2019 HGF – GSI – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

Title of the project:

Development of FPGAs based data acquisition system for furture experiment at FAIR Darmstadt

Helmholtz Centre and institute:

GSI Darmstadt

Project leader:

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CBM

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Description of the project (max. 1 page)**:**

The project aims to develop and deliver a state of the art data acquisition system, which will be deployed for the future experiment CBM at Facility for Antiproton and Ion Research. The Compressed Baryonic Matter experiment is one of the four scientific pillars of the FAIR research programme. CBM is a next-generation heavy-ion experiment, which will investigate nuclear collisions in the FAIR energy range in order to explore the phase diagram of strongly interacting matter.

A key feature of the CBM experiment is its ability to measure up to 10 million events per second. Such interaction rates are unprecedented in the research field. To cope with these extreme rates, the detector front-ends employ free-streaming and self-triggered electronics. The CBM data acquisition system heavily relies on FGPAs in the readout chains. The data-taking concept of CBM foresees real-time CPU processing of the entire data stream delivered by the detectors. This allows identifying and select event candidates potentially containing rare observables und thus suppress the raw data rate by several orders of magnitude before archiving. A small-scale experimental setup, mini-CBM, has been setup in 2018 as technology demonstrator. It allows for commissioning and

development of the CBM readout system under realistic conditions. The latest developments are scrutinised each year in spring, when the mini-CBM experiment joins the GSI beam time.

The project described here aims at the development of FPGA based hardware, the common readout interface (CRI) boards. These PCIe cards are populated with Xilinx Ultra scale FPGAs and interface the optical links from the detector front-end to the online processing farm. This project focusses on development and operation of these prototype components and evaluation their performance.

Know more about the CBM experiment at our webpage:
https://www.gsi.de/en/researchaccelerators/fair/research/cbm_inside_a_neutron_star.htm

Description of existing or sought Chinese collaboration partner institute (max. half page)**:**

CBM member institutes in China are:

- Beijing, Tsinghua University, Department of Engineering Physics
- Chongqing, Chongqing University
- Hefei, University of Science and Technology of China, Department of Modern Physics
- Wuhan, Central China Normal University, College of Physical Science and Technology
- Yichang, China Three Gorges University, College of Science

The focus of the Chinese contribution to CBM is the Time of Flight {TOF} detector system. The TOF readout chain is currently developed in co-operation with GSI and Chongqing University.

Experiences with the general data acquisition framework of mini-CBM would also be beneficial for future work in TOF or other CBM systems.

Required qualification of the post-doc:

- PhD in Physics or Electronics Engineering
- Knowledge in FPGA programming languages (VHDL) and tools (Vivado)
- Knowledge of scripting (python) and/or programming languages (C,C++)
- Experience with systems of digital electronics, preferably readout and data acquisition systems
- Additional skills: experiences in physics instrumentation and strong ability to work independently and in a team
- Language requirement: very good command of English language