

Fragmentation and disk formation in high-mass star formation

Henrik Beuther, MPIA

The Wonders of Star Formation, Edinburgh, Sept. 3-7, 2018



Fragmentation and disk formation in high-mass star formation

The Work

7, 2018

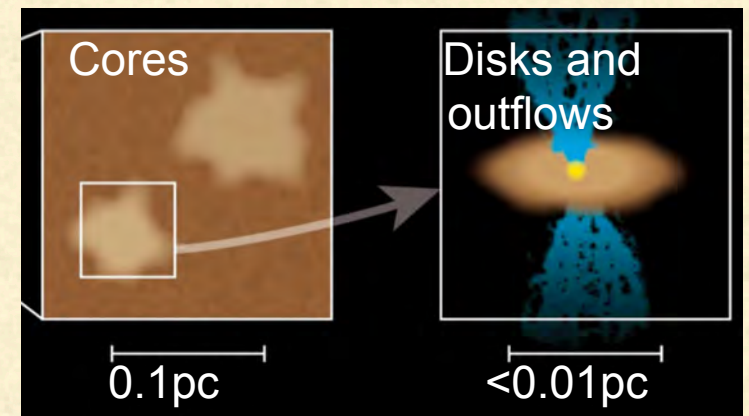




Fragmentation and disk formation during high-mass star formation

Survey (PI: H. Beuther):

- Large sample of high-mass star-forming regions
- $0.2''$ - $0.3'' \sim 500\text{AU}$
- (sub)mm line and continuum emission
- >300 hours large program at NOEMA/PdBI

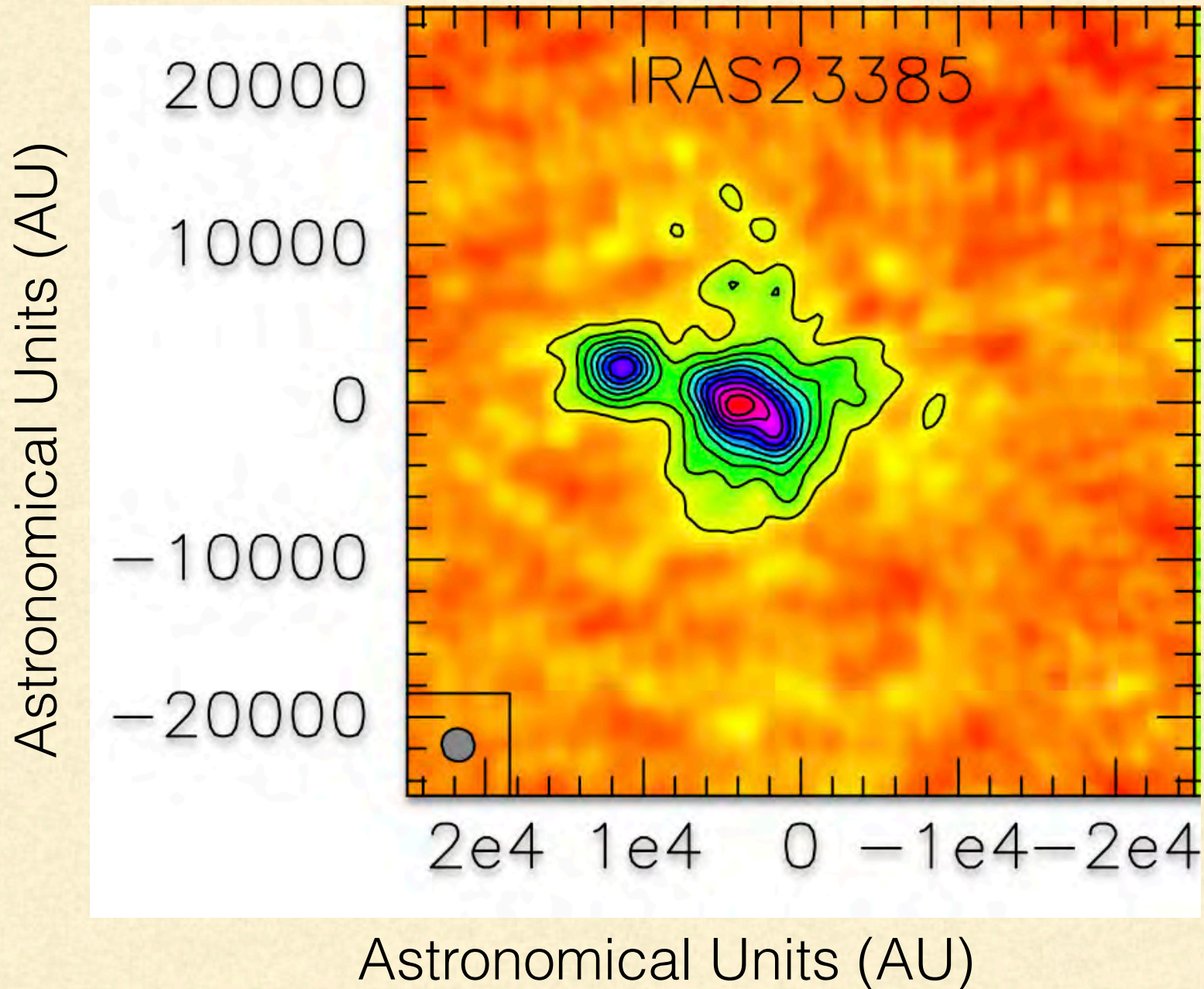


Northern Extended Millimeter Array (NOEMA)
Plateau de Bure Interferometer (PdBI)

