FP7 INCO.2010-6.1 Grant no: 266529

Institutional Development of Applied Nanoelectromagnetics: Belarus in ERA Widening

BY-NANOERA

Информационный день 7-й Рамочной программы научно-технологического развития ЕС
19 октября 2011 г.

Sergey Maksimenko
sergey.maksimenko@gmail.com

Outline

1. About Minsk team. Nanoelectromagnetics – what is it?
2. BY-NANOERA project structure, objectives and milestones
3. Nearest actions
4. Conclusion

- Elementary research unit: strategy
- выбор стратегии развития

1. *Определить привлекательную и научно значимую область исследований и найти незанятую нишу;*
2. *Добиться признания в научном сообществе как на национальном, так и международном уровне;*
3. *Войти в качестве исполнителей в национальные научно-исследовательские программы;*
4. *Добиться привлекательности выбранного направления для студентов и аспирантов;*
5. *Развить международное сотрудничество и добиться финансирования через различные международные фонды и программы.*

Institute for Nuclear Problems, BSU

Laboratory of electrodynamics of nonhomogeneous mediums

13 persons

2 ScD (Research professors)
5 PhD
3 PhD students
2 MS students
3 Undergraduate students

average age in the lab is 33 years

Lecture Course: Physics of nanostructured materials, Physical Department, BSU

Institute for Nuclear Problems, BSU

http://inp.bsu.by/

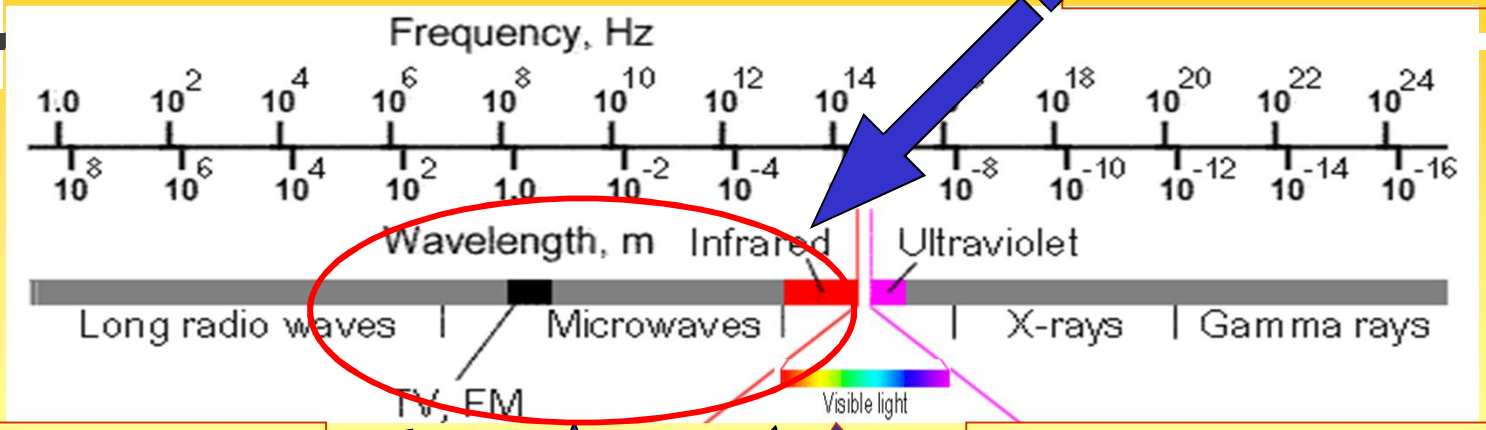
Laboratory of Electrodynamics of Nonhomogeneous Media

Research directions:

- Nano-scale elements of high-frequency (microwave-to-optical) electrical circuits
- Wave processes and signal propagation in nano-scale components and integrated nano-structured systems
- Electromagnetic response of composite materials with nano-sized fillers

Motivation

Active and passive circuit elements



RF agents for selective cancer cell destruction

Nonlinear optical elements; Optical limiting

NIR agents for selective cancer cell destruction

THz engineering material
THz detecting

EM shielding in RF & MWs
E-textile and polymers for MW and RF antennas

Bayram et. al, TAP, 2010

Main result: Nanoelectromagnetics

is currently emerging as a synthesis of macroscopic electrodynamics and microscopic theory of electronic properties of different nanostructures.

