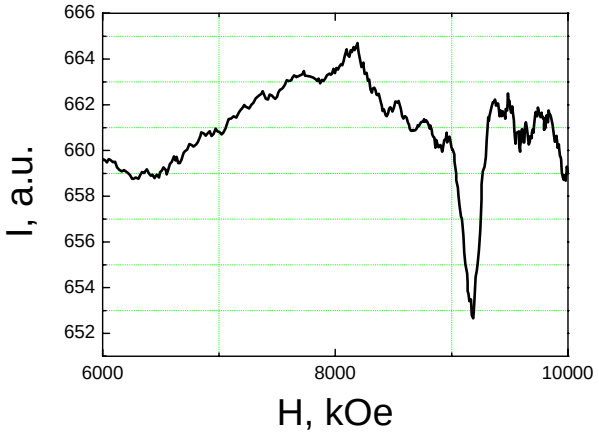

Fig 1 The spectrum of FMR.

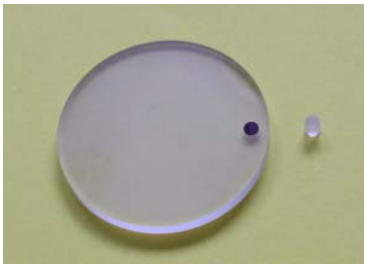

Fig.2 The DDR – sapphire.

Also we have investigated the cell №2, which made of sapphire in the form of DDR Fig.2, with an aperture for a sapphire and ruby insert. Experimental researches of the spectra of modes DDR registered in a frequency range 22-40 GHz have been spent for three configurations: 1) DDR with an empty aperture, 2) DDR with a sapphire insert, 3) DDR with a ruby insert. It is shown, that the sample with a sapphire insert is more high-Q.

During the first experiments the expediency of application DDR in magnetic radio-spectroscopy for millimeter wavelengths has been resulted and proved.

THE RESEARCH OF THE PROPERTIES OF THE SODIUM-TUNGSTEN BRONZES OBTAINED BY THE METHOD OF QUICK COOLING OF ALLOY.

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It is well known that the method of rapid cooling of alloys is of high scientific and practical interest. This is due to the fact that «stabilization» of the materials in various metastable structural conditions (which often have unique physical properties) becomes possible.

The purpose of the experiments, the results of which are presented in this report, is to use this method to produce nanostructured samples of the sodium-tungsten bronzes and explore their fundamental physical properties.

In doing so, we presented two possible ways to implement this state of nanostructures. The first way is to pilot the selection of such a speed of cooling that the process of crystallization in cooled alloy stopped at the stage of formation the nanocrystalls. The second way implies that the speed of the cooling of alloy will be sufficient to obtain the material in metastable vitrified state. In this case the formation of nanocrystalline component of bronzes in the vitrified matrix is also possible. We used exactly this method to obtain the samples.

Sodium-tungsten bronzes were obtained by the mechanical mixing of the components of WO_3 and Na_2CO_3, taken in certain proportions. Alloy was cooled by the method of «hammer and anvil». Rentgenodiffraction dimensions (DRON-2, 0) show us that as a result of the bilateral cooling we have obtained the samples of the natry-tungsten bronzes in the vitrified phase.

Differential thermal analysis (DTA) of the examined samples allowed us to determine the crystallization temperature range (360 - 420 ° C) and to determine the temperature of the phase transitions in crystalline state (620 ° C and 650 ° C).

The volt-ampere characteristics were examined and the conductivity was determined for all of the examined samples.

The spectra of fotoluminescence (FL) and of electron spin resonance (ESR) were examined in different structural forms.

Thus, during this study we have studied the materials received by using a method of rapid cooling and the materials that were cooled in natural way. We have also determined that by using the method of rapid cooling one can receive nanocrystalline component bronzes in this sample of the material.

MEASURING DEVICE OF POSISTORS' ELECTRIC TESTS ON THE BASIS OF THE MICROCONTROLLER

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Manufacture of semi-conductor resistive elements, such as posistors, there is a necessity for the automated definition and the control of electric parameters.

The results of the specialized multichannel information-measuring system intended for registration of volt-ampere characteristics, temperature dependences of resistance and carrying out of tests for cyclic changes of posistor's electric loading and self-restored fusses on the basis of the polymer filled conductive filler (graphite) are shown at the present work [1].

The system is developed on the basis of eight-digit microcontroller ATMega 16. The block diagramme of the measuring device is shown on fig. 1. The measuring system contains five measuring channels. The block of a choice of the measuring channel is realized by consecutive connection of the tested sample, powerful field transistor IRF 830 and a block of current resistors. During the choice of the necessary measuring channel the microcontroller forms binary code. The code arrives on the multiplexer. As a result on a transistor shutter a voltage is applied, and then the transistor opens (the channel is chosen). For an outcome of measuring and operating chains after the multiplexer is placed optoelectronic couple.

The operating program which has been "sewn up" in microcontroller, is developed with use of the programming language "C" of WinAVR environment [2] and its consists of service subroutines` section and section of management subroutines of measuring devices (a choice of the measuring channel, a choice current resistor R_T, management of a power unit, etc.).

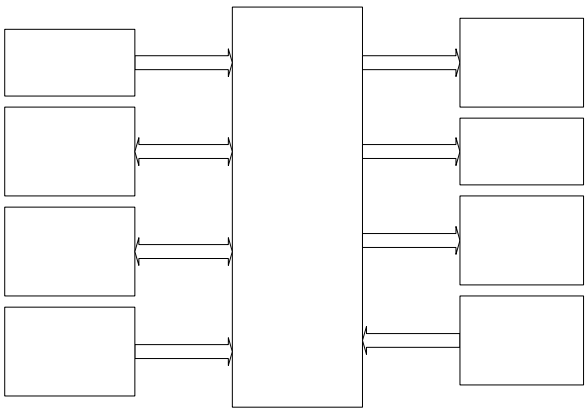

Fig. 1. The block diagram of measuring system

The obtained data can be sent through LPT-port to the computer for the further processing. The created device is universal and it can be used in other areas after minor alterations.

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ESTIMATION OF MATERIAL PARAMETERS OF MULTILAYERED NANO-FISHNET METAMATERIALS

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Metamaterials are artificial media with unusual electromagnetic properties. For example, it is possible to design media with both negative permittivity and permeability, and as result with negative refractive index. Creation of these materials may lead to development of superlenses capable of imaging with resolution which is much smaller than the wavelength of light. It's possible to create optical antennae with superior properties, nanolithography and nanocircuits, and 'metacoatings' that can make objects invisible [1].

The media with negative material parameters have been created only in microwave frequencies. In the visible and near-infrared bands they can be created using nano-fishnets [1-3]. The single-layered nano-fishnets are well investigated, whereas the multilayered structure are not studied in details.

In this work, the numerical simulations of plane-wave excitation of the multi-layered nano-fishnets are performed using the commercial software package CST MicroWave Studio. The material parameters are extracted using obtained reflection and transmission coefficients [4,5]. The frequency dependencies of the refractive index and the figure of merit of the structures are analyzed. The behavior of the material parameters of multilayered nano-fishnets depending on the number of single-fishnet-blocks and the thickness of air between the blocks is studied.

The larger is the thickness of air between nano-fishnet blocks, the smaller is the deviation of material parameters for multilayered structure from the ones for single-layer. When the distance between the blocks become less critical width, new pair of fishnet are formed in structure, that leads to serious differences of parameters extracted from the single and multi-layer structures. Therefore the optical parameters extracted from reflection and transmission spectra of a single layer do not correspond to those of many layers.

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OSA/SPIE SEMINAR FOR YOUNG SCIENTISTS AND STUDENTS ON NANOPHOTONICS & METAMATERIALS

INVITED LECTURES

III YOUNG RESEARCHER CAREER DEVELOPMENT WORKSHOP

SPIE POLISH-UKRAINIAN WORKSHOP ON «PHOTONICS AND METAMATERIALS»

RADARS AND WAVE PROPAGATION & REMOTE SENSING

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METAMATERIALS

PLASMAS AND MICROWAVE ELECTRONICS

OPTICS AND PHOTONICS

COMPUTATIONAL AND EXPERIMENTAL ELECTROMAGNETICS

BIOPHYSICS

TRANSMISSION OF IMAGES WITH SUBWAVELENGTH RESOLUTION TO DISTANCES OF SEVERAL WAVELENGTHS IN MICROWAVE, TERAHERTZ, INFRARED AND VISIBLE FREQUENCY RANGES

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The resolution of conventional imaging systems is restricted by the diffraction limit: the details smaller than half-wavelength of radiation cannot be resolved. Using novel engineered media with extreme optical anisotropy and their waveguiding properties it is possible to overcome the classical limit and create devices capable of transmitting images with subwavelength resolution over long distances [1-5]. We report experimental results that demonstrate transmission of a microwave image by means of an array of parallel metallic rods over a distance 3.5 times greater than the wavelength. The resolution of such imaging device is 15 times smaller than the wavelength. The magnifying, demagnifying and repeating properties of lenses formed by long metallic rods provide a unique solution for subwavelength imaging at microwave, terahertz and infrared ranges (up to 70 THz). At microwaves, the resolution of such lenses is determined by the characteristic period, which is limited only by the fabrication capability rather than by any physical constraints. At higher frequencies, the resolution is mainly limited by the skin-depth of the rods material. There is a possibility to create imaging devices operating in the same regime at the visible range using metal-dielectric multilayered structures [6]. This realization is closely related to the hyperlens concept [7-9].

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ANALYTICAL METHOD OF INVESTIGATING A MEDIUM WITH ELECTRIC AND MAGNETIC ANISOTROPY UNDER AN OBLIQUE PLANE WAVE PROPAGATION

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An investigation of electromagnetic properties of inhomogeneous anisotropic media is an important problem of the modern electrodynamics. Mediums only with magnetic or only with electric anisotropic properties are investigated today as rule [1-4]. A more general case of a medium with magnetic and electric anisotropy is considerated not so detaile because this problem is unwieldy and numerical methods are used as rule[5].

In this work a layered medium with both magnetic and electric anisotropy and arbitrary anisotropy axis direction under an oblique wave propagation is investigated analytically.

At first it is obtained 4x4 translation matrix for homogeneous medium with arbitrary direction of the anisotropic axis under oblique plane harmonic wave propagation analytically. It is verified that the matrix determinant is equal to complex unit in contrast to the case of a normal wave propagation. All four eigennumbers of the matrix are different and the modules of these are equal to unit. It is explained by the fact that the phase velocities of forward and backward waves in the medium are different. In the normal wave propagation case the phase velocities of forward and backward waves are equal and the eigennumbers of translation matrix are conjugate in pairs. This fact proves the results correctness. Also it is found the translation matrix of a layered structure as multiplication of the layer matrices. The eigennumbers of this matrix are analyzed for double layered period.

The 2x2 propagation and reflection matrices are found by use this translation matrix. The dependence of propagation and reflection coefficients on the ange between the plane containing an anisotropic axis and the wave propagation plane are studied. Also the dependence of these coefficients on an incident angle are investigated. The calculations are carried out for a plasma medium case.

Also it is found that the dependence of reflection coefficient on the angle between the plane containing an anisotropic axis and the wave propagation plane is symmetrical. This property may be used for detection of anisotropic axis angle direction.

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POLARIZATION OF ELECTROMAGNETIC WAVES BY AN ARRAY OF DNA-LIKE HELICAL CONDUCTORS

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The study of chiral (mirror-asymmetric) media has attracted great interest from the scientific community for many years. Earlier, researchers mainly studied the optical activity of such chiral media by native-grown crystals and artificial composite materials [1]. At present, however, investigations of artificial periodic media made of metallic elements and have assumed properties that not exist in nature are of special interest. Besides, the interest in research of physical principles of electromagnetic interaction on biological objects is increased.

Physical aspects of absorption of electromagnetic waves by living tissues are still not adequately studied, because of complexity of processes occurring in them. Biological objects contain many structures that have helical shape (DNA, RNA, proteins, nerve sheath etc.), therefore it is important to find out (from the classical principles as a first approximation) the peculiarities of interaction of electromagnetic field with this objects.

From a technical position it is significantly easier to conduct the investigation by using models of helical shaped structures, for example in microwave range, under the principle of electrodynamic similarity [2]. Such idea is implemented at the work, where experimentally investigated an electromagnetic wave of microwave range, which reflected by a 2D array composed of helical conductors. Each helical element has the geometrical form that is similar to those one which the molecule of DNA has. Both double and single helices are investigated. The dependence of the polarization type and the intensity of the reflected electromagnetic wave on the frequency are investigated under the main resonance. The main resonance take place under the condition $\lambda \approx P$, where P is the length of one turn of the molecule of DNA. The theoretically calculated optimum pitch angle between a helical chain, formed by atoms, and a plane, that is perpendicular to the helical axis, should be equal 24.5 degrees [3], whereas the pitch angle of the chain of DNA is equal 24 - 29 degrees (depending on experimental data) [4, 5].

On the basis of a principle of electrodynamic similarity it is concluded that the double helical molecule of DNA in the wave length range $\lambda \sim 7-8$ nm can radiate only an electromagnetic wave, which polarization is close to the left-handed screw. According to a principle of reciprocity, DNA is not influenced by right-handed circularly polarized electromagnetic wave in the specified range. Thus, by means of experiment, the result received earlier theoretically has proved. It is supposed, that the devices created by the specified principle will allow us to reduce the harmful influence of electromagnetic fields of the determined frequency range on DNA (humans, animals, plants, etc.) or, on the contrary, to accelerate chemical processes in the presence of helical bioobjects.

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GEOMETRY OPTIMIZATION OF PERIODIC SCREEN CELL WITH TWO ORTHOGONAL RECTANGULAR WAVEGUIDES

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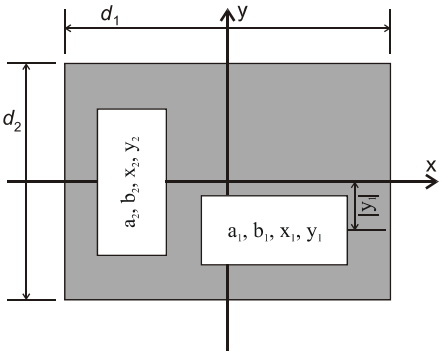
The practical usage of polarization effect in different devices connected with the necessity to develop and apply the elements allowing to radiate or receive differently polarized waves. For transforming of electromagnetic waves polarization different kinds of screens and covers have been applied in the open systems. It is reasonably to use the perfectly conducting screen of finite thickness where a periodical cell is two orthogonal located waveguide channels with a rectangular cross-section. It would be interesting to regard periodical cell screen with an offset of one slot with respect to axis cell symmetry (Fig.1). Such screen periodic element is chiral one and chirality value effects can arise during wave dispersion. We regard only reflected wave because the screen is given as a planar chiral structure for dispersion while for passing it is three dimensional and has more calculation complexity. The question about the offset value of the slot which leads to the brightest chiral effects is interesting.



First we consider the reflection characteristics of a linearly polarized wave falling normally from a screen with two-element cells depending on an offset of the second rectangle slot in the line of *y* axe. The calculation algorithm of dispersion characteristics of two-dimensional periodical finite thickness screens perforated by different forms slots has been based on the operator method [1]. The calculation algorithm of scattering operator of multiple-unit screen with the waveguide channel of rectangular cross-section is given in [2].

Second we calculate the numeric value of chirality by the method based on pure geometry of structure described in [3] and [4].

We can emphasis on two conclusions. First, we have found the optimal offset of slot in such periodic sell of thin enough screen. It's equal to 1.8mm (corresponding to Fig.1). This is a practically useful result. Second, this paper is an additional checkup of chirality measure model described in [3, 4].

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THE EXTERNAL MAGNETIC FIELD INFLUENCE ON THE PROPERTIES OF A FERRITE WAVEGUIDE LOCATED BETWEEN TWO LAYERED PERIODIC STRUCTURES

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Materials with artificial additional translation symmetry are of interest because of their features that can not be obtained in any homogeneous material. Layered periodic media can be treated as materials with controllable eigenwave spectrum zone structures. Guiding propagation of the electromagnetic waves in the core of the waveguides, if their clad has a periodic structure, provides for the high reflectivity of the layered periodic structures in the forbidden zones region (see, e.g., [1]). Using materials possessed the magnetic field dependence as either the guiding layer or the layers formed the periodic structure we have the additional possibility of the control of the properties of such waveuides [2].

In this paper the electrodynamic properties of the ferrite layer located between two identical semi-infinite periodic structures which formed by the alternation of two dielectric layers are investigated. In particular, the influence of the external magnetic field directed in the layer boundaries plane on the properties of such a guiding system is analyzed.

Theoretical analysis of the investigated waveguide has been carried out using Maxwell's equation and the boundary condition for each layer of the considered structure. To satisfy the boundary condition in the case of periodic structures we use the transformation matrix method (this matrix relates fields tangential components at the beginning and at the end of the period) and Floquet's theorem, that allows the periodicity.

It has been shown that in the case of the TM-polarization the external magnetic field does not effect on the properties of the guiding ferrite layer; it behaves like dielectric one. In such a waveguide either the guiding propagation (when the main part of energy is transferred in the guiding layer), or the propagation of the surface waves along the guiding layer boundaries are possible. Besides, the situation is possible when the energy flux in the guiding layer is almost absent, and waves propagate in the periodic walls. Waveguides with layered periodic walls posses the selectivity properties dependent on the band gaps that can be controlled by varying the parameters of the periodic structures' layers [3].

It was found that in the case of the TE-polarization the dispersion equation of the considered waveguide contains the components of the ferrite permeability tensor dependent on the magnetic field. So, the properties of the ferrite waveguide with layered periodic walls in this case can be controlled by means of the external magnetic field.

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CONCEPTUAL MODEL OF A MAGNETODIELECTRIC SWITCH FOR GHz AND THz WAVEBANDS

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Magnetically-controllable materials, such as ferrites, have an ability to dramatically change their physical parameters (permeability in particular) when a static magnetic field is applied onto them. This property has given them a wide spread in various periodic and non-periodic structures for millimeter and sub-millimeter wavebands, whose spectral characteristics can be controlled in realtime [1, 2]. Our group has performed multiple research works in the field of one-dimensional dielectric, magnetodielectric and metallodielectric periodic structures [3, 4], in which our modeling methods have proved to correlate well with the experimental results.

In this paper, we present a conceptual model of a magnetodielectric structure comprised of a square-shaped polymer with a thin (thinner than the wavelength) ferromagnetic film positioned diagonally inside it. By applying a magnetic field, it makes it possible to change the direction of electromagnetic waves propagating through this structure, from direct pass-through to 90-degrees reflection. This structure can be implemented in real world using conventional dielectric (e.g. polymer) and ferromagnetic materials, and serve as a compact and effective routing device that can be easily integrated into hollow or planar waveguides or periodic structures. Two or more of such magnetodielectric switches can also work together to direct electromagnetic waves in a more complex way, possibly mimicking binary logic.

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EXPERIMENTAL VERIFICATION OF LEFT-HANDED MEDIA PROPERTIES OF THE STRUCTURE (FERRITE/FLAT WIRES), PLACED INTO WAVEGUIDE AT THE FREQUENCY RANGE OF 21- 40 GHZ

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Left-hand media LHM ($\varepsilon' < 0$ and $\mu' < 0$) are one of most striking examples of artificial media (metamaterials), which property are unattainable for natural materials [1]. Design of LHM can lead to to development of superlens with superresolution, invisible coverings for microwave and optical ranges, etc. [2]. The given work is one more experimental example of LHM realization.

The investigated structure (LHM model) consisted of three flat parallel ferrite plates alternating with four polystyrene plates with sputtered flat copper wires (Fig 1). LHM model was placed into a waveguide with cross-section sizes 7.2x3.4 mm^2 and investigated in the frequency range of 21-40 GHz. The static magnetic field vector (0-7 kOe) was directed perpendicularly to alternating magnetic field vector. The zone of negative magnetic permeability was caused by a ferromagnetic resonance in ferrite plates and the zone of negative dielectric permeability was due to the fact that the investigated frequency range was below plasma frequency for such wire structure[3]. Experimental results have shown the presence of thransmission peak of -30 dB (Fig. 2) in the frequency range of overlapping of negative dielectric permeability zone and negative magnetic permeability zone. The tuning of frequency peak position by magnetic field has been shown.

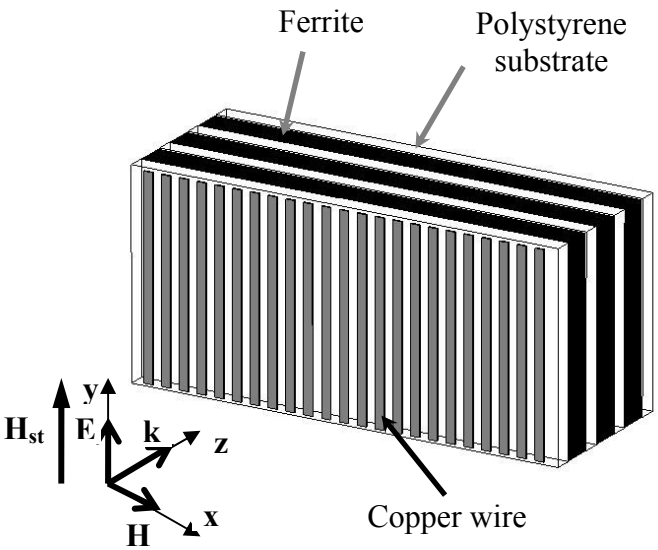

Figure 1 – Investigated structure

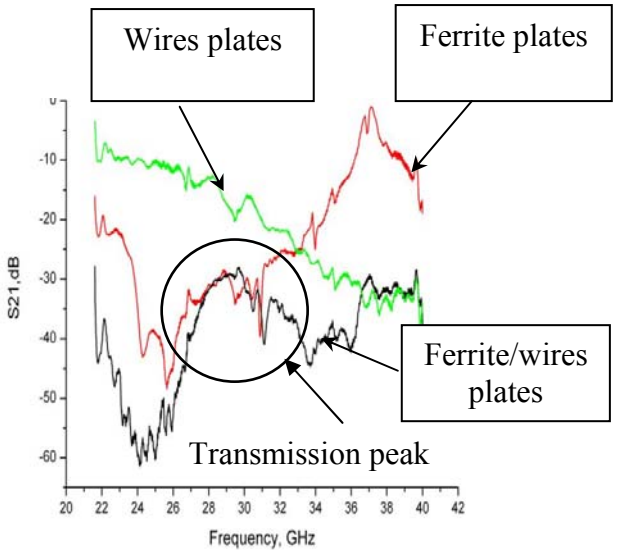

Figure 2 – Transmission coefficient of LHM

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REVIEW ON MAGNETO-OPTICAL EFFECTS IN FERROFLUIDS

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Ferrofluids are stable colloidal suspensions of magnetic nanoparticles, typically magnetite or cobalt, suspended in a suitable base fluid [1-3]. Brownian motion keeps the nanoscopic particles from settling under gravity and a surfactant layer, such as oleic acid, surrounds each particle to provide short-range steric hindrance and electrostatic repulsion between particles to prevent particle agglomeration.

Ferrofluids soon after their discovery in mid sixties gained great interest of scientific society due to its specific properties. The magnetic field induced structural anisotropy leads to many special magneto-optical properties such as The Kerr magneto-optic effect, magnetic birefringence and Faraday effect. Every single year, they find more and more applications. In many fields they have consolidated their position and nowadays are widely used as microelectromechanical/nanoelectromechanical sensors, actuators, in microfluidic/nanofluidic devices, as nanobiosensors, as targeted drug delivery vectors, in hyperthermia, in separations and cell sorting, for magnetic resonance imaging (MRI), and in immunoassays[2].

This review is focused mainly on already mentioned magneto-optical properties. I'm going to present theories and experiments explaining peculiar optical properties of ferrofluids[3-4], especially I'm going to compare results of experiments, computer simulations and predictions of theories. Moreover, actual and possible applications of ferrofluids due to their optical properties will be discussed.[5,6]

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BIOPHYSICS

AN INFLUENCE OF BROADENING OF LEVELS AND ELECTRON OVERHEATING ON CURRENT-VOLTAGE CURVE OF TUNNELING STRUCTURES OF METALLIC CLUSTERS

subject to A.V. Babich, V.V. Pogosov

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The islands-clusters of atoms are used in molecular devices as key components. Current gap and smoothed out stages of coulomb and quantum stairs which are yet more diffused with the increase of temperature of the system is observed on experimental current-voltage curves.

It is the general line of the experimental current-voltage curves of molecular structures circumstance that dependences of $I-V$ curves are smooth lines out of current gap. Even at low temperatures a coulomb blockade and quantum stair is diffused considerably. It was discovered in the experiment [1], that current gap in a structure on a disk by a radius 4 nm disappeared with growth of temperature from 5 to 300 K. A similar feature is also mentioned for spherical granules in the temperature range 30–300 K [2]. Such "anomalous" temperature dependence of the coulomb blockade mode and strong quantization does not find explanation within the framework of conception of quasi-equilibrium electronic gas and resonance current flowing through the stationary electron states in the cluster.

Explanation of the mentioned features of the current-voltage curves on the basis of broadening of levels at the expense of a tunneling effect and electronic gas overheating in a island with growth of bias voltage is the purpose of work.

An influence of broadening of levels and overheating of electronic subsystem of island electrode-cluster on current-voltage characteristic of three-electrode structure (molecular transistor) is explored in the work. Lower estimation of broadening for electronic levels in disc-like and spherical gold clusters is based on the tunneling effect of localized electrons for the zeroing bias voltage case and presence of coulomb blockade. The kinetic temperature of electrons subject to bias voltage is appraised in the two-temperature model of metallic cluster taking into account size dependence of Debye frequency.

The effects of broadening and overheating bring to strong smoothed $I-V$ curves even for a cluster consisting over of ten atoms that is observed in the experiments.

This job performances can be used for interpretation of experiment results on measuring of the current-voltage curves of the three-electrode structures on metallic clusters and development of fundamental theory of single-electron tunneling.

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PRINCIPLES OF CONSTRUCTION AND CALCULATION OF SUPPORTING SYNTHESIZER OF FREQUENCY

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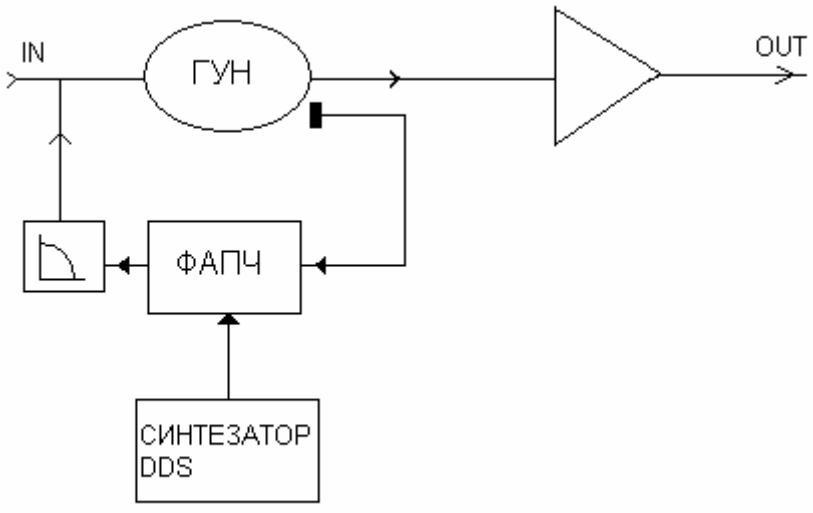
In this paper principles of construction and calculation of supporting synthesizer of frequency are examined for the systems of excitation of super-power klystrons

For forming of impulses is used a method of linear frequency modulation of pumping signals. For realization of similar method the rapid fast synthesizers of frequency are needed with high stability of phase and frequency of range of 2,5- 3 GHz

In the article considered the method of construction of such synthesizer is considered on the basis of the PLL system and digital synthesizer (DDS) of frequency as a regulative element. This method is based on comparing of frequency of generator of guided by tension to supporting frequency. In this case the digital synthesizer (DDS) of frequency comes forward the generator of supporting frequency. Maximum parameters which can be got in this structure are considered, requirements are formulated to the elements and knots of the system.

To basic dignities of this method behave: high speed of setting of phases, stability of frequency about $10^{-10\text{-}11}$, smallest step of alteration of frequency within 1μHz(1). Also not unimportant advantages of the described chart are small sizes of setting, autonomousness, possibility of frequency alteration and stability of parameters at the change of temperature conditions

The use of such system can allow substantially to improve the power parameters of bunch on the output of the linear accelerating of electrons



1.http://www.analog.com/en/rfif-components/direct-digital-synthesis-dds/ad9833/products/product.html

INVESTIGATION OF ELECTRON TRAJECTORIES IN OPEN RESONATOR OF DRO IN MM RANGE.

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The analytical expressions for electron trajectories in DRO have been obtained taking into consideration potential of open resonator (OR) mirrors effect on electron beam (EB). Numerical computations of electron trajectories for various DRO electron-optic system parameters have been conducted. It is studied the EB structure dependence on focusing magnetic field, initial conditions on cathode, anode slit thickness (in both cases of short-focus and long-focus lens) and accelerating voltage.

