Investigations of nuclear structure using gamma-ray spectroscopy

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Gamma-ray spectroscopy of atomic nuclei allows the identification of nuclear excited states and their intrinsic properties such as angular momenta, parities, lifetimes and electromagnetic moments. The investigations of these properties and efforts to understand them in terms of detailed models of nuclear structure have been one of the principal means by which our understanding of nuclear behavior has developed over the past several decades.

This presentation will give an overview of gamma-ray spectroscopic methods, with a main focus on measurements made with high-purity germanium semi-conductor detectors, highlighting the importance of Compton-suppression and of using arrays of detectors for time-correlated coincidence spectroscopy. Results obtained with (a) the CAESAR [1] gamma-ray detector array and the 14UD accelerator at the Australian National University, and (b) the Gammasphere [2] detector array and the ATLAS accelerator at Argonne National Laboratory, will be used to illustrate recent state of the art measurement techniques. A major advance in gamma-ray detection efficiency and counting rate, while retaining high energy resolution, can be found in the development of gamma-ray tracking detectors [3] such as GRETA and AGATA. Recent developments with the testing of these new detectors and discussion of the ways in which they will advance the state of the art in gamma-ray measurement, especially with respect to the next generation of radioactive ion beam facilities and their associated accelerators, will also be presented.

[1] G.D. Dracoulis and A.P. Byrne, Dept of Nuclear Physics ANU-P/1196, unpublished (1996).
[2] R. Janssens and F. Stephens, *Nuclear Physics News* Vol. 6, No. 4, 9 (1996).
[3] I.Y. Lee, M.A. Deleplanque and K. Vetter, Rep. Prog. Physics **66**, 1095 (2003).