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Search for shape coexistence in the Selenium isotopes near the N=50 neutron shell closure

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In this contribution we discuss the investigation of the shape coexistence phenomenon in neutron-rich Selenium (Z=34) isotopes (^{83}Se and ^{84}Se), near the N=50 neutron shell closure, by gamma-ray spectroscopy. The shape coexistence phenomenon consists in the appearance of different shapes (spherical, oblate and prolate) within the same nucleus at comparable excitation energies [1], and it can be visualized through the Potential Energy Surface (PES, i.e., the potential energy of the system as a function of its deformation), which may present local minima associated with different shapes of the nuclear system. In the Selenium case, the excitation of neutrons beyond the N=50 neutron shell closure is expected to lead to a coexistence of shapes, similarly to what observed along the Ni isotopic chain [2,3] in agreement with the prediction from Monte-Carlo Shell Model calculations [4].
The ^{84}Se (N=50) and ^{83}Se (N=49) nuclei have been populated by a sub-Coulomb barrier transfer reaction at IFIN-HH (Bucharest, Romania) and by a neutron capture reaction at ILL (Grenoble, France), respectively. The decay schemes of both nuclei have been significantly extended and they are currently under investigation.
The gamma decay of ^{84}Se was detected by the HPGe ROSPHERE array, coupled with the SORCERER Silicon detector array. Two excited 0^+ states, already known from literature, have been confirmed at 2244 keV and 2654 keV excitation energy, and their gamma decay to the first 2^+ state has been observed for the first time. Preliminary results from lifetime analyses, performed with both the Doppler Shift Attenuation Method and the Plunger technique, indicate that the lifetime of the third 0^+ is of the order of 1 ps, while a longer lifetime is expected for the second excited 0^+ state. The analysis is currently ongoing. In the case of ^{83}Se, the gamma decay was detected by the HPGe FIPPS array, composed of a total of 16 clover detectors. Prior to the present (n, γ) measurement, very little information was available from the literature, with only few primary gamma rays placed in a tentative level scheme [7]. The current gamma-spectroscopy data allowed to significantly expand the decay scheme of ^{83}Se, through the observation of 28 new primary gammas, 68 new transitions (plus 20 tentative new transitions) and 16 new populated energy levels. The data analysis is still ongoing and firm spin and parity assignments of newly found states will be obtained from angular correlation investigation.
For both nuclei, comparison with theoretical predictions from Monte Carlo Shell Model calculations will be made in order to achieve a microscopic description of their structure. The aim is to clearly identify excited states which can be associated to different deformed shapes.

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