INPAC General Meeting

29 November 2007, La Foresta

- INPAC 2006-2007
- Summary of activities Nov. 2006 – Nov. 2007
- Visibility & milestones
- Research highlights WP1-WP7

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BLAD NR. 2

NS KENMERK DOC/GC-HL/ef24
IW KENMERK
LEUVEN 2005-07-05

U zal in de loop van de maanden september-oktober uitgenodigd worden voor een opstartgesprek. De aanvang van het EF-programma is voorzien op 1 november. Wij wensen u alvast veel succes.

Met hoogachting,

R. Bouillon
Coördinator Onderzoeksbeleid

cc : Prof. K. Debackere

INPAC-INSTITUTE FOR NANOSCALE PHYSICS AND CHEMISTRY

www.kuleuven.be/inpac

V.V. MOSHCHALKOV, A. CEULEMANS, M. VAN DER AUWERAER, C. VAN HAESENDONCK, A. VANTOMME, K. CLAYS, P. LIEVENS, A. STESMANS, J. VANDERLEYDEN

Center of Excellence
@Katholieke Universiteit Leuven

INPAC MAIN OBJECTIVES

- ***To investigate the effect of nanostructuring and nanoscale confinement of charge, spin and photon on the electrical, magnetic, optical and chemical properties of inorganic, organic and bio-materials***

- ***To reveal the fundamental relation between quantized confined states and physical and chemical properties of these materials***

- ***To work out the basis of the new concept - "quantum design" through nanostructuring***

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Summary of activities Nov. 2006 – Nov. 2007

- INPAC website: www.kuleuven.be/inpac
- Second General Meeting:17 November 2006
- INPAC-IMEC Meeting: 23 January 2007
- Leuven Nano Conference LNC'07: 5-6 June 2007
- INPAC lectures: Modern Trends in Nanosciences
- INPAC seminars
- INPAC publications
- INPAC @ Nano Nu: 8-10 November 2007

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INPAC-IMEC Meeting

January 23, 2007

Summary of activities Nov. 2006 – Nov. 2007

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Modern trends in nanosciences

Institute for
Nanoscale Physics and Chemistry

INPAC Lectures on Trends in Nanoscience:

Left-handed media: recent breakthrough in optics and nanophotonics

Prof. Alexander Zharov

Institute for Physics of Microstructures RAS, 603950, GSP-105, Nizhny Novgorod, Russia

1st Lecture: June 14 at 16h00
2nd Lecture: June 19 at 16h00
Coffee at 15:45
Celestijnenlaan 200D, room 05:11

Abstract

In two lectures an overview will be given of the fundamental electrodynamic properties of the novel so-called *left-handed media* (LHM) which possess simultaneously *negative* dielectric permittivity and *negative* magnetic permeability. Most of unusual phenomena in such media are caused by excitation of bulk *backward* electromagnetic waves with oppositely directed wave vector and vector of energy density flow that, in turn, leads to the *reversed Doppler and Vavilov-Cherenkov effects, negative light pressure and negative refraction of electromagnetic waves*. The negative refraction seems to be one of the promising phenomena for applications.

Both geometrical optics and wave effects will be considered including *sub-wavelength imaging and "perfect" lensing* which arise due to the negative refraction. The peculiar properties of the surface polaritons at the interface between LHM and usual (right-handed, RH) medium and their excitation will also be discussed. The recent progress in this field is related to the manufacturing of micro and nanostructured composite materials (or metamaterials) demonstrating left-handed properties. The ideas underling the microstructure of LH metamaterials will be outlined. To clarify these ideas the detailed microscopic derivations of effective dielectric permittivity and magnetic permeability will be presented.

The key experiments demonstrating left-handed properties of metamaterials and overcoming the diffraction limit in different frequency domains from microwaves to optics will be reviewed. The suppression of the left-handed properties by the disorder will be considered. The effects of metamaterials discreteness, such as magneto-inductive waves' excitation, spatial dispersion, resonant cones etc. will be discussed as well.

