



2025 Helmholtz – OCPC – Programme for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Gearing up Effective Field Theory at the awe of FCC/CEPC area.

DESY Division & Group:

DESY-FH-T

Project leader/supervisor:

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Description of the project (max. 1 page):

Effective field theories are a convenient way to systematically explore quantum field theory in the presence of a large separation of physical scales, be there the weak scale and the scale of new physics. EFTs can be matched to any specific UV physics scenario but they can also be used to parametrise unknown physics in terms of few coefficients capturing local interactions of known particles. Locality and unitarity actually offer powerful constraints on the values of these coefficients. Consistency with the laws of gravity at the quantum level also impose some non-trivial constraints on these IR coefficients to separate a landscape of consistent EFTs from the swampland of EFTs that cannot be completed into a theory of quantum gravity. The aim of this project will be twofold: 1) to study how small instanton effects induce couplings between an axion-like particle to fermions and to relate these couplings to the flavour structure of new physics; 2) to investigate the constraints inherited from precision low-energy data on higher-dimensional Wilson coefficients at dimension-6 and 8 through renormalization group flow.

The Future Circular Collider at CERN, or similarly the Circular Electron Positron Collider in China, are profiling themselves as the next big challenges taken up by High-Energy-Physics after the Large Hadron Collider. Their ambitious program would be a unique opportunity to fuel the field of fundamental particle physics for several decades to come. Be it for testing the standard model predictions with unprecedented precision or to search for new particles, these machines are designed with versatility and diversity at the heart of their multi-stage program. This project will contribute to develop further theoretical tools to exploit data to be collected at these colliders.

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

- Five previous Chinese postdocs came to DESY supported by this postdoc exchange program, three of them now hold professor positions in China: Prof. Dr. Kechen Wang at Wuhan University of Technology, Prof. Dr. Jiayin Gu at Fudan University, Shanghai and Prof. Dr. Zhuoni Qian, Hangzhou Normal University. They expressed interest in hosting a joint DESY-China postdoc.
- This project should be conducted with people with a good knowledge of Effective Field Theory, in particular the team around Jiang-Hao Yu (Institute of Theoretical Physics, Chinese Academy of Sciences, Beijing) would be a natural partner.

Required qualification of the postdoc:

- PhD in Theoretical Particle Physics
- Experience with Quantum Field Theory, collider physics and Effective Field Theory
- Additional skills in Phenomenology and Collider Physics
- Language requirement: English