It is shown that potential on OR mirrors results in essential change of EB structure (trajectories),in particular of static pulsation of boundary electrons near to grating. The main results have been presented in form of graphics having practical importance for creation of DRO in mm and submm ranges.

SPIN TRANSPORT IN TRANSITION METAL ALLOYS

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The method for calculation of conductivity of disorder systems with strong electron correlations is developed. The method is based on the theory of multiple scattering. The cluster expansion is derived for two-particle Green's function of a disorder system with the account electron-electron and electron-phonon interactions. As a zero one-site approximation of that expansion it is chosen the coherent potential approximation. The received expressions allow investigating the phenomenon of spin transport in strong correlated systems. Calculation of spin transport for Fe-Co equiatomic alloy is carried out. It is shown, that the difference of electron streams for various spin orientation depends on position of Fermi level in respect of quasi-gap or energy band edge in electron energy spectrum.

ВИЗНАЧЕННЯ КОНСТАНТИ ЗСУВУ ДЕФОРМАЦІЙНОГО ПОТЕНЦІАЛУ В МОНОКРИСТАЛАХ n-Si ПРИ НАЯВНОСТІ РАДІАЦІЙНИХ ДЕФЕКТІВ

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Для вивчення впливу радіаційних дефектів на тензоефекти в n-кремнії в даній роботі досліджувались монокристали n-Si (ρ_{300K}=30 Ом) з вихідною концентрацією n_e=1,24·10^{14} см$^{-3}$, опромінені γ-квантами Co^{60} дозою 1,9\·10^{17} $кв/см^2$.Доза опромінення вибиралась такою, щоб на температурній залежності концентрації носіїв струму чітко проявлявся енергетичний рівень E_c-0,17 еВ, що належить А-центру (комплекс вакансії з міжвузловим атомом кисню) [1].

В умовах термодинамічної рівноваги

$$\frac{n_2}{n_1} = \exp(-\frac{\Delta E}{kT}) = C = \frac{1-\frac{\rho_x}{\rho_\infty}}{2\cdot(\frac{\rho_x}{\rho_\infty}K-1)}, \qquad (1)$$

де K- параметр анізотропії рухливості для n-Si в напрямку [100], n_1- концентрація електронів в мінімумах, які опускаються вниз по шкалі енергій а, n_2 відповідно - в мінімумах, які піднімаються вгору по шкалі енергій. ΔE- енергетична щілина між мінімумами, які піднімаються і опускаються відповідно, S_{11}, S_{12}- константи жорсткості, Ξ_u- константа зсуву деформаційного потенціалу [1].

Логарифмуючи вираз (1), отримаємо (в координатах $\ln C$ і X) рівняння прямої:

$$\ln C = -\frac{\Xi_u (S_{11}-S_{12})X}{kT}, \qquad (2)$$

за нахилом якої (при T=const) можна визначити Ξ_u.

Залежність в координатах ($\ln C, X$) має бути строго лінійною в умовах повної іонізації рівня радіаційних дефектів E_c-0,17 еВ. Відхилення від лінійності залежності $\ln(C\cdot 10^3) = f(X)$ (при T=77K), яке спостерігалось в області X>5000 $кГ/см^2$ пов'язане з відсутністю повного виснаження рівня E_c-0,17 еВ і залежністю від X величини енергетичної щілини між глибоким рівнем і дном зони провідності. В даному випадку значення Ξ_u слід визначати лише для X<5000 $кГ/см^2$, де лінійність $\ln(C\cdot 10^3)$ від X ще не порушується. При T=77K, згідно (2), Ξ_u=8,72еВ. При T>77K лінійність залежності $\ln(C\cdot 10^3) = f(X)$ буде порушуватись за рахунок зміни вкладу міждолинного розсіяння [2].

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SIC MESFET CLASS E WIDEBAND POWER AMPLIFIER

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At present time interest in silicon carbide (SiC) MESFET for power amplifier (PA) technology due its high breakdown voltage up to 100 V, low interelectrode capacity, high thermal conductivity leads to rapid development in investigation of different PAs using SiC active devices.

The aim of the present work is design, simulating and experimental investigation of wideband class E PA using SiC transistor CRF24010. In classical narrow-band class E amplifier active device acts as a switch with non-overlapping of drain voltage and current waveforms that allows to obtain maximal theoretical efficiency of 100%.

In UHF class-E PAs utilization of distributed output network based on microstrip lines is more useful than that of lumped-element network. The output circuit must provide input impedance at fundamental frequency

$$Z_1 = R \cdot \left(1 + j \tan 49.052^\circ\right), \quad (1)$$

where R – resistance, that is determined from values of output power and supply voltage, and impedance close to infinity on harmonics [1]. For realizing of required conditions at two different frequencies it's necessary to use multi-resonant circuit that utilizes combination of some stubs and lines. For two fundamental frequencies it's essential to realize load impedance value at the drain according to (1) and for corresponding harmonics in bands from $2f_1$ to $2f_2$ and from $3f_1$ to $3f_2$ the output network should provide infinite impedance.

Because of high on-resistance (about 15 Ohm) of present active device, maximal achievable efficiency of class E PA is limited, so it's necessary to take into consideration realizable criteria of class E PA: $R_{on} < 0.100152 \frac{V_{dd}^2}{P_{out}}$, where R_{on} – on-resistance of an active device, V_{dd} – supply voltage, P_{out} – output power [1]. So, parameters for amplifier designing were: supply voltage 29V, output power 5 W, frequency band 400–500 MHz.

Simulation of amplifier was held using harmonic balance method with Materka-Kasprczak transistor model with non-dependent gate-source and drain-source capacitances versus voltage [2, 3]. The simulated performance parameters are: 7.5 W of output power within 380–500 MHz frequency band with efficiency of 65%, that is greater than in [3] because of frequency band lowering of with 29 V of supply voltage.

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INFLUENCE OF NOT-IDEAL MAGNETIG PROPERTIES OF THE INTERFACE ON REFLECTION OF MAGNETOELASTIC WAVES IN THE FERROMAGNETICS

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Investigations of various waves features in the solid states is necessary not only for the description of the phenomena, connected with their propagation, but also for construction of the devices based on this waves, and also widening of areas of their technical application. Significant enhancement of manufacturing and application in microelectronics of magnetic materials with given properties, achieved due to progress in area of nanotechnologies, allows to construct new devices, action of which is based on characteristic effects, caused by presence of magnetic and elastic interactions.

In the present work we suggest to study the behavior of magnetoelastic waves in approximation of geometrical optics on an example of ferromagnetic with uniaxial magnetic anisotropy and isotropic elastic properties. In the work [1] a similar approximation was applied to the spin waves. We consider a magnetoelastic waves that propagates perpendicular to boundary of two half-infinitive homogeneous ferromagnetics having different values of parameters of exchange interaction and uniaxial anisotropy, according to JWKB method [2].

The main goals of our research are: 1) to obtain the expressions for determining the coefficients of reflection and transmission of magnetoelastic waves at the assumption of a non-ideal coupling in interface; 2) to investigate the dependences of intensities of reflected waves on the waves frequency and on the constant external magnetic field; 3) to analyze the change of the reflection intensity at change of value of parameter A, that describe the coupling in the interface.

It is obviously possible to obtain the dependences of the intensity of the reflected magnetoelastic waves for different values of parameter A, by means of expressions for determination the coefficients of reflection and transmission. The analysis of these dependences has shown that, intensity of reflection depends essentially on value of parameter which characterizes a coupling in the interface, and it is especially important at small values of this parameter. At decreasing of value of parameter A, the coupling in the interface weakens and consequently, intensity of the reflected wave increases. When $A=0$ we obtain the absence of coupling in the interface, and $A \to \infty$ corresponds to ideal boundary.

Besides, intensities of reflection depend in different ways on wave frequency for each component of magnetoelastic wave.

All mentioned details of the propagation of magnetoelastic waves in ferromagnetic media play an important role and have to be taken into account at construction of devises of microelectronics.

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ELECTROPHYSICAL PROPERTIES OF DISCHARGE PROCESSES IN LIQUIDS

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The phenomena of ball-lightning (BL) and its excitation in laboratory environment are very attractive in recent years [1-2]. There were proposed a lot of models for explanation of BL, processes of its excitation, life time and energy phenomena taking place inside plasma formation [3-4]. However up-to date models can't describe all phenomena taking place during BL excitation.
We reproduced conditions for BL initiation in laboratory environment and studied processes occurring during plasmoid forming. The special emphasis was laid on discharge process in liquid which initiate long-living plasmoid atmospheric emission. The research was conducted in two trends: 1) observation of radiation form liquid at electric discharge and 2) study of liquid structure during discharge as propagating density waves for electrodynamic properties of liquid determination. The obtained experimental data indicate the intense electromagnetic radiation from plasma during electric discharge in broad band – from long-wave centimeter to visible range. The radiation mechanisms can be connected with electric pump of atoms and molecules of dissociated liquid on rotational, vibrational and electron levels and re-emission into space. Also the possible mechanism is cyclotron bremsstrahlung excited because of high-energy electrons presence in plasma.

Also perturbations occurring in liquid were studied by means of signal recording from piezoelectric sensor. It was established that generated density waves propagate in vertical and horizontal directions unequally.

The time dependences, discharge photographs, SHF sensors signal waveform are presented in work for typical electrical discharges which energy doesn't exceed 10kDj.
For our and described in literature results on BL explanation we proposed the model of non-homogeneous complex electromagnetic waves in layered medium formed by liquid density waves. For periodic structure of dielectric and plasma the complex roots of dispersion equation has been found and microwave field distribution with closed energy flux corresponding to the complex roots has been plotted. We suppose the ionization of molecules of media during considerable electromagnetic wave concentration and hence the plasma formation excitation.

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CHARACTERISTIC EQUATION OF THE LASING MODES OF INFINITE PERIODIC CHAIN OF QUANTUM WIRES

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Modern technologies allow producing advanced light-emitting devices based on single or multiple quantum wires embedded in epitaxially grown semiconductor microcavities. The quantum wires as active media gain advantages comparing with quantum wells as, for instance, their better thermal stability, lower chemical reactivity, and higher mechanical strength.

We consider the resonator that consists of the parallel to the *z*-axis and periodic along the *x*-axis circular dielectric cylinders with the distance between cylinders p and the radius of a cylinder a. Assuming that the electromagnetic field is time-harmonic ($e^{-i\omega t}$) and does not vary along the *z*-axis, we will study the LEP as a 2-D problem. Studying two alternative polarizations, E and H, we may use the function $U(x,y)$, which will denote the E_z or $Z_0 H_z$ component of the electromagnetic field, respectively. It should satisfy the Helmholtz equation with different coefficients: $(k')^2 = k^2\nu^2$, where $\nu = \alpha - i\gamma$ $(\alpha,\gamma > 0)$, inside each cylinder and k^2 outside. Here, α is the refractive index and γ is the material gain which appears in the presence of pumping [1]. Also U must satisfy the condition of the local power finiteness and the condition of radiation at infinity. Although the most general situation implies that the field functions within the adjacent elementary cells of the periodic cavity differ by a phase factor, i.e. $U(x+p,y) = U(x,y)e^{i\beta p}$, in the following treatment we will assume that $\beta = 0$. We aim a problem to find non-zero solutions to the formulated homogeneous problem. All mentioned conditions bring us to a determinantal equation

$$\mathrm{Det}[I + A(\kappa,\gamma;\xi,\alpha)] = 0, \qquad A_{mn} = \frac{V_n(\kappa,\nu)J_m(\kappa)}{F_n(\kappa,\nu)J_n(\kappa)} S_{mn}(\kappa\xi) \tag{1}$$

$$F_m(\kappa,\nu) = \kappa' J_m(\kappa') H_m^{(1)\prime}(\kappa) - k J_m'(\kappa') H_m^{(1)}(\kappa) \tag{2}$$

$$V_m(\kappa,\nu) = k J_m'(\kappa') J_m(\kappa) - \kappa' J_m(\kappa') J'_m(\kappa) \tag{3}$$

$$S_{mn} = 2\sum_{s>0} H_{n-m}^{(1)}(\kappa\xi s) \tag{4}$$

Here $\kappa = ka$, $\kappa' = ka\nu$, $\xi = p/a$ and S_{mn} are the lattice sums whose convergence is extremely slow so they require a special approach [2]. The equation (1) contains the Fredholm second-kind matrix due to the face that its elements A_{mn} decrease rapidly enough if $n,m \to \infty$.

The determinantal equation (1) reduces to the characteristic equation of one cylinder $F_m(\kappa,\nu) = 0$ when $\xi \to 0$ (the distance between cylinders go to infinity), because the lattice sums decay to 0.

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NEW POLYMER MATERIALS IN FIBRE TECHNOLOGY

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Epoxy resins are a group of synthetic resins used to make plastics and adhesives. High resistance to chemicals and outstanding adhesion, durability and toughness have made them valuable as coatings. Because of their superior thermal, mechanical and electrical properties epoxy resins are widely used in the electronics. However, the further use of epoxies is limited because of their inherent brittleness. Improvements in heat resistance and toughness are also highly desired features. In most cases, enhancement of these characteristic is not achieved by improving only the structure of the epoxy resins.

An effective way to obtain materials with specific properties is to blend polymers. The concept of combining two or more different materials to obtain a new material with synergistic or additive properties has been widely used in polymer composites and polymer alloys.

Differential scanning calorimetry is a thermo analytical technique in which the difference in the amound of heat required to increase temperature of sample and reference are measured as a functions of temperature.

Epoxy resins can be modified by introduction into them thermoplastic polymers such as polysulfone (PSF), poly(ether sulfone) (PES) poly(ether imide) (PEI) and polyimide (PI) [1-2]. The thermoplastic polymer used to improve properties of resins needs to have high T_g and it has to be compatible in the epoxy matrix. To obtain an effective improvement in toughness large amount of thermoplastic polymer has to be used. Then the thermoplastic forms a continuous phase with the epoxy spherical domain, or the thermoplastic and the epoxy form a co-continuous phase [1-2].

Possible applications: new hard protective optical fibre clovers, “packaging”, matrixes for composite materials.

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COHERENT ELECTRON TRANSPORT THROUGH INJECTORS IN THE QUANTUM-CASCADE STRUCTURES WITH VERTICAL TRANSITIONS

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Semiconductor lasers with quantum-cascade structures (QCS) are promising sources of IR and THz radiation. History of these structures counts more than thirty years starting from the paper of Kazarinov and Suris [1]. Possibility of fabrication appeared within the last decade. However, the transport of carriers through injector of QCS is still unclear. Injectors separate the active regions and provide the transport of electrons from one cascade to another. It has been shown in [2] that the main part of all scattering processes appears in active regions. The result of it is coherent transport in injectors with high dephasing time.

In this work, theory of optical response for QCS with vertical transitions [3] has been developed. We include into consideration coherent transport of carriers through injectors and many-body effects in the active region. There are many approaches to modelling of optical propeties of semiconductors. Most applicable ones are method of non-equilibrium Green's functions [2] and density matrix approach [4]. In this work, we use the density matrix theory due to its simplicity. Moreover, the density matrix approach allow to consider easily high-order correlation effects in many-body interactions. After applying of some approximations, we derive semiconductor Bloch equations for QCS. Solutions of these equations are dynamics of polarization and carrier distribution functions which are directly related to the optical characteristic.

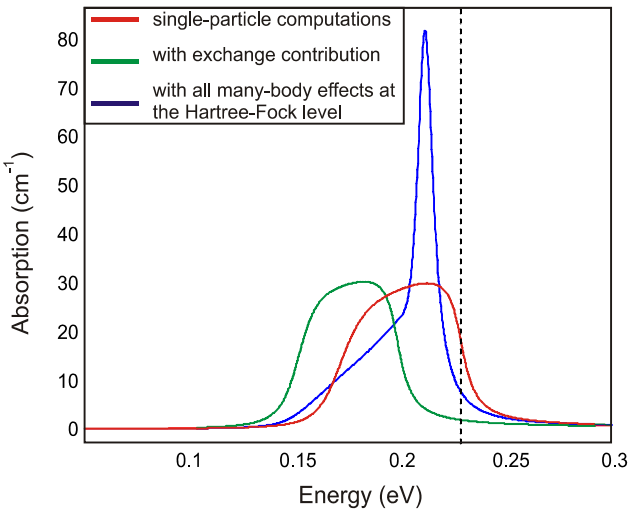

Fig.1

All results have been obtained for model structure consisting of one active region and injectors. In other word, only one cascade is under the consideration. The model structure is terminated by two reservoirs of carriers. Reservoirs are characterized by equilibrium distribution of carriers that is Fermi-Dirac distribution. Fig. 1 contains computed absorption spectra for the structure with coherent transport in injectors. We consider many-body effects in active region at Hartry-Fock level. Coherent transport in injector effect on dynamics of non-equilibrium distribution of carriers in subbands, in active region. This have own effect on optical characteristics.

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DISPERSION COMPENSATOR BASED ON 2D PHOTONIC CRYSTAL

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All dispersion effects though are connected with different properties of a fiber, lead to increase of duration of transferred pulses and, as a result, to an intersymbol interference (ISI), which complicates recognition of signals after propagation over a fiber. The chromatic dispersion (CD) brings appreciable distortions at a signal transmission. Various spectral components of a signal, as a result of CD, propagate with different velocities which leads to increase of its duration. The traditional way of CD compensation in optical range is using of optical compensators of dispersion. Usually, the compensator contains a fiber with an opposite sign of dispersion (in relation to dispersion in a standard fiber). Such optical compensation of dispersion has shown oneself as good one in long-distance communication lines, in which distance between the sender and the receiver is constant.

In this work, the dispersion compensator based on a two-dimensional photonic crystal is proposed. The structure with various radii of elements has been designed. The radii increase a a linear function of the distance from the device input. Radii were selected by computation of a band structure by the plane waves expansion method, and the field propagation modelling was made by means of finite difference time domain method, so lower wavelength is reflected from current layer while larger wavelength passed along the structure. Thus there was realized so-called chirped structure. During the work have been obtained the delay of pulses at various wavelengths as well as the value of the dispersion compensated by the device.

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FABRICATION AND CHARACTERIZATION OF SPECIALTY PHOTONIC CRYSTAL FIBERS

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The microstructured fibres (MSFs) or photonic crystal fibres (PCFs), also called holey fibres, became in recent years a subject of extensive research. Those fibers has a large potential for a number of novel applications in the sensing domain.

The manufacturing flexibility of PCF allows fabricating different types of specialty microstructured fibres including endlessly single mode, double clad, germanium or rare earth doped, highly birefringent, and many other fibres with particular features.

It has been demonstrated that PCFs can be used in optical and telecommunication applications such as generation of supercontinuum and compensation of chromatic dispersion.

Polarization properties of MSFs are also very interesting. For example, it has been shown that modal birefringence in MSFs may exceeds 10^{-3}, which is one order of magnitude higher than birefringence in classical high birefringent (HB) fibres. High birefringence in PCF's fibres can be induced by filling factor asymmetry of the cladding, elliptical shape of the core or by elliptical shape of the holes.

It has been also shown that in the some group of photonic crystal fibres a single-polarization light transmission can be achieved. The polarizing PCFs described in literature exhibit different mechanisms of polarization discrimination such as intraband guidance in supersquare photonic bandgap structures or the dissimilarity in cut-off wavelengths for orthogonally polarized fundamental modes in the index guided structures.

There are also increasing interest concerning possible applications of PCFs as evanescent field sensors and surface plasmon resonance sensors for monitoring specific chemical compounds in gases and liquids.

In the lecture present technology of fabrication and basic characterization of several kinds microstructured fibers made of silica and high silica glasses will be presented. The main point of view is sensing application of these fibers. Therefore, the low- and high birefringence index guided fibers with triangular lattice, very high birefringence passive and active fibers (rare earth doped – Nd and Er), new kind of single mode polarizing (named SMP) fiber composed with silica and high silica glasses and metallic silver. Also, new kind of single mode quadruple (named SMK) fiber composed with silica and high silica glasses and metallic silver layers deposited inside fiber holes.

SELF-IMAGING OF NONLINEAR-DISPERSIVE SIMILARITON OF FIBER WITHOUT GAIN

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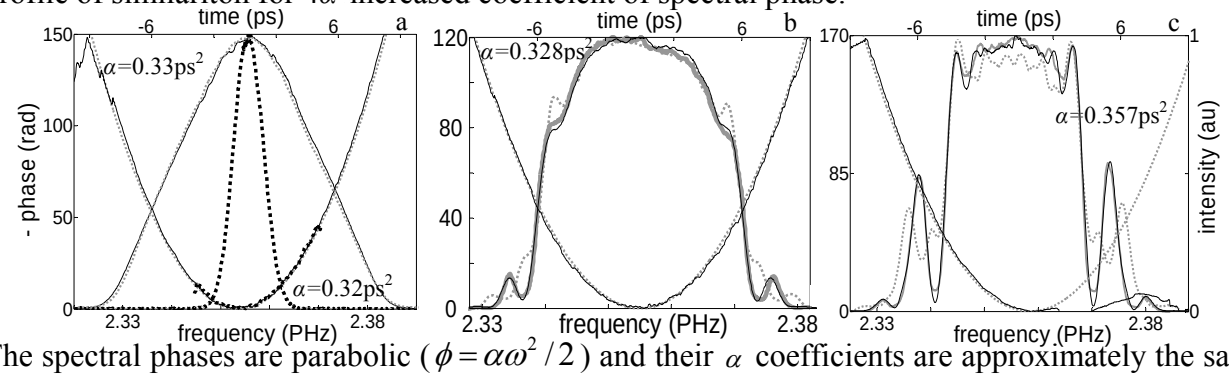
We studied experimentally the generation of nonlinear-spectronic similariton under the combined impact of nonlinearity (NL) and dispersion (D), its nature and distinctive properties [1,2]. We use the spectral interferometric methodology to completely characterize and study the generation process and peculiarities of NL-D similariton. In our experiment we split input radiation of a femto-second laser into two parts. The low-power pulse serves as a reference one. For the high-power pulse, first we filter its spectrum of the $\Delta\lambda$=11nm bandwidth down to the $\Delta\lambda$=2nm value. We shape pulses of different amplitude profiles and inject them into the NL-D fiber. The spectra of these pulses are broadened, however the spectrum of the reference pulse covers them completely. We record the spectral interferometric fringe pattern and retrieve the spectral phase. Figure illustrates the results for similaritons generated from input one peak (a), two-peak (b) and distant two-peak (c) pulses. Black solid curves show the spectrum and spectral phase of NL+D propagated pulse (black dotted ones of (a) are for the pure D-propagated pulse), gray dotted show the parabolas fitted to the spectral phase, and the retrieved temporal profiles. Gray solid curves of (b),(c) show the temporal profile of similariton for 4α increased coefficient of spectral phase.



The spectral phases are parabolic ($\phi = \alpha\omega^2/2$) and their α coefficients are approximately the same in all cases of D-propagation (a) and NL-D-propagation (a), (b), (c). The parabolic phase (/linear chirp) leads to the self-spectrotemporal imaging of similariton. For (b) and (c) the matching between the spectral and temporal profiles of similaritons is qualitative only. To obtain a quantitative agreement, one must use a longer fiber, increasing the coefficient α of the parabolic phase: the spectral and temporal profiles of similaritons practically coincide for the gray solid lines of (b), (c), showing the temporal profiles of similaritons for the 4α coefficient of spectral phase.

Our studies show the following properties of NL-D similariton:

- the linear chirp, with a slope given only by the fiber dispersion;
- the relation with the rectangular pulse of NL-D fiber;
- the property of spectro-temporal similarity / self-spectrotemporal imaging, with the accuracy determined by spectral broadening and pulse stretching together.

Concluding, we observed the NL-D similariton of single-mode fiber without gain. By means of spectral interferometric measurements, we showed parabolic phase of NL-D similariton, which leads to its self-imaging.

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LINEAR OPTICAL ANALYSIS OF MICRODISK LASERS CONCENTRICALLY COUPLED WITH MICRORINGS

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A microdisk laser embeeded in an annular Bragg reflector (ABR) is an example of an optical circuit consisting of several optically coupled elements, where the active region does not coincide with the whole resonance structure. This is because ABRs are manufactured with multiple rings and grooves while the pumping beam is focused on the central cavity into a spot several micrometers in diameter to prevent the device from lasing on the ring modes [1]. In this paper, we study the simple configuration of this sort, a uniformly pumped active disk inside passive ring, with the space between them filled with a less optically dense material. The lasing spectra and thresholds are investigated using the recently developed formalism of the Lasing Eigenvalue Problem (LEP) [2]. The 3-D boundary-value problem for the Maxwell equations is reduced to 2-D one with effective index method, and further in-plane 2-D problem is analysed accurately with the aid of separation of variables. Each mode of the active disk splits into a multiplet of the supermodes, which are having a certain number of field variations in radius along the whole combined structure. The influence of the microrings on the lasing frequencies and threshold values of material gain is studied, and the dependences of frequencies and thresholds on the thickness of rings are presented, demonstrating threshold reduction opportunities. This is explained though the analysis of the mode near-field patterns and the degree of their overlap with the active region, as suggested by the optical theorem applied to the LEP solutions.

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ELECTROMAGNETIC EIGENWAVES OF PLANAR LAYERED METAL-DIELECTRIC STRUCTURE

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It is well known that in layered structure free half-space – metal layer – dielectric half-space can be propagate two surface plasmons [1]. Surface plasmons differ from other waves that they are propagated to the big distances in metal or dielectric, than ordinary waves. The modern production technology of layers allows fabricate planar layered structures for an optical and near infra-red range. If on a substrate from dielectric place strip metal elements, given structure will have ability to transformation of polarization of incident wave, resonant reflection and transmission waves. The spectrum of application of such structures is wide enough: they can be used as polarizing and frequency filters, and also as high impedance and absorbing surfaces.

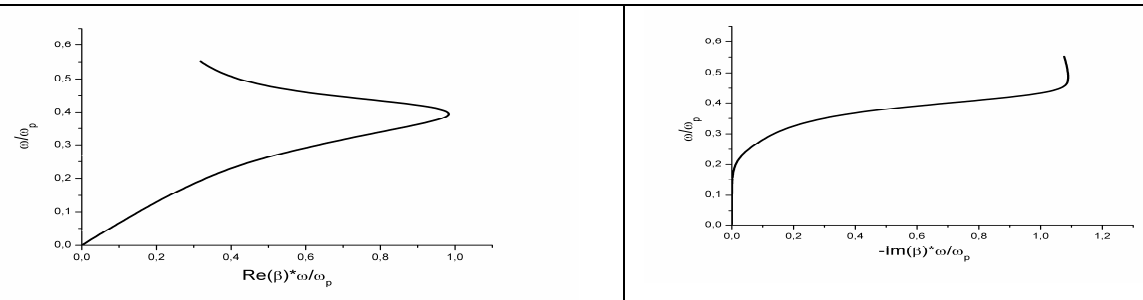
Thus, special interest represents research of propagation eigenwaves of planar layered dielectric – metal – dielectric structure. The analysis of dispersive relations $\omega/\omega_p = f\left(\beta c/\omega_p\right)$ will allow to estimate resonant length of strip metal element which can be cut out from the metal film placed on the dielectric substrate.

Let us consider propagation of electromagnetic waves in metall-dielectric structure. The layer of metal with permittivity ε_2 which depends on frequency is placed on dielectric free half-space with permittivity ε_3. From above metal layer is covered with dielectric layer with permittivity ε_1. The free space has relative permittivity $\varepsilon_0 = 1$. The form of the transverse wave numbers are: for field in free space - $\gamma_0 = \sqrt{k_0^2 - \beta^2}$, for field in dielectric layer - $\gamma_1 = \sqrt{k_0^2\varepsilon_1 - \beta^2}$, for field in metal layer - $\gamma_2 = \sqrt{k_0^2\varepsilon_2 - \beta^2}$, and for field in dielectric half-space - $\gamma_3 = \sqrt{k_0^2\varepsilon_3 - \beta^2}$.

With the help of transmission matrix of first and second layer it is possible to write a dispersion equation for such metall-dielectric system:

$$\left(\frac{\gamma_3}{\varepsilon_3}+\gamma_0\right)+i\left(\frac{\gamma_1}{\varepsilon_1}+\frac{\gamma_0\gamma_3\varepsilon_1}{\gamma_1\varepsilon_3}\right)tg\left(\gamma_1 h_1\right)+i\left(\frac{\gamma_2}{\varepsilon_2}+\frac{\gamma_0\gamma_3\varepsilon_2}{\gamma_2\varepsilon_3}\right)tg\left(\gamma_2 h_2\right)-\left(\frac{\gamma_0\gamma_2\varepsilon_1}{\gamma_1\varepsilon_2}+\frac{\gamma_1\gamma_3\varepsilon_2}{\gamma_2\varepsilon_1\varepsilon_3}\right)tg\left(\gamma_1 h_1\right)tg\left(\gamma_2 h_2\right)=0$$

With the help of the program written on FORTRAN the dispersive equation was numerically solved and plotted dispersion curves and decay curves correspond this equation (Fig.1).



a) b)

Fig. 1. Dispersion equation of surface plasmons in metall-dielectric structure.