The final part of the lectures will be devoted to the novel possible perspective developments of the LH metamaterials such as nonreflecting birefringent metamaterials, tunable nonlinear metamaterials, LH/RH bandgap structures, metamaterials consisting of metal nanoparticle arrays, etc. and to their possible applications.

14&19/06/2006

Institute for
Nanoscale Physics and Chemistry

INPAC Lectures on Modern Trends in Nanoscience
and
Colloquium Natuurkunde en Sterrenkunde

The Quantum World Observed Using Electron Waves

Prof. Akira Tonomura

Hitachi, Ltd, Hatoyama, Saitama, 350-0395, Japan
RIKEN, Wako, Saitama, 351-0198, Japan
OIST, 12-22, Suzaki, Uruma, Okinawa, 904-2234, Japan

Monday, November, 27 at 16h00

Coffee at 15:45
Celestijnenlaan 200D, room 05:11

Abstract

Quantum mechanics was first born as a law governing the behavior of electrons inside atoms. Recently, however, thanks to the development of advanced technologies, phenomena peculiar to quantum mechanics have been observed in more macroscopic regions.

We have successively developed brighter field-emission electron beams over 30 years [1] and applied them to directly observe quantum phenomena by using the wave nature of electrons. Every time we developed a brighter electron beam, new applications opened up. We can now carry out fundamental experiments in quantum mechanics that were once regarded as thought experiments. Examples include a single-electron build-up of an interference pattern and conclusive experiments on the Aharonov-Bohm effect. In addition, visualizing magnetic lines of force in h/e flux units by interference microscopy and visualizing quantized vortices in superconductors by Lorentz microscopy have become possible. This method is expected to become a useful tool for investigating quantum phenomena that have begun to be observed in more macroscopic regions.

[1] A. Tonomura, Proc. Natl. Acad. Sci. 102 No. 42, 14952, (2005).
http://www.hqrd.hitachi.co.jp/global/fellow_tonomura.cfm

27/11/2006

Modern trends in nanosciences

Institute for
Nanoscale Physics and Chemistry

INPAC Lectures on Modern Trends in Nanosciences

Protein-mediated electron transport: when does the protein structure matter, and why?

Prof. David Beratan

Reynolds Prof. and Chair, Department of Chemistry, Duke University, Durham, NC 27708-0346, USA

Monday, 19 March at 16h00
Coffee at 15h45
Celestijnenlaan 200D, room 05.11

Abstract:

Electron transfer through proteins proceeds over long distances via quantum mechanical tunneling. Theoretical analysis of these reactions reveals two distinct coupling limits. A protein structure insensitive regime arises when donor and acceptor are coupled through dynamically averaged multiple-coupling pathways. A structure dependent limit governs electron transfer partners coupled through a dominant pathway. This two regime paradigm provides a unified description of electron transfer rates in 26 chemically labeled heme and blue-copper proteins, as well as in photosynthetic proteins [1].

1.T.R. Prytkova, I.V. Kurnikov, D.N. Beratan, Science 315, 622-625 (2007).
david.beratan@duke.edu

19/03/2007

Institute for
Nanoscale Physics and Chemistry

INPAC Lectures on Modern Trends in Nanoscience:

Probing and Controlling Magnetism by Light on femtosecond time-scales

Prof. Theo Rasing

IMM, Radboud University Nijmegen, Toernooiveld 1, N-6525 ED Nijmegen, The Netherlands

1st Lecture: October 22 at 16h00
Colloquium Natuurkunde en Sterrenkunde
2nd Lecture: October 24 at 11h00
Celestijnenlaan 200 D, room 05:11

Abstract

The interaction of light with magnetic matter is well known: magneto optical Faraday or Kerr effects are frequently used to probe the magnetic state of materials or manipulate the polarisation of light. The strong developments in femtosecond lasers allows to currently do this on unprecedented timescales.

