



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

PART A

Title of the project:

Exploring the landscape of Effective Field Theories

Helmholtz Centre, division:

DESY-FH-T

Project leader:

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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 know 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 to investigate the geometrical structure of these constraints in terms of an amplituhedron and to study to which extent they can be probed at future colliders, like CEPC or FCC. In particular, the interactions violating CP and/or CP symmetry will be scrutinised. Special attention will also be devoted to scenarios with light and very weakly coupled degrees of freedom such as axion-like particles that can source local operators in the Standard Model Effective Field Theory.

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.



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- This project should be conducted with people working on the Circular Electron-Positron Collider, in particular the team around M. Ruan (Institute of High Energy Physics, Beijing) would be a natural partner.
 - Some important formal developments on the structure of the Standard Model Effective Field Theory have been obtained by J. Shu (Institute of Theoretical Physics, Beijing) and I am in contact with him to develop further collaborations

Required qualification of the postdoc:

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