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STUDY OF REACTION SECTIONS FOR THE SYSTEM $(n + Sn^{112})$IN THE ENERGY RANGE$(100 \leq E \leq 125MeV)$Using the METHOD OF (VMA)

Annotation: *In this research, reaction sections were determined for the system* $(n + Sn^{112})$ *in the energy range*$(100 \leq E \leq 125MeV)$ *using the method of (VMA), which relies on dispersion relation (DR) and connects the real and imaginary potentials.*

Keywords: *Method (VMA),* $(SPI - Genoa)$*, Neutron optical potential, reaction sections.*

ИССЛЕДОВАНИЕ УЧАСТКОВ РЕАКЦИИ ДЛЯ СИСТЕМЫ (N + 〖SN〗 ^ 112) В ДИАПАЗОНЕ ЭНЕРГИЙ (100≤E≤125 МЭВ) С ИСПОЛЬЗОВАНИЕМ МЕТОДА (VMA)

Аннотация: *В этом исследовании сечения реакций для системы* $(n + Sn^{112})$ *в области энергий* $(100 \leq E_n \leq 125)$ *МеВ определены с использованием метода (VMA), который основан на дисперсионном соотношении (DC), который соединяет реальные и мнимые части оптического потенциала.*

Ключевые слова: *метода (VMA), (SPI-Генуя), Нейтронный оптический потенциала сечениями реакций.*

1. Introduction:

The Optical Model has been able over the last fifty years with a relatively tangible success to give an analysis of the results of reactions of Pions and composite Deleted. This model was developed into a model called the dispersion optical model [1,c.274- 2,c.525], and one of its famous methods, the variational moment approach (VMA. This method looks at the potential components of the intermediate field (nuclear potential) (the real component (V_r) and the imaginary component (W)) that they are internally interconnected through the dispersion relationship (DR), this contributes to the treatment of two parameters of different potential optical parameters. This method was applied to study nuclear reactions $(n, P + Pb^{208})$, $(n, P + Ca^{40})$ [3,c.253- 4,c.7- 5,c.179- 6,c.413- 7,c.809- 8,c.23] , so we found it important to apply this method to study the system $(n + \ Sn^{112})$ in the energy field $(100 \leq E_n \leq 125MeV)$.

2. Theoretical Content of the Method (VMA):

According to the (VMA) method, the reciprocal effect between the nucleotides emitted by the neutrons and the target is expressed by the nuclear optical potential which is the following relationship:

$$U(r,E)=V(r,E)+iW(r,E)+V_{LS}(r,E)+V_C(r) \qquad (1)$$

$$V(r,E) = \Delta V(r,E) + V_{HF}(r,E)$$
$$= \Delta V_V(r,E) + \Delta V_d(r,E) + V_{HF}(r,E) \qquad (2)$$

$$\Delta V\ (r,E)=\frac{2}{\pi}(E-E_F)\int_{E_0}^{\infty}\frac{[r^2]_w(E')\,dE'}{g_w(E)\left[(E-E_F)^2-(E'-E_F)^2\right]} \qquad (3)$$

$[r^2]_w(E)$ is determined analytically according to Brown-Rao's relationship [9,c. 397-417]:

$$[r^2]_{wd}(E) = \beta_2 \frac{(E-E_0)^2}{(E-E_0)^2+{\rho^2}_2} - \frac{(E-E_0)^2}{(E-E_0)^2+{\rho^2}_w} \quad (4)$$

Where $(\rho_w, \rho_2, \beta_2)$ Variables are determined by the simulation method, while the second term $V_{HF}(r,E)$ determined according to the following relationship:

$$V_{HF}(r,E) = \frac{[r^2]_{HF}(E_F)}{g_{HF}}\{\exp\ [\alpha_{HF}(E-E_F)]\} f(x_{HF}) \quad (5)$$

Where $f(X_{HF})$ is the Woods-Saxon form factor , E_F Fermi energy is determined according to relationship: $E_F = \frac{1}{2}\left({E_F}^+ + {E_F}^-\right)$ (6)

$$[r^2]_{HF}(E) = \frac{4\pi}{3}\frac{{R_{HF}}^3}{A}\left[1+\left(\frac{\pi a_{HF}}{R_{HF}}\right)^2\right]V_{HF}(E) \equiv g_{HF}V_{HF}(E) \quad (7)$$

