Comparing the hot and cold gas structure of OMC1

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OMC1 is the type-site for a massive protostellar region. Using observations from the CFHT, SMA and (soon) IRAM we are making a study of the hot and cold gas components in OMC1, combining the IR and radio data to probe the outflow region in the core of OMC1. In earlier work we have described the structure of the hot gas component in great detail (Nissen et al. 2007, Gustafsson et al. 2006). This was done using the H_2 v=1–0 S(1) line, showing the structure of hot (> 1500 K), recently shocked gas. Using observations of the J=2–1 transistion of ^{12}CO, ^{13}CO and $C^{18}O$ we are performing a similar study of the cold gas structure. Comparing the two studies, we look for differences and similarities in the spatial and velocity structure of the hot and cold gas components. In this poster we present some preliminary results of this work.
This project also serves as a path-finding project for the kind of work that can be done in the future when next generation telescopes like ALMA, eVLT and Herschel comes online and provides high resolution images at wavelengths from the infrared to the radio.

Infrared observations:
In Nissen et al. (2007) we identified a large number of features showing two closely situated maxima (within ~1" or less), one a localized maximum in brightness and the other a similarly localized maximum in radial velocity. These features appears to be shocks moving through the gas.

Figure 1 shows the spatial relation between the features. In Region B (see Fig. 1) all features are blue-shifted suggesting that we are seeing bulk motion rather than individual features.

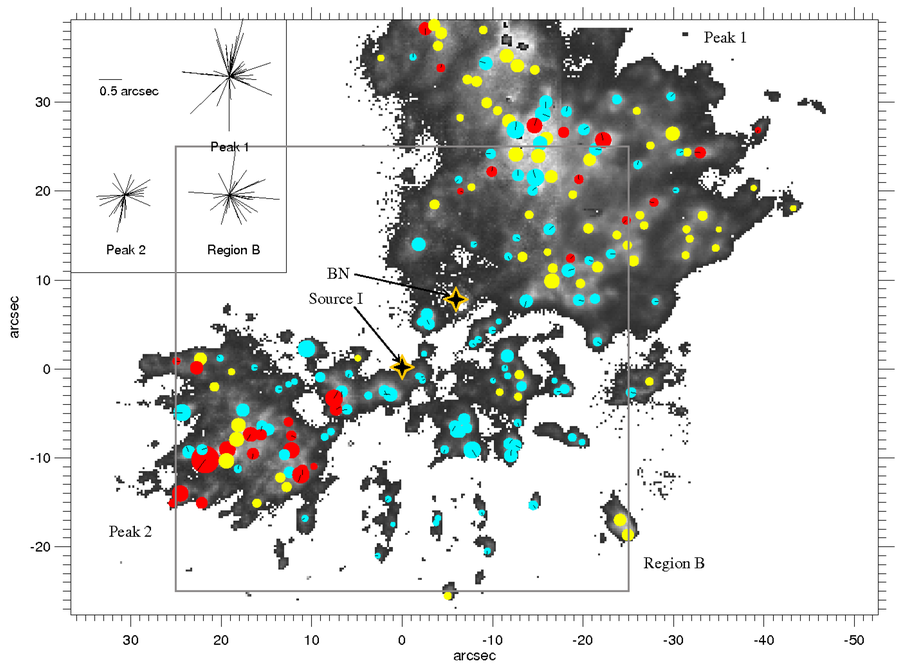

Fig. 1 H_2 v=1–0 S(1) emission at 2.121 μm (gray-scale). *Circles:* The centre marks the position of maximum brightness of a feature. Radius scales with the maximum brightness, a black line shows the position angle (where determined) and colour shows whether a flow is red-shifted (red), blue-shifted (blue) or with no cleaer radial velocity feature (yellow). *Inset:* The star diagrams show all position angles in a given region. The length of the lines corresponds to the displacement between maximum brightness and maximum velocity in a given feature. The grey square shows the region observed with the SMA.

Radio observations:
Currently we are repeating this detailed study of OMC1, but using a set of 230 GHz radio data obtained by Beuther et al. (2006) with the SMA.
These data have a spatial resolution of ~4" and a high signal-to-noise ratio. Maps of the ^{13}CO and $C^{18}O$ lines are shown in Fig. 2. Spectra are shown in Fig. 3.

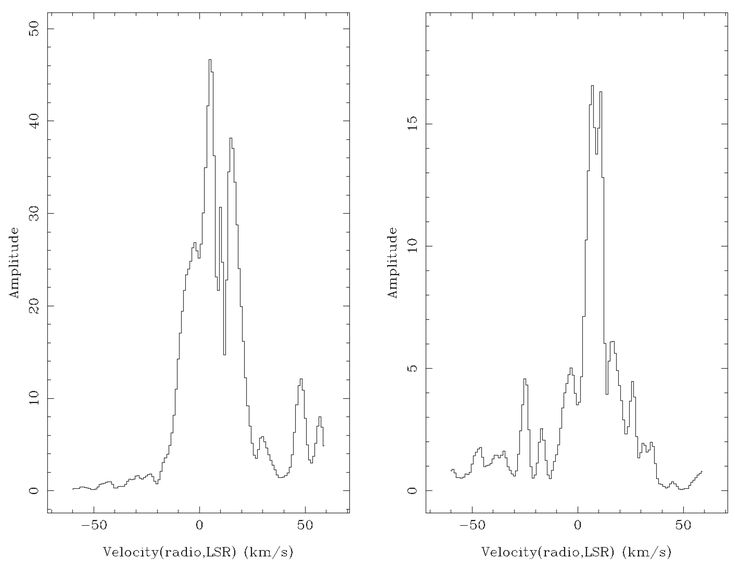

Fig. 3 *Left:* ^{13}CO, *Right:* $C^{18}O$

Preliminary results:
We can identify features in the radio data in the inner parts of region B corresponding to the larger extent of H_2 emission here (the smaller features are not seen, either they are lost due to the lower resolution or they are not prominent in the colder gas probed by the CO lines). The general orientation of the outflow in a NE-SW direction also seems to be confirmed.