Electromagnetic field diffraction

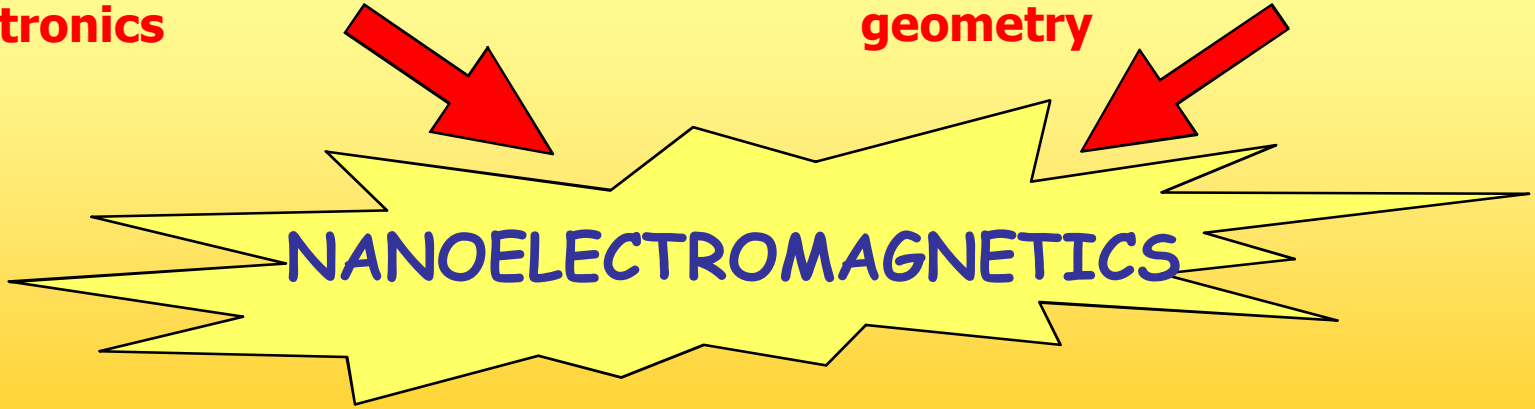
Confinement of the charge carrier motion

