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Plenary - From RISING at GSI to the DESPEC Fast-Timing Project at FAIR: The New Nuclear Spectroscopy of the Most Exotic Isotopes

Thursday, 12 July 2012 09:30 (1 hour)

Abstract content
   (Max 300 words)

The last decade has seen an explosion in research activity into measurements of the internal structure of nuclear species with unusual proton-to-neutron ratios. This work has been carried out at major international nuclear science laboratories such as NSCL-MSU(USA); RIBF(Japan); GANIL(France); and GSI(Germany). The study of nuclear matter with exotic proton-to-neutron ratios compared to the less than 300 'stable' isotopes which we see in nature allows scientific investigations to be made into the fundamental nature of the strong nuclear force, the creation of elements through explosive nucleosynthesis scenarios and basic interactions between protons and neutrons. Basic, 'long-known facts' regarding our understanding of nuclear structure science, such as the extra binding associated with closed shells of protons or neutrons are found to require modification with these new insights. The study of such nuclei often requires investments in facilities which are required to create the exotic nuclei for study using high-energy, heavy-ion collisions. The most exotic nuclear fragments from such reactions need then to be separated and selected on an event-by-event basis for detailed spectroscopic investigation. This presentation will give an overview of a major collaborative study, based at the GSI facility, to investigate the internal structure of hitherto unreachable sections of the nuclear chart. The Rare Isotope Investigations at GSI or 'RISING' collaboration utilised the most powerful, high-resolution gamma-ray spectrometer used to date for such studies, consisting of 105 independent, high-efficiency germanium semiconductor detectors, each with digital signal processing. Some of the experimental challenges and scientific highlights of the experimental campaigns will be presented, including new spectroscopic studies of the heaviest nuclei with similar numbers of protons and neutrons and the most neutron-rich heavy nuclei studied to date. The future of such
research requires continual upgrades, both in terms of accelerator performance and in terms of radiation detection equipment. The final part of the talk will discuss the potential for the use of arrays of LaBr3 scintillation detectors in future spectroscopic studies of exotic nuclei at new radioactive beam facilities such as FAIR in Europe and FRIB in the USA.

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Primary author: REGAN, Patrick (Department of Physics, University of Surrey, UK)

Presenter: Prof. REGAN, Patrick (University of Surrey, UK)

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