ADIABATIC FUSION BARRIERS FROM SELFCONSISTENT HARTREE-FOCK METHOD

Janusz Skalski
A. Sołtan Institute for Nuclear Studies, Hoża 69, PL 00-681, Warsaw, Poland

Adiabatic fusion potentials, extended well into compound nucleus (CN) region, have been calculated for a number of reactions within the selfconsistent Hartree-Fock method with the Skyrme SkM* interaction [1]. For deformed target or/and projectile pairs, whose relative orientation counts, tip- and side collision potentials were calculated. Since adiabatic barriers involve interaction-induced rearrangement of projectile and target densities, they differ considerably from the frozen density barriers [2]. In particular, the rise of the frozen density potential $V(R)$ with decreasing R vanishes in adiabatic potentials, except for the heaviest CN, when the fusion barrier top lies below the CN ground state.

Calculated barriers are compared to the lowest (adiabatic) fusion barriers extracted from the data in [3]. Both agree quite well, in spite of considerable errors in reaction Q values, inherent in SkM* force. This suggests some error cancellation. Calculated barrier heights are consistent with the idea [4] that in reactions with large $Z_T Z_P$ and deformed fragments fusion is suppressed in tip collisions, in spite of the substantially lower fusion barrier.

We have also studied adiabatic energy surfaces of heavy systems at large deformation to learn relative positions and heights of the fusion and fission potentials and gain some insight into their possible connection with the fusion hindrance at large $Z_T Z_P$.

[1] J. Skalski, Int. J. Mod. Phys. E 13, 305 (2004), nucl-th/0402033.
[2] V.Yu Denisov and W. Nörenberg, Eur. Phys. Journal A 15, 375 (2002).
[3] K. Siwek-Wilczyńska and J. Wilczyński, Phys. Rev C 64, 024611 (2002).
[4] D.J. Hinde et al., Phys. Rev. Lett. 74, 1295 (1995), S. Mitsuoka et al., Phys. Rev. C 62, 054603 (2000), K. Nishio et al., Phys. Rev. C 62, 014602 (2000).

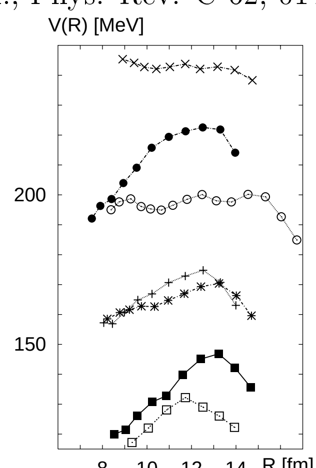

Figure 1: Adiabatic nucleus-nucleus potentials for the reactions: ^{90}Zr+^{40}Ca (shifted up by 40 MeV, open squares), ^{132}Sn+^{64}Ni (full squares), ^{208}Pb+^{48}Ca (stars), ^{90}Zr+^{90}Zr (pluses), ^{110}Pd+^{110}Pd tip-tip (open circles) and side-side collision (full circles) and ^{208}Pb+^{70}Zn (crosses).