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POLARIZED PROTON SCATTERING FROM ^{88}Sr: DETERMINATION OF NEUTRON TRANSITION DENSITIES

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Spectra of 200 MeV polarized protons scattered from ^{88}Sr were recorded at angles from 8° to 44°, chosen such that scattering from target impurities least obscured physics of interest. These spectra have since been reduced to cross sections and analyzing powers for excitation energies less than 4.2 MeV. The data set covers the complete angular range for the ground state, the 2^+ states at 1.836, 3.218, and 4.035 MeV, the 3^- state at 2.734 MeV, and the 5^- state at 3.585 MeV. Data for the 1^+ state at 3.486 MeV at 8° and 9.5° were also obtained. These two cross sections were reduced first, and reported at the 1983 Spring APS meeting.[1]

Recently, effort has been directed towards a combined electron scattering and polarized proton scattering analysis of the three lowest lying 2^+ states. Existing electron scattering measurements[2] performed at the MIT-Bates linear accelerator provide

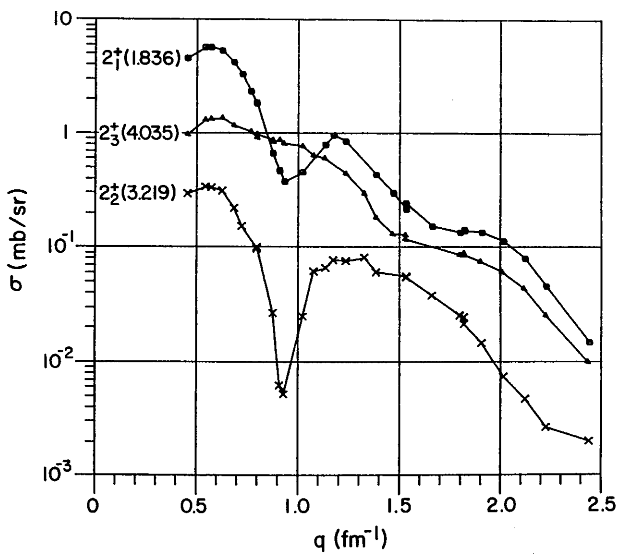

Figure 1. Cross sections for scattering to the first three 2^+ levels of ^{88}Sr. Note the differences in shapes coming from sensitivity of the proton probe to the transition density, including the nuclear interior.

accurate experimental charge transition densities. Large basis shell model calculations combined with Random Phase Approximation corrections produce an accurate theoretical description of these transitions.[3] These levels are suited for this study for two reasons. First, the charge densities peak at very different radii, allowing study of density dependence in the medium-mass region. Second, the theoretical predictions for the neutron contribution range from essentially 0% to 100%. With initial guesses guided by predictions of this theory package and with the charge densities for input, we have begun to extract experimental neutron transition densities. Calculations of proton scattering observables were performed for a set of basis density functions, in this case spherical bessel functions. Then the data were fit with neutron densities composed of linear combinations of these functions. Two density-dependent interactions were used: an interaction based on the Paris force and a calibrated interaction obtained by adjusting force parameters to reproduce cross sections and analyzing powers of 180 MeV proton scattering from the N=Z nucleus ^{16}O.[4] Initial results on the first two 2^+ levels indicate that the technique can indeed be used to successfully extract neutron transition densities. For the first excited state the extracted neutron density was large and stable for all choices of interaction and for initial guesses derived from theory or from assuming the neutron transition density equalled that for protons. The result qualitatively favored the theory, having a negative interior lobe and a positive exterior lobe, unlike the charge density, which has two positive lobes. Initial results for the second excited state showed less stability in the extracted neutron density. This can be expected because it is weaker by an order of magnitude and may be dominated by the proton contribution. Refinements of the analysis technique as well as the microscopic prediction are continuing.

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