Constraining the dust grain size distribution in molecular cores using coreshine and grainshine

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Context: Scattering from dust in molecular cores has been observed in both the near-infrared (Foster & Goodman 2006, ApJ, 636, 105) where it is known as **cloudshine** and in the mid-infrared (Pagani et al. 2010, Science, 329, 1622) where it is known as **coreshine**. Here we show the possibilities to place size limits on the grain size distribution within the molecular core by simultaneously Utilizing the near-infrared and mid-infrared wavelength by using Lynds 260-SMM2 as an example.

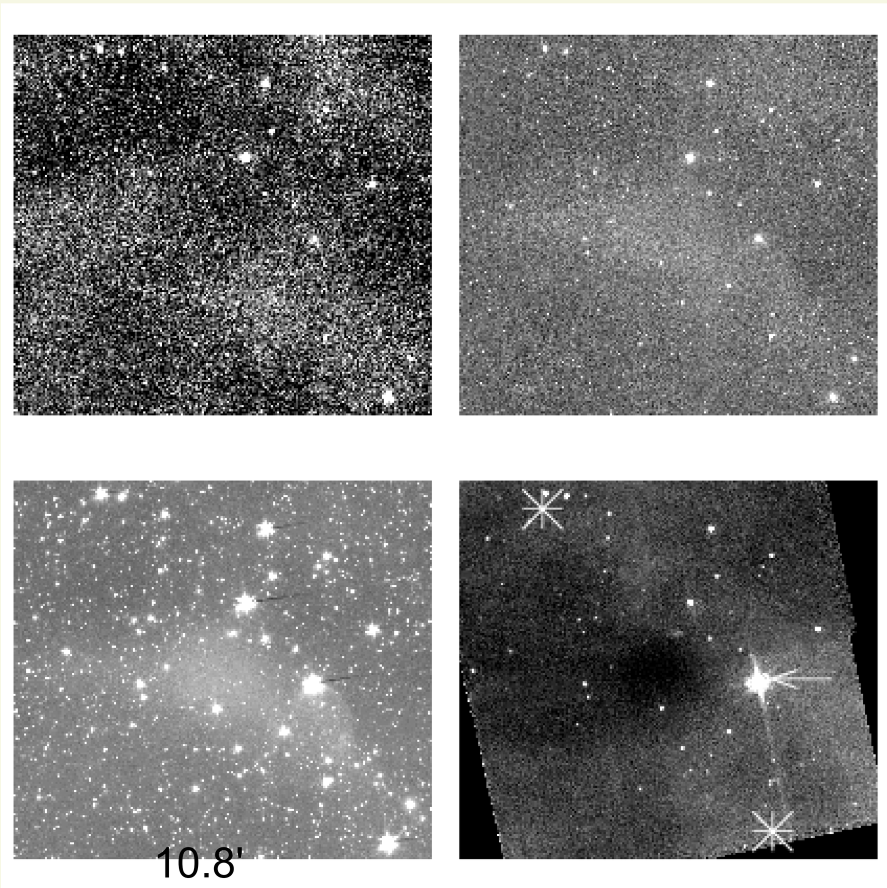

Figure 1: Top: Js and Ks VISTA VST images of Lynds 260-SMM2. Bottom: Spitzer 3.6 and 8 micron images of the core. The field of view is 10.8' x 9.8'. North is up and east is to the left. The white stars in the lower right panel indicate the start and end location for the cuts in Fig. 2.

