ROLE OF SPIN DEPENDENT NUCLEAR POTENTIAL IN THE FUSION OF Se^* ISOTOPES

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The heavy ion reactions have been extensively analysed using energy density formalism during last few decades. One of the major thrust is to understand the role of the spin density dependent interaction potential towards the complete fusion process or related mechanism. Here, we use the Skyrme nucleus-nucleus interaction with in the semi classical extended Thomas fermi (SETF) approach [1], under frozen density approximation where the nuclear potential is obtained as a sum of the spin-orbit density-dependent part and spin-orbit density independent part of the Skyrme Hamiltonian density. Within the SETF approach, the effect of deformations and related orientations are analysed on spin-orbit interaction potential to have further insight of nuclear structure of various Se^* isotopes.

In 2010, an experiment was performed to measure fusion evaporation cross-sections of $^{72}Se^*$ formed in $^{27}Al+^{45}Sc$ reaction over a wide range of incident energies spread across the Coulomb barrier [2]. In the present work, we have investigated the behavior of spin-orbit density dependent part of interaction potential in $^{23,25,27,29,31}Al+^{45}Sc$ reactions using the framework of SETF approach. The calculations are done for spherical and deformed choices of nuclei under frozen density approximation for various isotopes of $^{68,70,72,74,76}Se^*$ having N/Z ratio in the range 1 to 1.23. It is observed that, for spherical choice of nuclei, the barrier height increases slowly with increase in number of neutrons in the projectile beam. However, on inclusion of deformation effects with in optimum orientations, the barrier height increases significantly with increase in neutrons in the projectile and the variation is systematic, except that for oblate shaped projectiles where the barrier height and barrier distribution show different profile. In other words, for oblate projectiles the barrier is highest and the barrier position shifts towards smaller interaction radius, independent of the choice of Skyrme forces. It may be noted that although the trend of variation is independent of choice of Skyrme force but the magnitude gets influenced significantly, henceforth the choice of Skyrme force seems to play a important role in the synthesis and related dynamics of heavy ion collisions. In summary, the deformations play significant role on the spin-orbit density dependent interaction potential of various Se^* isotopes formed in heavy ion reactions. We are in process of accessing comprehensive role of spin dependent interaction potential in Se isotopes so that related aspect of fusion hindrance [2] may be addressed.

[1] R. K. Gupta, D. Singh, R. Kumar, W. Greiner, J. Phys. G: Nucl. Part. Phys. 36, 075104 (2009). [2] C. L. Jiang et al., Phys. Rev. C 81, 024611 (2010).