The imaginary potential (absorption) in its surface and volume particles are determination through the dispersion relationship in addition to the following relation:

$$[r^2]_W(E) = [r^2]_{W_w}(E) + [r^2]_{W_d}(E) = \frac{4\pi}{A}\int_0^\infty [W_d(r,E)+W_w(r,E)]r^2dr \quad (8)$$

The Spin-orbit Coupling and determined by the following relationship:

$$V_{LS}(r,E) = -V_{LS}(E)(4r_{ls}a_{ls})^{-1}g(x_{ls})\vec{L}.\vec{\sigma}$$

It is recommended that the values of potential $V_{LS}(r,E)$ are not dependent on energy, so they are taken as constant values:

$$(V_{LS} = 6.8\ Mev, \quad r_{LS} = 1.2\ Fm, a_{LS} = 0.6\ Fm, r_c = 1.22Fm)$$

It is proposed to describe the national characterization of all the boundaries of the relationship (1) using the form of Woda-Saxon expressed in the following relationship: $V(r,E) = V_v(E)\ f(x)_v$ (9)

Where $f(x_v) = [1+\exp x_v]^{-1}$, $x_v = \frac{r-R_v}{a_v}$, $R_v = r_v A^{\frac{1}{3}}$

The relationship of the detailed nuclear field is as follows:

$$U(r,E)=\frac{[r^2]_{HF}(E_F)}{g_{HF}}\exp[\alpha_{HF}(E-E_F)]f(x_{HF})+\Delta V_w(E)f(x_w)+\Delta V_d(E)g(x_d)$$

$$+iW_w f(x_w)+iW_d g(x_d)+V_{LS}(r,E)+V_C(r) \qquad (10)$$

After the identification of the components of the nuclear field (10), $\sigma(E)$ is found, according to a typical program $(SPI - Genoa)$ [10,c. 253].

3. The Results and Discussion:

At the beginning, in order to obtain the parameters of potential Neutron optical for $(\boldsymbol{n} + \boldsymbol{Sn^{112}})$ in the energy range $(100 \leq E_n \leq 125MeV)$. Special intermediaries $(\rho_w, \rho_2, \beta_2)$, as for E_0 the energy of the centers of attraction of the filled levels in the nucleus (A + 1) is determined by Relationship $[11, c1291]$:

$$\boldsymbol{E_0 = \frac{1}{N}\sum_{nlj} E_{nlj}}$$

Where (n, l, j) are represent the characteristics of the sub-energy levels, N number of energy levels. Determines the addition of torque ranked second for latency Hartree-Fock card equal to the energy of the Fermi following relationship [12,c132-146]: $U_V = V_0 - \frac{N-Z}{A}V_1$

Table 1, which contains those intermediaries and the graphs that helped to create the system $(n + Sn^{112})$ In the energy range $(100 \leq E_n \leq 125MeV)$ is shown below:

A	β_2 (MeV)	ρ_2 (MeV)	ρ_W (MeV)	$\propto$	E_F (MeV)	E_0 (MeV)	$[r^2]_{HF}(E_F)$
Sn^{112}	91	22	45	0.4227	-9.27	-4.63	444.6298

The graphing curves that have helped to find these intermediaries in the following two forms.

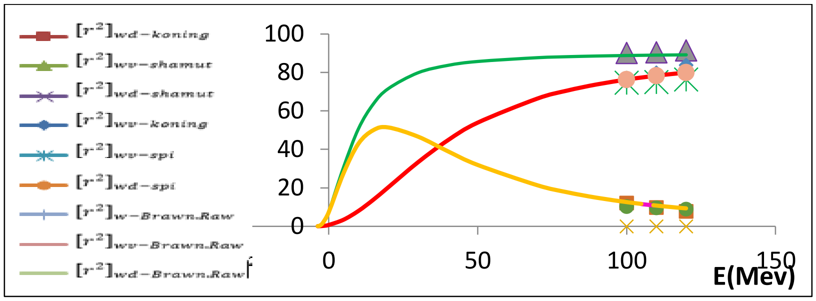


Figure 1: The energy dependence of the volumetric integral for $[r^2]_w(E_K)$ for $(n + Sn^{112})$ In the energy range $(100 \leq E_n \leq 125MeV)$.