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OPTICAL TRAPPING AND MANIPULATION MICRO OBJECTS WITH DIFFERENT OPTICAL CHARACTERISTICS

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Trapping and manipulating the particles has had a revolutionary impact on the field of scattering, atomic physics, in the biological sciences and other ones, which may be concerned to the nano- and micro technology [1-3].

Generally optical tweezers may be divided into two large types: multi-trap and single-trap ones. The most perspective way for realization of first kind of devices, as a rule, intends the use of electro-optical modulators, which allow us to create the pliable traps of arbitrary shape and numbers [2].

But two main defaults may be formulated for these devices:

1. relatively big cost of such equipment.
2. relatively small diffraction efficiency of the modulators, which results to large energetic losses under the formation of optical trap.

At the same time large set of practically important tasks exists where efficient single-trap tweezers are necessary.

Such devices are divided into tweezers with light trap [1] and dark one [3,4]. In one's turn, dark traps may be divided into vortex [2-4] and vortex less traps [4].

It is shown in the paper that all three kinds of traps may be integrated in one device on the base of special type of computer generated hologram.

The optical scheme of optical tweezers is presented in the figure 1.

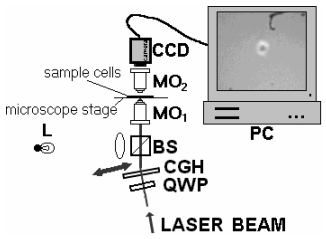

Fig. 1. Experimental setup

QWP-quarter-wave plate;
CGH- computer generated hologram;
BS- beam splitter;
MO- micro-objectives;
L- incoherent lamp; CCD- camera.

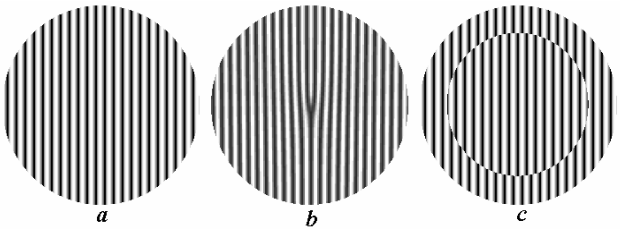

Fig.2. Computer generated hologram for formation of different kinds of trap.

The main spatial frequency is the same for all three holograms.

a – "Gaussian" hologram;
b – "vortex" hologram;
c – "vortexless" hologram.

Kind of trap is changed by simple replacing of corresponding part of hologram. The structure of hologram is presented in the figure 2.

Experimental results of the trapping of different kinds of micro-particles are presented.

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THE EFFECT OF ATMOSPHERE TURBULENCE ON BROADENING OF LIGHT PULSES: LONG-DISTANCE PROPAGATION

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A laser beam propagating through the turbulent atmosphere is affected by random fluctuations of the refractive index, which are result of random variations of temperature revealed themselves as variations of the atmosphere density. The characteristic sizes of density inhomogeneities range from millimeters (the inner radius of the turbulent eddies, l_0) up to 100 m (the outer radius of the turbulent eddies, L_0). Usually, due to so wide scattering of inhomogeneity scales, such phenomena as spread of the beam radius and wandering effect are present. In the case of very strong turbulence the possibility of increasing of pulse length (pulse broadening) should be considered because some negative phenomena such as fluctuations of the arrival time and overlapping of the neighboring pulses become possible. The main purpose of our study is to investigate the effect of pulse broadening in the most important for practice case of long-distance propagation.

The effect of atmosphere turbulence restricts the performance of quantum cryptography. This is because in some basic strategies for free-space quantum key distribution, single-photon pulses are used to carry the information bits. In general, in any high-data-rate communication system, where short pulses (of the order of or less than 10^{-12} s) are used, the atmospheric inhomogeneities can distort the information thus limiting the performance of long-distance channels [1].

To describe pulse propagation, the method of photon distribution function developed in [2] was used. Using this approach the problem is reduced to solving the equations of motion for individual photons which are affected by the random force originating from the gradient of the refractive index. Assuming the random force to be weak, we have solved these equations by means of the iterative procedure. The effect of this force is that the RMS (root-mean-square) of photon momentum perpendicular to the direction of beam propagation, $q_\perp$, increases with time as $t^{1/2}$ (like random displacements of Brownian particle in configuration space). By this reason, the trajectories of individual photons differ from straight lines. As result, the photons escaped from the source simultaneously could reach the detector at different instants. Therefore arrival-time fluctuations, revealing themselves as pulse broadening, occur. Besides mentioned mechanism, an additional broadening due to fluctuations of the modulus of group velocity is also important. In course of photon propagation their velocity fluctuates synchronically with fluctuations of the refractive index of the medium. We consider both mechanisms within the approach described above.

The expression for averaged pulse width is obtained within described method. There is the limitation on pulse length the effect of broadening to have place which coincides with previous investigations [1]. It is showed that in the case of strong turbulence ($C_n^2 \sim 10^{-13}$ m$^{-2/3}$) and long distance of propagation ($L = 10^4$m, $L_0 = 10$m) the additional contribution to the pulse length is $\sim 1.5\times10^{-12}$ s. Such value for pulse broadening is comparable with distance between single pulses. For the case of weak turbulence ($C_n^2 \sim 10^{-15}$ m$^{-2/3}$) and same distances of propagation the effect is negligible (5×10^{-14}s). It is showed that both above-mentioned mechanisms of pulse spreading don't interfere with each other.

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DETERMINTATION OF PARAMETERS OF THE LIGHT SCATTERED BY THE PARTICLES OF CIRRUS CLOUDS

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Cirrus clouds cover, in average, 20%-30% of Earth's surface that leads to their essential impact on climate. Therefore these optical properties are needed for incorporation in up-to-date models of Earth's radiation budget and, consequently, they should be used in numerical models of climate prediction or climate change.

The optical properties of ice crystal particles have been calculated for recent 20-30 years by a lot of authors under an assumption of 3-D random orientation. However, the crystals often reveal a tendency to be oriented near horizontal plane because of aerodynamic laws.

Phase functions for light scattering by preferably oriented hexagonal ice plates and columns are numerically calculated within the framework of geometric optics. The main quantitative properties of the halos (sundog, parhelion 120º, suncave Parry arc, sunvex Parry arc, and others) are obtained for a number of both incident light directions and aspect ratios of the plates and columns respectively. A parameterization of the phase functions for the plates and for the columns are proposed based on the integral contributions of the narrow angular peaks (halos) that are tabulated as the weight coefficients.

Also, the parameters of the Stokes vector have been analyzed on the basis of a modified scattering matrix.

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EXCITATION SYSTEM OF A DISK DIELECTRIC RESONATOR IN THE CRYODIELECTROMETER

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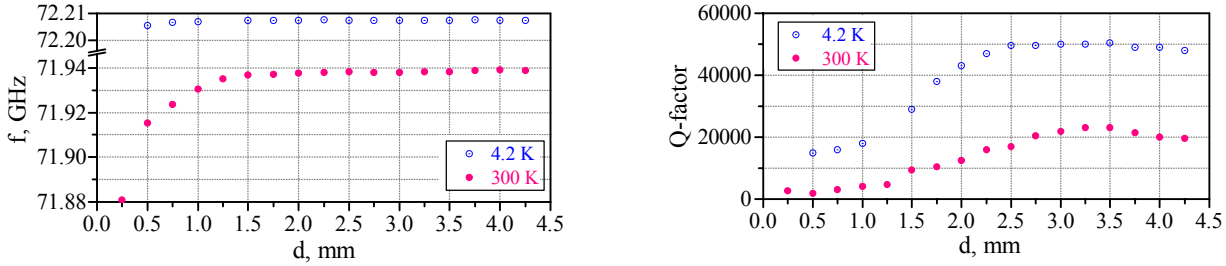
Selection of optimal excitation of high-Q optical microresonators with whispering gallery modes (WGM) is important, in particular, for increase of efficiency of lasing [1]. In the millimeter wave band the technique with use of disk dielectric resonators (DDR) with WGM is used as one of the most exact for determination of parameters of materials. Under condition of a weak coupling of exciting devices with DDR near to resonance the loss tangent in substance is inversely proportional to unloaded Q-factor. For carrying out of low-temperature measurements of properties of materials it is necessary to provide the optimal and adjustable coupling of DDR having different sizes and to exclude the influence of metal walls of the working chamber, which surrounds DDR.

In the present work the construction of the excitation system of DDR by use of dielectric waveguides (DW) in the frequency band of 50 – 80 GHz in the temperature range of 1 – 300 K for the cryodielectrometer [2] is proposed. The relative in-plane motion of DDR and DW is realized by means of control-rods and microscrews. The symmetrical change of the distance between the two DW and DDR is obtained with use of the device in the form of "dovetail". The walls of the working chamber were processed by the absorbing coating. From the dependencies of the frequency and the Q-factor of one of WGM of the quartz DDR at room and helium temperatures, shown in Figure 1, it is follows that at the distance between DW and DDR $d>0.7*\lambda_0$, where λ_0 is the wavelength, coupling losses become negligible low. The obtained data are in accordance with the results of the papers [1, 3]. It is determined that for research of properties of wide range of materials in the four-millimeter wavelength band the diameter of 30 mm is suitable for the chamber, which restricted by the screen.



a) b)

Figure 1 – Dependence of the frequency (a) and the Q-factor (b) of WGM on the distance between DDR and DW

The investigation was performed on "Cryomagnetic radiospectroscopy complex of the millimeter waveband", having the status of National Scientific-Related Property/Treasure, directive of the Cabinet of Ministers of Ukraine on 27.12.2006 No. 665-p.

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DEVELOPMENT OF METHOD AND TECHNOLOGY OF SCATTERING MEASUREMENTS OF WATER IN SMALL-ANGLE RANGE

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Influence of absorption band of light by the suspended particles in water on spectral properties of scattering are poorly studied. This problem becomes more actual, taking into account that the received results of theoretical analysis shows, that such influencing is exist, i.e. on the spectrum of attenuation must be characteristic peaks, corresponding to the maximums and minimums of absorption. Experimental data, confirmative this, was not getting yet.

Measurements of ocean natural waters shows, that basic variability of scattering index was on the of small angles area. In different natural waters the part of the scattering radiation in a small-angles area can reach the values 80-90%. For description of scattering by the suspended particles use «approximation of equivalent spheres». However in small angles area such approaching have large errors. The method of application model of equivalent spheres in this area quits adequately to describe the processes of scattering.

Elaborated method of research of spectral descriptions of dispersion on small angles enables to get more exact information about the spectral features of scattering in the range of small angles on the particles of biological origin, that in turn, will allows to decide more correctly the reverse tasks of hydrooptics.

In the generally accepted methods of measurements of scattering in small angles area there are considerable difficulties because distribution of radiation in the focal plane of receiving lens is determined not only by the light, scattered by water, but also by the background of light, parasite scattering on the elements of optical scheme and etc. There is a problem of weak signal selection on a background precip, witch is exceeding a useful signal in many times. In the principle, which we produce, we propose specific optical scheme, allowing to reduce percent of background precip.

The laboratory-scale devise to make measurements scattering spectrums of different water types in angles from 0.5 to 1.5 degrees with 8 minutes step was designed and constructed. Software in the «LabView» to operate the work of devise, data communication of measurement in PC and main process of information was developed. The experiments of determination relative scattering index spectrums types of water on small angles are produced.

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SURFACE PROFILE RECONSTRUSTION FROM DIFFERENCE DATA FOR TWO-COORDINATE LASER SCANNING DIFFERENTIAL-PHASE MICROSCOPE

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Differential-phase method is well known in the field of microscopy because of its advantages over other interferometric methods of surface investigation. It has high sensitivity to profile height variations and at the same time it is not sensitive to vibrations due to differential nature of measurements. In this method the object profile is not directly measured, but differences of height at adjacent points are obtained. To recover height profile, measured data should be processed in some way. Height variation function could be obtained by direct numerical integration of scanned data. But direct row-by-row integration yields unsatisfactory results of profile recovery. During integration, errors caused by noise are accumulated and large discrepancy in height of adjacent rows appears. Accumulated errors lead to incorrect profile recovery.

We propose the method of profile reconstruction which is not susceptible to error accumulation. Reconstruction is performed for the entire profile using redundancy available in measured data.

Differential-phase method allows obtaining two data arrays of partial derivatives of height function over two perpendicular directions. For row-by-row integration a derivative over perpendicular direction is needed only to determine boundary conditions and most of the measured data is not used. But significant redundancy of measured data could be used for reliable recovering of data in the presence of noise. We propose the method of solving profile reconstruction problem which is similar to least squares method. Assuming we know properties of measuring system, we can find such height function, which has two partial derivatives maximally close to both measured data arrays. Actually we approximate data using least squares criteria, but do this for two measured arrays simultaneously in the way to get minimal deviations from values of both partial derivatives.

It should be noted, that inverse problems of such type couldn't be solved in such a simple way as least squares fitting and some regularization technique is usually applied. Some a priori information (for example smoothness of solution) is used as additional condition which enables adequate solution to be obtained. Due to redundancy of measured data no regularization technique is required in our case. This inference is obtained during numerical simulations.

Developed algorithm of reconstruction was applied to experimental data obtained by laser scanning microscope. It was confirmed that proposed method is suitable for reconstructing profile height function from differential-phase data.

METHODS OF ACCURACY IMPROVEMENT OF FIBER BRAGG GRATING SENSOR INTERROGATOR

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Fiber Bragg sensor technology is the one of the most rapidly developing fields of applied optics. Due to the unique properties of these sensors such as low weight, small size, environmental ruggedness, electricity-free operation and immunity to electromagnetic interference they find wide use for various scientific and civil applications, where temperature, strain or pressure measurements needed. Nevertheless, fast growth of FBG-sensors installations is suppressed by the high cost of interrogating devices.

In this paper we describe and compare several techniques for sensor array interrogation based on optical spectrum analyzer (OSA) or tunable erbium lasers. Lasers were tuned by the means of the fiber Fabry-Pero interferometer (FPI) or tunable fiber Bragg grating (TFBG).

In order to tune grating, special mechanism driven by a stepper motor is employed to vary a gap between two ferrules with an FBG pasted in them [1]. This leads to the shift of the Bragg peak due to the axial deformation of a grating. This element provides a tuning range of more than 45 nm with a 4 pm resolution. At the same time it makes it possible to avoid application of expensive Fabry-Pero etalon or CCD array.

The main problem about use of a tunable fiber Bragg grating as a wavelength selector is nonlinearity of a grating tunability curve. Alone with a non-ideal repeatability and a hysteresis it decreases the accuracy of interrogator strongly. In this work a simple technique that takes into account these three effects is described. It employs a thermally stabilized reference FBG sensor and a Mach-Zehnder fiber interferometer with a free spectral range of ~30GHz. The interrogator based on this technique provides outstanding accuracy of a Bragg shift measurement compared to the one with only tunable FBG. Also, as far as it's an all-fiber device it is easy-to-operate and does not need any adjustments.

Comparison of performance of different FBG interrogation techniques is given. It shows that method which employs erbium laser with TFBG and foregoing nonlinearity compensation method has comparable properties with OSA or laser tuned with FPI and more cost-efficient for measurement of temperature with accuracy of 1^{o}C.

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COMPARATIVE ANALYSIS OF OPTICAL DESCRIPTIONS ABOVE BLACK SEA FROM DATA OF CIMEL AND MICROTOPS II

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Knowledge of spatial and temporary variation scales of aerosol optical features is required for evaluations of aerosol on climate change. Main way to measure optical features of atmosphere and its variable component (aerosol optical depth (AOD), precipitable water (W) and Angstrom parameter α) are measurements of attenuation in atmosphere spectral distribution of direct solar radiation. To work on international program AERONET Marine Hydrophysical Institute NAS Ukraine has proceed since May 2006 up today.

The AERONET measurements system is based on spectral radiometers sun/sky photometers CIMEL produced by Electronique (France). This device makes the direct sun measurements, the data processing of which is the great number of information of optical and microphysical characteristics of aerosol. Actuality of work is conditioned by the necessity of study of optical and microphysical characteristics of aerosol components of atmosphere and radiation streams over the Black sea for the decision of tasks: validation of satellite measurements of regional optical properties of sea water and atmosphere, modeling of climatic changes in a regional and global scales, modeling of transfer processes of radiation in the real atmosphere taking into account the aerosol, monitoring and determination of transformation dynamics and displacement of aerosol in an atmosphere, evaluation of trends (monthly, seasonal, annual) of changes of optical properties of atmosphere.

Aerosols often show wide variation of optical properties in time because of diffusion, and processes, such as coagulation and moistening due to co-operation with gases and precipitations. Such changeability takes place from the changes of forces of source of aerosols and advection (from local to synoptical) meteorological processes. Also there is spatial variability of aerosol, depending on the region of supervision (sea, desert, city etc). One of methods to expose the features of optical descriptions over Black sea - to analyze optical descriptions in a few regions of Black sea and analyze both temporal and spatial variability of optical characteristic of aerosol.

Comparison of data of the aerosol optical depth of CIMEL with the simultaneously data of MICROTOPS II is the aim of the work. Both devices are calibrated identically, however one of them is stationary - CIMEL 318, and other MICROTOPS II - portable. Both devices have identical interference filters with identical lengths of waves. The analysis of received data allows to get descriptions of city (concrete for Sevastopol) aerosol and expose spatial variability of characteristics of aerosol, depending on the location (region of city, coast, sea, region of shelf). All measurements were made every 10-15 minutes and accompanied by the visual observations of sky state (cloudiness or clean firmament), the records of direction and force of wind and also presence of haze near a sun and above the horizon were conducted.

SPECTROSCOPE FEATURES OF PHOTONIC CRYSTALS MODIFIED BY POLY-A

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Photonic crystals as a new class of materials take place between nano- and microstructural highly ordered composites. Electromagnetic wave propagation through structure with size of elements close to wavelength leads to Bragg diffraction, multiple scattering, etc. As a result of this process a forbidden photonic zone arises [1]. Photonic crystals with a tunable forbidden zone are of interest for researchers and technical applications.

Experimental data on synthetic opals have been obtained by visible and infrared spectroscopy and electron microscopy. Opal has fine globular structure with 0.2-0.5 μm size, above globular structure (2-5 μm) and superfine structure consisting from small balls with 0.05 μm size. So, we suppose that photon stop zones exist in ultraviolet, visible and IR region up to far-IR in the objects under study. Three regions of abnormal behavior of reflectance and absorbance for opals in the 7000-2000 cm^{-1} are observed in comparison with the separated SiO_2 globules in disordered states and/or condensed state.

Modification of synthetic opals by the molecules of poly-A leads to substantial change of IR spectra, and are discussed here.

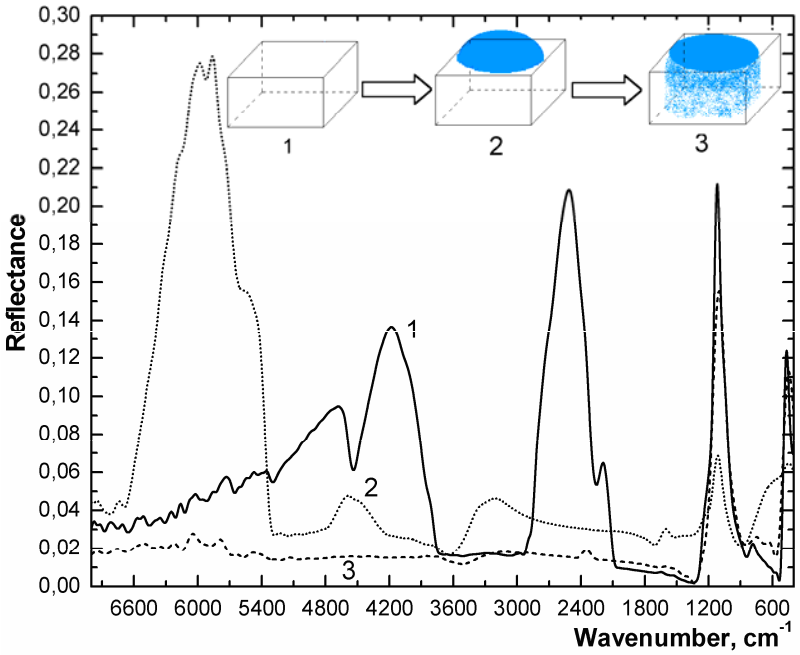

Figure 1. IR reflectance spectra of initial opal (curve 1), opal with drop of the aqueous solution of poly-A just after drop deposition on the crystal surface (curve 2) and dried film of poly-A on the opal surface (curve 3).

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SINGULAR-OPTICAL SPECTRAL MODIFICATIONS OF THE SPECULARLY SCATTERED POLYCHROMATIC BEAMS

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Scattering of a white-light beam at colorless intermediately rough surfaces is accompanied by coloring of the forward-scattered (regular) component of the beam or of the specularly reflected one. Though the interference origin of this effect is well established, interpretation of it is not satisfactory. So, conventional consideration of the coloring of the regularly scattered component of a white-light beam predicts the sequence of colors accompanying growth of the surface depth that is opposite to the sequence observed in practice. This hampers development of applications of the effect of scattering induced spectral modifications, in part, in diagnostics of intermediately rough surfaces, where other optical correlation techniques are of limited efficiency. To explain the real consequence of colors, we introduce a new model of intermediately rough surfaces as a transition layer with "diluted" refraction index and consider such surface as antireflecting coating for some spectral component of the probing beam. Such model is supported by the chromascopic simulation of the coloring effect.

In this paper we report new experimental arguments in favor of the proposed model. So, we demonstrate dependence of the coloring on inclination of a surface, show the topographs of surfaces providing a blue shift or a red shift, and explain the absence of green coloring, so that blue shift is "switched" by a red shift by jump, omitting green. For this purpose we attract the Berry's concept of the universal color distribution in the vicinity of the isolated phase singularity at the polychromatic (white-light) speckle field. We also experimentally ground the conclusion that the effect of scattering-induced spectral modifications is not restricted by the single-scattering regime, but can take place in multiple-scattering phenomena.

In theoretical part of the paper we consider several typical height distribution functions of the surface irregularities for obtaining reliable interconnections between the observed spectral modifications and statistical parameters of a roughness. For that, it has been stated that the studied effect is not obviously the effect of singular optics. Namely, it takes place also in the case when amplitude zeroes (and associated phase singularities) are absent in any spectral component of the probing radiation. It has been found that irrespectively of the specific height distribution function, estimations of a root-mean-square deviation of a profile from a mean surface line occur very close just for intermediately rough surfaces, *viz.* not weakly rough when the coloring effect is not observed and not rather rough to destroy the forward-scattered component.

This important result shows that the spectral modifications induced by scattering of a polychromatic (white-light beam) at a rough surface can be used for diagnostics of such surfaces as well as for control of crystal growth and thin films. Another prospective application of this effect is creation of spectral switch based on the mentioned direct transition from blue shift to red shift, omitting green. Such switch can be used in problems of optical telecommunications, in part for spectral coding of information.

POLARIZATION METROLOGY OF MUELLER MATRICES IMAGES OF PHASE-INHOMOGENEOUS LAYERS

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The application of lasers in biomedical diagnostics gave the possibility to use the polarization analysis of different kind object fields - speckle-modulled fields, the transformation operator of which is John's matrix . The topological inhomogeneity of coherent fields makes it possible to get the information on such an operator's microstructure, which is inaccessible for the traditional nephelometry and is defined by the bioobject morphology specificity.

This investigation is aimed at studying John's matrix microstructure of architectonics of different morphological structure biotissues; at searching the correlation of orientation, anisotropy parameters of multifractal nets with the topological distribution of matrix elements and their indices.

The interrelation of orientation, anisotropy structure of biotissue architectonics and topological element distribution of John's Matrices is investigated here. It is researched the analytical correlation of bioobject John's Matrices microstructure with matrix element indices measured in the far field of Fraunhofer's diffraction. The investigation is also dealt with the computer modeling and experimental researching the structure of matrix operator of mult i fractal amorphous - crystalline organization of different morphological structure biotissues.

ZINC OXIDE QUANTUM DOTS IN POROUS SILICA MATRICES

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The present research is stimulated by the demand for new efficient light-emitting materials with tunable color characteristics. These materials are necessary for the fabrication of the elements for nano-optoelectronics devices. One type of such materials is a composite materials that contain semiconductor quantum dots. Depending on the width of semiconductor band gap and the size of quantum dots these materials could emit light in the wide range of wavelength. To obtain the elements that emit in the ultra violet range wide band gap semiconductors are used.

The present work is devoted to the study of new nanocomposite materials that were synthesized in L. Pisarzhevskii Institute of Physical Chemistry. These materials are the porous silica matrices containing quantum dots of wide band gap ZnO semiconductor. In the present work we studied the photoluminescence properties of porous silica and the composite materials, which were fabricated for three technological methods (sublimation method, soaking method and sol method).

The ultra violet luminescence was observed in the samples that were fabricated by sublimation method. It should be noted that the energy of emitted light quanta was higher than energy of near-band-edge luminescence of bulk ZnO. This fact proofs that high-quality quantum dots were formed in the pores of the matrix and that the confinement effect was observed. In the samples which were fabricated by soaking method and sol method the ultraviolet luminescence was not observed. At room temperature the photoluminescence spectra of these samples are similar to the low temperature luminescence of pure porous silica without ZnO quantum dots. Such emitting properties of the synthesized structures probably could be ascribed to the combined influence of the replacement of physisorbed water in the matrix pores by ZnO and by the transfer of optical excitations to the light emitting centers on the surface.

Thus, it is shown that the sublimation method is the most perspective one for the fabrication of nanocomposite materials, because this method provides the formation of quantum dots in the matrix pores which emit in the ultraviolet range of spectra.

SPECTRUM OF LOW POWER EXCITATIONS Of CRYSTAL $KTm(MoO4)_2$.

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The crystal $KTm(MoO_4)_2$ belongs to the row of the isostructural halving, in which low temperature phase transitions are, known as a cooperative Yahn-Teller effect (CYTE). They have a brightly expressed stratified structure, and also low symmetry of crystalline grate (D_{2h}^{14}) also. Sharp peaks of density of states in the low-frequency region of swaying spectrum exist due to stratified structure. The complete removal of degeneration of the basic state 4f- shell of rare-earth ions is a results of low symmetry of crystalline grate and CYTE is observed on the quasi-degenerate states (Yahn-Teller pseudoeffect). In $KTm(MoO_4)_2$ structural phase transition of the CYTE type is not observed to the temperature 0,1K, probably it is conditioned by competition of magnetic and Yahn-Teller cooperations of paramagnetic centers [1]. Before was show, that in $KTm(MoO_4)_2$ low multiplet $^3H_6$ ions Tm^{3+} fission by the crystalline field with formation of quasi- doublet $\Delta E=2{,}3см^{-1}$. Further investigations of the crystal $KTm(MoO_4)_2$ in the external magnetic fields is interesting. A magnetic field moves a lowest electronic level of the ions Tm^{3+} so it can cross acoustic or optico-acoustic swaying branches in area of maximal density of states. Dynamic communication of electronic excitations of paramagnetic centers with vibrations of crystalline grate and, thus, their communication between itself are strengthening in this case. Thus, it is possible to stimulate the cooperative Yahn-Teller effect in this halving by the external magnetic field. With goal of finding out of features of dynamic cooperation of low-energy electronic excitation with the low-frequency swaying excitations and, as a result, possibilities of formation of orbital organization in the crystal $KTm(MoO_4)_2$ in the presented work were undertaken researches IR spectrums and microwaves takeover in the external magnetic field at the low temperatures. We measure the spectrums of skip of the crystal $KTm(MoO_4)_2$ in long-wave IR-band (10-40cm^{-1}), in the polarized light (E||a, E||c). Two swaying fashions with the energies 18,5 cm^{-1} (E||a) and 25,5 cm^{-1} (E||c) were found. A structure of low-frequency swaying spectrum in the Brillouin zone were definite using one-dimensional model. Then, dependences of the microwaves takeover of the crystal $KTm(MoO_4)_2$ from the external magnetic field were measured. There were bars in the spectrums of the microwaves takeover. We suppous that these features are caused by crossing by the lowest electronic level of the ions Tm^{3+} of acoustic and optico-acoustic swaying branches in area of maximal density of states. It is assumed, that an external magnetic field in the crystal $KTm(MoO_4)_2$ stimulates the cooperative Yahn-Teller effect with formation of intermediate disproportionate phase. Out the nonlinear dependence of the microwaves takeover at the increase of power of the microwaves pumping, which is interpreted as the phenomenon of stochastic resonance in the crystal $KTm(MoO4)_2$ also was found

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THERMOSTIMULATED LUMINESCENCE OF DOPED GLASSY LITHIUM TETRABORATE

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We have studied the thermostimulated luminescence (TSL) of undoped and doped glassy lithium tetraborate (LBO). LBO was doped with silver, copper, indium, cerium, manganese and terbium. The modifier concentration was considered optimal if it provides maximal intensity of TSL. It has been found that under irradiation at the 20 Gy dose for the undoped glass a characteristic wide maximum appeared in the range of temperatures 373–533 K with insignificant intensity. Doping glassy LBO with copper and indium causes the shift of the above maximum into the high temperature region (457–468 K) followed by the increase of TSL radiation intensity almost fourfold for a copper and up to six times for an indium. Doping of glassy lithium tetraborate by silver, manganese and terbium causes the shift of thermostimulated luminescence maximum into the low temperature region (407–443 K) with the substantial increase of intensity for glasses doped with terbium and manganese. For cerium-containing glasses a considerable change of thermostimulated luminescence at the indicated doses of irradiation was not detected.

