LLB Director's Foreword in 2003-2004

This scientific report describes an overview of the Laboratoire Léon Brillouin (LLB) activities during the 2003-2004 period, using the neutron beams provided by the ORPHEE research reactor in SACLAY, France. The LLB is a CNRS-CEA mixed research unit ("Unité Mixte de Recherche", UMR12) funded by the French research agencies, the "Centre National de la Recherche Scientifique" (CNRS) and the "Commissariat à l'Energie Atomique" (CEA). Since more than twenty (20) years, LLB is one of the best *large-scale* facilities for *small* science, where many "small" teams of scientists spend a few days performing specific experiments in physics, chemistry, biology, material or earth sciences.

The LLB, the French Neutron Laboratory, is:

- a **Large-scale National Facility** dedicated to neutron scattering experiments proposed by external users, from French academic laboratories, and also industrial firms, performed in the best conditions,
- a **Research Laboratory** with its own scientific activity centered on the use of the LLB facilities with experiments performed by permanent or associated teams,
- a **Training centre** for young researchers, in particular thesis students preparing PhD diploma essentially based on neutron scattering techniques and instrumentation.

This triple character of the LLB mission, neutron facility, research laboratory and training centre, leads to an integrated scientific platform of excellence and the research performed at the LLB is acknowledged worldwide in many scientific fields. The LLB, as the French national neutron facility, benefits from the quality of the Orphée reactor, almost exclusively dedicated to research. Orphée is flawlessly run and maintained by the Direction of the Nuclear Energy (DEN) of the CEA.

Orphée-LLB and the European Community (EC):

Brussels has selected the LLB since 1993 in the access programs for large installations. After the fifth program (FP5) operated until May 2004, Orphée-LLB is part of the "Neutron and Muon Infrastructure Integrated Initiative" (NMI3) of the sixth EU framework programme for Research and Technological Development (FP6). In the framework of this program, the LLB will deliver 500 days of neutron beam time during 4.5 years, from 2004 to 2008, to the research teams of the EC and associated countries. Aside the access program, LLB participates actively to technical network projects ("JRA" for Joint Research Activities) on neutron optics, polarisation techniques and detectors.

Neutron beam time for French and foreign researchers:

In the normal operation mode (180 days of neutron delivery per year) about 3500 beam time days are delivered on 23 spectrometers: 64% for the French community, 25% for EC countries including PECO countries now full participants in the EC, 4% for Russia and 7% for "other" countries. On average, nearly five hundred (500) experiments are performed every year by more than eight hundred (800) scientists for all over the world.

Research done at LLB is following the main strategic schemes and topmost priorities of the French research agencies, namely the CNRS and the CEA.

Condensed matter physics

The LLB is a leading centre for studies on superconductivity and magnetism. Internationally acknowledged highlights are focussing on magnetic excitations in the high T_C superconducting state and spin-charge-lattice interactions in manganites. New progresses have been achieved in photo-induced molecular magnetism, as well as in geometrically frustrated magnetic systems (crystallisation of a spin liquid under pressure), and low dimensional magnetic systems. A new magnetic phase has also been discovered for oxygen in extreme pressure conditions, a field of excellence at LLB.

Nanosciences

Adhesion phenomena, solubilization, chemical reactivity and grafting on nanocomposites, protein interactions are important processes operating at interfaces that can be studied by standard neutron reflectivity whereas polarised neutron techniques probe the magnetic structures of layered devices for the future spin electronics. Off-specular scattering experiments are now developed and will bring very valuable information on structure and magnetism of laterally-patterned systems.

Technologies for energy

New projects are developed at the LLB concerning environmental problems, earth sciences, innovative materials for cleaner energies like membranes for fuel cells, lithium batteries, special steels for new reactors (e.g. aging behaviour of dedicated steels under irradiation).

Life sciences

The focus at the LLB is on protein unfolding and structure-function relationship in biological systems. Neutron diffusion allows also characterizing bio-polymers from plants and polyelectrolytes that are important for technological interest in the

food industry. Neutron spectroscopy is a powerful tool to resolve the protein motions in the time range from picoseconds to tens of nanoseconds, with the help of the large cross section of hydrogen/deuterium atoms.

