X-Ray Scattering and Magnetism

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Magnetism has become a major field of investigation with synchrotron radiation. In particular, the highlights of the ESRF for 1996/1997 state that «The use of x-rays for the investigation of magnetic properties of matter is a relatively recent field», and then continues with 11 pages of various examples of new effects measured at the ESRF in this field. A large fraction of the allocated beam time is spent on studying various aspects of magnetism. To focus on this activity a workshop was organized at the ESRF and held over the weekend of 15/16 November 1997 before the large SR50 conference. Some 90 attendees came to hear speakers over the day and a half of meeting.

M. Blume (BNL, USA) opened the conference recalling the fundamental cross-sections and showing how the general non-resonance cross-section was modified by the introduction of resonant terms. B. Gyorffy (Bristol, UK) and M. Brooks (Karlsruhe, Germany) discussed new directions in theory stimulated by synchrotron experiments. We heard reports of experiments using both non-resonant (Th. Brueckel, Jülich, Germany; J. McCarthy, ESRF) and resonant techniques (C. Detlefs, Ames, USA; S. Langridge, Rutherford Lab, UK) that gave representative examples in the field of scattering from synchrotrons in Hamburg, Brookhaven and Grenoble, and included new experiments to look for «orbital ordering» in perovskite materials (S. Ishirara, Sendai, Japan). Later the first day we turned to dichroism with a theory talk by P. Carra (ESRF) on the sum rules, and contributions by G. van der Laan (Daresbury Lab, UK), A. Rogalev (ESRF), and the extension of dichroism to photoemission (G. Kaindl, Berlin) and magnetic EXAFS (G. Schütz, Wurzburg, Germany). These talks showed that techniques using the dichroic signal are rapidly expanding and that more advances can be anticipated.

After a long first day, the participants were rewarded with a fine dinner in town, and the second day started in earnest at 9am (on Sunday) with contributions on surfaces and films. N. Bernhoeft (ILL), D. Gibbs (BNL, USA), G. Helgessen (Kjeller, Norway) and C. Sutter (ESRF) showed the variety of that are now being examined with scattering, almost all using resonant techniques and involving rare-earths and actinides. The workshop ended with reviews of inelastic scattering (F. Sette, ESRF) and perspectives for the future (M. Altarelli, ESRF). These last talks introduced new areas and showed that, despite the considerable impact of synchrotron studies on magnetism, the field is rapidly expanding and the future looks bright and challenging.

All participants could enjoy a fruitful exchange of ideas and experiences. The interest and involvement of the audience was reflected in lively discussions. Although there were no neutron talks per se in the workshop, all attendees were aware of the significant impact neutrons have had, and continue to have, on magnetism. It was appropriate that much of the complementary nature of the photon probe should be emphasized in the Chadwick Amphitheatre of the Institut Laue Langevin – under the stern gaze of the discoverer of the neutron. It is planned to organize a common workshop in the near future together with the neutron community on the complementary use of neutrons and x-rays in the study of magnetism.

We illustrate the broad scientific range of the workshop with the following two articles that expose recent advances in the field, although they are not directly related to magnetism.

In a first paper M. Altarelli describes the physics of the ordering of electronic orbital occupancy, which shows some similarities with magnetic order, and N. Bernhoeft et al. present the competition between the coherence length of the probe and correlation length scales in the sample that lead to new effects in x-ray and neutron scattering experiments.