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Probing Nuclear Shell Evolution using Radioactive Ion Beams at ISOLDE, CERN

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The science of stellar nucleosynthesis aims at understanding how the elements in the universe are formed in stars. On a microscopic scale, the formation of elements is dictated by the properties of atomic nuclei and their interactions. Of special importance for r-process nucleosynthesis is a fundamental understanding of shell evolution towards neutron-rich nuclei. The finding of a soft $N=2$ harmonic oscillator shell in the “Island of Inversion” was one of the first discoveries of changing shell structure in exotic nuclei and triggered a renaissance in our field thanks to the availability of intense beams of unstable ions. Recent experiments at the RIKEN Nishina Center (Japan) indicate that also the $N=3$ harmonic oscillator shell is softened for extremely neutron-rich nuclei, which would effect the r-process flow in a dramatic way. I will discuss the underlying physics and will report on our recent experiments at the radioactive ion beam facility ISOLDE at CERN using the high-granularity MINIBALL array. In a series of studies we probed the $N=3$ Neutron harmonic oscillator shell gap around 68Ni . Specially, using a multiple coulomb excitation experiment a clear indication for an onset of deformation beyond $N=40$ can be observed, indicating the pivotal role of subshell structure on the evolution of collective nuclear properties.

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