Diffraction Theory

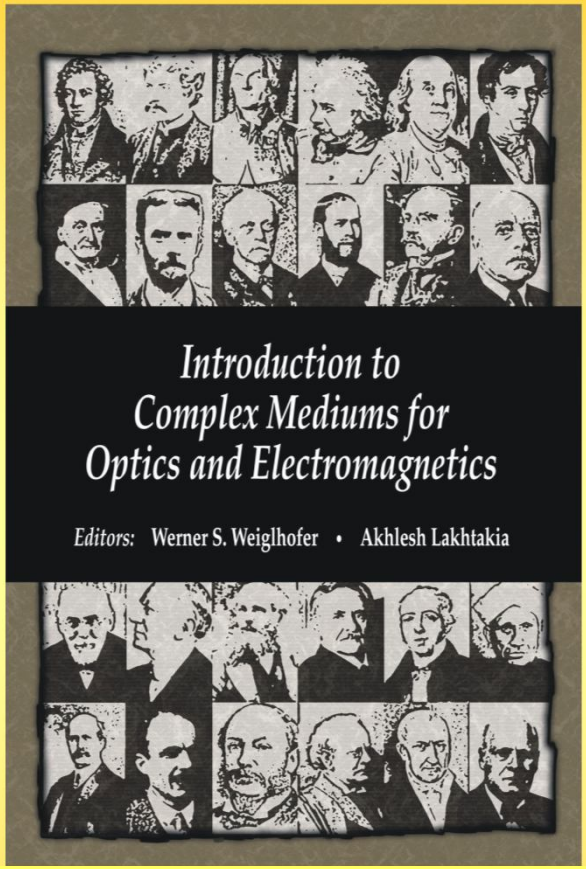
Condensed Matter Physics

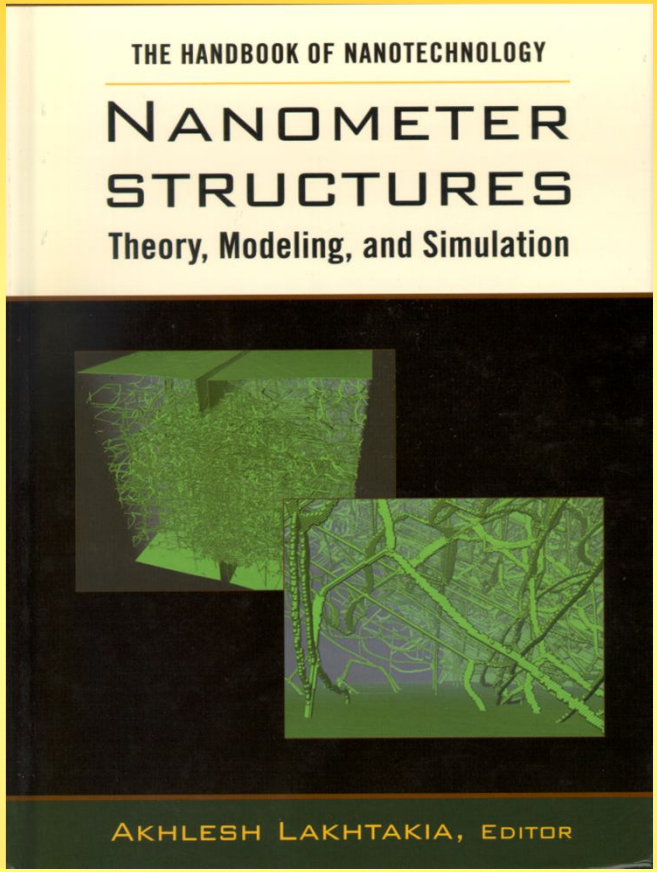
Boundary-value problems for complex-shaped regions:
Complex geometry, ordinary electronics

Quasi-particle concept:
Electrons, phonons, magnons…
Complex electronics, ordinary geometry



Introduction to Nanoelectromagnetics





S.A. Maksimenko and G.Ya. Slepyan, Electromagnetics of Carbon Nanotubes, in "Introduction to Complex Mediums for Optics and Electromagnetics", SPIE Press, 2003.

S.A. Maksimenko and G.Ya. Slepyan, Nano-electromagnetics of low-dimensional structures, in "Hand-book of Nano-technology: Theory, Modeling and Simulation", SPIE Press, 2004.

PHYSICAL REVIEW B VOLUME 60, NUMBER 24 15 DECEMBER 1999-II

Electrodynamics of carbon nanotubes: Dynamic conductivity, impedance boundary conditions, and surface wave propagation

G. Ya. Slepyan and S. A. Maksimenko A. V. Gusakov
Institute of Nuclear Problems, Belarus State University, Bobruiskaya str. 11, Minsk 220050, Belarus

A. Lakhtakia O. Yevt

PHYSICAL REVIEW B **73**, 195416 (2006)

Theory of optical scattering by achiral carbon nanotubes and their potential as optical nanoantennas

G. Ya. Slepyan, M. V. Shuba, and S. A. Maksimenko
Institute for Nuclear Problems, Belarus State University, Bobruiskaya 11, 220050 Minsk, Belarus

A. Lakhtakia

SPIE Newsroom

10.1117/2.1201007.003072

Carbon nanotubes as probes for scanning near-field optic microscopy

Andrei Nemilentsau, Gregory Slepyan, Sergey Maksimenko, Akhlesh Lakhtakia, and Slava V. Rotkin

PHYSICAL REVIEW B **79**, 155403 (2009)

Theory of multiwall carbon nanotubes as waveguides and antennas in the infrared and the visible regimes

M. V. Shuba, G. Ya. Slepyan, and S. A. Maksimenko
Institute for Nuclear Problems, Belarus State University, Bobruiskaya 11, 220050 Minsk, Belarus

C. Thomsen A. Lakhtakia

PHYSICAL REVIEW B **81**, 205423 (2010)

Terahertz conductivity peak in composite materials containing carbon nanotubes: Theory and interpretation of experiment

G. Ya. Slepyan, M. V. Shuba, and S. A. Maksimenko

APPLIED PHYSICS LETTERS **97**, 073116 (2010)

Terahertz sensing with carbon nanotube layers coated Carrier transport versus nanoantenna effects

Dalius Seliuta,[1,2,a)] Irmantas Kašalynas,[1] Jan Macutkevic,[1] Gintaras Valus
Mikhail V. Shuba,[3] Polina P. Kuzhir,[3] Gregory Ya. Slepyan,[3] Sergey A. M
Vitaly K. Ksenevich,[4] Vladimir Samuilov,[5] and Qi Lu[5]

