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1.42 Opposite-Sign Character of the Analyzing Powers for the Unnatural-Parity Transitions to the First and Second 3^+ States in the Reaction $^{208}Pb(p,t)^{206}Pb$

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$^{208}Pb(p,t)^{206}Pb(3^+)$ reaction is strictly forbidden in the zero-range distorted wave Born approximation (DWBA). Two-step (p,d)(d,t) process is believed to be the main part of the reaction mechanism[1]. In the shell model calculation, the wave functions of the 3_1^+(1.34MeV) and 3_2^+(3.122MeV) states are predicted almost pure configurations of $(p_{1/2},f_{5/2})$ and $(p_{1/2},f_{7/2})$[2]. The purpose of the present study is to measure the analyzing power and cross section for the $^{208}Pb(p,t)^{206}Pb(3_2^+)$ reaction and compare them with those for the 3^+_1 state[3,4]. Natural-parity transitions have been discussed in ref. 5.

A 22 MeV polarized proton beam is accelerated with the University of Tsukuba 12UD Pelletron. The average beam polarization was 0.77 with a typical beam current of 25 nA on target. The target was 0.48mg/cm^2 thick ^{208}Pb metallic foil backed by an aluminum foil. FWHM of position spectrum is mainly determined by triton energy loss of about 30 keV. Beam polarization was monitored with two SSD's which measure analyzing power of $^7Li(p,\alpha)^4He$ reaction. Fast spin flip system and the monitor increased the reliability of the present data. Tritons from (p,t) reaction are analyzed by a magnetic spectrograph and detected by a single wire position sensitive proportional counter[6]. Experimental set up is shown in Fig. 1. Figure 2 shows typical momentum spectrum. No unknown contamination peak was observed up to Ex=3.5 MeV (Fig.2).

Figure 3 shows measured angular distributions of cross section and analyzing power. Note that the sign of the analyzing power is inverted for the two 3^+ transitions. The data of 3^+_1 was quoted from a paper by Toba et al.[3].

Preliminary zero-range (p,d)(d,t) two-step calculations were done by using program TWOFNR[7]. Figure 4 shows the calculated differential cross sections and analyzing powers for 3_1^+ and 3_2^+ states. We assumed the wave functions of 3_1^+ and 3_2^+ to be pure configuration of $(p_{1/2},f_{5/2})$ and $(p_{1/2},f_{5/2})$. The values used for zero-range normalization constants are $D_0^2(p,d)=1.53*10^4$ and $D_0^2(d,t)=3.37*10^4$ in units of MeV^{2}fm^3. One-nucleon transfer form factors are bound state wave functions of Woods-Saxon potential with experimental neutron separation energies. Detailed analysis is in progress by Igarashi[8].

Table I. Distorting potential parameters used in this calculation

channel	V	Wv	Ws	rc	rv	av	rw	aw	Vso	rso	aso	Ref.
p	51.8	0.0	10.0	1.25	1.25	0.65	1.25	0.76	6.0	1.12	0.47	9
set 1 d	112.0	0.0	19.4	1.25	1.25	0.68	1.25	0.78	6.0	1.12	0.47	9
set 2 d	93.98	1.13	12.08	1.30	1.17	0.74	1.33	0.89	2.5	1.04	0.60	10
t	160.0	11.0	0.0	1.30	1.20	0.66	1.60	1.08	6.0	1.10	0.98	11
n					1.25	0.65			6.0			

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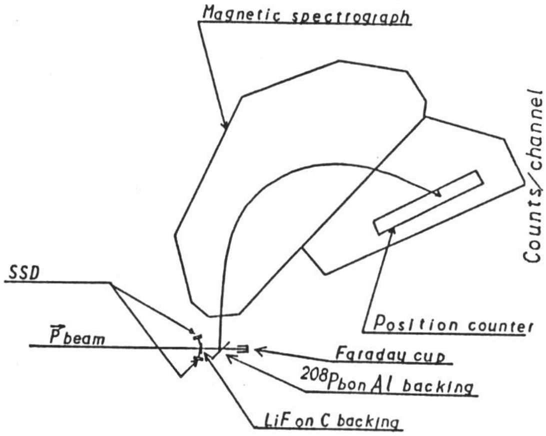

Fig. 1. Schematic view of the counter system.