The inverse effects are less known but certainly as fascinating: with light one can manipulate matter, for example orient their spins. Using femtosecond laser pulses we have recently demonstrated that one can thus generate ultrashort and very strong (~Tesla's) magnetic field pulses that provide unprecedented means for the generation, manipulation and coherent control of magnetic order on very short time scales.

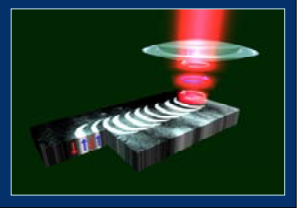
In these two lectures the basic ideas and prospects of both femtosecond magneto-optics as well as opto-magnetism will be discussed and illustrated with recent results.

References

[1] A.V.Kimel, A.Kirilyuk, A.Tsvetkov, R.V.Pisarev and Th.Rasing: Laser induced ultrafast spin reorientation in the antiferromagnet TmFeO. Nature 429 (2004) 850-853

[2] A.V.Kimel, A.Kirilyuk, P.A.Usachev, R.V.Pisarev, A.M.Balbashov and Th.Rasing,Ultrafast nonthermal control of magnetization by instantaneous photomagnetic pulses, Nature 435 (2005), 655-657

[3] C.D.Stanciu, F.Hansteen, A.V.Kimel, A.Kirilyuk, A.Tsukamoto, A.Itoh and Th.Rasing, All-optical Magnetic Recording with Circularly polarized Light, Phys.Rev.Lett.99, 047601 (2007)



Demonstration of compact all-optical recording of magnetic bits by femtosecond laser pulses. This was achieved by scanning a circularly polarized laser beam across the sample and simultaneously modulating the polarization of the beam between left and right circular. White and black areas correspond to 'up' and 'down' magnetic domains, respectively.

22&24/10/2007

Summary of activities Nov. 2006 – Nov. 2007

- INPAC website: www.kuleuven.be/inpac
- First General Meeting: 7 February 2006
- Second General Meeting:17 November 2006
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INPAC publications

- Second address on all publications of the INPAC research groups:

Title...

A. Author[1,2] ,...

1 – 1st address

2 – INPAC-Institute for Nanoscale Physics and Chemistry

INPAC: publications 2006

- Web of Science: **165 records (2 Nature, 1 Science, 3 PRL, 17 APL, 8 JACS, 1 Ang.Chem., etc)**

- AU=(moshchalkov or van haesendonck c or lievens p or vantomme a or stesmans a or clays k or van der auweraer m or ceulemans a or hofkens j or de feyter s or chibotaru or temst k or vanacken j or volodin a or vanderleyden j or verbiest t or nguyen mt or de schryver fc or hayne m or Afanas'ev VV)

- AD=(leuven or louvain or heverlee or belgium or 3001 or 3000 or K.U.Leuven or K.U. Leuven)

INPAC: publications 2006

Subject Category	Count	% of Record
PHYSICS, APPLIED	40	24.2424 %
CHEMISTRY, PHYSICAL	31	18.7879 %
PHYSICS, ATOMIC, MOLECULAR & CHEMICAL	27	16.3636 %
CHEMISTRY, MULTIDISCIPLINARY	26	15.7576 %
PHYSICS, CONDENSED MATTER	5	15.1515 %
MATERIALS SCIENCE, MULTIDISCIPLINARY	13	7.8788 %
PHYSICS, MULTIDISCIPLINARY	7	4.2424 %
BIOCHEMISTRY & MOLECULAR BIOLOGY	6	3.6364 %
CHEMISTRY, INORGANIC & NUCLEAR	6	3.6364 %
ENGINEERING, ELECTRICAL & ELECTRONIC	5	3.0303 %

INPAC: publications 2006

Country/Territory	Count	% of Record
BELGIUM	165	100.0000 %
USA	29	17.5758 %
GERMANY	14	8.4848 %
FRANCE	11	6.6667 %
SPAIN	9	5.4545 %
ENGLAND	7	4.2424 %
JAPAN	6	3.6364 %
NETHERLANDS	5	3.0303 %
PEOPLES R CHINA	5	3.0303 %
POLAND	5	3.0303 %

