Review of Neutron Scattering in Condensed Matter Physics

Neutron Scattering in Condensed Matter Physics (by Albert Furrer, Joël Mesot, and Thierry Strässle, World Scientific) provides an excellent introduction to neutron scattering techniques as they are applied to hard condensed matter physics and materials research. The book was developed from lectures presented by the authors and is formulated as a textbook that is quite suitable for a formal neutron scattering course. The level of the material is appropriate for graduate students, where a basic understanding of condensed matter physics and quantum mechanics (such as commutation relations, for example) is assumed. The emphasis is on experimental techniques, and the general approach, is to present only the formulae essential for the discussion, typically skipping over detailed derivations to get at the essence of the physics being discussed. Some of the mathematical detail can be found in the appendices, or can easily be supplemented by the instructor or reference texts depending on the interest and needs of the students.

The book first introduces the basic properties of neutrons and how they scatter, and reviews the modern instrumentation available to researchers, with a nice balance between steady-state and pulsed neutron sources and instrumentation. It then covers the traditional strengths of neutron scattering by discussing the fundamentals of crystal structure diffraction and the lattice dynamics of periodic systems, followed by a chapter on liquids and amorphous materials. These topics are followed by analogous chapters on magnetic structures, spin directions, magnetic form factors, and spin dynamics. The book then branches out into a number of more advanced topics that are both important to neutron scattering and of current interest in condensed matter physics; phase transitions and critical phenomena, superconductivity and superfluidity, defects in solids, thin films and interfaces, and finally hydrogen dynamics. Each chapter includes a helpful list of articles and books for further reading on the topic, which should be particularly useful for students and researchers who are interested in more in-depth material or need to prepare a term report on a particular topic of interest. A few of the chapters contain several exercises at the end, together with solutions. These should be useful for some readers, but not necessarily when teaching a formal course, and the inclusion of problems to be assigned by the instructor would be a welcome addition to the textbook. A complete table of scattering amplitudes and cross sections is provided, and the subject index is relatively complete.

Overall, the text is a very readable and thorough introduction to the subject of neutron scattering techniques. The material is generally what one would want every prospective neutron scattering physics graduate student to understand, and should also be quite helpful to any researcher new to the field. The book additionally can serve as an introduction to some of the topics of current interest to condensed matter physicists, which topics naturally reflect the authors' own interests and expertise. The level of coverage for these topics is by necessity cursory, but can motivate the students to acquire more depth through the *Further Reading*. This new textbook will be a valuable tool for the neutron scattering and condensed matter physics communities, providing an important resource for educating the next generation of condensed matter physicists about the power of neutron scattering.

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