DEUTERON ELASTIC SCATTERING CROSS-SECTION MEASUREMENTS FOR Si, ^{40}Ca AND ^{208}Pb AT 79 MeV

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Differential cross-section angular distributions, in the angular range $6° \leq \theta_L \leq 90°$, for elastic scattering of 79.2 MeV deuterons from Si, ^{40}Ca and ^{208}Pb have been measured using the QDDM spectrograph. An external monitor counter which consisted of a one inch thick Na(I) scintillator coupled to a RCA 8575 photomultiplier tube with a specially designed rate insensitive tube base was developed for this work. In addition, a newly designed internal Faraday Cup, split into left and right halves, was used to stop the beam in the spectrograph scattering chamber. A computer code, which samples the left-right current unbalance from this cup, automatically adjusts the current in the last horizontal beam-line steerer to keep the beam centered on the Faraday Cup. Measurements of elastic alpha scattering at 12 to 18 MeV have been made at the University of Pittsburgh in order to better determine target thicknesses for the targets used in the elastic deuteron study.

Data reduction is sufficiently complete at this time to allow presentation in this report of preliminary absolute cross-section angular distributions. The results for Si and ^{40}Ca are shown in Figures 1 and 2 (with ± 5% relative and ± 10% absolute uncertainties) and a preliminary relative cross-section angular distribution (± 5% relative uncertainty) for ^{208}Pb is shown in Figure 3. Prior to measurement of these distributions optical model predictions based on the global parameter prescription "E" of Childs and Daehnick[1] were made. These are shown as a solid line

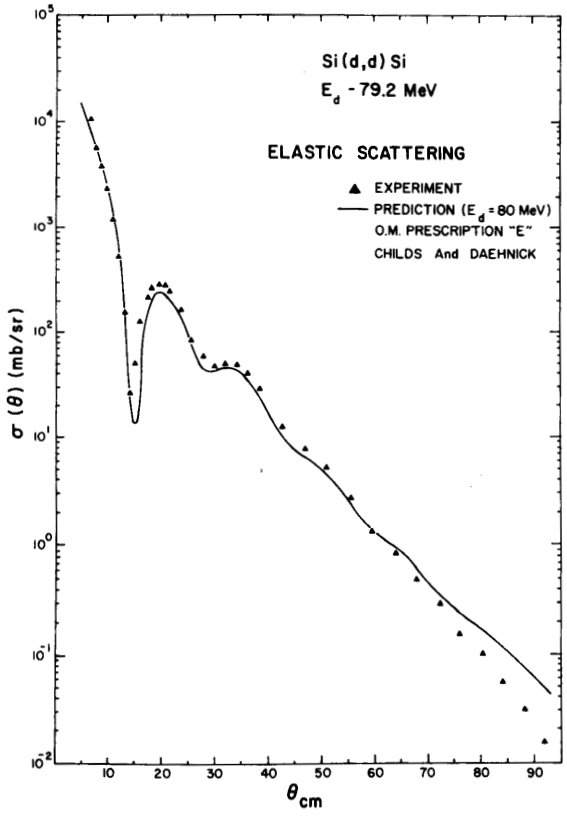

Figure 1.

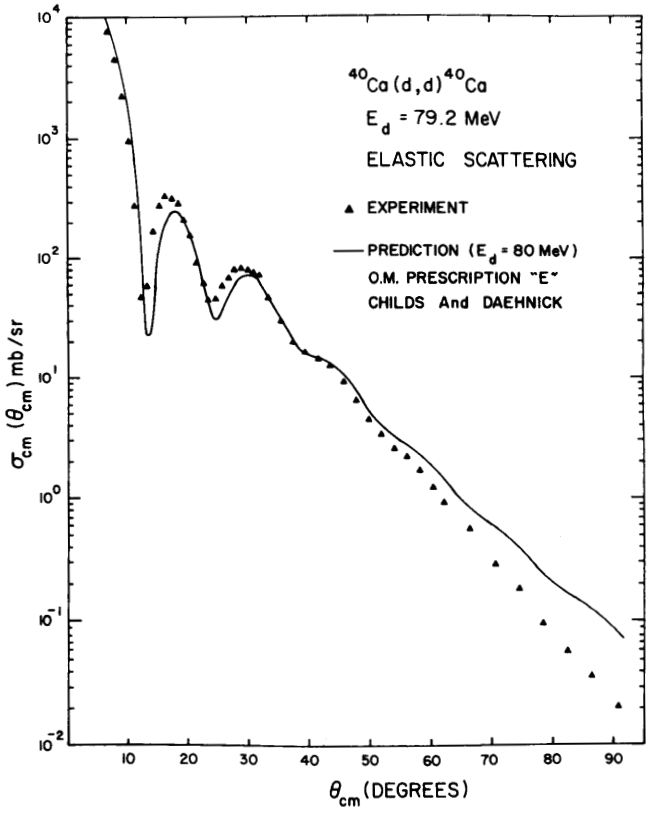

Figure 2.