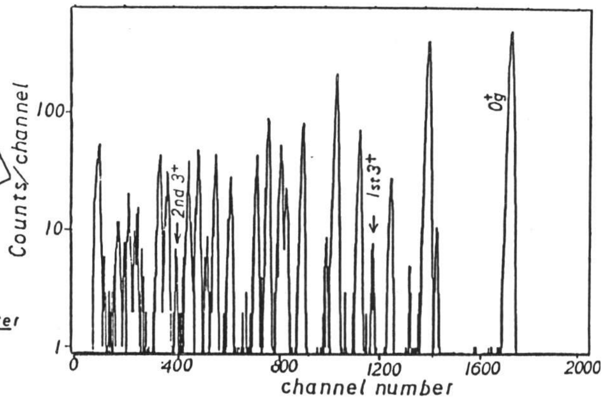

Fig. 2. Triton momentum spectrum of $^{208}Pb(p,t)^{206}Pb$ reaction at 22 MeV, Θ lab=25°, with spin up.

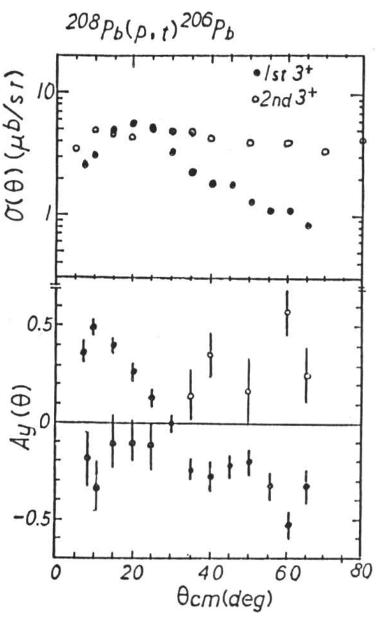

Fig. 3.
Cross sections and analyzing powers for the $^{208}Pb(p,t)^{206}Pb(3_1^+,\ 3_2^+)$ reaction at Ep=22 MeV.

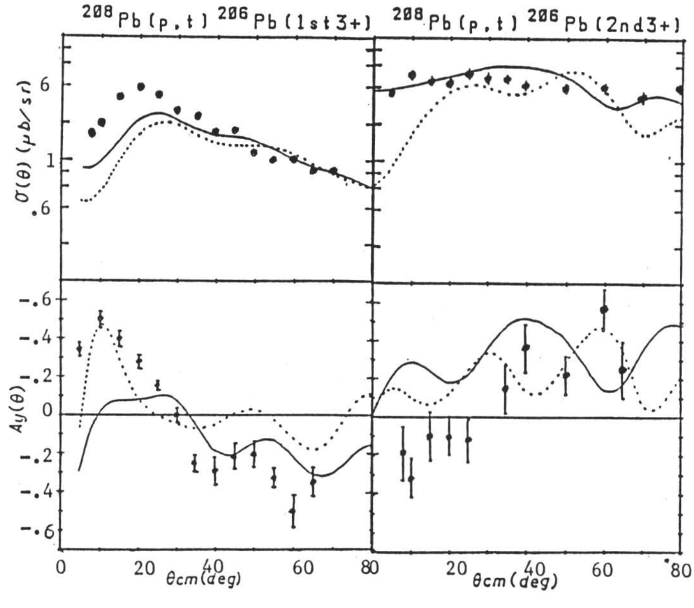

Fig. 4.
Experimental and calculated cross sections $\sigma(\theta)$ and analyzing powers $A(\theta)$ for the $^{208}Pb(p,t)^{206}Pb$ $(3_1^+$, 1.34 MeV) and $(3_2^+$, 3.122 MeV). The solid and dashed curves correspond to the (p,d)(d,t) two-step zero-range calculations using potentials set 1 and set 2 in Table I, respectively. Cross section curves for 3_2^+ transition are scaled by a factor of 10.