

## **Helmholtz - OCPC - Programme 2017-2021 for the Involvement of Postdocs in Bilateral Collaboration Projects with China 2019**

### **PART A**

**Title of the project:** Radio Detection of Cosmic Rays and Neutrinos of Highest Energies

**Helmholtz Centre and institute:** Karlsruhe Institute of Technology (KIT), Institute of Nuclear Physics (INP)

**Project leader:** Dr. Andreas Haungs, Prof. Dr. Frank G. Schröder

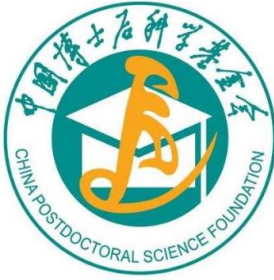
**Web-address:** [www.kceta.kit.edu](http://www.kceta.kit.edu)

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

Radio detection is a new and promising technique for cosmic-ray air showers initiated by cosmic particles of highest energies. These particles have energies up to several  $10^{20}$  eV, which is orders of magnitude beyond the reach of human-made accelerators, such as LHC at CERN or any future collider. These new detection technique can boost the accuracy for the energy and mass of the primary cosmic particles. Impinging particles can be nuclei of different elements as well as high-energy neutrinos. A combination of measurements of both particle types will help to understand the still unknown origin of the primary cosmic ray particles.

Currently, the Pierre Auger Observatory in Argentina is the world-leading and largest experiment for cosmic rays of highest energies. Its main detector is a 3000 km<sup>2</sup> large array of 1660 water-Cherenkov detectors for air-shower particles. These detectors will be enhanced by radio antennas to increase the total measurement accuracy for air showers of less than 30° elevation. The IceCube neutrino observatory located at the South Pole is the largest detector for measuring high-energy neutrinos and will be enhanced by a surface array of radio antennas. At both facilities the KIT has a significant contribution in enhancing the observatories by radio antennas.

Finally, the successful installation of large-scale radio detectors will also be a pathfinder for next-generation projects, especially the Giant Radio Array for Neutrino Detection (GRAND)



to be deployed and operated in China in the next decades. GRAND will be a huge antenna array based on the radio detection of inclined showers. Build up step-by-step, around 2025 GRAND will exceed the size of the Pierre Auger Observatory and become the leading experiment for cosmic particles of highest energies.

The present project is about the methodology applied in the reconstruction of GRAND data based on the experiences gained with the Pierre Auger Observatory and IceCube radio antennas. The necessary hardware development, simulation studies and analyses, particularly for the GRAND prototype station GRANDproto300, will be done together with colleagues at KIT, France and in China; i.e. with the international collaborators of the GRAND Collaboration.

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

There is an existing cooperation between KIT and Shanghai Jiaotong University (SJTU) in the fields of particle and astroparticle physics, which can be fostered by this project. Nevertheless, applicants from other institutions are welcome, too. In particular the institutions of collaborative GRAND members are options, e.g., the National Astronomical Observatory (NAOC), Chinese Academy of Sciences, Beijing. Moreover, a few members of KIT are co-authors of the GRAND White Paper recently published [arXiv:1810.09994]. The first prototype of GRAND will start operation in China this year, and later phases of GRAND will start 2021. Thus, the proposed project in developing optimised methodical approaches for GRAND can be the basis for a long-term strategic partnership in astroparticle physics.

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

- PhD in Astroparticle Physics, Astrophysics, Particle Physics or related fields
- Experience with Radio or Particle Detectors and/or Data Analysis and/or Simulation studies on high-energy cosmic particles; ideally experienced with collaborative work in international groups
- Additional skills in Software Programming (C++, Python, Linux, ROOT)

**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



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GRAND CHALLENGES

## **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