4. International symposium on polarization phenomena in nuclear reactions. Zurich, Switzerland 25-29 August 1975
CEA-CONF--3370 FR76 013 81

QUASI-ELASTIC (p,n) REACTIONS INDUCED BY POLARIZED PROTONS

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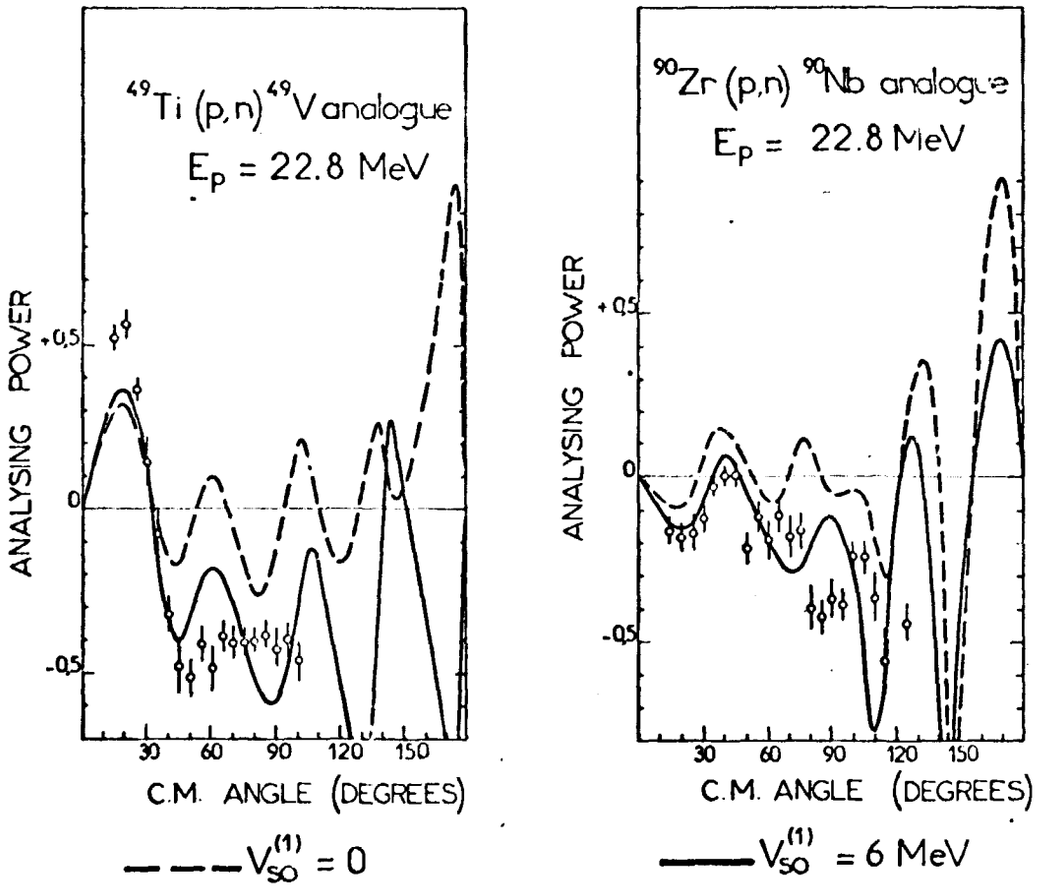
Quasi-elastic (p,n) reactions[1], i.e. (p,n) reactions leaving the residual nucleus in the analogue state of the target ground state, are very useful to study the isospin dependent part $U_1 \vec{t}.\vec{T}.$ of the optical potential [2], within the framework of the Lane model [3]. One expects to get informations about a possible spin dependence of U_1 by measuring the analysing power (AP) in such reactions. A previous experiment [4] favoured a spin-orbit component $V_{so}^{(1)}$ in U_1. In order to draw quantitative conclusions on $V_{so}^{(1)}$, we measured the AP angular distribution in quasi-elastic (p,n) reactions induced by 22.8 MeV polarized protons extracted from the Saclay variable energy cyclotron, on ^{49}Ti, ^{56}Fe, ^{64}Ni, ^{70}Zn, ^{90}Zr, ^{96}Zr, ^{117}Sn, ^{165}Ho and ^{208}Pb. To facilitate these measurements a new time-of-flight neutron spectrometer has been set up at the Saclay cyclotron. We used eight NE 213 liquid scintillator detectors, 1.6 liter each, coupled to eight 58 DVP photomultipliers. Data were stored and analysed by an on-line computer. The beam time structure and polarization were continuously monitored. We did not measure the efficiency of our detectors so that only relative cross sections were obtained, in good agreement with the absolute differential cross sections measured at Boulder [5] at the same energy. For comparison with the Distorted Wave Born Approximation calculations, we used the Boulder cross section data together with our AP measurements.

