

Electronic States and Phases Induced by Electric or Optical Impacts.

IMPACT-2012

<http://lptms.u-psud.fr/impact2012>

*September 10-14, 2012
Orsay, France*

Organizers:

S. Brazovskii	CNRS & Université Paris Sud, France
N. Kirova	CNRS & Université Paris Sud, France
L. Perfetti	Ecole Polytechnique, France
V. Yakovenko	University of Maryland, USA

ABSTRACT

The new and rapidly developing activity in condensed matter physics puts a goal of controlled transformation of electronic states and whole phases by external impacts. There are two main directions: the effects of strong electric fields and of the fast optical pumping. The meeting aims to reach a synergy and cross-fertilization between the branches of the new science which still lack an acquaintance in techniques, and on classes of materials.

1. SCIENTIFIC SUMMARY

Controlled transformations of electronic states and phases by external impacts is a very rapidly developing new activity in condensed matter physics with attractive applications and already moving scientific boundaries beyond their limits. The two major branches address effects of a very strong electric field and a supercritical optical pumping, or their combination. Being as young as from 2000's, the studies demonstrated an explosive development during last two years. The plenary presentations are selected for the latest biggest meeting like the APS March meeting and the M2S in the USA. Also a number of smaller focused meetings take place. Still, even within each of the two major branches, there is a lack of interactions, e.g. among studies focused upon cuprates and oxides and those upon organic conductors. But particularly noticeable is a lack of acquaintance and cross fertilization between the branches of the electric and optical impacts. There is an urgent need for a synergetic conference, which may give rise to sequential events in the future. We are planning to organize such a meeting as a five days workshop in September 2012 in France expecting more than 100 participants, including students. The event will be based at the University Paris Sud at Orsay close to Paris. Together with nearby institutions like the Saclay center of the CEA, Ec. Polytechnique, synchrotron SOLEIL, the Optical Valley institutes, and the center for photonics and nano-science, this area accumulates much of expertise and already running activity related to our project. We have already inquired with many of major players of that science over the world, and the reaction was typically very positive. The financial support has been already given by the ICAM (designated to scientists from USA and Asia), CNRS, RTRA. Still more funding is necessary to facilitate participation of young scientists and students, and to support senior keynote speakers from Europe, many of whom are very busy heads of leading laboratories.

CONTEXT, POSITION AND OBJECTIVES

Recent years witness an emergence and a very fast development of a new activity in condensed matter physics. The goal is a controlled transformation of electronic states or even of whole phases by external impacts. There are two main directions: the electrostatic doping effects of very strong electric fields and the supercritical optical pumping with a femto-second time resolution. These efforts originated a complex broad science which includes the surface physics at scales down to nanometer (in electrostatics), the femto-second time scale of the nonlinear optics, the arts of nano-fabrications by the molecular beam epitaxy (MBE) and by the focused ion beams (FIB); complex materials from cuprates, conducting oxides and now pnictides, to organic conductors and conjugated polymers. The geography of experimental researches embraces major advanced centers, particularly:

France - Orsay pole: Univ. Paris-Sud, synchrotron SOLEIL, Ec. Polytechnique, LPN - Lab. of Photonics and Nano-Science; Grenoble – Inst. Neel at the Polygone Sci., Toulouse – LNCMI (Nat. Lab. of High Magnetic Fields);

Canada McGill Univ.;

GB Cambridge and Oxford;

Germany Univ. of Augsburg, Berlin, Duisburg-Essen, Hamburg, Kiel, and Konstanz, Max Plank Inst. in Stuttgart, and more;

Russia Inst. Radio Engineering & Electronics – IREE;

Slovenia Univ. of Ljubljana;

Switzerland Univ. of Geneva, EPFL in Lausanne;

USA BNL, MIT, Univ. of California, Columbia, Chicago, Maryland, Minnesota, and Stanford;
Japan Univ. of Hokkaido, Tohoku, Tokyo (Applied Physics and Centre for Photonics), Tokyo
University of Sci, AIST in Tsukuba, RIKEN in Tokyo, Inst. for Molecular Science IMS at Okazaki.

