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Rotation of very proton-rich nuclei: new physical mechanisms and exotic shapes

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Abstract

Over the years, it was established that the cranked relativistic mean field theory without pairing can describe successfully the properties of different types of rotational bands at high spin across the nuclear chart (see Refs. [1, 2]). Using this framework a detailed and systematic investigation of rotational properties of the nuclei at and beyond the proton drip line has been carried out [3].

It is shown for the first time that rotational bands which are proton unbound at zero or low spins can be transformed into proton bound ones at high spin by collective rotation of nuclear systems. This is due to strong Coriolis interaction which acts on high-N or strongly mixed M orbitals and drives the highest in energy occupied single-particle states of nucleonic configurations into negative energy domain. These features are similar to those predicted in very neutron-rich nuclei at and beyond neutron drip line in Ref. [4]. Proton emission from such proton bound rotational states is suppressed by the disappearance of static pairing correlations at high spins of interest. These physical mechanisms lead to a substantial extension of the nuclear landscape beyond the spin zero proton drip line. In addition, a new phenomenon of the formation of giant proton halos in rotating nuclei emerges: it is triggered by the occupation of strongly mixed M intruder orbitals. Possible experimental fingerprints of the transition from particle bound to particle unbound part of rotational bands will be discussed and compared for proton and neutron rich nuclei located near and beyond respective drip lines.

References

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