It is noted from Figure 1 that the ideal match of values $[r^2]_{Wd}(E_K)$, $[r^2]_{ww}(E_K), [r^2]_w(E_K)$ which determined by (VMA) With their experimental counterparts [13,c.45- 14,c.427].

While Figure 2 represents the energy changes of the volumetric integral for the real part of the potential:

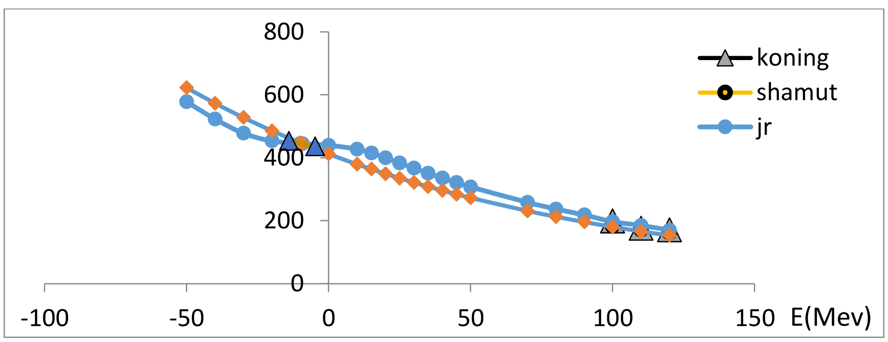


Figure 2: The energy dependence of the volumetric integral to the real part of the potential for interaction $(n + Sn^{112})$.

As shown from Figure 2 the ideal match of values $[r^2]_V(E_K)$ defined by the (VMA) method with their experimental counterparts [13,c.45- 14,c.427-15,c.206].

Based on the above results, a software program for data processing (VMA) and program assistant (SPI-Genoa) was designed and prepared to calculate $\sigma(\theta), p(\theta), \sigma(E)$. Based on this, the parameters of the neutron optical potential of the

flexible scattering process of the ejected neutrons by nucleus Sn^{112} will be presented in Table (2).

E MeV	V_2 MeV	r_0 (Fm)	a_0 (Fm)	W_W MeV	r_w (Fm)	a_w (Fm)	W_d MeV	$\bar{r}_d$ (Fm)	$\bar{a}_d$ (Fm)
1	49.08	1.238	0.7	0.104	1.27	0.52	0.3239	1.27	0.525
10	47.09	1.244	0.7	0.953	1.27	0.52	2.140	1.27	0.525
30	42.18	1.225	0.7	3.711	1.27	0.52	3.453	1.27	0.525
50	24.08	1.21	0.7	5.944	1.27	0.52	1.331	1.27	0.525
70	31.24	1.203	0.7	7.317	1.27	0.52	1.893	1.27	0.525
90	26.61	1.199	0.7	8.138	1.27	0.52	1.350	1.27	0.525
100	24.56	1.197	0.7	8.420	1.27	0.52	1.154	1.27	0.525
110	22.68	1.196	0.7	8.646	1.27	0.52	0.9938	1.27	0.525
120	20.95	1.195	0.7	8.827	1.27	0.52	0.8631	1.27	0.525
125	19.17	1.194	0.7	9.102	1.27	0.52	0.7721	1.27	0.525
$V_{SO} = 6.8MeV, r_{so} = 1.20Fm, a_{so} = 0.6, r_c = 1.22Fm$									

Table 2: The parameters of the neutron potential, through which the optical potential form is derived $(1 \leq E_n \leq 100MeV)$ by extending these derived parameters, we were able to characterize the lower energy range of the studied field and were able to cover energy areas that did not contain empirical data for $,\sigma(\theta)$ $,p(\theta), \sigma(E)$.