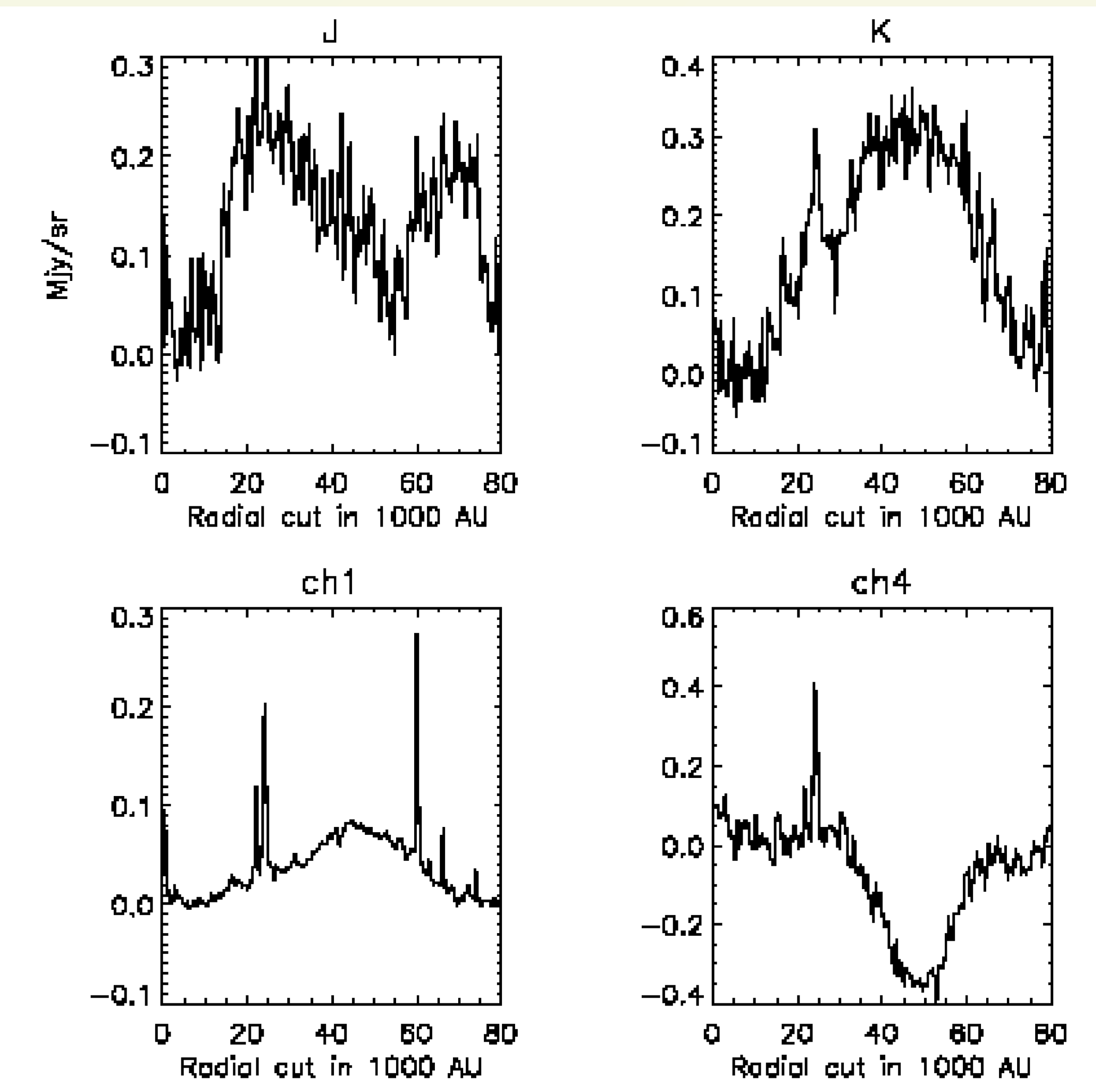

Figure 2: Top: Background subtracted cuts through the Js and Ks VISTA VST images at constant Galactic Latitude Bottom: Background subtracted cuts through the 3.6 (ch1) and 8 micron (ch4) images along the same line through the core. The 8 micron cut trace the dust column density through the core and the 3.6 micron emission follows closely. The sharp peaks are due to stars in the image

