2020 HGF – GSI – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

Title of the project:

Readout chain for the CBM Silicon Tracking System (STS)

Helmholtz Centre and institute:

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

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.
The Silicon Tracking System (STS) is the essential detector component for tracking up to 1000 tracks per event at event rates up to 10MHz using 900 double sided silicon strip sensors with 2x1024 strips each. With the resulting 1.8 million channels, it poses the most demanding requirements in terms of bandwidth and density of all CBM detectors.
The major elements of the STS readout chain are

- Frontend boards (FEB) with 8 custom readout ASICs (STS-XYTER) connected to the strip sensors and implementing the analog frontend, the digitizer and the generation of individual hit data with ADC and timestamp information.
- STS readout board (ROB) employing dedicated ASICs and modules for data aggregation from multiple FEBs and optical transmission in a radiation environment.

• FPGA based common readout interface (CRI) boards for data pre-processing, as interface to slow and fast control systems and the interface to the CBM data acquisition system.
Currently a first version of a STS readout system with full functionality is being operated.

The project is in the context of the setup and commissioning of the full STS readout chain with all final hardware components and full functionality of firmware and software components, based on the current experiences in operating the prototype components and evaluating their performance both in existing lab setups and in the larger mCBM system.

The project targets developments for the final, fully featured STS readout chain. Aspects to be covered are among the following:

- Development of procedures, software (scripts) and firmware for testing and operating the readout and its components. This includes developments for dedicated functional or performance tests as well as contributions to such components needed for operating the STS in the full CBM setup.
- Qualification and evaluation of the readout chain FEB – ROB - CRI: realization of operation and performance tests of the STS readout under various running conditions and in multiple systems (laboratory setups of various complexity and mSTS, a small precursor experiment of the STS)
- Contributions to the integration of the readout with common systems (readout, control)

The work is done in close cooperation with the CBM STS and DAQ integration teams at GSI.

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

Candidates from Chinese CBM member institutes as well as from other institutes interested in a longer-term involvement in the CBM experiment are welcome.

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 TOF detector system. The TOF readout chain is currently developed in co-operation with GSI and these institutes. Experiences from the STS readout chain and the general data acquisition framework 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
- Experience with systems of digital electronics, preferably readout and data acquisition systems
- Knowledge of scripting (python) and/or programming languages (C,C++)
- Very beneficial would be knowledge in FPGA programming languages (VHDL) and tools (Vivado)
- Additional skills: experiences in physics instrumentation and in working in a larger group/collaboration would be would be useful, but are not mandatory
- Language requirement: very good command of the English language