

AMBIGUITIES IN THE
ELASTIC SCATTERING OF 8 MeV NEUTRONS
FROM ADJACENT NUCLEI

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ABSTRACT

Ratios of the cross sections for elastic scattering of 8 MeV neutrons from adjacent nuclei are measured over the angular range $\approx 20^\circ$ – 160° for the target pairs $^{51}\text{V}/\text{Cr}$, $^{59}\text{Co}/^{58}\text{Ni}$, Cu/Zn , $^{89}\text{Y}/^{93}\text{Nb}$, $^{89}\text{Y}/\text{Zr}$, $^{93}\text{Nb}/\text{Zr}$, In/Cd and $^{209}\text{Bi}/\text{Pb}$. The observed ratios vary from unity by as much as a factor of ≈ 2 at some angles for the lighter target pairs. Approximately half the measured ratios (Cu/Zn , In/Cd and $^{209}\text{Bi}/\text{Pb}$) are reasonably explained by a simple spherical optical model, including size and isospin contributions. In all cases (with the possible exception of the $^{51}\text{V} - \text{Cr}$ pair), the geometry of the real optical-model potential is essentially the same for neighboring nuclei, and the real-potential strengths are consistent with the Lane model. In contrast, it is found that the imaginary potential may be quite different for adjacent nuclei, and the nature of this difference is examined. It is shown that the spin-spin interaction has a negligible effect on the calculation of the elastic-scattering ratios, but that channel coupling, leading to a large reorientation of the target ground state, can be a consideration, particularly in the $^{59}\text{Co}/^{58}\text{Ni}$ case. In the $A \approx 50$ – 60 region the calculated ratios are sensitive to spin-orbit effects, but the exact nature of this interaction must await more definitive polarization measurements. The measured and calculated results suggest that the concept of a conventional "global" or even "regional" optical potential provides no more than a qualitative representation of the physical reality for a number of cases.