CENTRE FOR ASTROCHEMICAL STUDIES

The core population and kinematics of a massive clump

An ALMA view of AG14.49

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Introduction

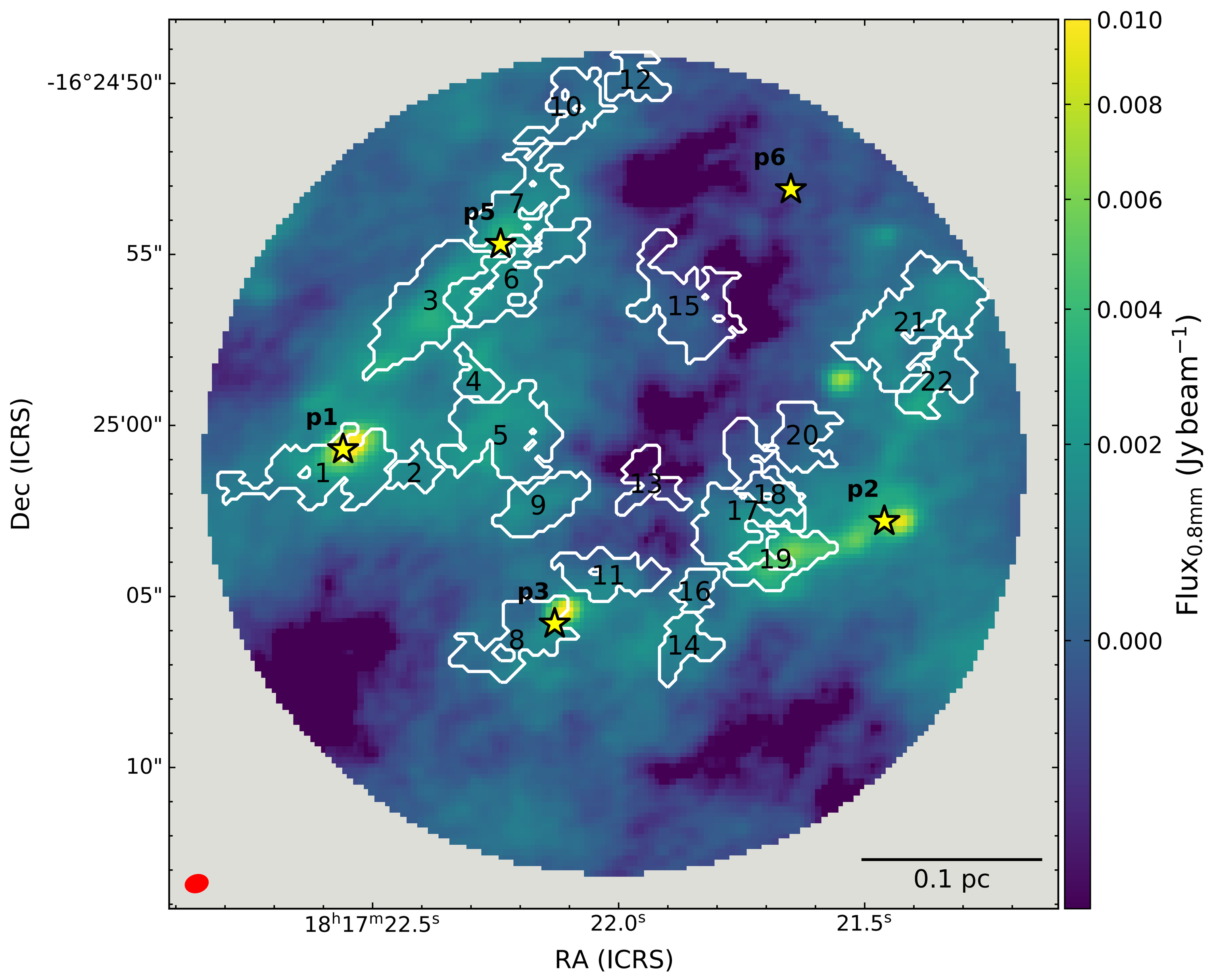
High-mass stars dominate the kinematics and energetics of the interstellar medium, and yet their initial stages are poorly known. In fact, high-mass stars are born in crowded, dense environment (infrared dark clouds) that pose significant observational challenges due to the high extinction and distances.
In this work, we use a combination of several ALMA datasets to investigate the properties of the high-mass clump AG14.49, focusing on two aspects: the prestellar core population embedded in it and the clump-scale kinematics.

2. Source and observations

AG14.49 is a massive (5200M$_\odot$) clump. It contains several protostars with outflows, as revealed by the ASHES project (Sanhueza et al. 2019, Li et al. 2020). It was target with ALMA observations of:

- Band 7: continuum at 0.8mm and o-H_2D^+, an ideal tracer of cold, prestellar gas (see Redaelli et al. 2021). The spatial resolution is ~2000AU;
- Band 3: N_2H^+ (1-0) line at ~5000AU resolution, used to infer the kinematics.