Our proposal is to realize common grounds and general problems of several directions which today develop very fast but almost no mutual interactions, by only barely overlapping scientific communities. The meeting program will incorporate studies of responses of diverse cooperative electronic states to external impacts.

First group includes already related directions from the decade "old" purely optical femto-second setups to the later time-resolved techniques of the photoemission spectroscopy and of just coming time-sliced diffraction attainable at X-ray laser sources. The theoretical universality suggests to bring experience of sister many-body systems – ensembles of polaritons and excitons.

Second group includes static transformation by highest available electric fields which is a direction of 2000's with an astonishing success in last two years. It is also fruitful to recognize a similarity of lower field phenomena in mesa nano-junctions, fabricated and studied since several years; here we face a combination of static and transient transformations; also there are challenging experiments in very high magnetic fields.

Systems of major interest possess a symmetry broken ground state – from crystallization of electrons (charge order) or e-h pairs (charge/spin density waves) to superconductivity. Hence, any realistic impact creates inhomogeneous states and starts an evolution of topological defects – domain walls, vortices, dislocation lines, down to truly microscopic solitons. That brings a unifying complex of theoretical problems aimed describing many observable effects from macro to micro scales. First principle and model calculations, for both the electrostatic and optical impacts, also start to flourish following the experimental demands.

While principles and methods are universal, differences in implementations play a role. The program shall address several material realizations of symmetrically well defined states: from cuprates, oxides and pnictides to organic conductors. A comparison will be provided among superconductivity, charge density waves, charge ordering, magnetic phases, and Mott insulators.

At present, the described field in general is of a fundamental character which is already very important as moving scientific boundaries beyond their limits (very short times, highest fields) and meeting a popular interest in "emerging phenomena". The same time, the idea of switching between electronic phases, particularly obtaining the superconductivity (even at surface or in short leaving forms) on top of a pristine insulating state targets the applied science including principally new devices.

2. PROGRAMME

Date	Time	Sections
Monday, 10/09/2012	8:30 – 9:45	Registration
	9:45 - 10:00	Opening
	10:00 - 11:15	Interface electronic phases : Electrostatic doping and field effect.
	11:15 – 11:45	Coffee Break
	11:45 - 13:15	Electrostatic manipulation of the superconducting state.
	13:15 – 14:30	Lunch
	14:30 – 16:00	Femtosecond optical pump-probes techniques.
	16:00 – 16:30	Coffee Break
16:30 - 18:00	Time evolution of lattice and collective modes.	
18:00 – 19:30	Welcome reception	

Date	Time	Sections
Tuesday, 11/09/2012	9:00 – 10:45	Optical pump – X probes techniques.
	10:45 – 11:15	Coffee Break
	11:15 – 13:00	Time resolved ARPES probes.
	13:00 – 14:30	Lunch
	14:30 – 16:15	Electrostatic manipulation of Mott insulators.
	16:15 – 16:45	Coffee Break
	16:45 - 18:15	Electrostatic manipulation of magnetically ordered states.

Date	Time	Sections
Wednesday, 12/09/2012	9:00 – 10:45	Time resolved diffraction, X-ray laser sources.
	10:45 – 11:15	Coffee Break
	11:15 – 13:00	Time evolution of electronic spectra.
	13:00 – 14:30	Lunch
	14:30 – 16:15	Electrostatic manipulation of electronic crystals: Charge and Spin Density Waves, ferroelectricity
	16:15 – 16:45	Coffee Break
	16:45 - 18:30	Poster session

