Core Masses in Orion
Initial results from SCUBA2

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Abstract

We show submillimetre data of the Orion B molecular cloud taken with the SCUBA2 camera on the JCMT during the shared-risk observing campaign under the auspices of the JCMT Gould Belt Legacy Survey (Ward-Thompson et al., 2007). The data cover almost two square degrees, and have a 1σ sensitivity of 20 mJy/beam. We identify 217 cores in the cloud. Of these, 40 are known to contain protostars. We plot a Core Mass Function (CMF) and a mass-size relation of the 177 remaining cores. We find that the CMF is consistent with earlier work, in that it broadly matches the IMF, but peaks at a higher mass. The mass-size relation is seen to extend previous work.

Observations

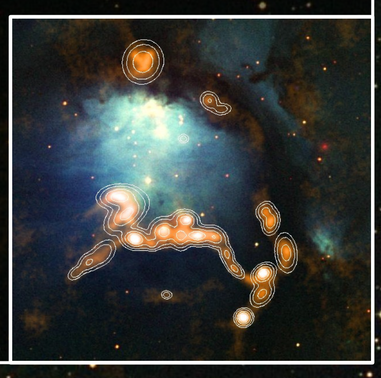
Submillimetre observations of Orion B were made at 450 and 850μm using SCUBA2 on the JCMT as part of the Shared Risks Observing (SRO) campaign in February 2010. Eight hours of data were acquired covering an area of almost two square degrees, across two fields which we label Orion B North & South. These data are shown in orange overlaid onto the DSS2 optical data, in Figs 3 & 4 respectively.

The data can be compared with earlier submillimetre maps of the same regions, observed with SCUBA (Nutter et al., 2007). The average depth of the old and new data is comparable, though the sensitivity across the maps is more uniform in the new data. This was achieved in spite of the new maps being a factor of three larger, and taking only 16% of the time. In addition, during SRO, only one of the four sub-arrays was available at each wavelength.

Source Extraction

Sources were extracted from the data using the Fellwalker algorithm (Berry et al., 2009), selecting all sources with a peak flux density greater than 5σ. The mass of each core was calculated assuming a distance of 450 pc, and a temperature of 20 K.

A Gaussian was fitted to each core after masking the neighbouring cores. A composite of the fitted Gaussians from a portion of Orion B North is shown in the inset. The average FWHM was determined for each core, and is shown in Fig. 2 where the mass of each core is compared to its radius.



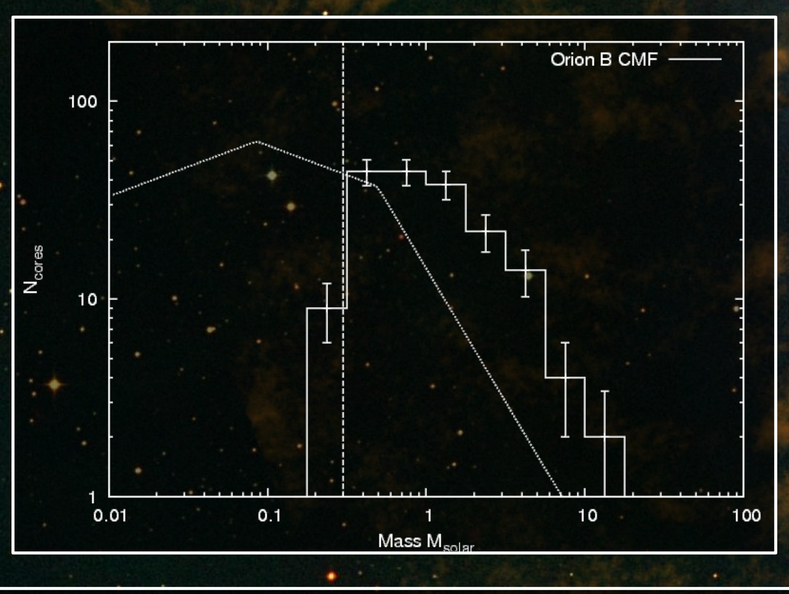


Fig. 1. The Core Mass Function (CMF) of the cores identified in Orion B. The cores harbouring embedded protostars, as identified by Spitzer, have been removed from the sample. The completeness limit of the data is shown as a vertical dashed line. A three-part power-law IMF is shown for comparison (Kroupa 2002, Chabrier 2003). The CMF is seen to be similar to the IMF down to the completeness limit.

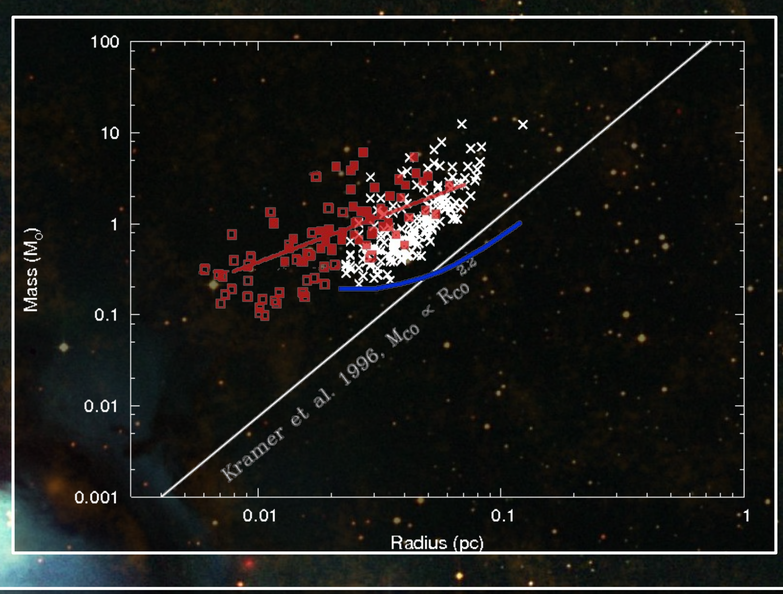


Fig 2. The mass-size relation of the cores in Orion B shown as white crosses. The cores containing protostars have been removed from the sample. The blue line shows the completeness limit of the data. The red squares show prestellar cores from Orion B (filled), and Ophiuchus (open) taken from Motte et al. (2001). The white line shows the mass-size relationship for CO clumps. The new data appear to follow the distribution seen in the earlier work.

Fig. 3. Orion B North submm data (orange), overlaid on the DSS2 optical data.

Conclusions

We have identified nearly 200 starless cores in the Orion B molecular cloud using SCUBA-2 on the JCMT. Sources were identified using the fellwalker algorithm and fitted with Gaussians. The CMF of these cores is consistent with earlier work, and is similar to the stellar IMF with a shift to higher mass. The mass-size relation of these cores follows that of earlier work.

References

Berry D., Starlink User Note, 255.1
Chabrier G., 2003, PASP, 115, 763
Kroupa P., 2002, Science, 295, 82
Motte F. et al., 2001, A&A, 372, 141
Nutter D. et al., 2007, MNRAS, 374, 1413
Ward-Thompson D. et al., PASP, 119, 855

Acknowledgments

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Fig. 4. Orion B South submm data (orange), overlaid on the DSS2 optical data.