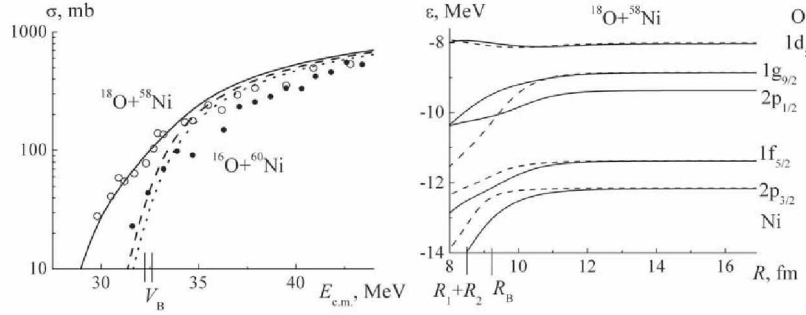
THE QUANTUM DESCRIPTION OF THE COUPLING WITH NEUTRON REARRANGEMENT CHANNELS IN FUSION REACTIONS IN THE VICINITY OF COULOMB BARRIER

Samarin V.V.
Joint Institute for Nuclear Research, Dubna, Moscow region, Russia
E-mail: samarin@jinr.ru

The quantum description of the coupling with neutron rearrangement channels in fusion reactions based on the expansion in series on two-centre wave functions was devised. Valence neutrons channels coupled equations were proposed in Ref. [1]. These equations were solved for reactions $^{18}O+^{58}Ni$, $^{40}Ca+^{96}Zr$, $^{32}S+^{96}Zr$ and some others. The enhancement of the fusion cross section for the reaction $^{18}O+^{58}Ni$ in comparison with reaction $^{16}O+^{60}Ni$ [2] (Fig. 1a) is explained by the neutron transitions to low-lied two-centered levels (Fig. 1b) near Coulomb barrier at central collisions. A comparison of the experimental data [2] with the calculation results demonstrates satisfactory agreement between them at energies near the Coulomb barrier (Fig. 1a).



a *b*

Fig. 1. (a)The experimental fusion cross section [2] of reactions $^{18}O+^{58}Ni$ (circles), $^{16}O+^{60}Ni$ (points) and calculation results: for $^{18}O+^{58}Ni$ with the neutron rearrangement $1d_{5/2}(O)\rightarrow 1g_{9/2}$, $2p_{1/2}$, $1f_{5/2}$, $2p_{3/2}$ of Ni channels coupling (the solid curve) and without this coupling (the dashed curve), for $^{16}O+^{60}Ni$ (the dotted curve), V_B is Coulomb barrier for spherical nuclei.
(b) Energies of two-centre states of the valence neutrons with angular momentum projections onto the inter-nuclear axis $\Omega = 1/2$ (full curves) and $\Omega = 3/2$ (dashed curves) in the $^{18}O + ^{58}Ni$ system versus the nucleus–nucleus distance R; R_B is the radius of barrier, R_1 and R_2 are radii of nuclei. The notation for states in the separated nuclei is indicated.

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2. M.Borges *et al.* // Phys. Rev. C. 1992. V.46. P.2360.