ELASTIC DEUTERON-TRITON SCATTERING AT $37 MeV$

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Results of measurement of differential cross section of elastic scattering of deuterons by tritons at the laboratory energy of $37\,MeV$ for the center-of-mass angles $\theta_{c.m.}$ ranging from 25° to 150° are presented. The experiment is carried out on the U-240 isochronous cyclotron of the Institute for Nuclear Research, National Academy of Science of Ukraine. Obtained experimental data is analyzed theoretically in the framework of microscopic nuclear diffraction model. Angular distributions of deuterons in a region of the main maximum ($\theta_{c.m.} \leq 60^\circ$) are described quite well at deuteron energies of 14.4, 37.0 and $39.9\,MeV$. An explanation of a broad secondary maximum emerging at low deuteron energies is proposed using the phenomenological quasiclassical approximation. The quasiclassical approximation allows to describe the angular distributions only qualitatively at large angles $60^\circ < \theta_{c.m.} < 150^\circ$, where the cross sections are quite small.

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1. INTRODUCTION

Collisions of deuterons with tritons at energies of tens MeV still remain studied insufficiently [1-7], though they are very informative and are of interest for investigation of both the few-nucleon nucleus structure and the nuclear interaction. Coulomb interaction gives negligibly small contribution (of the order of 1%) into the scattering cross section at the energies of incident deuterons in the interval of $10\,...\,40 MeV$. Therefore, in considering dt-scattering we will subsequently neglect the Coulomb interaction. For the same reason, the d^3He-scattering [7-9] is very much similar to the dt-scattering.

At the deuteron energies that are being considered, the wavelength λ of the relative motion of ^2H and ^3H nuclei divided by 2π appears to be a few times less than the radius of their nuclear interaction R_N (approximately $4\,...\,6\,fm$), therefore the diffraction approximation can be used for a calculation of the elastic deuteron - triton scattering cross section. Consideration will be inherently quasiclassical ($\lambda \ll R_N$) when an influence of many quantum mechanical effects (the Pauli principle, spins of nuclei, antisymmetrization of wave functions) becomes substantially weaker [10], which simplifies calculations significantly. In addition, as it will be shown, the macroscopic description of the dt-scattering process is also possible. In present work, we consider the dt-collision and solve the very complicated problem of five interacting nucleons of continuous energy spectrum approximately in the framework of nuclear diffraction model. The goal of this work is to present the results of our experiment on elastic scattering of deuterons with the energy $E_d = 37\,MeV$ by tritons as well as to provide the theoretical description and interpretation of our data together with the published data corresponding to other energies E_d using simple quasiclassical methods of quantum mechanics [10-15].

2. EXPERIMENT

Elastic scattering of deuterons by tritium nuclei with energy of deuterons $E_d = 37\,MeV$ was experimentally studied on Kiev isochronous cyclotron $U-240$ of KINR, NAS of Ukraine. Measurements were carried on self-maintained titanium-tritium target and on pure titanium target. Ti-T target is a tritium-loaded titanium film with activity of $7.57\,Ci$.

Charged particles were detected by three telescopes of counters ($\Delta E - E$) placed in reaction plane. Intensity of ion beam passed through the target was detected with Faraday cup connected to current integrator. For determination of angular distribution of elastically scattered deuterons data on elastic scattering of deuterons $T(d,d)T$ as well as data on recoil tritons were used. Registration was performed in angular range of $15^\circ \leq \theta_{lab} \leq 58^\circ$ for deuterons and in angular range of $15^\circ \leq \theta_{lab} \leq 52^\circ$ for tritons. (θ_{lab} is an angle in laboratory system of coordinates). Statistical error of measurement for inclusive spectra was $1\,...\,3\%$ depending on angle of detection. Absolute values of cross sections were determined with accuracy $\sim 15\%$. Measurement procedure and preliminary results were published in [1,6].

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Fig.1(a) presents one-dimensional deuterons spectra measured on $Ti-T$ and Ti targets at angle 15°, Fig.1(b) presents recoil tritons spectra at the same angle.