Diamond & Related Materials 19 (2010) 91–99

Contents lists available at ScienceDirect

Diamond & Related Materials

journal homepage: www.elsevier.com/locate/diamond

Dielectric properties of a novel high absorbing onion-like-carbon based polymer composite

J. Macutkevic [a,*], P. Kuzhir [b,2], D. Seliuta [a,1], G. Valusis [a,1], J. Banys [c,3], A. Paddubskaya [b,2], D. Bychanok [b,2], G. Slepyan [b,2], S. Maksimenko [b,2], V. Kuznetsov [d,4], S. Moseenkov [d,4], O. Shenderova [e,5], A. Mayer [f,6], Ph. Lambi

Recognizability of the group in the international nano R&D society has been reached

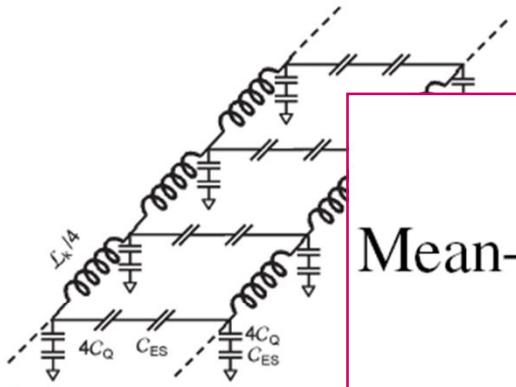
reviews

C. Rutherglen and P. Burke

Electromagnetism

Nanoelectromagnetics: Circuit and Electromagnetic Properties of Carbon Nanotubes

*Chris Rutherglen and Peter Burke**



From the Contents

This Review presents a discussion of the electromagnetic properties of nanoscale electrical conductors, which are quantum mechanical one-dimensional systems. Of these, carbon nanotubes are the most technologically advanced example, and are discussed mainly in this paper. The properties of such systems as transmission electron microscopy waveguides for on-chip signal propagation and also the radiation properties of such systems are discussed. This work is primarily aimed at microwave, nanometer-wave, and THz electronics. However, the use of nanotubes as antennas in the IR and optical frequency range is not precluded on first principles and remains an open research area.

IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 57, NO. 5, MAY 2009

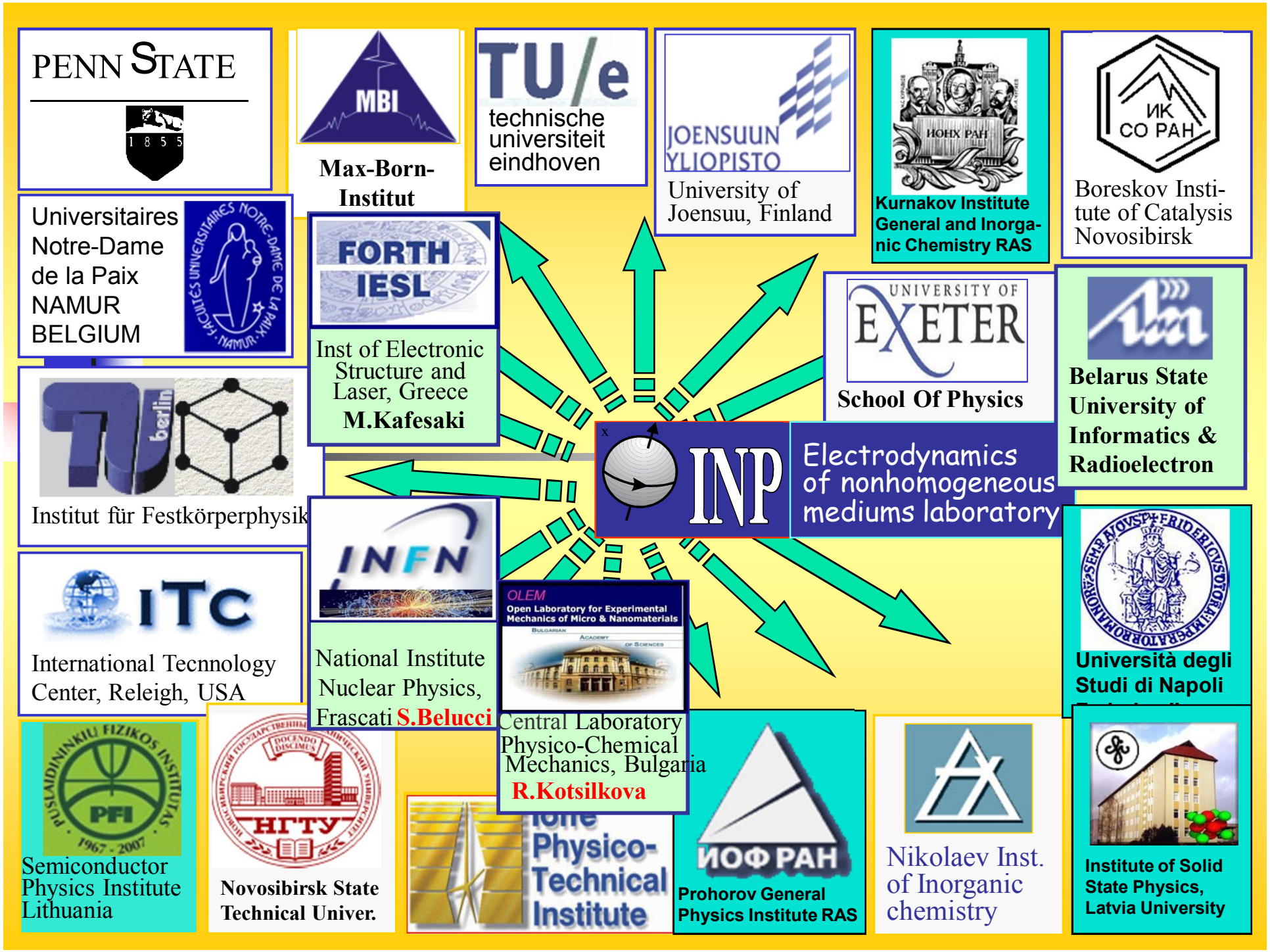
Mean-Field Electrodynamic Theory of Aligned Carbon Nanotube Composites

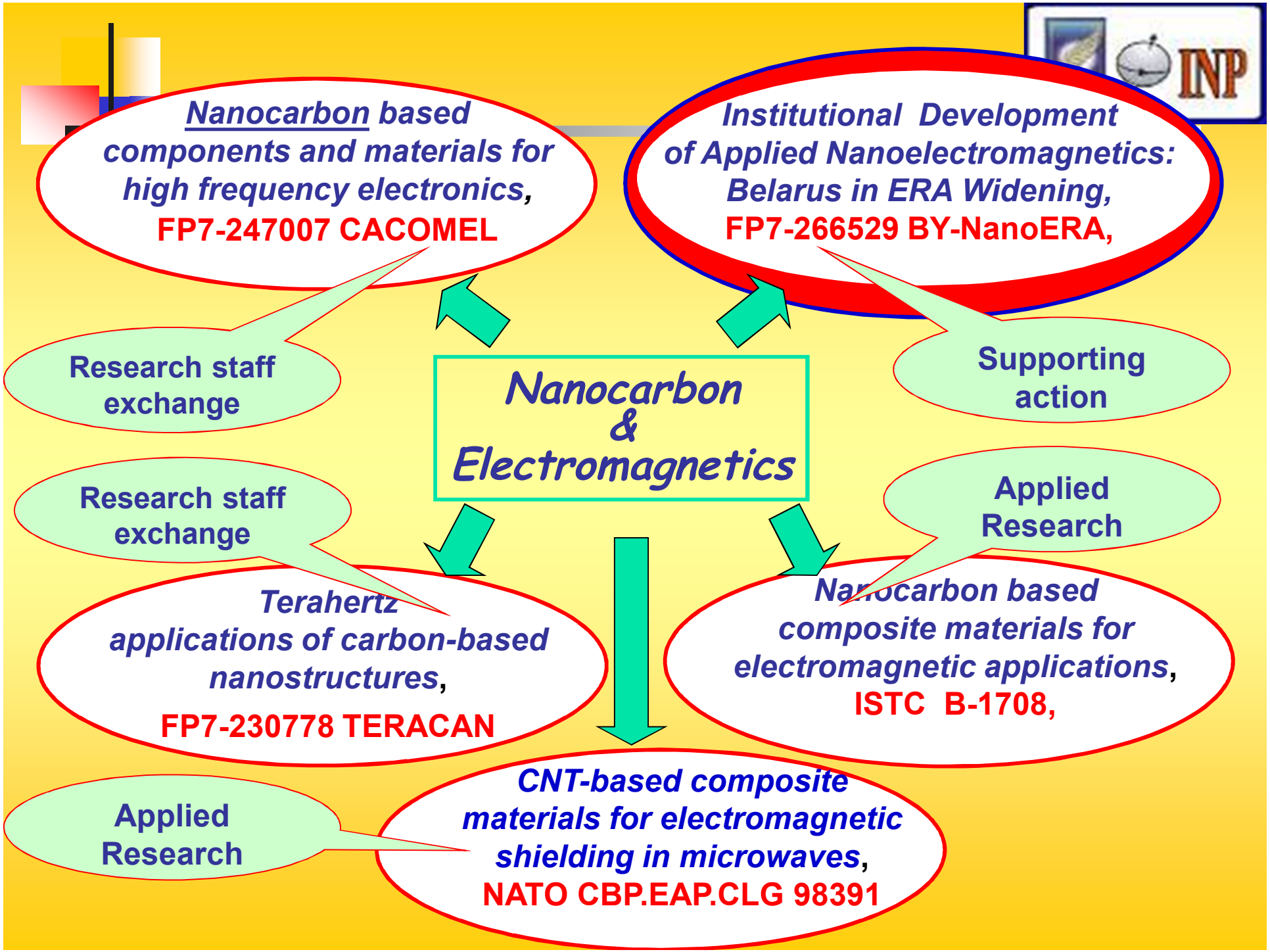
Said M. Mikki, *Member, IEEE*, and Ahmed A. Kishk, *Fellow, IEEE*

