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Searching for pygmy quadrupole states in 118Sn in thermal neutron capture experiments at the Institut Laue-Langevin

Extensively explored in both experimental and theoretical studies, the tin isotopes with their closed shell corresponding to the 50 magic proton number continue to provide a fertile ground for studies of both single-particle and collective behaviours of nuclear matter. One recent display of collective behaviour in the neutron-rich 124Sn74 nucleus is the phenomenon of Pygmy Quadrupole Resonance (PQR), manifested through a concentration of 2+ states with quadrupole character located below the neutron separation energy around 5 MeV [1]. Theoretical calculations show that these 2+ excited states are due to excitations of neutrons from the skin that can also have vibrations of quadrupole type. In this context, investigations on other tin isotopes can provide more information on the neutron skin properties and its degrees of freedom. Complementary experiments to inelastic scattering with 17O beam such as thermal neutron capture or beta decays are alternatives that are being currently explored.

Thermal neutron capture of 115,117,119Sn populates compound capture states at the neutron separation energy of about 9 MeV. The capture states in these experiments consist of 0+ and 1+ spins, ideal for populating subsequent 2+ states which could be attributed to the PQR predicted to exist in the 3-5 MeV range.

In the experiments performed at the Institut Laue-Langevin in Grenoble, France, a continuous high-flux of thermal neutrons of 108s-1cm-2 from the 57 MW research reactor was used for capture reactions on isotopically enriched odd-A Sn targets. Gamma ray transitions from excited states in nuclei of interest were detected by the Fission Product Prompt gamma-ray Spectrometer (FIPPS) [2] consisting of eight large n-type high purity germanium (HPGe) clover detectors and augmented with eight additional Compton-suppressed HPGe clovers from INFN Horia Hulubei, in Bucharest, Romania, for enhanced gamma-ray efficiency and additional angular coverage used to produce angular correlations for spin assignments.

Preliminary results from the 117Sn(n,g)118Sn experiment will be presented highlighting the newly observed levels within the 3-5 MeV energy range of interest for PQR and their decay patterns, including angular correlations for spin assignment of selected levels of interest.

[1] M. Spieker et al., Phys. Lett. B 752, 102 (2016).
[2] C. Michelagnoli et al., EPJ A 193, 04009, (2018).

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