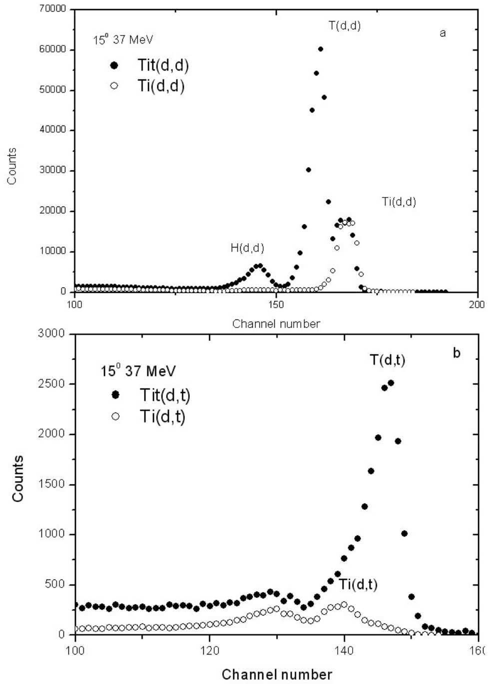

Fig.1. *Deuteron spectra measured on $Ti-T$ and Ti targets for the angle of 15° at the deuteron energy of 37 MeV (a); the same for recoil tritons (b)*

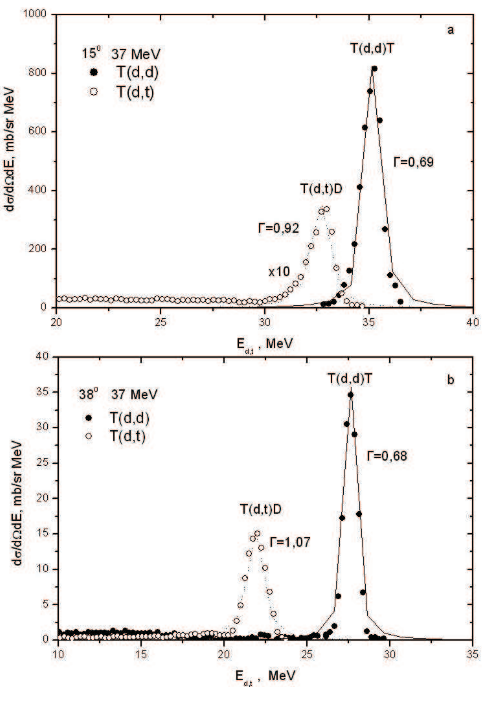

Fig.2. *Energy spectra for elastically scattered deuterons and recoil tritons at the deuteron energy of 37 MeV for the angle of 15° (a); (b) - the same for the angle of 38°. Solid and dashed lines correspond to the calculations based on the microscopic nuclear diffraction model [15,16]*

Isolation of peaks corresponding to elastic scattering of deuterons on tritons was carried by subtraction of spectra derived on Ti-target from spectra obtained from $Ti-T$ target. The same approach was used for separation of peaks of recoil tritons. Energy spectra of deuterons and recoil tritons from $T(d,d)T$ reaction obtained at 15° and 38° are illustrated on Fig.2(a,b). Analysis of energy spectra is presented in sections 4 and 5. Dependence of differential sections $d\sigma/d\Omega$ for elastic scattering of deuterons on tritons in center-of-mass system (c.m.) is presented on Fig.3(a). Before, the elastic scattering of deuterons on tritons was studied only at low energies (6.6 ... 14.4 MeV) [7]. On Fig.3(a) previously published data on dt-scattering at 8.3 and 14.4 MeV are presented together with data obtained in our experiment. Angular distributions have common typical features: sharp decrease of section with scattering angle increasing to $\theta_{c.m.} \leq 60°$ and noticeable rise of cross sections at angles starting from $\theta_{c.m.} \approx 130°$. However there are considerable differences at $60° \leq \theta_{c.m.} \leq 130°$ angle range. Wide maxima observed at $\theta_{c.m.} \approx 100°$ with energies 8.3 MeV and 14.4 MeV, disappears at our energy 37 MeV. We made comparison with data on elastic d^3He scattering at energies 10.0, 14.4 [7], 17.49, 39.9 MeV [7,8,9]. Comparison is presented on Fig.3(b).