A. *Effective-Boundary Conditions for CNTs*

Here, we review the approach to CNT electrodynamics using the effective-boundary condition [14]–[16]. The idea is to replace the atomic structure of the CNT by a continuous surface with a boundary condition derived using accurate quantum-mechanical calculation [15], [16]. Applying Boltzmann's kinetic

9. Individual Nanotubes Over a Ground Plane: The Belarus Method 895


PENN STATE
1855
MBI
Max-Born-Institut
TU/e
technische universiteit eindhoven
JOENSUUN YLIOPISTO
University of Joensuu, Finland
ИОНХ РАН
Kurnakov Institute General and Inorganic Chemistry RAS
ИК СО РАН
Boreskov Institute of Catalysis Novosibirsk
Universitaires Notre-Dame de la Paix NAMUR BELGIUM
FACULTÉS UNIVERSITAIRES NOTRE-DAME DE LA PAIX · NAMUR
FORTH IESL
Inst of Electronic Structure and Laser, Greece
M.Kafesaki
UNIVERSITY OF EXETER
School Of Physics
Belarus State University of Informatics & Radioelectron
berlin
Institut für Festkörperphysik
INP
Electrodynamics of nonhomogeneous mediums laboratory
INFN
National Institute Nuclear Physics, Frascati S.Belucci
ITC
International Tecnnology Center, Releigh, USA
OLEM
Open Laboratory for Experimental Mechanics of Micro & Nanomaterials
Central Laboratory Physico-Chemical Mechanics, Bulgaria
R.Kotsilkova
Università degli Studi di Napoli
PUSLAIDININKIU FIZIKOS INSTITUTAS
PFI
1967 - 2007
Semiconductor Physics Institute Lithuania
НГТУ
Novosibirsk State Technical Univer.
Physico-Technical Institute
ИОФ РАН
Prohorov General Physics Institute RAS
Nikolaev Inst. of Inorganic chemistry
Institute of Solid State Physics, Latvia University


Nanocarbon based components and materials for high frequency electronics, FP7-247007 CACOMEL
Institutional Development of Applied Nanoelectromagnetics: Belarus in ERA Widening, FP7-266529 BY-NanoERA,
Research staff exchange
Supporting action
Nanocarbon & Electromagnetics
Research staff exchange
Applied Research
Terahertz applications of carbon-based nanostructures, FP7-230778 TERACAN
Nanocarbon based composite materials for electromagnetic applications, ISTC B-1708,
Applied Research
CNT-based composite materials for electromagnetic shielding in microwaves, NATO CBP.EAP.CLG 98391