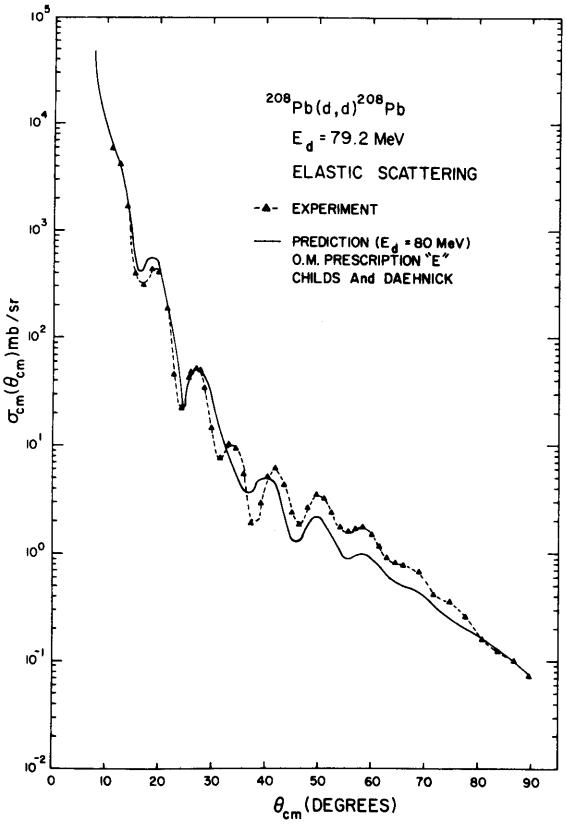

Figure 3.

on each figure. In the case of ^{208}Pb, the angular distribution has been normalized to the prediction at θ_{cm} = 27 degrees.

The quality of agreement between predicted and measured distributions is seen to be reasonably good for Si and ^{40}Ca, although there are regions of fairly large disagreement. In the case of ^{208}Pb, there is a peak near θ_{cm} = 33 degrees in the measured angular distribution which is not seen in the predicted distribution. Recent calculations show that this peak is better reproduced if parameter set "C" of Childs and Daehnick[1] is used. As soon as data reduction is completed a systematic optical model analysis of these data will be performed. At present the results indicate that one can obtain somewhat reasonable deuteron optical model parameters from the prescriptions "E" and "C" of Childs and Dachnick extended from the energy range (17 to 52 MeV) of their data base to 80 MeV and that prescription "C" is probably the better prescription to use. For convenience prescriptions "C" and "E" are included in Table 1.

Table 1. Global Deuteron Optical Model Parameter Prescriptions.[1]

C: $V_o = 84.0 - .196E + .79\ Z/A^{1/3}$

$W_v^* = .046\ (E-17)$

$W_D^* = 15.3 - .062E$

$V_{so} = 6.8$

$r_o = 1.2,\ a_o = .751$

$r_I = 1.31$

$a_I = .478 + .075A^{1/3} - .004\Sigma_i e^{-\left(\frac{N-M_i}{1.8}\right)^2}$

$r_{so} = .98,\ a_{so} = 1.0,\ r_c = 1.3$

E: $V_o = 89.5 - .23E + 1.0\ Z/A^{1/3}$

$W_v^* = .063\ (E-17)$

$W_D^* = 14.9 - .066E$

$V_{so} = 5.5$

$r_o = 1.15,\ a_o = .79$

$r_I = 1.33$

$a_I = .448 + .082A^{1/3} - .043\Sigma_i e^{-\left(\frac{N-M_i}{2.0}\right)^2}$

$r_{so} = 1.1,\ a_{so} = .55,\ r_c = 1.2$

* all imaginary depths W_v, W_D are either as stated above or zero, whichever is greater.

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1) J.D. Childs, Ph.D. Thesis, Univ. of Pittsburgh, 1976 (unpub.).