Reconstructing the density and temperature structure from Herschel data

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Abstract:

The projected surface brightness that we observe is the integral emission from dust at various temperature along the line of sight. This fact not only poses a difficulty in recovering density and temperature profiles of the astrophysical objects but also responsible for inaccurate determination of mass and global temperature for self-gravitating cores. An accurate mass derivation is important for studying the origin of core mass function.

We have used a new technique that is based on Abel's integral transform to reconstruct the intrinsic density and dust temperature profiles of the self-gravitating cores, disentangling the effect of temperature variations along the LOSs directly from the Herschel dust emission data alone, without any

assumption of underlying radiative transfer model. This method is very general and insensitive to background subtraction, but rely on quasi-spherical symmetry of the source.
As a case study, this technique has been applied to B68 and L1689B emission data acquired as a part of the Herschel Gould Belt Survey key-project. The reconstructed dust temperature profiles obtained for B68 and L1689B have a characteristic central dip; a flat central part; and a positive temperature gradient beyond the centrally flat region until it merges with the background dust temperature. Comparison of column density profile for B68 with the existing extinction observations provides a scope for assessing uncertainty on the adopted dust opacity assumptions.
Comparison of masses obtained by integrating volume density profiles with the masses obtained by fitting a single-temperature SED to flux densities suggests that the latter underestimates mass by about 15%. The departure is bigger for the cores with higher average column density because of stronger LOS temperature variations.