Microphysics of cloud formation: the path to heterogeneous nucleation

Christiane Helling
School of Physics & Astronomy
U. of St Andrews, UK
E: ch80@st-andrews.ac.uk
W: http://leap2010.wp.st-andrews.ac.uk/

Leen Decin
Institute for Astronomy
KU Leuven, Belgium
E: leen.decin@kuleuven.be
W: www.ster.kuleuven.be

Project Description:

As result of formation and evolution processes, exoplanets can have hugely different properties, e.g. giant gas planets, rocky planets, mini-neptunes and possibly carbon-rich planets. The understanding of these objects is, to a large extent, hampered by clouds obscuring their atmospheres. Clouds play a key role for the atmospheric dynamics and chemistry, as they are important opacity sources and deplete the local gas phase (Helling 2019, Exoplanet Clouds, Annual Review of Earth and Planetary Sciences 47). In order to understand the myriad of observational data from present (HST, Spitzer) and future space missions (CHEOPS, JWST, Ariel, PLATO), a thorough understanding of the cloud formation processes is required. The process that kicks off the cloud (or dust particle) formation is the nucleation process by which gas-phase species grow to larger clusters which then grow into condensation seeds. This project aims to conduct theoretical work on the nucleation process that is equally applicable to modelling cloud formation in exoplanets and brown dwarfs, and to dust formation in AGB stars (Decin et al. 2017, A&A 608). We will combine computational chemistry calculation with physical cloud formation modelling (Helling & Fomins 2017, PhiTransA 371).

Innovative Training Network (ITN) - CHAMELEON

This project is part of the Marie Sklodowska-Curie Innovative Training Network (ITN) **CHAMELEON** "Virtual Laboratories for Exoplanets and Planet Forming Disks" (chameleon.wp.st-andrews.ac.uk). The ITN combines the expertise of eight European research institutes (Universities of St Andrews, Groningen, Copenhagen, Edinburgh, Leuven and Antwerp, the Max-Planck Institute in Heidelberg and the Netherlands Institute for Space Research) to cover all relevant aspects for this complex modelling task, joining the expertise in planetary atmospheres and protoplanetary disks, including observation and interpretation. The network will consist of 15 Early Stage Researchers (PhD students) and the respective supervisors/local research groups. For a complete list of all open PhD positions within this training network please visit http://chameleon.wp.st-andrews.ac.uk/recruitment/.

The Host Institutes

The School of Physics & Astronomy at the University of St Andrews is an active member of the St Andrews Centre for Exoplanet Science (https://www.st-andrews.ac.uk/exoplanets/) which leads an interdisciplinary agenda on exoplanet research. St Andrews is renown for exoplanet research ranging from exoplanet discovery and characterisation, atmosphere chemistry and thermo-chemical disk modelling, to the impact of the host star on the exoplanet system. The Institute of Astronomy of KU Leuven in Belgium is a vibrant research group of some 70 scientists, engineers, and administrative staff), including 6 full-time and 3 part-time

professors. The institute is an expertise centre in stellar physics and active in several international consortia and collaborations, involving telescopes at observatories worldwide and in space. The IoA is responsible for the organisation of the 2-year Master in Astronomy & Astrophysics at the Faculty of Science and operates the 1.2m Mercator telescope at La Palma Observatory, Canary Islands.

The positions

The selected PhD students will be offered a fully funded PhD place with a required training secondment for this position foreseen at the University of Leuven, with an additional short training at the University of Copenhagen. The funding will be commensurate to the standard scale for PhD students in according to the Marie-Curie funding rules. The successful PhD applicants will have to register at, and comply with, the regulations of the St Leonard's Postgraduate College at the University of St Andrews and the Arenberg Doctoral School of the KU Leuven. The successful PhD applicants will follow a doctoral programme including personal training in management, science communication, and teaching.

Requirements

We seek an excellent student with a strong background in physics or astrophysics. Successful candidates must hold a Masters degree or equivalent by the starting date of the position. Previous research experience on planet forming disks and/or astrochemistry, and a track record of team work/mobility will be important criteria for the selection. This is a computational project: some prior knowledge of coding would be useful (e.g., Python and Fortran). Note that the general eligibility and mobility rules of Marie Sklodowka-Curie Actions apply, i.e. applicants must not have resided or carried out their main activity (work, studies, etc.) in the country of the main host institution for more than 12 months in the 3 years immediately before the recruitment date. Please also consider to apply to the open positions of our European partner institutions (https://chameleon.wp.st-andrews.ac.uk/recruitment/).

Application documents

The application package should be sent as **one single PDF** containing

(i) a curriculum vitae, with a publication list if relevant;

(ii) a statement of interest (max. one page, including a brief description of research interests and relevant experience);

(iii) copies of university grades, certificates and/or diplomas;

(iv) two letters of reference to be sent by the application deadline;

(v) a statement that confirms that you understood the requirements of the joint degree and the Marie Sklodowska-Curie mobility criteria as outline on https://chameleon.wp.st-andrews.ac.uk/recruitment/.

Use the portal of the School of Physics & Astronomy in St Andrews University https://www.st-andrews.ac.uk/physics/prosp_pg/phd/index.php to upload your application documents.

Application deadline: 3 February 2020

The application process will continue until the position is filled.