

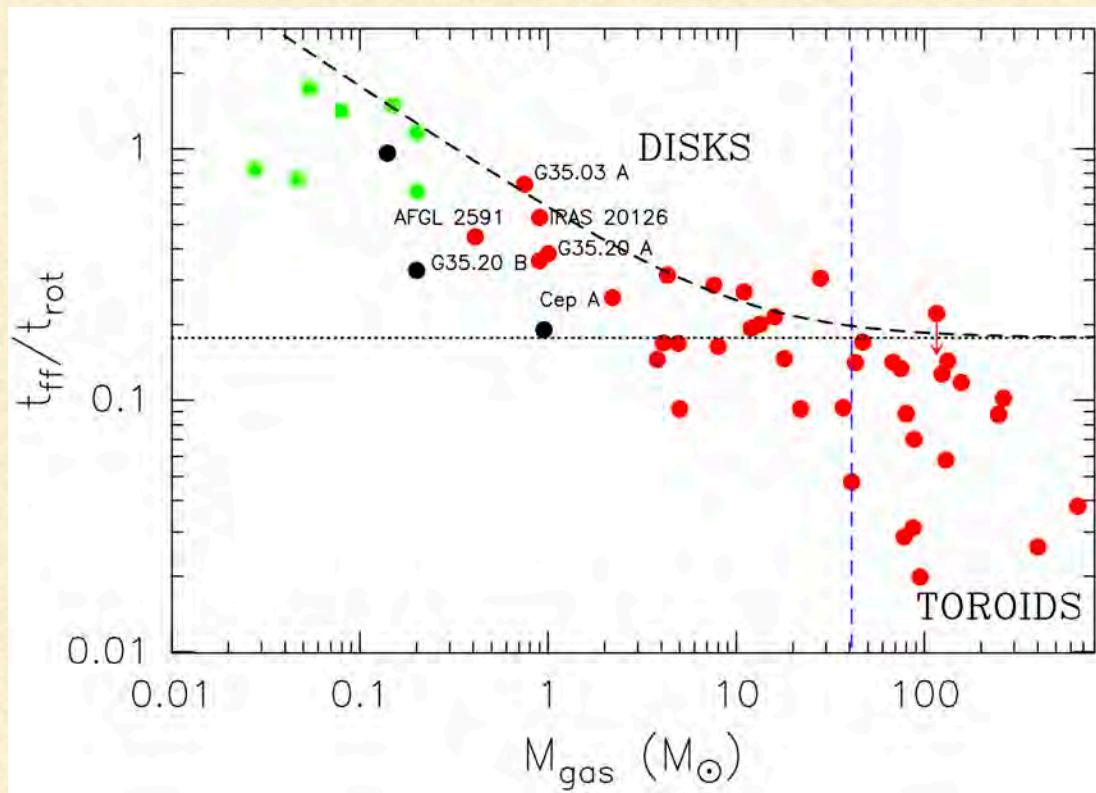
Disk structures and associated outflows in high-mass star formation

Henrik Beuther, MPIA

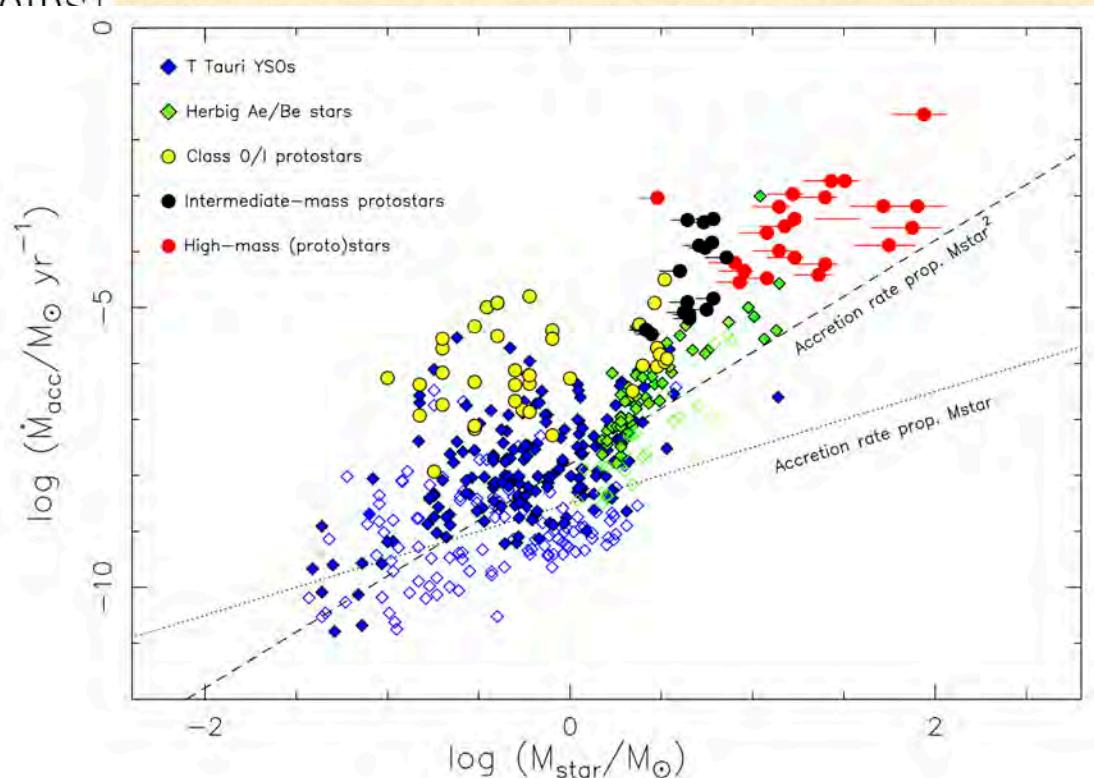
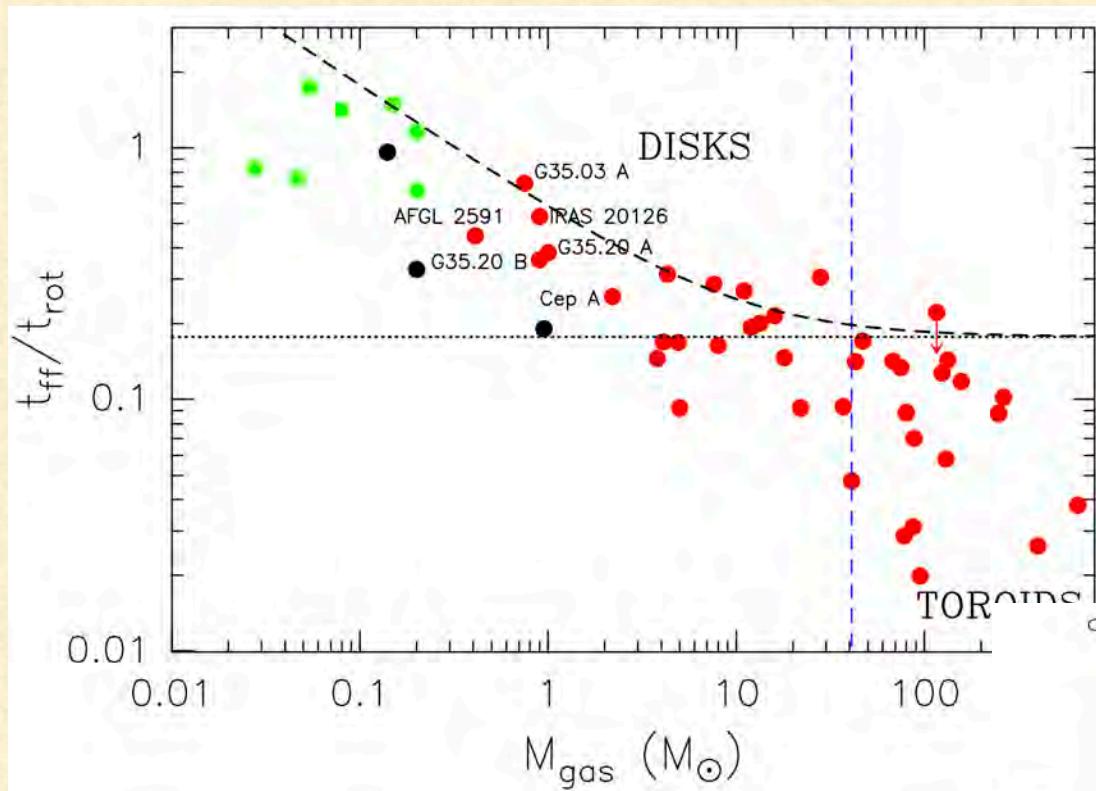
Tracing the flow, Lake Windermere, July 5, 2018



Where were we a few years ago?



Where were we a few years ago?



10^4 - 10^3 au

10^3 - 10^2 au

10^2 - 10 au 10 - 0.1 au

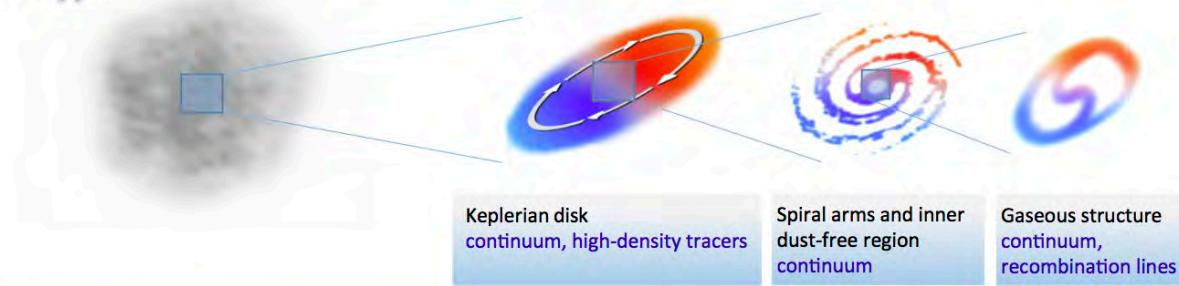
(sub)mm - cm

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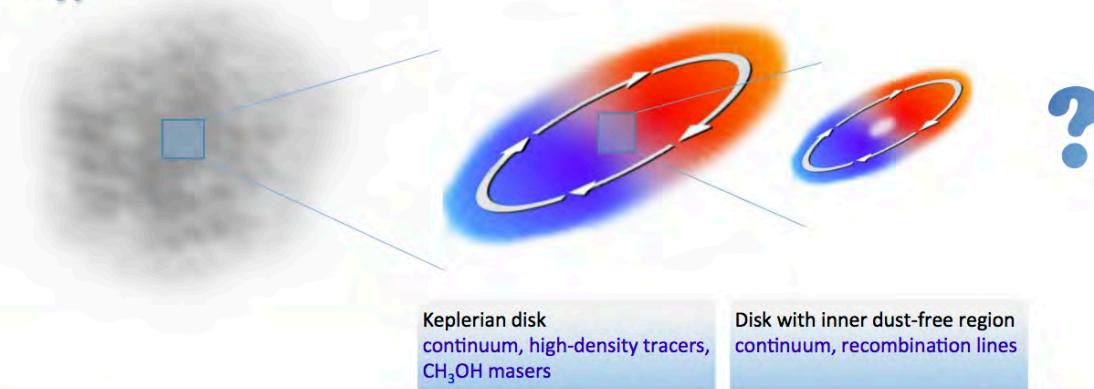
NIR - MIR

