**STFC funded PhD Project**

**Reference:** STFC-Alexander

**Supervisors:**

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**Project Title:**

The building blocks of planets

**Project Description**

In recent years there has been an explosion in our knowledge of exoplanets, but the avalanche of exciting new data has not yet been accompanied by a corresponding increase in our standing, and the origins of exoplanet systems remain shrouded in mystery. Planets form in cold discs of dust and gas around young, newly-formed stars. Solid particles ("dust") represent only a small fraction of the disc mass, but these particles are the initial building blocks of planetesimals and planets. The trace dust component also dominates the disc opacity, so most of our observations only "see" the dust rather than the gas. In this project the student will build new computational models of how dust and gas move in protoplanetary discs, and of how the dynamics of these planetary building blocks change in structures such as gaps and rings, and/or in the presence of planets. We will use a combination of 1-D, 2-D and 3-D calculations to study disc dynamics and evolution over a wide range of time-scales. We will then use radiative transfer modelling to generate synthetic observations, in order to test our models against new data from facilities such as ALMA and the ESO VLT. The overall aim of the project is to build up a detailed understanding the key physical processes that shape the appearance and evolution of planet-forming discs.

This project will be supervised on a day-to-day basis by Alexander and Rosotti, but there will be opportunities for collaboration with a number of additional colleagues. Our group works closely with observers using both the VLT and ALMA, and the student may also be able to take on a role in some of these collaborative projects.

The bulk of the project will consist theoretical and computational modelling of planet-forming discs, so some prior experience of computational or numerical work would be helpful. This is not a requirement, however, and we will provide ample training in these areas (including high-performance computing).

**References**

* "Gas and multispecies dust dynamics in viscous protoplanetary discs: the importance of the dust back-reaction." - <https://ui.adsabs.harvard.edu/abs/2018MNRAS.479.4187D/abstract>
* " Rings and gaps in the disc around Elias 24 revealed by ALMA " - <https://ui.adsabs.harvard.edu/abs/2018MNRAS.475.5296D/abstract>
* "Dust dynamics during protoplanetary disc clearing" - https://ui.adsabs.harvard.edu/abs/2007MNRAS.375..500A/abstract