

Dust properties inside molecular clouds from coreshine modeling and observations.

C. Lefèvre¹, L. Pagani¹ et M. Juvela²

¹ *LERMA & UMR8112 du CNRS, Observatoire de Paris, 61, Av. de l'Observatoire,
75014 Paris - France*

² *Department of Physics, P.O.Box 64, FI-00014, University of Helsinki, Finland*

Using observations to deduce dust properties, grain size distribution, and physical conditions in molecular clouds is a highly degenerate problem. The coreshine phenomenon, a scattering process at 3.6 and 4.5 μm that dominates absorption, has revealed its ability to explore the densest parts of clouds [1, 2]. We want to use this effect to constrain the dust parameters and investigate to what extent grain growth (at constant dust mass) inside molecular clouds is able to explain the coreshine observations (~ 100 sources). We aim to find dust models that can explain a sample of Spitzer coreshine data but we also look at the consistency with near-infrared data we obtained for a few clouds. We built a grid of dust models and investigated the key parameters to reproduce the general trend of surface brightnesses and colors of both coreshine and near-infrared observations with the help of a 3D Monte-Carlo radiative transfer code [3]. The grid investigates the effect of coagulation upon spherical grains up to 5 μm in size derived from the DustEm diffuse interstellar medium grains [4]. Fractal dimension, porosity, ices, and a handful of classical grain distributions were also tested. We used the near- and mostly mid-infrared colors as strong discriminants between dust models.

For starless cores, where detected, the observed 4.5 μm /3.6 μm coreshine intensity ratio is always lower than ~ 0.5 which is also what we find in the models. Embedded sources can lead to higher fluxes (up to four times greater than the strongest starless core fluxes) and higher coreshine ratios (from 0.5 to 1.1). This ratio enhancement is readily explained by the reddening of the sources, especially with Class 0 and 0/I objects, that changes the local balance of the radiation field at the mid-infrared wavelengths. Normal interstellar radiation field conditions are sufficient to find suitable grain models at all wavelengths for starless cores. The standard interstellar grains are not able to reproduce observations and, due to the multi-wavelength approach, only a few grain types meet the criteria set by the data. Porosity does not affect colors while fractal dimension helps to explain mid-infrared colors but does not seem to reproduce near-infrared observations without a mix of other grain types.

We will present the potential of combined near- and mid-infrared wavelengths to reveal the nature and size distribution of dust grains. Careful assessment of the environmental parameters (global interstellar and background fields, embedded or nearby reddened sources) is required to validate this new diagnostic and will be discussed.

Références

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