In our earlier research, we studied the TSL spectra for alloyed LBO single crystals, where the mechanism of thermostimulated luminescence was explained by the formation of a defect structure due to introduction of modifier, stipulating the formation of adhesion levels, which cause recombination processes [1,2].

It is well established that glassy materials in the pseudoforbidden area are characterized by the presence of the localized states with suitable density distribution, which can not be only of exponential character, as for the ideal glasses, but may also be characterized by fluctuations in such distribution, characteristic for the real glassy compounds.

According to Mott and Davis [3], there exist three models describing glassy material luminescence. First model, most suitable for describing our results, is based on the assumption that the excited electrons and the holes recombine through the localized states on band-tail with subsequent photon radiation.

There could also possibly exist recombination centers near the band gap, which trap the excited electrons from the conduction band (or the holes from the valence band), causing thermoluminescence.

There exists also the possibility that recombination centers in glassy materials (including the glassy LBO) could be caused not only by impurities, but also by free chemical bonds, acting as the trapping levels.

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RESEARCH OF POPULATION DYNAMICS IN A HYDROGEN ATOM UNDER THE ACTION OF PULSE OF TI:SAPPHIRE LASER

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We present the results of numerical modeling of dynamics of populations in a hydrogen atom under the action of a pulse generated by Ti:sapphire laser. Existing now Ti:Sa multiterawatt femtosecond laser systems [1-2] provide generation of ultra-short pulses of high intensity and are used in a different problems requiring ultra-high optic fields. The possibility of wave packets forming containing states with high values of orbital and magnetic quantum numbers under the action of the field from such laser, by means of transitions between continuum states and discrete levels, is investigated. For conformity increasing of computations performed within used model, to real processes in atom, the applicability of dipole approximation for description of transitions between ground state and excited states is estimated.

In the suggested model Schrödinger equation for population amplitudes is solved numerically in basis of hydrogen eigenstates and continuum states. For limitation of equations number, the discrete representation of the continuum by sequence of states with equidistant values of wave number k is used [3]. The action of circularly polarized field is considered, therefore the transitions corresponding to $\Delta l = 1$, $\Delta m = 1$ selection rules are allowed. The parameters of pulse from multiterawatt Ti:sapphire laser system [2] were used for modeling.

As result of pulse action practically all population 97 % is transferred from ground state to continuum. The discrete levels not populated significantly: maximal population, approximately 1 %, corresponded to state with $n = 2$.The comparison of population values obtained using dipole approximation and beyond it, showed, that difference between them is not significant near 1 %, for one pulse, but can be essential for a train of pulses. By using obtained results, one can conclude that sequence of pulses may cause further transitions between states of continuum and discrete spectrum with increasing l and m, and to provide the forming of wave packets with different degree of localization as shown in our earlier work.

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INFLUENCE OF ANODIC ALUMINA PORES DIAMETER ON EUROPIUM LUMINESCENCE INDICATRIX

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Porous anodic alumina (PAA) is a honeycomb porous structure with an about hundreds and tens nanometers period. PAA is an advanced material for light emitting structures producing. Thanks to a self-ordering 2-dimensional structure PAA has anisotropy of optical characteristic. This anisotropy is able to influence on intensity and scattering of propagation light [1]. In this work the influence of luminescence indicatrix of phosphor embedded in PAA from pore diameter under constant cell size is investigated.

The PAA samples 4 mkm had the same cell size and had a different pore size. The cell size was about 340 nm, and the initial pore size was about 120 nm. As a result of additional etching the samples with pore size about 150, 180, 240 nm were obtained. Titanium oxide xerogel doped with europium and formed by spinning and thermal heating methods was used as a phosphor [2]. Measuring of luminescence indicatrix was conducted at 612 nm that according to a maximum intensity peak in the europium ion luminescence spectrum (transition $^5D_0$–$^7F_2$). A nitric laser with wavelength 337 nm was used as an excitation source. Measuring of luminescence indicatrix shown that the indicatrix form and maximum intensity depended on pore size (Fig. 1). The most stretched form at a normal to surface direction has a sample with 150 nm pore size, and the widest form has a sample with 180 nm pore size. Luminescence intensity increased if the indicatrix width increases.

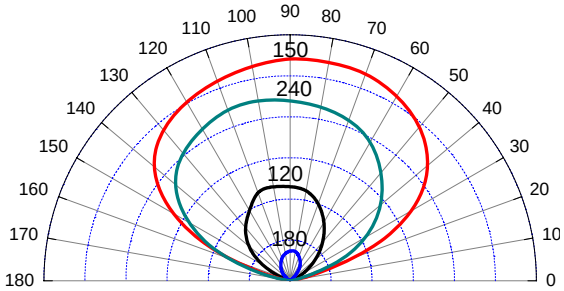

Figure 1. Luminescence indicatrix for samples with a different pore size from 120 to 240 nm

It was waited that intensity in the normal to the sample surface direction increase as it was obtained in [2]. Such disagreement might happen because the PAA thick at this research was about 10 smaller as it was at [2]. It is observed that form and intensity of luminescence indicatrix depend on pore size at the constant cell size. The dependence will be able to bring to phosphor bright increasing with the technology development.

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CALCULATIONS OF THE OPTICAL CHARACTERISTICS OF THE X-RAY ADIABATIC MICROCAPILLARY LENS

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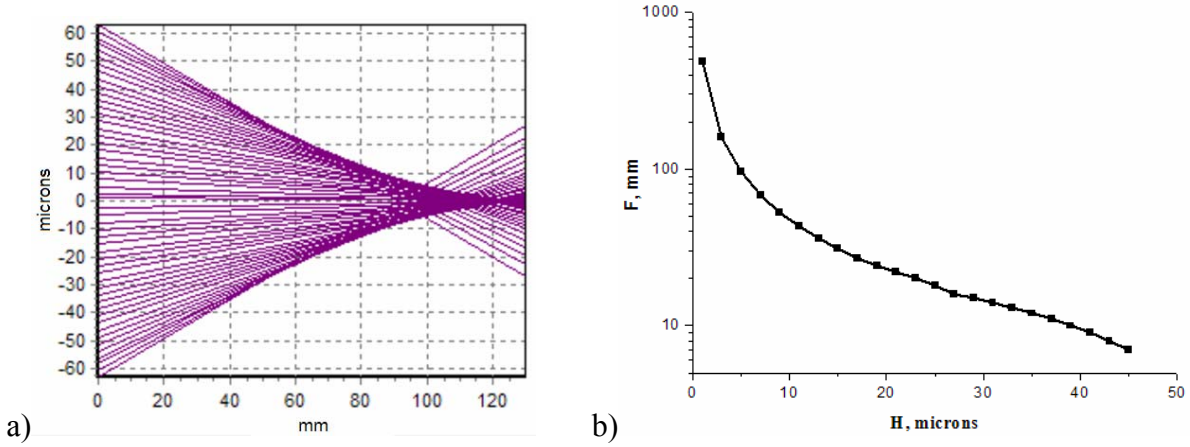
Traditional optical systems are not appropriate for hard x-rays with energy of photons more than 5 keV. In 1996 a new model of the X-ray refractive lens as a compound of a big number (N) identical bi-concave lenses made from low absorption material was suggested. According to theory it is possible to decrease focus of the lens proportional to N. As the next step after X-ray refractive lens there is adiabatic lens. Adiabatic lens is a compound of a big number of bi-concave lenses with variable radius.

Adiabatic lens as a tapered glass microcapillary filled spherical bi-concave lenses was proposed. Software for calculating shape of the glass microcapillary or shape of the adiabatic microcapillary lens was developed. Software for ray tracing calculations by Monte-Carlo method in adiabatic microcapillary lens was developed. The ray traces, focal distance, transmission and intensity distribution in the focal spot are main output of the program. As example, results of the rays tracing after adiabatic microcapillary lens are shown in Figure 1a. Results of the calculation of focal distances of the adiabatic microcapillary lens for 8 keV X-rays as function of the H parameter are shown in figure 1b. Value of the H parameter defines the shape of the adiabatic microcapillary lens.



a) b)

Fig.1. 1a - results of the rays tracing after microcapillary adiabatical lens. 1b - results of the calculation of focal distances for 8 keV X-rays as function of the H parameter.

The main goal of the work is to optimize shape of the adiabatic microcapillary lens for 5-25 keV X-rays. For each photons energy the many different shapes of the adiabatic microcapillary lens were calculated. For each shape the optical characteristics of the X-ray adiabatic microcapillary lens were calculated. Results of the calculations and functional dependence of the focal distance from shape of the adiabatic microcapillary lens for 5-25 keV X-rays are presented. Possibilities of the using adiabatic microcapillary lens for focusing and imaging experiments are discussed.

UNDERSTANDING THRESJOLDS OF MICROCAVITY LASERS THROUGH OVERLAP COEFICIENTS

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Although comprehensive microcavity laser models try to account for several physical mechanisms such as transport of carriers, heating, and optical confinement, considerable amount of useful information can be obtained if all non-electromagnetic effects are neglected, and the optical modes are viewed as eigensolutions of linear Maxwell equations.

Until recently, linear modelling of microdisk and other microcavity lasers has implied exclusively the calculation of the natural modes of the *passive* open dielectric resonators. Mathematically this means solving the time-harmonic Maxwell eigenvalue problem with the outgoing-wave radiation condition at infinity for the complex-valued natural frequencies, k. These eigenvalues form a *discrete* set and can be numbered, say, by using the index s. Then the modes with the largest Q-factors, $Q_s = \mathrm{Re}\, k_s / 2|\mathrm{Im}\, k_s|$, are associated with the lasing.

However, the lasing phenomenon is not addressed directly through the Q-factor – neither the presence of active region, nor the specific value of material gain that is needed to force a mode to become lasing is included in the formulation. Therefore in [1] we have formulated the Lasing Eigenvalue Problem (LEP): introduce macroscopic gain, γ, as the active imaginary part of the complex-valued refractive index, $\nu = \alpha - i\gamma$, $\alpha, \gamma > 0$ assigned to the active region and look for the real-valued pairs of (k_s, γ_s) as eigenvalues. We emphasize that the LEP and Q-factor problems cannot be reduced to each other by transformations and changes of variables.

Tailoring of the active region shape can be efficient tool for the threshold control and manipulation while keeps the emission frequency essentially untouched. The latter is true so far as the gain-induced contrast in the cavity is small, which is valid, for instance, for cavities confined using distributed Bragg reflectors (DBRs) [2].

We present several numerical examples demonstrating nontrivial interplay between passive and active parts of the laser cavities in their competition for the mode field, even in the simplest configurations such as 1-D DBR-equipped cavity with a quantum well. Applying the Optical Theorem to the lasing mode field, we derive expressions that provide a rigorous definition of the mode volume and the mode active-region overlap factor – this, in fact, bridges the gap between the Maxwell theory and the cavity quantum electrodynamics, where these two quantities are widely used. Our results indicate that, if the mode threshold is small, $\gamma_s < 10^{-2}$, then this quantity and the overlap factor behave as inverse values of each other while the mode volume and radiation loss are almost constant. In such case, we have found that approximate identity holds true: $\gamma_s = (\Gamma_s^{(0)} Q_s^{(0)})^{-1} + O(\gamma_s^2, \mathrm{Im}^2\, k_s)$, where the mode overlap coefficient $\Gamma_s^{(0)}$ and its Q-factor $Q_s^{(0)}$ are the values calculated using the optical field expressions neglecting the presence of γ_s or $\mathrm{Im}\, k_s$, respectively.

[1] E.I. Smotrova, A.I. Nosich, "Mathematical study of the lasing eigenvalue problem for the whispering-gallery modes in a 2-D circular dielectric microcavity," *Optical and Quantum Electronics*, vol. 36, no 1-3, pp. 213-221, 2004

[2] V.O. Byelobrov, A.I. Nosich, "Mathematical analysis of the lasing eigenvalue problem for the optical modes in a layered dielectric microcavity with a quantum well and distributed Bragg reflectors," *Optical and Quantum Electronics*, vol. 39, no 10-11, pp. 927-937, 2007

MODELLING OF SWITCHER WITH SEMICONDUCTOR ELEMENT CONTROLLED WITH STATIC MAGNETIC FIELD

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Electromagnetic systems with spatial change of refractive index are a promising subject of intensive theoretical and experimental investigations. Particular case of those systems is dielectric and semiconductor chains of disk resonators. Those systems can be used as wavelength-selective SHF components, specifically, for filtering, switching [1].

The opportunity of control of semiconductor element properties those systems at the expense of changing permittivity tensor with magnetic field leads to occurring new types of devices that controlled with magnetic field (specifically switchers controlled with magnetic field).

The purpose of given work is theoretical approbation of ability of design and controlling of switcher constructed on basis of coupled dielectric resonators system with semiconductor at the expense of changing material parameters of semiconductor material with magnetic field.

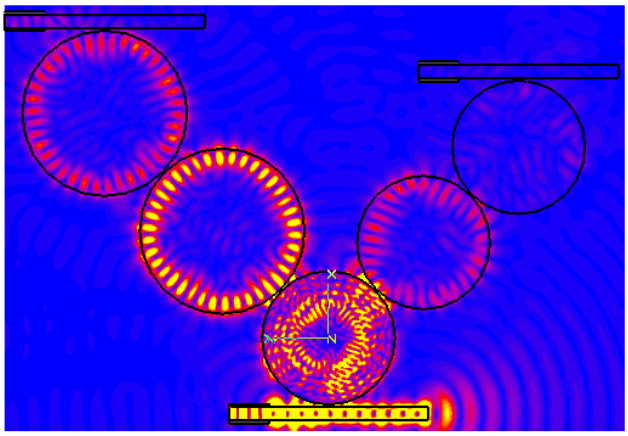

Fig. 1 – Electric field distribution for frequency 95.128 GHz (10 Oe)

In this work numerical calculation FDTD method (finite-difference method in time domain) was carry out and the dependences of transmission coefficient spectrum of dielectric disc resonators system on external magnetic field were obtained; the dispersion characteristics for effective dielectric permittivity of InSb and the distributions of electric fields (Fig. 1) for investigated frequency range (which corresponds to right and left branch of switcher for turn on and turn off magnetic field) were obtained. Turn off of magnetic field corresponds to “closing” regime and turn on – “opening” regime of switcher. For stimulation of given system the rectangular dielectric waveguides were used. In this work it was shown that the spectral properties of switcher constructed on basis of system coupled disk resonators can be controlled with static magnetic field at the expense of changing material parameters (real and imaginary part of permittivity and permeability) of semiconductor disk in the millimeter band.

[1] P. P. Absil, J. V. Hryniewicz, B. E. Little, F. G. Johnson, K. J. Ritter, and P.-T. Ho, ‘‘Vertically coupled microring resonators using polymer wafer bonding’’, *IEEE Photon. Technol. Lett.,*vol. 13, pp. 49–51, 2001.

DEMULTIPLEXOR TO WAVE LENGTH BASED ON EFFECT OF THE SUPERPRISM

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At present time, there is a large number of types of standard wavelength division demultiplexer which main elements are diffraction gratings and lenses or interferometers. However, because their are very large ones, they can not be included to photonic integrated circuits.

In our work, we propose the demultiplexer on the basis of 2D photonic crystal which possesses the anomalous dispersion which provides the superprism effect. The superprism possesses high chromatic dispersion which leads to possibility of high-efficiency wavelength demultiplexion within very low length (about tens of microns). The field propagation modeling inside the demultiplexor proposed was made by means of finite differences time domain method [1]. The demultiplexer consists of the uniform material with artificially made periodic refractive index modulation. The radiation containing a number of channels carried by different wavelengths is introduced to the input of the device. Then, as a result of high chromatic dispersion of the photonic crystal, the channels appear to be space-separated with possibility of further amplification, restoration or processing as required.

The demultiplexer parameters obtained in the work, allow to integrate it to all-optical photonic integrated circuit on the basis of 2D photonic crystal while the characteristics obtained show high channel separation efficiency.

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COUPLED DISK DIELECTRIC RESONATORS WITH WHISPERING GALLERY MODES IN THE MILLIMETER WAVE BAND

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Properties of microresonators and based on them photonic controllable devices, for example, coupled resonator optical waveguides (CROW), are intensively studied recently. Meanwhile, alongside with a good developed theory of calculation of CROW [1] experimental investigations of such structures in optics are difficult. In this work results of modeling of waveguide devices on the basis of coupled disk dielectric resonators on the whispering gallery modes (DDR on WGM) are given. The experimental research (modes spectrum, quality factor and field distribution) of a single and coupled DDRs on WGM has been carried out on the computerised 3D scanner in a frequency band of 51-79 GHz [2]. It is possible to create chains of the coupled resonators including controllable devices [3] by selecting of parameters of DDR and choosing of their arrangement configuration.

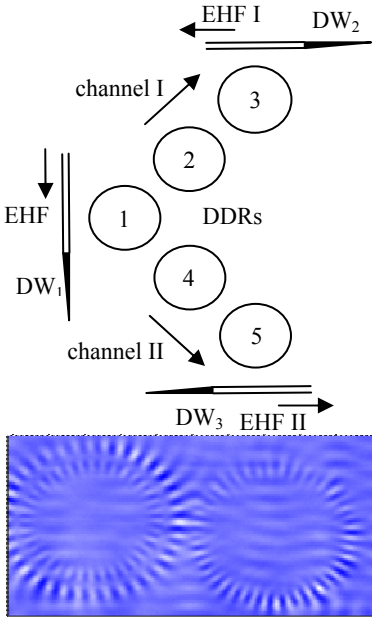

Fig. 1. The plan of model of the selective coupler and a picture of a field distribution in channel I (DDR_1 and DDR_2)

Controllable devices can use DDRs made from ferroelectric material, semiconductor or the ferrite, that can be controlled by exterior electrical or magnetic field. Such chains will possess unique properties. We have modeled the selective coupler which consisted 5 coupled disk resonators (Fig.1). Resonators were made of crystalline quartz ($DDR_{1,2,3}$), sapphire ($DDR_{4,5}$) and had the different sizes. Excitation of such structure was made through DDR_1. $DDR_{2,3}$ and $DDR_{4,5}$ formed channels I and II accordingly on which electromagnetic waves can propagates. The resonators have been selected on a such way, that then a broadband signal in a band 70.7 - 71.2 GHz was injected to the entrance of the system a frequency selection was happened and the wave with frequency (f_1=70.77±0.01 GHz) propagated in the channel I and the wave with frequency (f_2=70.99±0.01 GHz) in channel II. Comparison of our results with theoretical one [1] will allow us to improve structures' models for develop devices on a basis of one – three-dimensional bounded resonators for terahertz and optical frequency bands.

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[2] Golovashchenko R.V., Goroshko O.V., Varavin A.V., Plevako A.S., Derkach V.N. "Hardware and Software Complex for MM-Wave Spectroscopic Research" *Proc. of 16th Intern. Crimean Conf. on Microwave and Telecommunication Technology, 2006. CriMiCO '06,* vol. 2, pp. 817 – 818, 2006,

[3] Derkach V. N., Golovashchenko R. V., Goroshko E. V. "Coupled-cavity structures on the base of whispering gallery disk dielectric resonators at millimetres wave band" *Proc. of the 10th Anniv. Intern. Conf. on Transparent Optical Networks, ICTON 2008* , vol. 4, pp. 234-237, 2008.

DISPERSIVE DELAY LINE VIA PHASE FOURIER SYNTHESIS

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We propose and experimentally demonstrate a new dispersive delay line based on pulse shaping technique, with the advantages of compact design and possibility to manage the dispersion sign and strength by using relevant lens. D-lines have an important impact in signal analysis - synthesis problems of ultrafast optics / laser technology, particularly in pulse temporal and spectral compression, KLM lasers, short pulse stretching for amplification, etc. A pair of diffraction gratings [1] or prisms [2] can serve as a D-line. Diffraction gratings induce unwanted spatial shift of frequencies. Double-pass scheme allows to avoid this effect. Main disadvantage of diffraction gratings is the big energetic losses. Usually first order of diffraction carries ~50% of pulse entire energy. Prism compressor is used to compress frequency-modulated pulses with 10-100 fs durations, but it is unusable for pulses with picosecond durations because it demands long bases. Small energetic losses and the absence of frequencies spatial shift are the main advantages of prism compressor [3].

We present D-line with the possibilities to give pulses negative and positive chirps. It has a compact design and can be used for long pulses. The setup is shown in Fig. 1 below. It consists of SF11 dispersive prism (P), lens L_o for spectrum imaging in the focal plane, high reflective mirror (M) and another lens (L) as a phase mask.

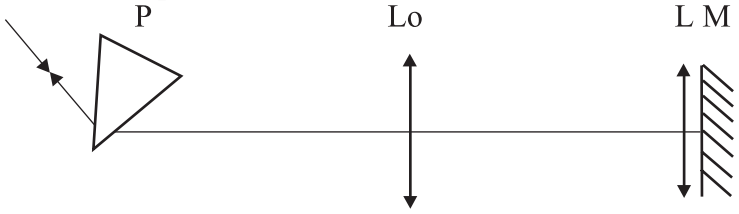

Fig.1.Principle of proposed D-line

Near the mirror we have spatial distribution of spectral components, and the L lens placing results in inducing of $\varphi(\omega) \sim \omega^2/f$ parabolic spectral phase depending on f focal length. In the experiment we use lenses with different focal lengths, i.e. we give the pulse various parabolic phases. We use collecting or diverging lenses to induce negative or positive chirps respectively.

In our experiment we use Coherent Verdi10+Mira commercial femtosecond laser system.The radiation from laser we split into two parts. First part is directed to D-line under our study and the second part is retro-reflected without changes and spectrally interfere with the shaped pulse. We use Ando AQ6315 optical spectrum analyzer to register spectral interferograms. These interferograms contain information about spectral phases induced by means of collecting and diverging lenses and allow us to retrieve phase information by numerical processing of results. Furthermore, we can retrieve pulses. Our proposed D-line allows to shape pulses with various shapes.

Concluding, we propose and experimentally demonstrate a new D-line based on prism-lens spectrometer. In comparison with traditional D-lines it has a compact and simple design, which is independent from dispersive force. Only changing of one lens allows us to tune dispersion easily and significantly, as well as to change dispersion sign.

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[3] S. Akturk, et al. “Extremely simple single-prism ultrashort-pulse compressor”, *Opt. Expr*. vol. 14, p.10101, 2006.

REFRACTIVE ADIABATIC MICROCAPILLARY LENS

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In 1996, the idea of using compound refractive lens for focusing hard X-rays was presented in the famous journal "Nature". One of the compound refractive lens is a microcapillary X-ray lens, which developed at the Belarusian State University. The microcapillary X-ray lens is developed as a row of bubbles in the glass capillaries. Each bubble has a refractive surfaces for X-rays. When the number of bubbles increases, the focal length of the microcapillary X-ray lens decreases. The number of the bubbles defines the length of the microcapillary lens. For huge number of the bubbles the true focus point is inside of the microcapillary lens. As a rough approximation, length of the microcapillary lens should not be longer then focal length.

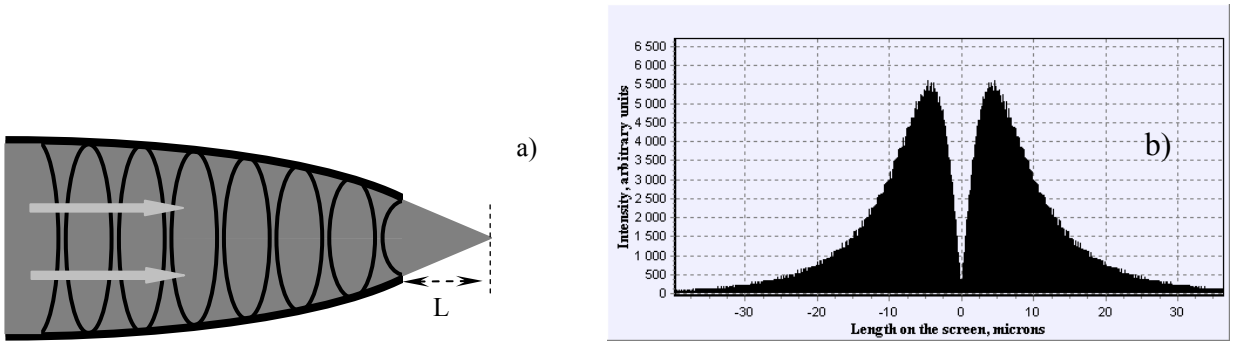

Fig.1. X-ray microcapillary adiabatic lens (a); Intensity distribution at the exit of the microcapillary adiabatic lens (b).

Adiabatic lens is a kind of shot-focal X-ray lenses. Adiabatic lens consists of a lens with variable radius (fig.1). As a kind of adiabatic lens the adiabatic microcapillary is proposed.

The glass capillary for arrangement microlenses are proposed. Experiment condition defines function for changing of the radius microlenses. It is possible to made glass microcapillary shaped as the function. Radius of the drop placed in the microcapillary is equal to the radius of the capillary. As the result, the shape of the capillary defines the function for changing of the radius microlenses. Different type of the function for changing of the radius microlenses are discussed. The method for calculation of the function for changing of the radius microlenses is developed. The function depends on X-ray energy and geometry condition of the experimental set up. Software for ray tracing is developed. Results of calculation of intensity distribution are presented and discussed (fig.2). Possibilities of generation structured in intensity X-rays microbeams are discussed.

MULTIBAND SYSTEM FOR NON-CONTACT TEMPERATURE MEASUREMENT

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Temperature is one of the most frequently controlled parameters during both physical, and technological processes and scientific research. Although many measurement methods are known, the problem of temperature measurements is of great importance. In some instances temperature measurements ought to be performed using non-contact methods, because of safety or convenience reasons. Unknown emissivity of the measured body degrades measurement accuracy, therefore research is being done on systems which give results independent of emissivity value [1,2].

One of the possible solutions of this problem is multiband methods. In these methods measurements of the emitted radiance of the object are taken at several wavelengths (usually more than four). The emissivty of the object, which is usually a function of wavelength (emissivity profile), and the temperature can be calculated by fitting the measurement data to the theoretical model [2]. In this paper we describe an idea of a multiband system for non-contact temperature measurement and analytic techniques which allow calculate temperature and emissivity of the examined body from the measured data. Influence of some factors on measurement accuracy is also discussed. Described technique gives a possibility to optimize construction of the whole system using computer modeling.

However, modeling of such systems, what is usually the first stage of system designing, requires acceptation of several simplifications and approximations. In this paper an experimental verification of modeling results is also described [3]. Based on developed experimental setup some tests are performed. It allows us to determine some systems parameters and whole system estimation. Results confirm the assumed simplification and the method for determination the object temperature in the range of performed experiments.

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[2]M. B. Kaplinsky i inni: „Recent advances in the development of a multiwavelength pyrometer", Opt. Eng. Vol. 36 No 11, pp. 3176-3187, 1997
[3]Adam Mazikowski, Marcin Gnyba, „Experimental verification of multiband system for non-contact temperature measurements", Proc. SPIE Vol. 5258 pp. 198-201, Workshop on Atomic and Molecular Physics., 2003

CONSTRUCTION OF TIME - DOMAIN BASIS FOR SPHERICAL SYMMETRIC SOLUTIONS OF MAXWELLS EQUATIONS

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In many optical processes interaction of light with substance develops in time in the limited spatial areas so for their detailed research the decision of initially boundary electrodynamical problems is required. Theoretical researches of such processes in most cases are limited one-dimensional, plainly layered, or two-dimensional layered structures. However, real objects are limited in space in all three measurements that demands the decision of three-dimensional initially boundary problems. The elementary model is layered spherically-symmetric limited area. In the given work the new function space for the purpose of creation of a convenient mathematical apparatus for the decision of spatio-temporal electromagnetic problems with spherical symmetry was constructed.