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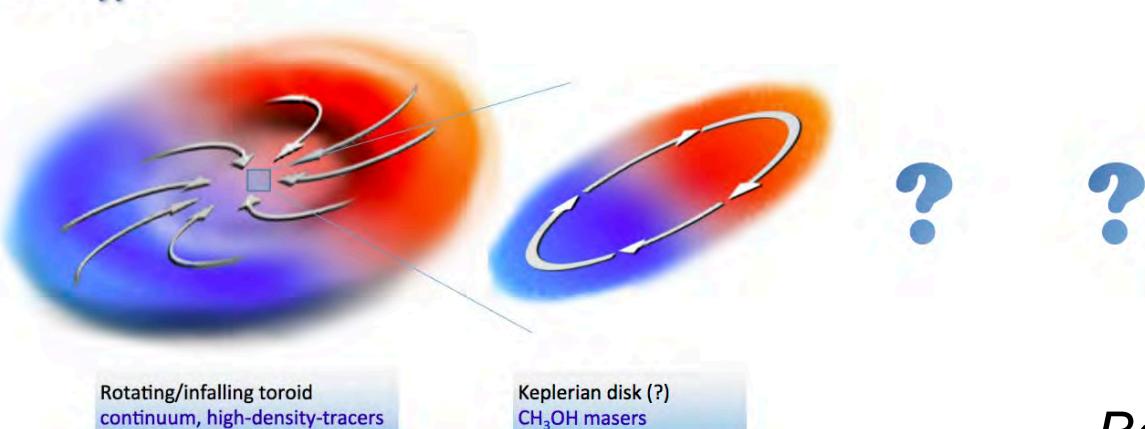
A - type



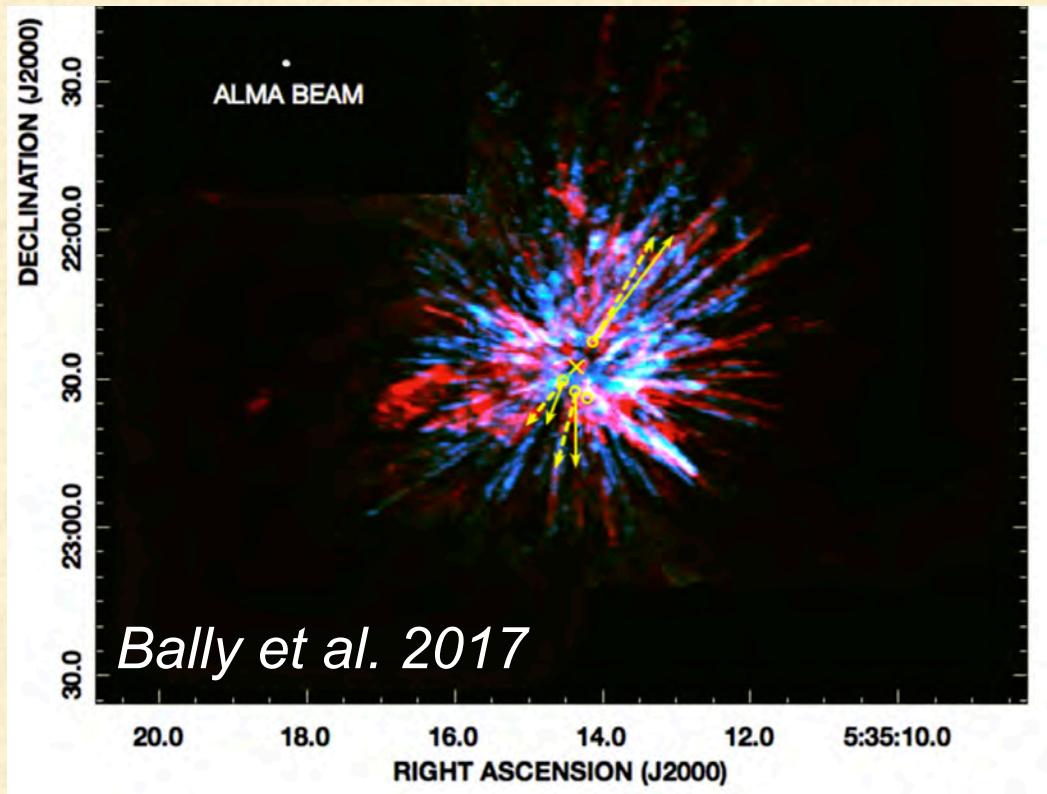
B - type



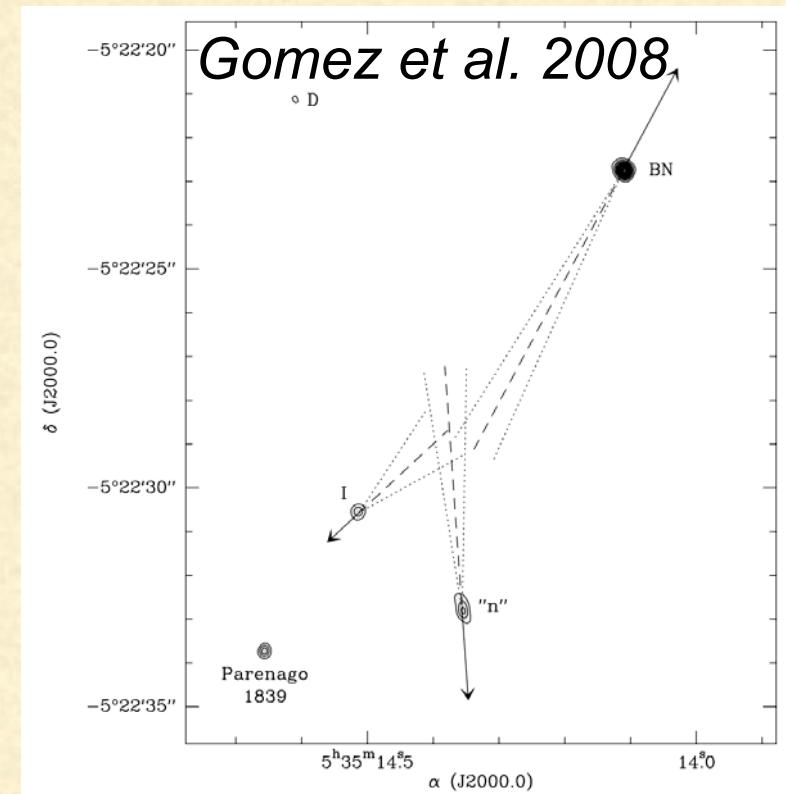
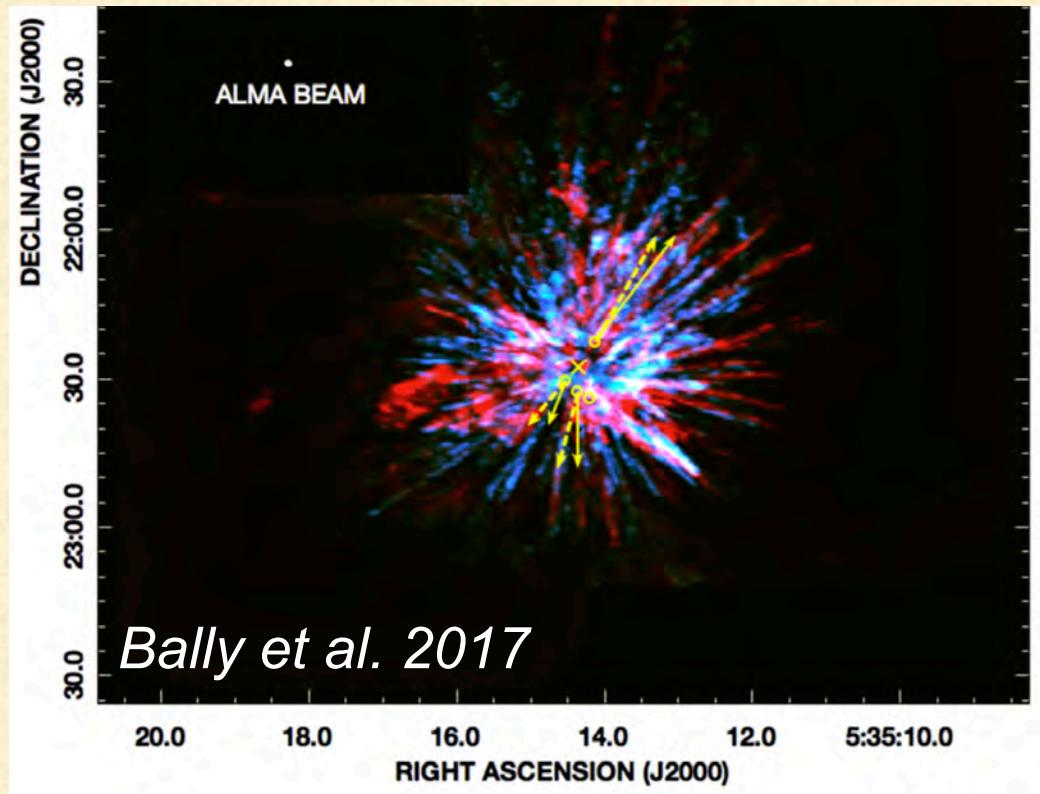
O - type



