Contribution ID: **154** Type: **Oral report**

Pairing and (9/2)n configuration in the neutron-rich Ni isotopes

Tuesday 21 September 2021 15:50 (25 minutes)

Neutron-rich nickel isotopes in vicinity of ^{78}Ni present an excellent opportunity to study the way in which neutron excess affects the properties of nuclear shell structure. Studies in this region of isotopes also provide insight in the nuclear mechanism of r-process responsible for their synthesis. The path of the consequent reactions constituting r-process is dictated by the shell structure of nuclei far from stability.
As experimental investigations kept advancing and a wealth of new spectroscopic information in various nickel isotopes was obtained, in particular, at the RIBF facility operated by RIKEN Nishina Center in Tokyo [1], the number of variants of their model description is growing, primarily the shell model approach. Neutron-rich $^{70-76}Ni$ are of particular interest due to the significantly different scheme of low-lying states and the $E2$ decay pattern in comparison with other $g_{9/2}$ nuclei, for example, ^{94}Ru and ^{96}Pd [2]. The new data in these isotopes may allow to test the conservation of seniority, the quantum number referring to the number of nucleons not coupled with total angular momentum $J = 0$. Seniority as a good quantum number can shed light on the properties of excited states such as their modes of decay.
We study the spectra of neutron-rich nickel isotopes $^{70-76}Ni$. To this end, pairing forces in form of surface delta interaction are employed to account for formation of the ground state multiplet (GSM) with seniority $= 2$ states. GSM splitting is described with mass relations or masses of neighbouring nuclei. Subsequently, seniority model is used to reproduce or predict the states $= 3$ in odd-odd isotopes and $= 4$ in even-even isotopes. Earlier in this approach, we considered multiplets of $= 2$ and $= 4$ states in isotones with $N = 50$ [3]. It is shown that the approximation of delta interaction is not sufficient to reproduce the energy of first $J = 2$ state. Correct account of this state should allow for description of reversed order of states $J = 4$ with $= 2$ and $= 4$ observed in experiment.

Refs:
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Session Classification: Section 1. Experimental and theoretical studies of the properties of atomic nuclei

Track Classification: Section 1. Experimental and theoretical studies of the properties of atomic nuclei.