Report to the 2005 General Assembly

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Commission 10 on the Structure and Dynamics of Condensed Matter covers a broad area of physics. During the period of 2002 to 2005, the following conferences have been sponsored by IUPAP, following the recommendations of the Commission :

The 5th International Conference on Exitonic Processes in Condensed Matter, held in Darvin (Australia) in 2002 ; Organizer : Prof. Jai Singh

The 7th International Conference on the Structure of Surfaces, held in Newcastle (Australia) in 2002 ; Organizer : Prof. O'Connor

The 11th International Conference on Phonon Scattering in Condensed Matter, held in St. Petersburg (Russia) in July 2004

The XIIIth International Conference on Hyperfine Interactions, held in Bonn (Germany) in August 2004

The 6th International Conference on Exitonic Processes in Condensed Matter held in Cracow (Poland) in July 2004.

Most of the Commissions meet at one of the major conferences sponsored by those commissions : International Conference on Low Temperature Physics for C5, International Conference in Semiconductor Physics for C8, Internatioanl Conference on Magnetism for C9, …Up to now, there are no such major conferences in the field of C10. However for 2006, C10 will recommand to IUPAP to sponsor the large type A conference entitled : International Conference on Materials and Mechanics of Superconductivity –High Temperature Superconductors (M 2S-HTSC). The VII conference will be held at Dresden (Germany). There is the hope that C10 will regularly host this conference for the future.

New Developments

Many of the research activities in the areas of condensed matter covered by the Commission are devoted to the characterization of the structure of very different kinds of materials with different ground states (metallic, semiconducting or insulating). They are also often complex disordered systems such as polymeric , granular or nanostructured materials.

An intense activity deals with the magnetic excitations in the high Tc superconducting state, as well as spin-charge-lattice interactions in manganites. New progresses have been made in photo-induced molecular magnetism as well as in geometrically frustrated magnetic systems and in low dimensional magnetic systems.

Many different techniques have allowed the study of adhesion phenomena, chemical reactiviy and grafting on nanocomposites

Large scale facilities

Neutron and synchrotron radiation techniques for the investigation of the structure and dynamics of condensed matter is of a direct relevance for the research fields covered by C10, including chemistry, materials science, physics, biological sciences, environmental and

engineering sciences. The structural knowledge obtained with x rays and neutrons holds the key to understand the properties of matter.

These experiments are performed in large-scale user facilities. New technology is allowing the upgrade of performance of the neutron sources and instruments. New reactor sources have started to be operating (Germany) or under construction (Australia). Dramatic improvements in accelerator technology have made possible to design and construct a source to produce very intense neutron pulses. Thus, a completely new dimension of neutron source is coming from the second-generation spalliation sources under construction in the US (Spalliation Neutron Source (SNS) to be operating in 2006) and in Japan (J-PARC in 2006-2007). The decision concerning the Europeean Spaliation Source(ESS) has been posponed for the future.

Over the last decade, world-class third generation synchrotron (SR) sources have entered operation – ESRF in France, Spring-8 in Japan and the Advanced Photon Source (APS) in the US. Several new sources are under construction. A class of revolutionary sources in the field of photon science is expected from Linac driven free electron laser (XFEL) working according to the self amplified spontaneous emission principle. They will provide laser radiation at X-ray energies with about 1 Angström wavelength for the first time. At these energies, XFEL will provide peak brilliance about 8 orders of magnitude higher than present storage ring based synchrotron radiation sources.

Many of the technological progresses of neutron and synchrotron sources are particularly interesting for applications in nanosciences : magnetic imaging, tomography techniques, grazing incidence small angle scattering giving access to morphology of nano-islands, chemical reactions with an unprecedented spatial and temporal resolution, nanoprocesses at surfaces as well as in buried interfaces, nanoscale dynamics over a wide range of time scales in entangled polymers, glassy materials and liquids, excitations in materials patterned in nanoscales,…

Initiatives are also under way to combine x-ray and synchrotron scattering with very high magnetic fields. A high potential of intense pulsed magnetic fields with synchrotron radiation is highly recognized.

Working Group on Facilities for Condensed Matter Physics

IUPAP has formed by a resolution of the Council in 1998 a « Working Group on Facilities for Condensed Matter Physics » The activity of the Working Group has concentrated on the problem of the future of neutron sources in 2 meetings , one in Mito (Japan) in November 2000 and the second one in Münich in September 2001. In 2004 the Working Group has produced a report on High Magnetic Fields summarizing

- the existing possibilities in both static and pulsed high magnetic fiels facilities
- the scientific achievements, illustrated by a few examples, obtained in such facilities
- a list of ambitious projects that might be undertaken in the next ten years

Neutron and synchrotron great installations are at the heart of our C10 community. Progresses in researches will be strongly improved by cross-fertilization and cross-boundaries between these two techniques. All around the world, synchrotron and neutron sources are often nearby and will strongly benefit of a mutual partenrship. These sources serve a large user community using alternatively one or the other technique. They should attract an increasing number of new user communities which are not « neutron or synchrotron experts ».

C10 members who attend a commission meeting during the APS meeting in Montreal (Canada) in

rch 2004 have considered that a Working Group on these sources will be of a great interest with the aim to create close links between users of both sources, with a specific attention to the complementarity of these probe beams.

C10 proposes the following brief for this Working Group:

Scientific complementarity of synchrotron radiation and neutron sources: past experience and future opportunities

After three decades of scientific exploitation of dedicated synchrotron X-ray sources and neutron sources, a significant knowledge base has been built up concerning the

complementary ways in which these two kinds of central facilities can be exploited. Over this time period, the power of both kinds of source, and their instrumentation, have both increased very significantly, and with these increases, the ways in which complementarity can be exploited have also developed. We are also faced with further enhancements with future sources, including the new neutron sources under construction in the US and Japan, and the discussion of next generation X-ray sources, for example in Europe.
In order to try to encourage optimal scientific exploitation of both existing and potential sources, the working group could be tasked with
(a) scientific assessment of the ways that the complementarity of neutron and synchrotron sources have so far been exploited in condensed matter science;
(b) comment on how effective this exploitation of complementarity has been;
(c) suggest ways in which it could be further and more effectively exploited on existing sources;
(d) suggesting mechanisms that might be put in place to encourage such better exploitation;
(e) considering how complementarity opportunities will further develop in the light of new sources that are both (i) currently under construction, and (ii) under consideration for the future.
While membership should be first and foremost active condensed matter research scientists who have 'hands on' experience with both kinds of sources, people from othe disciplines such as condensed matter areas in Chemistry, Biology, Earth Sciences should be also involved

Pierre Monceau
C10 Chair