

2026 Helmholtz – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Exploring Dense QCD Matter with the CBM Experiment at FAIR

Helmholtz Centre and/or institute:

GSI Helmholtz Centre for Heavy Ion Research

Project leader:

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www.fair-center.eu/user/experiments/cbm www.gsi.de

Department: (at the Helmholtz centre or Institute)

CBM – Compressed Baryonic Matter

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Description of the project (max. 1 page):

The Compressed Baryonic Matter (CBM) experiment is one of the major scientific pillars of the Facility for Antiproton and Ion Research (FAIR), currently under construction at GSI in Darmstadt, Germany (fair-center.eu). CBM is designed to explore the QCD phase diagram at high net-baryon densities — a region of the phase diagram that is complementary to experiments at RHIC and LHC. The experiment will study Au+Au collisions at SIS100 beam energies of 2–11 A GeV, producing strongly compressed baryonic matter at densities up to 5–8 times saturation density, comparable to the conditions in the core of neutron stars.

The CBM physics programme centres on the investigation of the nuclear matter equation-of-state at high densities, the search for the deconfinement and chiral phase transitions, and the possible discovery of a first-order phase transition and critical endpoint in the QCD phase diagram. Key diagnostic probes include multi-strange (anti-)hyperons, electron-positron and di-muon pairs, charmed particles, particle correlations and fluctuations, and hypernuclei — most of which will be studied for the first time in this energy regime. The CBM detector is designed to run at unprecedented interaction rates of up to 10 MHz, using free-streaming front-end electronics and real-time online reconstruction.

The selected postdoc candidate will join the CBM group at GSI and contribute to one or more of the following activities, to be defined in agreement with the candidate and the supervisor: (i) physics performance studies and simulation for selected observables (strangeness production, di-lepton spectra, collective flow, or fluctuations); (ii) detector commissioning and operation within the mCBM@SIS18 demonstrator setup currently running in FAIR Phase-0; (iii) development and optimisation of online track reconstruction and event selection algorithms; and/or (iv) data analysis of first CBM and mCBM datasets. The candidate will become a member of the CBM Collaboration and will be expected to present results at collaboration meetings and international conferences. The precise focus of the project can be adapted once the candidate has been selected. More information on the CBM experiment is available at fair-center.eu/user/experiments/cbm.

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

The CBM Collaboration has a long-standing and productive partnership with several Chinese institutions, including the Central China Normal University (CCNU) in Wuhan, the Chinese Academy of Sciences (SINAP, Shanghai), Tsinghua University (Beijing), and the Institute of Modern Physics (IMP) in Lanzhou. Chinese groups contribute to the physics programme, detector development, and simulation activities. The OCPC postdoc is expected to further strengthen this collaboration and to develop new links, particularly in view of the synergies between CBM at FAIR and the future High Intensity heavy-ion Accelerator Facility (HIAF) in China, which will explore a partially overlapping energy regime.

Required qualification of the postdoc:

- PhD in experimental nuclear or particle physics
- Experience with heavy-ion collision data analysis and Monte Carlo simulations (e.g. UrQMD, GEANT4, CBMroot/FairRoot)
- Good programming skills in C++ and Python; experience with the ROOT analysis framework
- Experience with detector systems or online/offline reconstruction algorithms is an advantage
- Language requirement: fluent English (speaking and writing)