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FPGA code for the data acquisition and real-time processing prototype of the ITER Radial Neutron Camera

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The main role of the ITER Radial Neutron Camera (RNC) diagnostic is to measure in Real-Time (RT) the plasma neutron emissivity profile at high peak count rates for a time duration up to 500 s. Due to the unprecedented high performance conditions and after the identification of critical problems, a set of activities have been selected, focused on the development of high priority prototypes, capable to deliver answers to those problems before the final RNC design. This paper presents one of the selected activities: the design, development and testing of a dedicated FPGA code for the RNC Data Acquisition prototype. The FPGA code aims to acquire, process and store in RT the neutron and gamma pulses from the detectors located in collimated lines of sight viewing a poloidal plasma section from the ITER Equatorial Port Plug #1. The hardware platform used was an evaluation board from Xilinx (KC705) carrying an IPFN FPGA Mezzanine Card (FMC-AD2-1600) with 2 digitizer channels of 12-bit resolution sampling up to 1.6 GSamples/s. The code performs the proper input signal conditioning using a down-sampled configuration to 400 MSamples/s, apply dedicated algorithms for pulse detection, filtering and pileup detection, and includes two distinct data paths operating simultaneously: i) the event-based data-path for pulse storage; and ii) the RT processing, with dedicated algorithms for pulse shape discrimination and pulse height spectra. For continuous data throughput both data-paths are streamed to the host through two distinct PCIe x8 Direct Memory Access (DMA) channels.

Minioral

Yes

Description

Neutron camera

Speaker

Ana Fernandes

Institute

IPFN

Country

Portugal

Authors: Dr FERNANDES, Ana (Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal); Dr PEREIRA, Rita (Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal); Dr CRUZ, Nuno (Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal); Mr SANTOS, Bruno (Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal); Mr CARVALHO, Paulo (Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal); Dr SOUSA, Jorge (Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal); Dr GONÇALVES, Bruno (Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal); RIVA, Marco (ENEA); Dr POLLASTRONE, Fabio (ENEA C. R. Frascati, Dipartimento FSN, via E. Fermi 45, 00044 Frascati (Roma), Italy); Dr CENTIOLI, Cristina (ENEA C. R. Frascati, Dipartimento FSN, via E. Fermi 45, 00044 Frascati (Roma), Italy); Dr MAROCCO , Daniele (ENEA C. R. Frascati, Dipartimento FSN, via E. Fermi 45, 00044 Frascati (Roma), Italy); Dr ESPOSITO, Basilio (ENEA); Prof. CORREIA, Carlos (LIBPhys-UC, Department of Physics, University of Coimbra, P-3004 516 Coimbra, Portugal); BRICHARD, Benoit (Fusion for Energy, Barcelona, Spain)

Co-author: FERNANDES, Ana

Presenters: Dr FERNANDES, Ana (Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal); FERNANDES, Ana

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