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Titel des Beitrags: A true singles list-mode data acquisition system for a small animal PET scanner with independent crystal readout

Abstract: We present a unique data acquisition system designed to read out signals from the MADPET-II small animal LSO-APD PET tomograph. The scanner consists of 36 independent detector modules arranged in a dual-radial layer ring (phi 71 mm). Each module contains a 4 x 8 array of optically isolated, 2 x 2 mm LSO crystals, coupled one-to-one to a 32 channel APD. To take full advantage of the detector geometry, signals from each crystal are individually processed without any data reduction. This is realized using custom designed mixed-signal ASICs for analogue signal processing, and FPGAs to control the digitization of analogue signals and subsequent multiplexing. Analogue to digital converters (ADCs) digitize the signal peak height, time to digital converters (TDCs) time stamp each event relative to a system clock and two 32 bit words containing the energy, time and position information for each singles event are multiplexed through three FIFO stages before being written to disk via gigabit Ethernet. Every singles event is processed and stored in list-mode format, and coincidences are sorted post-acquisition in software. The 1] 52 channel data acquisition system was designed to be able to handle sustained data rates of up to 11520000 cps without loss (10000 cps/channel). The timing resolution of the TDC was measured to be 1 ns FWHM. In addition to describing the data acquisition system, performance
measurements made using a 128-channel detector prototype will be presented.