Book Reviews

Experimental Neutron Thermalization. By P. A. Egelstaff and M. J. Poole. Pergamon Press (1969). 339 pp. $17.50.

This excellent book presents an account of coordinated theoretical and experimental work on slow neutron scattering and neutron thermalization. The necessity for the close interweaving of theory and experiment stems, as the preface states, from the impracticability of measuring thermal neutron cross sections over the ranges of energy and momentum transfer needed in reactor applications. Therefore, reactor physics quantities such as energy transfer cross sections for thermal neutrons must be calculated. To do this correctly requires models which express how the scattering depends on the dynamics of the motions of thermally excited atoms bound in the moderators.

Egelstaff and his collaborators have used the exact Van Hove formalism for slow neutron scattering[1] to guide the construction of their models. The Van Hove method is particularly useful for condensed matter where detailed knowledge of atom dynamics is lacking. In it the scattering cross section is expressed as a space-time Fourier transform of functions which show how atom positions, or atom velocities, are correlated over times of the order of those required by a slow neutron to traverse a scattering center. This book describes two methods for obtaining realistic approximations to these correlation functions. One method employs approximate forms for the velocity-time correlation and the other shows how the correlation function can be deduced directly from measured scattering data. An important part of the book is the chapters which evaluate the scattering models by comparing calculated results with deductions from scattering data.

The theoretical part begins with an excellent discussion of elementary scattering theory, followed by a very good treatment of the important features of the Van Hove theory. The physical principles are clearly expressed and the reader is given a good basis for understanding how the scattering data are used to develop models. The chapters describing experimental techniques are clearly written with adequate detail for the purposes of this book. These cover first the measurement of neutron energies and differential scattering cross sections. The last four chapters deal with techniques for measuring scalar spectra, angular spectra, time-dependent spectra, and spectra in lattices. Included in these chapters are evaluations of scattering models in terms of the spectral measurements. The material will assist the reader to identify situations where it should be important to have a model which correctly calculates moderator scattering.

At the end of the book is a useful Appendix by Schofield which gives the transport theory and diffusion approximations which employ the scattering kernels which are the concern of the book.

Because this book focuses on methods developed by Egelstaff and his collaborators, there is, understandably, limited discussion of procedures emphasized by other workers in this field. In particular, this book gives rather little attention to the formalism of Zemach and Glauber[2] which is particularly useful when the Hamiltonian for a system is known well enough to permit a detailed calculation of the dynamics of the atom motions. It is true, also, that the experimental part emphasizes the methods and equipment which these writers have found to be most useful. This concentration on the Egelstaff method is reflected, also, in the references. They cover the literature associated with his approach but do not everywhere reflect the full scope of work in the field. In this regard the book by Parks et al.[3] is more complete, although less digestible. However, as the preface states, a comprehensive treatment was not intended. The book does stand as an impressive account of the expert application of basic physics to the problem of calculating the behavior of thermal neutrons in reactors.

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About the Reviewer: Since 1970, H. L. McMurry has been Supervisor of the Reactor Analysis Section of Aerojet Nuclear Company. From 1958-70, he was concerned with the theoretical analysis of slow neutron scattering measurements being carried out using neutron beams from the MTR. Prior to 1958, he worked on reactor physics problems important to the operation of the Materials Testing Reactor.

[1] L. VAN HOVE, *Phys. Rev.*, **95**, 249 (1954).

[2] A. C. ZEMACH and R. J. GLAUBER, *Phys. Rev.*, **101**, 118 (1956).

[3] D. E. PARKS, M. S. NELKIN, J. R. BEYSTER, and N. F. WIKNER, *Slow Neutron Scattering and Thermalization*, W. A. Benjamin Company, New York (1970).

A First Course in Turbulence. By H. Tennekes and J. L. Lumley. The MIT Press, Cambridge, Massachusetts (1972). 300 pp. $12.50.

This book attacks a very real "closure" problem in turbulence theory faced by all newcomers to the field: the gap in coverage of turbulence theory between introductory texts in fluid dynamics and the sophisticated treatment