Date	Time	Sections
Thursday, 13/09/2012	9:00 – 10:45	Combined methods: the light and the field.
	10:45 – 11:15	Coffee Break
	11:15 – 13:00	Inhomogeneous and/or instantaneous cooperative electronic phases and topological defects
	13:00 – 14:30	Lunch
	14:30 – 16:15	Sister systems: polaritons and excitons.
	16:15 – 16:45	Coffee Break
	16:45 - 18:15	Theories of cooperative and correlated electronic phases at junctions.
	20:00	Conference dinner

Date	Time	Sections
Friday, 14/09/2012	9:00 – 10:45	Towards devices and applications. Super-semiconducting opto-electronics and oxitronics.
	10:45 – 11:15	Coffee Break
	11:15 – 13:00	Towards devices and applications. Nontraditional field-effect transistors.
	13:00 – 14:30	Lunch
	14:30 – 16:15	Spacio-temporal symmetry breaking and restoration.
	16:15 – 16:45	Coffee Break
	16:45 - 18:15	Theories of out-of-equilibrium cooperative electronic systems

3. CVs OF SCIENTIFIC ORGANIZERS:

Serguei (Serge) BRAZOVSKI

Date of birth 30/09/1945

Scientific degrees

1983 HdR, Landau Institute for Theoretical Physics, Moscow, Russia
1972 PhD in Physics, Landau Institute for Theoretical Physics, Moscow, Russia.
1969 Master, Physical-Technical Institute, Moscow, Russia

Affiliation

2011-now LPTMS, CNRS Leading research scientist, DR1, emeritat.
1998 - 2011 LPTMS, CNRS Leading research scientist, DR1.
1972 -1998 Landau Institute for Theoretical Physics, Moscow, Russia.

Scientific Responsibilities

Grants: INTAS, ANR, RTRA

Membre de Comite d'Evaluation d'ANR « Retour de post docs »

Expert of New Eurasia Found.« Measures to attract leading scscientists...»

1998-2011 Condensed matter group leader LPTMS,Orsay
1993-now Co-chaimen of tri annual the Intern. Conf. of Electronic crystals
1982–now International Advisory Board member of of ICSM
1979–now Regional Editor of the journal “Synthetic Metals”
1990–1997 Regional Editor of the journal “Journal de Physique”.
1996–2000 Consultant of Los Alamos National Laboratory (LANL)
1998–2005 Member of Scientific Council of LPTMS, Orsay
1989-1993 Member of Sci. C. of Institut of Scientific Interchange Turin, Italy
1986–1994 Member of Scientific Council of the Landau Institut, Moscow, Russia
1989-1992 Department head at the Landau Institut, Moscow, Russia
Responsable des groupes d'INTAS et du Européen network (France, Italy)
Expert du “Journal des Referats de Physique”, Moscou; Russie.
Long scientific visits at: NORDITA; ISI-Torino; Brookhaven NL; Los Alamos NL; Yukawa Institute, Kyoto; ISSP, Tokyo Univ.; Chicago Univ.; Seoul Univ.

Publications and communications: 153 publications in peer review journals, 82 invited presentations at international conferences

Most relevant publications of the last 5 Years:

1. S. Brazovskii, Ch. Brun, Zhao-Zhong Wang, and P. Monceau, " Scanning-tunneling microscope imaging of single-electron solitons in a material with incommensurate charge-density waves", *Phys. Rev. Lett* **108** 096801-04 (2012)
2. R. Yusupov, T. Mertelj, V.V. Kabanov, S. Brazovskii, J.-H. Chu, I. R. Fisher, and D. Mihailovic, “Coherent dynamics of macroscopic electronic order through a symmetry breaking transition”, *Nature Physics*, **6**, 681-684 (2010).
3. N. Kang, B. Salameh, P. Auban-Senzier, D. Jérôme, C.R. Pasquier, S. Brazovskii, “Domain walls at the spin density wave endpoint of the organic superconductor (TMTSF)₂PF₆ under pressure”, *Phys. Rev. B* **81**, 100509(R) (2010)
4. Serguei Brazovskii and Natasha Kirova, “Physical theory of excitons in conducting polymers” *Chem. Soc. Rev.*, **39**, 2453–2465 (2010).
5. N. Kirova, S. Brazovskii, “Ferroelectricity: from Organic Conductors to Conducting Polymers”, *Physica B*, **404**, 382–384 (2009).

