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Lifetime measurements in ^{129}Sn

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The measurement of level lifetimes around the doubly closed shell nuclei carries extreme importance as they give direct insight into the transition probabilities and thus the understanding of the n-n interaction. The validity of the double shell closure near ^{132}Sn has been revealed from the study of low lying states of the nuclei which have few proton (neutron) particles (holes) about Z = 50 and N = 82 [1,2,3]. However, the availability of spectroscopic information around ^{132}Sn is comparatively scanty as compared to other double shell closure due to experimental difficulty in reaching this region by compound nuclear or transfer reactions using the available target-projectile combinations and fission being the most reliable pathways to access these nuclei.
The excitation spectra in Sn nuclei close to A=132 is specifically important as these nuclei provide information uniquely for the neutron single particle orbitals. Study of ^{129}Sn, with three neutron holes with respect to neutron shell closure at N=82, is thus worth pursuing in detail. The $d_{3/2}$, $s_{1/2}$ and the unique parity $\nu h_{11/2}$ orbitals play significant roles in the development of low lying level spectra and the isomers in isotopes of Sn with mass numbers close to A=132. In odd-A Sn nuclei, the $\nu h_{11/2}$ orbital becomes most relevant as one approaches N = 82 and proximity of only relatively lower spin (3/2 and 1/2) positive parity orbitals generate long-lived isomers at low excitation. Even the low energy higher spin positive parity states like $23/2^+$, $19/2^+$ and $15/2^+$ are generated with spin contribution from two neutron holes in $1h_{11/2}$.
In ^{129}Sn, the $\nu d_{3/2}$ orbital crosses the $\nu h_{11/2}$ orbital as observed from the nearly degenerate $11/2^-$ first excited level to the $3/2^+$ ground state. The evolution of B(E2) values corresponding to the decay of the positive parity isomers, viz. $19/2^+$ and $23/2^+$, in odd-A Sn nuclei show the effect of gradual filling of the νh11/2 orbital with the increase in neutron number [4]. The shell model calculation on the low lying negative parity excitations of ^{129}Sn shows that many of these levels have pure $\nu {h_{11/2}}^{-n}$ configurations with admixtures from the configurations involving $\nu d_{3/2}$ and $\nu s_{1/2}$ orbitals [5]. Out of these, the lowest $11/2^-$ and the 2553 keV, $27/2^-$ levels are isomers of 6.9 min and 217 ns, respectively. It is necessary to locate all the candidates of pure multiplets of νh11/2 structure and to estimate the possible configuration mixing in both the positive and negative parity levels.
Hence, the measurement of level lifetime for the low lying levels of ^{129}Sn is of substantial importance to understand the role of configuration mixing and neutron-neutron interactions around the N = 82 shell closure. With this motivation, the low lying excited states of ^{129}Sn have been populated from the combined route of IT decay of higher lying μs isomeric level viz, $19/2^+$ & $23/2^+$ and β-decay of ^{129}In . The neutron-rich Sn and In (A~129) isotopes were produced through thermal neutron-induced fission at Institut Laue Langevin (ILL), Grenoble, France. The recoiling fission fragments were separated in mass and kinetic energy using the Lohengrin recoil fragment separator [6] and were detected with an ionization chamber (IC) placed at the focal plane. The IC provides a start signal for decay measurements of µs isomers. An array of four 1.5" X 1.5" $LaBr_3$(Ce) fast scintillator detectors placed at 90 degrees to each other and coupled with two Clover HPGe detectors were used for the detection of de-exciting γ radiations. The energy and time information from these detectors were obtained by digitizing the preamplifier outputs from the Clovers, the anode signals of the photomultiplier tubes (Hamamatsu 13435) connected to the LaBr3 crystals. The timing signals from the $LaBr_3$ detectors were also generated using analog CFD modules and the time differences were taken from the analog time to amplitude converter (TAC) modules. The TAC outputs were then digitized to get the time difference distributions required for lifetime measurements down to few picoseconds.
The gathered data are analyzed for the measurements of level lifetimes in picosecond range using generalized centroid difference(GCD) analysis [7]. The results from the present measurement in comparison with shell model calculations will be presented.

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