Société Française de Physique

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Machine learning and imaging approaches to improve the AGATA position resolution.

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In-beam gamma-ray spectroscopy with high-velocity recoil nuclei requires very accurate Doppler correction. The Advanced GAmma Tracking Array (AGATA) is a new generation gamma-ray spectrometer that is capable of tracking gamma-rays with up to 5mm resolution which allows for accurate Doppler correction. AGATA is made of high-purity germanium crystals (about 50 available so far) assembled to form a sphere with the goal to cover 4π (180 required). Each crystal is electronically segmented into 36 segments.

To determine the gamma-ray interaction positions, the signals coming from the 36 segments go through the Pulse Shape Analysis (PSA) algorithm. This algorithm estimates the interaction point positions by comparing the measured signals to a database of simulated signals. A tracking algorithm based on the Compton diffusion formula is then applied to reconstruct the full trace of the gamma-ray in the detector, giving access to its first interaction point

The PSA precision is a key point in the AGATA analysis. A way to improve its capabilities is to use experimental data to build the PSA databases instead of simulated ones. A scanning table has been created in Strasbourg to measure these experimental databases, but the current algorithm used to treat these data is very time-consuming. This work will present a new approach to improve the existing analysis using machine learning techniques. Finally, to characterize the improvement of the PSA, a new method based on gamma-ray imaging will be presented.

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