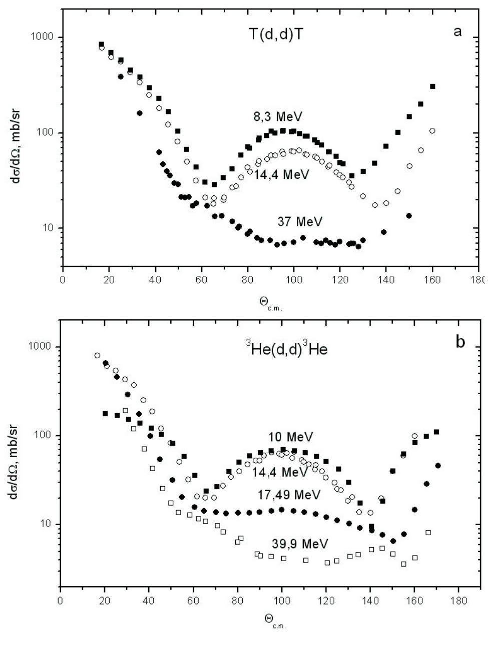

Fig.3. *Elastic scattering of deuterons by tritons at the laboratory energies of 8.3 MeV [7], 14.4 MeV [7] and 37 MeV (our data) (a); (b)- deuterons on helions at the laboratory energies of 14.4 MeV [7], 17.49 MeV [7,8] and 39.9 MeV [9]*

Nature of dependence of elastic d^3He cross-section at range of low and high angles is identical to dependence of cross-section for elastic dt-scattering. At angular range of $60° \leq \theta_{c.m.} \leq 130°$ the similar picture is observed: with deuterons energy increasing the wide maximum at angle $\theta_{c.m.} \approx 100°$ disappears distorting with energy 39.9 MeV. Data on $^3He(d,d)$ scattering obtained at energy 17.49 MeV already indicate maximum disappearing at angle $\theta_{c.m.} \approx 100°$. Deuterons elastic scattering on helions at energy $E_d = 39.9\, MeV$ has practically the same dependence as elastic scattering of deuterons on tritons at our energy.

3. FORMALISM FOR ANGULAR DISTRIBUTIONS OF SCATTERED DEUTERONS

We consider the deuteron - triton scattering in the center-of-mass frame and use the microscopic diffraction model [10,15], in which an interaction of each of three nucleons of ^3H nucleus with each of two nucleons of ^2H nucleus is described by the nucleon-nucleon profile functions of Gaussian type [10,12,16]:

$$\omega_{ij} \equiv \omega(|\vec{\rho}_{ij}|) = a \exp(-b^2 {\rho^2}_{ij})\,, \qquad (1)$$

where $\vec{\rho}_{ij}$ is the component of the vector $\vec{r}_{ij} = \vec{r}_i - \vec{r}_j$ perpendicular to the incident deuteron momentum $\vec{k}_d$ in the laboratory frame. Here $\vec{r}_i$ is the radius vector of the $i-th$ nucleon of triton (i = 1, 2, 3), $\vec{r}_j$ is the radius vector of the $j-th$ nucleon of deuteron (j = 4, 5).

The amplitude of elastic deuteron - triton scattering in the diffraction impulse approximation [11]

$$A(\vec{\chi}) = \int d^{(3)}\vec{\rho}_1 \int d^{(3)}\vec{r} \int d^{(3)}\vec{s} \int d^{(2)}\vec{R}_\perp \phi_d^2(\vec{s}) \times \phi_t^2(\vec{\rho}_1, \vec{r}) \psi^*_{\vec{\chi}}(\vec{R}_\perp) \psi_0(\vec{R}_\perp) \times (\omega_{14} + \omega_{15} + \omega_{24} + \omega_{25} + \omega_{34} + \omega_{35})\,, \qquad (2)$$

where

$$\vec{s} = \vec{r}_{45}, \qquad \vec{r} = \vec{r}_{23}, \qquad \vec{\rho}_1 = \vec{r}_1 - \frac{\vec{r}_2 + \vec{r}_3}{2}\,.$$