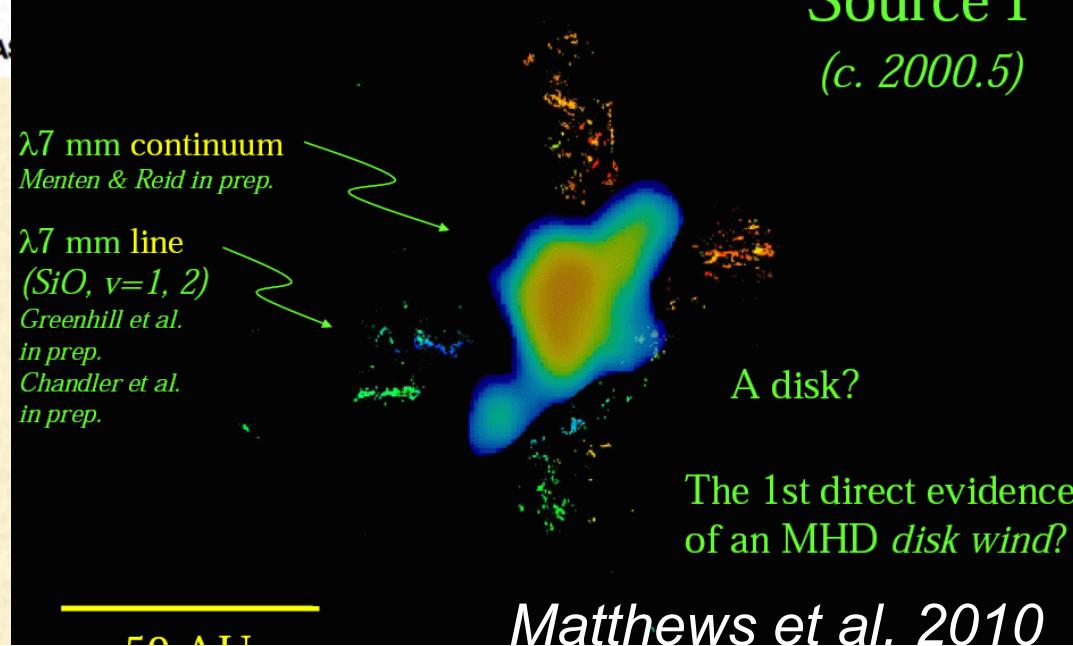
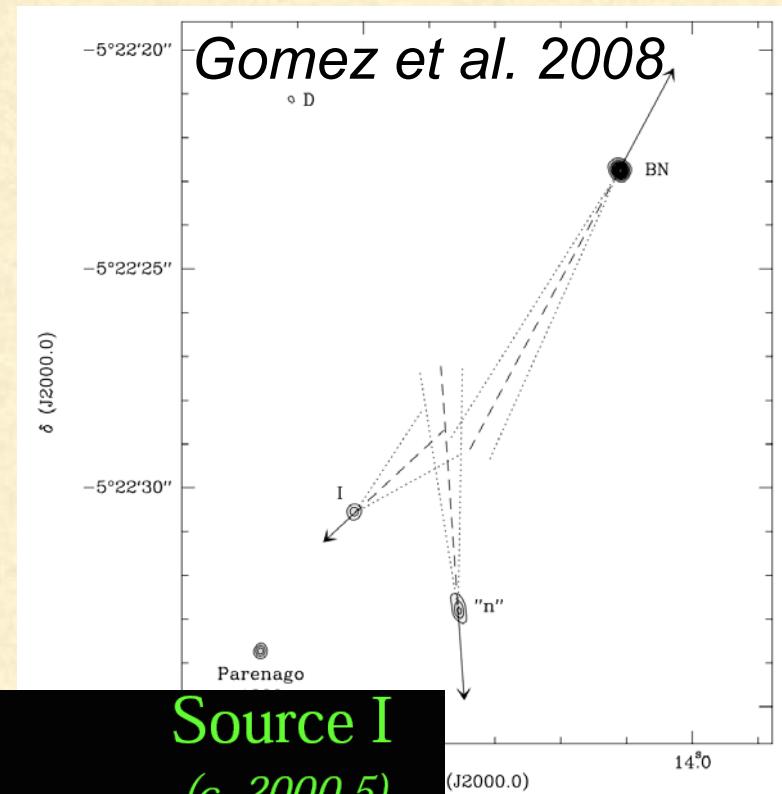
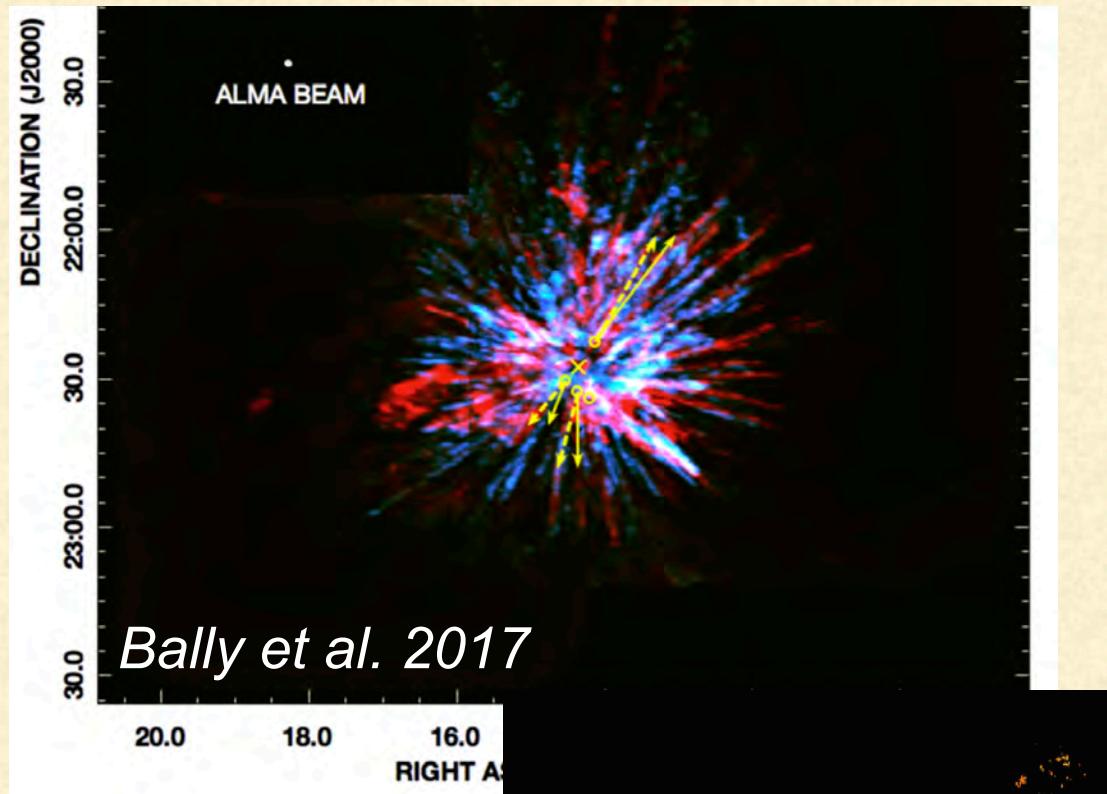
Orion explosion and source I disk



