Contribution ID: **42** Type: **Invited**

Gamma Spectroscopy as a Tool to Search for Particle-Phonon Coupled States: Status and Perspectives

Tuesday, 11 June 2013 14:30 (30 minutes)

The coupling between a particle and a phonon is a very important issue in nuclear structure studies, being a key process at the origin of the anharmonicities of vibrational spectra, quenching of spectroscopic factors and damping mechanism of giant resonances. The experimental and theoretical investigation of this problem is presented in connection with gamma spectroscopy works on neutron-rich nuclei around 48Ca and 64Ni. Results are reported from experiments performed at Legnaro National Laboratory, NIPNE (Bucharest) and ILL (Grenoble), using complex detection systems such as PRISMA-CLARA, ROSPHERE and EXOGAM. It is shown the feasibility of complete in-beam gamma spectroscopy, in terms of angular distributions, polarization and lifetime analysis, allowing to firmly establish spin and parity of excited states and their nature. The focus is, in particular, on 47Ca, 49Ca and 65Cu nuclei, which provide evidence for particle-phonon coupled states based on the 3- octupole phonons of the 48Ca and 64Ni cores, respectively. They are among the few fully established examples of particle-vibration coupling in nuclei with mass A<100, showing the robustness of nuclear collectivity in rather light systems. Perspectives will also be given in connection with similar type of studies around the 132Sn core, of great interest for future experiments with radioactive beams.

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Session Classification: Session 7