It describes well the corresponding diffraction cross section

$$d\sigma = \frac{k^2}{(2\pi)^2} \left| A(\vec{\chi}) \right|^2 d\Omega\,, \qquad k = \frac{3}{5} k_d\,, \qquad |\vec{\chi}| = 2k \sin\frac{\theta}{2}\,. \qquad (3)$$

In a region of the main diffraction maximum, where the scattering angle $\theta \equiv \theta_{c.m.}$ does not exceed 65° (in the laboratory frame this angle does not exceed approximately 40°), simple intrinsic wave functions of deuteron $\phi_d(\vec{s})$ and triton $\phi_t(\vec{\rho}_1, \vec{r})$ in Gaussian form [10,12,16] are used:

$$\phi_d(\vec{s}) = \left(\frac{2\lambda^2}{\pi}\right)^{3/4} e^{-\lambda^2 s^2}, \qquad \lambda = 0,267\, fm^{-1}, \qquad (4)$$

$$\phi_t(\vec{\rho}_1, \vec{r}) = \frac{3^{3/4}\alpha^3}{\pi^{3/2}} e^{-\alpha^2(\rho_1^2 + 3r^2/4)}, \qquad \alpha = 0,375\, fm^{-1}. \qquad (5)$$

The relative motion of deuteron and triton before and after scattering is described by the following wave functions [11]:

$$\psi_0(\vec{R}_\perp) = 1, \quad \psi_{\vec{\chi}}(\vec{R}_\perp) = e^{i\vec{\chi}\vec{R}_\perp}, \qquad (6)$$

where $\vec{\chi}$ is the transferred momentum ($\vec{\chi}\vec{k}_d = 0$), $\vec{R}_\perp$ is the component of vector $\vec{R}$, which connects the centers of mass of deuteron and triton ($\hbar = c = 1$), perpendicular to $\vec{k}_d$.

On using the equations (1) - (6), we get the following compact expression for the angular distribution of deuterons in elastic scattering in explicit form:

$$\frac{d\sigma}{d\Omega} = \frac{9a^2k^2}{b^4} \exp\left[-\chi^2\left(\frac{1}{2b^2} + \frac{1}{9\alpha^2} + \frac{1}{16\lambda^2}\right)\right], \qquad \chi = 2k\sin\frac{\theta}{2}, \quad k = \frac{2\pi}{\lambda} = \frac{6}{5}\sqrt{ME_d}, \quad \theta \le 65°, \qquad (7)$$

where M is the nucleon mass.

For quality description of scattering at large angles ($65° \le \theta \le 180°$) in the center-of-mass frame, where the cross section is quite small, we use quasiclassical expression for the scattering amplitude of two colliding impenetrable balls, which represent deuteron and triton, disregarding their internal structure [13]:

$$f(\theta) = i\frac{R_N}{2\sin\frac{\theta}{2}} J_1\left(2kR_N \sin\frac{\theta}{2}\right) - \frac{i}{2} R_N \exp\left(-2ikR_N\sin\frac{\theta}{2}\right). \qquad (8)$$

4. FORMALISM FOR ENERGY SPECTRA

With the help of the above formulae of the microscopic diffraction model, we obtained the following differential cross sections, which can be used to describe the energy distribution in the laboratory frame (where tritons are in the rest before collision) versus the energy of scattered deuterons E'_d and the recoil energy of tritons E_t at fixed deuteron angle θ_d and triton escape angle θ_t:

$$\frac{d\sigma}{d\Omega_d dE'_d} = \frac{9M\sqrt{E_d E'_d}}{5\pi^2} \left| A(\chi) \right|^2 \times \delta\left(5E'_d - E_d - 4\sqrt{E_d E'_d}\cos\theta_d\right), \qquad (9)$$

