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Effect of double spin-orbit parameters on fusion barrier of prolate-prolate deformed nuclei

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Relativistic mean-field model (RMF) and Skyrme Hartree fock (SHF) approach with effective energy functionals are applied to describe the bulk properties of nuclei. However, SHF model with standard parametrization fails to address the charge isotope shifts in the vicinity of major shell closures [1], which on the other hand is well described by the RMF model calculations [2]. This contrariety is related to the peculiarity of the spin-orbit (S-O) interaction potential (VJ) and hence corresponding modifications are required in SHF functional. In view of this, a simple generalization of the Skyrme functional is considered with a larger flexibility within the spin-orbit term by means of an additional coefficient W0term along with W0. Subsequently, six parameterizations of the Skyrme functional such as SkIx (x=1 to 5) [3] and SAMi [4] are obtained. In the present work, out of six forces, four different parameter sets are chosen such as SAMi (W0=137; W0 =42), SkI4 (W0=183.09; W0= -180.35), SkI3 (W0=94.25; W0=0) and SkI2 (W0=60.301; W0‘ =60.301) and their effect in terms of double spin-orbit strength is examined in the fusion dynamics of 90Zr+90-96Zr reactions. The explicit dependence of deformation effect is incorporated by taking prolate-prolate target-projectile combinations. The study is carried out within the framework of Skyrme energy density formalism (SEDF) [5] by calculating the change in fusion barrier height (ΔVB=VB (with VJ)-VB (without VJ)) of considered reactions. It is observed that independent of the reaction channel, maximum decrease in the fusion barrier height is obtained with SAMi force (having greater influence of S-O term) followed by SkI4, SkI3 and minimum with SkI2 Skyrme force. Moreover, the effect of target deformation is such that the value of ΔVB is maximum for 90Zr+96Zr reaction having strong deformation dependence (β2P=0.035; β2T=0.217) and minimum for weakly deformed combination i.e., for 90Zr+90Zr channel (β2P=0.035; β2T=0.035). This means that the double spin-orbit parameters of the spin-orbit strength along with deformations of interacting nuclei significantly affect the fusion barrier height of considered reactions. In further study the relative influence of these Skyrme forces will be analysed on fusion excitation functions and the results will be presented during the conference.

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Section

1. Experimental and theoretical studies of nuclear reactions

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