



2023 Helmholtz – OCPC – Programme for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Long-Lived Axion-Like Particles at CMS and CODEX-b

Helmholtz Centre, division:

DESY High Energy Physics (FH)

Project leader:

Dr. Juliette Alimena

Contact Information of Project Supervisor: (Email, telephone)

juliette.alimena@desy.de, +49 40 8998 6003

Web-address:

<https://cms.desy.de/>

DESY Group:

DESY-FH CMS

DESY-OCPC Programme Coordinator (Email, telephone and telefax)

Frank Lehner; frank.lehner@desy.de; +49 40 8998 3612



Description of the project (max. 1 page):

Axions were introduced in the 1980s in theories beyond the standard model (BSM) to address the strong CP problem. Axions and axion-like particles (ALPs) arise in many BSM theories that can be probed at the Large Hadron Collider (LHC) and are an important part of the local DESY program. For example, DESY is leading the search for ALPs with the ALPS II, MADMAX, (Baby)IAXIO, and LUXE experiments. In addition, there is an active theory community working on the same topic.

The postdoc's work will concentrate on searching for ALPs at the LHC, with a preferential focus on displaced signatures where ALPs are expected to appear. Along with the group at DESY, the postdoc will perform a search for a specific ALP signature with Compact Muon Solenoid (CMS) Run 3 data. This search with the CMS detector will be the primary topic of their postdoc, and it will culminate in a paper in a peer-reviewed journal. While performing this search, the postdoc will be immersed in the DESY CMS group, which consists of about 90 members, making it the largest German institute in the CMS Collaboration. The DESY CMS group is engaged in activities ranging from physics analysis and contributions to data taking (monitoring and alignment) to detector hardware projects. CMS DESY physicists are experts in top quarks, the Higgs boson, Supersymmetry and Dark Matter Searches, QCD, as well as studies of parton density distributions in the proton. We also work on data quality monitoring, tracker alignment, the high level trigger, beam condition monitoring, as well as research and development for the tracker and high-granularity calorimeter upgrades. DESY is also a Tier 2 site and thus directly involved in the LHC computing for the data processing chain. As a direct result of all these activities of the group, the postdoc will have a plethora of learning opportunities and career development.

Concurrently with the CMS analysis, the postdoc also will spend an appropriate fraction of their time contributing to the CODEX-b experiment, which is a proposed detector dedicated to searching for long-lived particles that are produced in proton-proton collisions, travel through the LHCb detector and decay within the CODEX-b detector. The postdoc will determine the sensitivity of the CODEX-b detector to long-lived ALPs, with either simulation alone or the first CODEX-b data. Depending on the postdoc's desires, substantial travel to CERN could be arranged in order to be directly involved in the data taking of this new experiment, for example. We foresee a second paper for the postdoc with the CODEX-b detector to be published within the timescale of the project as well.



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

Particle physics is a very collaborative and very international field, and the CMS collaboration has partnerships and experimental collaborators from almost 200 universities and research institutions across China and the world. Within the CMS collaboration, there are already 61 graduate students working on their doctorate in China. A postdoctoral position at a research institute like DESY would substantially improve the career perspectives for this group. Collaboration with any of the following Chinese institutes would be suitable:

Beihang University, Beijing
Tsinghua University, Beijing
Institute of High Energy Physics, Beijing
Peking University, Beijing
Sun Yat-Sen University, Guangzhou
University of Science and Technology of China, Hefei
Fudan University, Shanghai
Zhejiang University, Hangzhou
Zhejiang Institute of High Energy Physics
Chinese Academy of Sciences (IHEP)

Required qualifications of the postdoc:

- PhD in experimental particle physics or closely related field
- Demonstrated experience with data analysis
- Additional skills in hardware are a plus
- Good knowledge of spoken and written English
- Good oral and written communication skills as demonstrated by presentations and publications