Luca Perfetti

Date of birth : 1/10/73

Academic positions and degrees

From 2008: Assistant Professor at the Ecole Polytechnique

2003-2008: Postdoc at the Freie Universitaet Berlin in the group of M. Wolf.

2002-2003: Postdoc at Ecole Polytechnique Fédérale de Lausanne in the group of M. Grioni

1998-2002: PhD in physics at the Ecole Polytechnique Fédérale de Lausanne

Research experiences:

Time Resolved Photoelectron Spectroscopy, Time Resolved TeraHertz Spectroscopy, Non-linear optics, strongly interacting materials.

Publications and communications

A total of **42** Articles among which **2 Science** and **9 Physical Review Letters**, **2 book chapters** and **22 invited contributions** to international conferences.

Most relevant publications of the last 5 Years:

Temperature dependence of ultrafast phonon dynamics in graphite, M. Scheuch, T. Kampfrath, M. Wolf, K. von Volkman, C. Frischkorn, and **L. Perfetti**, Applied Physics Letters **99**, 211908 (2011).

Significant Reduction of Electronic Correlations upon Isovalent Ru Substitution of BaFe₂As₂, V. Brouet, F. Rullier-Albenque, M. Marsi, B. Mansart, M. Aichhorn, S. Biermann, J. Faure, **L. Perfetti**, A. Taleb-Ibrahimi, P. Le Fevre, F. Bertran, A. Forget, and D. Colson, Physical Review Letters **105**, 087001 (2010).

Transient electronic structure and melting of a Charge Density Wave in TbTe₃, F. Schmitt, P. S. Kirchmann, U. Bovensiepen, R. G. Moore, L. Rettig, M. Krenz, J.-H. Chu, N. Ru, **L. Perfetti**, D. H. Lu, M. Wolf, I. R. Fisher, and Z.-X. Shen, Science **321**, 1649 (2008).

Ultrafast electron relaxation in superconducting Bi₂Sr₂CaCu₂O_{8+δ} by time resolved photoelectron spectroscopy, **L. Perfetti**, P. A. Loukakos, M. Lisowski, U. Bovensiepen, H. Eisaki, and M. Wolf, Physical Review Letters **99**, 197001 (2007).

Time Evolution of the Electronic Structure of 1T-TaS₂ through the Insulator-Metal Transition, **L. Perfetti**, P. A. Loukakos, M. Lisowski, U. Bovensiepen, H. Berger, S. Biermann, P. S. Cornaglia, A. Georges, M. Wolf, Physical Review Letters **97**, 067402 (2006).

Victor Yakovenko

Date of birth 24/03 1961

Affiliation

2004 – now Full Professor, Department of Physics, University of Maryland, USA
1999 – 2004 Associate Professor, Department of Physics, University of Maryland, USA
1993 – 1999 Assistant Professor, Department of Physics, University of Maryland, USA
1991 – 1993 Research Associate, Department of Physics and Astronomy, Rutgers University, USA
1987 – 1991 Research Scientist, Landau Institute for Theoretical Physics, Moscow, Russia

Visiting Positions

1990, 1991 - Interdisciplinary Research Center in Superconductivity, Cambridge Univ. UK
1990 - Institute for Scientific Interchange, Turin, Italy
1989 - CNRS, Laboratoire de Physique des Solides, Université □ R. M. Lutchyn, P. Nagornykh, and V. M. Yakovenko, "Gauge-invariant electromagnetic response of a chiral p_x+ip_y superconductor",

