The protostar OMC-2 FIR 4

Results from the CHESS *Herschel*/HIFI spectral survey

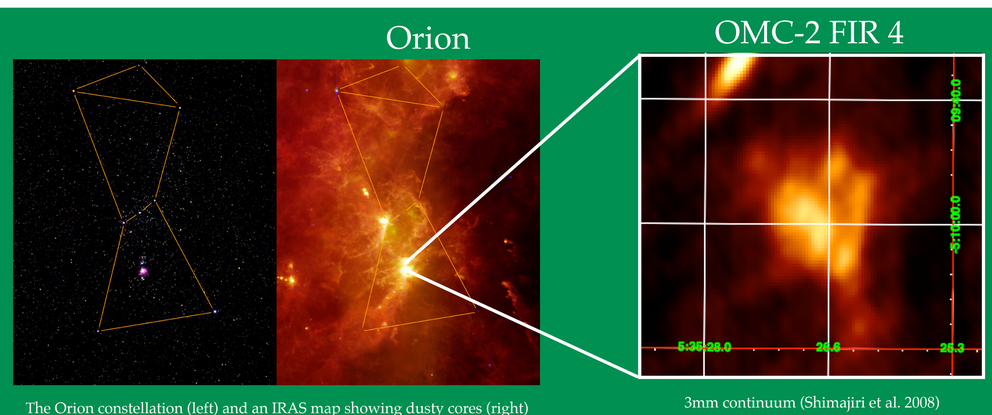
Mihkel Kama*[,1], A.López-Sepulcre[2], C.Ceccarelli[2], C.Dominik[3], E.Caux[4], A.Fuente[5] *et al.*

In Brief

OMC-2 FIR 4 is an intermediate-mass (~30M_o) protostellar core in Orion. We present an analysis of its *Herschel*/HIFI sub-mm spectrum, obtained within the CHESS[1] key program targeting a sample of protostars.

Conclusions[2]

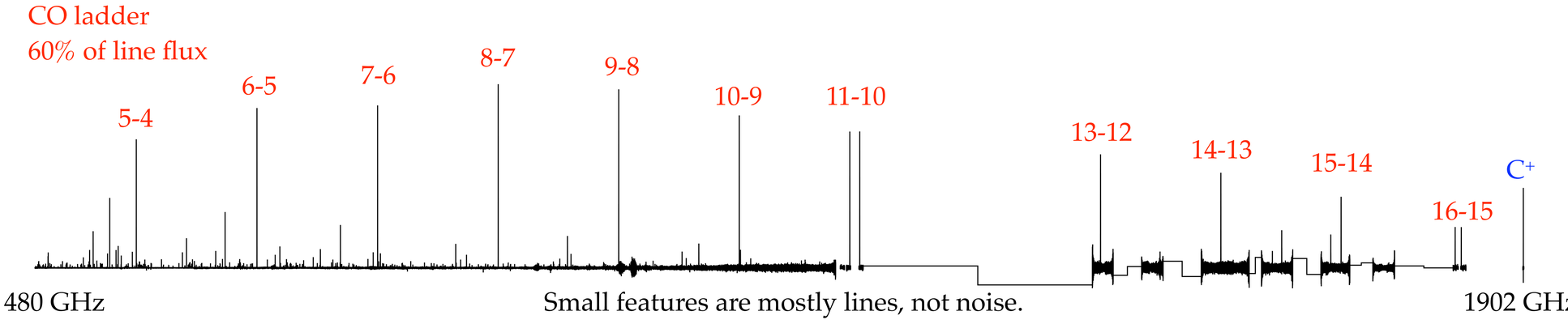
We detect 719 lines from 40 species in OMC-2 FIR 4. Many lines from warm, dense gas. New components: an outflow and a foreground cloud. Line flux is 2% of total cooling between 480 and 1901 GHz, CO dominates.



The Orion constellation (left) and an IRAS map showing dusty cores (right)

