THE OPTICAL POTENTIALS FOR PROTON ELASTIC SCATTERING ON ^6Li, ^{12}C, and ^{14}N AT 144 MeV

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The optical potentials for proton elastic scattering on ^6Li, ^{12}C, and ^{14}N at 144 MeV were required for some theoretical (p,n) calculations. (See "A Study of One-Pion Exchange in (p,n) Reactions Using PCAC and the Elementary Particle Model" in this volume.) Although good data already existed[1] for ^6Li and ^{12}C, it was not analyzed relativistically or with a Woods-Saxon formfactor, so the analysis was redone. The ^{14}N cross section had to be measured.

The measurements were made with the QDDM spectrograph. The standard helix and scintillator detectors were employed with the standard electronics. A BN target was used for laboratory angles of 10 to 58 degrees. For smaller angles, the elastic peaks from B and N overlapped too much to extract peak areas reliably. Therefore, measurements at smaller angles were made with a melamine ($N_6C_3H_6$) and a carbon target, and the carbon contributions were subtracted from the melamine. The data is shown in Figure 1.

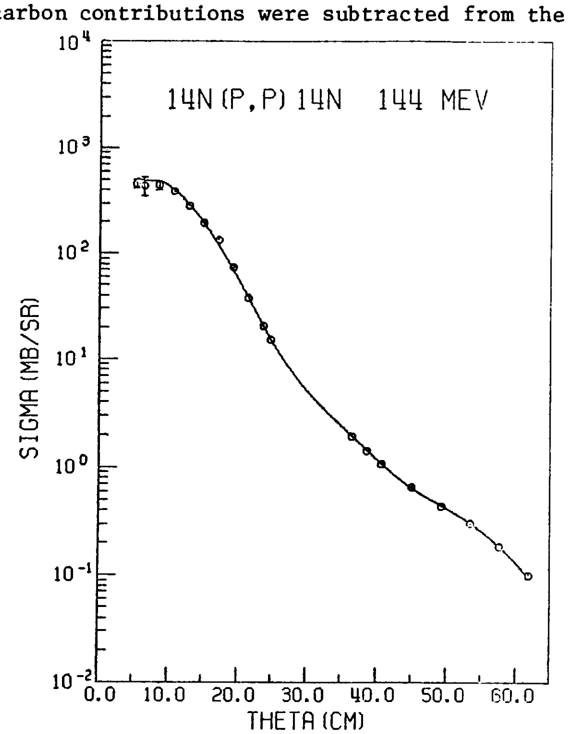

Figure 1.

The optical potential was found with the computer code SNOOPY6.[2] The potential was taken to have the form

$$U(r) = U_{coul}(r) - V_o f_o(r) - i W_s f_w(r)$$

$$+ \left(\frac{\hbar c}{m_\pi}\right)^2 (V_{so} + i W_{so}) (r + 0.10 e^{-r/a_{so}})^{-1}$$

$$\frac{d}{dr} f_{so}(r) \vec{L} \cdot \vec{\sigma}$$

where the $f_i(r)$ are Woods-Saxon formfactors with radius $r_i A^{1/3}$ and diffuseness a_i. The calculations were done with relativistic kinematics and a relativistic modification of the potential in the Schroedinger equation following the prescription of Goldberger and Watson.[3] The potentials listed here can be used in a nonrelativistic code to a good approximation if relativistic kinematics are employed and if all potentials are multiplied by the factor γ. The potentials and the γ factors are given in Table 1.

Table 1. Optical Potentials

	^6Li	^{12}C	^{14}N
V	16.96	17.24	16.77
r_o	1.110	1.158	1.260
a_o	.713	.632	.587
W_s	10.78	9.55	9.37
r_w	1.000	1.186	1.260
a_w	.855	.843	.852
V_{so}	-3.86	4.43	2.93
W_{so}	-2.796	-2.838	-2.797
r_{so}	.870	.904	.915
a_{so}	.862	.548	.478
r_c	1.12	1.17	1.17
γ	1.061	1.066	1.067
χ^2/pt	.25	3.3	1.4

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1) O.N. Jarvis, et al., AERE rep. R6769, 1971.

2) P. Schwandt, IUCF Internal Report #77-8.

3) Goldberger and Watson, Collision Theory (Wiley, New York 1964).