Spectroscopic Factors from the Single Neutron Pickup Reaction ^{64}Zn($\vec{d}$,t) ◇

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1. Motivation

A great deal of attention has recently been paid towards high precision superallowed β-decay $\mathcal{F}t$ values. With the availability of extremely high-precision ($< 0.1\%$) experimental data, precision on the individual $\mathcal{F}t$ values are now dominated by the $\sim 1\%$ theoretical corrections [1]. This limitation is most evident in heavier superallowed nuclei (e.g.^{62}Ga) where the isospin-symmetry-breaking (ISB) correction calculations become difficult due to a truncation of the model space. With the inclusion of core orbitals in the shell model calculation, recent revisions [1] to the radial-overlap portion, δ_{C2}, of the ISB correction are given by:

$$\delta_{C2} \approx \sum_{\pi,\alpha} \frac{T_f(T_f+1) + \frac{3}{4} - T_\pi(T_\pi+1)}{T_f(T_f+1)} S^{T_\pi}_{\alpha,T_f} \Omega^\pi_\alpha \qquad (1)$$

where $S^{T_\pi}_{\alpha,T_f}$ is the spectroscopic factor for pickup of a single neutron in quantum state α from an A-particle state with isospin T_f. The decision as to which core orbitals are important to include are determined from an experimental examination of these spectroscopic factors. In order to help constrain the ^{62}Ga ISB correction calculation, a measurement of the single-neutron pickup reaction ^{64}Zn($\vec{d}$,t)^{63}Zn was performed.

2. Experimental Details

The experiment was performed using a 22 MeV polarized deuterium beam from the MP tandem Van de Graaff accelerator and the Stern-Gerlach polarized ion source. The beam was incident on 126 μg/cm^2 of ^{64}Zn with a 13 μg/cm^2 carbon backing. Using the Q3D magnetic spectrograph, and a cathode-strip focal-plane detector, outgoing tritons were analyzed at 9 angles between 10° and 60°. Five momentum settings of the spectrograph were taken at each angle to cover excitation energies of up to ∼6 MeV, with both polarizations.

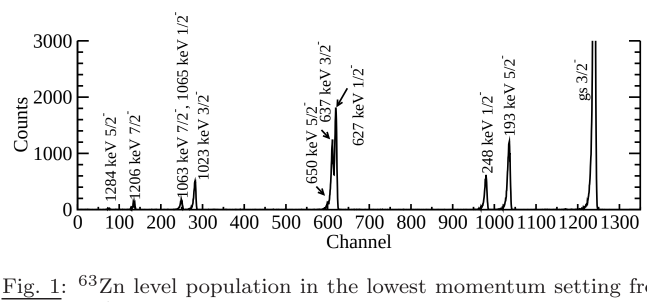

Fig. 1: ^{63}Zn level population in the lowest momentum setting from the ^{64}Zn($\vec{d}$,t) transfer at 15°.

Deuteron scattering measurements were also taken in 5° increments from 15° to 90° to validate the deuteron optical model parameters (OMPs).

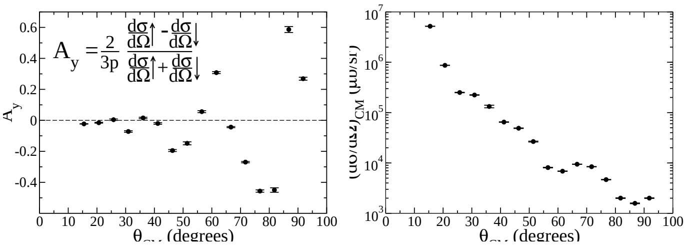

Fig. 2: The experimental analyzing power (left), and angular distribution (right) for 22 MeV deuteron scattering from a ^{64}Zn target.

3. Preliminary Results

Since we require accurate DWBA calculations to determine spectroscopic factors, we are using the data in Fig. 2 to construct a new set of deuteron OMPs. This process is currently underway. Particularly advantageous for this are the analyzing powers, which are very sensitive to the spin-orbit interaction.

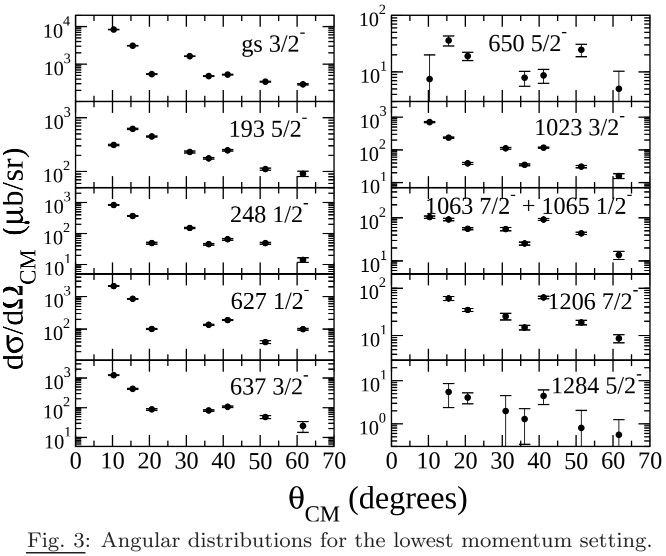

Fig. 3: Angular distributions for the lowest momentum setting.

Angular distributions and analyzing powers for the ^{64}Zn($\vec{d}$,t) transfer have been constructed for three of the five momentum settings, and the analysis of the final two are underway.

References

[1] I.S. Towner and J.C. Hardy, Phys. Rev. **C77** (2008) 025501

◇ This work has been partially supported by the Natural Sciences and Engineering Research Council of Canada (NSERC).