$$\frac{d\sigma}{d\Omega_t dE_t} = \frac{3^{3/2} M\sqrt{E_d E'_t}}{5\sqrt{2}\pi^2} \left| A(\chi) \right|^2 \times \delta\left(2\sqrt{6E_d E'_t}\cos\theta_t - 5E_t\right), \qquad (10)$$

where $|A(\chi)|^2$ is taken from (3) and (7). In addition, the variable χ in the amplitude $A(\chi)$ should be expressed in terms of kinematic variables in the laboratory frame. So, we substitute the following expression to (9):

$$\chi = \left[4M(E_d + E'_d - 2\sqrt{E_d E'_d}\cos\theta_d)\right]^{1/2}, \qquad (11)$$

and the following expression to (10):

$$\chi = \sqrt{6ME_t} = \frac{12}{5}\sqrt{ME_d}\cos\theta_d, \qquad (12)$$

where the relationships for scattering (escape) angles and energies of nuclei before and after collision in the center-of mass and laboratory frames were used [14].

In calculations of the cross sections (9) and (10), the delta-functions $\delta(E)$ were replaced with the finite functions $\delta_\Gamma(E)$, whose narrow maxima are defined by the finite width Γ [10,16]:

$$\delta_\Gamma(E) = \frac{\Gamma}{2\pi}\frac{1}{E^2 + \frac{1}{4}\Gamma^2}, \quad \lim_{\Gamma\to 0}\delta_\Gamma(E) = \delta(E)\,. \qquad (13)$$

5. ANGULAR AND ENERGY DISTRIBUTIONS ANALYSIS

5.1. ANGULAR DISTRIBUTIONS ANALYSIS

Differential cross-sections of elastic dt-scattering $d\sigma/d\Omega$ in center of mass system obtained at deuterons energy 37.0 MeV as well as published data at energy 14.4 MeV [7] and data on d^3He scattering at energy 39.9 MeV [9] were used in analysis. Fig.4(a,b,c) presents these data and corresponding theoretical calculations. Curves 1-1a on Fig.4 are derived using equation (7). As shown on Fig.4 experimental angular distributions of scattered deuterons in the vicinity of main maximum ($\theta_{c.m.} \leq 65°$) are quite well described theoretically by (7) at energies $E_d = 14.4$; 37 and 39.9 MeV.

Curves 2 and 3 on Fig.4(a) and curves 2 on Fig.4(b,c) are derived using equation (8). Curves 2a are plotted using only first item in (8) i.e. based on model of colliding black balls with sharp edge, and curves 2b are plotted using only second item in (8), which is concerned with classical isotropic scattering ($R_N = 4.4\,fm$). Curves 3 on Fig.4(b,c) corresponds to the same second item in (8), but with $R_N = 2\,fm$, what better describes cross-section at $\theta \geq 65°$.

Decreasing of radius of interaction R_N with increasing θ when energy transmission is increasing, is in accordance with long ago observed [17-19] decreasing of R_N with increasing of relative energy of colliding nuclei, when energy transmission is increasing. This phenomenon was confirmed (and explained) by optical model calculations [17].

Appearance of wide but low in height experimental maximum on Fig.4(a) for $E_d = 14.4\,MeV$ at $65° \leq \theta \leq 140°$ is explained by the advent of secondary diffractive maximum due to the first item in (8), which however is distinctly distorted by interference of quantum and classical amplitudes in (8) and by influence of inner structure of nuclei. This maximum disappears with increasing of energy E_d.

Phenomenological semi-classical approach can't describe well in angles range $25° \leq \theta \leq 150°$ the observed cross-section dependence on $\theta_{c.m.}$ without taking into account some number of quantum effects and real structure of colliding nuclei. In the angular range $65° \leq \theta_{c.m.} \leq 150°$ only qualitative description of cross sections is achieved.

