INTERPLAY BETWEEN PARTICLE AND CORE EXCITATIONS IN THE ONE-VALENCE-PROTON NUCLEUS ^{133}SB

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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 interplay between particles and collective phonon excitations. 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, the understanding of these phenomena is of primary importance, since couplings between valence particles and excitations of the core are responsible for the quenching of spectroscopic factors [1] and they are also the key processes at the origin of the damping of giant resonances [2].

An ideal system, in this respect, is ^{133}Sb, made of one valence proton outside the doubly magic ^{132}Sn exotic core. The γ-ray decay of ^{133}Sb was recently studied using cold-neutron induced fission of ^{235}U and ^{241}Pu targets, at the ILL reactor in Grenoble, using a highly efficient HPGe array coupled to fast $LaBr_3$(Ce) scintillators. For the first time, high-spin excited states above the 16.6 μs isomer were observed, and lifetime analysis by fast-timing techniques pointed to a complex nature of medium spin, positive-parity, yrast states. The data were well interpreted by a newly developed microscopic model taking into account couplings of the valence proton with excitations of the core (both collective and non-collective), using the Skyrme effective interaction in a consistent way. Similar types of studies on ^{41,47,49}Ca [3,4] nuclei will be also mentioned, together with future extended investigation of ^{133}Sb, with cluster transfer reactions with HIE-ISOLDE radioactive beams.

[1] M.B. Tsang *et al.*, Phys. Rev. Lett. 102, 062501 (2009).
[2] P.F. Bortignon, A. Bracco, and R. A. Broglia, Giant Resonances: Nuclear Structure at Finite Temperature (Harwood Academic, New York, 1998).
[3] D. Montanari *et al.*, Phys. Lett. B697, 288 (2011).
[4] D. Montanari *et al.*, Phys. Rev. C85, 044301 (2012).