Fellowships, prizes, and Awards

1995--2000 , 2006 Fellow of the Joint Quantum Institute, UMD--NIST
2004 Fellow of the American Physical Society
2003 Richard A. Ferrell Distinguished Faculty Fellowship, Dept. of Physics, UMD
1995--2001 David and Lucile Packard Fellowship in Science and Engineering
1994—1996 Alfred P. Sloan Research Fellowship
1990 Soviet Youth League Prize in Physics

Other

- Member of the American Physical Society: Division of Condensed Matter Physics (DCMP) and Group on Statistical and Nonlinear Physics (GNSP), since 1993
 - Honorary Member of the Institute of Theoretical and Applied Physics, Marmaris, Turkey, since 2006
1. R. M. Lutchyn, P. Nagornykh, and V. M. Yakovenko, "Gauge-invariant electromagnetic response of a chiral p_x+ip_y superconductor", Phys. Rev. B **77**, 144516 (2008). **PRB Editors' Suggestion.**
 2. K. Sengupta and V. M. Yakovenko, "Spontaneous spin accumulation in singlet-triplet Josephson junctions", Phys. Rev. Lett. **101**, 187003 (2008).
 3. R. M. Lutchyn, P. Nagornykh, and V. M. Yakovenko, "Frequency and temperature dependence of the anomalous Hall conductivity in a chiral p_x+ip_y superconductor with impurities", Phys. Rev. B **80**, 104508 (2009). **PRB Editors' Suggestion**
 4. S. S. Pershoguba and V. M. Yakovenko, "Energy spectrum of graphene multilayers in a parallel magnetic field", Phys. Rev. B **82**, 205408 (2010).
 5. R. M. Lutchyn, M. Dzero, and V. M. Yakovenko, "Spectroscopy of the soliton lattice formation in quasi-one-dimensional fermionic superfluids with population imbalance", Phys. Rev. A **84**, 033609 (2011)

Natasha KIROVA

Date of birth 30/09/1946.

Scientific degrees

1995	French University Professor State Qualification
1988	Habilitation in physical and mathematical sciences, Moscow, Russia
1983	Senior Research Scientist degree, Moscow, Russia.
1972	Ph. D. in physical and mathematical sciences, Moscow, Russia.
1969	Master (Physical-Technical Institute, Russia), Diploma com Lauda.

Affiliation:

2011 – now	Visitor, CNRS, LPS, Université Paris-Sud, Orsay, France
2004 – 2011	Research Director, CNRS, LPS, Université Paris-Sud, Orsay, France
2002 – 2004	Research Director, CNRS, POMA, Université d'Angers, Angers, France
1989 - 2002	Leading Research Scientist, Inst. for Physical Problems, Russia.
1979 – 1988	Senior Research Scientist, Inst. for Physical Problems, Russia.
1973 – 1979	Research associate, Inst. for Physical problems, Russia.

Scientific Responsibilities

Co-organizer of the series of International Workshops on Electronic Crystals

Grants: INTAS, ANR, RTRA

2006-2010	Elected Member of Council of the Solid State Physics Lab, CNRS;
1989 – 98	Member of Sci. C. at the Science Centre of Microelectronics, Russia.
1989 – 96	Member of Jury for annual awards for best scientific works, Russia.
1986 - 98	Member of Sci. Council at the Institute of physical Problems, Russia.
1989 – 96	Member of Jury for PhD and Habilitation at Sci. Centre, Russia.
1986 - 93	Member of Sci. Council « Molecular Electronics » Russia
1975 – 87	Interpreter of books at the "Mir" Publishing House, Russia.
1978-1993	Group leader at the Institute of Physical Problems, Russia.

Invited positions:

USA: Univ. of Chicago; S. Barbara; Brookhaven Nat. Lab., Los Alamos Nat. Lab.

Italy: Institute for Scientific Interchange Foundation, Turin. *Japan:* Yukawa Institute; Univ. of Tokyo; Univ. of Aizu. *South Korea:* Seoul University.

