PhD Studentship

Collision Induced Physical and Chemical Processes in Interstellar and Planetary Grain Aggregates.

Department of Physical Sciences

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CLOSING DATE June 8th 2012

As part of the Department's developing research in Astrochemistry, applications are invited for an experimental PhD studentship centred on collision-induced processes in icy-grain collisions as model systems for star and planet-forming environments. The programme will focus on the chemical reactions, out-gassing rates, nano-scale collision fragments and physical restructuring of grains, after collisions of icy particles, under pseudo interstellar and planetary conditions. Such particles are loose aggregates of smaller particles that may contain trapped gas, carry charge, and be chemical nano-factories, key in the generation of pre-biotic material and its subsequent delivery to a planetary surface during star- and planet- formation.

The challenge of this work comes from the fact such collisions have to be studied under low velocity, low pressure and low temperature conditions. We therefore often utilise microgravity environments to overcome sedimentation and convection heating effects. We are particularly interested in the link between micro-scale and nano-scale processes in icy grain collisions, utilising both imaging technology and time-of-flight mass spectroscopy. The position will primarily involve both laboratory-based research and fieldwork on microgravity platforms such as parabolic flight campaigns.

The student will exploit an established experiment for imaging collisions of icy and dusty grain particles, which has flown on 5 parabolic flight campaigns previously. Whilst using the existing equipment to study micro-scale collisions, the studentship will involve developing methods of generating amorphous icy grains, as well as developing the instrumentation for nano-scale studies. A time-of flight mass spectrometer will be incorporated into the existing machine to study small fragmentation particles not visible to the current micron-scale imaging video equipment. Such clusters provide vital information on populations of small grains detected in planetary disks, cometary comae and planetary regolith.

In parallel, collision induced reaction and out-gassing will be studied using existing UHV surface-science apparatus, adapted to this programme. Energy in collisions, even at low temperature is often sufficient to induce chemical change as well as physical change, and this work will pioneer the field. The two sets of equipment and experimental data will then be combined to establish a complete picture of the micro-

and nano-scale effects of grain collisions. The student will be expected to maintain a strong link with planetary scientists at the OU, particular with a view to exploiting the data outcomes in the context of existing and upcoming missions such as ExoMars and Rosetta. Likewise, a strong link with the star-formation astronomy community is required, to enable rapid dissemination and exploitation of the data at the other-end of the grain collision scale – namely in protoplanetary disks and star-forming regions. Whilst not essential, it would be desirable for suitably qualified candidates to supplement their experimental work with theoretical simulations of grain aggregate collisions, using an existing molecular dynamics code, written in collaboration with colleagues at University of Edinburgh and Imperial College. The code also offers scope for development.

Applicants must have graduated (or be about to graduate) with a Master's level undergraduate degree in Physics, Chemistry, or Astronomy, or a very closely related discipline. Furthermore, the student should have strong practical skills and enthusiasm for experimental work. A solid undergraduate-level knowledge of physical chemistry or solid-state physics is preferable. A clear demonstration of enthusiasm or understanding of astronomy is also desirable. As the PhD will require participation in parabolic flight campaigns, the candidate must be fit and healthy, as they will be required to pass a Class II Pilot's medical to be able to take up the post and undertake their research.

The successful candidate will receive a tax-exempt stipend of £13,590 per year over 3 years and tuition fees will be covered by the University. The required start date is mid-September - October 2012. Potential candidates are requested to send (by email as PDF attachment) a 2-page CV, list of publications (if any), a cover letter describing their suitability and enthusiasm for the post, as well as any questions to Dr Helen Fraser 5pm (UT) June 8th 2012. Candidates should also arrange for two letters of recommendation to be emailed directly to Dr Fraser, under separate cover, by the same date. The name, occupation, address, email and phone contact of each referee, including their relationship to the candidate should be attached as a separate sheet to the back of the CV. Candidates short-listed for interview will be contacted in June, and a final decision made shortly thereafter.

PLEASE NOTE:

a. If you feel you have any underlying medical condition (e.g. asthma, allergies, heart conditions, lung conditions, anaemia, or epilepsy) which would not usually affect your day-to-day working but could exempt you from flying, please mention it in your application. It will not preclude you from interview, but could affect the final scope of your research programme.

b. Candidates from outside the EU will be required to obtain and satisfy the current UK visa requirements, appropriate to their appointment. Please be aware that this now includes proof of proficiency in English, and without such qualifications it is beyond our control whether a visa application is accepted or rejected. If you fall into this category, please

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