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1.49 $^{208}Pb(d,p)^{209}Pb$ Reaction at E_d=12.3 and 15.0 MeV

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It is well known that the tensor analyzing powers are quite sensitive to the deuteron D-state. Particularly, in $^{208}Pb(d,p)^{209}Pb$ reaction at sub-Coulomb energy the tensor analyzing powers are considered to come from mostly deuteron D-state effect.[1] It is expected that the magnitute of the D-state effect should increase with increasing energy.[2] At the incident deuteron energy near the Coulomb barrier, the reaction seems to be sensitive to the tail of the nuclear potential. Therefore we measured the reaction $^{208}Pb(d,p)^{209}Pb$ at energy below and near the Coulomb barrier.

Angular distributions of the differential cross section and vector and tensor analyzing powers (iT_{11},T_{20},T_{21} and T_{22}) were measured for the reaction $^{208}Pb(d,p)^{209}Pb$ at Ed=12.3 MeV and 15.0 MeV. Results were obtained for transitions to states in ^{209}Pb at excitation energies of 0.0, 1.57 and 2.03 MeV. The data of E_d=12.3 MeV are in good agreement with the previous data.[3),4)] The measurements are carried out using the vector- and tensor-polarized beam from the University of Tsukuba Lamb-shift polarized ion source. The self-supporting ^{208}Pb target enriched to 98.7% and 2.8 mg/cm^2 in thickness was used. Protons emitted from the reaction were momentum analyzed by a magnetic spectrograph and detected by a 40cm long single wire position sensitive proportional counter for the scattering angles from θ_L=15° to 60°. For the backward angles from θ_L=40° to 170°, two ΔE-E counter telescopes symmetrically located to the beam direction were used. The elastically scattered deuterons were also recorded. Each counter telescope consisted of two solid state detectors with depletion depth of 400μm (ΔE) and 1.5mm (E). The solid angle of the detectors was 3.0 msr. The spin states were changed every few seconds by FASSICS.[5)] The beam intensity on the target was 10nA. Typical beam polarization was 75%. The beam polarization were determined by the quench-ratio method and monitored by the polarimeters using the $^3He(d,p)^4He$ or $^{12}C(d,d)^{12}C$ reaction.

The measured cross sections and analyzing powers for the ground state transition are shown in fig.1. The error bars indicate the statistical error only. The observed tensor analyzing powers are rather smooth functions of the scattering angle. T_{20} is much larger than the other two tensor analyzing powers, especially T_{20} of backward angle at Ed=15.0 MeV shows maximum value of 0.5. The magnitude of T_{21} near the medium scattering angles increases as the deuteron incident energy increases. Same tendency of the tensor analyzing powers was observed in the other transitions.

We preliminary analyzed these data by the finite range DWBA code TWOFNR[6)] which include D-state effect and the tensor optical potential. The n-p interaction is taken to be the soft-core potential of Reid[7)] . The deuteron and proton channel optical model potential parameters used were obtained from the formula of Deahnick[8)] and Becchetti and Greenlees[9)], respectively. The results of the calculations with and without D-state are shown in fig.1. The gross behavior of T_{20} and T_{21} are reproduced. It can be seen that the D-state effect increases as energy increases.

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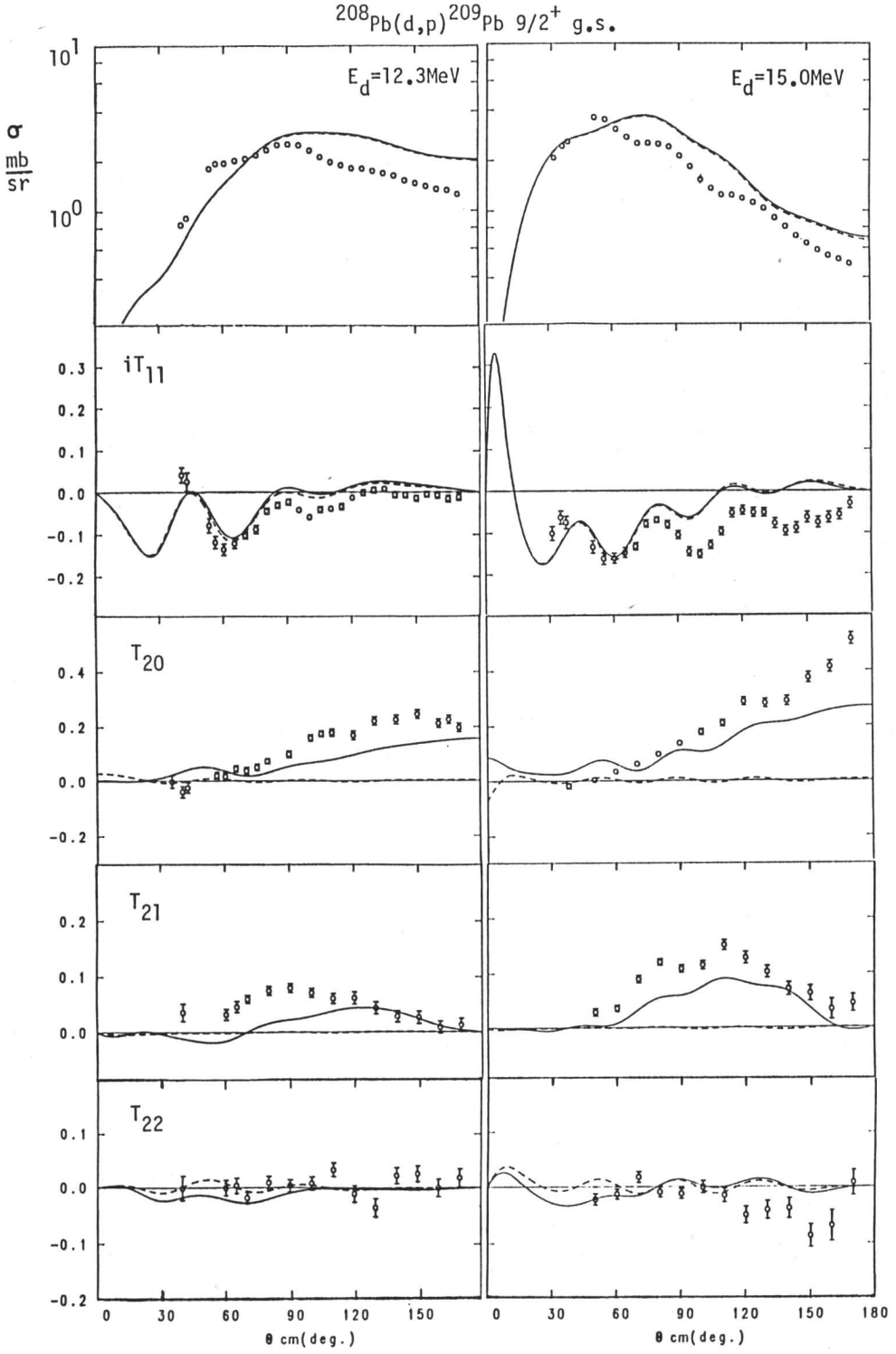

Fig. 1. Cross sections and vector and tensor analyzing powers for the ^{208}Pb(d,p)^{209}Pb g.s. reaction at 12.3MeV and 15.0MeV. The solid and dashed curvesare results of finite-range DWBA calculations with and without D-state, respectively.