Abstract

The Compton camera is a new detector system for imaging radioactively labeled nuclides in the range of γ-rays that can in principle provide extremely good resolution and high sensitivity. This is invaluable for the modern bio-medicine research or diagnostic studies based on it.

For this system a new concept of software based coincidence measurements has been developed; inspired by the data acquisition systems built for high energy physics, where the information from thousands of channels of various detectors has to be merged. A data acquisition system based on digitizing analog signals with FADCs (flash analog to digital converters) has been built consisting of a modern structure of first level processor unit realized with FPGAs (Field Programmable Gate Arrays) and an extendable fast data bus. The developed data acquisition system is capable of collecting the signals from a 19-channel scatter detector and an absorption detector (Anger camera) unambiguously. Here the usage of time stamping plays a central role in order to attribute the asynchronous signals of detector components to synchronous event fragments for further processing. With this data acquisition system it is shown for the first time that the signals from the silicon drift detector that are generated through Compton electrons and signals of scattered gamma quants produced in the second absorption detector can be put in pairs to reconstruct scattering events where an angular resolution of approximately 1° is achieved. This precision is close to the theoretically expected value.

There has been no clue on the influence of a processor on the quality of the image acquisition till now. The usual way of defining "Detective Quantum Efficiency" (DQE) has been enhanced to this process. For this purpose, Monte Carlo simulations with time stamps over the deadtime relation of this software based coincidence system have been performed.

It could be shown that this new system behaves as if it was limited with a paralyzable deadtime at high rates. More detailed analysis shows that the duration of processing an event in the processor and the depth of the buffers are decisive parameters that are for future real-time applications and further development essential. However, today's available newest generation processors have the performance of fulfilling the requirements of complex detectors without considerable losses.