The transition from space with basis in spherical coordinates to new basis is performed as follows:

$$\left\langle \vec{x} \middle| \vec{p} \right\rangle_{mn} = e^{pt} \cdot \begin{pmatrix} \vec{L}_{mn} \\ \vec{M}_{mn} \\ \vec{N}_{mn} \end{pmatrix} \qquad \left\langle \vec{p} \middle| \vec{x} \right\rangle_{mn} = e^{-pt} \cdot \begin{pmatrix} \vec{L}_{mn} & \vec{M}_{mn} & \vec{N}_{mn} \end{pmatrix}$$

Here vector functions $\vec{L}_{mn}, \vec{M}_{mn}, \vec{N}_{mn}$ are determined by relations:

$$\vec{L}^1_{mn}(s,\vec{r}) = \frac{1}{s} grad[\Upsilon mn(\theta,\varphi) j_n(sr)] = \frac{1}{s}\frac{d}{dr}[j_n(sr)]\vec{P}_{mn}(\theta,\varphi) + \sqrt{n(n+1)}\frac{1}{sr} j_n(sr)\vec{B}_{mn}(\theta,\varphi)$$

$$\vec{M}^1_{mn}(s,\vec{r}) = rot[r\Upsilon_{mn}(\theta,\varphi) j_n(sr)] = \sqrt{n(n+1)} j_n(sr)\vec{C}_{mn}(\theta,\varphi)$$

$$\vec{N}^1_{mn}(s,\vec{r}) = \frac{1}{s} rot[M_{mn}(s,\vec{r})] = n(n+1)\frac{1}{sr} j_n(sr)\vec{P}_{mn}(\theta,\varphi) + \sqrt{n(n+1)}\frac{1}{sr}\frac{d}{dr}[rj_n(sr)]\vec{B}_{mn}(\theta,\varphi)$$

here $\Upsilon_{mn}(\theta,\varphi) = P_n^m(\cos\theta)e^{im\varphi}$.

Vectors $\vec{P}, \vec{B}, \vec{C}$ are the spherical harmonics forming full orthogonal system of vectors. The given vectors have been used for construction of the discrete solution in the work [1]. The purpose of the given work is a finding of the continuous analytical solution.

Transition to new representation and back, to coordinate, is performed as follows:

$$\left\langle \vec{p} \middle| \vec{a} \right\rangle = \int d\vec{x} \left\langle \vec{p} \middle| \vec{x} \right\rangle \left\langle \vec{x} \middle| \vec{a} \right\rangle \qquad \left\langle \vec{a} \middle| \vec{p} \right\rangle = \int d\vec{p} \left\langle \vec{x} \middle| \vec{p} \right\rangle \left\langle \vec{p} \middle| \vec{a} \right\rangle .$$

The integration symbols have the following sense

$$\int d\vec{p} = \sum_{m=0}^{\infty} \sum_{n=-m}^{m} \int_{-i\infty}^{i\infty} \frac{dp}{2\pi i} \int_0^{\infty} s^2 ds \qquad \int d\vec{x} = \int_0^{2\pi} d\varphi \int_0^{\pi} d\theta \sin\theta \int_0^{\infty} dt \int_0^{\infty} r^2 dr .$$

The basis elements are orthogonal in sense of the entered scalar product.

[1] G.Kokkorakis, J. Fikioris. “EM Field induced in inhomogeneous dialectric spheres by external sources”, *IEEE Transactions on Antennas and Propag. Magazine,* vol. 55, no.11, pp. 3178-3190, 2007.

SPECTRAL COMPRESSION AND SPECTRO-TEMPORAL IMAGING OF FEMTOSECOND PULSES BY SECOND HARMONIC GENERATION

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We experimentally demonstrate an aberration-free spectral compression and spectro-temporal imaging of femtosecond pulses through a new method based on second harmonic generation. The technique is self-reference by the use of a nonlinear-spectronic reference pulse self-shaped in a single-mode fiber without gain.

Temporal lensing - SC has promising applications to signal analysis-synthesis problems in ultrafast optics [1]: spectro-temporal imaging (STI) for direct, real-time femtosecond pulse measurements [2], fine frequency tuning of radiation along with SC, generation of dark solitons, and nonlinear-optic suppression of radiation noise. High order nonlinear (NL) and dispersive (D) effects, accompanying the femtosecond pulse self-interaction in fiber, lead to temporal lens "aberrations". For aberration-free temporal lensing, cross-phase modulation method of SC serves with a specially shaped reference pulse, involving the separation problem of signal and reference pulses to avoid the walk-off, etc.

We report on a new method of SC and STI through sum frequency generation. The new method is self-reference and aberration-free by self-shaping of nonlinear-spectronic reference pulse. In our experiment, we use femtosecond pulses of a standard Coherent Mira-900 + Verdi-V10 laser system. We split the radiation to be into low- and high-power parts. We direct the low power pulse to a dispersive delay line. The second high-power pulse we inject into a single mode fiber and have a similariton.The nonlinear-spectronic nature of such a pulse makes its chirp linear and independent of the initial pulse parameters: only the fiber dispersion determines the chirp slope, and so the technique becomes a self-reference one. In both paths of setup, we have linearly chirped pulses for which the pulse temporal profiles repeat the spectral ones, and so, we have STI for these pulses. Afterwards, we direct these two pulses to a nonlinear crystal for the non-collinear second harmonic generation (SHG). The chirp cancellation, under the condition of a constant reference pulse during the stretched signal, results in SC and STI. To test our system in our temporal lens in sense of its aberrations, we shape different pulses, measure their images and compare the calculated autocorrelation tracks of images with the measured ones for the pulses under test. The frequency tuning process is also investigated with the presented technique. The temporal delay between the signal and reference pulses leads to the frequency shift of the output signal. The temporal delay in range of ±4 ps results in the ±8 nm wavelength shift along with the SC.

Concluding, we demonstrate a new method of SC and STI in the second harmonic generation process instead of self- or cross-modulation. The proposed method has the following advantages:

- free of demand to differentiate the signal and reference radiation, moreover
- self-reference and aberration-free by self-shaping of a sub-parabolic, nonlinear-spectronic reference pulse,
- permitting to follow up the process steps.

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GENERATION OF FEMTOSECOND RECTANGULAR FOURIER TRANSFORM PULSES IN SPECTRAL COMPRESSOR

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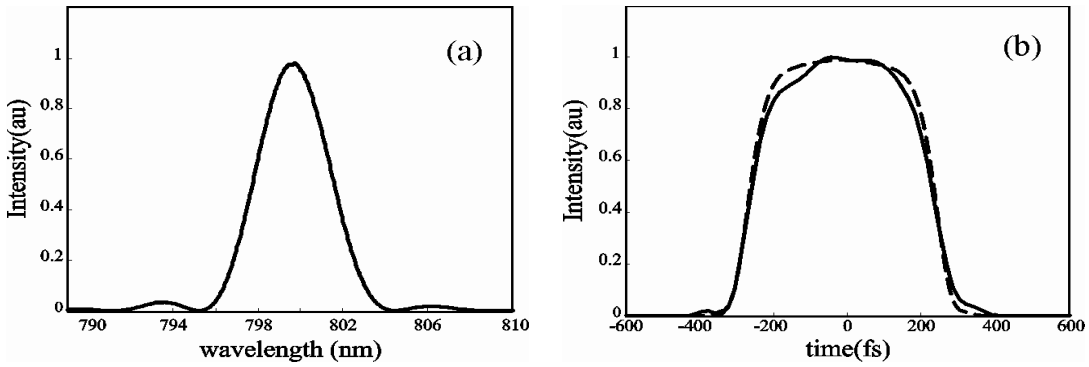
Short pulse spectral compression (SC) has promising applications to signal analysis-synthesis problems in ultrafast optics [1]: spectro-temporal imaging for direct, real-time femtosecond pulse measurements, fine frequency tuning of radiation along with SC for resonant spectroscopy, generation of dark solitons, etc. For the lengths of dispersive delay line (DDL), comparable with the doubled length of single-mode fiber (SMF), an effective SC regime is achieved in which transform limited ultrashort pulses with a rectangular time envelope are generated in the range of the maximal SC. The shaping and generation of rectangular optical signal is of great interest especially for optical communication, and device characterization-calibration. The rectangular optical pulses are required also for a wide range of pump-probe experiments such as to study carrier dynamics, coherent excitation, and control of optically induced quantum states [2].

In our experiment, the SC system consists of two-prism compressor (pair of dispersive prisms with the reverse mirror) as a dispersive delay line, and single-mode fiber. During the dispersive delay line, the pulses are stretched and phase modulated, and the prorogation through nonlinear fiber leads the spectral narrowing. We demonstrate ~3 times spectral compression of 100 fs pulses. Afterwards we use spectral interferometric method to recover completely the temporal profile of the rectangular pulses. We inject the signal pulse into SC system to form a rectangular pulse and as a reference we use the initial pulse. The measured spectrum of signal pulse together with the retrieved spectral phase, permit us to describe completely the signal pulse in spectral domain and to pass to the temporal domain via Fourier transformation. The figure below shows our recorded spectrum (a) and retrieved temporal profile of the rectangular pulse in comparison with simulated one (b). The solid line represents the retrieving pulse and the dashed line is for numerical simulation.



Concluding, we demonstrate experimentally the forming of Fourier transform rectangular pulses in the dispersive regime of SC, along with the achievement of maximal SC ratio. By means of spectral interferometric measurements, we completely characterize these pulses. All obtained results are in a good agreement with numerical simulations.

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INVESTIGATION OF OBJECT IMAGE RESTORATION BY ITS SPECTRUM

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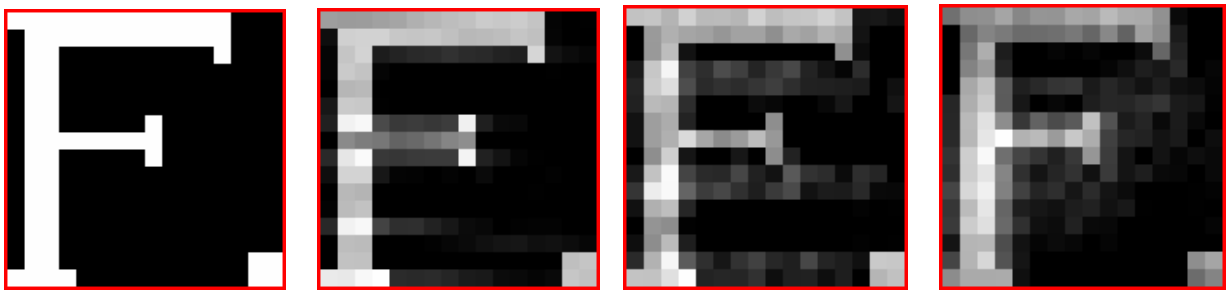
The possibility of object image restoration by the modulus of its Fourier-transform was shown theoretically in [1] (later in [2]) and practically in [3]. In our report a convergence of an iterative process applied for this purpose is examined by using numerical analysis. It is shown that in the case of using random initial approximation a probability of convergence to the proper result decreases while a mean square distance between initial approximation and correct object image increases. The cases of proper and incorrect convergence (the latter is called a trap, fig. 1) are illustrated. A discrete character of traps set is discovered. The maps of convergence on a plane randomly chosen in the image space are presented. The possibility of using described algorithm for restoration of complex function in a finite area on a plane is shown. The possibility to determine atmosphere parameters using such procedure to the image of point source is examined. The first results of such kind of calculations are given.



a b c d

Fig. 1 – Restoration of object images in the cases of proper convergence (a) and three traps (b-d)

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OSA/SPIE SEMINAR FOR YOUNG SCIENTISTS AND STUDENTS ON NANOPHOTONICS & METAMATERIALS

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III YOUNG RESEARCHER CAREER DEVELOPMENT WORKSHOP

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BIOPHYSICS

COMPACT X-BAND COAXIAL MONOPOLE ANTENNA

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Computational modelling of the plug-shape ground plane antenna with different geometrical parameters is carried out. The input reflection coefficient, near-field distributions, and radiation patterns of antenna operating both in the dual-band mode and the wide frequency band are determined. Based on the near-field distributions of this antenna the configuration and mutual arrangement of antenna elements are chosen in order to shape the mono-beam radiation pattern.

It is worth noting that a monopole antenna with the plug-shape ground plane was proposed by us earlier [5]. It has been shown that one may to shape the mono-beam radiation pattern by changing the geometrical parameters of antenna. Based on these results we have assumed that the location of antenna in the dielectric layer can result in the enhancement of antenna bandwidth and gain.

The antenna under testing is the cylindrical monopole with plug-shape ground plane imbedded in the dielectric with permittivity ε_1 (Fig. 1). The throat height of the ground plane is d_r and the radius of the plane part of the ground plane is R. In this case the central core of coaxial is the monopole of d_{r1} in the height.

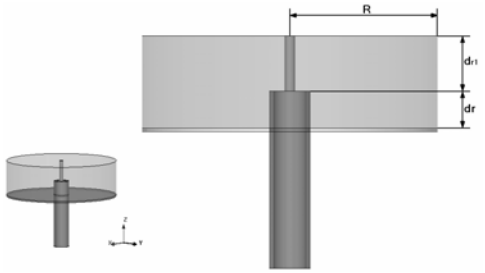

Fig. 1 Antenna design

The X-band monopole antenna design with the plug-shape ground plane imbedded into the dielectric has been presented. As a result of computational modeling and following experimental verification it has been shown that by means of the proper choice of antenna elements the given small-size antenna can operate in the dual-band mode or be in use as the wide-band antenna shaping the mono-beam radiation pattern. Furthermore, the antenna performance can be substantially changed by means of the suitable choice of the geometric and physical parameters of the antenna elements. The proposed antenna design seems to be very attractive for different wireless applications.

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EFFICIENT ANALYTICAL-NUMERICAL METHOD FOR THIN DISC SCATTERING PROBLEM

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In this paper we consider the problem of diffraction of an arbitrary electromagnetic wave by a thin disk. To build the mathematical model of this problem, we use Maxwell equations and the following generalized boundary conditions: $[E_{tg}^{+} + E_{tg}^{-}] = 2Z_0 R \, \vec{n} \times [H_{tg}^{+} - H_{tg}^{-}]$ and $Z_0 [H_{tg}^{+} + H_{tg}^{-}] = -2Q \, \vec{n} \times [E_{tg}^{+} - E_{tg}^{-}]$. Here Z_0 and k are the impedance and the wavenumber in free space, R and Q are the electric and magnetic resistivities.

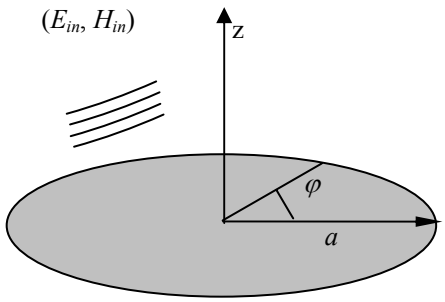

Fig. 1. Geometry

Our aim is to find efficient analytical-numerical method for solving this problem. We express the normal to the disk field components in terms of the azimuth-angle Fourier series and the radial scalar integral Hankel transform. Then the tangential to the disk components can be written in terms of azimuth-angle Fourier series and radial vector integral Hankel transform (see [1]). Thus, the electromagnetic field can be express in terms of Fourier series and integral Hankel transforms of $4m$ ($m = 0 \ldots \infty$) independent functions. Note that such field expressions satisfy the Maxwell equations outside the source points and radiation condition automatically. Substituting these expressions to the boundary conditions we obtain coupled dual integral equations (CDIEs). Then we condotionally "decoupled" them by using integration on radial variable and introduce four (for each CDIEs) constants of integration that we call coupling or "free" constants (see [2]). By analogy to the acoustic problems of scattering by rigid and soft disks (see [3]) or by using inverse Hankel transform, each DIEs can be reduced to the Fredholm second kind integral equation (FIE2). We use the edge condition (or equivalent smoothness condition for the images of jump and sum limit values of the normal to the disk field components in the Abel transform domain) to find the coupling constants. Thus, as a result we have $4m$ coupled FIE2s which are equivalent to the CDIEs. We propose to solve these equations by using numerical inversion of the matrix FE2s operator which can be obtained by any reasonable discretization scheme of FIEs2 with corresponding truncation.

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BASICS OF PARTICLE SWARM OPTIMIZATION ALGORITHM

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Particle Swarm Optimization (PSO) is a powerful evolutionary computational algorithm based on the social behavior of swarm of bees in the nature that is used to search for global extremes in complex multi-dimensional optimization problems.

The PSO algorithm is easy to implement, use and adapt to any multi-parameter problems. It has been shown that in certain instances PSO outperforms other methods of global optimization like genetic algorithms [1].

In evolutionary computation one uses the principles developed by living organisms in the process of evolution via adaptation to the external environment. For instance, the PSO imitates a swarm of bees tracing the unknown field in a search for the location of the most flowers density. The bees start moving in random directions and with random velocities. During the search, each bee communicates with other bees in order to correlate its movement, i.e. at each step the speed and direction is determined based on the personal experience and information obtained from other bees about the area of highest concentration of flowers found by any other bees of the swarm. In such a way all the bees are approaching to the area with highest flower density following its own path and testing the flower density along its trajectory. If a new area with highest density is found, a new center of attraction for all bees appears.

Proposed by Eberhart and Kennedy in 1995 [2], the PSO method has attracted attention of researcher working in many fields including electromagnetics where it has been successfully applied for a synthesis of antennas and other components for mm and sub-mm wave applications [3].

The aim of research was to develop a numerical algorithm capable of performing a fast and reliable search for global maxima of multi-parameter function. The algorithm has been developed based on PSO principles. The code was written in Fortran 90 and organized in the way suitable for easy integration with other algorithms to enable its further application for synthesis of various electromagnetics components. Working-capacity of the algorithm was examined for several multi-parameter test-functions. Different boundary conditions have been implemented and the optimal values for the coefficient in the formula for the speed-vector of each agent (bee) have been experimentally determined.

During presentation, the basics of the method and algorithm will be presented together with the results of numerical optimization for test functions.

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ЧИСЛОВИЙ МЕТОД РОЗВ'ЯЗУВАННЯ ГІПЕРСИНГУЛЯРНОГО ІНТЕГРАЛЬНОГО РІВНЯННЯ ДЛЯ ЕЛЕКТРОМАГНІТНОГО ПОЛЯ У МЕТАЛІ З НЕСКІНЧЕННО ТОНКОЮ ТРІЩИНОЮ

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Одним із поширених методів виявлення дефектів типу тріщин у провідних конструкційних матеріалів є неруйнівний контроль за допомогою низькочастотного електромагнітного поля [1]. Якщо розкрив тріщин малий, то для дослідження цієї взаємодії використовують модель тріщини у вигляді розрізу, на якому задано деякий розподіл електричних диполів, електромагнітне поле яких еквівалентне полю тріщини [2]. Визначення цього розподілу зводиться до розв'язування системи з двовимірних гіперсингулярних інтегральних рівнянь першого роду. Аналогічні рівняння отримують в теорії пружності для тіл із тріщинами, механіки крихкого руйнування, термопружності, аеродинаміки, дифракції електромагнітних хвиль на провідних екранах тощо. Незважаючи на великий обсяг публікацій, присвячених цій тематиці, загальна теорія розв'язання таких рівнянь далека від завершення. Тому актуальне створення ефективних числових методів їх розв'язання.

Розглянуто наступну тривимірну задача: на границю напівбезмежного металічного матеріалу, що містить тріщину еліптичної форми з безмежно малим розкриттям під довільним кутом падає плоска електромагнітна хвиля. Необхідно визначити розподіл електричних диполів по поверхні тріщини. Як первинне поле будемо розглядати поле плоскої хвилі напрям поширення якої перпендикулярний до поверхні провідника. Вектор електричного поля у цьому випадку записується у вигляд $\vec{E} = \vec{E}_0 e^{ikh}$, де k - хвильове число, $\operatorname{Im} k > 0$, h - відстань від точки спостереження до поверхні провідника, $\vec{E}_0$ - тангенціальна складова вектора електричного поля на поверхні провідного середовища. Методом граничних інтегральних рівнянь визначення розподілу диполів звелося до розв'язання гіперсингулярного інтегрального рівняння, яке інтерпретувалось в сенсі скінченних частин за Адамаром:

$$\frac{1}{4\pi\sigma}\iint\limits_{S_e} \varphi(\xi)\frac{e^{ikR}}{R^3}\left(k^2R^2 + ikR - 1\right)dS_\xi = -\left(\vec{E}(\eta), \vec{n}\right),$$

де $R = R(\xi,\eta) = |\eta - \xi|$, $\eta,\ \xi \in S_e$, $S_e : \xi_1^2/a^2 + \xi_2^2/b^2 \le 1, b \le a$, $\vec{n}$ - нормаль до поверхні S_e

Для побудови числового алгоритму його розв'язання запропоновано адитивне виділення інтегралів: гіперсингулярного з ядром статичної задачі, з полярною особливістю, з неперервним ядром, з подальшою регуляризацією отриманого рівняння. Поділом області тріщини на граничні елементи у формі прямокутників побудовано дискретний аналог інтегрального рівняння. Так отримано наближені аналітичні формули для обчислення певного класу особливих інтегралів, що суттєво підвищило точність обчислення матричних елементів відповідної системи лінійних рівнянь – дискретного аналога інтегрального рівняння.

Проведено числове тестування запропонованого алгоритму розв'язання інтегрального рівняння. Встановлено, що метод граничних елементів ефективний для інженерних розрахунків, які вимагають невисокої точності (порядку декількох відсотків).

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THE MATHEMATICAL MODEL OF SCATTERING WEAVES BY THE IDEALLY CONDUCTING CYLINDRICAL SURFACE WITH THE LONGITUDINAL SLITS ON THE DIELECTRICAL CYLINDER

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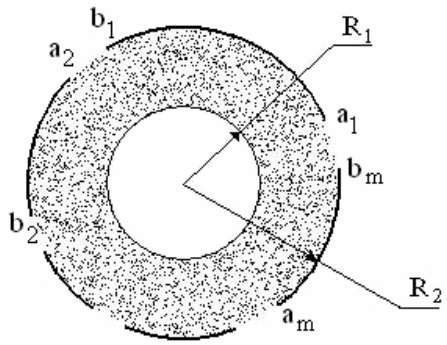
Mathematical diffraction models of the plane monochromatic weave by the cylindrical surface with the finite number of the longitudinal slits have been widely used by projecting of the aperture and surface antennas, open resonators, slitted waveguides and based on them filters. Diffraction of the E-pol electromagnetic weave by the cylinder having ring in the cross-section with single longitudinal slit in the external surface is presented in the work [1].

In the present work a diffraction problem of the plane monochromatic weave by the cylindrical layer, the internal surface of which is covered with the ideally conducting cylindrical surface, and the external one is covered with the finite number of the longitudinal slits is considered. The corresponding 2-D problem in the ring is studied. The ring corresponds to the cross-section of the structure with the plane which is perpendicular to the base of the cylindrical surfaces (pic. 1). The wave vector of the falling field is lying within this plane.



Pic. 1. The cross-section of the cylindrical surface with the plane.

The corresponding boundary value problem for the Maxwell equations comes to the two independent boundary value problems for the Helmholtz equation (the cases of TE-, TM-waves, see, for example, [2]). Presenting the fields as Fourier generalized series and using the parametric representation for hypersingular and singular integral operators, and also as the integral operator with the logarithmical kernel, the considered boundary value problems are reduced to the boundary integral equations: in the case of TM-waves – to the singular integral equation, and in the case of TE-waves – to the hypersingular integral equation.

The discrete mathematic models of the boundary integral equations are built, and then, by using quadrature formulae of interpolation type [2], we get the systems of the linear algebraic equations for receiving the approximate values of unknown functions, through solving which the physical values are being evaluated. The rigorous substantiation of the approximate solutions is given with the use of the discrete mathematical model and the evaluations of the convergence rate speed are received.

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ЧИСЛЕННОЕ МОДЕЛИРОВАНИЕ РУПОРНОЙ АНТЕННЫ С ДИЭЛЕКТРИЧЕСКИМИ ВСТАВКАМИ

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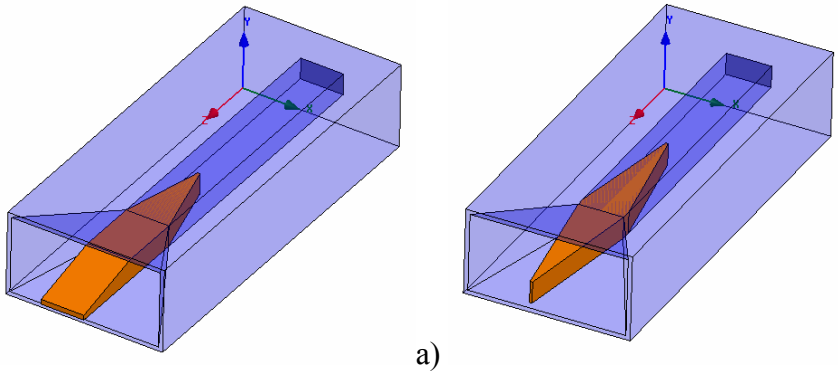
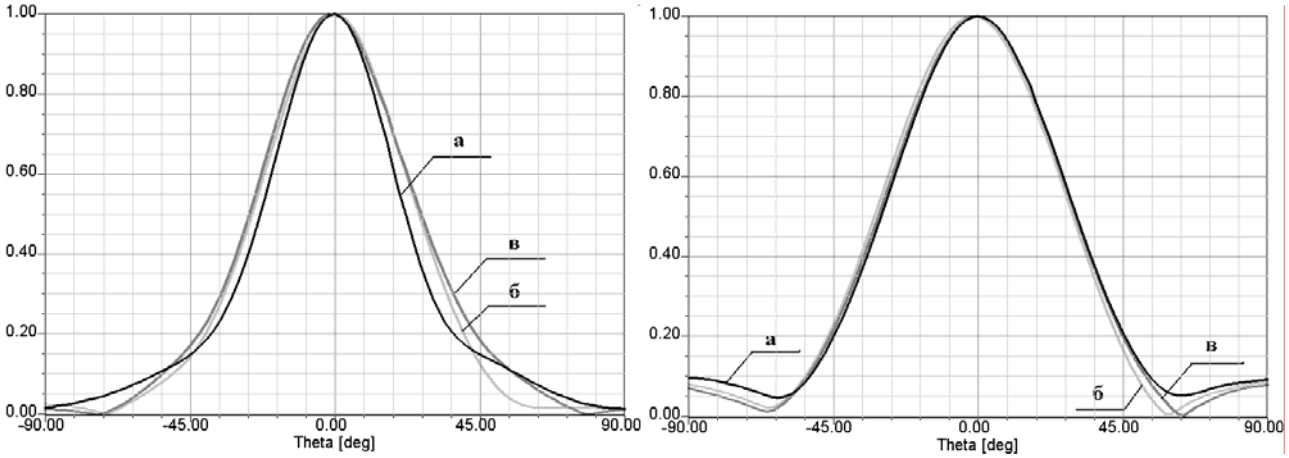
В работе рассмотрены результаты численного моделирования пирамидального рупора с плавным волноводным переходом, образованным диэлектрическими вставками и дополнительными формирователями диаграммы направленности в виде выступающих из раскрыва рупора концов диэлектрических вставок, для согласования и коррекции поля излучения на рабочей частоте 37ГГц.

Для обеспечения минимальных потерь при переходе с металлического прямоугольного перехода на диэлектрический волновод, методами численного моделирования были получены форма и размеры диэлектрической вставки, а также расстояние перехода (рис. 1а,б), обеспечивающие минимальное значение коэффициента стоячей волны (КСВ).



а) б)

Рисунок 1 – Модели рупора с диэлектрическими вставками



а) б)

Рисунок 2 – ДН рупорной антенны а - в плоскости Н, б – Е

Результаты численного моделирования показали, что использование диэлектрических вставок позволяет изменить форму ДН, на рис. 2: а – рупор без диэлектрической вставки, б – для вставки на рис. 1.а, в – для вставки на рис. 1.б.

