



## **Astrophysics Data Science Cluster (5 PhD Scholarships) at the University of Hull (UK) – The Astrophysical Data Science Cluster (ADSC)**

To celebrate the University's research successes, the University of Hull is offering a full-time UK/EU PhD Scholarship or International Fees Bursary **for candidates applying for each of the following projects.**

**Closing date: - Thursday 8<sup>th</sup> February 2018**

Studentships will start on 17<sup>th</sup> September 2018

### **Summary**

The Astrophysical Data Science Cluster (ADSC) is an exciting new development for the University of Hull's world renowned E.A. Milne Centre for Astrophysics. A series of five Grand Challenges underpin the ADSC, each of which are aligned with the science roadmaps shaping the science & technology landscape for the UK and Europe for the coming decade. The successful candidates will work alongside international leaders striving to identify the physics driving the formation and evolution of galaxies, stars, and planets, with cross-disciplinary opportunities characterising the development of complex biological life and astrochemistry. A blend of computational and experimental approaches will be adopted, employing Big Data analytical techniques and multi-dimensional data mining, with access provided to one of the country's most powerful supercomputers and some of the best international telescopes, through our various partnerships. One of the most ambitious computational experiments ever undertaken – the Horizon Run – will ensure opportunities to data mine unprecedented peta- and exa-scale datasets, all within one of the country's most dynamic, supportive, and social research centres. **An extremely generous research budget (£9k) is provided to all successful candidates**, above and beyond the stipend. Interested applicants should contact Professor Brad Gibson ([brad.gibson@hull.ac.uk](mailto:brad.gibson@hull.ac.uk)) for additional details.

### **PhD Scholarship project 1: Data Mining the Horizon Run**

The Horizon Run is one of the most ambitious simulations ever undertaken. In collaboration with Milne Centre and the Korea Institute for Advanced Study, ~100 million core hours will be used to reproduce the Universe and its galaxies at unprecedented resolution. The successful candidate will lead the development of data mining algorithms for exploring the chemical abundance patterns of the stars within the simulated galaxies. This Galactic Archaeology experiment will allow us to isolate the physics driving the evolution of the Milky Way, and provide significant overseas time with our partners in Seoul and Paris.

### **PhD Scholarship project 2: The Production of Radioactive Elements in Stars**

Despite the well-known structure of the periodic table, remarkable mysteries remain unsolved – the aims of this studentship is shed light on the origin of particularly perplexing radioactive isotopes of, for example, aluminium, titanium, and uranium. Once ejected upon a star's death, their radiogenic signature becomes a powerful diagnostic for stellar simulations. The student will model the cumulative contribution of such isotopes, from many generations of stars, within a galactic chemical evolution context. Close links with our colleagues in Budapest and the NSF's Joint Institute for Nuclear Astrophysics provide extensive opportunities for establishing long-term international collaborations.

### **PhD Scholarship project 3: The Growth of Galaxy Clusters**

Galaxy clusters are the largest structures in the Universe, and they are still growing today. Unprecedented contemporary observational campaigns have shown that these systems are remarkably complex, with poorly understood internal dynamics, driven by multiple merging sub-structures, each of which interact with the cluster in a regime where plasma physics plays a critical role in shaping the outcome. The successful candidate will undertake idealised multi-merger simulations and translate them into multi-wavelength mock

observations to compare with real data. The idealised simulations will be supplemented with cluster mergers drawn from our unprecedented Horizon Run of the Universe, realised in a fully cosmological framework. This work will inform the observing strategies of the next-generation of international observatories.

#### **PhD Scholarship project 4: Dusty Interstellar Ices**

This project will focus on predicting vibrational signatures of carbon-rich molecules embedded in the ice surface of interstellar dust grains. This will shed light on the nature of the mysterious diffuse interstellar bands that have puzzled astronomers for nearly a century and help develop better chemical networks models. The structural complexity of amorphous ice requires high-performance computing to describe its disordered interaction network. Access to one of the country's most powerful supercomputers will allow the successful candidate to combine accurate quantum chemical methods with a periodic density functional theory, providing a unique way to compute interactions and vibrational signatures. New high-end data visualisation techniques will be developed with our industry partners.

#### **PhD Scholarship project 5: The Feeding Habits of Galaxies**

This studentship will exploit current surveys, such as the Sloan Digital Sky Survey, and future surveys, using instruments such as the TAIPAN project that aims to deliver the largest suite of observations of the Southern Sky to date. In conjunction with the Milne Centre's unprecedented Horizon Run simulation of the Universe, the studentship will address the question of how primordial galaxies in the early Universe assemble, and mature/evolve into the objects we observe today. We will use our collective expertise to conduct a systematic, wide-field sweep for low-mass disk galaxies to determine if low-mass disks cease star formation through environmental effects or if heating from central supermassive black holes dominates. This will answer the long-standing question of what causes bursty star formation histories in galaxies and be used as a test case for determining how galaxies are fuelling their growth.

#### **Entry requirements and application process**

Applicants should have at least a 2.1 undergraduate degree in Physics, Chemistry, Computational Science, or related discipline, together with relevant research experience. It is anticipated that the successful applicant will have a 1st class undergraduate degree or Masters level qualification. Interested applicants should contact Professor Brad Gibson ([brad.gibson@hull.ac.uk](mailto:brad.gibson@hull.ac.uk)) for additional details.

Full-time UK/EU PhD Scholarships will include fees at the 'home/EU' student rate and maintenance (£14,553 in 2017/18) for three years, depending on satisfactory progress.

Full-time International Fee PhD Studentships will include full fees at the International student rate for three years, dependent on satisfactory progress.

PhD students at the University of Hull follow modules for research and transferable skills development and gain a Masters level Certificate, or Diploma, in Research Training, in addition to their research degree.

**To apply for these Scholarships please visit this website, click on "Astrophysical Data Science", then on the particular project, and follow the guidelines:**

<http://www.hull.ac.uk/Study/PGR/PhD/PhD.aspx>

**Interviews will be held the final two weeks of February 2018; initial offers will be made by 5<sup>th</sup> March 2018, with decisions returned by 31<sup>st</sup> March 2018, in line with the UK's Science & Technology Facilities Council guidelines.**