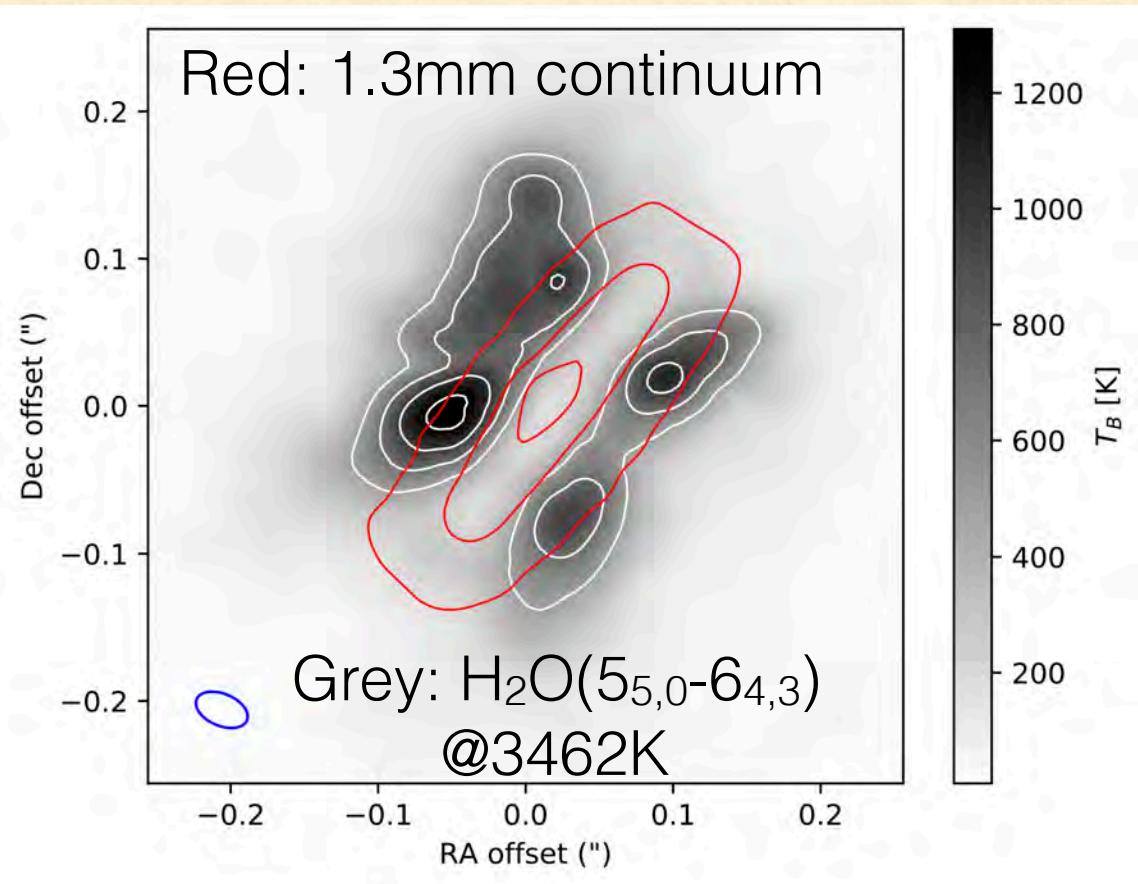
Orion explosion and source I disk



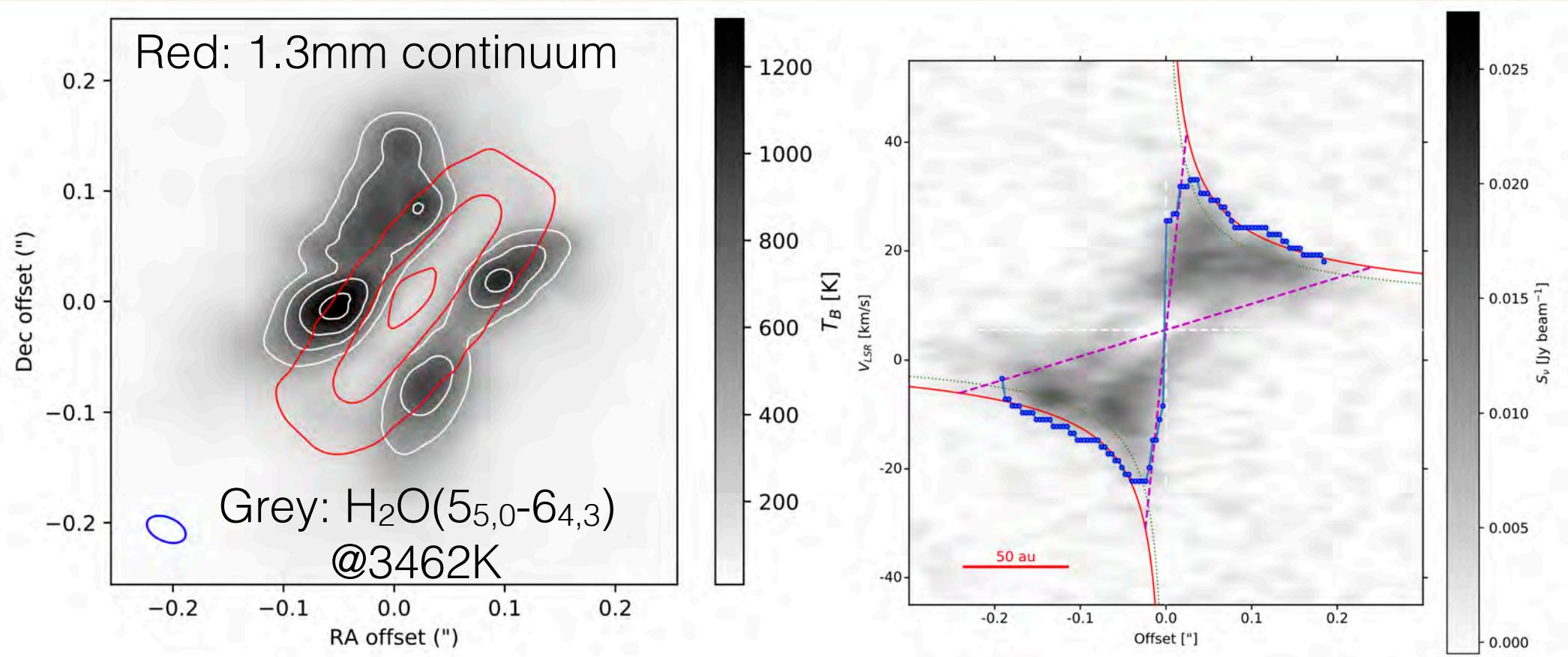
Orion explosion and source I disk



Source I disk



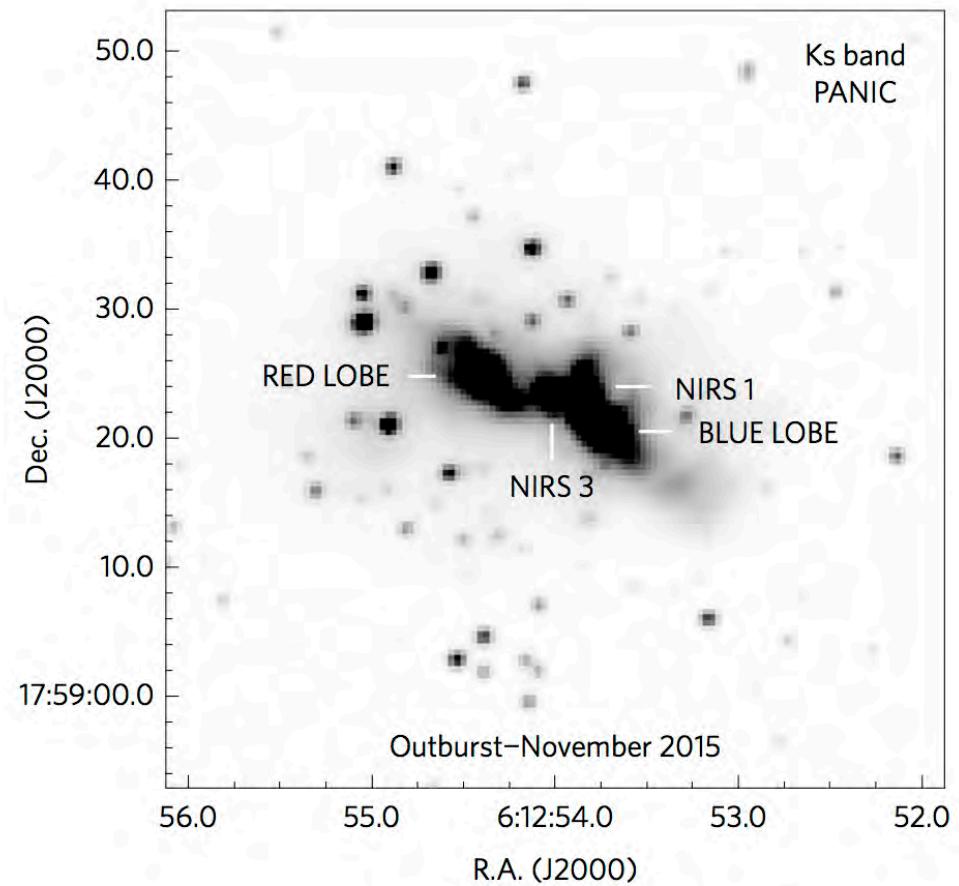
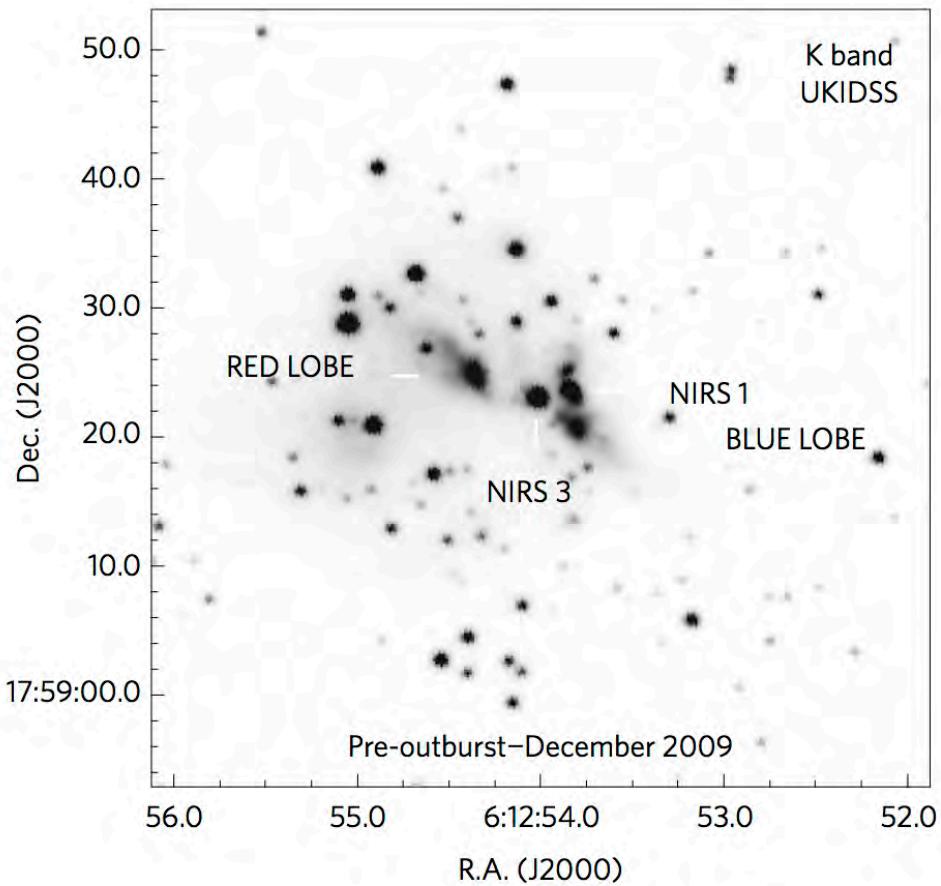
Source I disk