Outline

1. About Minsk team. Nanoelectromagnetics – what is it?
2. BY-NANOERA project structure, objectives and milestones
3. Nearest actions
4. Conclusion

Objectives

Institutional Development of Applied Nanoelectromagnetics: Belarus in ERA Widening

As a principal goal, the project implies

Reinforcement of the cooperation capacities of INP BSU in ERA through the institutional development of the new research discipline – applied nanoelectromagnetics

BY-NANOERA Consortium

Institutional Development of Applied Nanoelectromagnetics: Belarus in ERA Widening

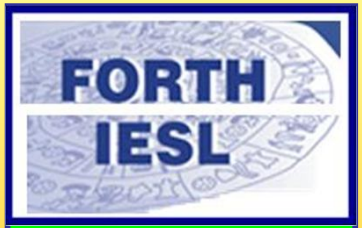
Institut für Festkörperphysik TUB
A. Hoffmann

FP7-266529

Inst for Nuclear Problems BSU
S.Maksimenko

Central Laboratory Physico-Chemical Mechanics, Sofia
R.Kotsilkova

National Institute Nuclear Physics, Frascati **S.Belucci**



Inst of Electronic Structure and Laser, Greece
M.Kafesaki

Institute of System Analysis and Information Support
O.Meerovskaya

Sci & Techn Park "Politechnik" BNTU
L.Shmygova

A set of coupled tasks must be solved:

- *To prove necessity and promising capability of NEM in the core objective of FP7 Theme 4 'NMP' and* ***to develop a concept of nanoelectromagnetics*** *as a perspective direction in NMP;*
- ***To develop the strategy of INP BSU*** *as a focus institution for the applied NEM evolution on the national and European levels;*
- *To establish network with research centers in MS or AC in applied NEM aimed with* ***the progress in solving concrete research problems and submission of joint INCO proposals;***
- ***To develop training modules*** *to build competency and facilitate the participation in FP7 of INP BSU;*
- ***To organize a set of workshops and seminars on NEM;***
- ***To propose the reinforcement scheme developed for INP BSU as a model for the Belarus teams' incorporation into ERA.***

Work packages

WT1
List of work packages

Project Number [1]	266529	Project Acronym [2]	BY-NanoERA

LIST OF WORK PACKAGES (WP)

WP Number [53]	WP Title	Type of activity [54]	Lead beneficiary number [55]	Person-months [56]	Start month [57]	End month [58]
WP 1	Framing and supporting the INP BSU's research activities and institutional development in NEM	SUPP	1	15.50	1	36
WP 2	Facilitating INP BSU's research potential, information exchange and identifying partners	SUPP	1	13.00	1	36
WP 3	Training for INP BSU's competence building and facilitating its participation in FP7	SUPP	6	5.50	1	36
WP 4	Management	MGT	1	4.00	1	36
			Total	38.00		

Outline

1. About Minsk team. Nanoelectromagnetics – what is it?
2. BY-NANOERA project structure, objectives and milestones
3. What we are doing right now?
4. Conclusion

Current activity : task 1 and 2

✓*To prove necessity and promising capability of NEM in the core objective of FP7 Theme 4 'NMP' and* ***to develop a concept of nanoelectromagnetics*** *as a perspective direction in NMP;*

✓***To develop the strategy of INP BSU*** *as a focus institution for the applied NEM evolution on the national and European levels;*

A … we have started …

B We have established expert group on the development of nanoelectromagnetic prognosis and strategy;

C On the national level, we enter the State R&D Programme "Convergation" under Project 3.4.01.1

Development and implementation, on the base of new research discipline "Applied nanoelectromagnetics", of national interdisciplinary platform on modeling, study and application of electromagnetic properties and processes in nanostructured objects and systems

Project direct result

Current activity: Task 3

✓To establish network with research centers in MS or AC in applied NEM aimed with **the progress in solving concrete research problems and submission of joint INCO proposals;**

To the moment, about 10 published & accepted papers acknowledge a support from BY-NANOERA

БелИСА
SEVENTH FRAMEWORK PROGRAMME
Consulting, Partners Search

БНТУ
МЦ НИР I C SRW
Innovative management, end-users search

OLEM
Open Laboratory for Experimental Mechanics of Micro & Nanomaterials
Polymer processing, advanced material study

INFN
Nuclear Science abbilities, Ionazing radiation shielding, NanoMedical studies

