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Nd:YAG トムソン散乱計測のための高速 AD コンバータシステムの共同開発の進展
Progress of Joint Development of High Speed AD Converter for Nd:YAG Thomson Scattering Measurement

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Purpose of the project is a development of a new high speed analog to digital convertor for data processing of the Nd:YAG Thomson scattering measurement. The Thomson scattering method has advantages of which can measure local values of plasma electron density and temperature, then it provides profile information for an inside of a fusion plasma. In addition, the Nd:YAG Thomson scattering method provides time evolution of the plasma profile due to the high repetition rate of the Nd:YAG laser. However, the Thomson measurement requires the high speed data processing, because the short laser pulse width ($\sim 10ns$) is required for improvement of S/N ratio. Until now, a charge integrating type AD convertor was mainly utilized for the Nd:YAG Thomson scattering, because there has been no high speed and high resolution AD converter chip. Recently, the high speed AD converter of 12 bits resolution and 500MHz sampling time is developed, then we design the new AD converter system that can directly convert the scattered light signal to the digital signal. The present status of the project is that the conceptual design has been completed and the detailed design of a FPGA (Field programable gate array) start.

The system has following features,

1. AD5463 (12 bits, 500MHz sampling) that is developed by Texas Instruments is chosen as the high speed and the high resolution AD converter chip.

2. The system has a ring buffer memory and a stop trigger due to sampling only short period in which the the scattered light is detected. Consequently, an amount of the total data that is stored in data storages is reduced to below 0.01% compared to a full data conversion.

3. The data transfer to the analysis computer is executed by SiTCP[1] which has developed by KEK. The SiTCP can transfer the data by the TCP protocol using a wire logic circuit without CPU. Then the real time data acquisitions is realized, which is required for a real time feedback plasma control of the fusion plasma.

4. Because the AD converter control unit, the data memory unit, and the data transfer unit are consolidated on one FPGA, the system has scalability, expandability, and affordable cost to construct the multi channel data acquisition system for the Nd:YAG Thomson scattering measurement.

The development is carried out by the collaboration of Kyoto university, NIFS, and JAEA. The project of the initial phase has been progressed successfully. We report the present status and the future plan of the development.

[1] Tomohisa Uchida , IEEE Transactions on Nuclear Science. vol. 55, no. 3, 2008.6, pp. 1631-1637