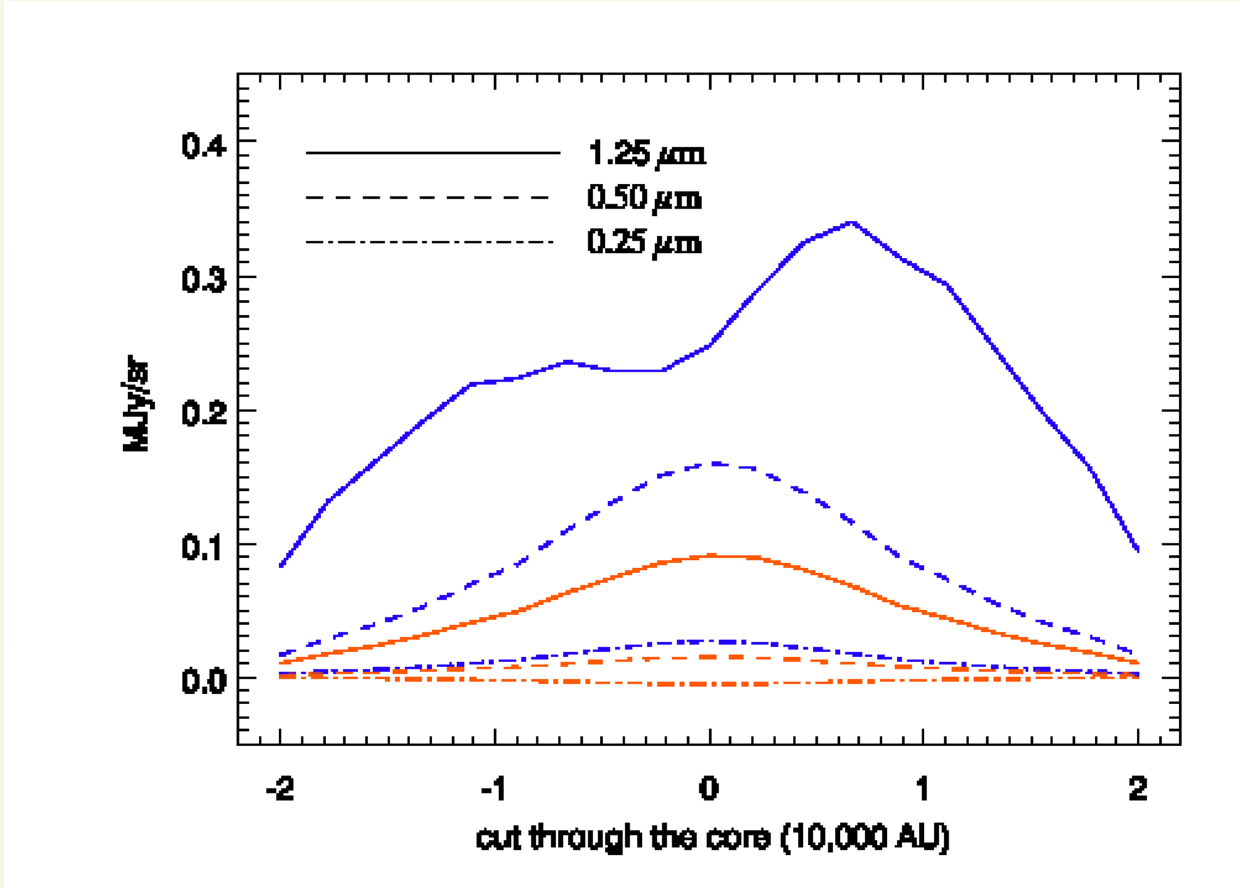

Figure 3: Results from a radiative transfer calculation of a spherical core similar to Lynds 260-smm2 with the best fitting parameters as provided below but with three different maximum grain sizes for an MRN type distribution. Blue lines are the K band surface brightness profiles, red lines are the 3.6 micron surface brightness profiles. Grains of some 0.5 micron are necessary to provide emission in the Ks band whereas even larger grains are necessary for the 3.6 micron emission. Note that for large grains the shape of the Ks band emission turns asymmetric due to optical depth effects which is a constraint on the largest grains.

