SPIN-ORBIT EFFECTS ON THE SHAPES OF CROSS SECTIONS IN THE $^{90}Zr(p,p')$ REACTION AT 160 MeV

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Relativistically corrected collective model calculations have now been completed[1] for this experiment, in which the deformed-spin-orbit (DSO) deformation parameter β_L^{SO} was varied from a value much less than the fixed central (real and imaginary) parameter β_L up to a value much greater than β_L; for L=8 up to $\beta_L^{SO} = 8.0\beta_L$. Comparisons of these calculations were made with measured cross sections for the L=3 transition to the 3^- collective state at 2.75 MeV, for the L=5 transition to the $(p_{1/2}, g_{9/2})$ state at 2.32 MeV and for the L=2, 4, 6, and 8 transitions to the $(g_{9/2})^2$ proton states.

Two clear features are revealed in these collective calculations; the first prominent maximum of the DSO partial cross section alone is always at a significantly larger angle than the maximum of the central partial cross section alone (with real and imaginary components, and Coulomb excitation where necessary), and secondly the subsidiary maxima and minima of the DSO cross section are out of phase with those of the central cross section for each transition. These two features sensitively prevent a good fit to the shape of each measured cross section except for a narrow range of the ratio β_L^{SO}/B_L. The best fits for the sequence of $(g_{9/2})^2$ states require increasing DSO contributions as the L-transfer increases; for L=4 $\beta_4^{SO} = 1.25\beta_4$(central), and for the L=6 and L=8 transitions the DSO cross sections alone yield good fits to the data shapes. The fit to the cross section for the 3^- state at 2.75 MeV requires $\beta_3^{SO} = 1.5\beta_3$(central), and the fit to the cross section for the L=5 transition to the $(p_{1/2},g_{9/2})$ proton state at 2.32 MeV requires $\beta_5^{SO} = 2.9\beta_5$(central). In later preliminary DWIA calculations for these transitions to $(g_{9/2})^2$ proton states with L=2, L=4, L=6 and L=8 (with the free nucleon-nucleon G3Y force used earlier[2] and with only the simple $(g_{9/2})^2$ wave functions), Love finds[3] the spin-orbit cross section increasingly dominates the central part of the force as the L-transfer increases, until for L=8 the spin-orbit cross section is about 8 times larger than the central cross section. For this L=8 transition, Love finds the cross section for the tensor force about half that for the central part of the force. Core polarization amplitudes need to be added to these DWIA calculations with simple $(g_{9/2})^2$ wave functions, since Love was required to multiply his overall cross section by a factor of 10 to match the data for the L=4 transition, by a factor of 3 for the L=6 cross section, and by a factor of 2 for the L=8 transition.

A manuscript describing these major effects of the spin-orbit amplitudes is in final preparation, which will shortly be submitted for publication.

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1. A. Scott, unpublished.

2. W.G. Love, Alan Scott, F. Todd Baker, W.P. Jones and J.D. Wiggins, Jr., Phys. Lett. 73B (1978) 277.

3. W.G. Love, Conference on the (p,n) Reaction and Nucleon-Nucleon Forces, Telluride, March 29-31, 1979, to be published.