

**R-Matrix**

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**Analysis of the Proton Elastic Recoil Cross Section  
Using R-Matrix Theory**

56-1

R-matrix parameter (normalization) Los Alamos, R-matrix  $\chi^2$  .

R-matrix 0.2 17.8 MeV 가 가 .

**Abstract**

The R-matrix theory is used for the calculation of proton elastic recoil cross sections. The R-matrix parameters of Los Alamos are used in the calculation, and the normalization is performed which minimize the  $\chi^2$  value corresponding to the difference between experimental data and calculated cross sections. The experimental data are compared with the calculated results for the various energy and recoil angles, so they are well consistent. The proton elastic recoil cross sections which are quite consistent with 0.2 17.8 MeV proton scattering cross sections are obtained by R-matrix analysis.

1.

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ERD(Elastic Recoil Detection)

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ERD

He

. ERD

${}^4\text{He}$

(kinetic inverse reaction) He

[See

reference list of ref. 1]. Los Alamos Dodder [1] 0.2 17.8 MeV

30

R-matrix parameter

He

[2-9]. He

ERD

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. He

1

[2] Ingram [3], Wang Zhou[5], Quillet [8]

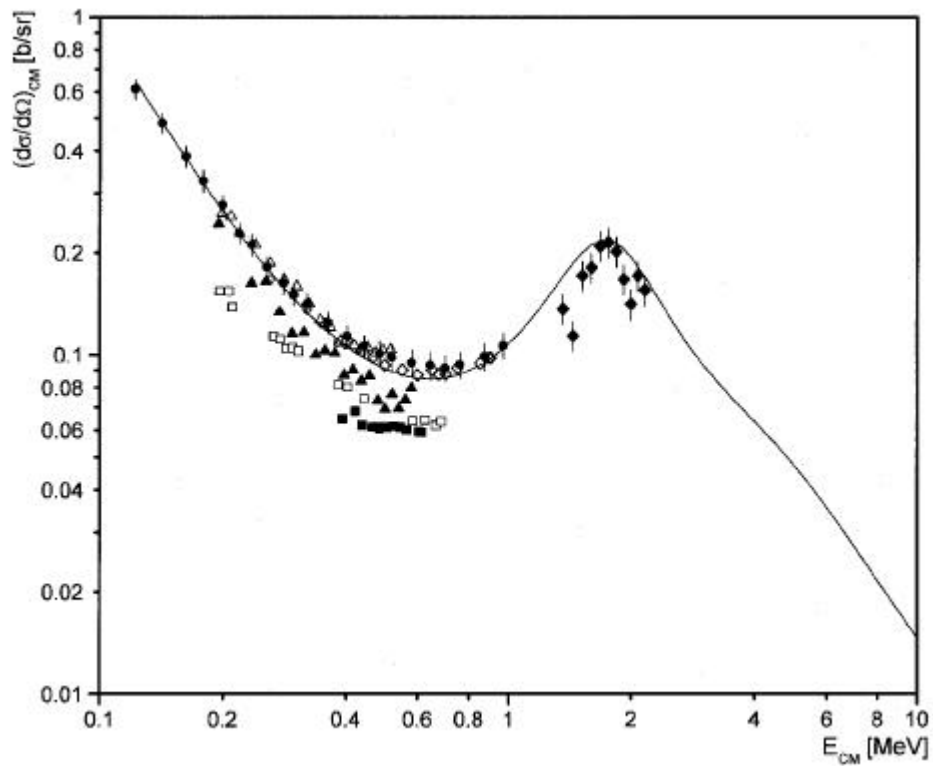


Fig. 1. The proton elastic recoil cross sections at the lab. recoil angle of  $30^\circ$  or nearby angles as a function of  $p$ - ${}^4\text{He}$  center of mass energy. The experimental points are from various sources and the continuous line is by R-matrix calculation. (  $\square$  : Kim et al.[2],  $\triangle$  : Ingram et al.[3],  $\diamond$  : Nagata et al. (at recoil angle  $31.3^\circ$ ) [4],  $\circ$  : Wang and Zhou[5],  $\square$  : Szilágyi et al. (at  $31^\circ$ ) [6],  $\square$  : Baglin et al.[7],  $\square$  : Quillet et al.[8],  $\square$  : Nurmela et al. (at  $28^\circ$ ) [9], — : R-matrix calculation.)