Preliminary macroscopic DWBA calculations using the DWUCK code [6], showed that the AP is very sensitive to the addition of a spin-orbit component $V_{so}^{(1)}$ in the form factor U_1, especially to its magnitude but not so much to the geometrical parameters used for $V_{so}^{(1)}$. The effect of this component is an overall displacement of the AP towards more positive or negative values, according to the sign (respectively negative or positive) of $V_{so}^{(1)}$. The data favour a negative $V_{so}^{(1)}$ meaning that the spin-orbit potential must be greater for neutrons than for protons, in agreement with a simple model [4]. Unfortunately the AP was also found to be sensitive to the geometrical parameters used for the spin-orbit distorting potentials in the entrance and exit channels.

Therefore we fixed this geometry and tried to determine quantitatively the $V_{so}^{(1)}$ component by adjusting it in order to fit our AP data. The starting values for the optical parameters, with $V_{so}^{(1)}$ equal to zero, were taken from the energy-dependent, Lane-model, nucleon-nucleus optical potential determined by Patterson et al.[7] from their quasi-elastic (p,n) reaction cross section measurements. The results of this adjustment are quite satisfactory since $V_{so}^{(1)}$ is concentrated, for all the nuclei, around a mean value of 4.3 MeV, with a radius of 1.01 fm and a diffuseness of 0.75 fm. Remembering the possible ambiguity with respect to the geometrical parameters used for the spin-orbit distorting potential, we tried another geometry (radius 1.17 fm and diffuseness 0.60 fm) which was also found to give a good agreement to the proton elastic scattering data [8]. With this geometry we obtained a mean value of 6 MeV for $V_{so}^{(1)}$ instead of 4.3 MeV with the first geometry. This ambiguity corresponds approximately to a constant product of the depth and the diffuseness of this $V_{so}^{(1)}$ term, which seems reasonable for a surface-peaked potential.

The results obtained with the second geometry are compared on fig.1 with the experimental AP data for ^{49}Ti and ^{90}Zr. This figure shows, and it is the same for the other nuclei, that the spin-orbit component $V_{so}^{(1)}$ of the isospin dependent part of the optical potential improves very much the global agreement between the experimental and calculated AP but does not yet give a perfect account for the data, which present less structure than the calculations.



Références

1) J.D. Anderson and C. Wong, Phys. Rev. Lett. 7 (1961) 250.
2) G.R. Satchler, Isospin in Nuclear Physics (North-Holland Publ. Comp. Amsterdam (1969) p. 391.
3) A.M. Lane, Phys. Rev. Lett. 8 (1962) 171 and Nucl. Phys. 35 (1962) 676
4) J.M. Moss, C. Brassard, R. Vyse and J. Gosset, Phys. Rev. C6 (1972) 1698.
5) R.F. Bentley, J.D. Carlson, D.A. Lind, R.B. Perkins and C.D. Zafiratos Phys. Rev. Lett. 27 (1971) 1081.
6) P.D. Kunz, DWUCK code, private communication.
7) D.M. Patterson, R.R. Doering and Aaron Galonsky, Michigan State University Cyclotron Laboratory, preprint (1974).
8) F.D. Becchetti and G.W. Greenless, Phys. Rev. 182 (1969) 1190.