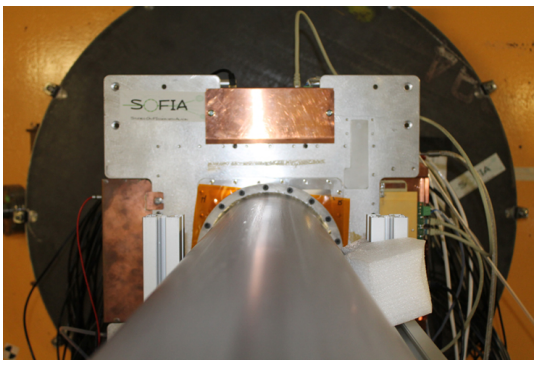
Fission, FPGAs and VHDL

Subatomic physics thesis project



General description

SOFIA (Studies On FIssion with ALADIN) is the world's most advanced experiment on nuclear fission. It succeeded for the first time to measure the nuclear charge and mass of both fission fragments simultaneously! It thereby provides unprecedented insight into a process, which was explained for the first time in 1938 in nearby Kungälv by Lise Meitner and Otto Frisch.

Advances in physics are coupled to advances in technology. The SOFIA experiment had to push limits, also in terms of electronics, to minimize the error on time-of-flight measurements and on the determination of fission fragment trajectories. Here modern front-end electronics is used, which is often controlled by FPGAs (Field-Programmable Gate Arrays). In order to program FPGAs, the language VHDL (VHSIC Hardware Description Language) is used. In this project, a new front-end for the multi-wire chambers employed by the SOFIA experiment will be adjusted to the needs of the experiment.

Project description

The front-end board, based on an Artix-7 100T FPGA, is only loosely coupled to the rest of the setup. To assign the digitised data for each triggered event to the correct global event, the board must be time synchronised to the global set-up, better than 100 ns. For this, a single-wire protocol can be used. Part one of the project is to implement the receiver for this into the firmware of the board.

The board delivers the data to the next stage in the data acquisition chain using Ethernet and UDP (User Datagram Protocol), with the transmitter protocol logic implemented directly on the FPGA. This delivery is currently unreliable, meaning that packets can be lost, which is not acceptable, especially for a large experiment with many of those boards. The second part of the project is to introduce at least an acknowledgement protocol, such that data is reliably delivered. Alternatively, the network protocol implementation can be replaced by a light-weight system, which is currently in development at Chalmers.

Contact information

Andreas Heinz, andreas.heinz@chalmers.se,
031-7723430, Forskarhuset F8008
Håkan Johansson, f96hajo@fy.chalmers.se,
031-7723253, Forskarhuset F8109

Major subjects:
Engineering Physics / Computer Science

Supervisor: Andreas Heinz
Examiner: Thomas Nilsson
Department of Physics /
Division of Subatomic and Plasma Physics