ENERGY DEPENDENCE OF THE RATIO OF ISOVECTOR EFFECTIVE INTERACTION STRENGTHS $|J_{\sigma\tau}/J_\tau|$ from 0° (p,n) CROSS SECTIONS

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At intermediate energies, the differential cross sections at $\theta=0°$ for $\Delta J^\pi=1^+$ and 0^+ (p,n) transitions are proportional to the reduced transition probabilities B(GT) and B(F) for the analogous Gamow-Teller (GT) and Fermi (F) beta decays, respectively. This proportionality may be exploited to gain information about the isovector effective interaction strengths. For even-A targets we define the empirical quantity $[R(E_p)]^2 = [\sigma_{GT}(0°)/B(GT)][B(F)/\sigma_F(0°)]$ where B(GT) and B(F) are obtainable from measured beta-decay ft values according to[1] $B(F)+(1.25)^2B(GT)=(6163.4 \text{ sec})/ft$. A similar relationship may be defined for odd-A targets. In terms of the distorted-wave impulse approximation (DWIA), $R(E_p)$ may be interpreted as $R(E_p) \simeq |J_{\sigma\tau}/J_\tau|(N_{\sigma\tau}/N_\tau)^{1/2}$, where $J_{\sigma\tau}$ (J_τ) is the Fourier transform at momentum transfer q=0 of the spin-flip (non-spin-flip) effective interaction and $N_{\sigma\tau}$ and N_τ are distortion factors. The distortion factor ratio is approximately independent of energy and has the value $N_{\sigma\tau}/N_\tau=1.2$ at intermediate energies.[2] The quantity $R(E_p)$ thus represents very nearly the ratio of interaction strengths $|J_{\sigma\tau}/J_\tau|$. In Fig. 1 we plot
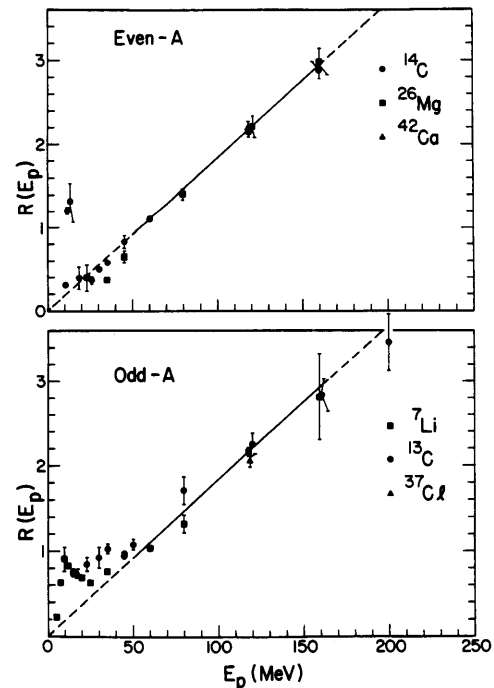

Figure 1. The empirical quantity $R(E_p)$ for odd-A and even-A targets. The solid line represents the average value $R(E_p) = (54.9 \pm 0.9 \text{ MeV})^{-1} E_p$.

R(E_p) as determined from the (p,n) reaction on several odd-A and even-A targets. The points for energies larger than 50 MeV are from data obtained in (p,n) experiments at IUCF. The lower energy points are from (p,n) cross sections obtained by other investigators at MSU, ORNL, LLL, Colorado, and Harwell. Our analysis[3] shows that the empirical quantity R(E_p) is well represented by the linear form R(E_p) =

(54.9 ± 0.9 MeV)$^{-1}$ E_p for energies larger than about 50 MeV.

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1) H.S. Wilson, R.W. Kavanaugh, and F.M. Mann, Phys. Rev. C 22, 1696 (1980).

2) C.D. Goodman et al., Phys. Rev. Lett. 44, 1755 (1980).

3) T.N. Taddeucci et al., Phys. Rev. C 25, 1094 (1982).

THE (p,n) REACTION AT INTERMEDIATE ENERGIES WITH ^{16,17,18}O AND ^{9}Be AS PART OF A UNIFIED APPROACH TO THE STUDY OF THESE NUCLEI

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Neutron energy spectra have been determined for 135 MeV protons on targets of Be^{16}O, Be^{17}O, Si^{18}O$_2$, and ^{9}Be. Cross sections and analyzing powers were obtained for various transitions in each target. Analysis of measurements of analyzing powers is still in progress.

Some energy spectra and an angular distribution for the ^{16}O(p,n)^{16}F (4$^-$, 6.37 MeV) reaction have been presented in previous reports. The analysis of the ^{16}O(p,n)^{16}F energy spectra and angular distributions was used to identify several new states in ^{16}F. A paper describing this spectroscopic analysis in detail has been accepted for publication in the Physical Review.[1] Besides the strong excitation of the 4$^-$, T = 1 "stretched" state at E_x = 6.37 MeV, two strongly excited 2$^-$ states are seen at E_x = 0.40 MeV and 7.6 MeV and two 1$^-$ states at E_x = 9.4 and 11.5 MeV. The cross-section angular distributions to these states are described well by a DWIA calculation using the nucleon-nucleon effective interaction of Love and Franey[2] and simple 1p-1h wave functions obtained by

Picklesimer and Walker.[3] Three weakly-excited 1$^+$ states are observed at E_x = 3.75, 4.65, and 6.23 MeV. These states are analogs of known[4] 1$^+$ (M1) states in ^{16}O and directly indicate correlations in the ground state of ^{16}O. All of the most strongly-excited states align (to within 200 keV) with known T = 1 analog states in ^{16}O for a common net displacement energy of 12.6 MeV.

The ^{18}O(p,n)^{18}F forward-angle spectra are dominated by the strong transition to the 1$^+$ ground state of ^{18}F, and the wide-angle spectra by the transition to the "0ℏω" 5$^+$ stretched state at E_x = 1.12 MeV. Unfortunately, the 5$^+$ state is unresolved from the 0$^+$ isobaric analog state (IAS) at E_x = 1.04 MeV and a 3$^+$ state at E_x = 0.94 MeV. A careful analysis of this complex is in progress. The 0° spectrum [with ^{28}Si(p,n) and ^{16}O(p,n) subtractions] is presented in Fig. 1. Besides the very strong transition to the 1$^+$, T = 0 ground state, transitions to the 0$^+$, T = 1 IAS at E_x = 1.04 MeV, and four transitions to known[5] 1$^+$, T = 0