Advances in gamma-ray tacking: GRETINA status, physics and future plans*

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The gamma–ray tracking technique uses highly segmented Ge detectors, and measures pulse shapes from each of the segments using fast digital electronics. These pulses are analyzed, in a procedure called signal decomposition, to determine energy, time, and three–dimensional positions of all gamma–ray interactions. This information is then used, together with the characteristics of the Compton and pair–production processes, to group and sequence the interactions points and determine the scattering path of the original gamma–rays. A 4π detector array based on this novel technique would provide high efficiency ($\sim$40% for 1 MeV gamma–rays), excellent peak–to–total ratio ($\sim$0.6), and accurate position resolution ($\sim$2 mm), increasing the detection sensitivity of the spectrometer by several hundreds compared to current arrays used in nuclear physics research.

GRETINA, a first implementation of such an array using coaxial crystals (6x6 segments) and covering 1 solid angle, was completed in March 2011 at LBNL. A similar system developed in Europe, the AGATA demonstrator, is currently running a campaign at Legnaro. In this talk, we will review the basic principles of gamma ray tracking and the measured performance of GRETINA with radioactive sources and in-beam experiments.

Besides their intrinsic value as demonstrators of the tracking technique, these instruments provide unique physics opportunities in nuclear structure: we will discuss some examples and present the plans for commissioning runs and first research campaigns.

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