INPAC: publications 2006

Author	Count	% of Record
MOSHCHALKOV, VV	30	18.1818 %
CLAYS, K	18	10.9091 %
STESMANS, A	17	10.3030 %
VANTOMME, A	17	10.3030 %
LIEVENS, P	14	8.4848 %
NGUYEN, MT	13	7.8788 %
AFANAS'EV, VV	12	7.2727 %
ASSELBERGHS, I	12	7.2727 %
HOFKENS, J	12	7.2727 %
PERSOONS, A	12	7.2727 %

INPAC: publications 2006

1. Roeffaers MBJ, Sels BF, Uji-i H, et al. Spatially resolved observation of crystal-face-dependent catalysis by single turnover counting NATURE 439 (7076): 572-575 FEB 2 2006 *Times Cited: 27*

2. Mamdouh W, Uji-i H, Ladislaw JS, et al. Solvent controlled self-assembly at the liquid-solid interface revealed by STM JOURNAL OF THE AMERICAN CHEMICAL SOCIETY 128 (1): 317-325 JAN 11 2006 *Times Cited: 18*

3. Silva CCD, de Vondel JV, Morelle M, et al. Controlled multiple reversals of a ratchet effect NATURE 440 (7084): 651-654 MAR 30 2006 *Times Cited: 16*

4. Braeken K, Moris M, Daniels R, et al. New horizons for (p)ppGpp in bacterial and plant physiology TRENDS IN MICROBIOLOGY 14 (1): 45-54 JAN 2006 *Times Cited: 16*

5. Yeow EKL, Melnikov SM, Bell TDM, et al. Characterizing the fluorescence intermittency and photobleaching kinetics of dye molecules immobilized on… JOURNAL OF PHYSICAL CHEMISTRY A 110 (5): 1726-1734 FEB 9 2006 *Times Cited: 14*

6. Kang H, Evmenenko G, Dutta P, et al. X-shaped electro-optic chromophore with remarkably blue-shifted optical absorption. synthesis, characterization, linear/nonlinear optical properties, self-assembly, and thin film microstructural characteristics JOURNAL OF THE AMERICAN CHEMICAL SOCIETY 128 (18): 6194-6205 MAY 10 2006 *Times Cited: 13*

7. Uji-i H, Melnikov SM, Deres A, et al. Visualizing spatial and temporal heterogeneity of single molecule rotational diffusion in a glassy polymer by defocused wide-field imaging POLYMER 47 (7): 2511-2518 MAR 22 2006 *Times Cited: 12*

8. Furukawa S, Uji-i H, Tahara K, et al. Molecular geometry directed Kagome and honeycomb networks: Toward two-dimensional crystal engineering JOURNAL OF THE AMERICAN CHEMICAL SOCIETY 128 (11): 3502-3503 MAR 22 2006 *Times Cited: 12*

9. De Keersmaecker SCJ, Sonck K, Vanderleyden J Let LuxS speak up in al-2 signaling TRENDS IN MICROBIOLOGY 14 (3): 114-119 MAR 2006 *Times Cited: 11*

10. Crispin X, Jakobsson FLE, Crispin A, et al. The origin of the high conductivity of poly(3,4-ethylenedioxythiophene)-poly(styrenesulfonate) (PEDOT- PSS) plastic electr. CHEMISTRY OF MATERIALS 18 (18): 4354-4360 SEP 5 2006 *Times Cited: 10*