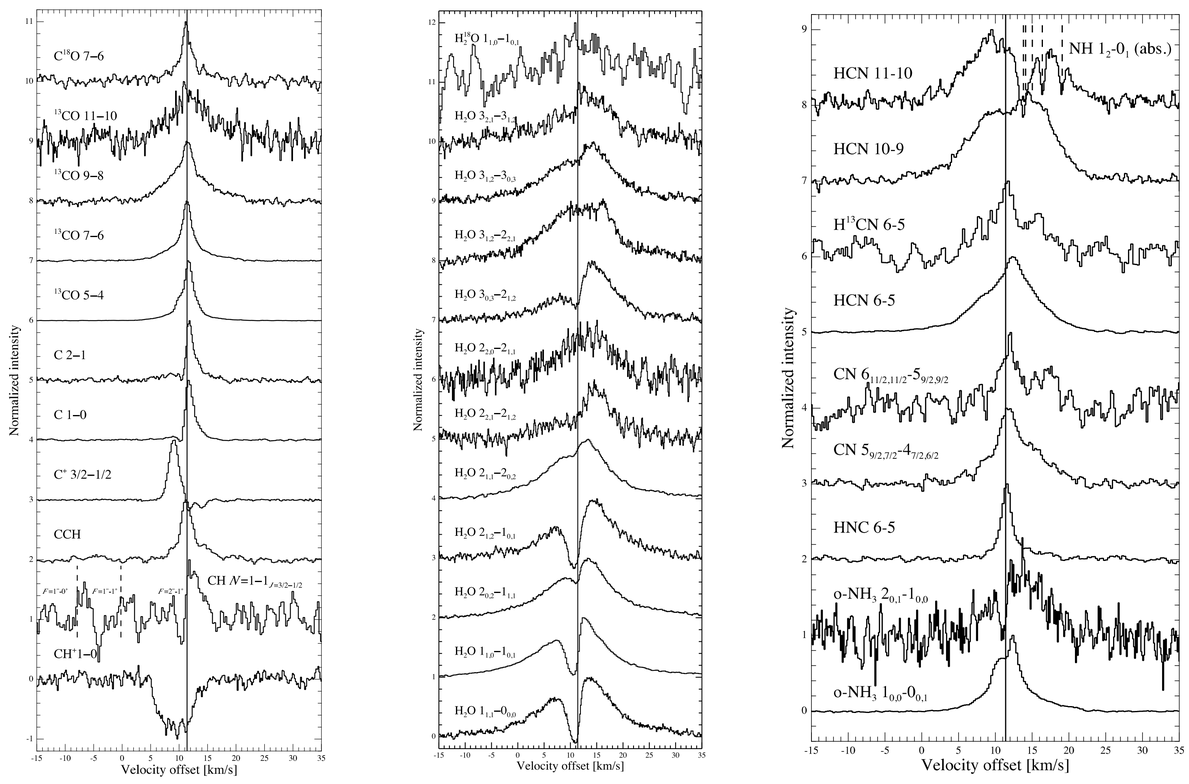
3mm continuum (Shimajiri et al. 2008)

For more on the small-scale clumpy structure of FIR 4, see poster 1G016 by López-Sepulcre et al.



Detected species:

- CO, ^{13}CO, $C^{18}O$, $C^{17}O$
- H_2O, $H_2{}^{18}O$, OH, OH^+, H_2O^+
- CH_3OH, H_2CO, HCO^+, $H^{13}CO^+$, N_2H^+
- Carbon: C, C^+, CH, CH^+, CCH
- Nitrogen: HCN, $H^{13}CN$, HNC, CN, NH, NH_3, $^{15}NH_3$
- Sulphur: CS, $C^{34}S$, H_2S, SO, SO_2, SH^+
- Deuterium: HDO, DCN, ND, NH_2D
- Chlorine: HCl, $H^{37}Cl$, H_2Cl+, $H_2{}^{37}Cl+$
- Fluorine: HF



Overview of the survey results

In a HIFI spectrum from 480 to 1901 GHz, shown above, we detect 719 lines from 40 species, with upper level energies (E_u) from 24 to 752 K. Many transitions with high critical densities ($n_{crit} > 10^8$ cm^{-3}). A diversity of line profiles.

Examples of line profiles are given at left. 60% of the lines are from CH_3OH, the most complex molecule detected in our data.

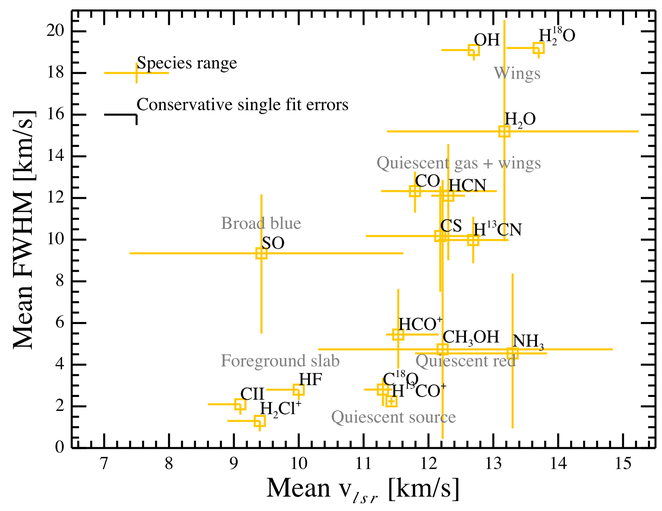
Kama et al. (2013)[2]

Complementary spectral surveys with JCMT and IRAM 30m.