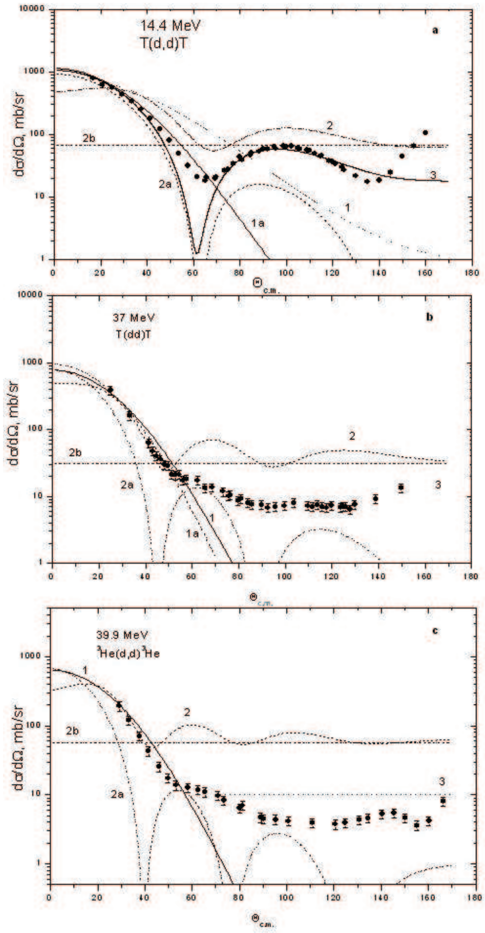

Fig.4. *Ttheoretical calculations compared with experimental angular distributions at the following energies: (a) - 14.4 MeV, (b) - 37 MeV, (c) - 39.9 MeV. Curves 1 and 1a - calculations based on the microscopic nuclear diffraction model (7) with the following parameters: (a) 1 - $\alpha = 1.30$, $b^2 = 0.30\,fm^{-2}$; 1a - $\alpha = 0.5$, $b^2 = 0.10\,fm^{-2}$; (b) 1 - $\alpha = 0.80$; $b^2 = 0.31\,fm^{-2}$; 1a - $\alpha = 0.65$, $b^2 = 0.22\,fm^{-2}$; (c) 1 - $\alpha = 0.70$, $b^2 = 0.31\,fm^{-2}$. Line 2 - calculations based on quasiclassical approximation (8) with the following parameters: (a) 2 - $R_N = 5.2\,fm$; 3 - $R_N = 4.15\,fm$, (b) $R_N = 4.4\,fm$, (c) $R_N = 4.4\,fm$. Curve 3 on (b,cb) denotes the cross section $\frac{d\sigma}{d\Omega} = \frac{1}{4}R_N^2$ for deuteron scattering angles $\theta_d > 70°$, $R_N = 2\,fm$*

5.2. ENERGY SPECTRA ANALYSIS

Experimental energy spectra at angle $\theta_{lab} = 15°$ for deuterons ($\Gamma = 0.69\,MeV$) and tritons ($\Gamma = 0.92\,MeV$) are represented on Fig.2(a), and Fig.2(b) shows spectra for deuterons ($\Gamma = 0.68\,MeV$) and tritons ($\Gamma = 1.07\,MeV$) at angle $\theta_{lab} = 38°$. Location, width Γ, and height of maxima are well described with curves calculated by equations (9) - (13), except of cross section $d\sigma/d\Omega_t dE_t$ at $\theta_t = 15°$ and E_t in range from 15 MeV to 30 MeV (see Fig.2(a)). The last circumstance is concerned with fact that at low

θ_t and $E'_t > 15\,MeV$ impulse and energy of recoil triton gain high values what can excite inner degrees of freedom of colliding nuclei with its transition into intermediate quasisteady states, majority of which come back to bound states and we detect it in our experiment, minority break up and we don't detect the decay products.

6. CONCLUSIONS

1. Differential cross sections of the elastic scattering of deuterons with the energy of $37\,MeV$ by tritons are measured for the center-of mass scattering angles ranging from 25° to 150°.

2. The analysis of the elastic scattering of deuterons by tritons (helions) is carried out for deuteron energies of $14.4\,MeV$ [7], $37\,MeV$ (our data) and $39.9\,MeV$ [9] in the framework of the microscopic nuclear diffraction model. The experimental angular distributions of scattered deuterons in the region of main maximum ($\theta_{c.m.} \leq 65°$) are quite well described theoretically for the deuteron energies of $14.4\,MeV$, $37\,MeV$ and $39.9\,MeV$.