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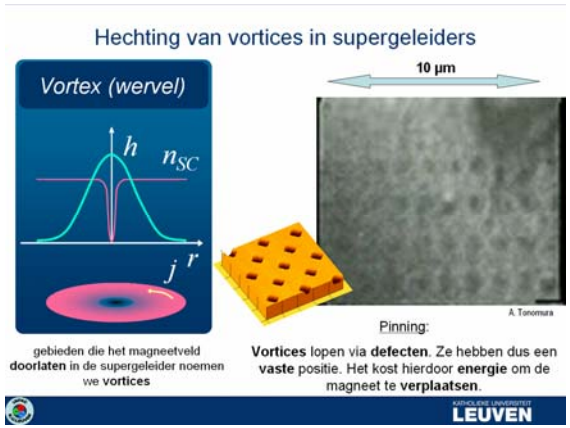
INPAC @ NanoNu

kiosk
1: **Zwevende trein**
2: **Tunnel microscopie**
3: **Magnetische dataopslag**
4: **Computer simulaties**
5: **Fluorescentie microscopie**

INPAC @ NanoNu



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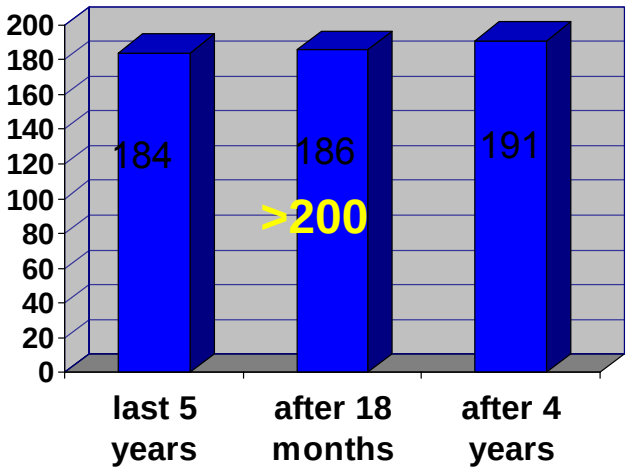
MILESTONES

