J/A+A/651/A36 Probing the ISF in Orion A with ArTeMiS (Schuller+, 2021)

Probing the structure of a massive filament:
ArTeMiS 350 and 450 um mapping of the integral-shaped filament in Orion A.
Schuller F., Andre P., Shimajiri Y., Zavagno A., Peretto N., Arzoumanian D., Csengeri T., Koenyves V., Palmeirim P., Pezzuto S., Rigby A., Roussel H., Ajeddig H., Dumaye L., Gallais P., Le Pennec J., Martignac J., Mattern M., Reveret V., Rodriguez L., Talvard M.
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Abstract:
The Orion molecular cloud is the closest region of high-mass star formation. It is an ideal target for investigating the detailed structure of massive star-forming filaments at high resolution and the relevance of the filament paradigm for the earliest stages of intermediate- to high-mass star formation. Within the Orion A molecular cloud, the integral-shaped filament (ISF) is a prominent, degree-long structure of dense gas and dust with clear signs of recent and ongoing high-mass star formation. Our aim is to characterise the structure of this massive filament at moderately high angular resolution (8" or ~0.016pc) in order to measure the intrinsic width of the main filament, down to scales well below 0.1pc, which has been identified as the characteristic width of filaments. We used the ArTeMiS bolometer camera at APEX to map a ~0.6x0.2deg$^2$ region covering OMC-1, OMC-2, and OMC-3 at 350 and 450um. We combined these data with Herschel- SPIRE maps to recover extended emission. The combined Herschel-ArTeMiS maps provide details on the distribution of dense cold material, with a high spatial dynamic range, from our 8" resolution up to the transverse angular size of the map, ~10-15'. By combining Herschel and ArTeMiS data at 160, 250, 350, and 450um, we constructed high-resolution temperature and $H_2$ column density maps. We extracted radial intensity profiles from the column density map in several representative portions of the ISF, which we fitted with Gaussian and Plummer models to derive their intrinsic widths. We also compared the distribution of material traced by ArTeMiS with that seen in the higher-density tracer $N_2H^+$(1-0) that was recently observed with the ALMA interferometer. All the radial profiles that we extracted show a clear deviation from a Gaussian, with evidence for an inner plateau that had not previously been seen clearly using Herschel-only data. We measure intrinsic half-power widths in the range 0.06 to 0.11pc. This is significantly larger than the Gaussian widths measured for fibres seen in $N_2H^+$, which probably only traces the dense innermost regions of the large-scale filament. These half-power widths are within a factor of two of the value of ~0.1 pc found for a large sample of nearby filaments in various low-mass star-forming regions, which tends to indicate that the physical conditions governing the fragmentation of pre-stellar cores within transcritical or supercritical filaments are the same over a large range of masses per unit length.

Description:
The high-resolution temperature and $H_2$ column density maps that we constructed from the combined ArTeMiS + Herschel data are made available. The resolution of the temperature map is limited by that of the Herschel-SPIRE 250um data (18.2arcsec). The column density map has a resolution of 8arcsec.

File Summary:

| FileName | Lrecl | Records | Explanations |
|---|---|---|---|
| ReadMe | 80 | . | This file |
| list.dat | 139 | 2 | List of fits maps |
| fits/* | . | 2 | Individual fits maps |

See also:
J/A+A/600/A141 : Orion A integral shaped filament image (Kainulainen+, 2017)
J/A+A/610/A77 : Orion Integral Filament ALMA+IRAM30m N2H+(1-0) data (Hacar+, 2018)

Byte-by-byte Description of file: list.dat

| Bytes | Format | Units | Label | Explanations |
|---|---|---|---|---|
| 1- 9 | F9.5 | deg | RAdeg | Right Ascension of center (J2000) |
| 10- 18 | F9.5 | deg | DEdeg | Declination of center (J2000) |
| 20- 23 | I4 | --- | Nx | Number of pixels along X-axis |
| 25- 28 | I4 | --- | Ny | Number of pixels along Y-axis |
| 30- 34 | I5 | Kibyte | size | Size of FITS file |
| 36- 65 | A30 | --- | FileName | Name of FITS file, in subdirectory fits |

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  67-139  A73   ---     Title     Title of the FITS file
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(End) Patricia Vannier [CDS] 27-May-2021

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