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Tom Bonner Prize: Gamma-ray energy tracking array GRETINA and its early science results

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Gamma-ray detector with good energy resolution has been one of the essential instruments for the study of nuclear structure. To push these studies toward the exotic nuclei near the particle stability line, we need detectors with higher peak efficiency and good peak-to-total ratio. In addition, radioactive ion beams needed for such studies are often produced by the projectile fragmentation method. They have high velocities, and detectors must provide adequate position resolution for accurate Doppler correction. To fulfill these requirements, the new concept of gamma ray energy tracking array was developed. GRETINA, with 1π solid angle coverage, is the first implementation of this concept. It uses electrically segmented Ge crystals in a close packed geometry, fast digital electronics, and signal decomposition to determine the position and energy of the individual interaction points. Then the path of a gamma ray can be tracked using the angle-energy relation of the scattering process. GRETINA was completed at LBNL and started physics operation in 2012. It has been used at NSCL at MSU and ATLAS at ANL for a large number of experiments addressing diverse topics from nuclear structure to nuclear astrophysics.

In this talk I will describe the concept of gamma-ray energy tracking and the technology developed for GRETINA. A few representative experiments showing the breadth of the science and the power of the instrument will be discussed. Finally the plan toward the full 4π array GRETA will be presented.