International Conferences (invited and oral talks) 78. Publications: 110.

Selected publications:

1. N. Kirova, S. Brazovskii, "Ferroelectricity: from Organic Conductors to Conducting Polymers", *Physica B*, **404** (2009) 382.
2. D. Le Bolloc'h, V.L.R. Jacques, N. Kirova, J. Dumas, S. Ravy, J. Marcus, F. Livet "Observation of micrometric correlations in the sliding regime of a charge density wave", *PRL* **100** (2008) 096403. **Suggest. of editor PRL June 2008**
3. N.Kirova "Electronic states at junctions of molecular semiconductors." *J. Phys. Chem. Solids*, **69**, (2008) 2248.
4. N. Kirova, Long-Range and Local Instabilities in Sliding Charge Density Waves, *Journ. of Superconductivity and Nouvel Magnetism*, **22** (2009) 559.
5. N.Kirova "Understanding excitons in optically active polymers." *Polymers International*, **57** (2008) 678.

4. CONFIRMED SPEAKERS.

Henri Alloul (<i>LPS, Universite Paris-Sud, France</i>)	Experiment	Superconductors
Dimitri Basov (<i>University of California, San Diego, USA</i>)	Experiment	Optics
Michael Bauer (<i>University of Kiel, Germany</i>)	Experiment	Optics
Ivan Božović (<i>Brookhaven National Laboratory, USA</i>)	Experiment	MBE
Hervé Cailleau (<i>Inst. de Physique de Rennes, France</i>)	Experiment	Ferroelectrics
Andrea Cavalleri (<i>MPSD, Univ. of Hambourg, Germany</i>)	Experiment	ARPES
Leonardo Degiorgi (<i>ETH, Zurich, Switzerland</i>)	Experiment	Optics
Jure Demsar (<i>University of Konstanz, Germany</i>)	Experiment	Optics
Marc Gabay (<i>LPS, Universite Paris-sud, France</i>)	Theory	Correlations
Allen Goldman (<i>University of Minnesota, USA</i>)	Experiment	Field Effect
Richard Greene (<i>University of Maryland, USA</i>)	Experiment	Superconductors
Isao Inoue (<i>AIST, Tsukuba, Japan</i>)	Experiment	Junctions
Shinichiro Iwai (<i>Tohoku University, Japan</i>)	Experiment	Electrolites
Shin-ya Koshihara (<i>Tokyo Inst. of Technology, Japan</i>)	Experiment	FET
Peter Littlewood (<i>Argonne National Lab, USA</i>)	Theory	Polaritons
Gennady Logvenov (<i>MPI Stuttgart, Germany</i>)	Technology	MBE
Marino Marsi (<i>LPS, Universite Paris-Sud, France</i>)	Experiment	Photoemission
Dragan Mihailovic (<i>Ljubljana University, Slovenia</i>)	Experiment	Optics
Daniele Nicoletti (<i>MPSD, Univ. of Hambourg, Germany</i>)	Experiment	X-rays
Hiroshi Okamoto (<i>University of Tokyo, Japan</i>)	Experiment	Optics
Yung Woo Park (<i>Seoul National Univ., South Korea</i>)	Experiment	Polymers
Davor Pavuna (<i>EPFL, Switzerland</i>)	Experiment	Oxides
Marcelo Rozenberg (<i>LPS, Universite Paris-Sud, France</i>)	Theory	Mott state
Hideaki Takayanagi (<i>Tokyo Univ. of Sci., Japan</i>)	Experiment	Semiconductors

Takami Tohyama (<i>Yukawa Inst., Kyoto, Japan</i>)	Theory	Computations
Javier E. Villegas (<i>CNRS/THALES , France</i>)	Experiment	Ferroelectricity
Jean-Marc Triscone (<i>University of Geneve, Switzerland</i>)	Experiment	MBE
Philipp Werner (<i>ETH,Zurich, Switzerland</i>)	Theory	Surface states