The curves derived from Table 2 will be presented by the following:

1- Dispersion Contribution:

Based on the physical basis of the VMA method, we have determined the contribution of the dispersion volume integral of the potential and graphically represented as shown in Figure (4):

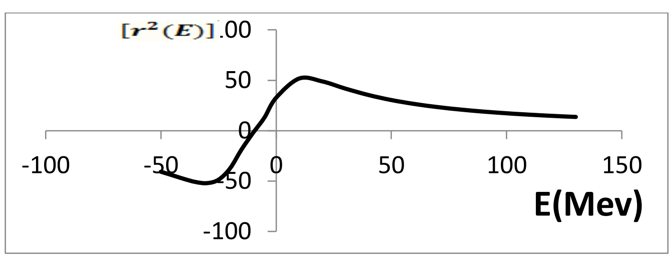


Figure (4): represents the energy dependence of the dispersion volumetric integral in the energy range $(100 \leq E_n \leq 125MeV)$ for $(n + Sn^{112})$.

We observe from Figure (4) that the behavior of the dispersion volumetric integral for energy is similar to that of the general behavior in reference [11, c1291].

2- Formation of potentials form $V_{HF}(E), V(E)$ for reaction $(n + Sn^{112})$ in the energy range $(100 \le E_n \le 125 MeV)$

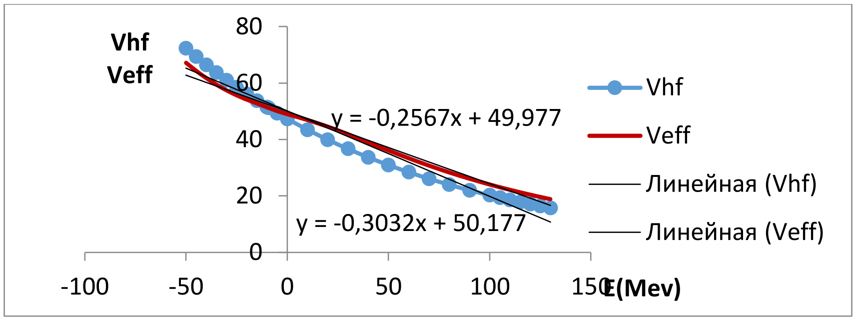
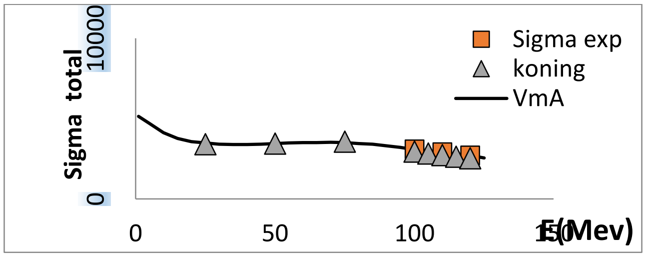


Figure 5: Energy dependence of the real portion of $V(E)$ and V_{HF} for $(n + Sn^{112})$ within the studied range.

Figure 5 shows that the linear dependence of both real and Hartry-Fock potential energy and this characteristic is characterized by two relationships as follows: $V_{HF} = -0.3032E + 50.177$, $V = -0.2567E + 49.977$

Follows are the results which are graphically represented in Figure 7:



Figure(7): Energy dependence of the total reaction section of $(n + Sn^{112})$ within energy range$(0 \le E_n \le 125MeV)$

Figure 7 shows that there is a good match between the values determined by the (VMA) method of the total reaction sections $\sigma(E)$ with its experimental counterparts [14,c.427], it is worth mentioning here that this congruence is rarely observed in the low-energy areas, which makes these parameters valid for the characterization of the total section of the reaction $(n + Sn^{112})$. The reason for the decrease in the values of the total reaction sections in the high energies area is due to a decrease in the input of the channels of interaction.

Throughout what is mentioned above, we can say that the dispersion optical model offers a new and accurate method through which it could develop the form of optical potential and to find the values of the volume integral for the potential, as well as to determine the values of the total and reaction sections, and then it can be used as a reference basis for future studies of the nuclei studied.

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