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IMPULSE WAVE PROPAGATION IN RADIAL-INHOMOGENEOUS ASYMMETRICAL BICONICAL LINE

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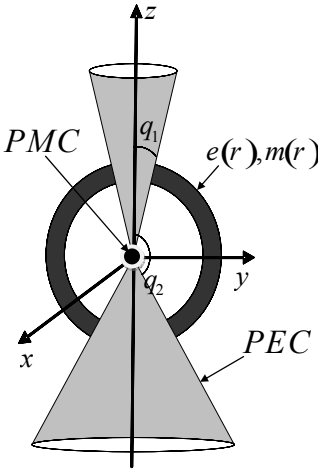
Mode Basis Method in spherical coordinate system was applied to studying in time domain the fields of pulse sources radiating in inhomogeneous magnetodielectric medium bounded with PEC conical surfaces. In this work application of the method is demonstrated on the problem of asymmetrical biconical line with radial-inhomogeneous filling. The permittivity and permeability depend on radial coordinate: $e = e(r)$, $m = m(r)$. There is no intermodal coupling in radial-inhomogeneous medium, and each mode propagates independently. The structure under study is excited by a ring of non-stationary electrical current of the form: $\vec{J}(\vec{r},t) = \vec{j}_0 d(r - R)d(q - p/2)f(t)$, where $\vec{j}_0$ is ort, $d(\cdot)$ is Dirac function, $f(t)$ is arbitrary waveform function. Under such conditions only *TM* –waves are excited and each mode propagates uncoupled. The electric and magnetic field strengths in this case has following form:



$$\sqrt{e_0}\vec{E}(\vec{r},t) = r^{-1}\sum_m e_m(r,t)\vec{E}_m(q,j)$$

$$\sqrt{m_0}\vec{H}(\vec{r},t) = r^{-1}\sum_m h_m(r,t)\vec{H}_m(q,j) + r^{-2}\vec{r}_0\sum_m h_m^r(r,t)p_m F_m(q,j)$$

$\vec{r}_0$ is radial unit-vector. The vector and scalar mode distributions are defined as follow:

$$F_m(q) = C_m^1 P_{n_m}(\cos q) + C_m^2 Q_{n_m}(\cos q); \quad \vec{E}_m = -\vec{j}_0 p_m^{-1}\partial_q F_m; \quad \vec{H}_m = \vec{q}_0 p_m^{-1}\partial_q F_m.$$

Where $P_{n_m}(\cdot), Q_{n_m}(\cdot)$ are associated Legendre functions of first and second kind correspondingly. The constants C_m^1, C_m^2 are to be found as eigenvectors of the following homogenous SLAE and normalized by condition $1/4p\int_W F_m F_n dW = d_{mn}$ (W is full spherical angle):

$$C_m^1\frac{dP_{n_m}(\cos q_1)}{dq} + C_m^2\frac{dQ_{n_m}(\cos q_1)}{dq} = 0 \qquad C_m^1\frac{dP_{n_m}(\cos q_2)}{dq} + C_m^2\frac{dQ_{n_m}(\cos q_2)}{dq} = 0 \qquad (1)$$

The spectral parameter is defined as $p_m = \sqrt{n_m(n_m+1)}$. The eigenvalues n_m are to be found from the condition of zeroing determinant of system (1). The evolutionary coefficients satisfy the following system of linear PDE with r -dependent coefficients $e(r)$, $m(r)$:

$$em\frac{\partial^2 e_m}{\partial t^2} - \frac{\partial^2 e_m}{\partial r^2} + \frac{1}{m}\frac{dm}{dr}\frac{\partial e_m}{\partial r} + m\frac{p_m^2 e_m}{r^2} = -\sqrt{m_0}rm\frac{1}{4p}\int_W \vec{r}_0\cdot\frac{\partial \vec{J}}{\partial t}\vec{H}_m dW$$

$$\frac{\partial h_m}{\partial t} = -\frac{1}{m}\frac{\partial e_m}{\partial r} \qquad \frac{\partial (mh_m^r)}{\partial t} = -e_m \qquad (2)$$

The system (2) was solved numerically by finite difference method.

This method will be further applied to analysis of antennas consisting of such lines of finite size radiating into the free space.

SOLUTION OF THE PROBLEM OF WAVEGUIDE OPEN END PULSE RADIATION BY METHOD OF MODE MATCHING IN TIME DOMAIN

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Much of the problems of short pulse propagation and diffraction are most naturally treated in the Time Domain. Among most universal techniques used for solving such problems is the method of Finite Differences in Time Domain (FDTD). Meanwhile some simple problems such as propagation in a regular waveguide can be solved analytically. In this paper the stated problem is solved using a hybrid method that exploits FDTD calculating pulse propagation in uncoupled mode channels while mode-matching is used for describing boundary conditions that provides mode coupling at the discontinuity (waveguide open end with infinite flange).

The problem of field propagation in a regular domain (regular part of the waveguide, free space) can be solved analytically by Mode Basis Method [1]. At this the sought fields are presented in the form of mode decomposition with mode amplitudes governed by the Klein-Gordon Equation (KGE) $\left(\partial_t^2 - c^2\partial_z^2 + c_n^2\right)e_n = 0$, where $e_n(z,t)$ are the mode amplitudes, c_n are the corresponding eigenvalues. It should be noted that while in the closed waveguide the field can be presented by a sum over discrete modes, in the free space one need to use integral over continuous spectrum in order to present the fields. The modes both in the waveguide and in the free space propagate independently and can be coupled only at some inhomogeneity, such as the waveguide open end in this case.

In the proposed method the fields in the regular domains are calculated by applying FDTD to KGE while the mode coupling at the inhomogeneity is accounted for with mode matching in every time moment by imposing boundary conditions in the space domain [2]. Since the spectrum is continuous one would need to solve the EKG for each eigenvalue from this continuity that is surely impossible. In spite of this the proposed method allows correctly evaluate the fields in the flange plane. In the mode domain the fields in the flange plane in the free space can be presented as a superposition of the spectra (decomposition over free space modes) of the accounted modes of the waveguide:

$$F\left(c, c_n\right) = \int_S \mathrm{F}_n\left(\vec{r}_\perp, c_n\right)\Psi\left(\vec{r}_\perp, c\right)dS$$

here c_n are the eigenvalues of the mode F_n from the discrete spectrum of the closed waveguide, Ψ are the free space modes. At that the spatial spectrum of the field at the flange plane should be presented as linear combination of the finite number of these spectra for the accounted discrete modes. That is why calculating the spectrum at several spatial frequencies (the number is equal to the number of the accounted waveguide modes) one can recover the coefficients in the linear combination and hence recover the total spatial spectrum at any frequency.

After calculating the fields in the flange plane by such a method the radiated fields both in the near zone (if required) and in the far zone can be calculated by evaluating the Kirchhoff integral.

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THE ACTIVE PHASED ARRAY OF COAXIAL-SECTOR WAVEGUIDES

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In the given article the considered the phased array of coaxial-sector waveguides. The base cell of array is present on fig.1. Characteristics of a considered waveguide are insufficiently investigated at the moment. Computational complexity of such structure is caused by the geometrical form of a waveguide. The Bessel functions and Neumann functions of fractional indexes are used in mathematical formulation of waveguide fields. Use of coaxial-sector wave guides as radiators allows expanding considerably scanning sector of phased array in comparison with grids of circular or rectangular waveguides. They allow receiving more compact grids of an arrangement of radiators in active phased array.

Critical frequencies are found for TE-and TM-waves of a coaxial-sector waveguide. The lowest type of a wave is wave TE_{11} in the given wave guide.

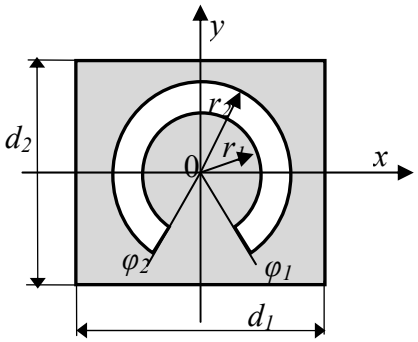

Fig.1. Base cell

Characteristics of an antenna array of coaxial-sector waveguides are defined by a method of the partial areas [1]. This method is based on direct sewing together of fields on border of two environments with use of boundary conditions. By means of the given method it is possible to receive infinite system of the linear algebraic equations of the second kind. This system allows calculating reflection coefficient of the basic wave in a waveguide and partial pattern of an antenna grid at excitation of waveguides by the basic oscillation mode - wave TE_{11}.

Results of calculations of reflection coefficient and partial pattern for an antenna array of coaxial-sector waveguides are presented on fig.2. The optimal geometrical sizes (*d/l* 0.1, where *d* - width of a ring, *l* - electric length of a waveguide) are used.

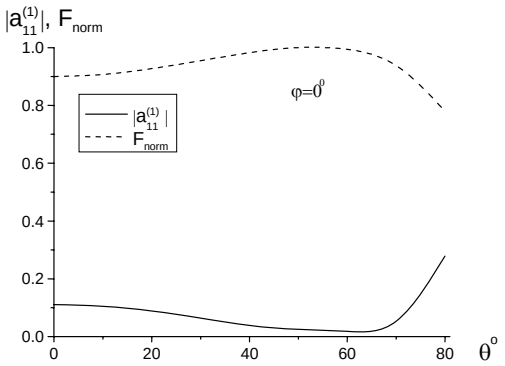

Fig.2. Reflection coefficient and partial pattern

The quantity of scanning sector of a considered antenna array surpasses quantity of scanning sector of antenna array from wave guides of more complicated section form, for example four-ridge waveguides [2]. Researches have shown, that coaxial-sector radiators allow to project phased array with scanning sector ~ 70^0 with reflection coefficient no more than 0.15.

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ELEMENT OF ANTENNA ARRAY **WITH CONTROLLED RADIATION POLARIZATION**

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The increasing of the capacity of radiochannels is related to the optimization of the existing radiosystems' parameters. One of the key ways of performing the task is the creation of new antennas and modernization of that already in use. For instance deploying of antenna arrays allows realization of dynamic control of the directional characteristics that may be considered the spatial radiosignal processing that is aimed at the rise of the radiochannel power budget. At the same time there are the approaches of polarization matching between the receiving and transmitting antennas [1], however this field is not explored well enough and the polarization structure of the radiated field is only taken into the account on the basic level for antennas design.

By now there are several ways known of how to create elliptic radiation polarization in particular circular one with the help of antenna elements with linear polarization by the way of introduction of additional phase shifts in the excitations [2]. The control of polarization in the case is realized by commutation of the correspondent excitation channels [3]. Patch antennas and electric dipoles are the main types of antennas used in such applications. The bandwidth of these types of antennas is not large and the polarization control tends to be rough. Thus the goal of the proposed research is to design and explore the antenna element that would allow creation of the field with elliptical polarization of arbitrary parameters and besides would have rather wide bandwidth.

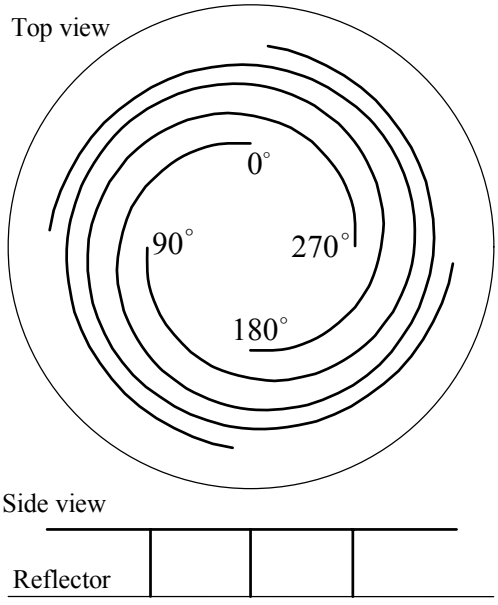

Figure 1 — The view of flat spiral element

Such an element is based on the flat 4-wire spiral structure with 90 degree shifted excitation (fig.1). The analysis of the structure is done with the help of generalized electromotive forces (EMF) method. This method is most suitable for the problem as it allows getting the results of high precision comparatively quickly.

The results of the research showed that the proposed antenna structure provides high axial ratio (AR) in the frequency range that is usual for spiral elements. To increase the steadiness of input impedance and the directional characteristic a special law of spiral winding is proposed. The key point of this winding is that its step decreases in the direction away from the center of element. The control of the polarization parameters is realized due to the appropriate changes in amplitude ratio between two excitation signals of the element. The direction of electric field intensity vector rotation may be changed by the switching the polarity of the excitation in the horizontal branch to the opposite one.

[1] *Comarovich V.F., Nikitchenko V.V., Rozhkov A.G.* Systems of information processing (Adaptive radiosignals processing). — M.: Znanie, 1989. — 64 p.

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SPECTRUM DESIGN OF ROTATIONAL SHAPED CAVITY RESONATORS

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Open resonator exited by open circular waveguide, located in the center of plane reflector; the second reflector has the spherical shape is described in [1,2]. In such electrodynamic system the axially symmetrical modes can be exited. Within whole tuning of resonator length of order wavelength, only single axially symmetric oscillation mode can be excited, it has been demonstrated in [2]. Thus such resonant system may be usable at different instruments and devises of millimetric and submillimetric wavelength range. In particular cases such resonant system enables to measure the electromagnetic characteristics of the material with high losses.

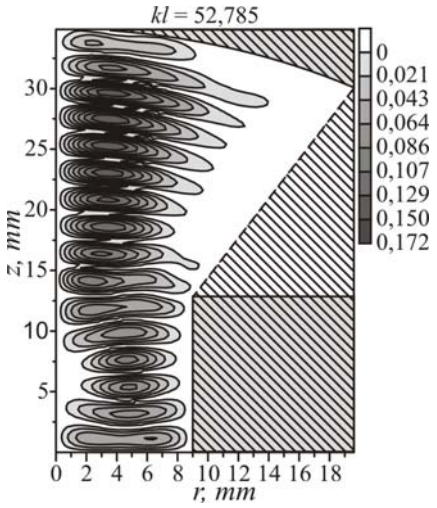

Fig. 1. Field patterns in such resonator. E_ϕ – field component is displayed. Figure is symmetrical respectively rotation about *0z*.

It is needs to numerical algorithm development for obtaining eigenfrequencies and fields spectrum for further investigation of such resonator.

The method of this problem solution is based on the idea that in OR the axially symmetric types of oscillations are bounded by caustic surfaces, and, hens, they have rather small diffraction losses. So the introduction of the metal surfaces in domain where the field decays exponentially (see dashed lines in Fig.1) does not disturb the field pattern inside the resonator. Hence we reduce the problem to the study of closed volume resonator. Selecting from the spectrum only oscillations with small diffraction losses will be obtained the corresponding spectrum of open resonator.

Eigenfrequency problem for such resonator with applying Bubnov-Galerkin method is reduced to linear problem of eigenvalues and eigenvectors of certain infinite matrix searching.

In the result of numerical analysis for such resonator the oscillations which have small diffraction losses, is obtained. A calculation for resonators with different diameter of cylindrical part is executed. As obtained results is shown, that within whole tuning of resonator length of order wavelength, only single axially symmetric oscillation mode can be excited. This fact is demonstrated the close fit with [2]. The good correspondence between theoretical and experimental results is obtained.

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RESONANCE OF TOTAL REJECTION PRODUCED BY A THIN BAR IN RECTANGULAR WAVEGUIDE

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The problem of the dominant TE_{10} mode diffraction by a thin step bended metallic bar placed in a rectangular waveguide (Fig. 1) is considered. Such waveguide model is an analogue of planar two periodic gratings total reflection of incident plane wave at the end of single-mode frequency band. Similarly even a small stepped bend of the bar provides the resonance of total rejection of the TE_{10} mode in the single-mode band of frequencies. As a method of analysis the combination of mode matching technique and the generalized scattering matrices method [2] were applied. Application of this approach allows getting the most high-speed, stable and exact algorithms.

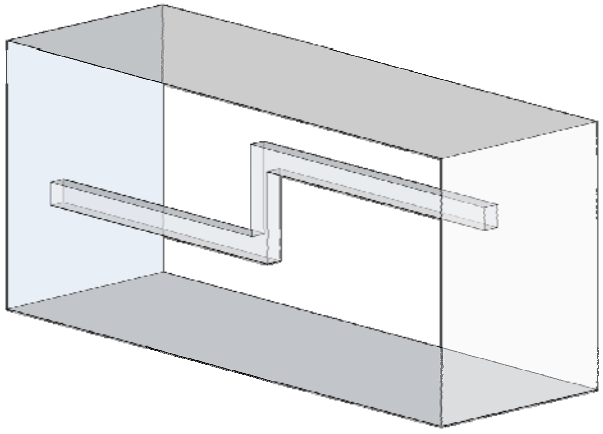

Fig. 1. The sharp step bended bar of rectangular cross-section, placed into a rectangular waveguide.

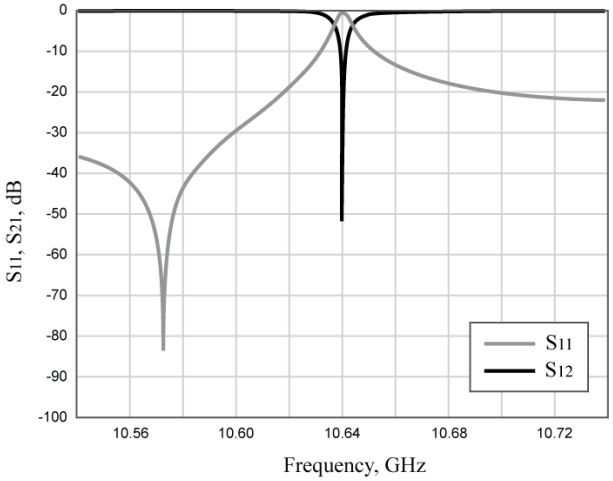

Fig. 2. Frequency-response of the sharp step bended bar.

Influence of the bar geometrical dimensions on the frequency and Q factor of resonances was studied. Practical recommendations for the choice of sizes of bar that is necessary to provide the desired resonance frequency and bandwidth are given.

[1] S.L. Prosvirnin, P.L Mladyonov, “Electromagnetic wave diffraction by the two-periodic grating of uninterrupted curvilinear metal strips.”, Radio Physics and Radio Astronomy, vol 7, №3, p.265-272, 2002 (in Russian).

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ELECTRODYNAMIC PROBLEMS OF MIMO TECHNOLOGY REALIZATION

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Conceptual aspects of the further development of radio communication systems are formed mainly by requirements of the market, demands for new kinds of services, high-speed data transmission and volume of the transmitted information. All this reveals a necessity of further wireless communication systems development in the direction of substantial growth of their throughput accompanied by high quality of given high-speed services. Now basic stages of development of wireless communication systems for the nearest future are determined. In particular, in [1] the increase in efficiency of use of a radio-frequency spectrum in a radio access network is offered on the basis of MIMO (multiple input multiple output) — technology of transmitting-receiving antenna with a multichannel outputs and inputs. Thus theoretical basis of MIMO technology is the theory of spatio-temporal processing of signals [2] that describes methods of optimal reception of signals in view of spatio-polarization structure of electromagnetic field.

The results of research submitted in the report have shown, that the theoretical increase in capacity of the wireless channels for system on basis of MIMO technology is achieved due to application of a set of aerials, spatial division of radio channels and suppression of undesirable interference effects. The main disadvantage of radio systems constructed on basis of MIMO technology is that the increase of information transfer speed is possible only on condition that a multibeam radio channel is provided. It states the initial electromagnetic problem — the research of spatial - polarizing properties of a multibeam radio channel. Besides, the complexity of the system rises as several antennas are used instead of one. Also among the disadvantages one may note a low level of exploration of the problems connected with realization of antenna systems, that finally becomes the basic factor. Therefore the second electrodynamic problem is practical realization of the antenna system as it forms the required radiation and also carries out primary processing of radio signals in a multibeam radio channel.

Novelty and originality of the proposed way of the stated problems solution consists in construction of receiving antenna systems, taking into account the fact that in the points of reception the field of complex polarization structure is formed as a result of multibeam propagation of electromagnetic waves. Thus the omnipolarization antenna systems are proposed [3] with the help of which there exists an opportunity to control not only directional characteristics but also polarization structure of the field independently.

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HOMOGENEOUS LINES WITH ARBITRARY LOSSES UNDER EXPOSINUSOIDAL EXCITATION

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Results of researches on application in the field of telecommunications of the phenomenon of active power appearance in reactive elements in an electric circuit have shown the opportunity to use the above-stated phenomenon in distributed parameters circuits. In the field of distributed parameters circuits the greatest interest is represented with homogeneous lines, i.e. the lines having along their length identical primary parameters [1].

In report [2] questions of modeling of the above-stated lines and also the questions of passage of exposinusoidal signals through such lines modeling are considered in details, however the researches which have been carried out in the specified work, are limited to consideration of homogeneous lines without distortions [3], and general research of lines with arbitrary losses were not carried out, therefore the purpose of the given report is to show the results of the research of a homogeneous line with arbitrary losses under exposinusoidal excitation.

As a result of the carried out researches expressions for secondary parameters of a homogeneous line are given for expofunctional excitations of the given line. Also the carried out experiments have proved the deduced expressions for the value of parameter λ determining, necessary for full compensation of arbitrary losses in a homogeneous line under expofunctional excitations,

$$\lambda = \frac{RC + GL}{2LC}, \tag{1}$$

where R, L, C and G — primary parameters of the line.

Research of amplitude-frequency characteristic (AFC) of a homogeneous line with arbitrary losses under exposinusoidal excitation showed the results presented in fig. 1. In fig. 1 top characteristic corresponds to AFC of a lossless line (length of a line is 40 km), the bottom characteristic corresponds to AFC of a line with losses, and points on the top characteristic show the measured values of AFC of the given line under exposinusoidal excitation.

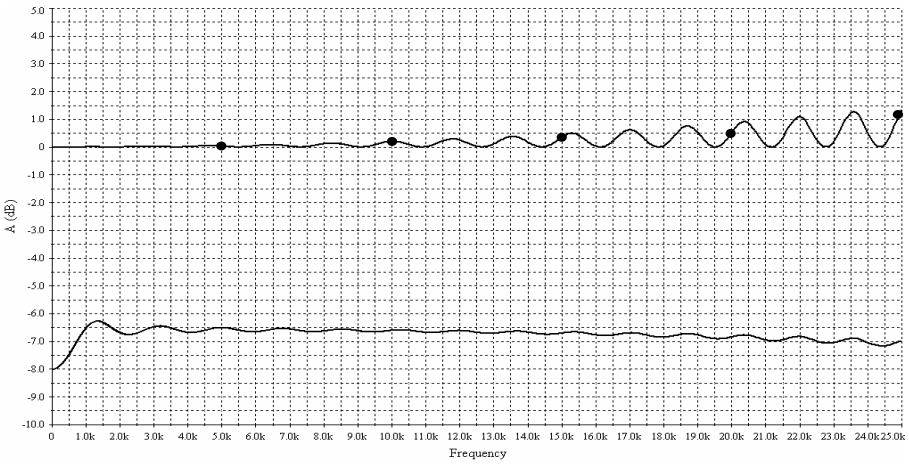

Figure 1 - AFC of a line (modeling).

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[2] Elements of practical application exposinusoidal signals: The report on SRW (Code «Zastosuvanya») / Odessa National Academy of Telecommunications named after A.S.Popov; GR №0107U001778. – Odessa, 2007. – 65p.

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GOOD QUALITY OF THE RECTANGULAR FLOW RESONATOR WITH PARTIAL DIELECTRIC FILLING AT STRONG CONNECTION

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In techniques of microwave frequency constructions with the dielectric loading widely use. In the presented paper partially filled rectangular flow resonator at strong connection by dielectrics with various properties, a geometrical structure and a positional relationship is considered.

The calculation of such devices parameters is a very interesting and complicated electrodynamics problem, especially, if to consider complex character of dielectric inductivity of inhomogeneities.

At present their calculation as a rule is done by the circuit theory methods presenting an element in the form of different connections of elements with lumped parameters regardless of a dielectric filling geometry.

In the given paper the calculation of a rectangular flow resonator with a partial dielectric filling at strong connection is done by the method of partially intersected fields using the integral equations of microscopic electrodynamics. This method enables to take into account both a dielectric element parameters and its geometric form.

As mathematical model the rectangular flow resonator with partial dielectric filling at strong communication containing two dielectric element of a cylinder shape with given dielectric inductivities was chosen (Fig.1).

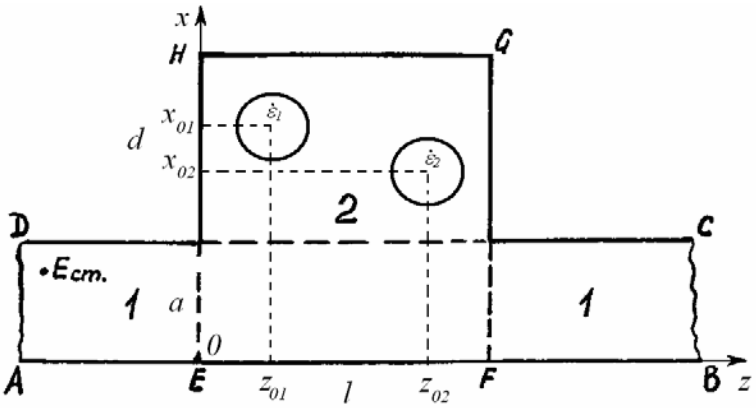

Figure1. The rectangular flow resonator with partial dielectric filling at strong communication

The method of partially intercrossed fields allows to calculate quality factors of various Hm0n types of oscillations for arbitrary number of the dielectric inhomogeneities depending on their placement in the resonator, a dielectric inductivity, the geometrical shape, and also the sizes of the rectangular resonator.

The design procedure of full energy reserved by the resonator, power of wall losses of the resonator, power of losses in partial dielectric filling, the radiated power given by the resonator in external devices is offered. That in turn allows to calculate the loaded good quality of the rectangular flow resonator with partial dielectric filling at strong communication.

SPATIO-TEMPORAL VARIATIONS OF THE POYNTING VECTOR IN THE NEAR ZONE OF TRANSMITTING ANTENNA

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The modern level of development and general use of radio devices of different purposes reveals the problems of their operation both in presence of other radio devices — electromagnetic compatibility and in presence of biological organisms — electromagnetic ecology. The key factor in the solution of the mentioned problems is the calculation and analysis of the electromagnetic energy flux density at an arbitrary distance from transmitting antenna including its spatial distribution in a particular time moments.

Some results close in subject are presented in [1], where the attention is focused on the temporal variation of the Poynting vector. The goal of the present research is derivation of general expressions for calculation and analysis of the averaged value of the Poynting vector at an arbitrary distance from transmitting antenna and also the numerical modeling for qualitative and quantitative comparing of the results including comparing to the known ones.

The novelty of the presented results consists in derivation of general expressions characterizing spatial distribution of the electromagnetic energy flux density with an arbitrary spatio-temporal structure. For the purpose the vectors of electric field intensity and magnetic field intensity were first resolved on the orts' directions in the spherical coordinate systems and then the cross product of the vectors was found. After this the mean and variation terms of the Poynting vector were found out with its subsequent temporal averaged value calculation.

The results of the derived expressions analysis and the results of modeling are also presented in the report. The main conclusion of the research consists in the necessity of the consideration of variation components of the Poynting vector that leads to the widening of the borders of sanitary-hygienic zones around transmitting antennas.

As an example the near field of the symmetric electric dipole was considered. The picture of the streamlines and distribution of the amplitude of the Poynting vector are shown in fig. 1 and fig. 2 correspondingly.

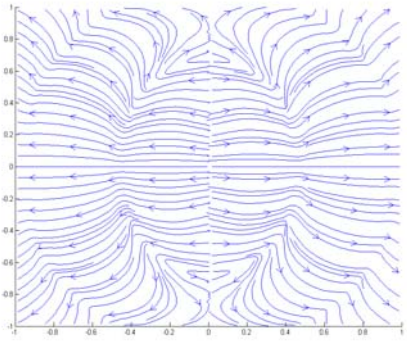

Figure 1 – Streamlines of the Poynting vector

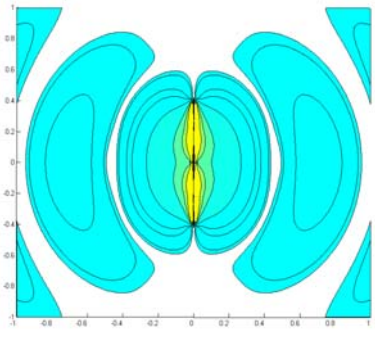

Figure 2 – Amplitude of the Poynting vector

1. *Gaynutdinov T.A.* Calculation of the averaged value of the energy flux density in the near zone of antenna / T.A. Gaynutdinov, G.A. Erohin, V.G. Kocherzhevsky, A.A. Petrovsky //Elektrosvyaz. — 2000. — № 12. — p.39 – 40.

REFLECTION FROM MATCHING SECTION LOADED BY INCLINED CONDUCTING SAMPLE IN REDUCED CROSS-SECTION RECTANGULAR WAVEGUIDE IN SECTION DECRISE WAVEGUIDE

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A number of measurement techniques are known for study of superconductor complex conductivity σ and its dependence on temperature T in microwave frequency range. The resonance methods of measurement use different type of resonators with superconductor specimen located in resonant microwave field. The method allows one to investigate dependence of $\sigma(T)$ only in resonance frequency, however when $T > T_c$ sensitivity of the method strongly goes down.

The non-resonant methods of measuring are based on use of specimen placed in transmitting line, such as waveguide or strip-line. The measurement of superconductor in wave pass mode allows one to provide the measuring in broad enough frequency range and when $T > T_c$, but it needs very thin specimen. Its thickness must be less then a field penetration depth. If to use the method of wave reflection from specimen the reflection coefficient Γ from such a specimen changes not enough in order to provide a measuring with sufficient accuracy.

Recently in IRE NAS of Ukraine a new non-resonant method of measuring of $\sigma(T)$ was proposed and it is developed actively at the present. The approach allows one to increase sensitivity and, consequently, of $\sigma(T)$ accuracy measurement of conducting samples [1]. In this method the specimen is placed in E-plane of rectangular waveguide under angle near Brewster one, which allows realizing grazing incidence of parallel polarized EM wave onto the sample under test. Decrease of the waveguide cross-section allows reducing area of the conducting sample under study and increasing an angle of EM wave incidence without specimen area increase. The latter will allowed to increase the sensitivity of the method, because the angle of incidence will be close to Brewster angle. The waveguide cross-section decreasing needs careful elaboration of a section for optimal matching of two waveguide, namely a standard waveguide and a waveguide of reduced cross-section.

