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P3.068 The Radial Neutron Camera DAQ Prototype Performance Results

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The ITER project aims at building an experimental fusion device, twice the size of the largest current device in operation, JET, to demonstrate the scientific and technical feasibility of fusion power. Presently, ITER is being equipped with a set of diagnostics to provide accurate measurements of plasma behavior and performance, as the neutron diagnostics. In particular, the Radial Neutron Camera (RNC) diagnostic aims at demonstrating the generation of fusion power by measuring the total neutron source strength with high accuracy and reliability, and predicting the feasibility of thermonuclear plasma self-sustained ignition, which depends on the highly energetic particles produced from fusion reaction.
The demanding ITER operating conditions will present new challenges to the diagnostics, resulting in high quantities of data production: longer plasma discharges and higher neutron and gamma fluxes.
The dedicated Data AcQuisition (DAQ) system must be capable of providing sampling rates fast enough to digitize fast-decay time events from the state-of-the-art detectors while processing and sending in real-time the relevant data to the host, without losing events or exhausting the system storage capabilities.
The first accepted challenge was defining and setting up a DAQ prototype dedicated to ITER RNC with the adequate architecture and processing techniques that will not be obsolete in 7 years when a complete system will be built.
The prototype goal is to mitigate known technical risks and detect hidden risks. At the Frascati Neutron Generator facility the real-time pulse processing algorithms, including neutron count, have been evaluated as compliant with the control loop cycle of 10 ms for the neutron emissivity reconstruction. The 1 GB/s of expected data throughput has been achieved using a ×8 PCIe Gen 2.0 link from the digitizing unit to the host computer. The prototype architecture, results and conclusions are presented.

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