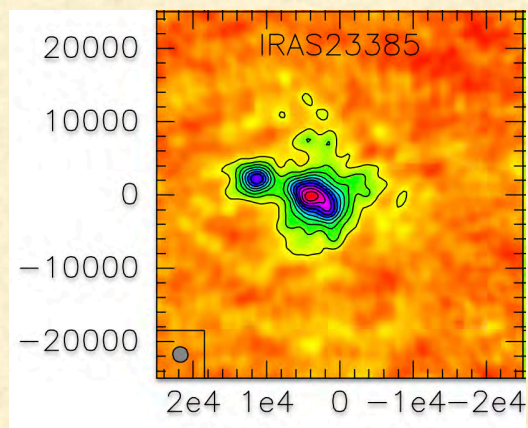


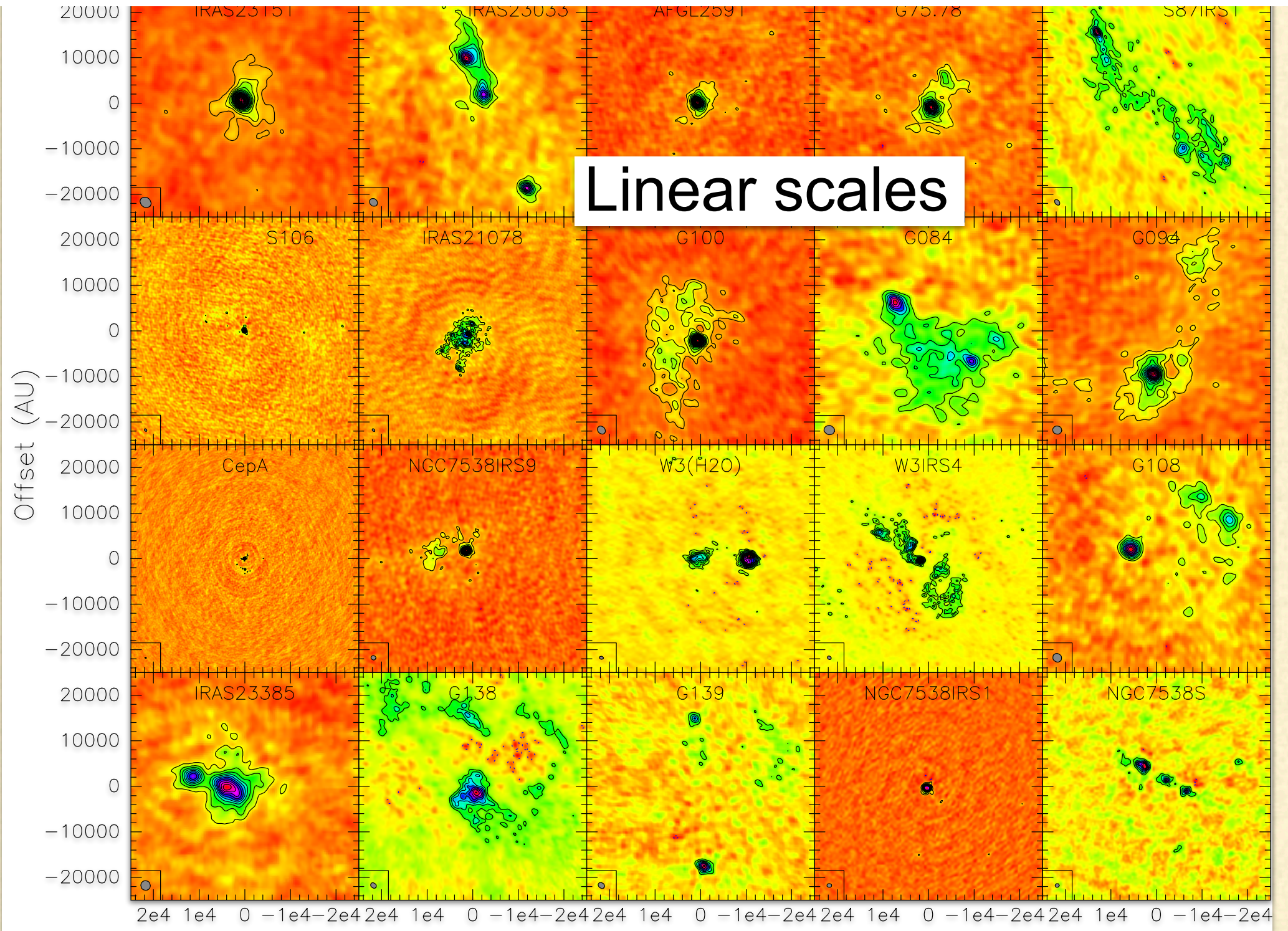
<http://www.mpia.de/core>

Dense cores in 1.3mm continuum

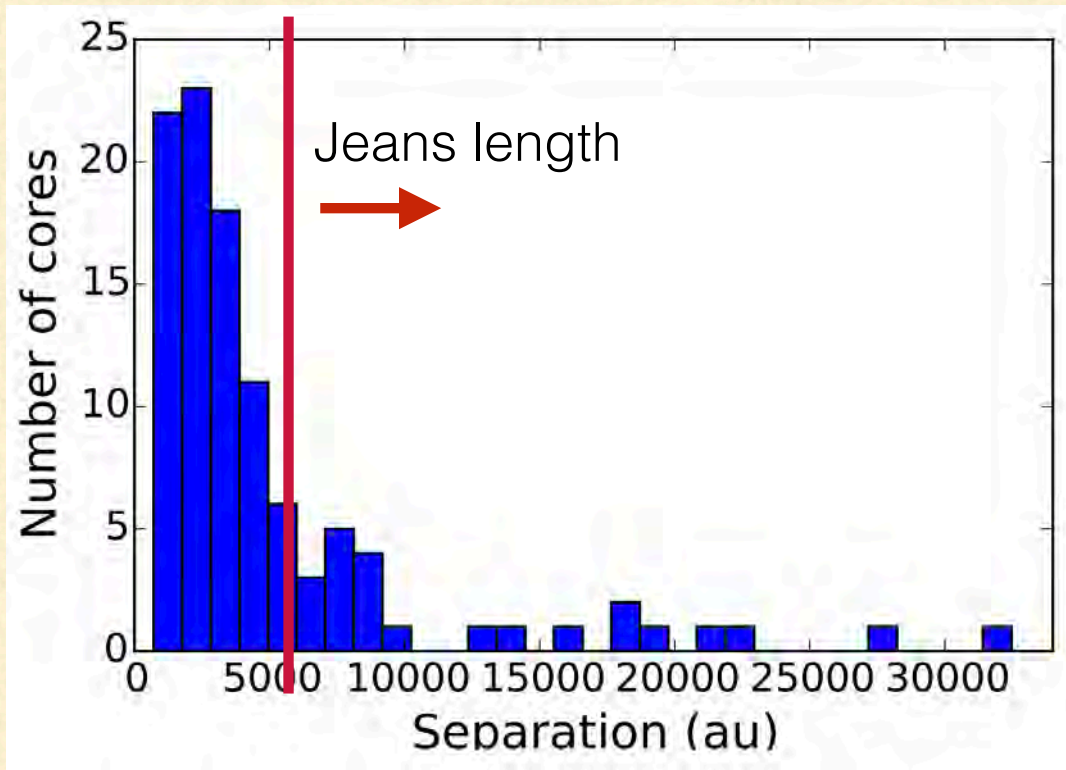


Dense cores in 1.3mm continuum

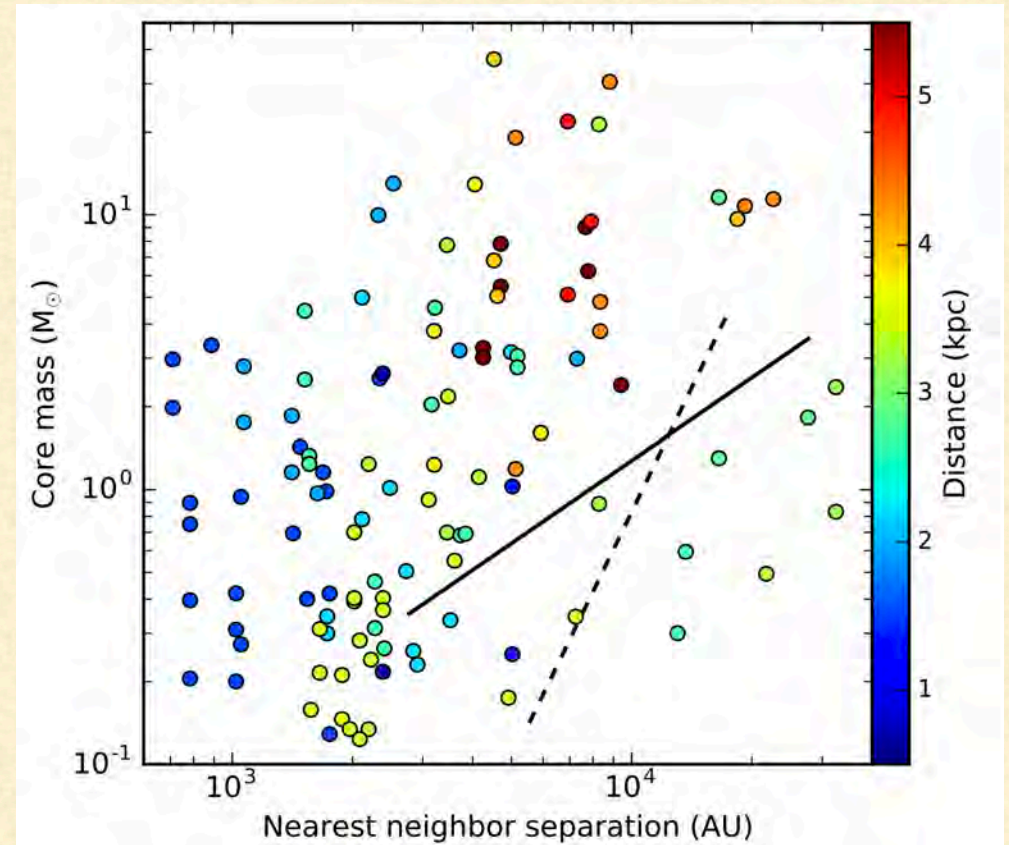
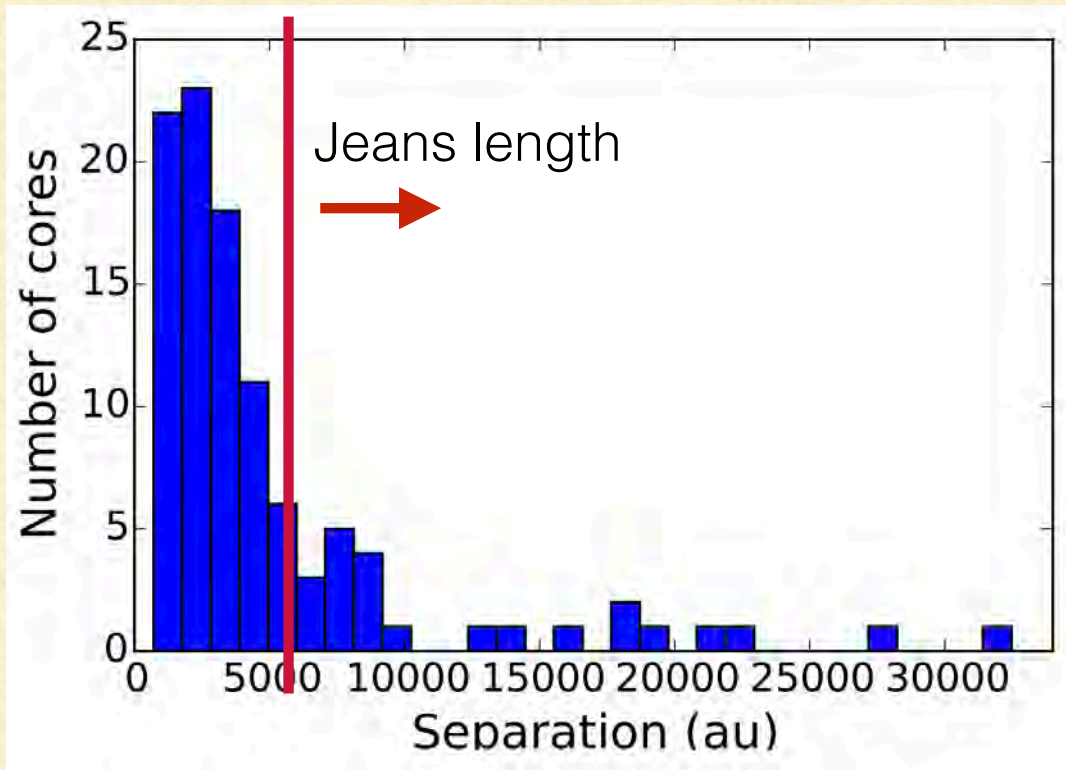