The major discrepancy is that the radio emission in Region B is predominantly red-shifted which is opposite of what we found from the H_2 data.

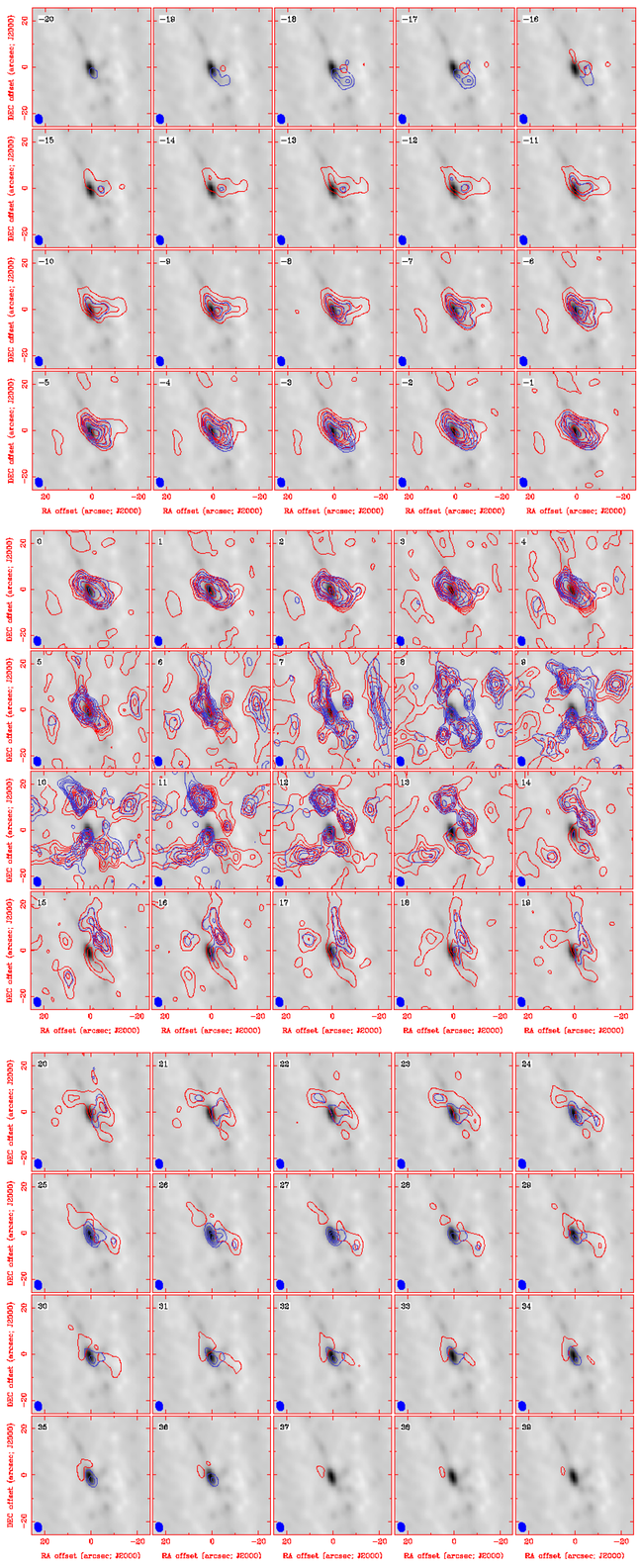

Fig. 2 Maps of the ^{13}CO (red) and $C^{18}O$ (blue) contours. The maps are centered on source I. The grey-scale map shows a continuum image of the region.
^{13}CO contours are 1, 3, 5, 7, 9, 13, 17, 21, 25, 29 Jy/beam,
$C^{18}O$ contours are 0.5, 1, 1.5, 2, 3, 4, 6, 8, 10 Jy/beam

Future work:
Imaging of more lines – 4 GHz of bandwidth are available in the SMA data, and this will allow us to probe different densities in the gas.

Time on the IRAM 30m telescope to obtain short-spacings has already been granted for the ^{13}CO and $C^{18}O$ lines.

Applications for more extended configurations on the SMA to increase the resolution – we know from the infrared data that many details only becomes visible at resolution of <2".

And ultimately: Find out what is powering OMC1

Acknowledgements:
We would like to thank Henrik Beuther for providing the SMA data used in this work and for his help in introducing us to the field of sub-mm observations.

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Beuther et al. 2006, ApJ, **636**, 323 Gustafsson et al. 2006, A&A, **445**, 601 Nissen et al. 2007, A&A, **466**, 949