3. The phenomenological quasiclassical approximation cannot adequately well describe the observed dependence of the cross section on $\theta_{c.m.}$ in the whole range of angles $25° \leq \theta_{c.m.} \leq 150°$ without taking into account a number of quantum effects and real structure of colliding nuclei. In the range of angles $65° \leq \theta_{c.m.} \leq 150°$, only qualitative description of the cross sections is achieved.

4. An explanation of the broad secondary maximum emerging in the dependence of the observed cross section on the deuteron scattering angle in a range $65° \leq \theta_{c.m.} \leq 140°$ for the incident deuteron energies $E_d \leq 17\,MeV$ is proposed. It is shown that the maximum emerges due to the diffraction process and the interference of quantum and classical isotropic scattering amplitudes as well as to the manifestation of the structure of colliding nuclei.

5. The analysis of measured energy spectra of deuterons and recoil tritons from the reaction $t(d,d)t$ at the energy $E_d = 37\,MeV$ is carried out. Our calculations of the energy distributions, based on the microscopic nuclear diffraction model, are in good agreement with the experiment at width $\Gamma = 0.68...0.69\,MeV$ ($15° \leq \theta_{lab} \leq 38°$) for deuterons and $\Gamma = 0.92...1.07\,MeV$ ($15° \leq \theta_{lab} \leq 38°$) for recoil tritons.

References

1. O.O. Belyuskina, S.V. Berdnichenko, V.I. Grantsev, et al. Investigation of nuclear reactions in $D + T$ system // *Nuclear Physics and Atomic Energy.* 2007, v.8, N3(21), p.54-59 (in Russian).

2. M. Ivanovich, P.G. Young, G.G. Ohlsen. Elastic scattering of several hydrogen and helium isotopes from tritium // *Nucl.Phys.* 1968, v.A110, p.441-462.

3. V.M. Lebedev, V.G. Neudachin, B.G. Struzhko. Reactions involwing the flip of the deuteron spin and isospin and supermultiplet potential model for the interaction of extremely light clusters// *Phys. At. Nucl.* 2002, v.65, N3, p.462-477.

4. V.I. Konfederatenko, B.G. Struzhko, O.M. Povoroznik. Investigation of three-particle channels of $d + t$ reaction for $47.3\,MeV$ // *Ukr. Journal Phys.* 1994, v.39, N3, p.393-397 (in Russian).

5. S. Blagus, D. Miljanic, M. Zadro, et al. ^4H nucleus and the $^2H(t,tp)$ reaction // *Phys.Rev.C.* 1991, v.44, N1, p.325-328.

6. V.O. Alyoshin, O.O. Belyuskina, S.V. Berdnichenko, et al. Investigation of the deuteron triton interaction // *International Conference "Current Problem in Nuclear Physics and Atomic Energy".* Part.1. Kyiv. 2007, p.270-282 (in Ukrainian).

7. J.E. Brolley, Jr.T.M. Putnam, L. Rosen, L. Stewart. Hydrogen-Helium isotope elastic scattering processes at intermediate energies // *Phys.Rev.* 1960, v.117, N5, p.1307-1316.

8. T.R. King, S. Rotman. Cross sections for $^2H(^3He,^3He)$ and $^2H(^3He,^4He)$ at 7 to $18\,MeV$ center-of-mass energy // *Nucl.Phys.* 1972, v.A183, p.657-665.

9. R. Roy, F. Seiler, H.E. Conzett, F.N. Rad. Cross section and vector analyzing power iT_{11} of the processes $^3He(\vec{d},d)^3He(\vec{d},p)^4He$ between 15 and $40\,MeV$ // *Phys.Rev.* 1981, v.C24, N6, p. 2421-2433.

10. V.K.Tartakovsky, A.V. Fursaev, B.I. Sidorenko. Diffractive dissociation of tritons by incident protons // *Phys. At. Nucl.* 2005, v.68, N1, p.33-41.