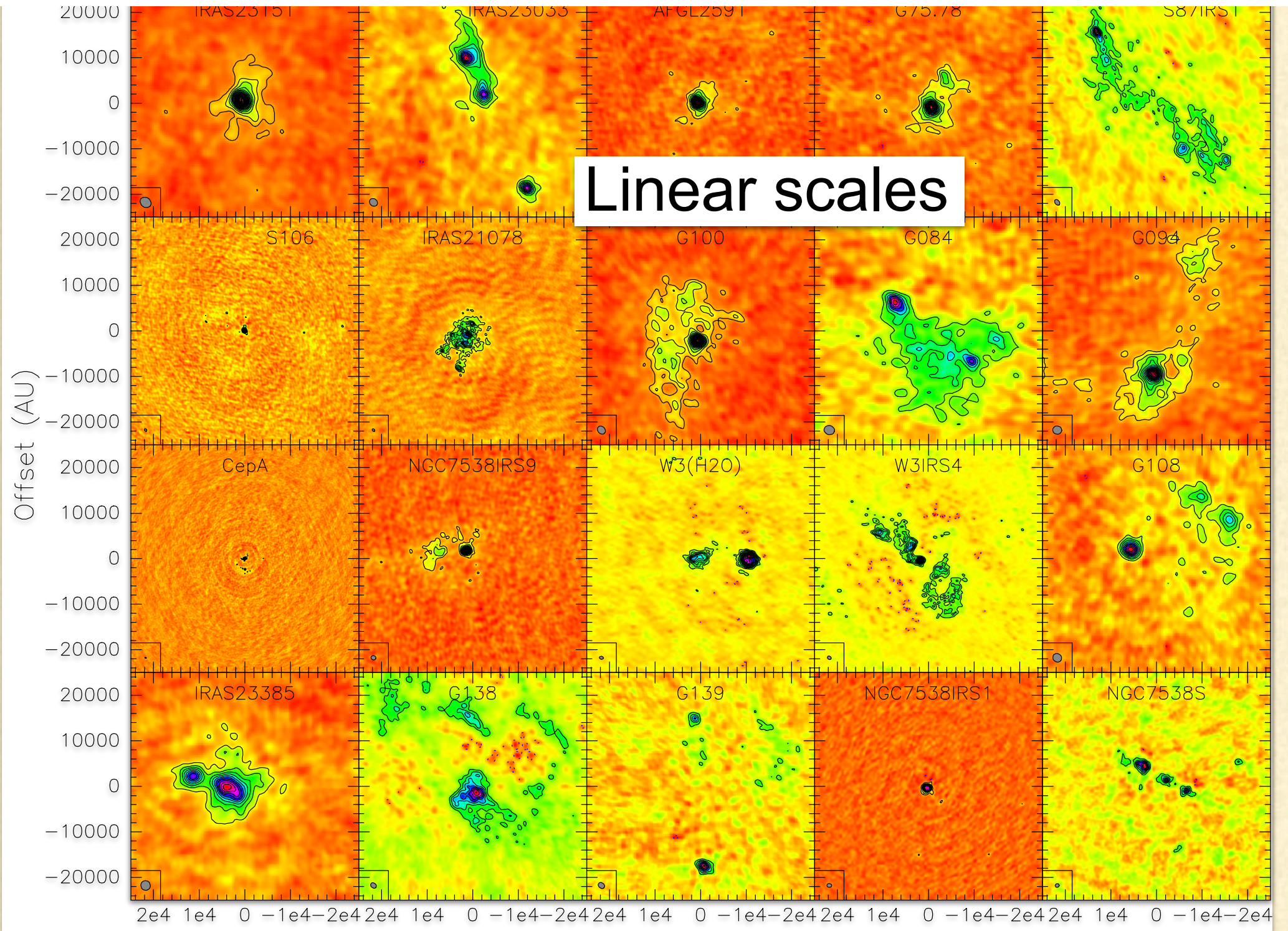


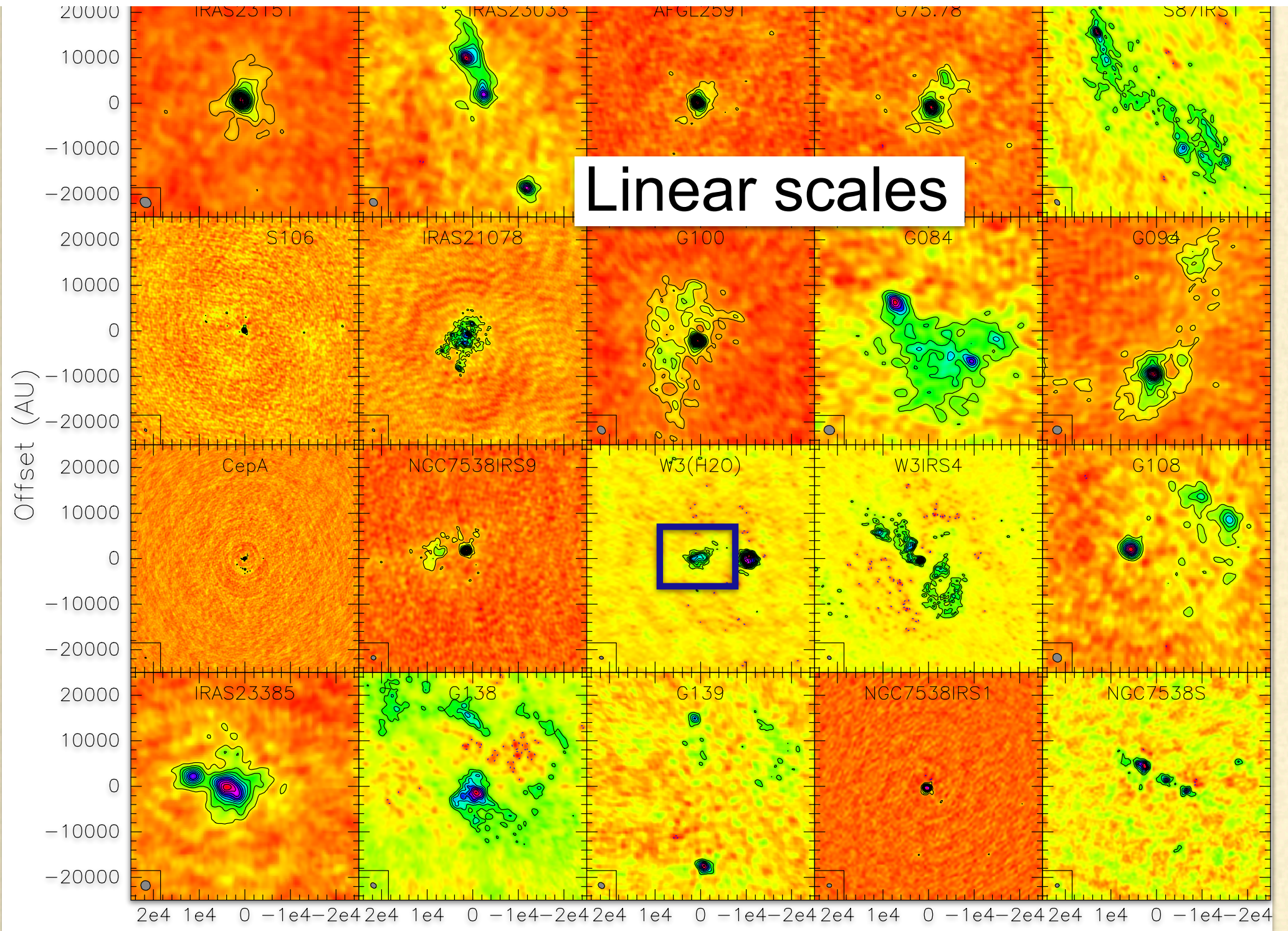
Core properties



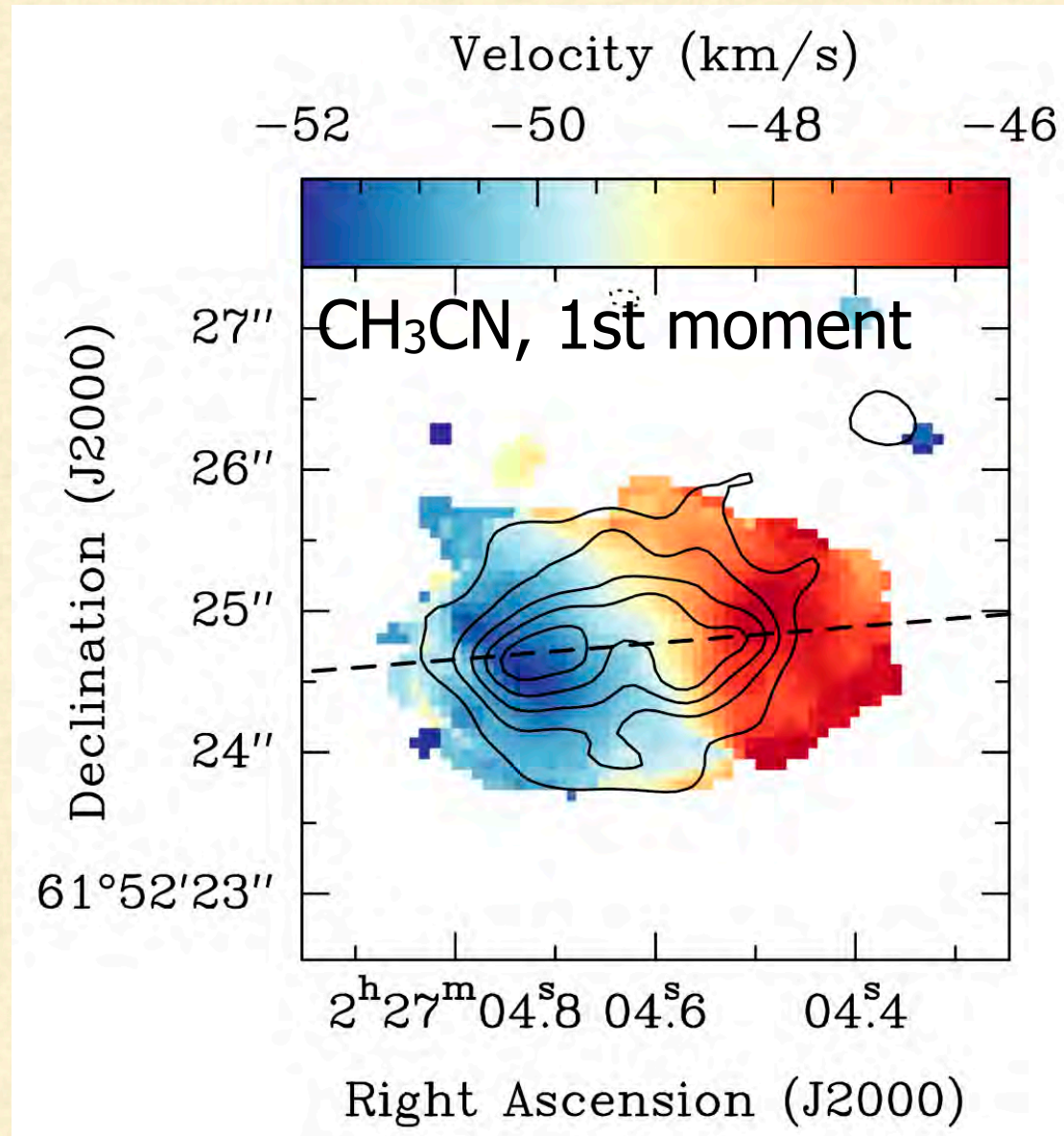
Core properties







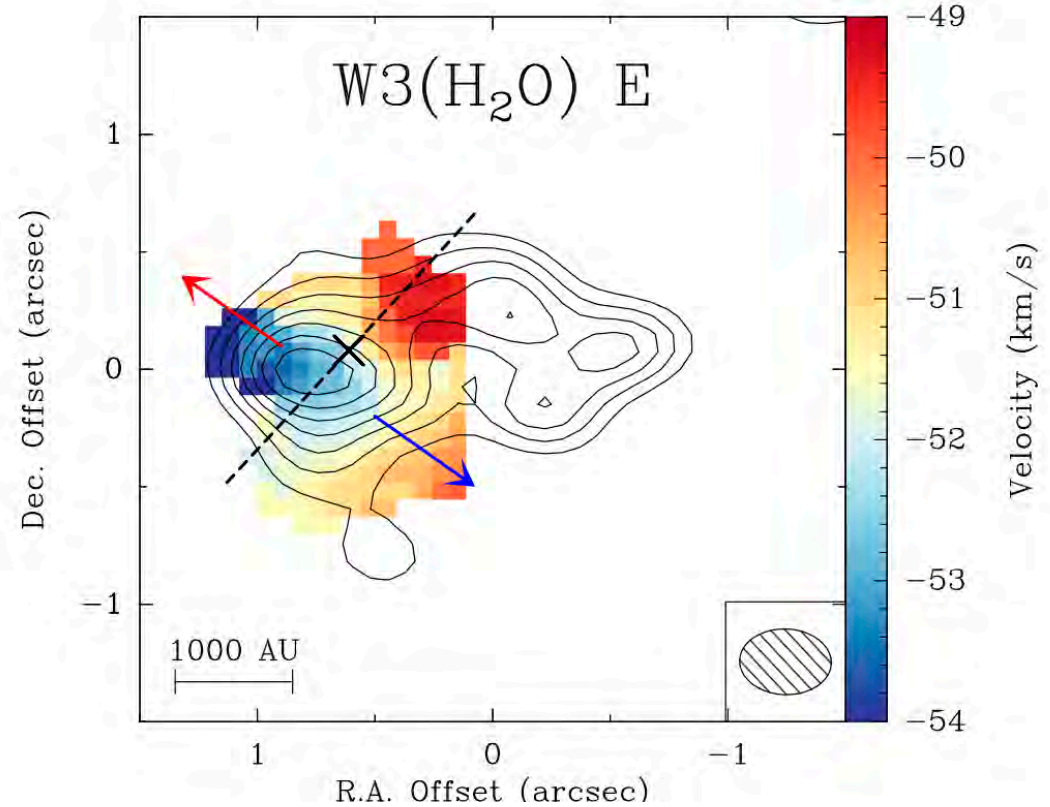
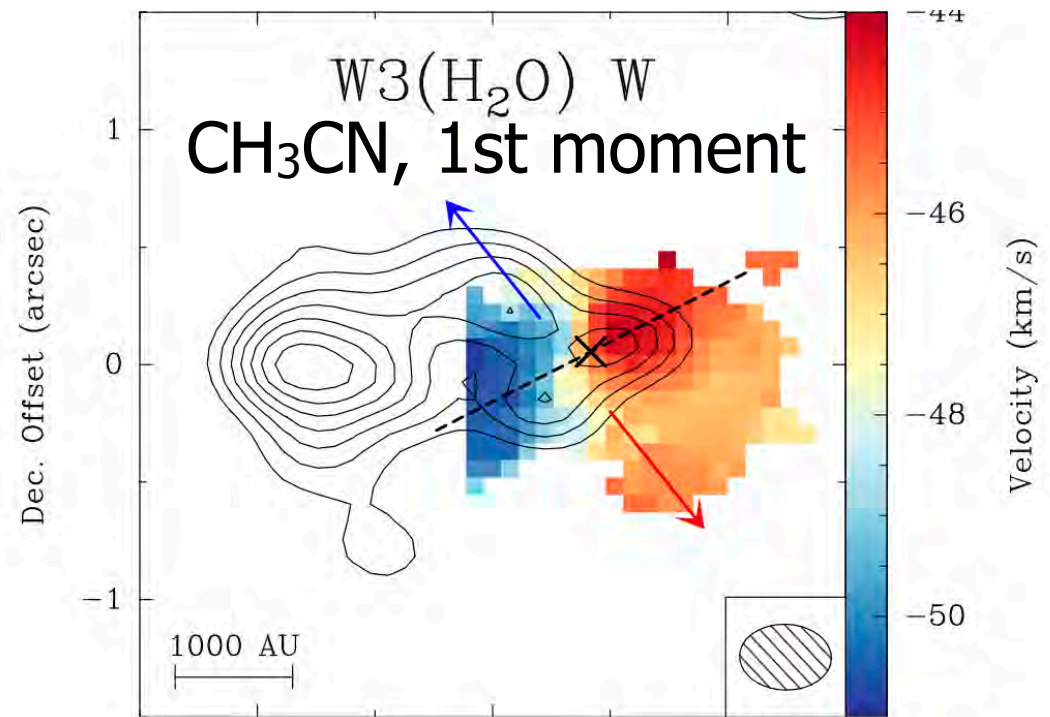
Velocity structure of W3(H2O)



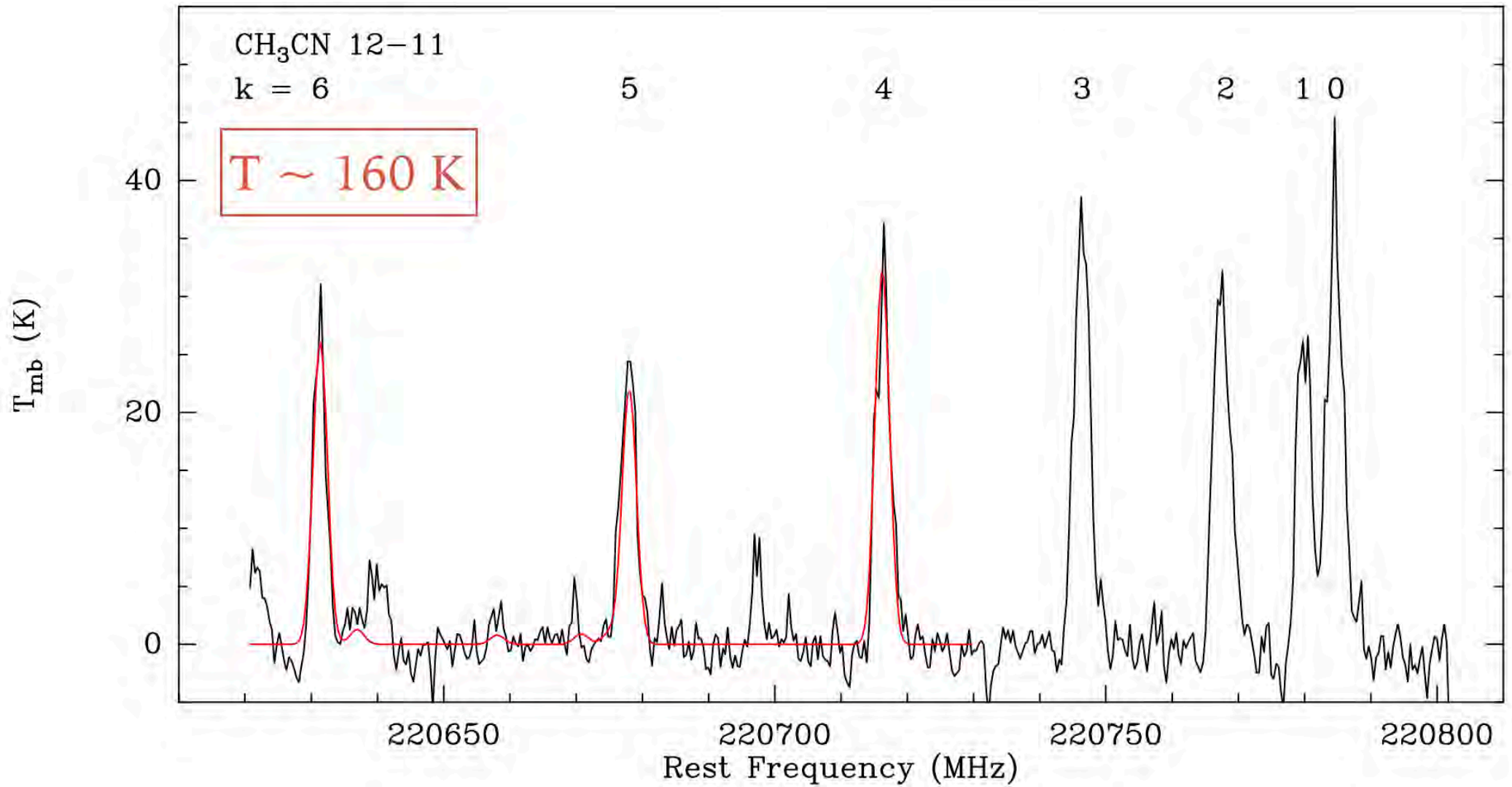
(Ahmadi et al. 2018)

