2017 Helmholtz – OCPC – Programme
for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:
Development of a novel ground-based interferometer to observe thermospheric neutral winds

Helmholtz Centre and institute:
Forschungszentrum Jülich, Institute for Energy and Climate Research: Stratosphere (IEK-7)

Project leader: Dr. Martin Kaufmann

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Description of the project:

The weather of Earth's upper neutral and ionized atmosphere is strongly influenced by energy injections at high latitudes connected with magnetosphere-ionosphere coupling and solar radiation variability at extreme ultraviolet wavelengths. Beside the undisputed importance of solar and magnetospheric variability, a variety of new evidence emphasizing the impact of waves forced in the lower parts of Earth's atmosphere on the spatial as well as temporal variability of the thermosphere was obtained in recent years.

Some of the results are that local wave sources (such as a single convective plume) have a global impact on neutral horizontal wind and plasma density variations, linking tropospheric weather to space weather. Neutral atmosphere dynamics, such as non-migrating tides in the low and middle latitude E-region, are able to move the partially ionized plasma through Earth's magnetic field, crossing magnetic field lines. Moreover, tidal wind shears in the E-region play a significant role in forming ionospheric intermediate layers, called sporadic E. These processes demonstrate the importance of understanding the neutral as well as the ionospheric dynamical processes, which couple in a complicated manner and cannot be understood by investigating these two domains separately.

To predict space weather becomes an important topic in the context of global navigation satellite systems and satellite based communication. As a result, large nations like the US, Russia, China and Europe build up space weather service centres to increase the space weather situational awareness. Amongst others, this requires a better understanding of processes linking the neutral and charged components. Ground-based measurements of

neutral wind are a suitable means to obtain information about the neutral atmosphere dynamics at E- and F-layer altitudes.

A common way to obtain wind information is to measure the Doppler shift of molecular or atomic emission lines. This has been realized by Fabry Perot interferometers (FPI) or phase stepping Michelson interferometers. A new technique called Doppler Asymmetric Spatial Heterodyne (DASH) interferometry is becoming increasingly popular and seems be an ideal base for future instruments.

The aim of the project is to design, build and verify a ground-based DASH instrument suited for the harsh environment of remote observatories. Within this project, a computer model will be set up to quantify the signal, which needs to be detected by the new instrument. A DASH interferometer will be designed using an optical ray-tracing software. Thermoelastic calculations of the optical components will be performed by means of Computer Aided Design (CAD) software. Following this design work, an instrument will be build up in the laboratory and optical performance analyses will be performed by means of various calibration sources. Finally, field measurements of thermospheric wind will be performed from Xinlong observatory in China in tandem with the existing wind instruments.

Description of existing or sought Chinese collaboration partner institute:

The post-doc project is embedded in a joint activity between Forschungszentrum Jülich, universities in Germany (University of Wuppertal) and Canada (University of New Brunswick), the National Metrology Organization of Germany (involved in the calibration of the instrument), and the State Key Laboratory of Space Weather (SKLSW) of the National Space Science Centre (NSSC) which is part of the Chinese Academy of Sciences (CAS).
The NSSC is one of China's leading institutes for middle and upper atmosphere research. This institute operates various instruments for the observation of the upper atmosphere within the Chinese Meridian Network, which contains a wealth of ground based instruments at longitude and latitude circles along 120°E and 30°N, respectively. The Meridian Network observational capabilities of temperature and wave activity will complement satellite measurements with their high temporal- and spatial- resolution and feed space weather assimilation systems in the future.

Therefore, we are very interested to strengthen the cooperation with NSSC and to establish new collaborations with institutes in China on space weather research.

Required qualification of the post-doc:

- PhD in atmospheric physics, space physics or related subject
- Experience with modelling atmospheric radiation
- Experience with optical design and optical characterization / performance analysis

PART B

Documents to be provided by the post-doc:

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

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