STFC CASE+ Studentship

Light-Field Motion Tracking in Laboratory Studies of Planet Formation

A collaboration between The Open University and Dynamic Imaging Analytics Limited

Deadline for Applications: May 29th 2020
Remote Interviews: June 5th 2020

Supervision team: Dr Helen Fraser & Prof Simon Green (OU)
Dr Neil Murray & Dr Anthony Evagora (DIAL Ltd)

Following the competitive award of an STFC CASE-Plus studentship, we are delighted to offer a 3.5 year fully-funded PhD studentship position starting in October 2020, based at the Open University, School of Physical Sciences.

This PhD will be focused on the engineering and technology developments required to adapt and develop DIAL’s light-field video camera technology to be capable of operating in low pressure (< 10⁻⁴ mBar), temperature (< 180 K) and microgravity conditions. The ambition is to record, track, and subsequently compute, the 3D motions of an ensemble of icy particles (sized between micron and cm diameter) in a suitable environment, i.e. drop tower, parabolic flight, sounding rocket or ISS payload.

The methodology involves bread-boarding a prototype camera to a flight-ready model through two iterations spending some months each year based at industrial partner DIAL’s Milton Keynes premises. At each step benchmarking, testing, and space-qualifying the camera technology by employing it in a range of scientifically-motivated laboratory and microgravity experiments (based at the OU labs in Milton Keynes), focused on icy-grain aggregation relevant to planet-formation processes, exploiting existing experimental set-ups at the OU.

Are you a student with a strong Physics or Engineering background, expected to graduate in 2020 with a minimum 2:1 MPhys or MEng? Do you have an interest in optics and imaging technologies? Are you interested in Space-Sciences – then this is likely to be the PhD for you!

If you would like to apply send a completed application form - home and EU students or application form - overseas students, an up to date CV, list of individual courses taken and grades obtained (or full course transcript), a personal statement of why you are interested in this particular project and how your skills match the research area, together with IETLS score (non UK nationals) to STEM-SPS-PhD by May 29th 2020. You are encouraged to contact the lead supervisor Dr Helen Fraser (helen.fraser@open.ac.uk) prior to your application to discuss the project in more detail.
Additional Background

Overarching aim:- One of our key scientific drivers in the OU Astrochemistry group is to describe qualitatively and quantitatively the collisions that dominate the earliest stages of icy planetesimal-formation, to answer “how do planets form?”.

We aim to be the first in the world to develop and exploit an experimental payload to address this challenge, taking advantage of the high-quality, medium-duration microgravity environments in sub-orbital flight, to study sub-cm/s collisions between ensembles of ~nm-sized icy grains, forming μm-mm sized fluffy ice aggregates, that stick to form cm-sized icy pebbles. Without these specific microgravity conditions, our particles sediment (at the low velocities), the aggregates fall apart or compact (weight effects), and there is insufficient time to collide and aggregate all the particles.

The ability to attempt such collision experiments is only just emerging as sub-orbital flight providers commence operating, making this studentship timely for developing the underpinning technology ‘just in time’ to realize our scientific ambitions.

This PhD

This scientific aim is reliant on the deployment of appropriate video camera technology capable of operating in low pressure (< 10^{-4} mBar), temperature (< 180 K) and microgravity conditions, to record, track, and subsequently compute, the 3D motion of every particle in the ensemble, accounting for appropriate illumination, adapting to opacity changes as the aggregation progresses, accounting for dynamic changes in particle orientation, occlusion, shadowing and range as a function of time, and ensuring rapid data storage (no lost frames at a high frame rate) over a sustained (> 240 s) period, in a field of view not smaller than ~ 100 cm³.

Consequently, this PhD will involve significant hardware, software and optical engineering and the PhD student will be expected to work closely with the industrial partner DIAL Ltd. The major technological outcome of the studentship will be to demonstrate that 3D motion tracking of an ensemble of icy particles undergoing aggregating collisions in simulated planet-forming environments can be performed using a single light-field camera operating in video mode, concurrently addressing our scientific outcome; to enhance our empirical understanding of the processes that dominate the earliest stages of exoplanets, exomoon and exocomet formation.

Additional CASE Benefits

STFC CASE studentships provide outstanding students who are successful in applying with access to training, facilities and expertise not available in an industrial setting alone. CASE students have a chance to significantly enhance their future employability and develop valuable skills that translate between academic and industrial environments. This studentship comes with an enhanced student stipend and tuition fees (for UK and EU students). The STFC CASE+ studentship can, depending on the performance of the student, lead to the offer of a 1 year employed position within the industrial partner company, for 12 months subsequent to thesis submission (provided that the thesis is submitted within 3.5 years).
**Industrial partner**

Dynamic Imaging Analytics Limited is a micro-SME based in Milton Keynes, UK. Dynamic Imaging Analytics (DIAL) was formed in February 2015 to address the need for the fast and reliable interpretation of image data to provide scientific and engineering measurements for space exploration and Formula One™.

DIAL’s core themes are developing novel and bespoke imaging measurement solutions, optimisation of imaging detectors, finding new applications for existing and new technologies, generating rich public engagement materials and inspiring the next generations into science and engineering.

[https://www.dynamicimaginganalytics.co.uk](https://www.dynamicimaginganalytics.co.uk)

**Associated References:**