Prolate non–collective – A rare shape phase in high spin state proton emitters $^{141-144}$Ho and $^{131-135}$Eu

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New experimental advances in measuring proton decay and identification of large number of proton emitters [1] in ground or excited isomeric states near proton drip line have opened up a new era of nuclear structure physics as it can be used as a powerful tool to probe the structure of proton unbound Nilson orbitals and investigate nuclear deformations beyond proton drip line. These experimental findings provide valuable information about exotic nuclei which give impetus to the theoretical models truted for the stable nuclei to test their predictions on the unstable nuclei that too in the extreme conditions of temperature and spin. We study structural transitions in high spin states of deformed odd – Z proton emitters $^{141-144}$Ho and $^{131-135}$Eu in a theoretical framework [2] using the deformed Nilsson potential and Strutinsky's prescription combined with statistical theory [3] of hot rotating nuclei. These proton emitters are found to exhibit shape transition to a rare prolate non–collective shape phase in excited high spin state. This prolate noncollective equillibrium phase had not been anticipated before the Ref. [4] and then our work on proton radioactivity from high spin states of proton rich ^{94}Ag [5], which is caused directly by rotation at certain angular momentum values which creates a residual quantum shell effect. This unexpected prolate noncollective phase generated by rotation undergoes the expected transition to the oblate noncollective phase at higher angular momentum values [5]. Such a phase exists only in a narrow domain bound by the two spin dependent very low critical temperatures. Investigation of high spin states of the experimentally identified proton emitters $^{141-144}$Ho shows shape transition from highly deformed triaxial to rarely seen prolate non–collective shape phase. Shape transition from deformed prolate non–collective to oblate non–collective shapes at high spins is observed in $^{131-135}$Eu. Phenomenon of shape coexistence with prolate and oblate non–collective shapes is also speculated in high spin state ^{131}Eu.

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