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The first measurement of the 0_3^+ lifetime in ^{120}Sn using thermal neutron capture

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The semi-magic $^{120}_{50}\mathrm{Sn}_{70}$ lies in the neutron mid-shell among the other stable Sn isotopes, where shape coexistence was observed with the signature of deformed 2p-2h 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^+ 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 $\mathrm{LaBr_3}$(Ce) scintillation detectors. The $\mathrm{LaBr_3}$(Ce) 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 4.3×10^9 counts in the $\gamma\gamma\gamma$ cube where two $\mathrm{LaBr_3}$(Ce) events were in coincidence with one HPGe following 14 days of beam on target.

Lifetime measurement for the 0_3^+ state in ^{120}Sn using the GCD technique will be presented. Additional lifetimes will also be measured where the $\gamma\gamma\gamma$ cascade's statistics permit, and detailed gamma-ray spectroscopy will be performed using the FIPPS data to significantly extend the ^{120}Sn level scheme.

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