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Gamma-Ray Tracking and the GRETINA Physics Program

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The structure of nuclei far from the stability line is a central theme of research in nuclear physics. Key to this program has been the worldwide development of radioactive beam facilities and novel detector systems, which provide the tools needed to produce and study these exotic nuclei.

In particular, gamma-ray spectroscopy plays a vital and ubiquitous role in these studies.
The γ-ray tracking technique marks a major advance in the development of γ-ray detector systems and can provide order-of-magnitude gains in sensitivity compared to existing arrays. It uses highly-segmented hyper-pure germanium crystals together with advanced signal processing techniques to determine the location and energy of individual γ-ray interactions, which are then combined to reconstruct the incident γ-ray in a process called tracking.

A 4π tracking-array will be a powerful instrument needed in a broad range of experiments addressing the intellectual challenges of low-energy nuclear science. Developments of these instruments are underway both in the US (GRETINA/GRETA) and Europe (AGATA).

Following a short overview of the concept of gamma-ray tracking and its technical requirements, I will discuss GRETINA, a first implementation of a tracking array, and present selected examples from its physics campaigns at ATLAS/ANL and NSCL/MSU. Future plans for the full array, GRETA, will also be discussed.

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