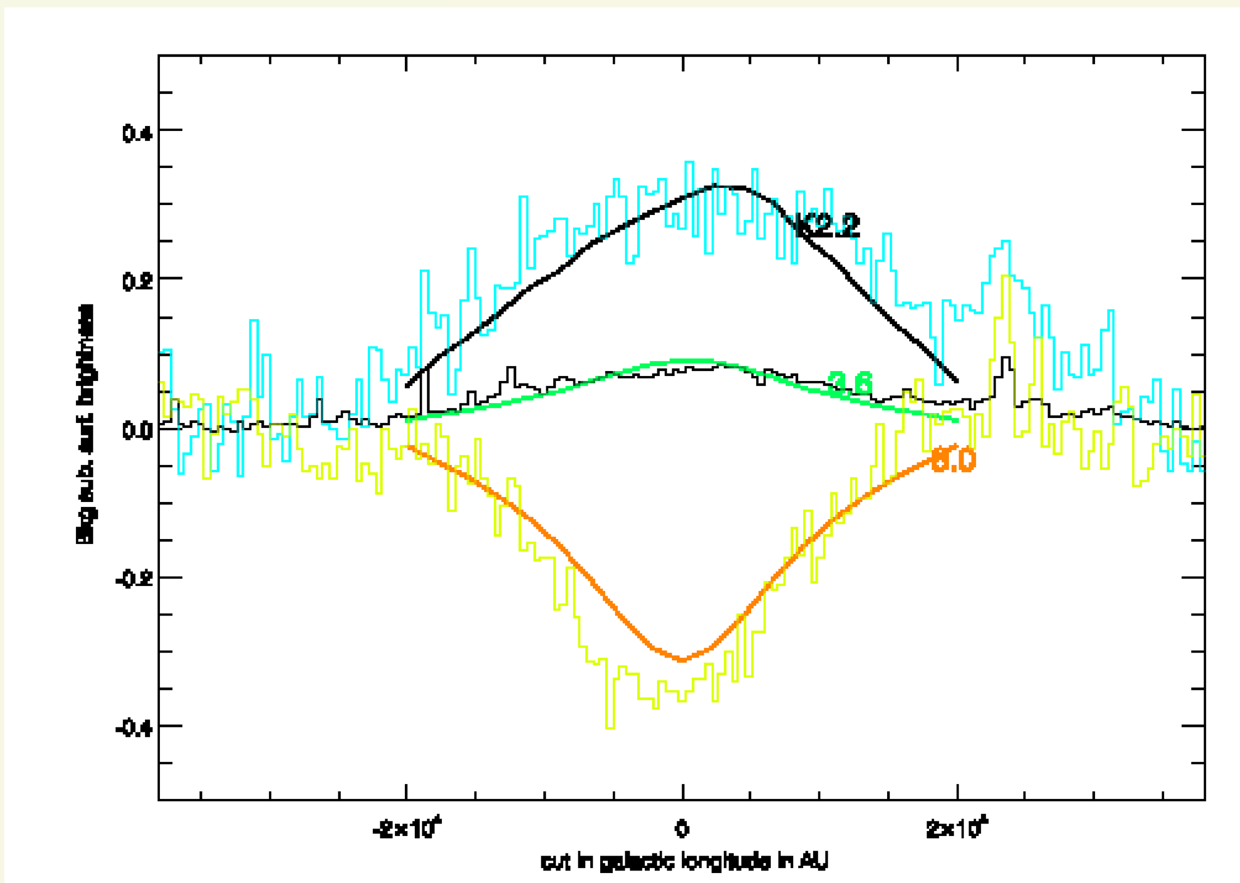

Figure 4: The best fit for Lynds 260-smm2. A local enhancement of the radiation field compared to the interstellar radiation field of 1.8 was adopted. The largest grains for the MRN-like distribution where a_min=0.005 micron, a_max=0.9 micron, a slope of -3.5, and 99% ice covered silicates were assumed. A core mass of 3 Msun was adopted with a central flattening out to a radius of 6500 AU with a powerlaw drop outside this radius to 20000 AU in agreement with the column density estimated from CO isotopes and the shape of the 8 micron absorption feature, As shown in Fig. 3 the large grains are necessary to reproduce the emission at 3.6 micron whereas the close to symmetry of the K band surface brightness profile suggests and upper limit to the grain size of 0.9 micron.

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