STUDY OF ROLE OF ISOTOPIC DEPENDENCE IN FUSION PROCESS

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The availability of large number of neutron-rich and deficient nuclear beams has generated a new interest in the field of fusion dynamics that may also shed light on the synthesis of new elements. One is able to analyze the properties of nuclei with $0.43 \leq N/Z \leq 4.00$ whereas fusion studies are limited for $N/Z \leq 1.4$. We here report the fusion of neutron rich and deficient colliding nuclei using Skyrme Energy Density Model. For the details, reader is referred to refs. [1,2].

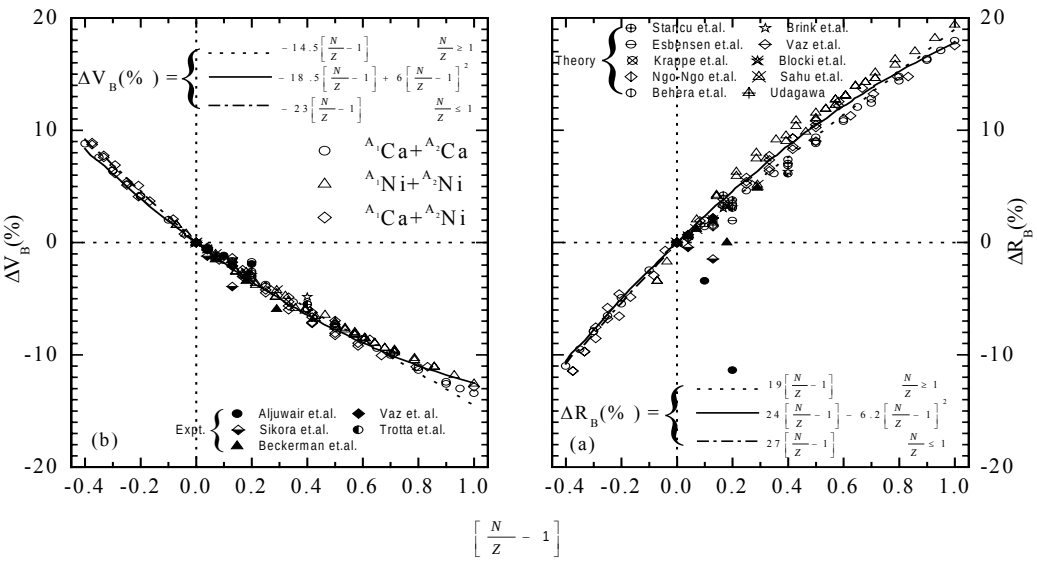
The present systematic study of fusion is carried out for three series: Ca+Ca, Ca+Ni and Ni+Ni. Starting from the symmetric (N=Z) nuclei, neutrons are added/removed gradually from the projectile and/or target [2]. We calculated the fusion barrier heights and positions for a large number of isotopes with $0.6 \leq N/Z \leq 2.0$ and analyzed the normalized variation in the barrier heights and positions over N=Z colliding pair as:

$$\Delta R_B\,(\%) = \frac{R_B - R_B^0}{R_B^0} \times 100\ ; \tag{1}$$

$$\Delta V_B\,(\%) = \frac{V_B - V_B^0}{V_B^0} \times 100\ , \tag{2}$$

where R^0_B and V^0_B are, respectively, the positions and heights of the barriers for N=Z colliding pair. In figure 1, we display $\Delta V_B(\%)$ and $\Delta R_B(\%)$ as a function of [N/Z-1]. The addition of neutrons pushes R_B toward larger distances monotonically whereas V_B decreases linearly. One sees a reverse trend in the case of neutron-deficient colliding nuclei. In addition, the variation in the barrier positions for neutron deficient nuclei is stronger compared to neutron-rich colliding nuclei. The unified formula for the above variation is given by [2]:

$$\Delta R_B\,(\%) = 24\left(\frac{N}{Z} - 1\right) - 6.2\left(\frac{N}{Z} - 1\right)^2,$$

$$\Delta V_B\,(\%) = -18.5\left(\frac{N}{Z} - 1\right) + 6\left(\frac{N}{Z} - 1\right)^2.$$

1. R.K. Puri et.al, Phys. Rev. C43, 315(1991).
2. R.K. Puri and N.K. Dhiman, Phys.Letts. B submitted (2004).