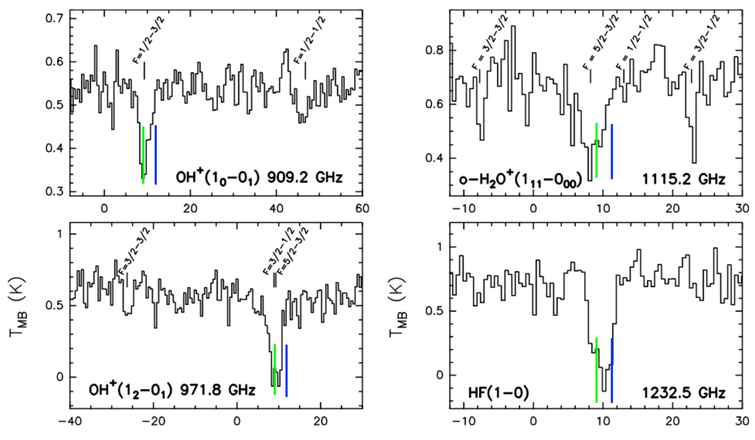
Kinematics

The mean v_{lsr} and *FWHM* of the species align in groups tracing different components. New findings include a compact outflow (species at top right) and an absorbing foreground cloud (species at bottom left, see also one panel down).

Kama et al. (2013)[2]



New foreground PDR



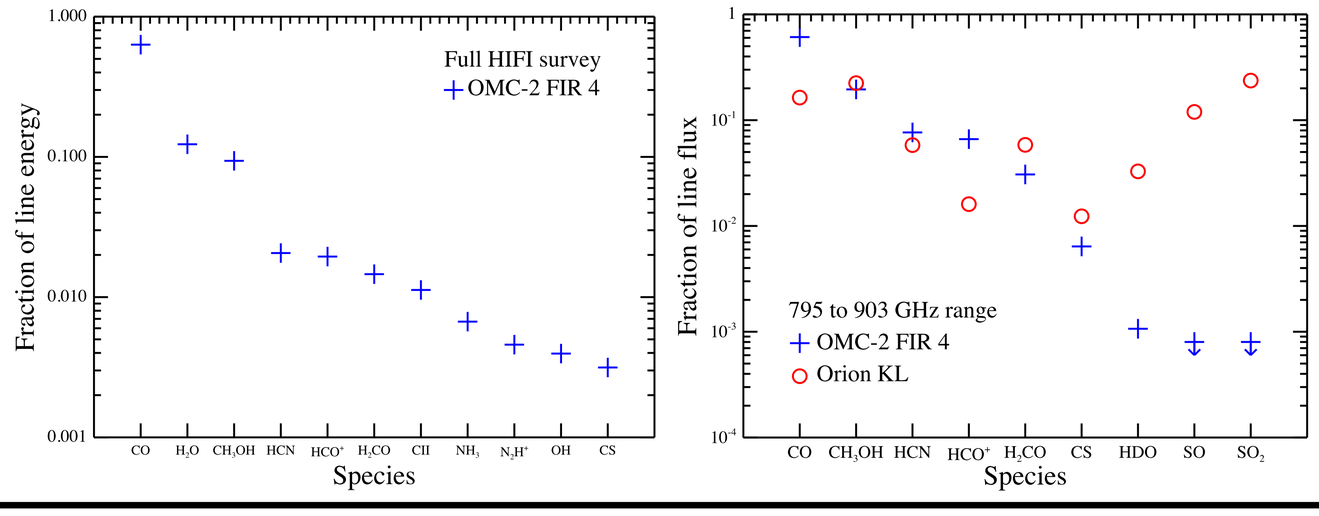
PDR tracers such as OH+, H_2O+ and HF are blueshifted by 2 km s^{-1} with respect to OMC-2 FIR 4. We find n_H=100 cm^{-3} and an UV field with G_0=1500 for this new PDR. We propose it is a tenuous foreground cloud within a few pc of OMC-2.

López-Sepulcre et al. (2013a)[3]

Line cooling

From 480 to 1901 GHz, lines carry 2% of all flux. Of this, CO lines carry 60%, H_2O lines 12% and CH_3OH lines 9%. The contribution SO to the line flux is below that typical for CHESS sources, and a factor 100 below Orion KL.

Kama et al. (2013)[2]; Ceccarelli et al. (2010) [1]



* Mihkel Kama
Leiden Observatory, Leiden University
mkama@strw.leidenuniv.nl

References
[1] Ceccarelli, C., et al., Astronomy & Astrophysics, v.521, id.L22, 8 pp.
[2] Kama, M., et al., Astronomy & Astrophysics, in press.
[3] Lopez-Sepulcre, A., et al., Astronomy & Astrophysics, v.594, id.A114, 9 pp.

Affiliations
1 - Leiden Observatory, Leiden, the Netherlands
2 - Institut de Planétologie et d'Astrophysique de Grenoble, Grenoble, France
3 - API, University of Amsterdam, the Netherlands
4 - CNRS/IRAP/Université de Toulouse, Toulouse, France
5 - Observatorio Astronómico Nacional, Alcalá de Henares, Madrid, Spain

Netherlands Organisation for Scientific Research