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Title: **Development of Gamma-Ray Tracking Detectors**

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The investigation of new phenomena in atomic nuclei requires the study of their structure under extreme conditions at the boundary of stability, where the excitation energy, the spin or isospin take extreme values. The most powerful means for such studies is the high-precision γ-ray spectroscopy with highly efficient and highly granulated γ-detector arrays. The array should for a maximum coverage of the total solid angle consist only of Ge detectors. A new concept is required to build such a Ge shell since with present-day Ge detectors the performance would be poor due to the large probability to detect several γ-rays in one detector and the scattering of γ-radiation between them due to the Compton effect. However, if one could follow the tracks of the γ-rays in the Ge shell an unprecedented performance could be obtained. Such a Ge shell will have a sensitivity which is about two orders of magnitude larger than that of present-day γ-detector arrays. The prerequisite for the construction of such a γ-ray tracking array is the development of γ-ray tracking detectors. They consist of high-fold segmented Ge detectors and front-end electronics, based on digital signal processing techniques, which allows to extract energy, timing and spatial information for a γ-ray by pulse shape analysis of the Ge detector signals. Utilizing the information on the positions of the interaction points and the energies released at each point the tracks of the γ-rays in a Ge shell can be reconstructed in three dimensions on the basis of the Compton scattering formula.

To design γ-ray tracking detectors for a 4π γ-detector array research and technical development is carried out in the following areas: (i) Development of segmented Ge detectors, (ii) Development of digital signal-processing electronics, (iii) Development of pulse shape analysis methods, (iv) Development of tracking algorithms and (v) Simulation of tracking arrays.

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