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COMPET a high-resolution, high-sensitivity pre-clinical PET scanner

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COMPET is aiming for high-resolution with a high sensitivity by the use of a novel detector geometry. In classical PET detectors where detector elements are mounted radially the number of photo detectors to be read out scales with the square of the detector resolution. The lack of depth of interaction information contributes to a position dependent parallax error. The COMPET detector overcomes these issues with a geometry that consists of four modules forming a square barrel, each with five layers. Each layer consists of 30 LYSO crystals (80×3×2 mmˆ3) axially mounted interleaved with 24 wavelength shifting fibers (80×3×1mmˆ3). The resulting detector has an effective voxel size of 0.6×3×2 mmˆ3. The precise measurement of the gamma ray point of interaction in three dimensions gives a small parallax error which is uniform across the field of view thus allowing us to place the detector elements close to the imaged object, effectively increasing the sensitivity. There are in total 600 LYSO crystals with 480 wavelength shifting fibers which are read out separately with SiPMs. The DAQ chain consists of an analog pre-amplifier which charge integrates and discharges linearly with a constant current source. This signal is input to a comparator, and a Time-Over-Threshold (ToT) signal as output. The ToT signal is input to an FPGA where energy and event start time is extracted from a deserializer running at 1 Gbps. One read-out card handles one layer (54 channels), and a total of twenty read-out cards are needed to read out all twenty layers. Synchronization is done with a logic clock distributed by a central coincidence processing unit (FPGA), and coincidence processing is done asynchronously with the use of a 1 Gbps UDP/IP network.

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