—> 15M_\odot central object

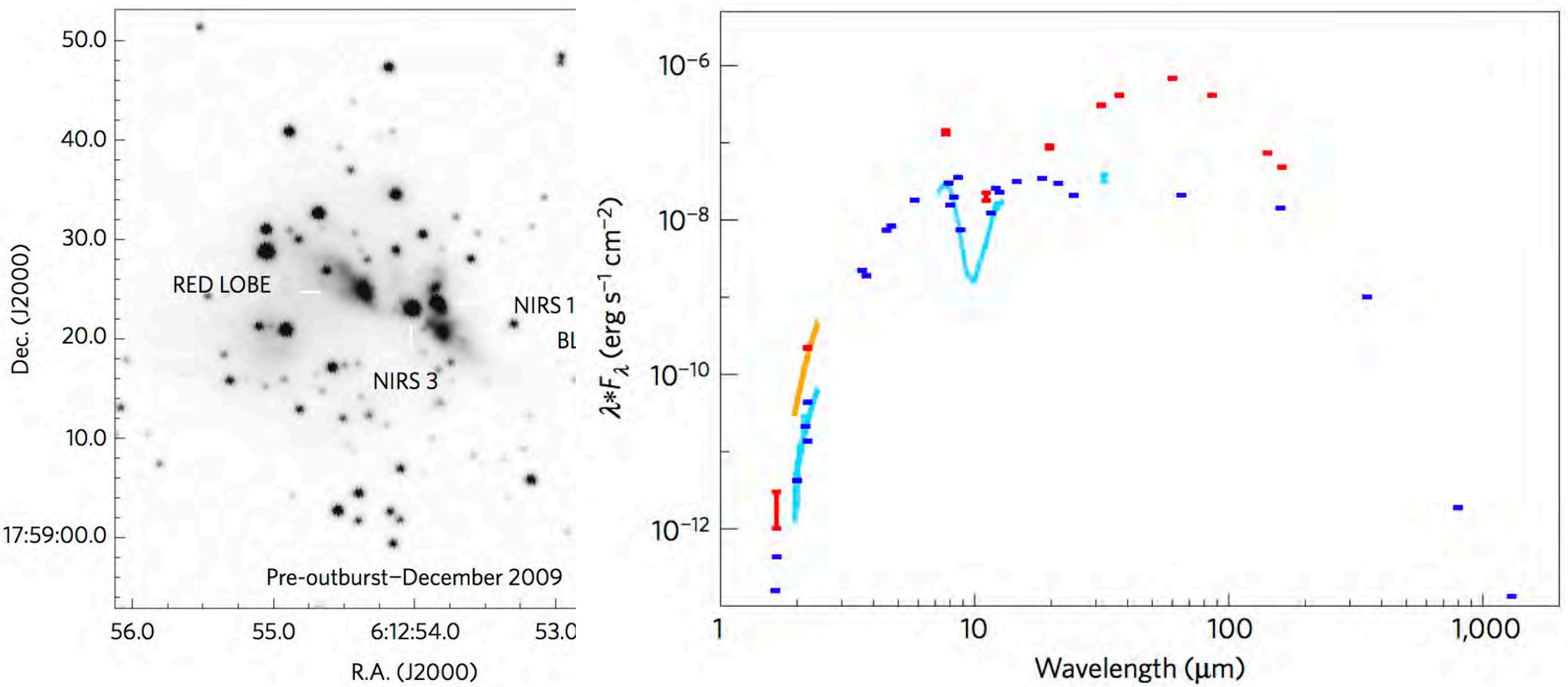
Accretion burst

S255

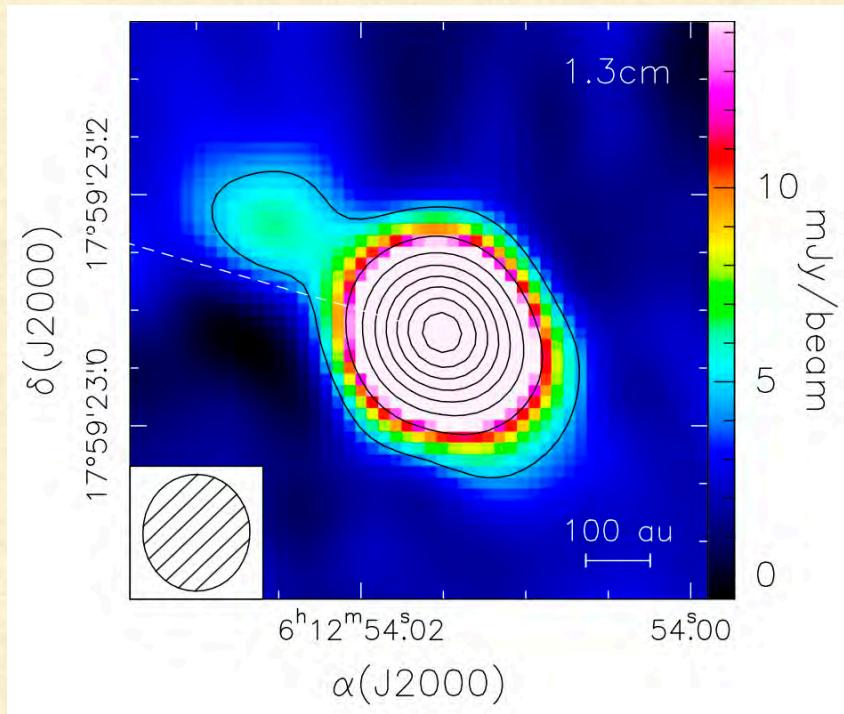


Accretion burst

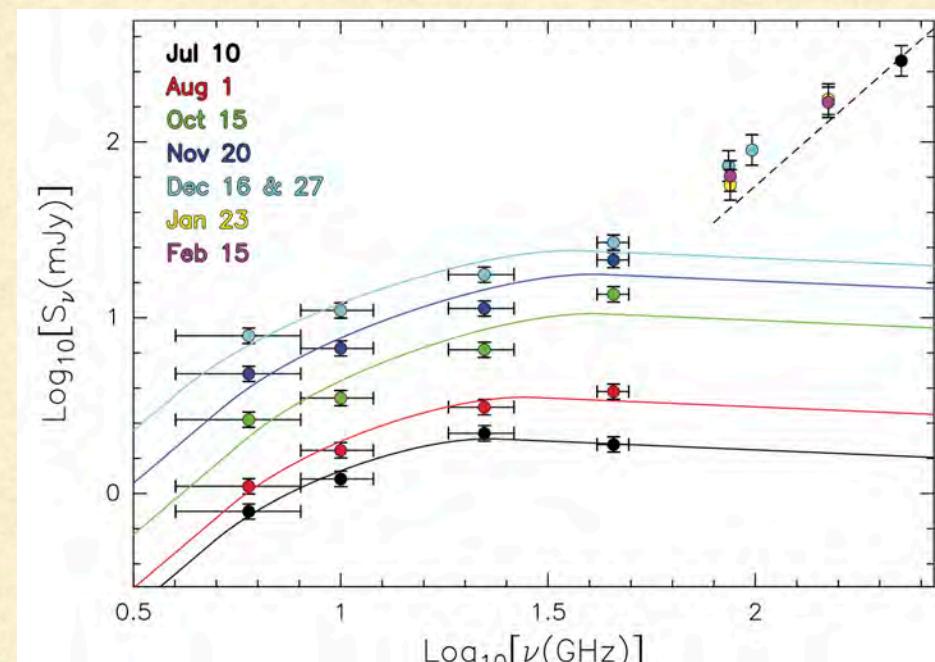
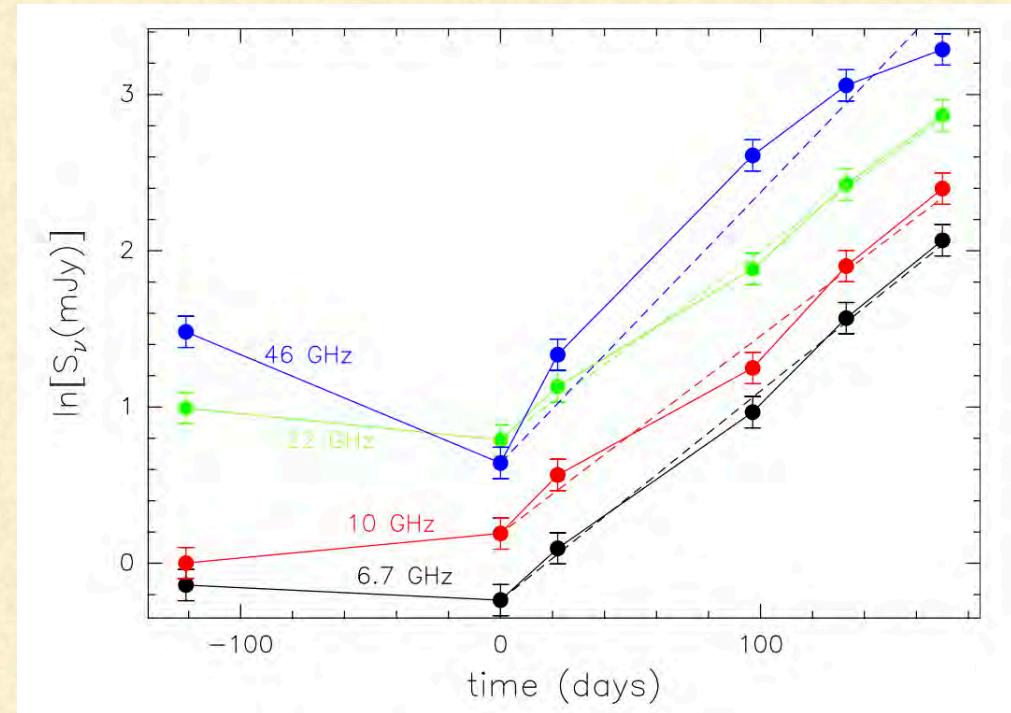
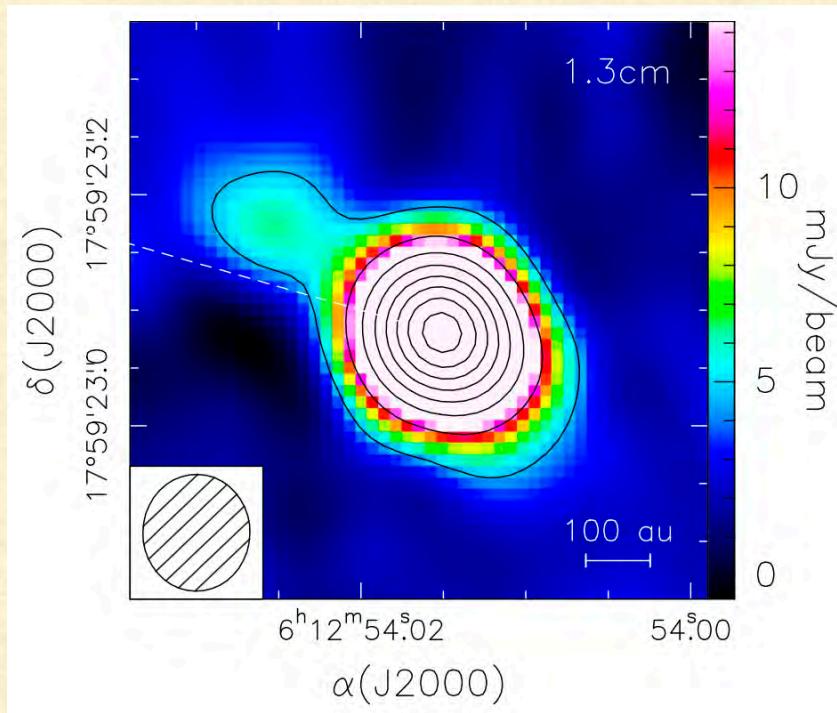
S255



