Contribution ID: **42** Type: **not specified**

Interplay between collective and single particle excitations around neutron-rich doubly-magic nuclei

Wednesday, 29 June 2016 17:20 (20 minutes)

In nuclei with one or two particles outside of a doubly-closed core the lowest structures are dominated by the couplings between phonon excitations and valence particles, giving rise to series of multiplets. The identification of these multiplets can provide precise, quantitative information on the phonon-particle couplings. In fact, the energy and transition probability for states belonging to phonon-particle multiplets can be calculated within mean-field based models and comparisons with experiment can provide a unique test of various theoretical approaches.
From a broader perspective, understanding the coupling of a single particle to vibrational motion in nuclei is of primary importance, as this coupling is responsible for the quenching of spectroscopic factors [1] and it is also the key process at the origin of the damping of giant resonances [2].

This talk will present the situation in nuclei lying in close proximity of doubly-magic systems, such as 41,47,49Ca [3,4] and 133Sb. Various types of reactions will be discussed: from multinucleon transfer with heavy ions, to cold neutron capture (n,) and neutron induced fission on 235U and 241Pu targets. The results of measurements performed at Legnaro National Laboratory and ILL (Grenoble), using complex detection systems based on HPGe arrays coupled to magnetic spectrometers (PRISMA) or fast LaBr3 scintillator detector arrays for lifetime measurements will be presented. Experimental data will be compared with theoretical calculations using a newly developed model which takes into account coupling between core excitation (both collective e and non-collective) of the doubly magic core and the valence particle.
Perspectives for studies with cluster transfer reactions employing radioactive beams from ISOLDE and SPES will be finally given.

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Session Classification: Nuclear Structure and Reaction II