Individual fragments

(Ahmadi et al. 2018)

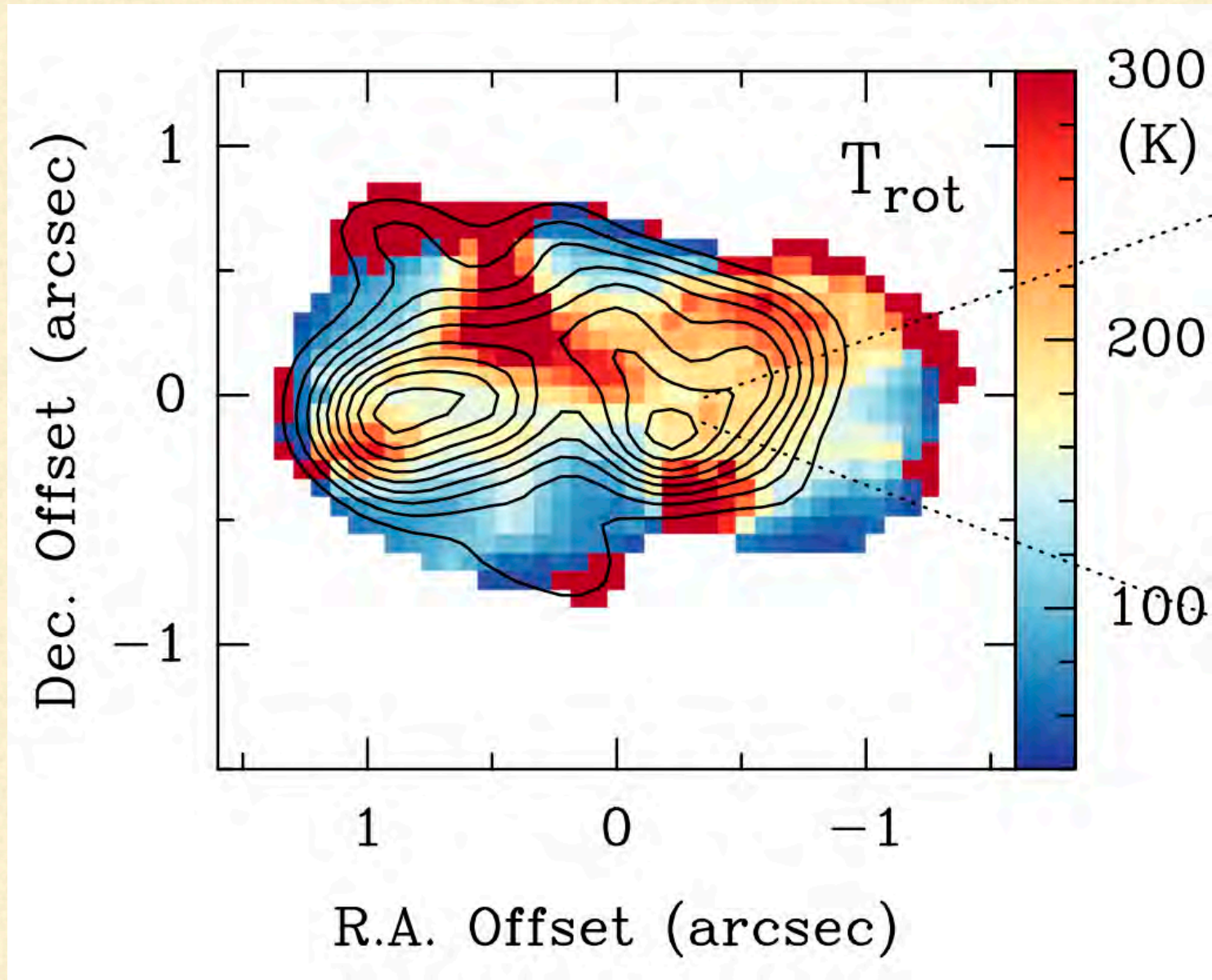


CH₃CN spectra



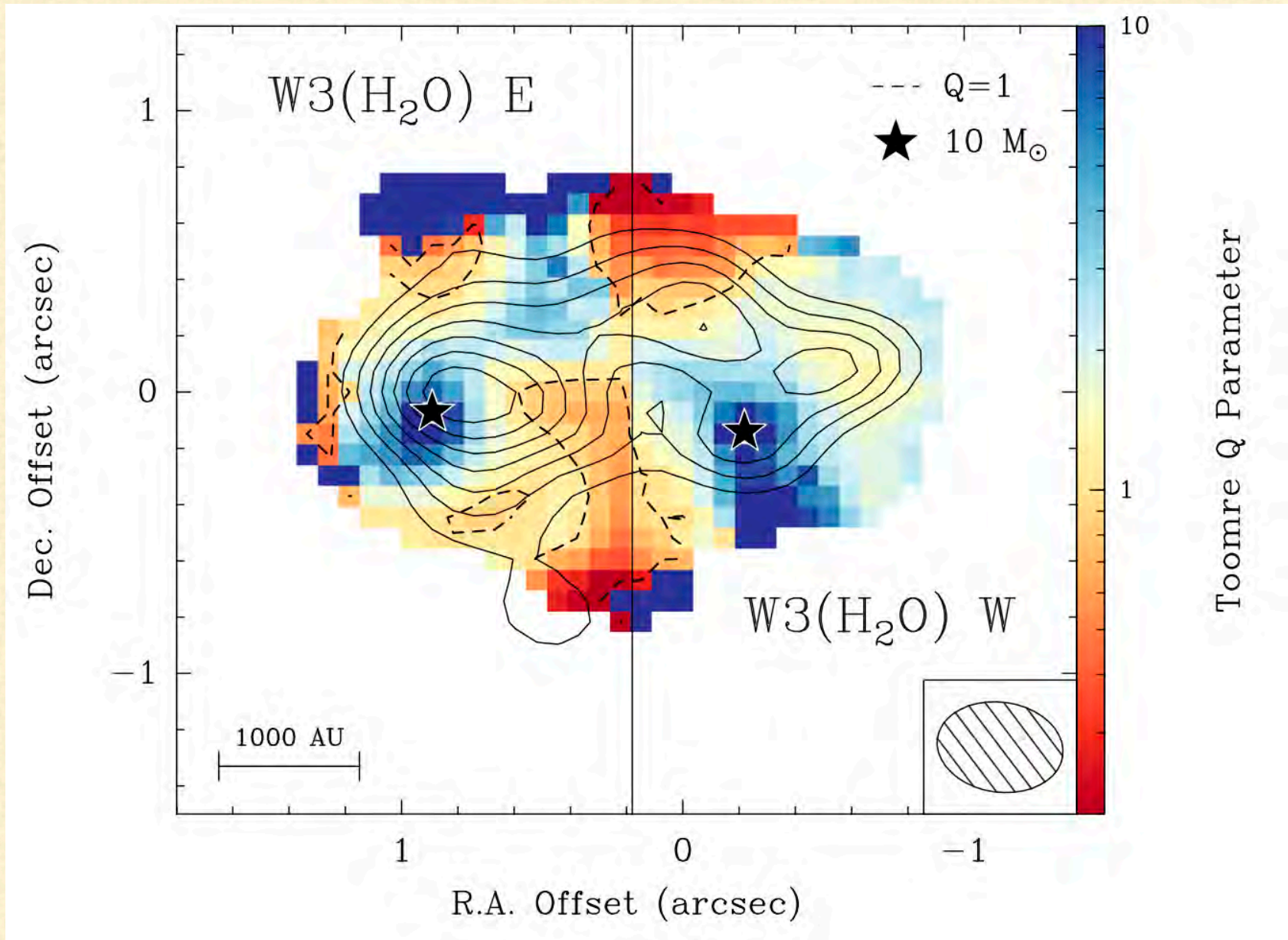
(Ahmadi et al. 2018)

Temperature map



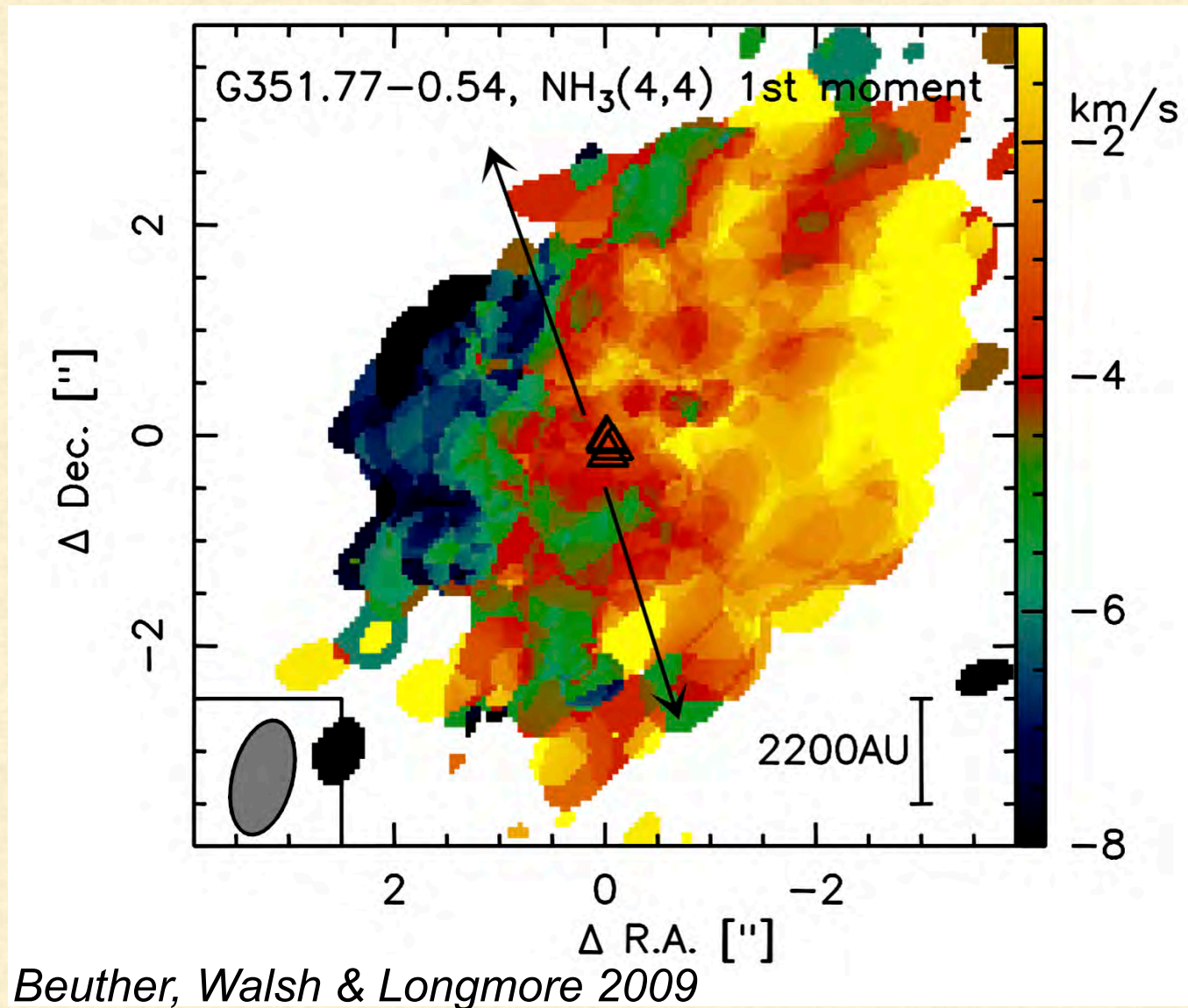
(Ahmadi et al. 2018)