11. O.I. Akhiezer, O.G. Sitenko. Diffractional nuclear processes at high energies // *Ukr. Fiz. Zh.* 1958, v.3, p.16-34 (in Russian).

12. V.I. Grantsev, V.V. Davydovskyy, K.K. Kisurin, et al. Excitation of medium nuclei in the continuum region in inelastic scattering of deuterons // *Problems of Atomic Science and Technology.* 2007, N5(48), p.13-17 (Kharkov).

13. V.M. Galitzkyi, B.M. Karnakhov, V.I. Kogan. *Problems of quantum mechanics.* M: "Nauka", 1981, 648p. (in Russian).

14. 14. L.D. Landau, E.M. Lifshitz. *Quantum mechanics.* M: "Nauka", 1974, 703p. (in Russian).

15. V.K.Tartakovsky. On the scattering of ultrarelativistic deuterons on nuclei // *Izv.vuzov USSR. Physics (Tomsk).* 1980, N9, p.3-8 (in Russian).

16. V.I. Grantsev, V.V. Davydovskyy, K.K. Kisurin, et al. Excitation of states of medium-mass nuclei in the region of giant resonances in inelastic deuteron scattering // *Phys. At. Nucl.* 2008, v.71, N10, p.1711-1723.

17. K. Seth. Proton optical potentials from 30 to 180 MeV // *Nucl.Phys.A.* 1969, v.138, p.61-72.

18. Yu.A. Bereshnoy, N.A. Shlyahov. About determination of nuclear parameters on the ground of diffractional model // *Ukr. Fiz. Zh.* 1976, v.21, N2, p.192-196 (in Russian).

19. M.V. Evlanov, A.M. Sokolov, V.K.Tartakovsky. Diffractive dissociation of deutrons and exotic nuclei ^6He and ^{19}C // *Nuclear Physics.* 2003, v.66, p.278 (in Russian).

УПРУГОЕ dt-РАССЕЯНИЕ ПРИ ЭНЕРГИИ 37 МэВ

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Представлены результаты измерений дифференциальных сечений упругого рассеяния дейтронов с энергией $E_d = 37$ МэВ на тритонах в диапазоне углов рассеяния $25° \leq \theta_{c.m.} \leq 150°$. Эксперимент выполнен на изохронном циклотроне У-240 ИЯИ НАН Украины. Проведен теоретический анализ полученных экспериментальных данных в рамках микроскопической дифракционной ядерной модели. Угловые распределения дейтронов в области главного максимума ($\theta_{c.m.} \leq 60°$) достаточно хорошо описываются при энергиях дейтронов $14,4$; $37,0$ та $39,9$ МэВ. Предложено с использованием феменологического квазиклассического приближения объяснение появления широкого вторичного максимума при низких энергиях дейтронов. Квазиклассическое приближение позволяет лишь качественно описать угловые распределения на больших углах $60° \leq \theta_{c.m.} \leq 150°$, где сечения уже весьма малы.

ПРУЖНЕ dt-РОЗСІЯННЯ ПРИ ЕНЕРГІЇ 37 МеВ

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Представлено результати вимірювання диференціальних перерізів пружного розсіяння дейтронів з енергією $E_d = 37,0$ МеВ на тритонах у діапазоні кутів розсіяння $25° \leq \theta_{c.m.} \leq 150°$. Експеримент виконано на ізохронному циклотроні У-240 ІЯД НАН України. Проведено теоретичний аналіз отриманих експериментальних даних в межах мікроскопічної дифракційної ядерної моделі. Кутові розподіли дейтронів в області головного максимуму ($\theta_{c.m.} \leq 60°$) задовільно описуються при енергіях дейтронів $14,4$; $37,0$ та $39,9$ МеВ. Завдяки використанню феноменологічного квазікласичного наближення вдалося пояснити природу появи широкого вторинного максимуму при низьких енергіях дейтронів. Квазікласичне наближення дозволяє лише якісно описати кутові розподіли на великих кутах $60° \leq \theta_{c.m.} \leq 150°$, де перерізи досить малі.