1. The core population from o-H_2D^+ observations



The emission in continuum at 0.8mm is shown in colorscale; the white contours show the cores identified in o-H2D+ data, labelled with numbers. The star symbols are the known protostar positions.

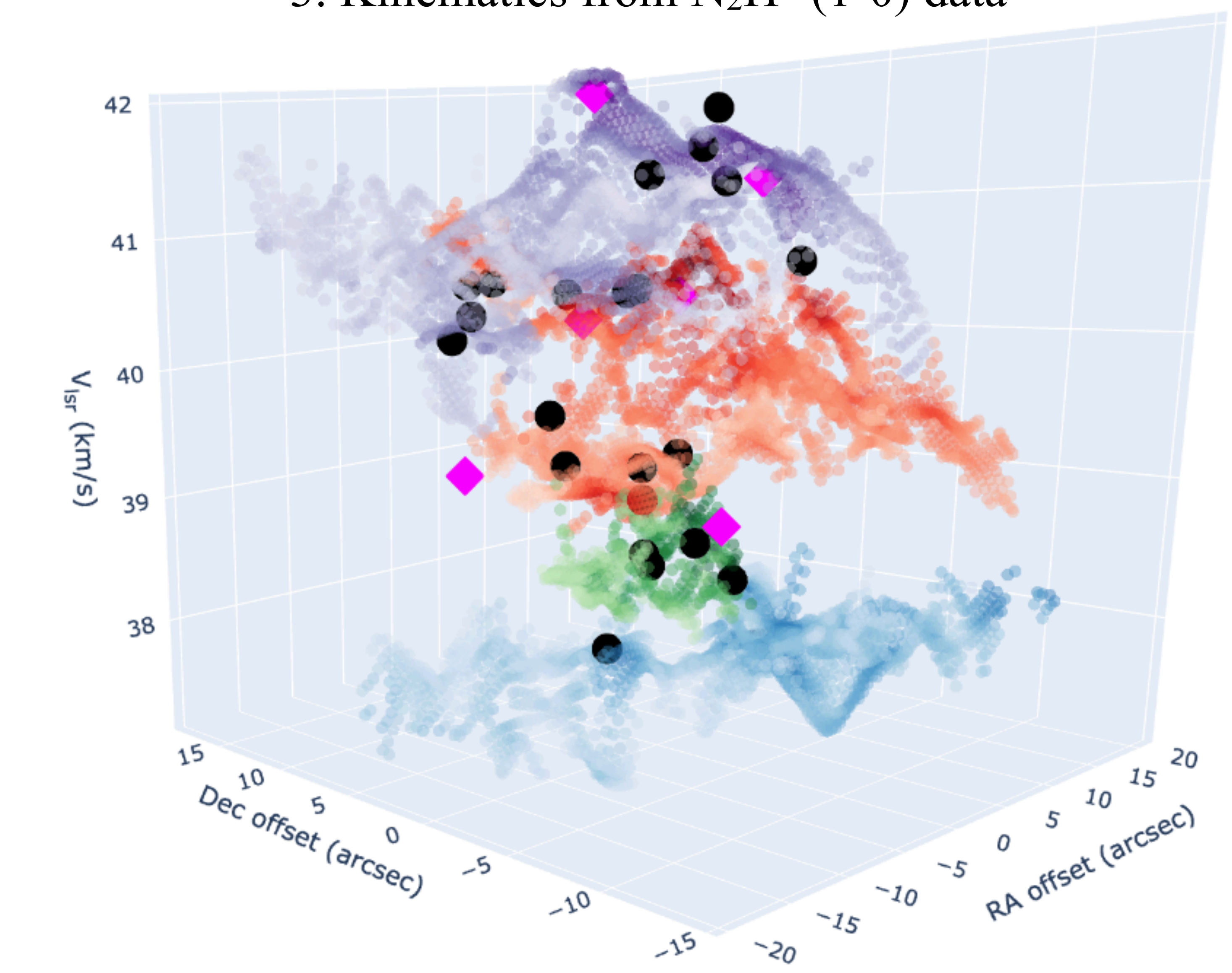
- The o-H_2D^+ morphology does not coincide with the continuum one, which trace the protostar positions
- Cores has been identified with the core-finding algorithm SCIMES, which is based on dendogram analysis (Colombo et al. 2015)
- We found 22 cores, and we estimated their mass from the continuum emission at 0.8mm. All cores at 10K are less massive than 30M$_\odot$, and subvirial

☜ Link to the arXiv

Want to know more?