Toomre Q map

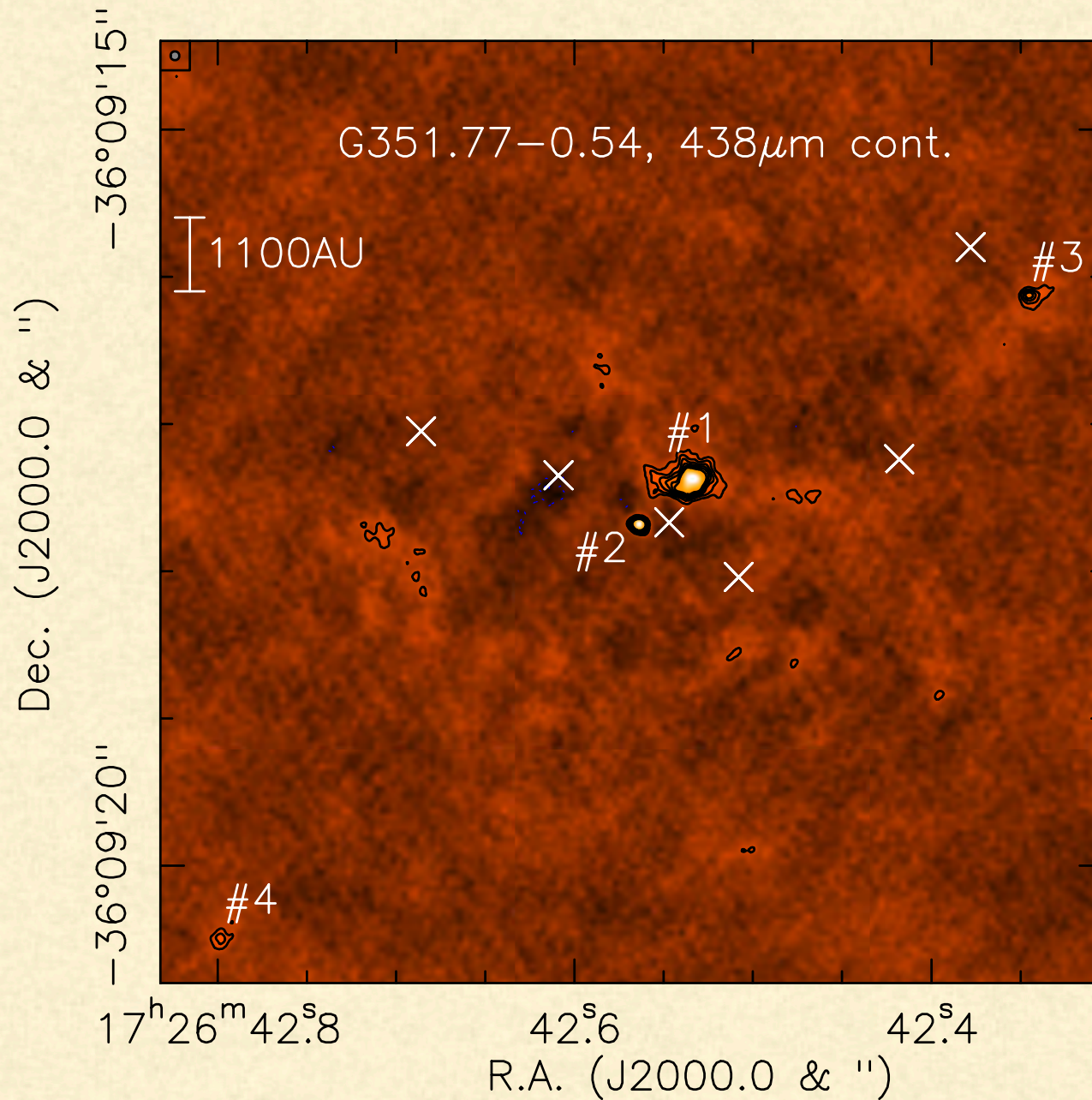


Ahmadi et al. 2018 —> check out poster for sample analysis

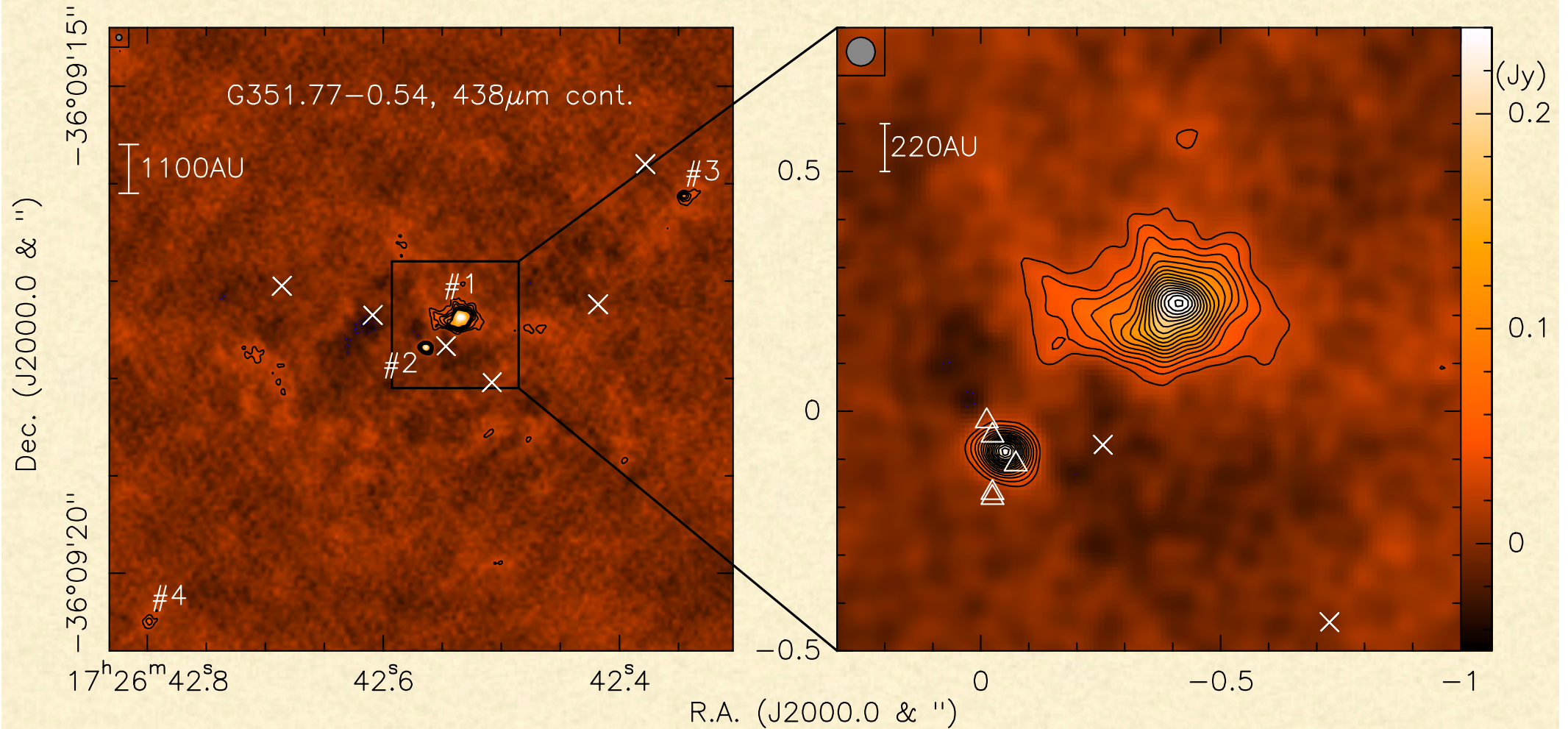
The hot core G351: ALMA@690GHz & 0.06''



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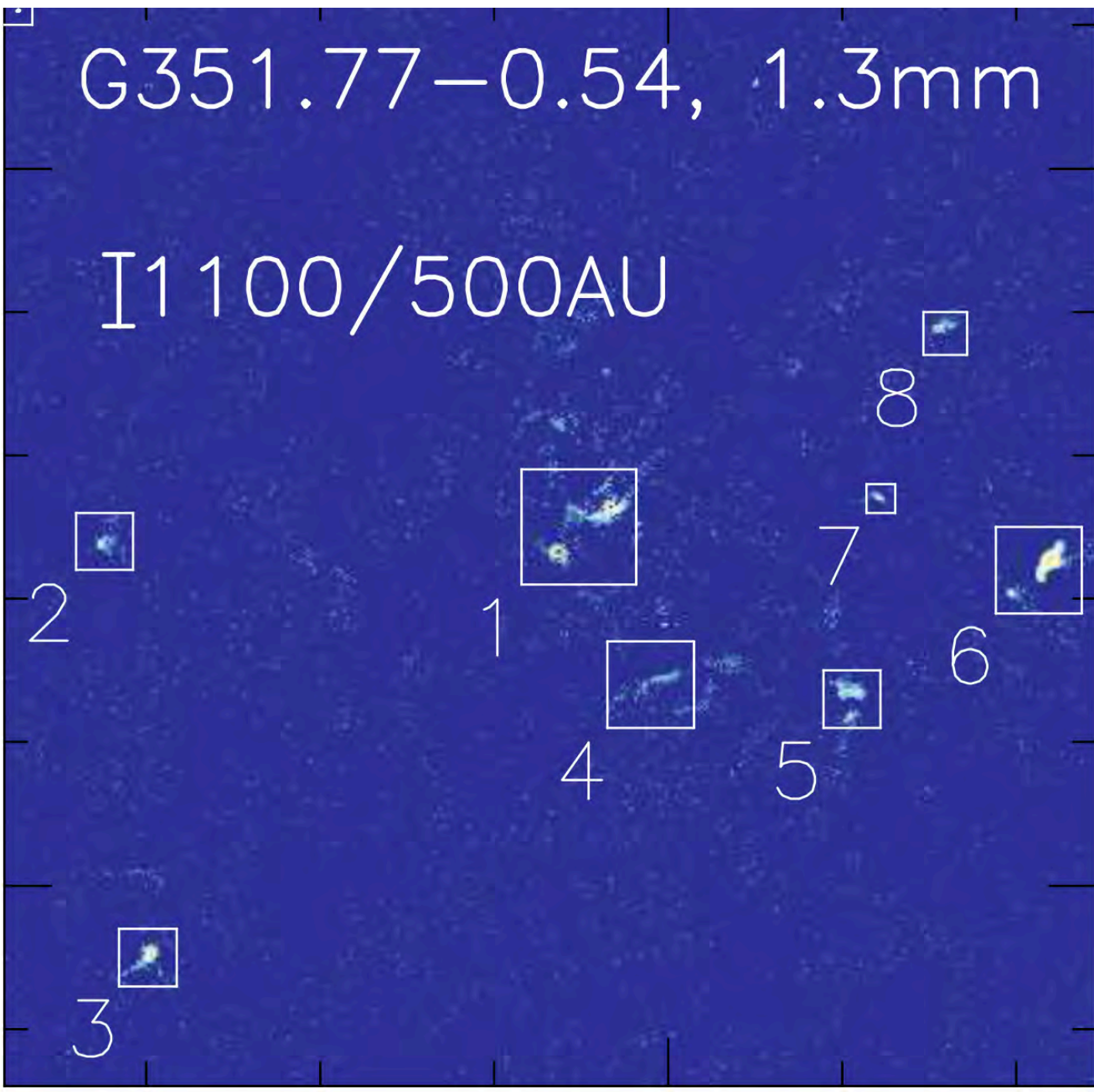
The hot core G351: ALMA@690GHz & 0.06''