By means of numeric method the Γ from tapered section with various forms of cross-section loaded by ideal load was obtained. Here the tapered waveguides had various functions of cross-section reduction against a longitudinal coordinate. Through the numeric experiment results the section with the best characteristics was chosen. Then the Γ was obtained for the matching tapered section loaded by conducting specimens with various conductivity placed under various angles in decreased cross-section waveguide.

In result the coefficient Γ was obtained using the specimens with various conductivity, various incidence angles and various waveguide cross-sections. It was established, that using reduced cross-section waveguide and placing the specimen in it with a bigger angle, than in standard waveguide, method sensitivity increases 2 or more times without specimen area extension.

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CIRCULAR LOOP ANTENNA NEAR THE FINITE CONDUCTING CONE

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Abstract. The scattering of the axial-symmetric TE-wave produced by the circular loop antenna near the finite cone is investigated using the anaytical regularization method. The characteristics of the far field pattern and the distribution of the radiation power are analysed. The physical effects connected with electromagnetic wave radiation by the electrodynamic system "finite cone-circular loop antenna" are studied.

Introduction. The interaction of electromagnetic waves radiated by the circular loop with the finite cone has potential applications in the field of antenna engineering. Accounting for the importance of such structures in the wide range of problems arising in technical physics as well as for the complexity of the analysis of the corresponding diffraction processes, in this paper we investigate the electromagnetic wave scattering by a finite metallic conical screens rigorously using the analytical regularization technique. The problem of exitation of finite cone surfaces by the system of loops is very important in the contemporary antenna science. We can model the necessary field distribution using different sources configuration. The considered approach is based on an exact analytical inversion of asymptotic of the infinite system of linear algebraic equations.

Statement of the problem. Let us consider the finite conical screen

$$\mathbf{Q}: \{r \in (0,c);\ \theta = \gamma; \varphi \in [0, 2\pi)\}$$

in spherical coordinate system (r, θ, φ). Cone $\mathbf{Q}$ is excited by an axial symmetric H-polarized electromagnetic wave $(H_r, H_\theta, E_\varphi \neq 0)$ produced by the ring source located at the the conical axes $J_\varphi = I_\varphi r^{-1} \sin^{-1}\gamma\, \delta(r-l)\delta(\theta-\gamma)$, where I_φ is the current amplitude and (l, γ) are the source spherical coordinates. The problem is reduced to the infinite linear algebraic system of the second kind.

Numerical calculation. We have computed normalised radiation power as a function of parameter $h = kl\cos\gamma$, which characterises the loop antenna location on the conical axes, and the electric far field pattern $D(\theta) = \lim\limits_{r\to\infty} | r\, E_\varphi(r, \theta) e^{-ikr} |$, for different geometrical parameters of the electrodynamic system. We analize the the radiation power oscillations when the geometrical centre of loop antenna moves along the conical axes and investigate the far field patterns for the case when the radiated power has the local maxima and minima. The dominant peak of far field pattern as well as the small oscillation peaks covered the observation area that correspond to the local radiated power extremum are investigated.

Conclusions. In this paper we have analyzed the axial symmetric diffraction for a finite cone excited by the circular loop antenna rigorously using the analytical regularization technique and have investigated physical effects connected with electromagnetic wave radiation of the electrodynamic system "finite conical surface – circular loop antenna".

MODELING OF A PERIODIC IRIS-LOADED CIRCULAR WAVEGUIDE H_{0l} – EIGENWAVES

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Though a periodic iris-loaded circular waveguide (PICW), Fig.1, since long as has found a number of quite important practical applications, e.g. in the particle acceleration technique (the waveguide sections of the linear accelerators of electrons [1, 2], the particle separators [3]), its electromagnetics theory is still far from completion. It is so even as regards the eigenwave mode of the waveguide [2,4].

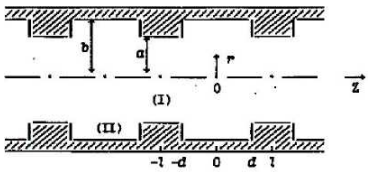

Figure.1 Periodic iris-loaded circular waveguide

PICW is a representative of the vast class of periodic-boundary structures with a great complexity of their guided-wave processes. Quite successfully, those processes yield only to rigorous computations. The first stage of such a rigorous study of PICW eigenwaves is given in [4], with all the required terms and notions to be employed.

In this work, the effect of PICW geometric parameters on its H_{0i}-eigenwaves is characterized. For this purpose, one large (l=3) and one small (l=0.75) [4] PICW period values are treated for a wide and a narrow cells d each, as radius a is optimally varied. The PICW dispersion curves are modeled/compared with those of the smooth circular waveguide, and certain physical conclusions are arrived at.

For instance, when the period value is large and cell wide, b=3, l=3, d=2.8, some regular waveguide modeling r=b features are in relevancy. When b=3, l=3, d=0.3 or b=3, l=0.75, d=0.2, there is some regular modeling with r=a. When b=3, l=0.75, d=0.65, the regular waveguide modeling generally fails.

The results of the modeling quite meet the PICW eigenwave general characteristics of [4].

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EXPERIMENTAL INVESTIGATION OF THE ELECTROMAGNETIC WAVE DIFFRACTION ON THE COMPLEX SHAPE ELEMENTS GRATING

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Now the researches take an interest in the chiral structures of the complex shape elements. The gratings included such elements possesses a lot of properties depended on the shape of the grating elements and the method of the grating elements including. Possessed a lot of interest electromagnetic properties, the chiral materials can be widely used in microwave technique. The principal property of the chiral medium is the cross-polarization phenomenon. The frequency and polarization selective filters, the polarization changers, frequency selective shields can be constructed with the help of chiral materials using.

3D grating consisted of two copper strip element located on layers dielectric surfaces. The elements are connected by the copper wires. The dielectric is glass fiber plastic.

The transmission and reflection coefficients were measured by two-position bistatic method. To decrease the static error influence the method of the signal information accumulation in time domain and averaging were used.

The normal incidence transmission coefficient of the chiral grating was experimentally measured in the bandwidth 26-37 GHz. The incident wave is a quasi-plane linear polarized wave.

The frequency dependences of the transmission coefficients for the grating and its components (one-layer grating, and non-connected two-layer grating) are presented. The connection between the strip elements results in the resonance regions displacements to the long-wave region.

The frequency dependences of the transmission coefficients for different angles of the grating turn with respect to the incident wave direction. The principal difference between the transmission coefficients during the grating turning is consisted in the signal level changing (the frequency dependence do not change).

The frequency dependence of cross-polarization characteristics of the transmission coefficients was obtained. From the obtained data one can see that the structure can transform the linear polarization to the elliptic polarization. The major semiaxis of the polarization ellipse is collinear to the incident wave direction in the explored bandwidth.

The frequency dependence of the elliptic coefficients was measured. There is the pronounced maximum on the 34GHz.

Now the reflection field characteristics are investigated.

EFFECTIVE SMOOTH-WALLED SPLINE-PROFILE HORN FOR RADIO ASTRONOMY APPLICATION

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Over the past few years, a number of single-reflector radio telescopes have moved towards a multi-beam mode of operation, allowing essentially to expand the field of view and to achieve the reception of multi-pixel radio images of some extent of the sky area without mechanical scanning. For the realization of such a mode of operation, a multi-beam receiving array with elements as densely packed as possible is required to avoid a map under sampling. In the present paper simulated characteristics and test results of a compact and efficient smooth-walled spline-profile horn for radio telescope RATAN-600 are presented.

The traditional corrugated horn with a linear profile is widely used in radio astronomy and is effective enough, but the corrugation-depths add to the overall cross-section size of the element and, for array applications, restricts the possibility of packing the elements close to each other. The smooth-walled spline-profile horn hasn't this imperfection and its characteristics are close to the corrugated horn [1]. Shaping the profile with a spline allows us to optimize the radiation pattern characteristics and the horn size.

In terms of the array geometry and the optical schemes of radio-telescope we can formulate the following requirements to the horn: bandwidth 30-38GHz, beamwidth on the level-10dB should be about 80º, the side lobe level should be less than -25dB, a target cross-polarization level lower than -20 dB and a stability of the phase centre should be within the limits ±2mm. The main design constraint for this application was that the aperture size of the horn was limited to about $1.6\lambda_0$.

The smooth-walled spline-profile horn prototype was optimized, manufactured and tested. To calculate the radiation pattern and S-parameters, we use the proven accurate mode-matching method. The minimization is done via a quasi-Newton method in which the derivatives are approximated by finite difference. All requirements to the horn noted above have been satisfied.

Experimentally were measures the following parameters: return losses (S_{11}) and radiation pattern at the E/H/45^0-planes at the highest frequency 38GHz. The measured and simulated beamwidths at different levels are given in the Table 1 which demonstrates a good agreement between the theoretical and experimental results.

	Simulation			Measurements		
Level	E-plane	H-plane	45^0-plane	E-plane	H-plane	45^0-plane
-3dB	35.8^0	42^0	38.6^0	37^0	40^0	38^0
-10dB	62.8^0	77.2^0	68.8^0	59^0	76^0	70^0
-20dB	82.5^0	111.6	94.8^0	79^0	114^0	96^0

Table 1. Beamwidth at levels -3/-10/-20dB.

The characteristics of the smooth-walled spline-profile horn as a feed of the radio telescope RATAN-600 were measured in June. There was sun's passing curve and the fine structure of the sun (so-called the radio-granulation). These measurements and the following observations of the Sun showed high aperture efficiency and characterizes the efficiency of the horn comprised in the array configuration. We keep in mind the small both the direct and return losses as well as a stability of the phase center.

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THREE-AXIAL MEASURING INSTRUMENT OF THE MAGNETIC FIELD

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The important factor influencing electromagnetic compatibility of radioelectronic equipment, and also at carrying out of high-precision measurements is the magnetic field created by various sources (power cables, electromotors etc.) and a natural magnetic field of the Earth. One of possible methods of the account of a magnetic field is its measurement on three axes X, Y and Z. In the report the possibility of construction of a demanded measuring instrument on a basis of the magnetoresistive sensors of firm Honeywell and a principle of its action will be considered.

At the heart of a principle of sensor's action anisotropic magnetoresistive effect (AMR) lays, which consists at the ability of the long permalloy (NiFe) films to change the resistance depending on mutual orientation of a current proceeding through it and a direction of its vector of magnetisation.

For construction of a demanded three-axial measuring instrument association of two sensors is necessary: two-axial HMC1022 and one-axial HMC1021. It is necessary to arrange the one-axial sensor in a plane, perpendicular to an arrangement of the two-axial sensor.

It is expedient to use the CAN-interface for data transmission at the computer for the purpose of their further processing. CAN-interface possesses following important advantages: work possibility in a mode of rigid real time; high stability to hindrances; a wide range of speeds of work.

Also important advantage of the given protocol is possibility of easy connection of additional gauges to a CAN-network for the purpose of magnetic field measurement at the different space points on removal to 500 m, for example, in different premises.

The measuring instrument block diagramme is presented at figure 1.

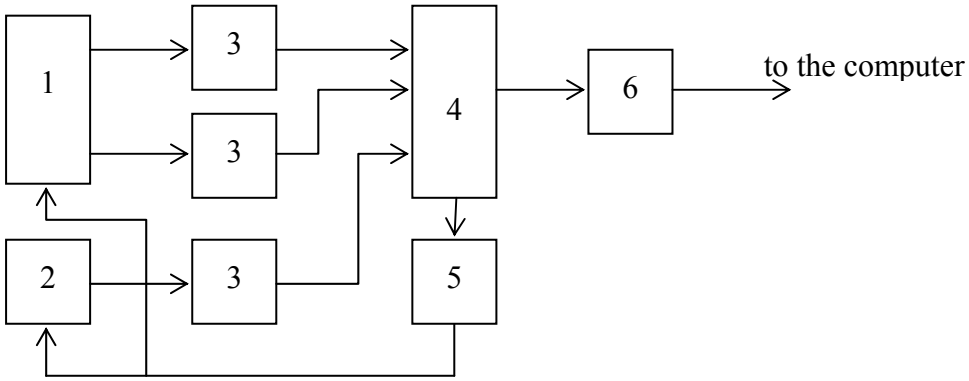

Fig. 1 — The measuring instrument block diagramme

1 — Two-axial magnetoresistive sensor
2 — One-axial magnetoresistive sensor
3 — Operational amplifiers
4 — the Microcontroller
5 — the dump-installation Scheme
6 — the CAN-interface Driver

Thus, possibility of creation of cheaply high-precision device for magnetic field measurement is represented. Also the given device can find application in other areas, for example, as the course gauge on a magnetic field of the Earth.

H10 WAVE DIFFRACTION IN A RECTANGULAR WAVEGUIDE WITH IMPEDANCE NARROW WALLS PARTIALLY FILLED WITH DIELECTRIC

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A joint of waveguides with the different dielectric filling is the element of a number of waveguide arrangements. There is of interest a case, when are joined regular and non-regular waveguide partially filled with dielectric, narrow walls of which are impedance, for example, formed the secondary side waveguides. Thus, in general case, impedance is complex, which allows taking into account losses in walls.

H_{10} wave is the basic type of waves which can propagate in areas for both sides from a joint. The considered diffraction problem consists of determination of the system physical performances at the incidence on the joint of H_{10} wave from the side of regular waveguide, which is considered single-mode.

In the present paper by the matching method [1] a solution has been obtained for problems of the H_{10} basic wave diffraction at the joint of a regular and non-regular waveguides, partially filled with dielectric.

Presently the different variants of projection methods are successfully used for the decision of the most various waveguide problems. The offered variant of projection method is analogical to that which is developed in the work [2], as and in this case as basis functions, unlike other variants of the method, are used the eigen-functions of regular and non-regular waveguides which are matched together on the joint of these waveguides. Due to it a problem is taken to the solution of the infinite system of the second family linear algebraic equations, having undoubted advantage before the systems of the first family.

As a result of numeral solution the values of transversal wave numbers and propagation constants of non-regular waveguide partially filled with dielectric have been obtained, which at complex impedance are also complex. Numeral results showed that in the given structure propagate both bulk and surface dielectric waves

The solution of the algebraic equations system allowed to calculate reflection coefficient and transmission factor and to determine their features at the change of value and reactivity of walls impedance, and also parameters of dielectric plate (dielectric permeability and fill factor). The calculated reflection coefficient and transmission factor enabled to define important diffraction (energy) response of waveguide is a transformation coefficient of H_{10} wave in a wave quasi-H_{m0}.

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NONLINEAR ELECTRODYNAMICS IN THE REDUSED DESCRIPTION METHOD

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The Bogolyubov-Peletminsky redused description method is widely used at construction of sentineling equations for the parameters of description of the macroscopic systems [1]. In particular, at construction of nonlinear electrodynamics equations taking into account field fluctuations [2]. In this paper the method of redused description of the nonequilibrium states is applied for consideration of the electromagnetic field (EMF) in a nonrelativistic thermostat from the charged particles of a few sorts. In quality of parameters of the EMF description strangth of the electric field $\vec{E}(\vec{x},t)$ and vectorial potential $\vec{A}(\vec{x},t)$ in the Hamilton gauge are selected, which satisfy the Peletminsky-Yatsenko condition [1], that is had oscillated dependence on time. The main idea of the paper consists in the selection of harmonious oscillations with frequency ω_k characteristic for a select process as main description of the EMF time evolution. For this purpose at construction of perturbation theory the following main EMF hamiltonian is select [3]: $H_0 = \frac{1}{8\pi}\int d\vec{x}\left(\vec{E}^2(\vec{x}) + \frac{1}{c^2}\int d\vec{x}'\omega^2(\vec{x}-\vec{x}')\vec{A}(\vec{x})\vec{A}(\vec{x}')\right)$. Proper to the interaction EMF with a thermostat hamiltonian $H_{\text{int}} = -\frac{1}{c}\int d\vec{x}\vec{j}(\vec{x})\vec{A}^2(\vec{x}) + \frac{1}{8\pi}\int d\vec{x}\left(rot\vec{A}^2(\vec{x}) + \frac{1}{c^2}\Omega^2(\vec{x})\vec{A}^2(\vec{x}) - \frac{1}{c^2}\int d\vec{x}'\omega^2(\vec{x}-\vec{x}')\vec{A}(\vec{x})\vec{A}(\vec{x}')\right)$ is considered small. Here $\vec{j}(\vec{x})$ is the current of free charges, $\Omega^2(\vec{x}) = \sum\frac{4\pi e^2 n(\vec{x})}{m}$ there is plasma frequency (sum on the sorts of charges). In the interaction picture vectorial potential is such as: $\vec{A}(\vec{k},\tau) = \cos(\omega_k\tau)\vec{A}(\vec{k}) - c\sin(\omega_k\tau)\vec{E}(\vec{k})/\omega_k$. The use in the current following after the second aproximations is considered in an electrodynamics as the account of non-linearity, that will give the high degrees of strangth and potential of EMF. But absence of nonequilibrium correlations among the parameters of the EMF description is assumed. Only in this case it is possible to get rid of dependence of current on the magnetic field (whether vectorial potential) through equation of bond, that will result in expression of potential in interaction picture only through strangth. Thus, using expression for the third approximation and the next approximations, we can express the phenomenological coefficients of dielectric permeability and receptivity of medium through correlations of electric currents. In agreement with the Peletminsky-Yatsenko condition we search the solution as a plane monochromatic wave, that after the Fourier transformations gives $\vec{E}(\vec{k},\omega) = \vec{E}(\vec{k})\frac{1}{2}\left(\delta(\omega-\omega_k) + \delta(\omega+\omega_k)\right)$. The kinetic coefficients of proportion at the parameters of the EMF description in a current are found. Within the second order an electric current is linear on EMF. First by the Bogolyubov-Peletminsky method dispersion equations are found not only for short transversal waves but also for long-wave and low-frequency, both longitudinal and transversal EMF. Permeability, that is expressed through the Green functions, is coincided with obtained from other methods. For nonrelativistic limit it is possible to rewrite the interaction hamiltonian through operators of strangth of the field [2], that the type of equations of nonlinear electrodynamics gives absolutely identical to phenomenological.

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DEVELOPMENT OF THE TERMOPHOTOVOLTAIC AS AN ENERGY-SAVING TECHNOLOGY

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Termophotovoltaic (TPV) generation of the electric energy takes place due to conversion of infrared radiation of the heated objects with the help of semiconducting converter.

The using of the heat, which is emitted in the high-temperature technologic processes, could become the huge market for termophotovoltaic. A lot of sectors –production of glass, aluminium, ceramic products – is vainly lost as a troop landing in an atmosphere. Development of the systems of utilization of the given heat can open new possibilities of the commercial use of termophotovoltaic.

In the real terms of work termophotovoltaic transformers are disposed in a direct nearness from radiants, which have a high temperature, that can lead transformers to the rise of temperature. Considering this, the analysis of influencing of temperature of exploitation is executed on the output descriptions TPV – transformers with the use of the real spectral descriptions of the known filters IR – radiations, influence of temperature of exploitation on basic electrophysical properties of transformers is definite. For the receipt of quantitative estimations influencing of increase of temperature of substrate is analysed on all components of the algorithm of the computation efficiency on an example the InN and GaSb. Got results show more weak dependence efficiency from the temperature of transformer for InN comparing with GaSb. Possibility of the using InN at the promoted temperatures of exploitation is shown, and also it's advantage before TPV – by transformers on the basis of antimonida gallium is shown.

Obviously, for the commercial use notoriously more low launch power TPV – the elements intended for utilization IR – radiations of high temperature processes, must be compensated by the decline of the cost of TPV – element. For the creation of TPV – systems, transforming the thermal radiation of high temperature technological processes, expediently application both simple technologies, and rather inexpensive semiconductor materials [1].

Most acceptable, in our view, is construction of the separately made structures optimized on a spectral sensitiveness and united between itself in a tandem. Possibility of wide choice of materials for every element is undoubted advantage. The necessity of concordance of properties of materials between itself falls off, as every element can be made separately, whereupon construction is clamped mechanically. However there are some difficulties in realization of such charts. One of them – increase of resistance and optical losses. The decline of losses can be attained by brightening of back surface of overhead element and facial surface of lower element, and also connection of these elements through an optical environment with the large index of refraction. In the given direction the row of computations for determination of efficiency of such systems is conducted, and also choice of materials suitable for exploitation in the indicated terms is made.

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OSA/SPIE SEMINAR FOR YOUNG SCIENTISTS AND STUDENTS ON NANOPHOTONICS & METAMATERIALS

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OPTICS AND PHOTONICS

COMPUTATIONAL AND EXPERIMENTAL ELECTROMAGNETICS

BIOPHYSICS

NATURE OF DIFFERENT EFECTS OF Mg^{2+} AND Ni^{2+} IONS ON AU→A2U (2→3) TRANSITION OBSERVED IN PHASE DIAGRAMS OF THESE ION COMPLEXES WITH POLYA·POLYU.

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At present it is ascertained that double- and three-stranded oligo- and polynucleotides are of biological functionality [1], that makes urgent studies on their complexes with metal ions. Contamination of the environment with the latter can result (under adverse conditions) in irregularities of the normal functioning of biological macromolecules [2].

Earlier, upon examinations of phase diagrams of Mg^{2+} and Ni^{2+} ion complexes with polyA·polyU, qualitatively different effects of these ions on the 2→3 transition temperature were revealed: Mg^{2+} ions lower the temperature while Ni^{2+} ones increase it [3,4].

Performed in the frames of the equilibrium binding theory [3], thermodynamic analysis revealed that the expansion of the AU existence region in the presence of large Ni^{2+} concentrations is induced by the fact that difference between binding constants of these ions with AU and polyA is larger than that between association constants of these ions with A2U and AU. Accordingly, opposite ratios in the difference between constants of Mg^{2+} ion binding to these polynucleotides lead to widening in the region of the stable existence of three-stranded A2U. Effective constants of Ni^{2+} ion binding to AU and A2U are determined, as well as enthalpies of 2→3 and A2U→AU (3→2) transitions.

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THE REPRESENTATION OF THE DNA DOUBLE HELICAL AXIS AS A BROKEN LINE WITH A MINIMUM NUMBER OF SEGMENTS

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The shape of DNA is known to play an important role in the processes of molecular recognition. The binding of biologically active substances and proteins to DNA by means of intercalation or in the DNA grooves often causes the bend of the helical axis. In the literature, the smooth bend and sharp bend of DNA or kink are distinguished. The kink is defined as a distortion of base stacking in the DNA helical step. This term is usually used for the description of double helix bend. However, the bend due to the stacking distortion in one helical step can be compensated in the neighbouring helical steps as a consequence of which the global helical axis will be almost straight. At the same time, for the understanding of the recognition processes, it is important to know the number of DNA helical axis bends and their location.

In this study, the problem of representation of the global helical axis of B-DNA as a broken line with a minimum number of segments was considered. The interior points of this broken line describe the bends of the DNA helix. The solution of problem consisted of two stages: on the first stage, the points of the DNA global helical axis were determined, and on the second stage, the approximation of these points by the broken line with a minimum number of segments was done. The following methods were used for the construction of global helical axis points: by the centroids of base pairs, by the mean normals to the base pair planes of the DNA helical step, by the C1'-C1' and N1(Y)-N9(R) vectors, and by the origins of reference frames attached to base pairs. For the approximation of the obtained points, the following algorithms were proposed: the method based on the correlation coefficients, the method of the maximum angle between the broken line vectors and the method of the minimum average distance. The comparative analysis of these methods was performed. The method of the minimum average distance was chosen as the most effective one. The examples of this method application to a number of test cases are given.

SPECTROSCOPIC INVESTIGATIONS OF PROFLAVINE INTERACTION WITH DIFFERENT BASE COMPOSITION MATRIXES

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It is known that binding mode of ligand with polynucleotide matrixes depends on theirs base composition. There are many investigations of proflavine – DNA interaction, but the information about ligand selectivity is still not clear. Absorption and luminescent spectroscopy are used for investigation of interaction of proflavine with calf thymus DNA and model at different DNA – ligand concentration ratio (P/D).

From the spectrophotometric data we calculate binding parameters of proflavine using the optimization program DALSMOD. We obtain binding constants, binding site size and relative concentrations of complexes in the proflavine – polynucleotide mixture. The interaction parameters of proflavine depend on base composition of matrix.

By the method of luminescent spectroscopy we show that the ligand binding mode differs on base composition of matrix. Proflavine interaction with polyG·polyC results in significant luminescence quenching, and interaction with polyA·polyU leads to increase of intensity. The dependence of quantum yield on P/D is complex for natural DNA.

In the present work we try to determine the contribution of complexes formed on different nucleotides in total spectral changes which accompany binding with DNA.

INVESTIGATION OF ALKALI MONOVALENT IONS INFLUENCE ON THE LIGAND-DNA INTERACTION

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The most studies of how various drugs can interact with DNA molecule carried out basically consider forming only one type of complex between DNA and ligand. Nevertheless, recent investigations proved that intercalating drugs can interact with DNA matrices by forming different thermodynamically and spectrally modes of complexes. Undoubtedly, availability of several types of complexes complicates determination of binding parameters for each complex. Moreover the presence in the DNA-ligand mixtures different monovalent ions, which can play the role of competitors of binding sites, can influence on relative concentration of forming complexes and considerably complicate calculation of their spectral and thermodynamic characteristics. In that case we consider monovalent ion as competitor ligand using models allowed describe complexation process and carry out exact calculation of equilibrium composition in the tripartite systems monovalent ion-basic ligand-DNA.

Spectrophotometry titration in visible region was used to investigate complexation processes in the systems DNA-actinocine derivative (ActII*) analog of antitumor agent actinomycin D in the presence of different concentrations of Na^+, K^+ and ammonium ions. In contrast to usual used methods at such analysis (constructing Scatchard's plots and other simple methods) we used in optimization programs whole set of obtained spectral data and determined binding parameters considering forming several types of complexes.

Using competitive binding model we obtained binding constants of different types of monovalent ions with native and denatured DNA. Besides, in the process of optimization thermodynamic and spectral binding parameters of ActII* with native and denatured DNA were obtained and influence of different types of monovalent ions on amount of forming complexes was determined. In the examined models influence of monovalent alkali metal ions (as competitors) is consider for both types of complexes of dyed marker – actinocine derivative either for external and for intercalate binding types.

INDIRECT MECHANISMS OF PROTEIN-NUCLEIC-ACID RECOGNITION: ANALYSIS OF PROTNA-ASA STRUCTURAL DATABASE

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Structural analysis of the nucleic acid backbone in protein–DNA complexes is important for understanding the principles of indirect mechanisms of protein-nucleic acid recognition. Detailed structural data obtained for protein-nucleic acid complexes with available crystallographic coordinates can be found in a number of internet databases. Unfortunately, none of such bases is focused on evaluation of the influence of structural distortions of nucleic acid backbone on DNA/RND propensity to interact whereas such information is important for understanding the principles of indirect readout. In the frame of the reported work, we have analyzed the sequence-specificity of the dependence of the accessible surface area (ASA) of nucleic acids atoms from the DNA backbone conformation on a set of protein-DNA complexes and created a freely-accessible internet database (ProtNA-ASA) where the calculated data have been deposited.

The ProtNA-ASA database (www.protna.bio-page.org) combines the data on conformational parameters of the DNA backbone and calculations of ASA of DNA/RNA atoms for nearly 300 non-homologous DNA/RNA-protein complexes. The database accumulates data files with the following information: (i) crystallographic coordinates of protein-nucleic acids complexes and their separate components *i.e.* proteins, DNA/RNA and crystal water molecules, (ii) structural parameters of DNA/RNA received by 3DNA/CompDNA package [1, 2], (iii) value of the entire ASA of DNA/RNA atoms, and (iv) ASA of DNA/RNA atoms exposed to the minor or major groove. ASA values are calculated using the self-developed software built on the basis of Higo and Go algorithm [1, 3]. Atomic coordinates of the complexes with a resolution less than 2.6 Å are retrieved from the Protein Data Bank and Nucleic Acid Database.

The data collected in the database enabled us to perform a comparative analysis of the DNA backbone structure for free and bound DNA. The study has shown, that alternative *gauche-* and *trans* conformations of the torsion angle γ are ~5 times more frequent in bound DNA than in the free B-DNA, this fact being an evidence of advantages of the alternative γ angle conformations over the canonical ones for the process of complex formations. Analysis of sequence specificity of γ angle transitions demonstrates that the majority of nucleotides in *gauche-* conformation contain thymine; while cytosine fraction is predominant in nucleotides with γ angle *trans* conformation.

In order to evaluate the role of γ angle conformation in the process of protein - DNA interaction, we have studied correlations between ASA of O3′, O5′, and C5′ atoms and γ angle conformation. These atoms are chosen as they are highly important for the process of protein-DNA recognition. The analysis has shown that by transitions into alternative γ angle conformations more ASA of polar atoms and less ASA of non-polar atoms is exposed to the minor groove. These changes are of great biological importance as the majority of protein-DNA interactions in minor groove occur via contacts with polar sugar groups, while in the major groove direct recognition of bases by protein is predominant.

The results obtained demonstrate that conformation of the DNA backbone and the γ angle in particular plays an important role in protein-DNA interactions and thus improve our understanding of the molecular mechanism of indirect readout of the DNA sequence.

