Ministry of Human Resources and Social Security

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

# 2020 Helmholtz – OCPC – Program
## for the involvement of postdocs in bilateral collaboration projects

**PART A**

**Title of the project:**
Characteristics of 3D edge transport in magnetically confined fusion devices with island divertor configuration

**Helmholtz Centre and institute:**
Institute of Energy and Climate Research, Plasma Physics (IEK-4), Forschungszentrum Jülich GmbH

**Project leader:** Prof. Dr. Yunfeng Liang

**Web-address:** http://www.fz-juelich.de/iek/iek-4/EN/

**Description of the project:**

A great challenge for fusion energy research and technology is to confine a burning plasma while maintaining tolerable heat and particle fluxes on plasma-facing components. Previous experimental results from both tokamak and stellarator devices demonstrate that the magnetic topology plays a key role in plasma confinement, edge magnetohydrodynamic (MHD) stability, and interactions between the plasma and the first wall, particularly with the divertor. The island divertor configuration of stellarator has three-dimensional (3D) field characteristics, and it is beneficial to increase the equivalent radial transport and the power decay length, and consequently reduce the peaking heat load on the divertor target.

On the Wendelstein 7-X (W7-X) stellarator, in order to investigate the synergy between 3D edge transport physics and plasma-wall interactions, a group of edge diagnostics and modelling has been developed by Institute of Energy and Climate Research, Plasma Physics (IEK-4), Forschungszentrum Jülich GmbH. Two endoscopes have been designed for visible and ultraviolet spectroscopy and tomography of the plasma edge, along with infrared thermography of the divertor tiles. 2D profiles of impurities (e.g. helium, carbon) will be measured by two endoscopes viewing the island divertor region in the plasma edge with a spatial resolution of <2 mm. A multipurpose manipulator, which is used as the carrier either of the probe head for measuring the plasma edge profiles or of samples for plasma exposure studies, was installed at the outside mid-plane on W7-X in 2015. A poloidal correlation reflectometer has also been installed at W7-X. The system consists of an antenna array observing the propagation of turbulent phenomena in the mid-plane. A kinetic neutral particle transport code (EMC3-EIRENE) package has been adapted for plasma edge transport in helium plasma at W7-X using a hybrid fluid–kinetic approach by enabling EMC3 to treat non-hydrogen isotopes and extending the usage of EIRENE features within EMC3-EIRENE.

This project aims to characterize 3D edge heat and particle transport on W7-X with an island divertor, and to explore the application of the island divertor configuration on tokamak using the external resonant magnetic perturbations (RMPs). By means of numerical calculation and experimental observation, this project will investigate the mechanism and method of forming and controlling the magnetic island at the plasma boundary on tokamak, and study the effect of 3D field on the turbulence transport and stability of edge plasma.

The team in Jülich is looking for a researcher who can support the team in 3D edge plasma transport studies on either stellarator or tokamak. Understanding of the involved physics as well as required code improvements is part of the project. The project also includes some simulation works on the Chinese tokamak devices, such as EAST and J-TEXT.

**Description of existing or sought Chinese collaboration partner institute:**

Our team is cooperating with Chinese partners such as Institute of Plasma Physics (Chinese Academy of Science), Southwestern Institute of Physics (SWIP), and Huazhong University of Science and Technology. The current collaborations are focusing on both the experimental and theoretical studies in plasma devices including W7-X, EAST, HL-2A/M and J-TEXT. The research directions involve magnetohydrodynamic (MHD) stabilities, edge plasma diagnostics and simulations, as well as plasma-wall interactions, and so on.

**Required qualification of the post-doc:**

- PhD in plasma physics or diagnostic technology
- Experiences with plasma diagnostics or transport studies on the tokamak or stellarator
- Additional skills in spoken and written English with a very good level

**PART B**

**Documents to be provided by the post-doc, necessary for an application to OCPC via a postdoc-station in China, which is affiliated to a research institution like a university:**

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae, copies of degrees
- List of publications
- 2 letters of recommendation
- Proof of command of English language

**PART C**

**Additional requirements to be fulfilled by the post-doc:**

- Max. age of 35 years
- PhD degree not older than 5 years
- Very good command of the English language
- Strong ability to work independently and in a team