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Position Sensitive Detectors for Nuclear Structure Physics and their Applications

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The nucleus is a unique, strongly interacting many-body system. There are many techniques and reactions to study different features of the nucleus which all rely on the detection of charged particles or gamma-rays. Each major technical advance in detection devices has resulted in significant new insights into nuclear science. As the systems evolve more exotic features of the nucleus can be measured and some key questions can be investigated such as how are elements and isotopes found in the Universe formed?
A number of these position sensitive semiconductor arrays will be covered in this talk along with the physics they are investigating and results they have produced.
The TRIUMF ISAC Gamma Ray Escape Suppressed Spectrometer (TIGRESS) array at TRIUMF, Canada, uses 12 32–fold segmented Germanium detectors in the shape of clovers for use with accelerated radioactive ion beams. Coulomb excitation and nucleon transfer reactions of interest have been studied with this array. The gamma rays emitted in these reactions are measured using this spectrometer and insight into the internal structure of the nucleus can be gathered and reconstructed.
The next major global step is to remove the suppression shields producing a 4 pi highly segmented high purity Germanium array constructed from 180 36-fold tapered hexagonal detectors resulting in 6660 channels . A gamma-ray tracking system measures the position and energy of gamma rays that Compton scatter through the crystals so that the path and sequential energy loss of a single gamma-ray can be deduced. The full energy of the event can then be reconstructed using gamma ray tracking (GRT) methods. The Advanced GAmma Tracking Array (AGATA) represents a major advance in gamma-ray spectrometer design. Using gamma-ray tracking a much higher efficiency and much lower Doppler broadening is achieved.
The Advanced Implantation Detector Array (AIDA) will be assembled from wafers of double sided silicon strip detectors and will be used in decay spectroscopy experiments of exotic nuclei on the Facility for Anti proton and Ion Research (FAIR) accelerator at GSI, Germany.
The development of these position sensitive detectors has the potential to be used in the medical, security, decommissioning and environmental imaging fields. Their applications will be discussed.

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