Effect of the absorption from collective states on fusion cross section for heavy systems

J. Rangel, J. Lubian, P.R.S. Gomes
UFF- RJ- Brasil

Luis F. Canto
UFRJ- RJ- Brasil

It is sometimes assumed that the contribution to the fusion cross section comes mainly from the absorption from the elastic scattering. Thus, one can perform coupled channel calculations and extract a polarization potential. Using this polarization potential one can obtain the elastic scattering wave function by performing optical model calculations. The fusion cross section is obtained trough

$$\sigma_{fus} = \frac{k}{E}\langle\psi^{+}_{elas}|W|\psi^{+}_{elas}\rangle \quad (1)$$

In the present work we demonstrate that this approximation may not work for tightly systems where the coupling to the bound states is very important ,like the 48Ca+154Sm system, for which the collective excitation of the target are of upmost importance. In this case the fusion cross section must be calculated by the expression:

$$\sigma_{fus} = \frac{\pi}{k^2}\sum_{k,\alpha,l}\frac{4k}{E}(2J+1)\langle u^{J}_{\alpha,l}(r)|W|u^{J}_{\alpha,l}(r)\rangle \quad (2)$$

for the special case of even-even nuclei. In the expression above the sum is taken for all the excited states of the projectile and/or of the target. This means that the flux to fusion may come not only from the elastic scattering, but also from the collective excited states. To obtain these results we performed coupled channel calculations with FRESCO code and print the corresponding wave functions for all the specific states of the system. To calculate the flux from any specific state we wrote a program. The situation may be different in the case of the weakly bound system, for which the absorption from the continuum states feeds the incomplete fusion. Nevertheless, some absorption from some important bound states may feed the complete fusion.