Restoration of Heavy-Ion Potentials at Intermediate Energies

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Contrary to the usual phenomenological optical potentials the following forms are constructed:

$$U_{opt}^{A,B,C} \;\Rightarrow\; N_r^A V^H + iN_{im}^A W^H; \quad N_r^B V^{DF} + iN_{im}^B W^H; \quad N_r^C V^{DF} + iN_{im}^C V^{DF}.$$

The suggested potentials are based on the microscopically calculated patterns for the real V^H and imaginary W^H parts of the potential obtained in [1], which reproduce the high-energy amplitude of scattering [2]. Another used template V^{DF} is calculated within the standard double-folding (DF) model with the exchange term included [3]. They are as follows

$$U_{opt}^H(r) \;=\; V^H + iW^H = -\frac{2E}{k(2\pi)^2}\bar{\sigma}_{NN}(\bar{\alpha}_{NN}+i)\int dq\, q^2 j_0(qr)\tilde{\rho^\circ}_p(q)\tilde{\rho^\circ}_t(q)\tilde{f}_N(q),$$

$$V^{DF}(r) = \int d^3r_p d^3r_t\, \rho_p^\circ(\mathbf{r}_p)\,\rho_t^\circ(\mathbf{r}_t)\, v_{NN}^D(\mathbf{r}_{pt}=\mathbf{r}+\mathbf{r}_t-\mathbf{r}_p)\; +$$

$$+\int d^3r_p d^3r_t\, \rho_p^\circ(\mathbf{r}_p,\mathbf{r}_p+\mathbf{r}_{pt})\,\rho_t^\circ(\mathbf{r}_t,\mathbf{r}_t-\mathbf{r}_{pt}) v_{NN}^{EX}(\mathbf{r}_{pt})\,\exp\left[\frac{i\mathbf{K}(r)\mathbf{r}_{pt}}{M}\right].$$

Here $\tilde{\rho^\circ}_{p(t)}(q)$ are form factors of the point densities $\rho_{p(t)}^\circ(r)$ of the projectile and target nuclei, $\tilde{f}_N(q)$ is expressed through the form factor of the NN-scattering amplitude, $\bar{\sigma}_{NN}$ is the total cross section while $\bar{\alpha}_{NN}$ is the ratio of the real-to-imaginary part of the forward NN-scattering amplitude. The "bar" means averaging on isotopic spins of colliding nuclei; $K(r)$ is the local relative momentum motion of nuclei; $Mm = A_pA_tm/(A_p+A_t)$ is the reduced mass; v_{NN} is the effective NN-potential given in [3].

Thus, we do not introduce free parameters except the N_r and N_{im} factors, the weights of contributions of the microscopic real and imaginary heavy-ion potentials of scattering. Doing so, we calculated within the high-energy approximation (HEA) (see, e.g. [4]) the differential cross-sections for scattering of the ^{16,17}O heavy-ions on different target-nuclei at about hundred Mev/nucleon [1], [5], [6] and compare them with the experimental data from [7]. As an example the Fig. 1 shows that the potential $U_{opt}^A = 1.13V^H + iW^H$ (dashed lines in (a),(b)) behaves in a peripheral region in coincidence with the phenomenological 4-parameter WS-potential [7], and results in the corresponding cross-section (dashed curve in (c)) closed to that calculated for the WS-potential.

Main conclusion is that the presented idea proves itself to utilize the microscopic models as patterns for further fit with the experimental data. Moreover, at high energy

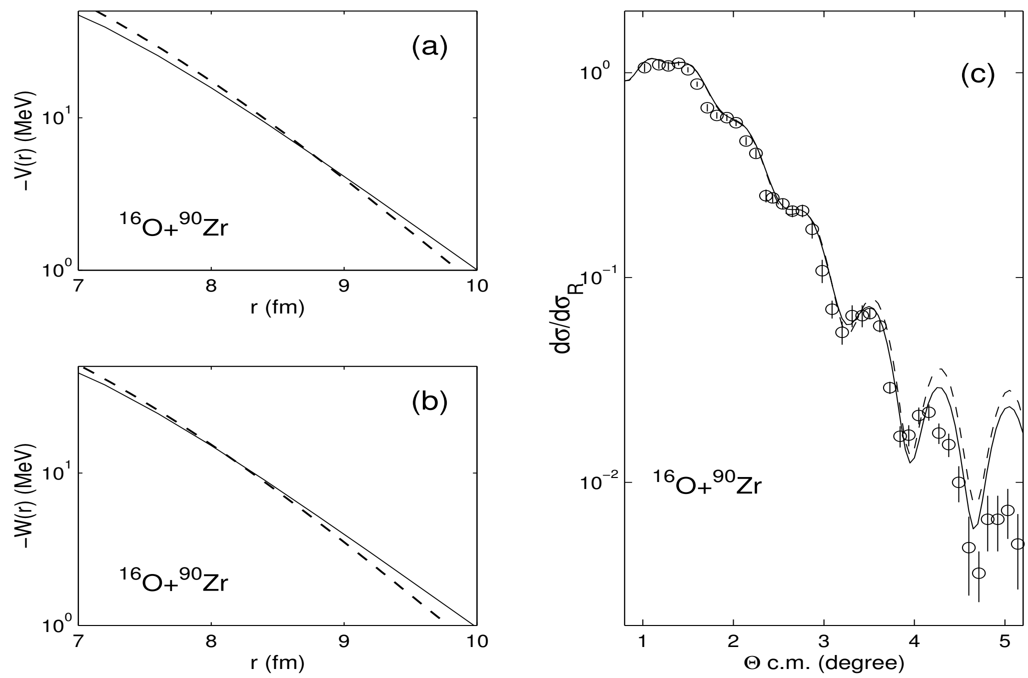

Figure 1:

interactions, one can be confident to claim that the results of the calculations done by using the microscopic potentials show that in the outer region of the interactions a true prediction and behavior of these potentials can be gained in the very sensitive domain of the heavy-ion scattering.

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