Instrumental developments at Orphee-LLB

These projects are gathered under the item CAP2010. The neutron spectrometers must be continuously refurbished and upgraded to be kept attractive at an international level. The upgraded 3T2 high-resolution powder diffractometer will be in operation in the 2005 summer. The time-of flight reflectometer EROS is upgraded to face the growing studies on liquid interfaces in soft matter and complex systems. The new very small angle spectrometer TPA is now in its building phase (the monochromating sections and detector housings will be available in 2005 and a multibeam collimator is currently designed and tested on the G5B position). The last project concerns the high-resolution TOF (Time-of-Flight) and NRSE (Neutron Resonance Spin Echo) machines Mibemol and Muses: a new TOF spectrometer Fa# is under study and will be placed on the G3 end-guide position and a multidetector secondary spectrometer is studied for Muses. Aside these six major instrumental projects, there is a rising request of supermirror guides and two-dimensional detectors to be financed and built.

Orphee-LLB in the French Research turmoil in 2003-2004

In 2003, the LLB was in the middle of nowhere, “Il Casino Totale” in italian. In March 2003, the French government decided to cancel 10% of the budget for research (out of salaries) and to freeze 30% of this budget. The consequence on Orphée-LLB in 2003 was the CNRS reduced financial contribution to 60 days of beam time, compared to the 180 days scheduled. Also, due to foreseeable budget difficulties in the following years, the CNRS was considering to discontinue its financial support to the installation. A great support from France and abroad users as well as from international organisations and Institutions yielded to a temporary CNRS-CEA agreement for 2004 and 2005 with a limited number of neutron days (6 cycles of 19 days, i.e. 114 days). In autumn 2003 and spring 2004, an international evaluation committee (chaired by Ph. Nozières) and many delegations from CNRS, CEA and French Ministry of Research have intensively scrutinized the strategic and scientific activities of Orphée-LLB. This procedure led to the decision of the extraordinary steering committee held on 4 October 2004 to have Orphée-LLB back to normal working conditions – namely, a minimum of 180 days per year- as soon as possible in 2006. This decision sticks to the Minister of Research instructions aimed at the Chief Executive Officer of the CEA and the Director-General of the CNRS. This conclusion put an end to the high anxiety about the Orphée-LLB fate after 2005. A new CNRS-CEA contract will be signed in the beginning of 2005; this new agreement will start on January 2006 for five (5) years and will be renewed for 5 year-periods by tacit approval. The LLB has now a clear future.

Orphee-LLB in the neutron European and International landscape

The Munich reactor FRMII started in 2004 and will complement the neutron work done at Jülich and Berlin. ISIS is investing 100M£ to build a second target station and the related instrumentation to be in operation in 2007, in phase with the new DIAMOND synchrotron. We are still in a stimulating phase when the main European countries, like Great Britain and Germany, develop their national neutron sources while reinforcing their association with the ILL, the European high-flux reactor.

The LLB collaborated closely with all these centres to promote the case of the European Spallation Source ESS in the last years. However, Europe has lost the neutron initiative and the ESS project was shut down in 2003. Following the move done in Europe towards the ESS project, the US is now *building* in Oakridge its next generation Spallation Neutron Source SNS. And the Japan Hadron Facility J-PARC includes a Megawatt spallation source much more powerful than ISIS, showing that Neutron Scattering is an essential technique in many research domains, like material science, superconductivity, nanosciences, chemical physics and life science. With a bright future, the LLB will be able, on the long term, to reinforce the European scientific community among the other European synchrotron sources, laser and RMN platforms and, of course, neutron centres.

The Saclay platform: Orphée-LLB Neutron Centre and SOLEIL Synchrotron

The two French facilities will start in 2005 regular workshops focusing on scientific or technical subjects of interest for the neutron and synchrotron community. The first workshop, “Magnétisme et Nanostructures”, is scheduled in May 2005. It is foreseen that, in a near future, the “Saclay Plateau” will become a meeting point for complementary techniques and we hope that this will be as successful on a French stand as in other countries (Germany, Switzerland and UK) or in Grenoble on a European level with the ILL and the ESRF.

Finally, early in February 2005, Philippe Mangin will take the position of Director of the LLB and will replace P. Monceau who will go back to Grenoble, to the “Centre de Recherches sur les Très Basses Températures” (CRTBT).

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