

PROJECT TITLE: Detecting Ionising Radiation from Lightning Flashes on the Ground and in Space

DTP Research Theme: Changing Planet

Lead Institution: University of Bath

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Project keywords: Atmospheric Physics , Particle Physics



Lightning flashes emit ionising radiation which will be recorded from satellite, from the ground and in the laboratory.



Lightning flashes are caused by thunderstorms which are often perceived as spectacular fireworks produced by Nature.

Project Background

Lightning discharges remain an enigma to date despite extensive research. In particular, the recently discovered emission of ionising radiation by lightning is still poorly understood. This project will integrate existing technologies to enable fundamental scientific advances understanding lightning discharges.

A key novelty will be the use of the TARANIS satellite to measure terrestrial gamma ray flashes and terrestrial electron flashes simultaneously. The TARANIS mission will be complemented with a ground-based network of miniaturised ionising radiation detectors developed at the University of Bristol. These new detectors will be characterised and tested in the Morgan-Botti Lightning Laboratory at Cardiff University where lightning discharges are produced artificially. Subsequently, the detectors are deployed during field work.

The successful candidate will participate in meetings with the team around the TARANIS satellite to maximise the impact of the project in the context of the space mission. The candidate will participate in the production, testing and validation of ionising radiation detectors in collaboration with the Space Science group at the University of Bristol. The project will measure the ionising radiation from laboratory sparks which simulate real-world lightning discharges in the Morgan-Botti lightning laboratory at Cardiff University. The successful candidate will deploy a network of ionisation radiation detectors and compare the measurements with the recordings on board the TARANIS spacecraft. The occurrence times and locations of lightning flashes are provided by the UK Met Office in Exeter and the candidate will participate in meetings with the staff from the Met Office in a non-academic environment.

At the end of the project, the successful candidate will be able to plan and conduct complex projects and manage the implications of the research toward academic research at higher education institutions, applications in industry and understand the needs of governmental agencies.

Project Aims and Methods

The project offers training on the development of novel instruments, collection of data, subsequent data analysis and interpretation at academic institutions and in a non-academic environment. This training will maximise the scientific understanding associated with ionising radiation from lightning flashes as observed from a major world leading space mission, the TARANIS satellite. The candidate is welcome to prioritise the training elements according to background knowledge and training needs, and also to propose novel training elements or lines of research, as required. The candidate is expected to travel overseas and to present the work during international scientific conferences.

Candidate requirements

The student will need to have a strong background in at least one of the following STEM areas: Science, Technology or Engineering. Experience of experimental laboratory work using or developing instruments or electronic devices is also needed.

Collaborative partner

The Met Office acts as a collaborative partner, facilitating the PhD with insights into operational service delivery in a non-academic environment which is closely associated with the topic of the PhD.

Training

The successful candidate will have the opportunity to participate in specialist training programs offered by NERC, the University of Bath, the University of Bristol and Cardiff University. Overseas travel to international scientific conferences and field work will be arranged as required.

Background reading and references

T. Neubert et al., 2020. A terrestrial gamma-ray flash and ionospheric ultraviolet emissions powered by lightning. *Science*, doi: 10.1126/science.aax3872, 367, 183-186.

M. Fullekrug et al., 2011. Relativistic electron beams above thunderclouds. *Atmospheric Chemistry and Physics*, doi:10.5194/acp-11-7747-2011, 11, 7747-7754.

K.L. Aplin, G. Marlton, et al. 2017, Measuring ionizing radiation in the atmosphere with a new balloon-borne detector, *Space Weather*, <https://doi.org/10.1002/2017SW001610>, 15, 5, 663-672

Useful links

Enquiries relating to the project should be directed to the lead supervisor (see email address above for Project Enquiries). Enquiries relating to the application process should be directed to doctoraladmissions@bath.ac.uk.

In order to apply, you should select the relevant University of Bath PhD online application form found here: <https://www.bath.ac.uk/study/pg/applications.pl>. When completing the form, please state in the 'Finance' section that you wish to be considered for GW4+ DTP funding and quote the project title and lead supervisor's name in the 'Your research interests' section.

Further information about the application process may be found here: <http://www.bath.ac.uk/topics/postgraduate-research/>

The application deadline is Friday 8 January 2021 at 2359 GMT. Interviews will take place from 8th to 19th February 2021. For more information about the NERC GW4+ Doctoral Training Partnership please visit <https://www.nercgw4plus.ac.uk>.