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NEUTRON SCATTERING AND MODELS: - IRON

by

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ABSTRACT

Differential elastic and inelastic neutron-scattering cross sections of elemental iron are measured from 4.5 to 10 MeV in increments of \( \approx 0.5 \) MeV. At each incident energy the measurements are made at forty or more scattering angles distributed between \( \approx 17^\circ \) and \( 160^\circ \), with emphasis on elastic scattering and inelastic scattering due to the excitation of the yrast \( 2^+ \) state. The measured data is combined with earlier lower-energy results from this laboratory, with recent high-precision \( \approx 9.5 - 15 \) MeV results from the Physikalisch-Technische Bundesanstalt and with selected values from the literature to provide a detailed neutron-scattering data base extending from \( \approx 1.5 \) to 26 MeV. This data is interpreted in the context of phenomenological spherical-optical and coupled-channels (vibrational and rotational) models, and physical implications discussed. Deformation, coupling, asymmetry and dispersive effects are explored. It is shown that, particularly in the collective-rotational context, a good description of the interaction of neutrons with \(^{56}\)Fe is achieved over the energy range \( \approx 0 \rightarrow 30 \) MeV, avoiding the dichotomies between high and low-energy interpretations found in previous work.