Mapping the column density and dust temperature structure of IRDCs with *Herschel*

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Abstract

Infrared Dark Clouds (IRDCs) are believed to represent the earliest stages of star formation in the Galaxy. Using the Hi-GAL Science Demonstration (SDP) data we are able to construct the column density and dust temperature maps for 22 IRDCs. We find that dust temperature is not uniform, varying typically from 20 to 10 K from edge to centre, bearing strong consequences for cloud fragmentation. We are also able to identify few cold, high H_2 column density peaks, some of which are already forming massive proto-stars/clusters, while the others remain apparently starless. These preliminary results suggest that within the full Hi-GAL dataset we should be able to identify few hundreds of massive prestellar core candidates (Peretto, Fuller, Plume, et al. 2010).

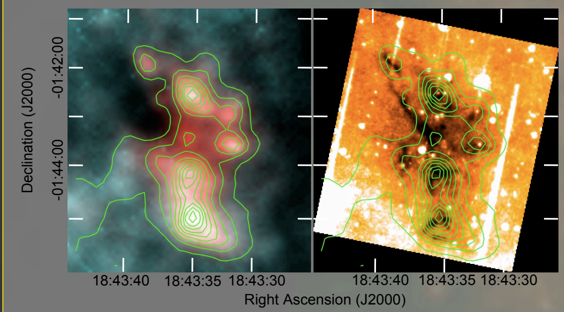

Figure 1: *(left)* Herschel 2 colour image (160 µm- blue and 250 µm-red) of one of the 22 IRDCs. *(right)* Same IRDC seen with Spitzer at 8µm. On both images are overlaid the Herschel 250 µm contours

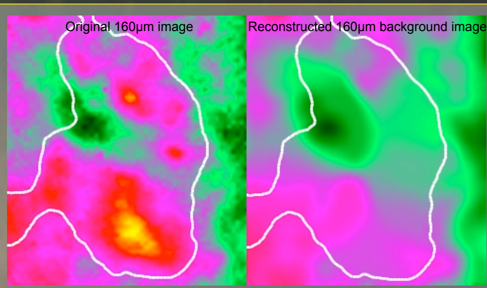

Figure 2: 160µm original *(left)* and background reconstructed *(right)* images. The white contour marks the IRDC limit, as defined from the 500µm data

1-Data & IRDC sample: Hi-GAL SDP data (Molinari et al. 2010) consists in two 2˚x2˚ tiles centered on l=30˚,59˚ b=0˚. For each tile 5 bands (70/160/250/350/500µm) have been observed in parallel. For this study we selected 22 IRDCs (Fig.1) from the Spitzer IRDC catalogue of Peretto & Fuller (2009). These clouds are large enough to be resolved at 500µm (36") with Herschel.

2-IRDC background: The main goal is to perform a pixel by pixel SED fitting in order to construct the IRDC column density and dust temperature maps. For this we need to reconstruct the background emission behind each IRDC. To do this, we used a nearest neighbor interpolation method (Fig.2).

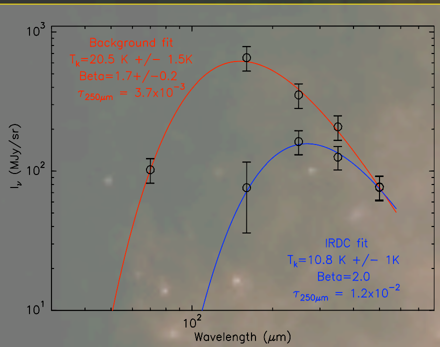

Figure 3: Pixel SED fit example. The red solid line shows the background fit while the blue solid line shows the fit towards the IRDC. The fit parameters are shown too.

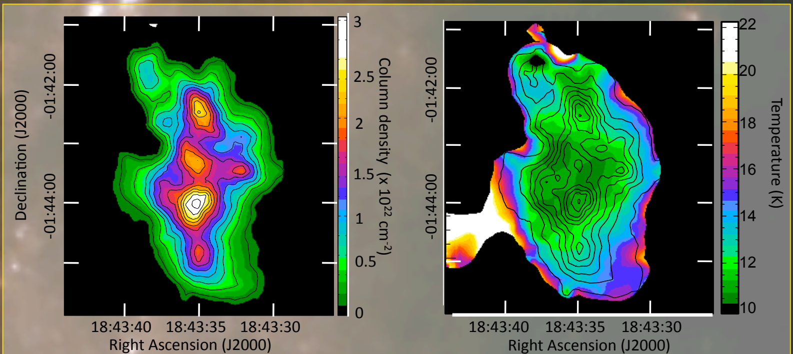

Figure 4: *(left)* Column density map (colour and contours) of the IRDC shown in Fig.1. *(right)* Dust temperature map (colour) of the same IRDC overlaid with the column density contours

3-Pixel SED fitting & temperature/column density maps : Once we know the background contribution at each wavelength we can fit the SED of the IRDC itself for each pixel (Fig.3). Then from the best fit parameters and assuming some specific dust opacity, we can construct the column density and dust temperature maps as shown in Fig.4.

4-Statistics from a small sample of IRDCs: Applied to the sample of 22 IRDCs this method allowed us to show that IRDCs are not isothermal structures (Figs.4&5), in contrast with the initial conditions of most hydrodynamical simulations (e.g. Krumholz et al. 2010). We also confirm that while on average IRDCs have rather low column densities, few peaks are high enough to form massive stars (Fig.5). Within the full Hi-GAL dataset, we expect to find few hundreds of massive prestellar core candidates.

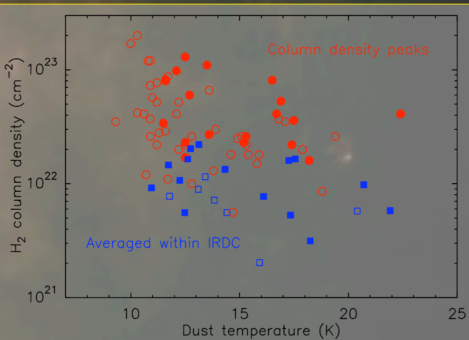

Figure 5: Dust temperature vs Column density averaged over the IRDCs (blue) and for colum density peaks (red). The filled symbols correspond to star forming peaks.

References: Krumholz, Cunningham, Klein, McKee, 2010, ApJ, 713,1120
Molinari, Swinyard, Bally, et al., 2010, A&A, in press
Peretto & Fuller, 2009, A&A, 405, 505
Peretto, Fuller, Plume et al., 2010,A&A, in press