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Multi-Input Readout System for 3He/BF3 Position Sensitive Neutron Detectors

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Neutron sources are currently becoming standard tools to investigate the structures of various materials using elastic scattering techniques, which are applied across a wide spectrum of scientific disciplines such as physics, biology, materials science. Moreover, typical neutron physics experiments carried out at Neutron Spallation Sources and other laboratories make use of large arrays of 3He/BF3 position-sensitive tubes to detect neutrons. We present a 19"rack-mount solution for the readout of 3He/BF3 tubes for the above-mentioned applications, which could also be deployed as a solution for nuclear security scenarios thanks to its compactness. The solution is scalable and may acquire signals from few to hundreds of neutron detectors with the possibility of firmware real-time reconstruction for imaging and time-of-flight. It can be composed starting from three basic building blocks: high voltage board, charge sensitive preamplifier specifically designed for 3He/BF3 tubes and a 14-bit 125MS/s Digital Pulse Processor, with 32 independent analogue inputs. The described instruments can be controlled through a dedicated software which handles configuration and data analysis. It is possible to compute the collected charge, report the interaction time with a precision of 8 ns and perform a reconstruction of the interaction position. It provides simultaneous recording of all the required information, including the pulse waveform, in an oscilloscope mode. The DAQ chain includes a fast path for trigger generation and a slow path for charge evaluation and axial position calculation.

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