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Revealing microscopic origins of shape coexistence in the Ni isotopic chain

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Since the 80's, various mean-field theoretical approaches indicated neutron rich Nickel isotopes among the best candidates for the appearance of the shape coexistence phenomenon, including the possibility of finding its most extreme manifestation, i.e. shape isomerism. Shape isomerism arises from the existence of a secondary deformed minimum at large deformation in the nuclear potential energy surface, separated from the primary energy minimum by a high barrier, what results in a significantly hindered gamma transition between the minima. In an experiment performed in Bucharest [1], we have identified a shape-isomer like structure in the 66Ni nucleus. This is the lightest atomic nucleus exhibiting a photon decay hindered - solely - by a nuclear shape change. Such a rare process, at spin zero, was clearly observed only in actinide nuclei in the 1970's. 66Ni was populated employing a two-neutron transfer reaction induced by an 18O beam on a 64Ni target, at sub-Coulomb barrier energy. The experimental findings have been well reproduced by the Monte Carlo Shell Model Calculations [1].
Encouraged by the results on 66Ni, we have started a comprehensive gamma spectroscopy investigation of 62Ni, 64Ni and 65Ni at IFIN-HH (Bucharest), ILL (Grenoble) and IPN Orsay, using different reaction mechanisms to pin down the wave function composition of selected excited states. We aim at shedding light on the origin of deformation in neutron-rich Ni isotopes, and at possibly locating other examples of shape isomerism in this region. Preliminary results will be presented and compared with Monte Carlo Shell Model predictions. Perspectives in the search for shape isomerism in other mass regions will be also discussed, following recent calculations pointing to Pt, Hg and Pb nuclei (with N≈110) and Pd, Cd and Sn (with N≈66) as best candidates. Such systems could be investigated with radioactive beams from HIE-ISOLDE and SPES.

[1] S. Leoni et al., Phys. Rev. Lett. 118, 162502 (2017).

Primary author: LEONI, Silvia (MI)

Presenter: LEONI, Silvia (MI)

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