Radio jet outburst



Radio jet outburst



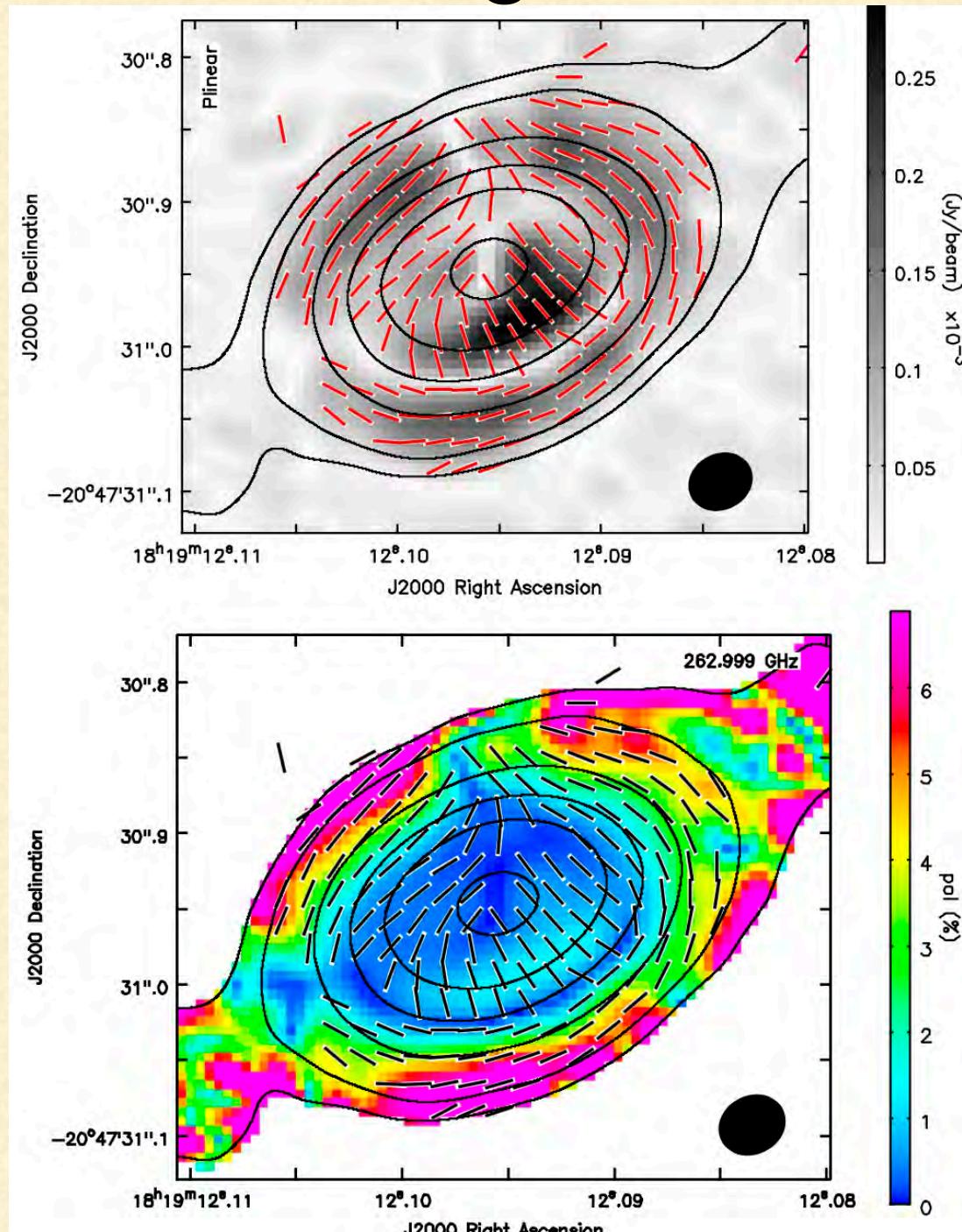
Polarization in high-mass disks

Grey:
polarized intensity

Contours: Stokes I

Segments:
polarisation angles

Color: polarization
fraction



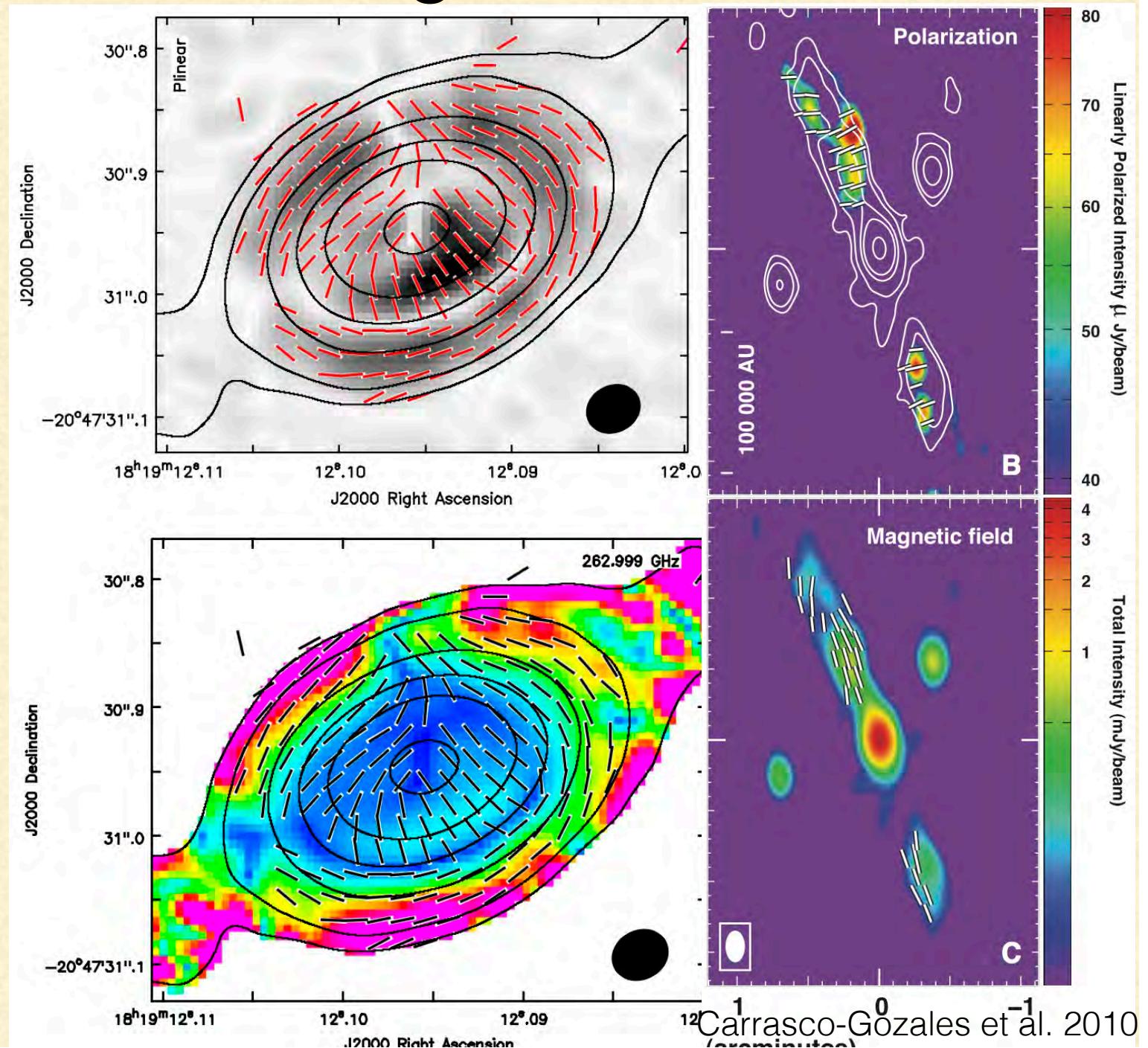
Polarization in high-mass disks

Grey:
polarized intensity

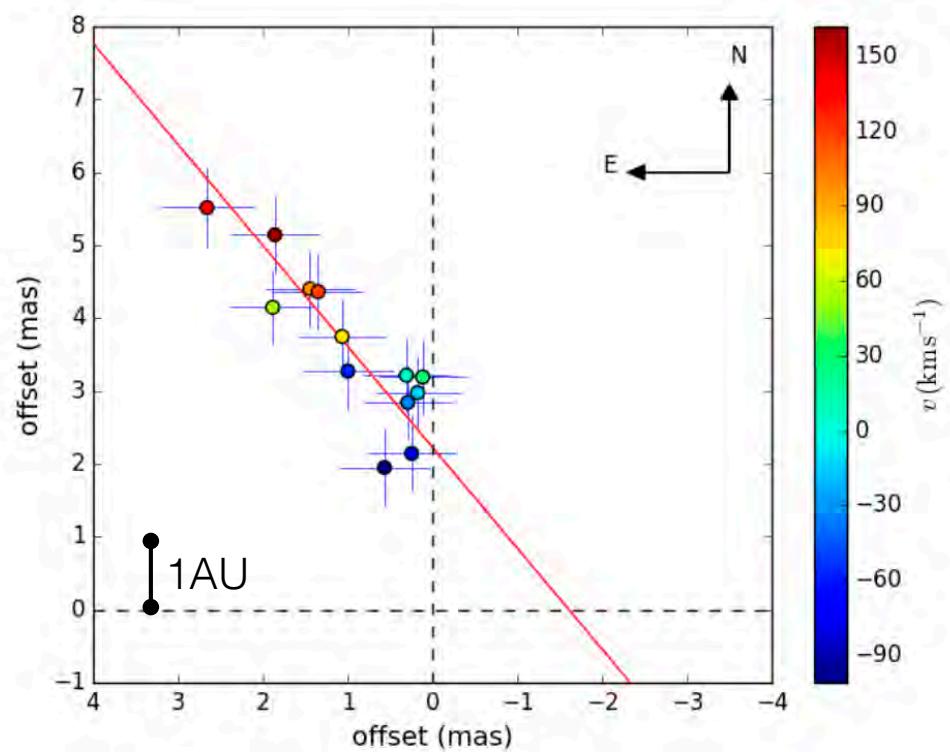
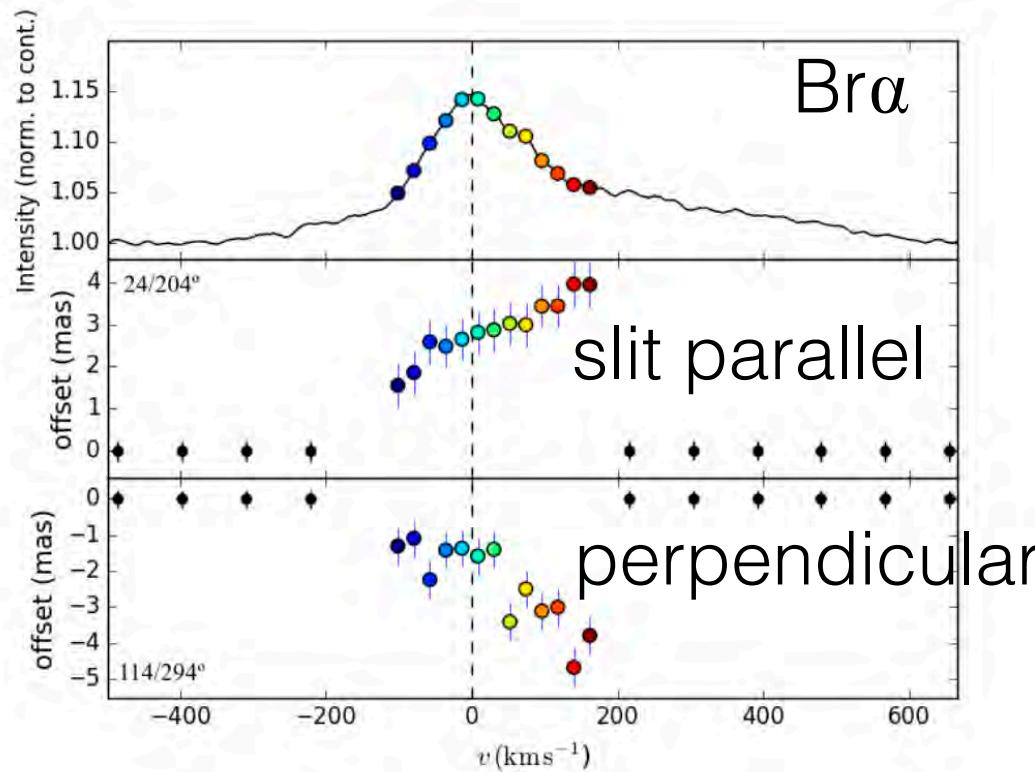
Contours: Stokes I

Segments:
polarisation angles

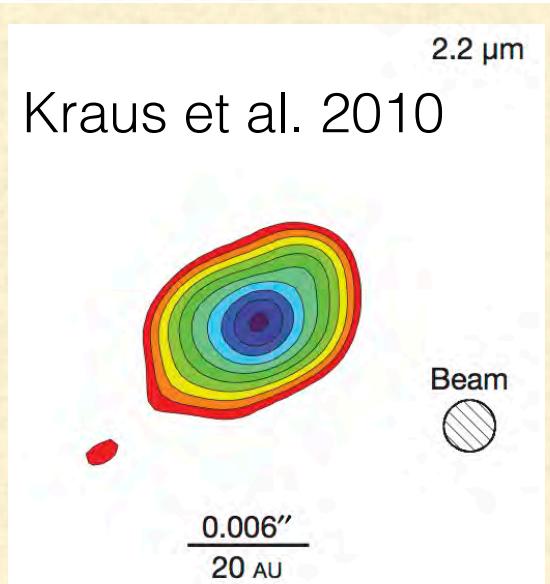
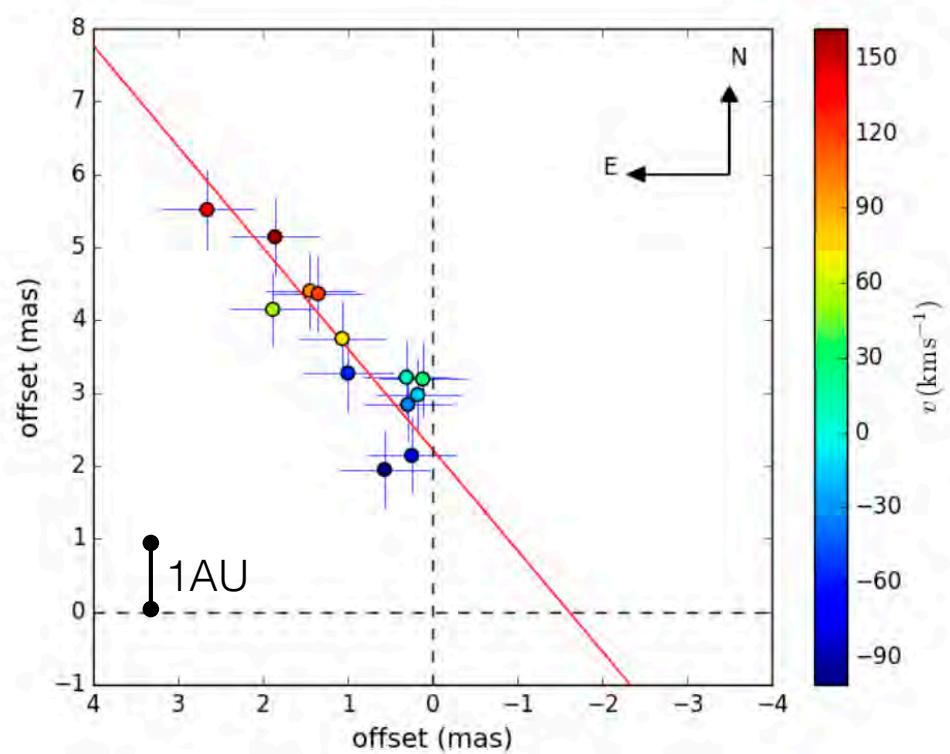
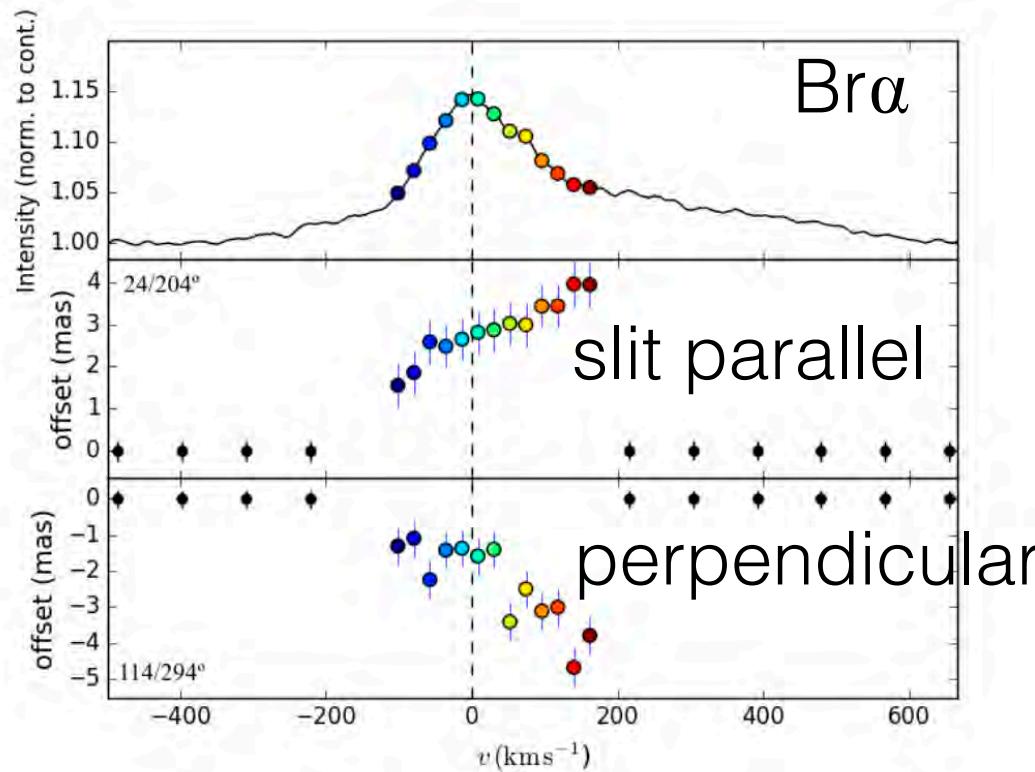
Color: polarization
fraction



