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Editorial

The rapidly developing activity in condensed matter physics has a goal of controlled transformations of electronic states and whole phases by external impacts. There are two main directions: electrostatic doping by ultra-strong electric fields and very fast and powerful optical pumping. Being, in general, as young as from 2000's, the field has experienced an explosive development during the last few years. The studies explore several classes of materials such as superconducting cuprates and pnictides, conducting oxides and chalcogenides, traditional and organic semiconductors, and semimetals including graphene. Their states encounter superconductivity, charge/spin density waves, charge ordering, ferroelectricity, magnetic phases, and Mott, Peierls and topological insulators. Primarily interests are focused upon systems with various symmetry-broken ground states – from crystallisation of electrons (charge order) or electron-hole pairs (charge/spin density waves) to superconductivity. That brings to the agenda the topological defects: domain walls, vortices, dislocation lines, down to microscopic solitons. An impact applied to a material with a symmetry broken state can even yield a new, stable, long living electronic phase unknown in equilibrium conditions.

Techniques of femto-second optical impacts vary from the well established purely optical pump-and-probe setups to recent time-resolved photoemission spectroscopy ARPES, and time-sliced diffraction attainable only with special X-ray and freeelectron laser sources. A very recent trend is to exploit the Tera-Hz diapason both as an optical probe and to build short-lived but very high and non-destructive electric fields. Other recent achievements include the ultrafast time-resolved scanning tunnelling microscopy STM, the light emitting semi-super-conducting device, and the light emitting Bose condensate of excitons in semiconductors. First principles models and phenomenological theories have flourished following experimental demands and confront highly technical challenges.

On the way to electrostatic doping, the experimental success was achieved on several lines: the ferroelectrically enhanced field effect in high-T_c superconductors, the superconductivity induced by interlayer charge transfer and finally by the ionic field effect exploiting solid electrolytes to achieve surface electric fields superior to anything else. The most spectacular achievement is the field-effect transformation of normal and even insulating states to the superconducting one; mention also manipulations with an exotic Mott state. At present, the described field has a fundamental character which is already very important for moving scientific boundaries beyond their limits (shortest times, highest fields) and meeting a popular interest in "emerging phenomena". At the same time, achieving the controlled switching between electronic phases, particularly obtaining superconductivity (even at surfaces or in short leaving forms) on top of a pristine insulating state, the hybridisation of semi- and superconducting (opto)electronics, and also new types of memory based on metalinsulator switching are all that targets for applied science when designing promising new devices. A more detailed and updated description of the current activity and history of these excursions can be found at the editors' web site `http://lptms.upsud.fr/membres/brazov/IMPACT2012.html`.

This page also provides information on a related conference, *Electronic States and Phases Induced by Electric or Optical Impacts* (`http://lptms.u-psud.fr/impact2012`) which took place in 2012 at the University Paris-Sud in Orsay, France

and was organized by S. Brazovskii and N. Kirova (CNRS & Université Paris Sud, France), L. Perfetti (Ecole Polytechnique, France), and V. Yakovenko (University of Maryland, USA). The meeting, the very first of its kind, attracted a significant fraction of all major players from leading laboratories around the world and was primarily aimed at reaching synergies between different communities working on closely related problems, but having had only few opportunities so far to interact through closer collaborations or joint meetings.

Keeping this spirit, the present volume, based on selected original and refereed material from this meeting, is organized around common physical phenomena or applications rather than around particular techniques.

We believe that this collection of articles, together with materials of the IMPACT meeting will serve to integrate communities working in these fascinating leading edge directions of science.

Serguei Brazovskii and Natasha Kirova