Developments Using Fast-Timing Scintillation Detectors for Precision Nuclear Spectroscopy

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The precision measurements of electromagnetic transition rates provide accurate inputs into nuclear data evaluations and are also used to test and validate predictions of nuclear structure models. Measurements of transition rates can be used to ascertain or rule out multipolarity assignments for the measured EM decay, thereby providing spin- and parity-difference information for states between which the EM transition takes place. This conference contribution reports and reviews a range of recent measurements of electromagnetic transition rates between excited nuclear states using coincidence 'fast-timing' gamma-ray spectroscopy with cerium-doped, lanthanum-tri-bromide ($LaBr_3$) detectors. Examples of precision lifetime measurements using a combined $LaBr_3$-HpGe hybrid spectroscopy array [1] based at the tandem accelerator, Bucharest, Romania include studies around the N=20 and N=82 shell closures using stable-beam induced fusion-evaporation reactions [2, 3]; and the evolution of nuclear deformation in neutron-rich tungsten nuclei using ^{7}Li induced light-ion transfer reactions [4]. This contribution will also present the ongoing development and current performance parameters of a new multi-detector $LaBr_3$ array for future studies of highly exotic nuclei produced at the upcoming Facility for Anti-Proton and Ion Research (FAIR) as part of the NUSTARDESPEC project [5, 6] and reports on the pre-NUSTAR implementations of detectors from this array to study electromagnetic transition rates in neutron-rich fission fragments at ILL-Grenoble [7], France and RIBF at RIKEN, Japan. Finally, the use of such arrays for to produce primary and secondary radioactive calibration standards at National Measurement Institutes, such as at NANA project at the NPL, UK [8] will be discussed.

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