

Evolution of shell structure in neutron rich Cu and Ni nuclei

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The evolution of shell structure with neutron and proton excess is a compelling interest in nuclear physics over the decade. The existence of the single-proton (single-neutron) shifts is well known experimentally in a series of isotopes (isotones) [1]. Although shell gaps, defined within a given theoretical framework as differences of effective single particle energies (ESPE), are not observables, they are useful quantities to assess the underlying structure of nuclei [2]. The nucleon-nucleon (NN) interaction is originally due to meson exchange processes as predicted by Yukawa, and its tensor-force part is one of the most distinct manifestations of this meson exchange origin [3]. The introduction of tensor force improved the systematic agreement between model predictions and experimental data in the shell evolution of exotic nuclei, and also the spin-orbit splitting [4]. A region of experimental interest nowadays is around the magic numbers $Z=28$ and $N=50$, where measurements of the decay properties in Co, Ni, Cu and Zn reveal the magic character of the nucleus 78Ni . The experimental results in Cu isotopes suggest that the crossing between the $2p_{3/2}$ and $1f_{5/2}$ proton levels take place in the nucleus 75Cu , which implies that the ground-state of 79Cu has spin-parity $5/2^-$ [2]. It has been examined using different mean-field interactions such as Skyrme, Gogny and SEI-interactions that the tensor interaction may not always be necessary to reproduce the crossing between the $2p_{3/2}$ and $1f_{5/2}$ single-particle proton levels in neutron-rich Cu and Ni isotopes.

References

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Experimental nuclear physics

Theoretical nuclear physics

1

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