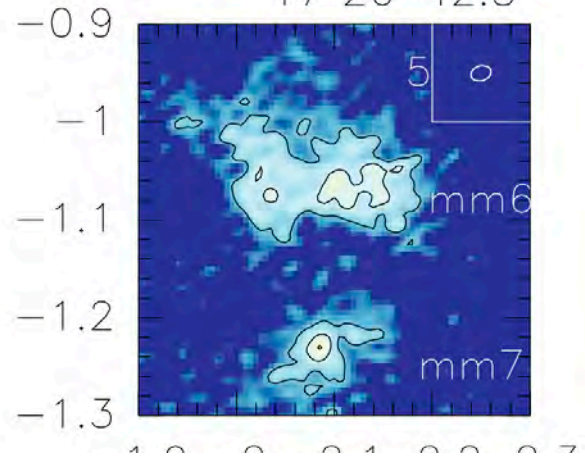
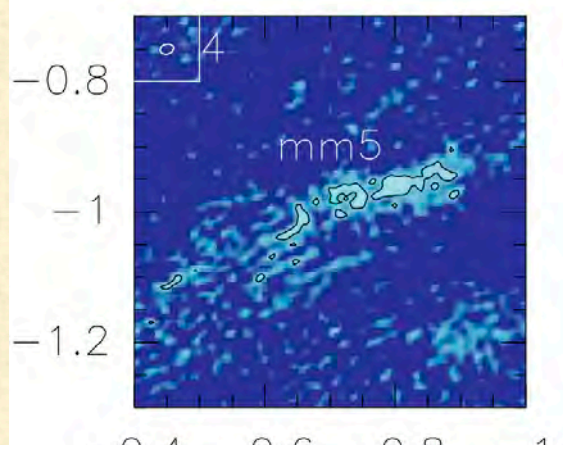
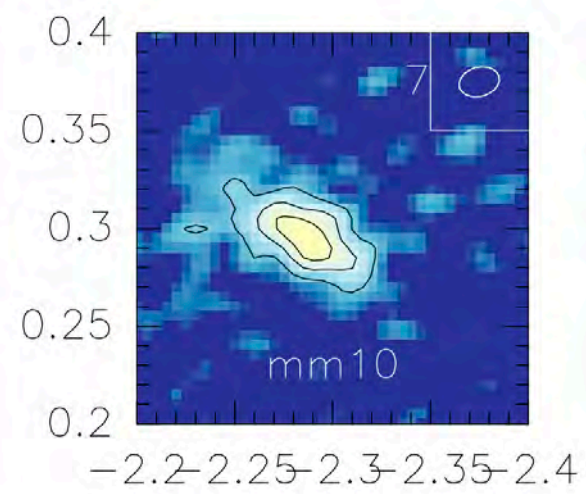
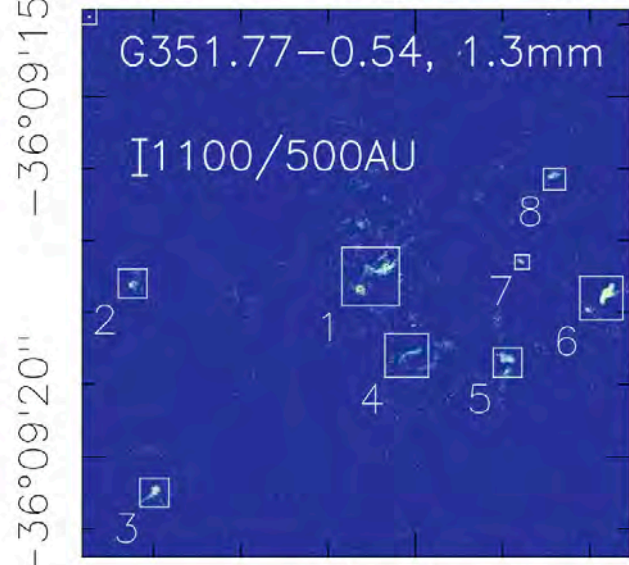
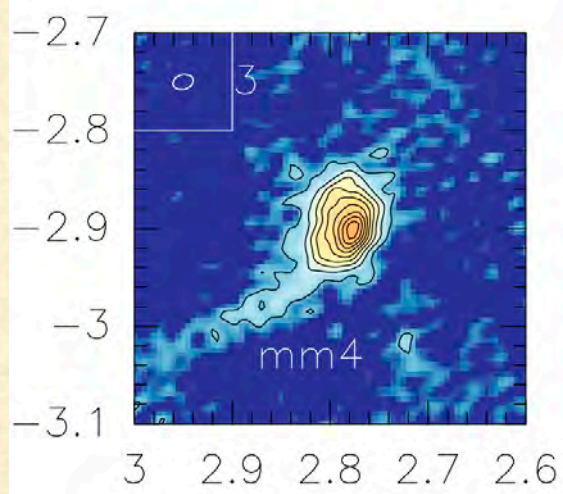
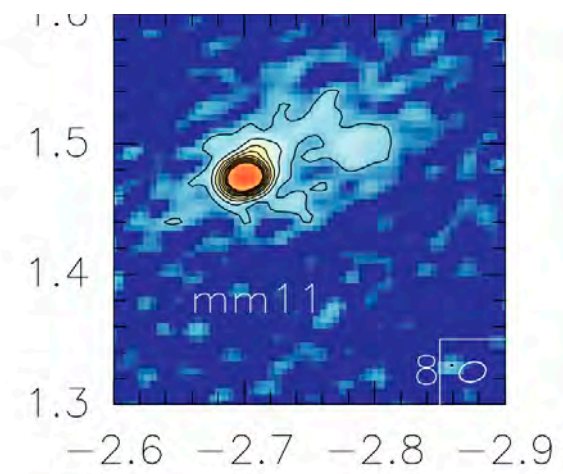
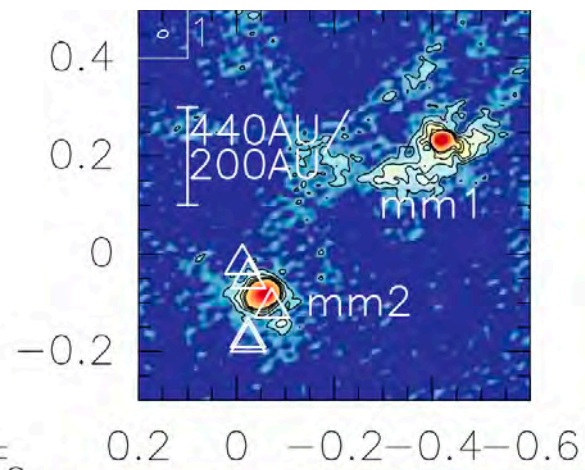
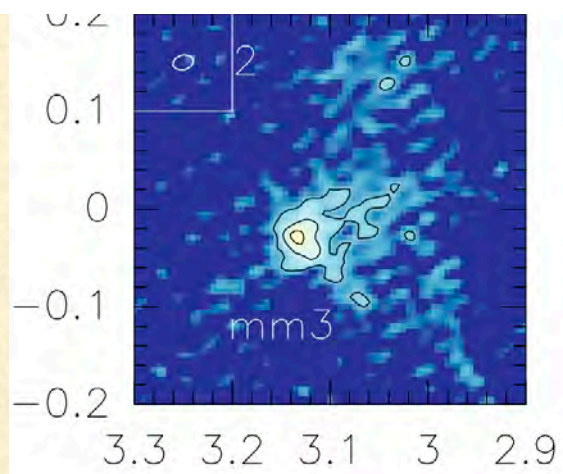
— 36°09'20" — 36°09'11"

