Stable and radioactive beam studies using $LaBr_3$ detectors for precision lifetimes measurements of excited states in exotic nuclei

P.H. Regan,[1] T. Alharbi,[1] P.J. Mason,[1] Zs. Podolyák,[1] C. Townsley,[1] S. Rice,[1]
R. Britton,[1] A.M. Bruce,[2] O.J. Roberts,[2] F. Browne,[2] N. Marginean,[3]
D. Filipescu,[3] D. Deleanu,[3] T. Glodariu,[3] D. Ghita,[3] R. Marginean,[3] C. Mihai,[3]
D. Bucurescu,[3] A. Negret,[3] L. Stroe,[3] T. Sava,[3] K. Mullholland,[4] and J.F. Smith[4]

[1]*Department of Physics, University of Surrey, Guildford, GU2 7XH, UK*
[2]*School of Engineering, University of Brighton, Brighton, BN2 4GJ, UK*
[3]*Horia Hulubei National Institute of Physics and Nuclear Engineering, (IFIN-HH), RO-077125*
[4]*School of Engineering, University of the West of Scotland, Paisley, PA1 2BE, UK*

Precision measurements of electromagnetic transition rates provide accurate inputs into generic nuclear data evaluations and are also used to test and validate predictions of state of the art nuclear structure models. Measurements of transition rates can be used to ascertain or rule out multipolarity assignments for the measured EM decay, thus providing (in some cases) firm spins and parities for states between which the transition takes place. We report on a variety of precision measurements of electromagnetic transition rates between excited nuclear states using coincidence "fast-timing" gamma–ray spectroscopy with cerium–doped lanthanum–tribromide ($LaBr_3$(Ce)) detectors. Examples of recent precision measurements using a combined $LaBr_3$–HpGe array based at the tandem van de Graaff accelerator, Bucharest, Romania will be presented addressing nuclear structure issues around the N=20 [1], N=82 [2] using stable-beam induced fusion-evaporation reactions; and the evolution of nuclear deformation around in neutron-rich Hf, W, Os nuclei using ^{7}Li induced light–ion transfer reactions and following beta-decay [3]. The presentation will also discuss the ongoing development of a new multidetector $LaBr_3$ array for future studies of exotic nuclei produced at the upcoming Facility for Anti–Proton and Ion Research (FAIR) [4] as part of the NUSTARDESPEC project and current plans for pre–NUSTAR implementations of this array to study electromagnetic transition rates in neutron-rich fission fragments at ILL–Grenoble, France and RIBF at RIKEN, Japan.

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[1] P.J.R. Mason *et al.*, Phys. Rev. **C85**, 064303 (2012)
[2] T. Alharbi *et al.*, App. Rad. Isotopes **70**, 1337 (2012) & submitted to Phys. Rev. C
[3] P.J.R. Mason *et al.*, AIP Conf. Procs. **1491**, 93 (2012)
[4] P.H. Regan, App. Rad. Isotopes **70**, 1125 (2012)