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Probing the coexistence of nuclear shapes through the first lifetime measurement of the 0_3^+ state in ^{120}Sn

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The semi-magic $^{120}_{50}Sn_{70}$ lies in the neutron mid-shell among the other stable Sn isotopes, where shape coexistence was observed with the signature of deformed bands built on excited 0^+ states intruding into the yrast band that is built on the spherical ground state. However, the lifetime of the excited 0_3^+ state only has a lower limit of 6 ps in the literature, which prevents the study of transition strengths, and as a result, its structure is obscured.

The 0_3^+ lifetime was measured in the first thermal neutron capture experiment, ^{119}Sn(n,γ^{many})^{120}Sn, at the Institut Laue-Langevin, where the world's highest-flux thermal neutron beam was delivered at 10^8 n/cm^2/s at the target position on an isotopically enriched ^{119}Sn target. Low-spin states in ^{120}Sn were populated up to the neutron separation energy $S_n = 9.1$ MeV, and the decaying gamma-ray cascades were detected with the Fission Product Prompt Gamma-ray Spectrometer (FIPPS) comprised of eight Compton-suppressed HPGe clovers coupled to an array of 15 $LaBr_3$ scintillation detectors. The $LaBr_3$ scintillators, which were used for gamma-ray detection and lifetime measurement using the Generalized Centroid Difference (GCD) method, have fast timing responses and are ideal for extracting lifetimes between 10 and a few hundred ps.

In total, there are 4×10^9 counts in the $\gamma\gamma\gamma$ cube where two $LaBr_3$ events were in coincidence with one HPGe.

Lifetime measurement for the 0_3^+ state in ^{120}Sn using the GCD technique will be presented with nuclear structure interpretations from realistic shell-model calculations. Additional lifetimes will also be measured where the $\gamma\gamma\gamma$ cascade's statistics permit. Analysis is also underway for a similar neutron-capture experiment populating low-spin excited states in ^{118}Sn.

Authors: GARGANO, Angela; MICHELAGNOLI, Caterina (Institut Laue-Langevin); Prof. ANDREOIU, Corina (Simon Fraser University); PETRACHE, Costel (Université Paris-Saclay CNRS/IN2P3); WU, Frank (Simon Fraser University); RÉGIS, Jean-Marc (IKP); SPAGNOLETTI, Pietro Nicola (University of Liverpool (GB)); KARAYONCHEV, Vasil (ANL)

Presenter: WU, Frank (Simon Fraser University)

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