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Design of Low-Power Readout Electronics for 3He Tube Position-Sensitive Neutron Detectors at CSNS

Most of the neutron spectrometers planned in the China spallation neutron source (CSNS) are based on position-sensitive 3He tube detectors. To reduce the influence of air on neutron scattering experiments, the detector must be placed within a vacuum chamber for this kind of spectrometers. The readout electronics should also be placed within the vacuum chamber, so the number of feed-through cables can be reduced and the signal-to-noise ratio can be improved. The hit position determination of the 3He tube detector is based on the charge division method, which requires the readout electronics has a digitization sampling rate around 40MHz. To operate such readout electronics in vacuum is a challenge since the power consumption is significant and the heat can't be removed by air convection. In this research, several scenarios are being explored: (1) Replace the discrete front-end with a low-power ASIC; (2) Use the start-of-art low-power ADC chip and FPGA; (3) Clock gating the system to reduce the dynamic power consumption; (4) Use high-efficiency heat dissipation media to effectively conduct the heat to the metal mechanical structure of the 3He tube detectors. A demonstrator based on some of the above methods has been developed and the tested power consumption is 4.4W. An 8-tube readout prototype with all the above methods employed are being developed, hopefully the total power consumption could be lower than 3W, which is sufficient for operation in vacuum.

Minioral

Yes

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No

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