2023 Helmholtz – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

ALICE at the LHC Run 3: towards high-precision heavy-ion physics.

Helmholtz Centre and/or institute:

GSI Helmholtz Center for Heavy-Ion Research

Project leader:

Prof. Dr. Silvia Masciocchi

Contact Information of Project Supervisor:

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Department: (at the Helmholtz centre or Institute)

ALICE

Programme Coordinator (Email, telephone and telefax)

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

ALICE is the experiment at the Large Hadron Collider devoted to the study of the quark-gluon plasma and other fundamental properties of strongly interacting matter. Since 1996, the ALICE group at GSI is strongly involved in the experiment activities with 1) the operation of central detector systems such as the Time Projection Chamber, 2) detector calibration and event reconstruction, and 3) several physics analyses in lead-lead, proton-lead and proton-proton collision data.
One of the major areas of research in the group is the investigation of charmonium and open-heavy-flavour hadron production. We have a leading role in several analyses dedicated both to the study of J/ψ production and to the reconstruction of charmed baryons in all collision systems recorded at the LHC. These analyses profit significantly from the use of a powerful software framework for the reconstruction of decay chains, the KFParticle package, and from the application of machine learning algorithms.
Run 3 of the LHC started in 2022 and ALICE already collected a data sample from proton-proton collisions, which is more than 100 times larger than all previous years. In summer 2023, an extended lead-lead campaign is planned. ALICE will fully profit from its recently upgraded detectors: with the

Inner Tracking System newly built with CMOS Monolithic Active Pixel Sensors and with the Time Projection Chamber (TPC) in continuous readout mode, the Collaboration will record the highest statistics available to date for precision measurements in the heavy flavour sector.
The selected candidate will work with the analysis team expert of one of the two topics mentioned above (charmonium or open heavy flavours, to be determined at the time of the candidate selection). The work will include the analysis of the LHC Run 3 data, which will lead to the publication of the results obtained, as well as their presentation at international conferences. We aim at reaching higher precision and a broader scope of the measurements, for example extending the studies to the beauty sector. We will achieve this both thanks to the increased statistics and precision of the experimental data, and by further use of advanced artificial intelligence methods.
In addition, the candidate will be involved in software developments in close connection to the TPC (detector calibration, track reconstruction, particle identification via specific energy loss, etc.) or within the new Online-Offline (O2) ALICE software framework. For these tasks, good expertise in programming, developing fast and efficient algorithms, applying multivariate analysis techniques and machine learning is desirable.
The selected candidate will join the various activities and responsibilities of the group in the Collaboration (detector operation, shifts, etc.). She/he will be welcomed by the GSI ALICE group composed of nine staff scientists, five postdocs and ten doctoral students. We are a very dynamic, competent, and welcoming group, which highly values fair and collaborative work.

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

Existing and strong collaborations within the ALICE Collaboration at the LHC:

- **CCNU Wuhan**
  Prof. Dr. Daicui Zhou, Prof. Dr. Zhongbao Yin, Dr. Xiaoming Zhang
  Institute of Particle Physics
  Central China Normal University (CCNU)
  Key Lab. of Quark & Lepton Physics (CCNU), MoE
  Wuhan 430079 China
- **UST Hefei**
  Prof. Dr. Zebo Tang, Dr. Xiaozhi Bai
  University of Science and Technology of China (USTC)
  Jinzhai Road 96
  Department of Modern Physics
  Hefei, Anhui 230026 China
- **Fudan University, Shanghai**
  Prof. Song Zhang, Dr. Qiye
  Shou Institute of Modern Physics
  Fudan University
  Shanghai 200433, China
- **China University of Geoscience, Wuhan**
  Dr. Xinye Peng
  No. 388 Lumo Road, Wuhan, P.R. China

Required qualification of the postdoc:

- PhD in Physics
- Experience in experimental physics
- Experience with data analysis in the field of heavy-ion physics (C++, ROOT, Python)
- Additional skills in use of machine learning methods
- Language requirement: fluent English (speaking and understanding).