Evolution of dust properties inside molecular clouds from coreshine modelling

Charlène Lefèvre (Observatoire de Paris), Laurent Pagani (Observatoire de Paris & CNRS), Mika Juvela (University of Helsinki), Roberta Paladini (IPAC)

The coreshine phenomenon has revealed the presence of grains up to 1 µm in size by emission in the mid-infrared (MIR) wavelengths. Nevertheless, only detailed 3D radiative transfer modelling combining several wavelengths is able to give an access to the composition of the grains, to their shape (compact or porous) and to the spatial evolution of dust population inside clouds. In a first approach, using a simple cloud model, we have investigated the main key parameters to play with in order to reproduce the general trends of the observations.
The ratio of grain scattering efficiency compared to grain absorption efficiency, $R(a,\lambda) = Qsca(a,\lambda)/Qabs(a,\lambda)$, is strongly dependent both on the wavelength, the grain type (silicates, amorphous carbon, etc.) and the grain size (Fig. 1a). We will show, thanks to this quantity, that bare grains are not able to reproduce coreshine observations even if increasing the maximum size reachable. Ice mantles, coagulation and porosity could be part of the answer to increase the scattering efficiency.
The comparison of the intensity of the coreshine signal between Spitzer IRAC1 (I1) and IRAC2 (I2) bands provides us with an additional constraint on how the slope between R(a,4.5µm) and R(a,3.6µm) has to vary. Moreover, investigating other ratios at shorter wavelengths will reinforce the constraints in different parts of the cloud because near-infrared emission takes place in more external parts than MIR emission.
By merging all the available coreshine observations, we have found that the ratio of the 4.5µm to 3.6µm IRAC band coreshine intensities is varying between 20 and 80% (Fig. 1b), with the highest values for cores which contain a buried object. This result is suspected to trace in particular the evolution of the grains and also the influence of the reddened radiation of the protostellar objects.

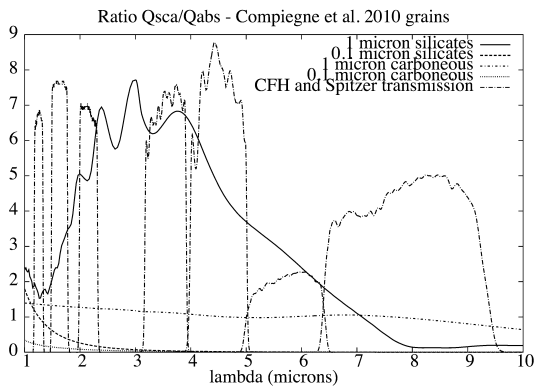

Figure 1a

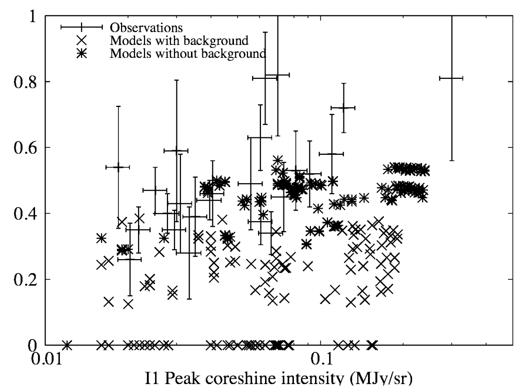

Figure 1b

Fig 1 : a) Ratio of the scattering and absorption efficiencies for 2 types of grains and 2 different sizes b) Observations compared to models with bare grains (I1 = IRAC1 = 3.6µm, I2 = IRAC2 = 4.5µm)