Spectroscopy with next generation scintillator arrays

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Historically, gamma-ray spectroscopy has transitioned from using scintillator detectors with high efficiency but relatively low energy resolution to germanium detectors with high intrinsic energy resolution but much lower intrinsic efficiency. Next-generation scintillator materials such as lanthanum bromide, cerium bromide have become available over the last decade offering significantly improved energy resolution (~3% at 662-keV) and timing resolution. Such detectors are opening up new opportunities for medium-resolution spectroscopy. A number of ideas for future studies for stand-alone arrays of such scintillators as well as composite germanium-scintillator arrays will be presented, focusing particularly on challenges related to clustering in nuclei [1]. A brief overview of existing arrays and detector types will be given e.g. the PARIS calorimeter [2], motivated towards the physics goals.

An overview will be given of detector development work on next-generation scintillator detectors at the University of York. This work is focused both on nuclear physics experiments as well as societal applications. In particular, significant advances have been made in coupling scintillators with silicon photomultipliers (SiPM) in replacement of conventional photomultiplier tubes which are bulky and require high voltages. In fact, the performance of detectors with SiPM readout is beginning to be superior to PMT in several important respects. This opens up new paradigms for compact detector design and for detectors which can operate readily in high magnetic field environments. Perspectives for new detector designs will be given.

[1] D.G. Jenkins, “Electromagnetic transitions as a probe of clustering in nuclei” in C. Beck (ed.), “Clusters in Nuclei, Vol III”, Lecture Notes in Physics 875, pp 25-49 (2013)
[2] A. Maj et al., Acta Physica Polonica B 40, 565 (2009)