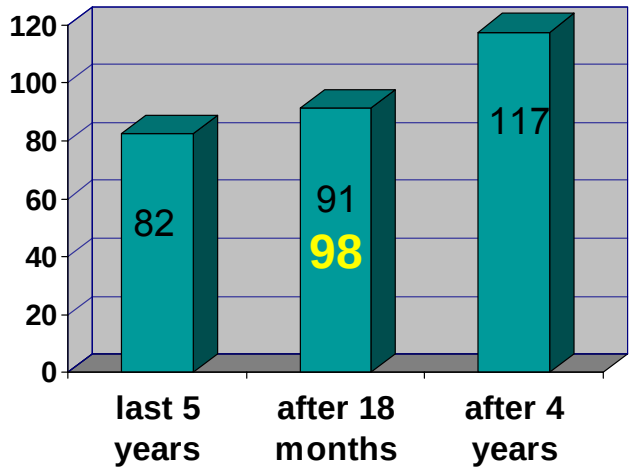
International publications

 # per year



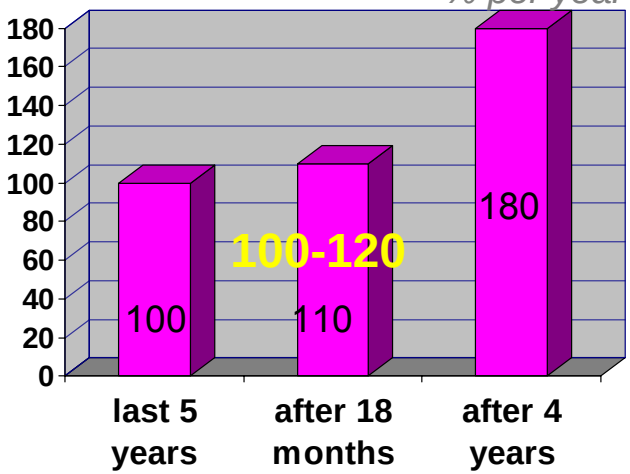
Top publications

 # per year

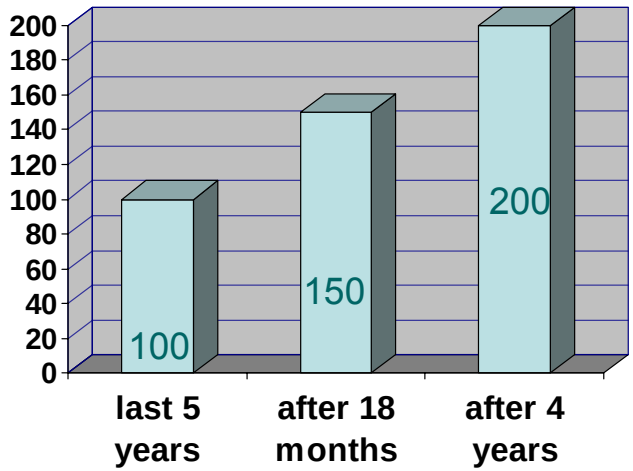


Joint publications

% per year



Joint PhD, *% per year*



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INPAC WORK PACKAGES

- ***Nanosuperconductors (WP1, V.V. Moshchalkov)***
- ***Nanomagnets (WP2, A. Vantomme)***
- ***Superconductor/Ferromagnet hybrid nanosystems (WP3, V.V. Moshchalkov)***
- ***Carbon nanosystems (WP4, A. Ceulemans)***
- ***Silicon nanosystems (WP5, A. Stesmans)***
- ***Materials for nanophotonics (WP6, K. Clays)***
- ***Molecular and supermolecular nanostructures (WP7, M. Van der Auweraer)***

Annual INPAC Meeting

La Foresta, Vaalbeek, November 29, 2007

Programme

8:30-9:00	**Arrival, coffee**
9:00-9:30	**Victor V. Moshchalkov *"INPAC: General indicators"***
	WP1: Nanosuperconductors (Chairman: Mark Van der Auweraer)
9:30-9:50	**Vu Hung Dao *"Composite vortices in two-band superconductors"***
9:50-10:10	**Roman Kramer *"Scanning Hall probe microscopy of superconducting nano and microstructures"***
	WP2: Nanomagnets (Chairman: Peter Lievens)
10:10-10:30	**Nikie Planckaert *"The spacer layer of an interlayer-coupled trilayer directly probed with synchrotron radiation"***
10:30-10:50	**Stijn Vandezande *"Manipulation of magnetic domain walls"***
10:50-11:20	**Coffee**
	WP3: S/F hybrid nanosystems (Chairman: Arnout Ceulemans)
11:20-11:40	**Werner Gillijns *"Confinement of the superconducting order parameter in superconductor-ferromagnet hybrids"***
11:40-12:00	**Niels Verellen *"Guided vortex motion in nanostructured S/F hybrids"***
	WP4: Carbon nanosystems (Chairman: Andre Stesmans)
12:00-12:20	**Alexander Volodin *"Scanning probe microscopy based investigations of carbon nanotubes and of carbon nanowalls"***
12:20-12:40	**Erwin Lijnen *"The radial rescaling approach for confined eigenvalue problems"***
12:40-14:00	**Lunch**

Annual INPAC Meeting

La Foresta, Vaalbeek, November 29, 2007

Programme

12:40-14:00	**Lunch**
	WP5: Silicon nanosystems (Chairman: Andre Vantomme)
14:00-14:20	Mihaela Jivanescu *"Interfaces and morphology of Si nanocrystals in SiO/SiO2 superstructures"*
14:20-14:40	Sheron Shamuilia *"Photoconductivity of metal/oxide nanolayers"*
	WP6: Nanophotonics (Chairman: Chris Van Haesendonck)
14:40-15:00	Koen Clays *"Colloidal photonic crystals and superlattices for photonic applications"*
15:00-15:20	Christina Flors *"Super-resolution imaging with Dronpa and its mutants"*
15:20-15:50	**Coffee**
	WP7: SA mol. and macromol. structures (Chairman: Koen Clays)
15:50-16:10	Thierry Verbiest *"Magneto-optische eigenschappen van polymeren en nanomaterialen"*
16:10-16:30	Steven De Feyter *"Templating at the nanoscale"*
16:30-16:45	Victor V. Moshchalkov *"Concluding remarks"*