G351.77-0.54, 1.3mm

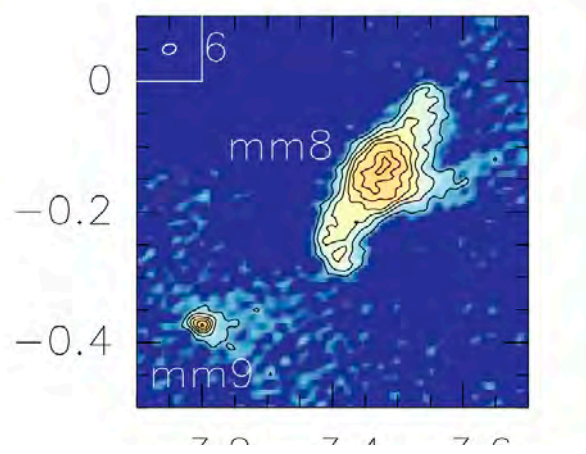
I 1100/500AU

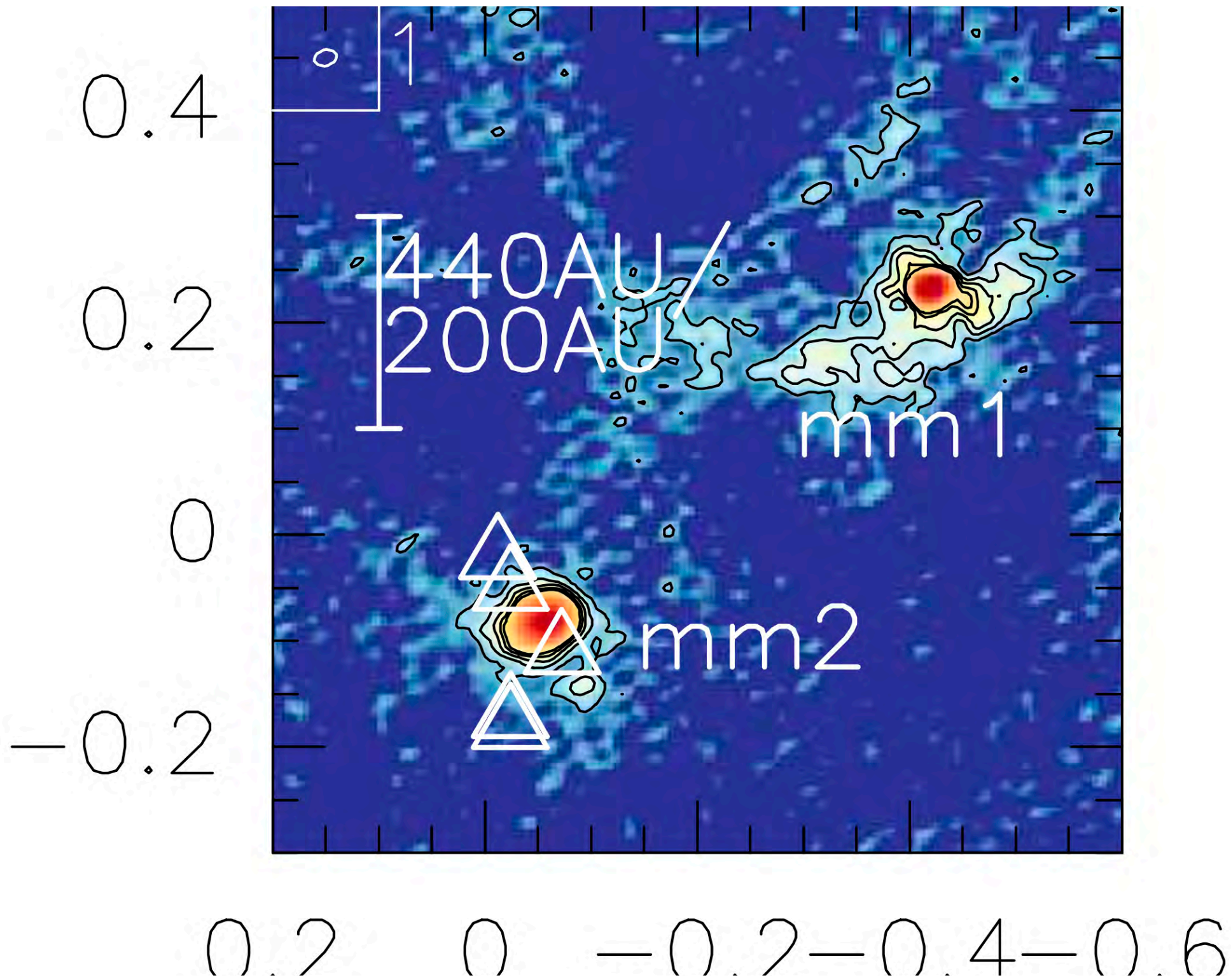


17^h26^m42^s.5

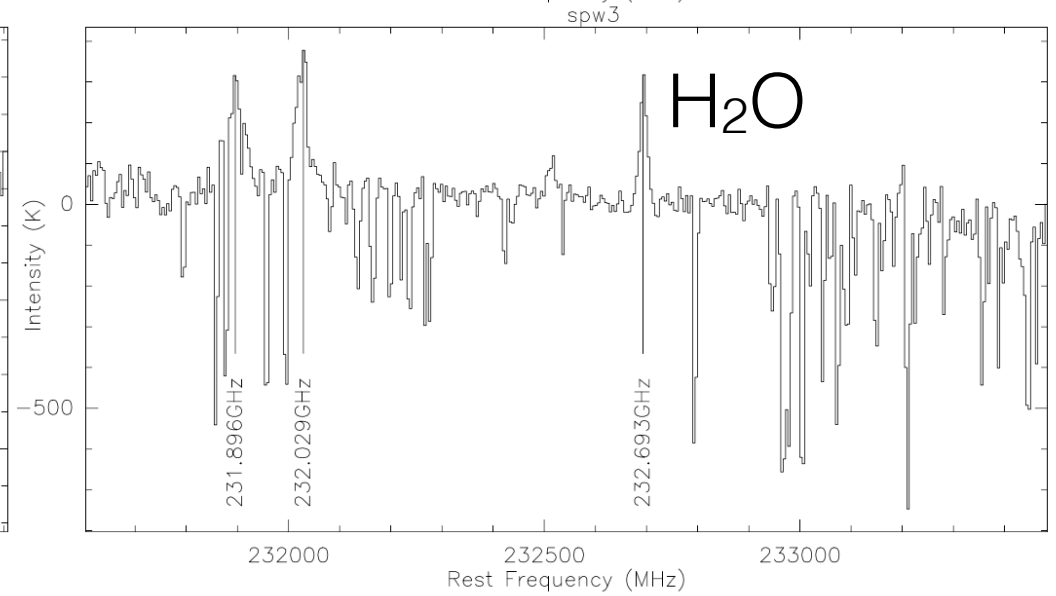
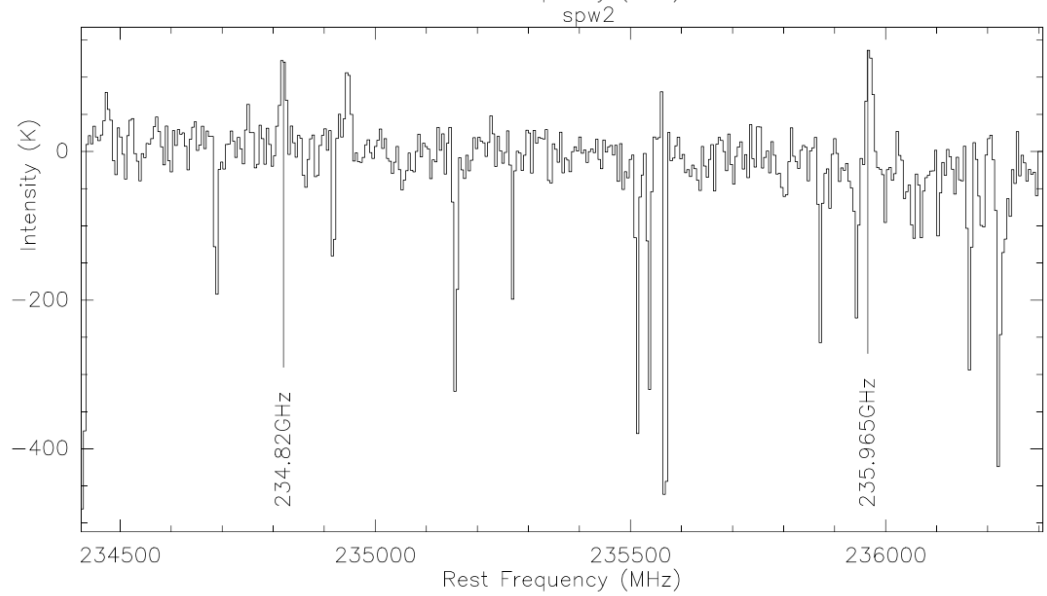
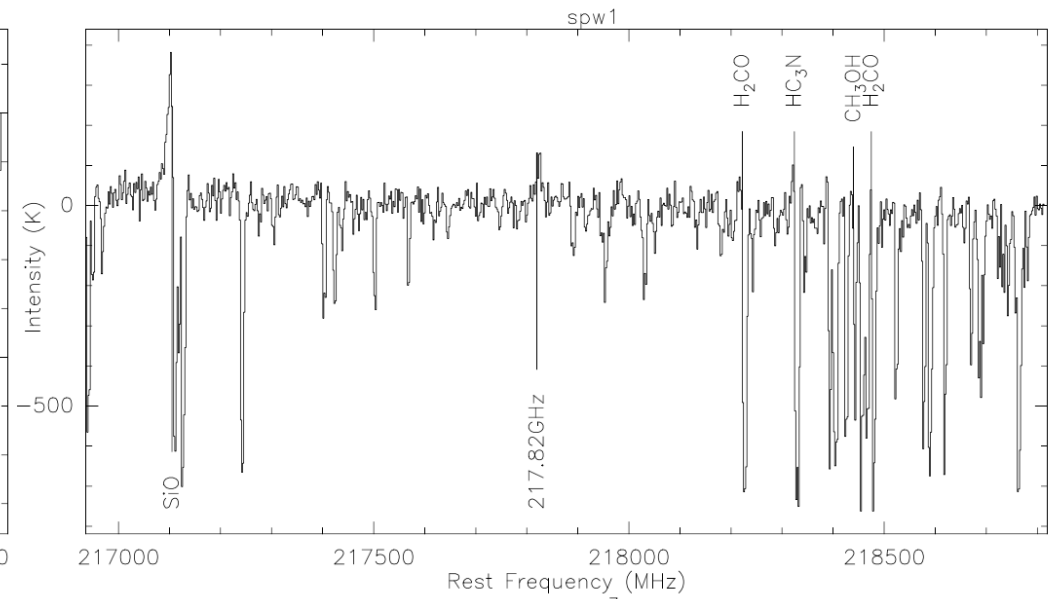
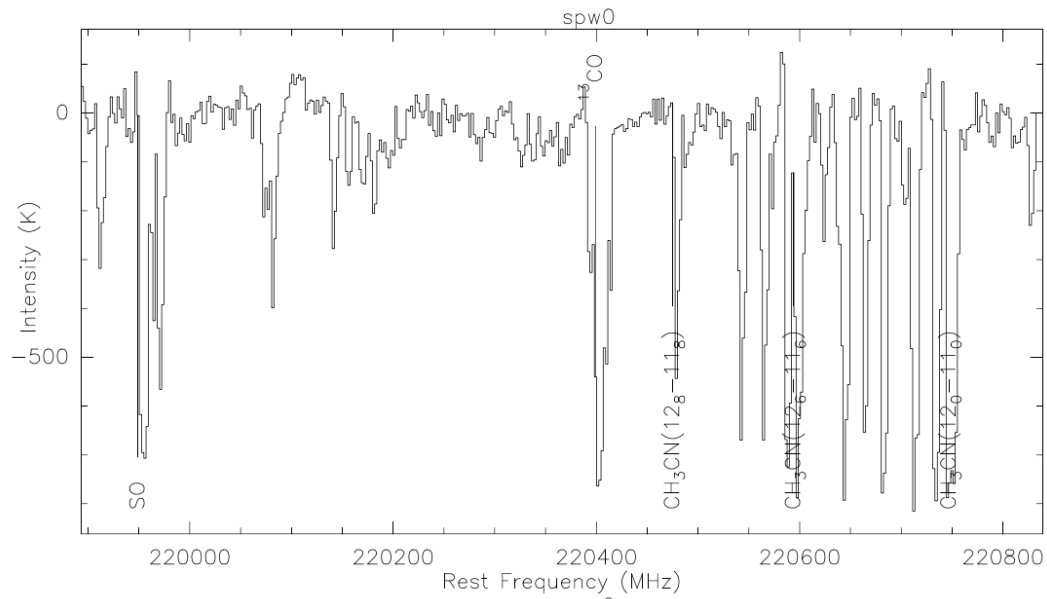


Beuther et al. subm.

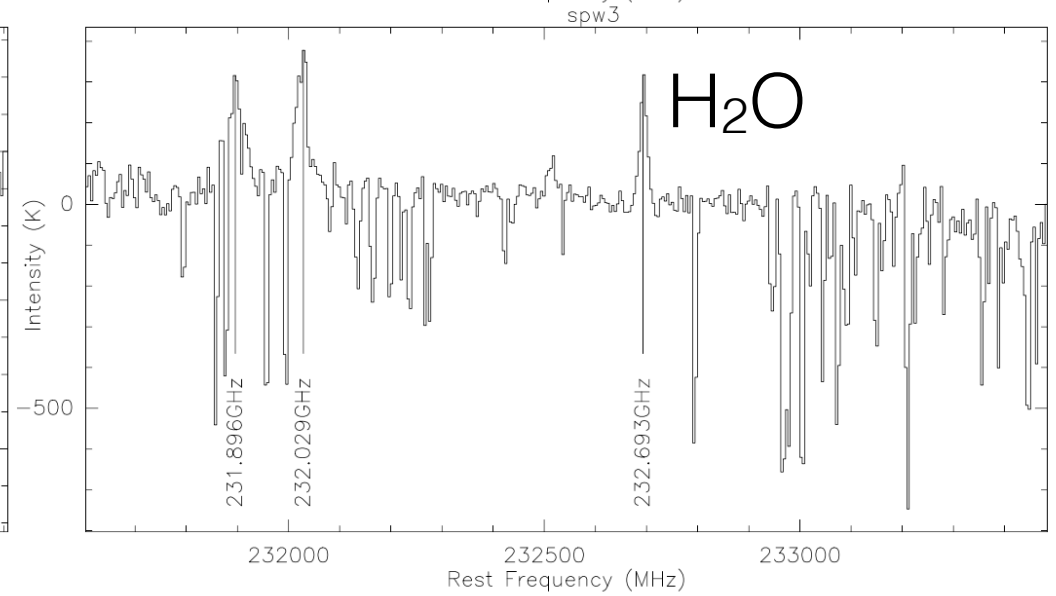
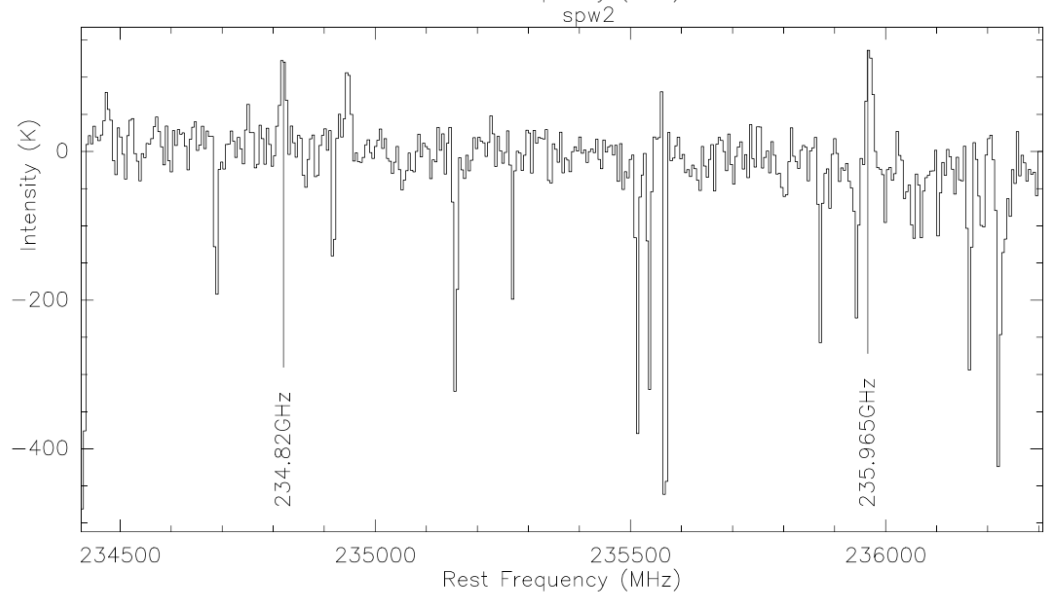
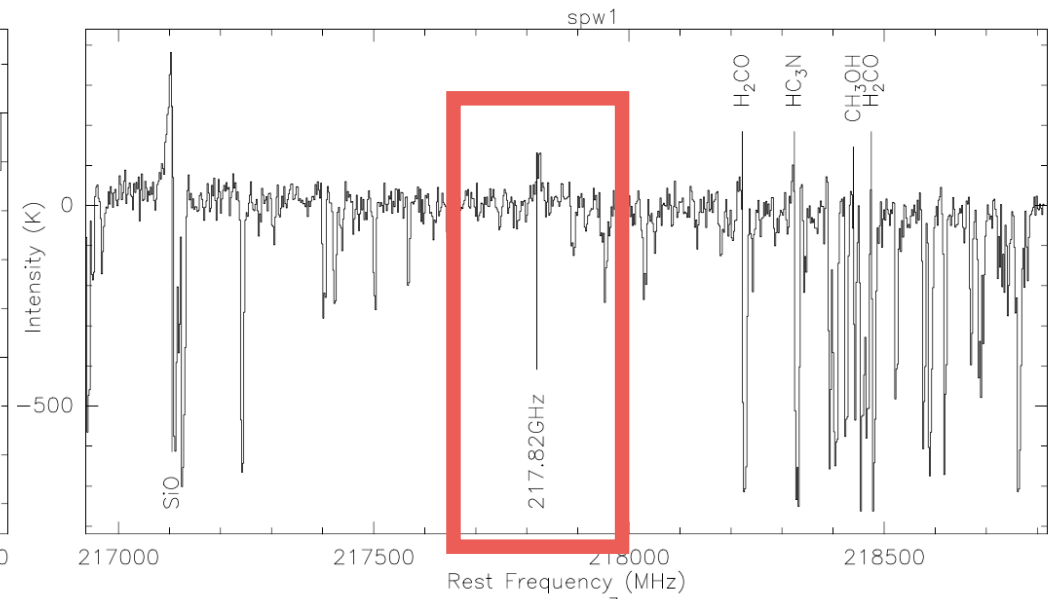
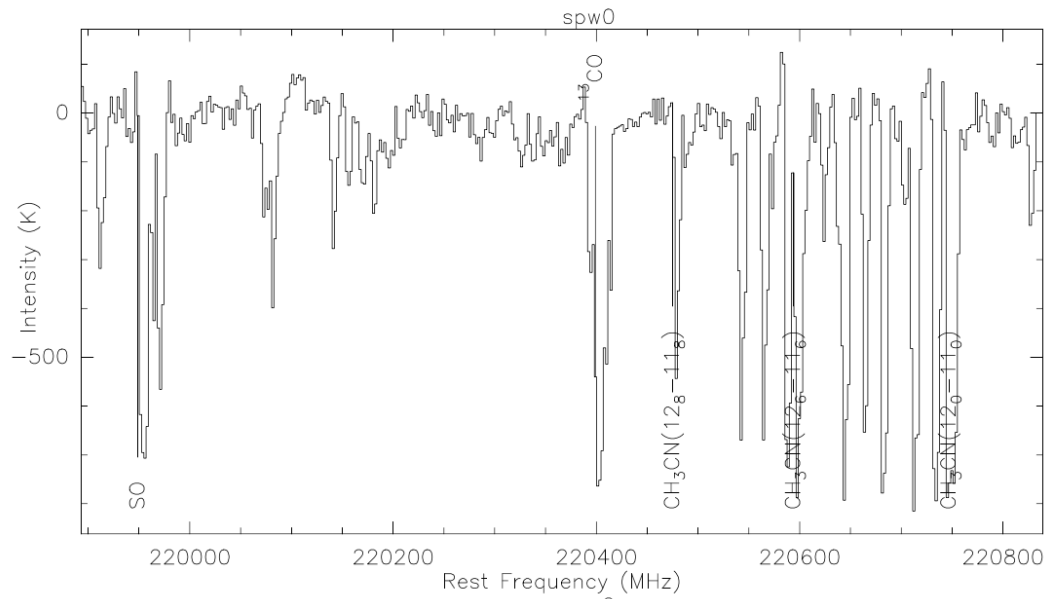




