Contribution ID: **33** Type: **Theoretical Nuclear Physics**

Finite range Simple effective interaction with tensor terms

Monday, 22 August 2022 14:30 (15 minutes)

The crossing of the $2p_{3/2}$ and $1f_{5/2}$ proton s.p. energy levels in neutron-rich *Ni* isotopes and the magic character of the atomic number *Z=28* in this isotopic chain is a subject of current interest from both, experimental and theoretical points of view[1,2]. The finite range Simple effective interaction(SEI) is able to reproduce the experimentally observed crossing even without requiring a tensor term. Using SEI, the crossing of the $1f_{5/2}$ and $2p_{3/2}$ s.p. proton levels in the isotopic chain of *Ni* and the spin inversion in the ground-state of *Cu*-isotopes are found to be a function of nuclear matter(NM) incompressibility. The role of the incompressibility is also noticed in the study of sd-level splitting in *Ca* isotopic chain using the SEI model. Experimental studies[3,4] establish that the proton $2s_{1/2}$ and $1d_{3/2}$ s.p. levels invert going from ^{40}Ca to ^{48}Ca. However, the observed proton gaps between the $1h_{11/2}$ and $1g_{7/2}$ shells in *Sn* and *Sb* isotopic chain, and the neutron gaps between the $1i_{13/2}$ and $1h_{9/2}$ shells in *N=82* isotones[5] require explicit consideration of a tensor part with SEI as the central contribution is not enough to initiate the required level splittings. In this work, we will analyze the observed proton and neutron single-particle energy gaps in *Sn* and *N=82* isotopic and isotonic chains respectively by adding a short-range tensor force to SEI within the Quasi-local Density Functional Theory (QLDFT) formalism and compared the results with the available experimental data[5] as well as with the predictions of other mean field models such as the SIII and SAMI-T Skyrme forces and the D1MTd Gogny interaction.

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Session Classification: Young Scientist Session 2