In this case, the A_y gives information mainly on the distorting potentials, and seems no more sensitive to the ℓ-transfer than the cross section. However, a full finite range calculation (with a spin dependent interaction) will allow $\Delta S = 1$ transitions and hence the excitation of unnatural parity states.

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SEARCH FOR $3s_{1/2}$ HOLE-STRENGTH FRAGMENTS VIA THE $^{208}Pb(d,^3He)^{207}Tl$ REACTION

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Studies of fractional occupation numbers of shell-model orbitals in doubly-magic nuclei with the proton removal reactions (d,^{3}He) and (e,e′p) yield insights into the limitations of the mean-field description of nuclei. Unfortunately, occupation numbers are not directly measurable, but can be derived in a model-dependent way through sum rules from absolute spectroscopic factors.

For the doubly-closed shell nucleus ^{208}Pb, recent mean field calculations by Mahaux *et al.*[1] predict an occupancy of $\sim 85\%$ at the Fermi surface, whereas calculations of Pandharipande *et al.*,[2] based on nuclear matter results, yield only 64%.

It has been shown that occupancies with less model dependencies can be derived via the CERES approach[3] which combines the results of the charge density measurements[4] with relative spectroscopic factors. Here the uncertainties of DWBA and DWIA calculations are greatly reduced. Thus, occupation numbers derived via the CERES approach depend mostly on the interpretation of the charge density difference in terms of an independent particle model.

Previous (d,^{3}He) experiments on ^{208}Pb have focused in general only on the five dominant single-hole states.[5−9] Consequently, all recent analyses of proton removal experiments have assumed no ℓ=0 transition to be present except for the transition to the ground state of ^{207}Tl. However, by combining the results of old (t,α)[10] and (t,p)[11] investigations, two additional ℓ=0 fragments around $E_x \sim 4.5$ MeV have been reported,[12] but without specification of the spectroscopic strengths. As the absence of significant ℓ=0 strength besides the ^{207}Tl ground state transition is important for the CERES approach, we undertook the present search for weak ℓ=0 transitions in the ^{208}Pb(d,^{3}He)^{207}Tl reaction.

Vector polarized deuterons ($P_y \approx 0.55$) were accelerated by the Indiana University Cyclotron Facility (IUCF) to 80 MeV and focused onto a 1.38 mg/cm^2 thick ^{208}Pb foil, enriched to 99%. The reaction products were analyzed by the K600 magnetic spectrograph which was set up (together with the beamline) in a dispersion-matching mode. The beam itself was stopped in a Faraday cup within the scattering chamber as the spectrometer was set to scattering angles in the range of 4° to 28°. Particle identification was performed by a combination of the time-of-flight of the ejectile and its pulse height deposited in a scintillation detector. Kinematical corrections and determination of the actual scattering angle were performed off-line; a final overall resolution of 55 keV, predominantly due to the target thickness, was obtained.

Angular distributions for cross sections and analyzing powers were obtained for final states up to about 5 MeV of excitation. Selected angular distributions are presented in Fig. 1. The full lines represent exact finite-range DWBA predictions performed with

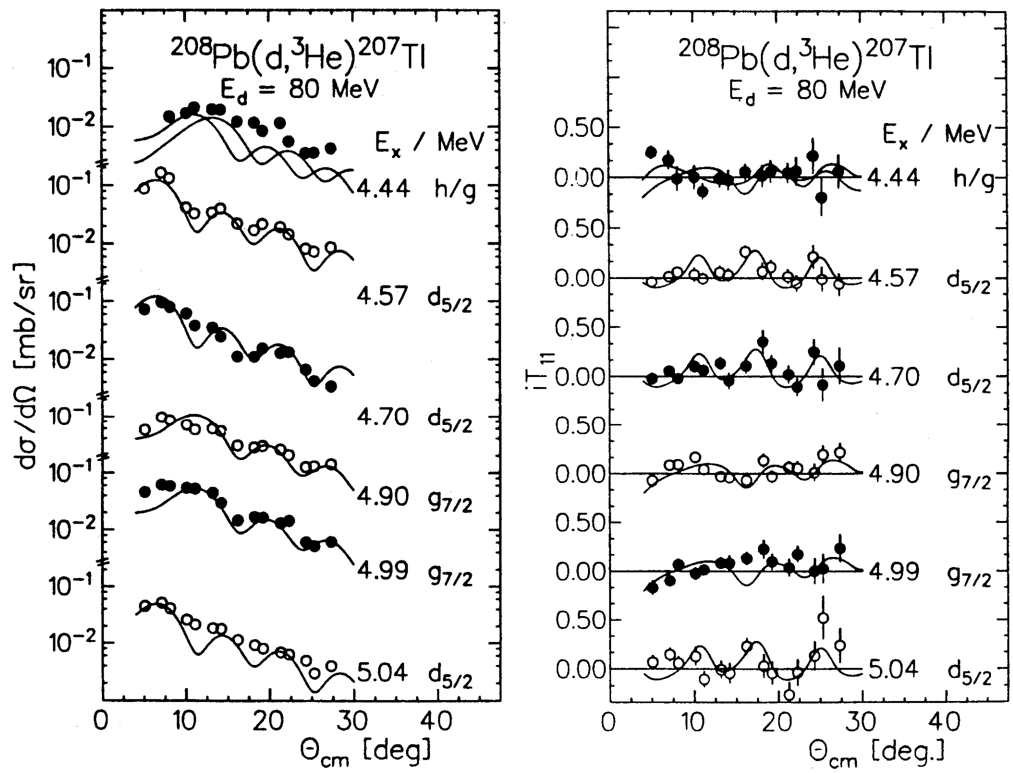

Figure 1. Angular distribution of cross sections (left panel) and analyzing powers (right panel) of the ^{208}Pb(d,^{3}He)^{207}Tl reaction. The curves represent exact finite range DWBA calculations for the pickup from the orbitals indicated.

the code DWUCK5 using the parameters of Radhakrishna *et al.*[13] Detailed spectroscopic information for higher lying hole states of ^{207}Tl could be extracted. In particular, several spin and parity assignments could be made on the basis of characteristic distributions. With regard to the fragmentation of the $3s_{1/2}$ hole strength, the present analysis shows that the two known $1/2^+$ states indeed carry no ℓ=0 strength exceeding $\Sigma C^2S = 0.04$, i.e. 2.4% of that of the ground state transition. The upper limit of total possible $3s_{1/2}$ strength in the valence region ($E_x \leq 5$ MeV) is 5% of that of the ground state transition. This value is about the same as the result of $(0 \pm 5)\%$ provided by the analysis of the quasi-free (e,e'p) reaction.[14]

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