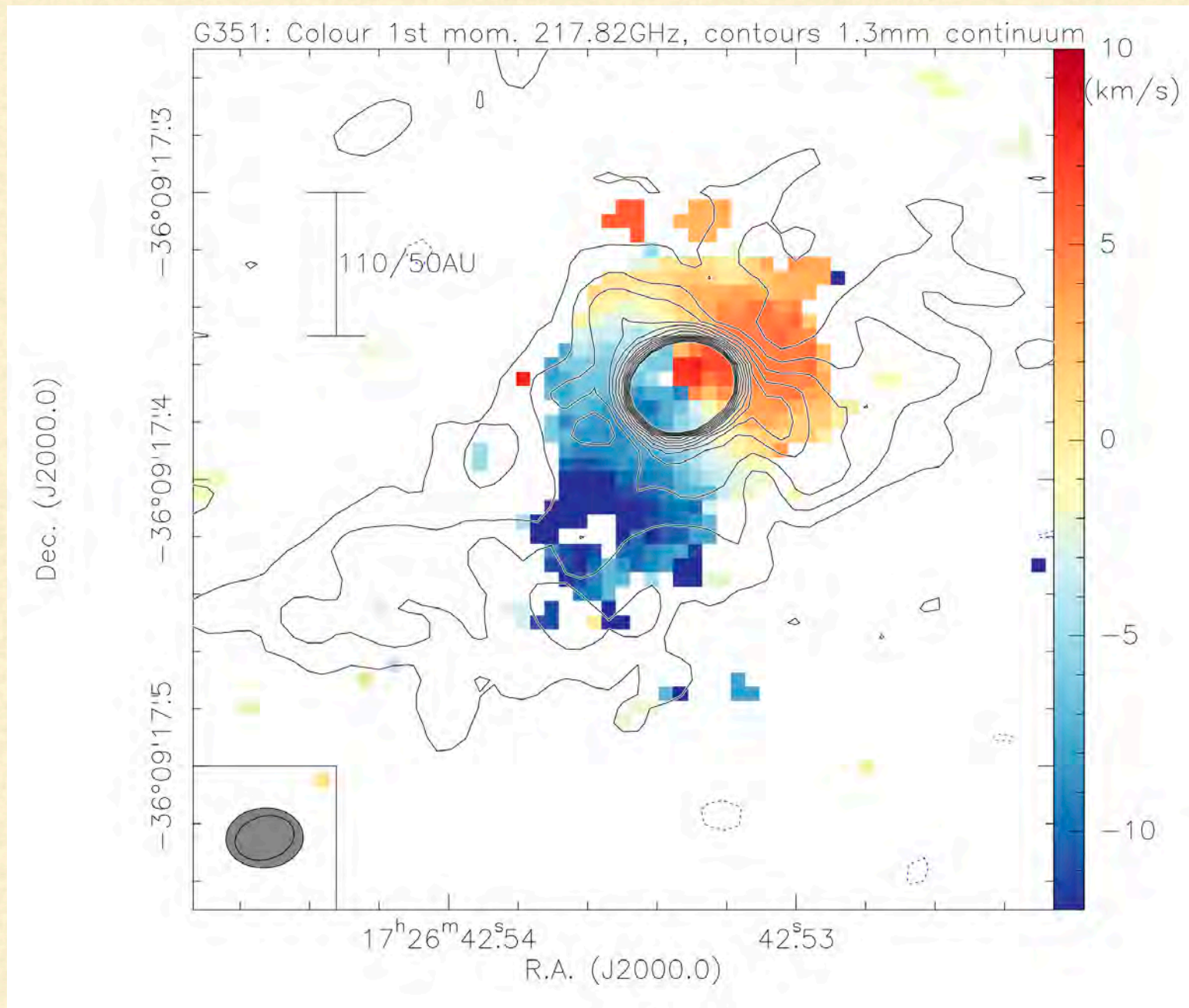
Spectral lines



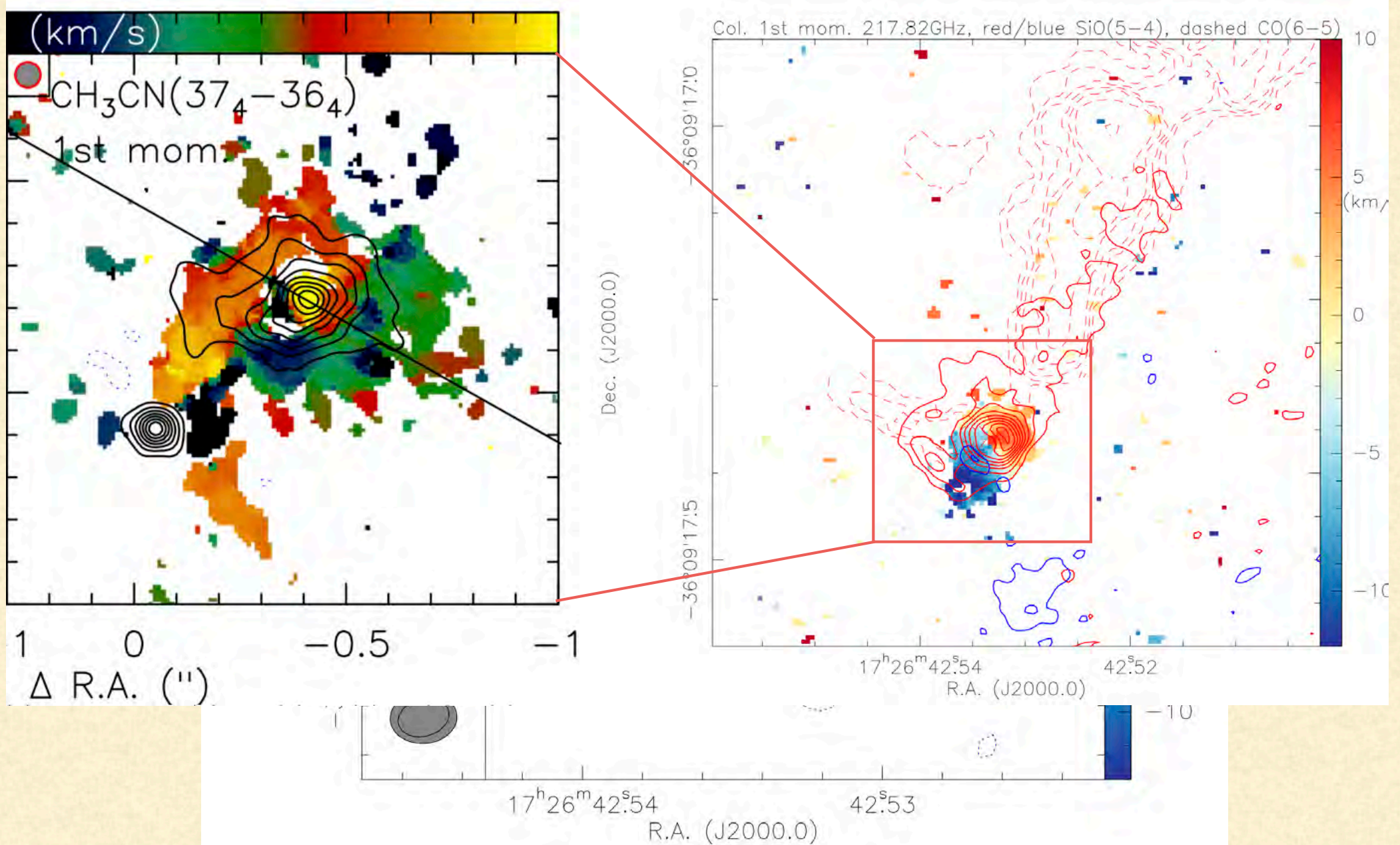
Spectral lines



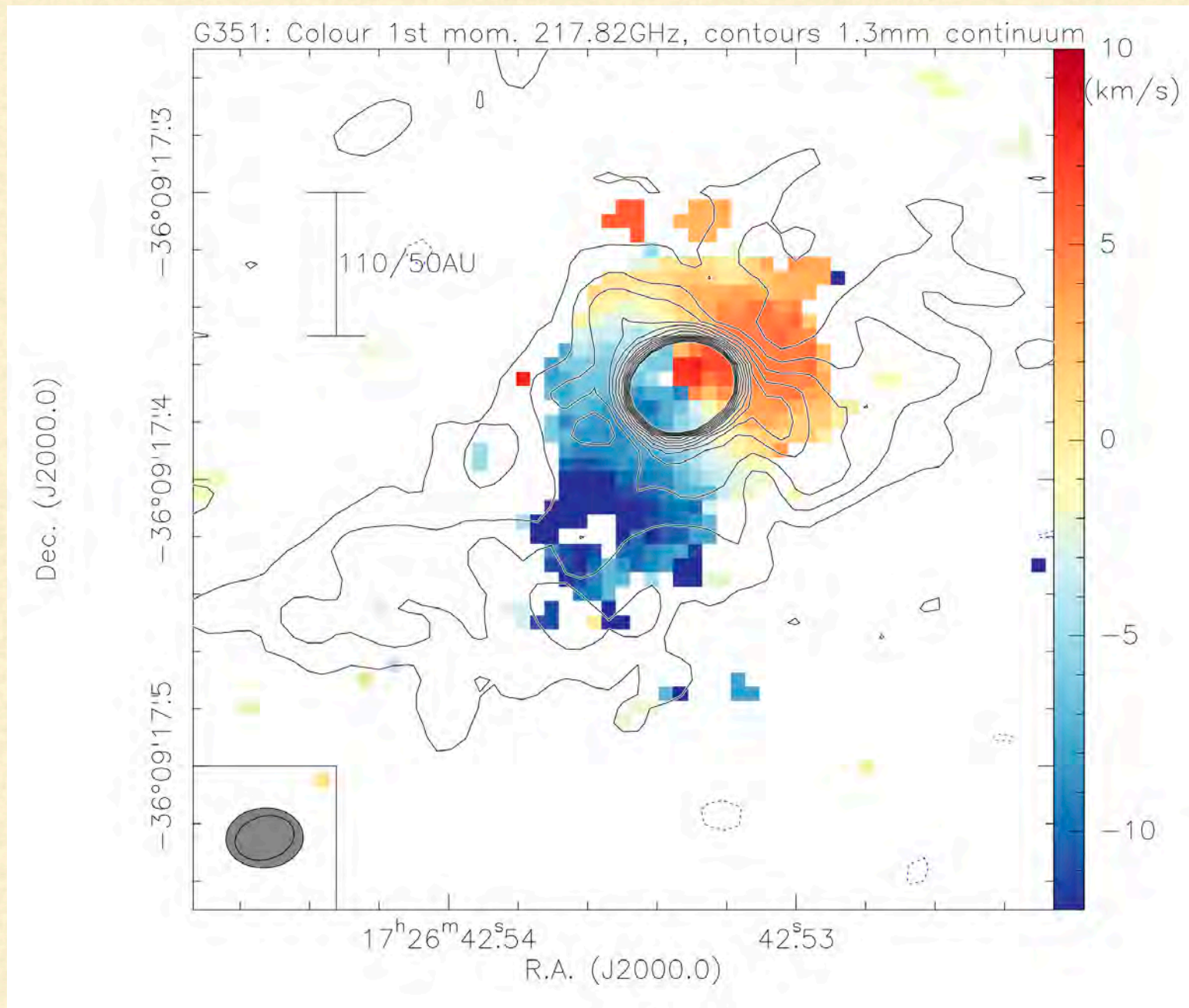
Gas velocities



Gas velocities



Gas velocities



Summary

- Fragment separations very small, below Jeans length
—> possible cause: density structure and magnetic field
 - Toomre analysis allows fragmentation studies on disk scales
 - ALMA long baseline data reveal incredible small-scale structure
 - Highly excited lines may stem from inner outflow, indicative of turbulent entrainment
- > more statistical studies needed!**