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NEUTRON INTERACTION WITH DOUBLY-MAGIC ^{40}Ca

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ABSTRACT

Differential neutron elastic- and inelastic-scattering cross sections of elemental calcium (96.94% doubly-magic ^{40}Ca) are measured from ≈ 1.5 to 10 MeV with sufficient detail to determine their energy-averaged behavior in the highly fluctuating environment. These results, combined with values previously reported in the literature, are assessed in the contexts of optical-statistical, dispersive optical, and coupled-channels models, applicable to the energy domain $0 \rightarrow 30+$ MeV, with particular emphasis on the lower energies where the interpretations are sensitive to the dispersion relationship and the effective mass. The interpretations define the energy dependencies of the potential parameters (resolving prior ambiguities), suggest that previous estimates of the prominent low-energy (n,p) and (n,a) reactions are too large, reasonably describe observables to at least 30 MeV, and provide a vehicle for extrapolation into the bound-state regime that gives a good description of hole- and particle-state binding energies. The resulting real-potential parameters (in contrast to many ^{40}Ca parameters reported in the literature) are shown consistent with global trends.