Link to interactive ppv plot ☞

3. Kinematics from N_2H^+ (1-0) data

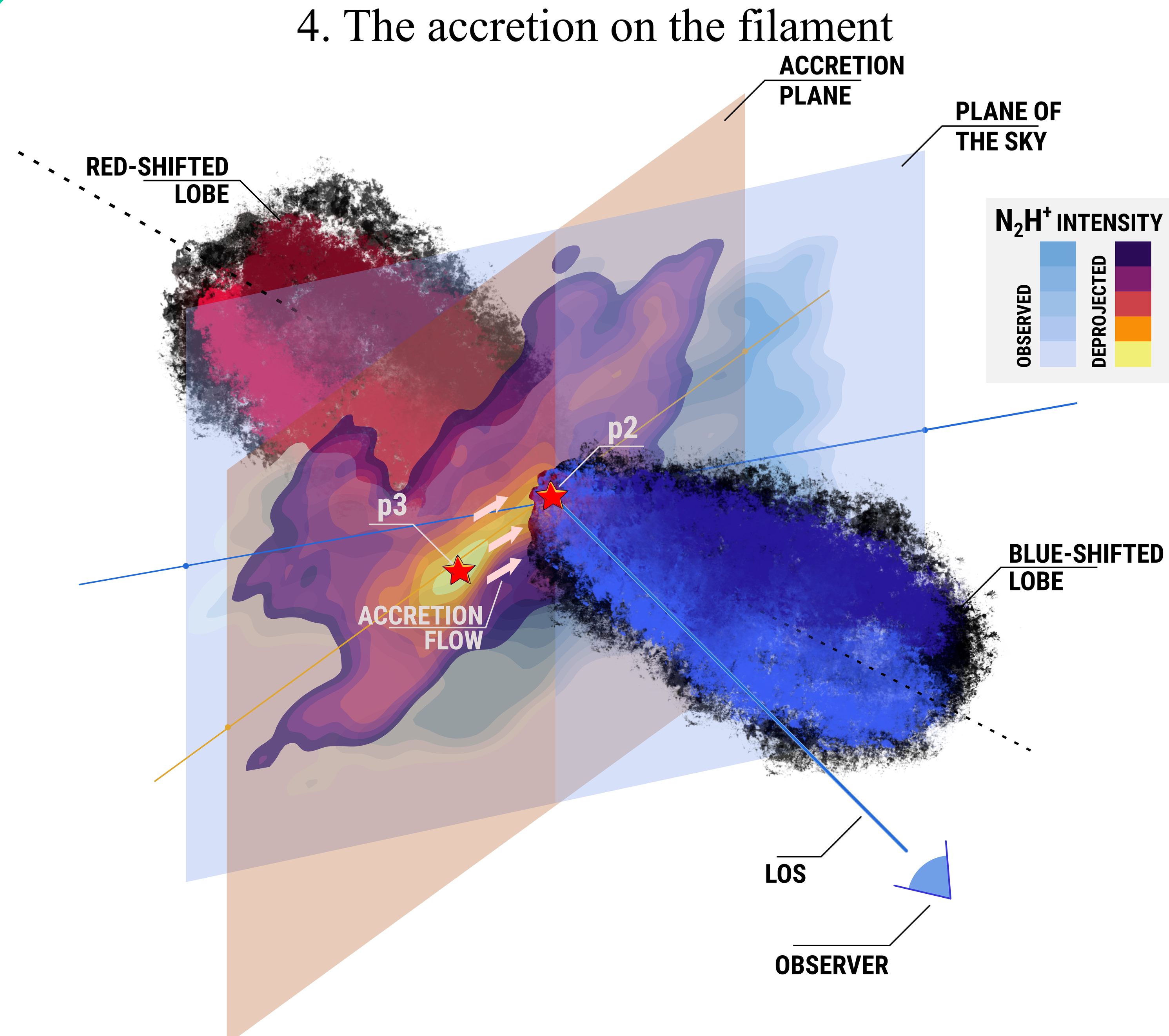


Position-position-velocity plot of the structures identified by ACORNS, shown in different colors; the black dots and magenta diamonds show the prestellar and protostellar core positions, respectively.

To analyse the N_2H^+ data:

- We fitted multiple gaussian components
- The results were fed to the clustering algorithm ACORNS (Henshaw et al. 2019), which identifies the hierarchical structure in the data
- ACORNS identifies several coherent structures, all associated with prestellar/protostellar cores.

4. The accretion on the filament



In the largest ppv structure identified by ACORNS, a clear velocity gradient is seen going from protostar p3 towards p2, which in turns power a bipolar outflow. A possible scenario, depicted in the above artistic view, is that the gas is accreting towards p2, and fueling the outflows. We computed an accretion rate of ~2x10^{-4} M$_\odot$/yr, in good agreement with similar estimations.

References

Colombo, D., et al., 2015, MNRAS, 454, 2067
Henshaw, J. D., et al. 2019, MNRAS, 485, 2457
Li, S., Sanhueza, P. et al. 2020, ApJ, 903, 119
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