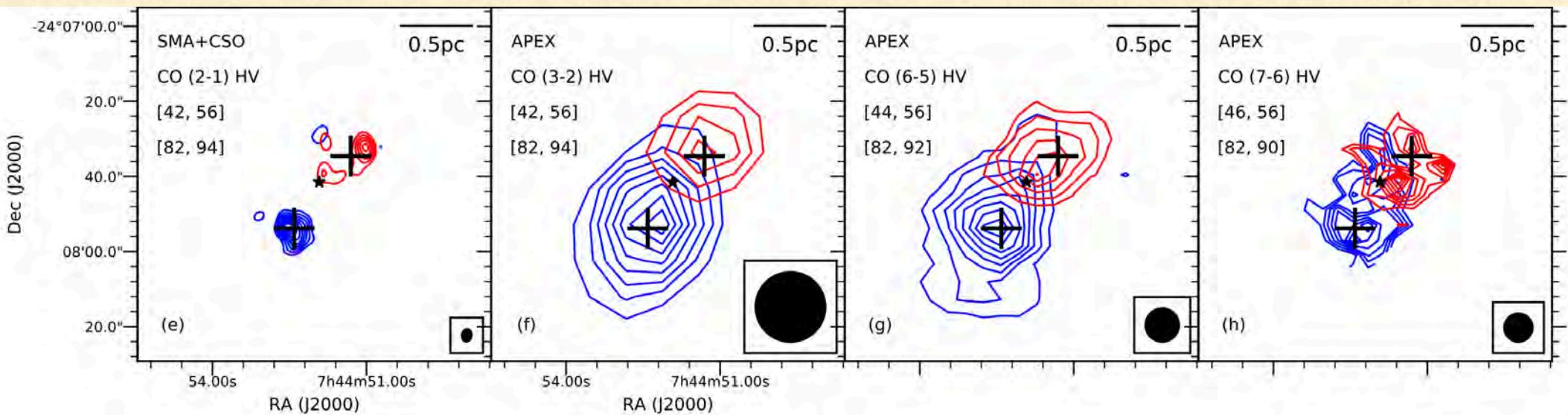
AU-scale jet emission (IRAS13481)



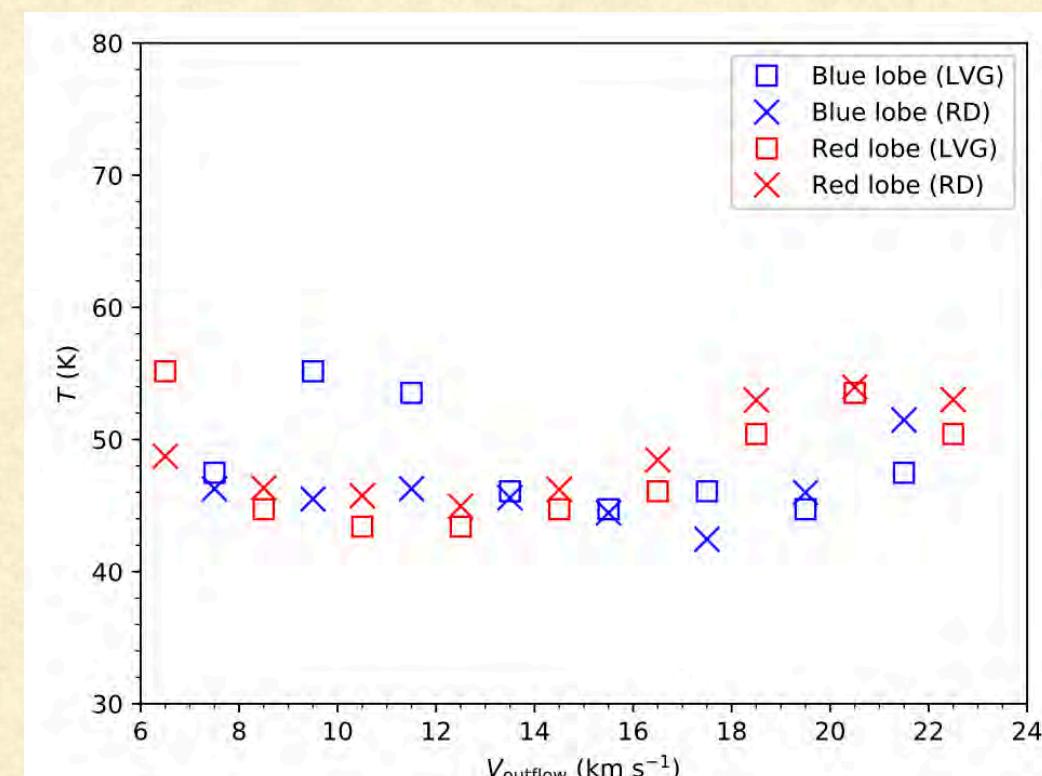
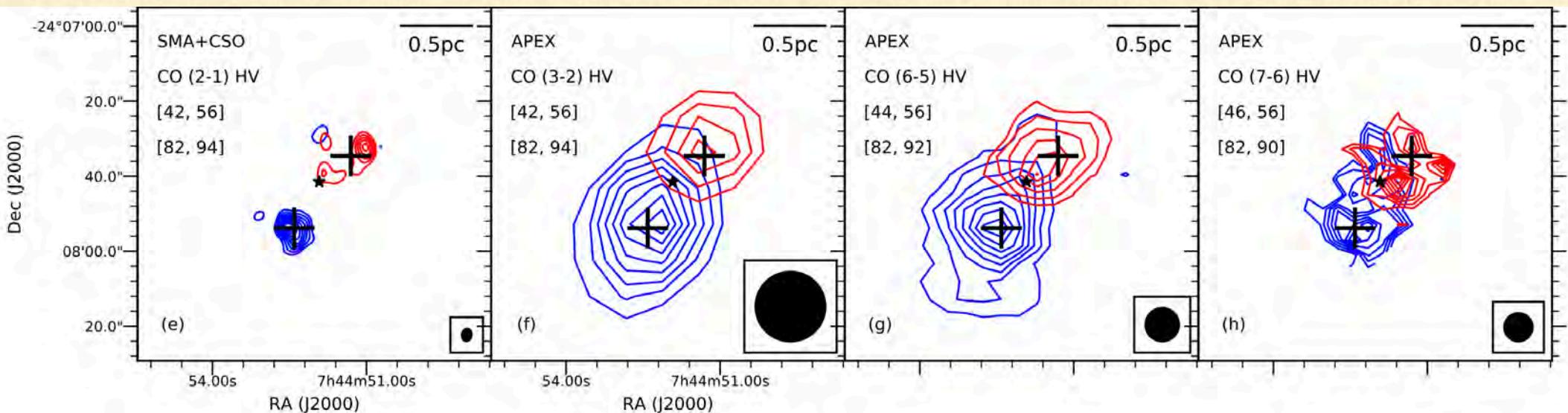
AU-scale jet emission (IRAS13481)



