Core accretion in debris disc

Since gas has recently been discovered in debris discs, the current model of planet formation and evolution doesn't take this late gas into account. However, planets have already been discovered in debris discs with significant amounts of gas (e.g. Beta Pic), and gas has been observed in discs older than 100 Myr, i.e. 10 times longer than in protoplanetary discs. The impact of this gas especially onto planetary atmospheres is not well known but can be very significant because the gas is regenerated for a very long time.

An analytical model (Kral et al, 2020) developed in this context suggests a very efficient accretion. However, this model can’t account for some physical aspects. We are therefore developing a more complex numerical model to quantify how the accretion proceeds over a wide range of the parameter space. Because of this long characteristic time, we use a one-dimensional thermal model based on the stellar structure equations instead of hydrodynamic codes to follow the atmospheric evolution of a planet during late gas accretion.

We will explain the basis of our model, which has had to be significantly updated in relation to the codes used in the protoplanetary disc community. For instance, there is a maximum accretion rate related to the gas generation rate in debris disc. We will expose how we can deal with such a constraint and how it changes the behaviour of the atmosphere during the simulation compared to the protoplanetary disc cases. The aim is to determine the influence of different parameters such as the core luminosity, the opacities of the gas or the initial conditions on the accretion rate and the atmospheric structure. We will present some preliminary results based on this new description of core accretion in debris discs and what it entails.