가  
 Nagata [4]  
 Nurmela [9] He  
 He  
 2 MeV

[2]. Kim [2] 0.6 5.0 MeV  $^4\text{He}$   $10^\circ$   $40^\circ$   $5^\circ$   
 7 9%  
 He R-matrix parameter  
 Los Alamos parameter R-matrix  
 Kim

**2. R-matrix**

R-matrix [10]  
 parameter  
 R-matrix 가 [1]. p-  $^5\text{Li}$  parameter  
 Coulomb R-matrix parameter  
 Dodder R-matrix Los Alamos 0.2 17.8 MeV  
 1976 [1].  
 1100 가 18 MeV  
 $l=0$   $l=3$  Dodder  
 R-matrix parameter polarization  
 0.04 0.27% [1]. 1  
 He 가  
 Kim [2] R-matrix  
 가

(normalization factor) N

$$\chi^2 = \sum_i \omega_i (N X_i - Y_i)^2$$

factor  $1/(Y_i)^2$   $Y_i$   $X_i$   $Y_i$  weighting [11]

He Kim [2]

2 4% scale

He 5 7%

2 10, 20, 30, 40°

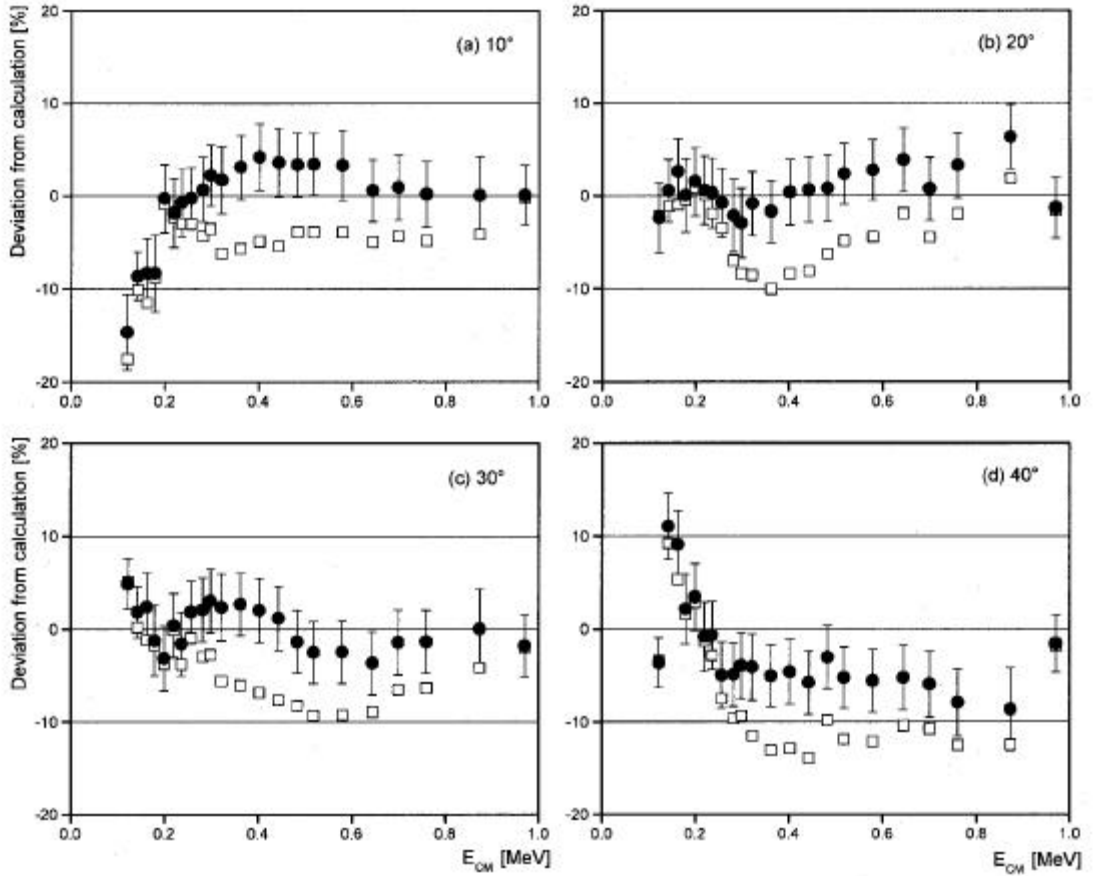


Fig. 2. The percent deviation of the measured cross section from the R-matrix calculation at lab. recoil angle 10° (a), 20° (b), 30° (c), 40° (d). The rectangular symbol is presented at the percent deviation from unnormalized calculated cross section, and circular symbol from normalized calculated cross section. The error bar shows the relative error.

, 30° 10% 가 , 2  
 5% ,  
 0.08 1 , N 1.05  
 scale 가 5 7%

3.

R-matrix He  
 R-matrix Los Alamos parameter  
 Kim  
 17.8 MeV  
 가 가

**References**

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