INP
Theoretical and Experimental NanoElectroMagnetics, Heat transfer on nanolevel

FORTH IESL
New- and Meta- Materials Study, Applied Electromagnetics

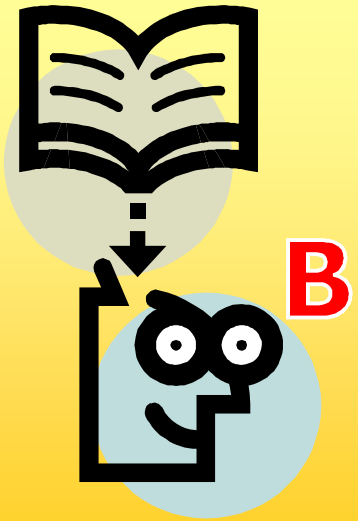
TU berlin
Institut für Festkörperphysik
High- level experimental research for NanoElectronics

Current activity: Task 4

✓***To develop training modules*** *to build competency and facilitate the participation in FP7 of INP BSU;*

BY-NANOERA FP7 Trainings:

A Training Course 1 HOW TO GET IN? General introduction to FP7 and basic soft skills needed to express your interest. May 19-20, Minsk



B Training Course 2 YOU ARE IN A CONSORTIUM: obligations and requirements for a partner in FP7 project

Sci & Techn Park "Politechnik" BNTU
L.Shmygova

Institute of System Analysis and Information Support
O.Meerovskaya

Current activity: task 5

✓*To organize a set of workshops and seminars on NEM;*

A The talk **"Presentation of new EU projects FP7-247007 CACOMEL and FP7-266529 BY-NanoERA"**, has been delivered by Sergey Maksimenko

NATURE PHOTONICS | VOL 4 | OCTOBER 2010

The Second International Workshop on Nanocarbon Photonics and Optoelectronics
Koli/North Karelia/Finland
1-6 August 2010

To the moment, 6 published and accepted papers acknowledge a support from BY-NANOERS

Current activity: task 5

- *To organize a set of workshops and seminars on NEM;*

B

http://www.nanomeeting.org/

Special Session "Nanoelectromagnetics"

International conference on Physics, Chemistry and Applications of Nanostructures "Nanomeeting 2011", May 24-29, 2011, Special session on Nanoelectromagnetics has been organized under a support from BY-NANOERA. The support is acknowledged in the Conference Program and in the Conference Proceedings (World Scientific, 2011).

C

Nanoscience and Nanotechnology 2011
INFN, Frascati, 26-30 September 2011
A special school-type one-day session devoted to topics of interest of the EU project BY-NanoERA

Current activity: task 5

D

Int. Conference on Electromagnetics in Advanced Applications September 12-17 2011 Torino, Italy

SS on Electromagnetics of nanowires and nanotubes

A Special Session "Electrodynamics of nanowires and nanotubes" headed by Dr G. Slepyan (INP) has been organized as a part of BY-NANOERA activity at the International Conference on Electromagnetics in Advanced Applications & IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications, September 12-17, 2011 Torino, Italy, http://www.iceaa.net/ ganized with the emphasis on Nanoelectromagnetics.

FANEM'12

Fundamental and Applied NanoElectroMagnetics

Belarusian State University, Minsk, Belarus, May 22-25, 2012

You are Welcome!

www.nano.bsu.by/en

Confirmed key lectures

HOFFMANN Axel IFKP, TU Berlin, Germany	**Electron-Phonon Interaction in Nano-Scale Objects**
KIVSHAR Yuri The Australian National Univ., Canberra Australia	**Tunable metamaterials and plasmonic structures**
LAMBIN Philippe FUNDP, University Of Namur, Belgium	**Nanomechanics (what remains from elasticity in the nanoworld)**
SHENDEROVA Olga ITC, Raleigh, USA	**Nanodiamond and Carbon Onion Composites: Optical and Electronic Applications**
SEPYAN Gregory INP, Belarusian State Univ, Minsk, Belarus	**Nanoelectromagnetics**
THOMSEN Christian IFKP TU Berlin, Germany	**Plasmonic effects in semiconductor nanostructures**

Current activity: task 6

- ✓*To propose the reinforcement scheme developed for INP BSU as a model for the Belarus teams' Incorporation into ERA.*

A … we work on that …

Thank you for your attention