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14.35 Upgrade on DIII-D neutron measurements utilizing ultra-fast digitization and pulse identification techniques

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A system for neutron detection with an ultra-fast digitizer and on-board Field Programmable Gate Array (FPGA) based pulse identification techniques has been implemented on the DIII-D tokamak. The neutron rate measurement is a critical tool for determining the global fast-ion transport, among other uses. Compared to the conventional analog approach with complex Nuclear Instrumentation Module (NIM) & Computer-Aided Measurement And Control (CAMAC) electronics, this straightforward solution has a variety of advantages, including reliability, flexibility, expandability, easier implementation and maintenance, besides being simple and budget friendly. The system features a 12-channel, 16-bit resolution digitizer sampling at a maximum rate of 120 MSPS per channel and a Kintex-7 family FPGA for real-time signal processing. It will create less than 5 GB data per regular experimental day, and can stream the raw data to disk for post-processing when desired. The system can be used as a pulse height analyzer and has the potential capability for neutron and gamma discrimination after some upgrades. Details on system setup, algorithms for digital pulse identification and data management will be presented. Work supported by U.S. DOE Contract DE-FC02-04ER54698

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