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IONIZATION OF GUANINE MOLECULES

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This work is about investigation, strong dissociation of gas phase guanine upon electron impact ionization. Guanine is one of the five main nucleobases and is a derivative of purine. The electronic properties of these molecules play an important role in biochemistry, biophysics, medical chemistry and nano-biotechnological applications.

The ionization energy of the molecule and the appearance energies of the some fragment ions were determined. The ionization efficiency curves of guanine with temperature range 323-478 K were obtained. The experimental setup, used for the studies is based on a monopole mass spectrometer MX7304A with an advanced electron ionizer, has been described in papers [1],[2].
The mass scale was calibrated, using Ar, Kr, and Xe, and appearance potentials for different groups of fragments ions were determined, using a special method of processing of the threshold part of the cross-section by polynomial fit [3]. From the threshold dependences, the fragment appearance potentials were determined.

From these spectra, the evolution of the fragment formation has been traced as well as the effect of temperature on the dissociative ionization.

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ANALYSIS OF LANGMUIR, SIPS, HILL ADSORPTION MODELS

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An important characteristic of adsorption is the binding energy ΔE of ligand to the binding site. The simple model for adsorption is Langmuir model. Binding of ligand to different binding sites occures with the same energy. The function of distribution of energy in such model is expressed as delta function. Another model of adsorption was proposed by Sips [1]. This model describes binding in case of heterogeneous adsorption, when function of distribution of energy resemble normal destribution. Hill's model of adsorption describes n-mer binding to sites [2]. The most general adsorption model is the model described by generalized Langmuir equation [3]. But until now there are lack of papers that consider all the models from one point of view.

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INVESTIGATION OF THE HETERO-ASSOCIATION OF DIMETHYLXANTHINES WITH AROMATIC BIOLOGICALLY ACTIVE COMPOUNDS

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Methylxanthines are one of the most widely consumed by a human compounds, present in food and beverages. It is recognised that methylxanthines can form non-covalent complexes with aromatic drugs, resulting in alteration of their medico-biological action.

With an aim of search for a general pattern of the interaction of methylxanthines with aromatic biologically active compounds (BAC), in the present work an investigation of the hetero-association of the set of dimethylxanthines: Theophylline (THP), Theobromine (THB) and Paraxanthine (PARA) with Daunomycin (DAU), Ethidium Bromide (EB) and Proflavine (PF) has been performed in aqueous solution by means of NMR spectroscopy. Based on concentration and temperature dependences of proton chemical shifts the hetero-associaiton parameters: equilibrium constant, enthalpy and entropy were obtained.

Analysis of the calculated parameters has led to a conclusion that the discrepancy of the hetero-association constants of the investigated dimethylxanthines with BAC appears to be relatively insignificant. However, there is some specificity of PF and EB to THB, and DAU to THP, which comes from comparison of the calculated hetero-association constants. It also follows that the whole set of dimethylxanthines demonstrates the highest affinity towards Proflavine, which presumably, is due to the absence of bulky side chains in the structure of PF as compared to DAU and EB.

Analysis of the thermodynamical parameters of interaction clearly demonstrates the action of the effect of enthalpy-entropy compensation in the energy of the hetero-association. The presence of charge on the chromophore of BAC, as well as the presence or absence methyl group in position 1 of xanthine chromophore, seems contributes negligibly to the total energy of complexation.

DNA AS A NATURAL SELECTOR OF POLARIZATION OF ULTRAVIOLET RADIATION

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From positions of the classical electromagnetic theory [1] the optimum form of a long helical molecule for the most effective interaction with circularly polarized wave is calculated under a resonance condition. Three various methods of classical electrodynamics are used: the theory of dipole radiation of electromagnetic waves [2], the energy approach, and also the helical model of molecules of chiral substance. In all three cases the identical result for the optimum geometrical form of a long helical molecule is obtained. A pitch angle between a helical chain, formed by atoms, and a plane, that is perpendicular to the helical axis, should be equal 24.5 degrees. This condition imposes restrictions on the radius and simultaneously on the pitch of the helical molecule. It is known, however, that the pitch angle of a chain of DNA is equal 24 - 29 degrees (depending on experimental data) [3, 4].

From theoretical calculations also follows, that interaction of a circularly polarized wave with a helical DNA-like molecule is much stronger if the molecule looks like a double helix and it is weaker for an identical single helical chain. Besides, from our calculations follows, that the obtained results are true for any molecular currents in DNA, including for a current of displacement, which most likely takes place in a molecule of DNA. Moreover, from theoretical calculations follows, that property of polarization selectivity of DNA does not depend on its concentration in a solution. It is essential to DNA, in fact, besides influence of the field of an incident electromagnetic wave, molecules exercise electromagnetic influence on each other, which depends on concentration of molecules.

Experimental researches, which have been leaded by us on prototypes of DNA-like molecules in the microwave wave length range, have confirmed conclusions concerning the dependence of the polarization selectivity of DNA on its form. Presence of the effect of polarization selectivity is experimentally confirmed at interaction of right-handed double helices with electromagnetic radiation of left-handed circular polarization. It allows us to draw a following conclusion: possessing the optimum geometrical form, the molecule of DNA is not influenced by right-handed circularly polarized electromagnetic wave in a range $\lambda \approx 7-8$ nm. Such wave, for which the right-handed molecule of DNA is "transparent", should propagate orthogonally to the helical axis and to form in space the right-handed screw. Accordingly, a wave radiated by a right-handed molecule of DNA orthogonally to the helical axis in a range $\lambda \approx 7-8$ nm has the left-handed circular polarization.

The effect of polarization selectivity under the influence of an electromagnetic field is one of determinative for helical objects and is directly connected with infringement of mirror symmetry in natural structures and phenomenon. It can be important at genetic preservation of distinctions between right-handed and left-handed forms of objects in nature.

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RESEARCH INFLUENCE OF DECIMETRIC DIAPASON ELECTROMAGNETIC WAVES UPON STRUCTURAL FEATURES OF WATER

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The influence of the radio waves of mobile phone (ν = 900 MHz, λ = 33 cm,) upon the structural characteristics of water was researched. Proportions of the water clusters, its concentration, water polydispersity were detected with the help of the dimension of angular dependence of laser emission intensity with λ≈0,65 μm, $P_{radiation}$<1 mW scattering with water [1]. Scattering indicatrix was measured in the angular interval $4° \le \Theta \le 90°$ regarding incident emission. Irradiation of spring water was made during various time in interval 1 min ≤ t_o ≤60 min.

It's known that irradiation leads to the unconventional alteration of the structural properties of water. Character of this change depends on influence time t_o and parametres water structural properties .

When the middle-scale (0,4≤ r ≤ 0,9 μm) and the large-scale clusters (r<0,4 μm) were only in source sample water their concentration increased approximately by 55% and ~ 35-40% just after effect when $t_o \le 10$min. It indicates the increasing of the scares light integral intensity.

Important feature of the structural alteration of these sample water except the increasing of cluster concentration with the radius of r = 0,53; 0,40; 0,28; 0,24 μm was the formation when t_o= 10 min large-scale clusters with r ≈ 3,5 ÷ 5,3 μm. The stabilization of the middle- and the large-scale concentration occurred during the increasing of the time irradiation and the concentration of the large-scale centres was decreasing but the last one were not revealed.

The presence of the large-scale clusters with r ≥ 2 μm in the source sample besides the large-scale clusters (with r ≈ 0,73; 0,47; 0,35 μm) stipulated the formation of more large-scale clusters with r_1 ≈ 4,36 μm и r_2 ≈ 7,20 μm after the irradiation in the time interval 1 ≤ t_o ≤30 min and the decreasing of the summary cluster concentration, the most substantial (by ~ 40%) when t_o = 10 min. The increasing of the summary cluster concentration in comparison with the source by 40-60% after the irradiation when t_o = 60 min and the decreasing of the large-scale clusters to r ≈ 2,1 ÷ 2,9 μm took place.

The supposed mechanism of radio wave influence upon the water is brought to the process of vibration synchronization of individual water molecules as well as joined into clusters, that intensifies the process of structurisation. As facts show there is an optimal dose of irradiation, that provides the maximal effect of structurisation.

Forming of big clusters and change of their sizes by temperature changing can be connected with joining by unsaturated hydrogenous ties of small and middle clusters as a result of lessening of distance between clusters by the radio wave influence as well as with their partial destruction caused by dissipative loss.

Possible influence of structure changing of cell water and bioliquid of organism upon health during repeated influence of mobile phone radiation is discussed.

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ELECTROMAGNETIC IMPULSE INTERACTION WITH BIOLOGICAL TISSUES ON THE FLATLAYERED DIELECTRIC AS EXAMPLE

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Quick development of pulse technology of late years states for researchers the problem of investigation of processes and mechanism of electromagnetic impulses interaction with biological objects from the cell level to the human organism. In this paper the process of electromagnetic pulses interaction with biological tissues (skin, fat, muscular tissue) is considered on example of flat layered dielectric. Modeling is based on the problem solution of a pulse wave beam scattering on semispace [1]. Dispersion of the dielectric permeability and the losses related to an imaginary part of the dielectric permeability, we consider by means of the Debye impairment formula [2]. Using this solution time-space forms of reflected and transmitted signals for various incident angles, for arbitrary form and duration of the incident impulse are calculated. Also parameters of reflected and transmitted signals (duration, slope, amplitude) for every boundary are computed. It was calculated that for mediums with dispersion and decay the transmitted signal has amplitude on 2-4 orders lower than for mediums without dispersion and decay [3]. The transmitted impulses durations decrease in comparison with an incident signal, but the account of dispersion and decay conduces to duration magnification at 12-16 % in comparison with nondispersive and not dissipative mediums.

The estimate of the transmitted power in various biological tissue types with the account of dispersion and decay show, that for mediums with dispersion and decay it is about 99 %, and without dispersion and losses it is 95 %. In a fatty tissue there transits one per million part of incident power, and in muscular - on 14 orders it is less, than power of an incident signal. The account of dispersion and losses reduces quantity of past power from 3 orders in a skin to 8 orders in a muscular tissue. So, taking into account results of experiment [4], we can define unsafe levels of incident power for every type of tissues.

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MASS SPECTROMETRIC STUDY OF INTERACTION OF AMINO ACID PROLINE WITH CRYOPROTECTORS BASED ON OXYETHYLATED GLYCEROL DERIVATIVES

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Search for new effective cryoprotectors is an urgent task in connection with the progress of new medicine technologies, including a cell therapy and transplantology. Study of physico-chemical processes occurring in model systems consisting of cryoprotectors and of small biomolecules – monomer components of proteins – amino acids, presents great interest for molecular mechanisms of cryodamage and cryoprotection investigation.

The aim of the present work was the study of solution of an amino acid proline in a new cryoprotector based on glycerol oxyethylated derivatives OEG-5 (which was synthesized in IPCC NAS of Ukraine) by means of low temperature mass spectrometry with fast atom bombardment.

Mass spectra of OEG-5 in the positive ion mode consist of two serieses of protonated oligomers $M_n \bullet H^+$ and cationized oligomers $M_n \bullet K^+$, n= 3-10 (where n is degree of polymerization). Mass-spectra of proline solution in OEG-5 include, along with the serieses mentioned above peaks corresponding to molecular ion proline $Pro \bullet H^+$ and a number of solvent clusters of amino acid with OEG-5 - $Pro \bullet M_n \bullet H^+$, n=3-9.

We have determined correlations between the way how mass spectra change with temperature varyation and physical state of the system. These correlations are in good agreement with data obtained using differential scanning calorimetry [2]. When the temperature decreases, we observe gradual decrease of all ion series intensity. At the T=-50^{o}C viscosity of the system reaches the value, at which whole molecules can not be sputtered from the sample. This leads to ion fragmentation and registration of noise spectrum. On warming of the frozen sample, the opposite tendency is observed, which agrees with formation of liquid phase.

The molecular ion of proline was registered in the whole temperature range of liquid phase exsistance. This and the fact of observation of solvent clusters of the amino acid indicates a positive cryoprotector function – prevention of phase separation in the frozen system.

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THE OBTAINING FUNCTIONAL COVERING OF HIGH GRADIENT FERROMAGNETTIC MATRIX (HGFM) FOR MAGNETIC SEPARATOR

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There is a search for new methods of sewage purification in connection with sharp growth of level of impurity of environment by heavy metals. Heavy metals are extraordinarily toxiferous, repress a large quantity of enzymes - the basic executors of biochemical functions in human organism. Small quantities of heavy metals are capable to lead to physiology gross infringements, are especially vulnerable for nervous and reproductive systems, threat of diseases and mutations is extremely great. Power development also leads to sharp increase in requirement for water. The most part of water comes back in the rivers in the form of sewage after its use for economic-household needs. Association of biological methods of purification with magnetic technologies [1-2] is perspective.

In this connection, HGFM (high-gradient ferromagnetic matrix) has been created. It has a functional covering with the same characteristic sizes of a roughness of a surface, as well as characteristic size of impurities for maintenance of high degree of sewage treatment. Use of the functional coverings obtained at corrosion and electrodeposition gives the chance to receive ferromagnetic matrixes which are components of magnetic filters. It is necessary to make these matrixes with the maximum roughness of a surface. It gives the chance to make water treatment as much effective as possible.

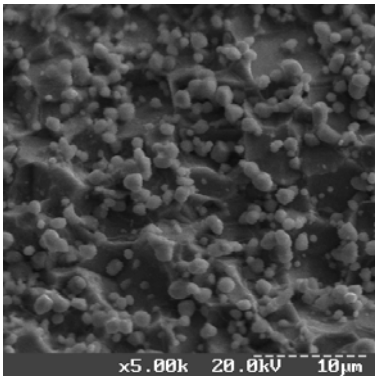

Fig. 1 SEM the surface image - HGFN with a functional surface

The operating efficiency of the HGFM in magnetic filters (Fig. 2) as a primary element for sewage purification is caused by a functional covering which helps to make the greatest possible surface inhomogeneity and surface on unit of volume of a matrix.

The results of study on magnetic field dependence of mass loss and surface roughness (characterized by fractal diminution) allow choosing an optimal external MF value 1600 Oe which results in fabrication of HGFM with maximum surface roughfnes. Such a HGFM has better performance as a consistent part of a high-gradient ferromagnetic filter (separator) for sewage purification than HGFM obtained without MF application under etching process.

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SQ-1 AS A NEW MEMBRANE PROBE RESPONDING TO MODULATION OF PROTEIN-LIPID INTERACTIONS BY PHYSICAL FACTORS

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Increasingly growing use of mobile phones, microwave ovens, personal computer processors and other sources of electromagnetic waves of ultrahigh frequencies makes the problem of biological effects of EMF especially acute. However, despite fast evolution of device technical characteristics insufficient attention has been given to investigation of EMF influence on biological systems at molecular and subcellular levels.

In the present work our interest was focused on evaluating the applicability of newly synthesized squarylium fluorescent dye SQ-1 to detection of the processes induced by microwaves in the model lipid membranes dressed by hemoglobin (Hb). The principal advantage of SQ-1 involves its emission in long-wavelength region where spectral distortion due to intrinsic protein fluorescence and light scattering is negligible.

Although Hb is not a membrane protein it avidly interacts with lipids forming complexes stabilized by electrostatic and hydrophobic interactions which depend on the protein form and conformation. In turn, dye-lipid complexes are stabilized mainly by hydrophobic interactions. While SQ-1 is non-fluorescent in aqueous solution, its binding to the model membranes results in appearance of broad fluorescence spectrum with well-defined emission maximum at 682 nm.

Examination of SQ-1 spectral behavior in the model systems composed of phosphatidylcholine (PC) lipid vesicles and hemoglobin revealed Hb-induced significant decrease of the probe fluorescence. This finding was interpreted as arising from the dye degradation by the free radical products of lipid peroxidation. Judging from SQ-1 fluorescence response, Hb exposure to microwave irradiation with the frequencies of 1770, 1810, 1885, 2000, 2200, 2500 MHz gives rise to the alterations in both the lipid-associating and bilayer modifying properties of the protein. Analysis of SQ-1 fluorescence kinetics allowed concluding that the most pronounced influence on Hb has been exerted by the 1770- and 1885 MHz-irradiation.

The molecular mechanisms of microwave effect on living systems are not yet fully understood. Since the EMFs of above-mentioned frequencies are efficiently absorbed by water, a main component of biological macromolecules, it may be supposed that one of the possible explanations of our findings involve the fact that irradiation stimulates water heating and, consequently, Hb thermal denaturation. However under employed experimental conditions no considerable increase in temperature has been detected. An alternative explanation of the experimental results is direct effect of microwaves on protein conformation which manifests itself in modified spectral properties of SQ-1. It should be noted that microwave-induced alterations in Hb conformation may affect protein functioning as oxygen carrier.

CONTRIBUTION OF CHANGE OF TRANSLATIONAL, ROTATIONAL AND VIBRATIONAL DEGREES OF FREEDOM TO ENERGY OF COMPLEXATION OF AROMATIC LIGANDS WITH DNA

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In this work the method of calculation and analysis of contributions from the change of translational, rotational and vibrational degrees of freedom to the energy of complexation of aromatic compounds with DNA duplex is presented. The results of calculation of thermodynamical parameters (ΔG, ΔH, ΔS) have shown that the changes of translational and rotational degrees of freedom destabilize complexes and the changes of vibrational degrees of freedom stabilizes them, and the energetic contribution from the examined motions is mainly of entropic origin. It was shown that on the whole the energetic contribution from the change of translational, rotational and vibrational degrees of freedom is commensurable with experimental energy of DNA complexation, which requires an obligatory account of these components in energetic analysis of reactions of DNA binding of aromatic molecules. It was found that the total contribution of change of translational, rotational and vibrational degrees of freedom to Gibb's energy of complexation reaction of aromatic molecules with DNA can be taken for different ligands equal to average value 8.2 kcal/mol.

APPLICATION OF MAGNETIC TWEEZERS IN MEDICINE FOR STUDYING AND TREATMENT OF ONCOLOGICAL FORMATIONS

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Search of new and improvement of existing microparticles manipulation methods is one of modern physics directions. These methods find wide application in scientific researches, in different spheres of human activity, particular in medicine. Development of modern medicine requires improvement of treatment methods by delivery of the dosed out quantity of medical preparations directly to a place of an inflammation with using of blood vessels. For today this question remains opened and research of new approaches and possibilities are still going on, therefore using of a magnetic tweezers, gives a chance application of these parts localization methods in medicine. There are such methods of a manipulation parts as: optical tweezers, magnetic tweezers, electrophoresis etc. Unlike of laser tweezers or electric fields which can lead to an overheat of biological objects or start course of dangerous chemical reactions, using of a manipulation technique by microparticles by means of magnetic fields allows to refuse application of these destructive methods. In this connection the new type of magnetic tweezers is offered in the given work. To localize in space a part which is under the influence of a magnetic field, the condition of a point existence where potential energy reaches the local minimum, i.e. created a potential hole should be satisfied. It's impossible for a ferromagnetic part to reach such local minimum in a constant magnetic field [1], so in the given work it's offered to use a variable magnetic field. The transformation method of a local maximum of energy to a local minimum with the help of fast oscillation force, offered by academician Kapitsa [2], gives possibility to solve a question of localization of a ferromagnetic part by means of a fast oscillation magnetic field. For possibility of a new type magnetic trap realization in a liquid stream two conditions is necessary: the first one – the magnetic field force which influence on a part, should be higher than a liquid stream force; the second one consists in oscillation amplitude minimization for more directly positioning of a part in required area. According to these conditions it is possible to keep a part in a blood stream in case when the size of a part represents to 3 microns, the part is made from ferromagnetic with magnetic susceptibility from 0,5 up to 0,8 at frequency of a magnetic field from 200 up to 300 Hz. Essential advantage of magnetic fields conclude that human body fabrics are inert to concerning of magnetic field influence. It provides possibility without harm for an organism to influence ferromagnetic parts which are inside. Results of research confirm, that localization of a part by means of a fast oscillation magnetic field method is possible, but in a certain range of entry conditions. Using of this method gives perspective possibilities of the magnetic tweezers creation which application in medicine will give possibility to become closer to solve a problem of a part delivery in medicine of oncological formation. Such approach will provide preparation action only in a place of fabrics defeat, thereby depriving all organism of destructive influence of a chemical preparation.

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DETERMINATION OF THE MAGNETIC SUSPECTIBILITY OF A BIOSORBENT

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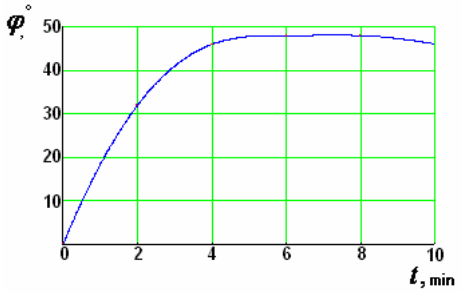
The environmental contamination by the heavy metals and the search of the way of their extraction is one of the most serious problems in the world. The biosorption with using of such materials as bacteria, fungi and algae is considered like a cheap biotechnology for the processing of big amounts of the polluted sewage with the small concentration of heavy metals from 1 to 100 ml/l. Among the methods of biomaterial extraction after the heavy metals sorption the method according to which the biomass is preliminarily assigned the magnetic properties and after the heavy metals ions sorption is precipitated by the magnetic separator is obtaining the development. The nanomagnetite is adding to the suspension in the volume relation 100:1 according to the methods [1] for the assignment the magnetic properties to the yeast *S. cerevisiae*.

The magnetic suspectibility of the obtained complex yeast cells-magnetic marks of the nanomagnetite was determined on the installation which consisted of the electromagnet , flow system and the system of the visualization. The element of high-gradient ferromagnetic nozzle in the form of the spherical metal bead with the diameter 100 micrometers was introduced to the cuvette installed in the air spacing between the pole pieces. The flow of the magnetically marked solution was passing through the cuvette.The magnetically marked cells were precipitated on the single nozzle under the magnetic action which direction of the electric-field vector was paralleled to the velocity vector of the movement of the medium.

The determination of the magnetic suspectibility of the yeast cells-magnetic marks complex was fabricated by the precipitation angle of cells to the high-gradient ferromagnetic element according to the methods [2].The dependence of the magnetic suspectibility of the biosorbent from the time of the mixing of the yeast with the magnetic marks solution was researched in the experiments. The method of the mechanical mixing was used which is simple in performance and relatively cheap. After the tests implementation the dependence between the precipitation angle and the time of mixing of the yeast with magnetite solution was determined.



Pic. 1. Graphical dependence between the precipitation angle and the mixing time

According to the obtained experimental data the optimal mixing time is about six minutes. After the six minutes of mixing of the nanomagnetite with the yeast cells which is shown on the pic.1 the precipitation angle of the magnetically operated biosorbent on the spherical bead are practically not increased which testify that the longer mixing time is not economically inexpedient because it is not leading to the increasing of the magnetic suspectibility of the biosorbent. Since the mechanical mixing demand the expenditure of electric energy the determination of the optimal mixing time is very important factor for the magnetically marked biosorbent manufacturing.

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MODELLING OF TRAJECTORY ORIENTATION OF DIAMAGNETIC UNICELLULAR ORGANISMS IN STRONG MAGNETIC FIELDS

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Many unicellular organisms possess properties of magnetotacsis in applied strong magnetic field. In some cases it is caused by presence in their structure so-called magnetosom - magnetite nanopaticles. However, in a number of experimental works the effect of anisotropic trajectories orientation of diamagnetic monocelled microorganisms in magnetic fields 10 - 15 Tl [1] is observed. The given effect is presumably connected with presence at a diamagnetic monocelled microorganism of magnetic susceptibility anisotropy [1].
In the given work the average corner of microorganisms trajectories orientation calculation on the basis of the statistical approach. Energy of a microorganism an axis of anisotropy of which magnetic susceptibility deviates on corner θ a direction of external homogeneous magnetic field $\vec{H}_0$ looks like:

$$U = \frac{\chi H_0^2}{2} \cdot \cos^2\theta - \frac{H_0^2}{2} \cdot \chi_\perp , \qquad (1)$$

where $\chi = \left|\chi_\square - \chi_\perp\right|$, $\left|\chi_\square\right| > \left|\chi_\perp\right|$, $\chi_\square$, $\chi_\perp$ - longitudinal and cross-section magnetic susceptibilities of a microorganism accordingly.
Then Boltsman distribution on a corner of microorganisms orientation in a magnetic field looks like:

$$dw = b \exp\left(-\frac{\chi H_0^2 \cos^2\theta}{2kT}\right) \sin\theta d\theta , \qquad (2)$$

where normalising constant $b = \dfrac{1}{2\int\limits_0^1 \exp\left(-\alpha x^2\right) dx}$, $\alpha = \dfrac{\chi H_0^2}{2kT}$, $x = \cos\theta$.

Average value of a corner cosine of an axis anisotropy deviation of a biomolecule magnetic susceptibility from a direction of an external magnetic field has been calculated under the general formula:

$$\left\langle \cos\theta \right\rangle = \int\limits_0^\pi b \cos\theta \exp\left(-\alpha \cos^2\theta\right) \sin\theta d\theta . \qquad (3)$$

As a result of averaging procedure by the formula (3) dependence of a corner average cosine of an axis deviation of a magnetic susceptibility anisotropy of a biomolecule from a direction of an external magnetic field has been received:

$$\left\langle \cos\theta \right\rangle = \frac{b}{\alpha}\left[1 - \exp\left(-\alpha\right)\right]. \qquad (4)$$

The formula (4) shows, that with growth of value of intensity of an external magnetic field the corner of an average anisotropy deviation of a biomolecule magnetic susceptibility from a direction of an external magnetic field decreases. Thus trajectories of microorganisms movement should have the expressed anisotropy induced by an external homogeneous magnetic field.

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MOBILITY OF NUCLEOBASES DURING DEHYDRATION OF DNA IN THIN FILMS

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Revealing the structure and features of nucleic acids (NA) in different hydration conditions is important for understanding the principles of DNA packaging, *e.g.* in bacteriophages and viruses, chromatin condensation, as well as for developing practical mechanisms for packaging DNA into cationic liposomes for delivery as gene therapy agents. As there is a limited number of experimental data on dehydrated NA structure [1,2], the aim of this work is to develop a numerical algorithm that models transition of NA from hydrated to dehydrated state and calculate the structural characteristics of NA in several hydration conditions. The study is carried out for double-stranded polynucleotides poly(rA)-poly(rU), poly(rG)-poly(rC), poly(dG)-poly(dC), poly(dA)-poly(dT), and DNA of *M. luteus* (GC 72%) and *Cl. Perfringens* (CG 26,5%).

The model uses experimental data on absorption band frequencies of stretching vibrations of C=O groups of nucleobases at different values of relative humidity [3] and calculations of frequency shifts, caused by coupling of transition dipole of C=O groups in adjacent nucleobases. The algorithm is based on Miyazawa perturbation theory [4] that treats adjacent C=O groups as weakly connected oscillators. According to this theory the frequency of a given IR band, ν, is shifted from the unperturbed frequency, ν_0, by hydrogen bond formation, $\Delta\nu_{hydr}$, and transition dipole coupling, $\Delta\nu_{res}$ as $\nu = \nu_0 - \Delta\nu_{hydr} \pm \Delta\nu_{res}$, where resonance frequency shift may be calculated from the crystallographic coordinates of the structure according to the following formula $\Delta\nu_{рез} = \frac{1}{h}\sum_{n\alpha} C_\alpha^f C_\beta^f V_{n\alpha,m\beta}$, where h is Planck constant; C_α^f и C_β^f are symmetry coefficients for vibration of f symmetry type; ν_0 is the unperturbed vibration frequency; m, n numerate vibration groups in the unit cell, and $V_{n\alpha,m\beta}$ is an array element of the operator of dipole coupling.

In case of polynucleotides, the values ν, ν_0, and $\Delta\nu_{hydr}$ are known for all hydration states, whereas $\Delta\nu_{res}$ can be calculated according to the above formula only for canonical B/A-form of the fully hydrated deoxyribo/ribonucleotides with the help of their crystallographic atomic coordinates. We presuppose, that it is possible to model distortions that occur during polynucleotide dehydration as the change of the helical twist parameter of the canonical B/A-form while adjacent base pairs remaining in parallel plains. By doing this, we will be able to obtain the values of the helical twist parameter which gives the correct values of $\Delta\nu_{res}$ for each hydration state. Taking into account that in case of DNA, the exact coordinates of atoms are unknown, we chose for our study DNA of two bacteria species which is AT-rich (*Cl. Perfringens*) and CG-rich (*M. luteus*). The values of $\Delta\nu_{res}$ for these DNAs are calculated using the atomic coordinates of poly(dA)-poly(dT) and poly(dG)-poly(dC), correspondingly.

Analysis shows that during transition from totally hydrated into totally dehydrated state the helical twist in studied structures changes from 10° to 20° and reveals that nucleobases of AT-rich poly(dA)-poly(dT) and *Cl. Perfringens* DNA are more mobile than those of CG-rich poly(dG)-poly(dC) and *M. luteus*.

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