Fusion Reactions as a Probe for the Nucleus-Nucleus Potential at Short Distances

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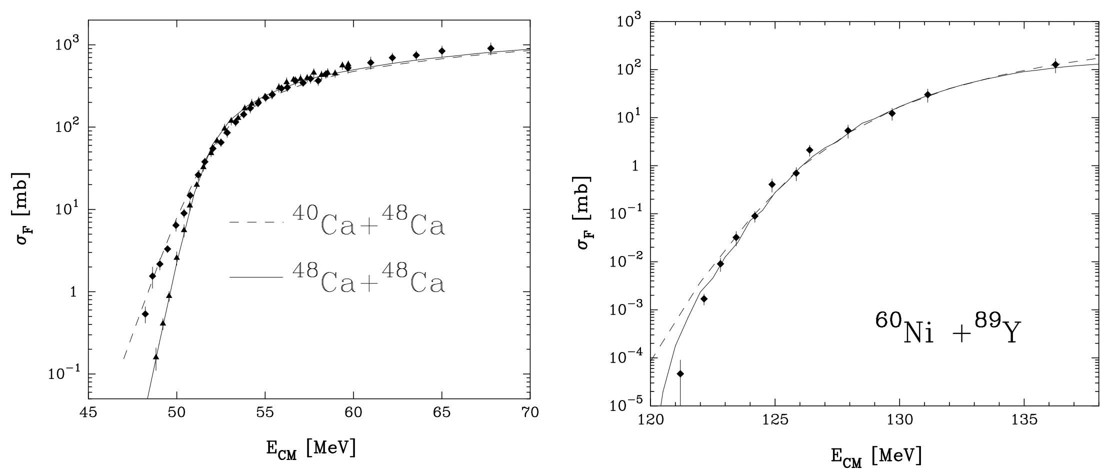
In this contribution I will address to the behavior of the fusion excitation function at very low energy. This has been shown [1] to deviate from the exponential slope predicted by the Wong formula. To do this I will use a semi-classical model [2] that has been developed for the study of heavy ion reactions in the quasi-elastic regime. This model incorporates, on the same footing, the degrees of freedom associated with the excitation of surface modes and with the transfer of nucleons. The model has been successfully applied [3] to the calculations of fusion excitation functions (an example in show below, left panel), barrier distributions and multi-nucleon transfer reactions.

The exponential fall-off of the fusion cross section derives from the inverse-parabolic approximation of the barrier of the effective nucleus-nucleus potential. This, at short distances, displays a pocket (the actual position and value are not well known) and deviation from the parabolic approximation must show-up: the energy of the pocket provides, in fact, a natural cut-off since for lower energy no fusion can take place. The low-energy behavior of the fusion cross section can thus be used to learn about the inner pocket of the potential [4]. Modifying the shape of the potential at short distances but keeping constant the position of the barrier and the value of $\hbar\omega_B$ one obtains, for the ^{60}Ni $+^{89}$Y reaction, the results shown in the right panel below (full line) in comparison with the unmodified potential (dash-line). The full line corresponds to a potential whose inner pocket is only $\simeq$10% lower than the barrier. The implications of this shallow potential at high bombading energy will also be discussed.



[1] C.L. Jiang, H. Esbensen et al., Phys. Rev. Let. 89 052701 (2003)

[2] A. Winther, Nucl. Phys. A572 (1994) 191 and Nucl. Phys. A594 (1995) 203

[3] G. Pollarolo and A. Winther, Phys. Rev. C62, 054611 (2000)

[4] C.H. Dasso and G. Pollarolo, Preprint DFT-22/03