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Studies of Exited States in 118,120Sn Produced via Thermal Neutron Capture at the Institut Laue-Langevin

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The tin isotopic chain with its magic 50 proton closed shell is a benchmark for models of nuclear structure. While the neutron-rich tin nuclei around the magic 82 neutron shell play an important role in the rapid-capture nuclear process, the mid-shell region of the tin isotopes can display collective phenomena known as shape coexistence [1]; for example, in $^{116}Sn_{66}$ deformed bands based on 2 particle –2 hole excitations across the proton 50 shell gap exist [2,3]. Furthermore, at energies below the particle threshold, a new phenomenon called Pygmy Quadrupole Resonance (PQR) have been recently observed in ^{124}Sn below 5 MeV [4]. Coupled with theoretical calculations, the new excitation mode was interpreted as a quadrupole-type oscillation of the neutron skin. This study prompted investigations for corresponding states in the neighboring ^{118,120}Sn nuclei populated using thermal neutron capture of ^{117,119}Sn(n,g).

Thermal neutron capture of ^{117,119}Sn populates states in ^{118,120}Sn 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 10^8 s^{-1} cm^{-2} from the 57 MW research reactor was used for capture reactions on 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) [5] 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. In addition, 15 fast response $LaBr_3$(Ce) were used to allow for fast timing measurements of nuclear states using the centroid-shift method as described in [3].

Preliminary results from the ^{117,119}Sn(n,g)^{118,120}Sn experiments will be presented highlighting the newly observed levels within the 3-5 MeV energy range of interest for PQR and lifetimes of excited states in ^{120}Sn.

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