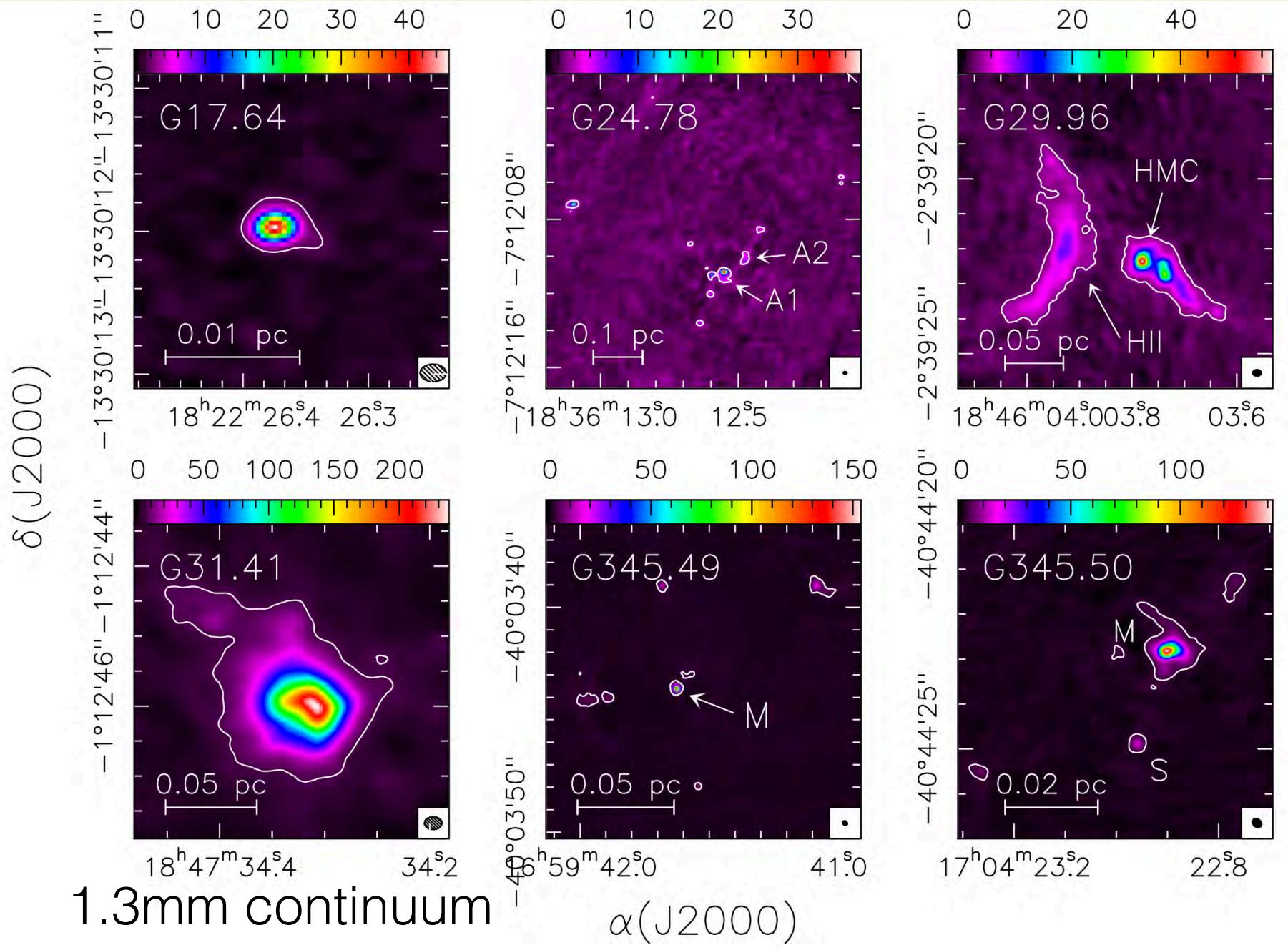
Isothermal outflow properties



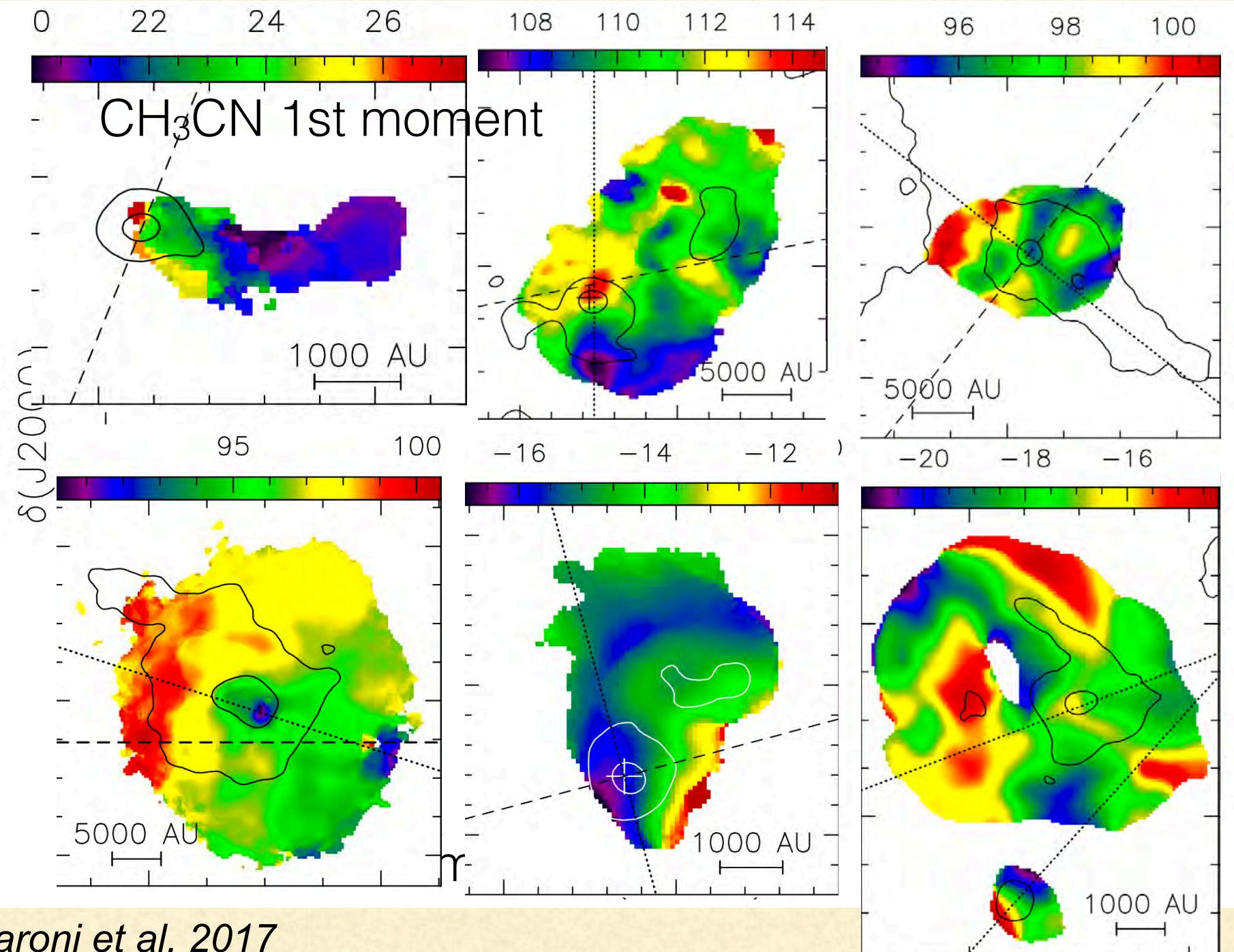
Isothermal outflow properties

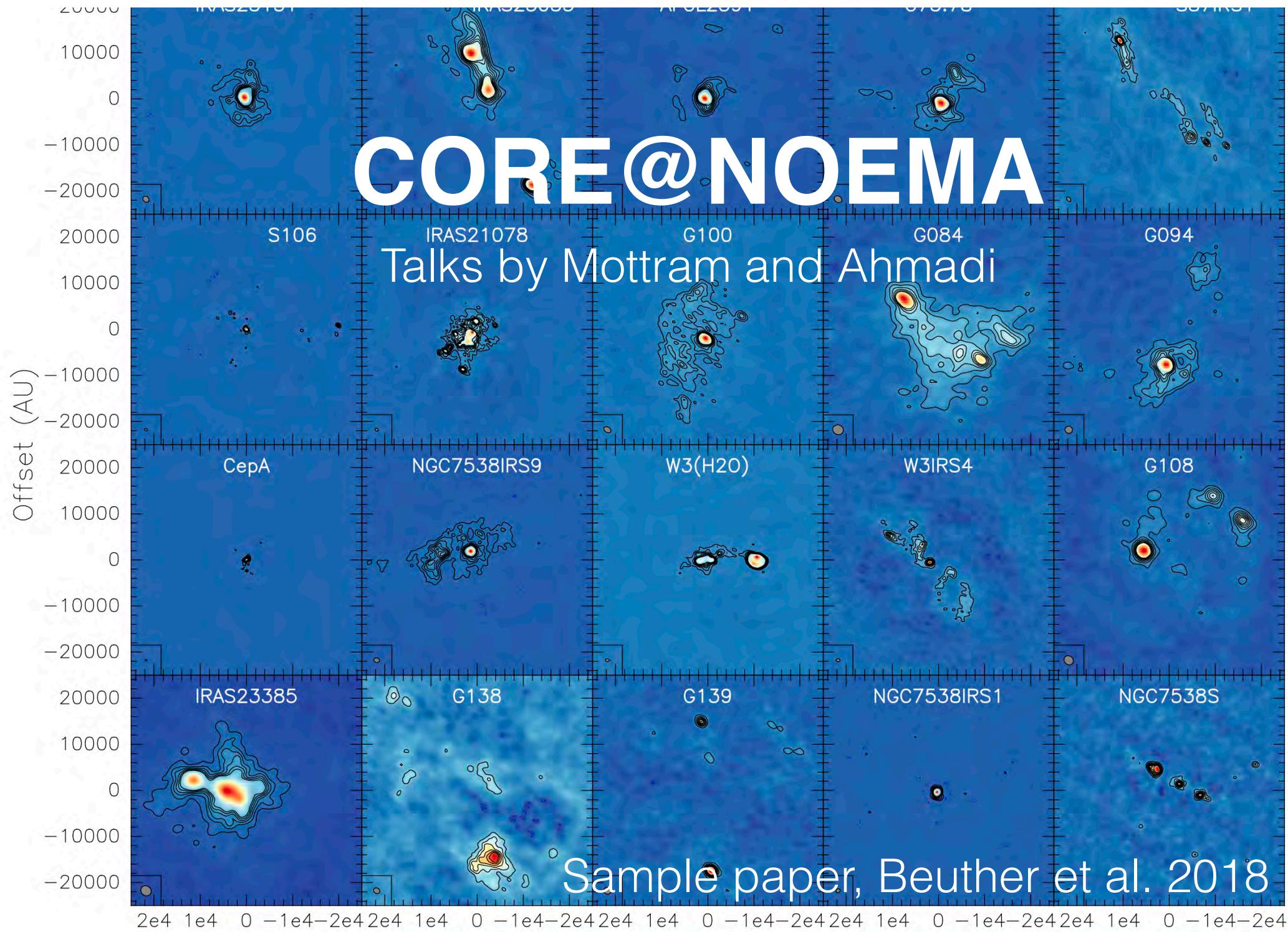


Possible disks around O-type sources

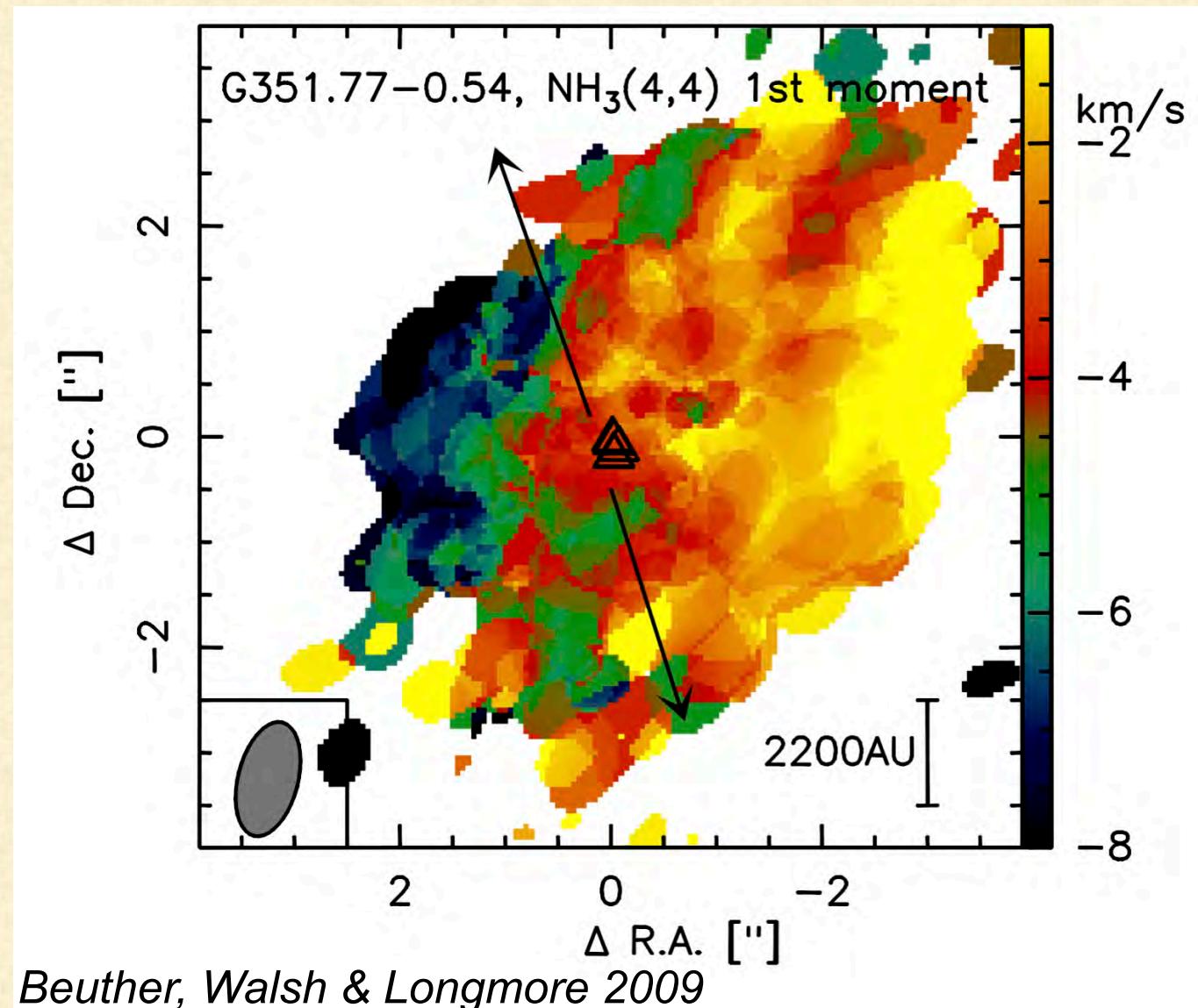


Possible disks around O-type sources

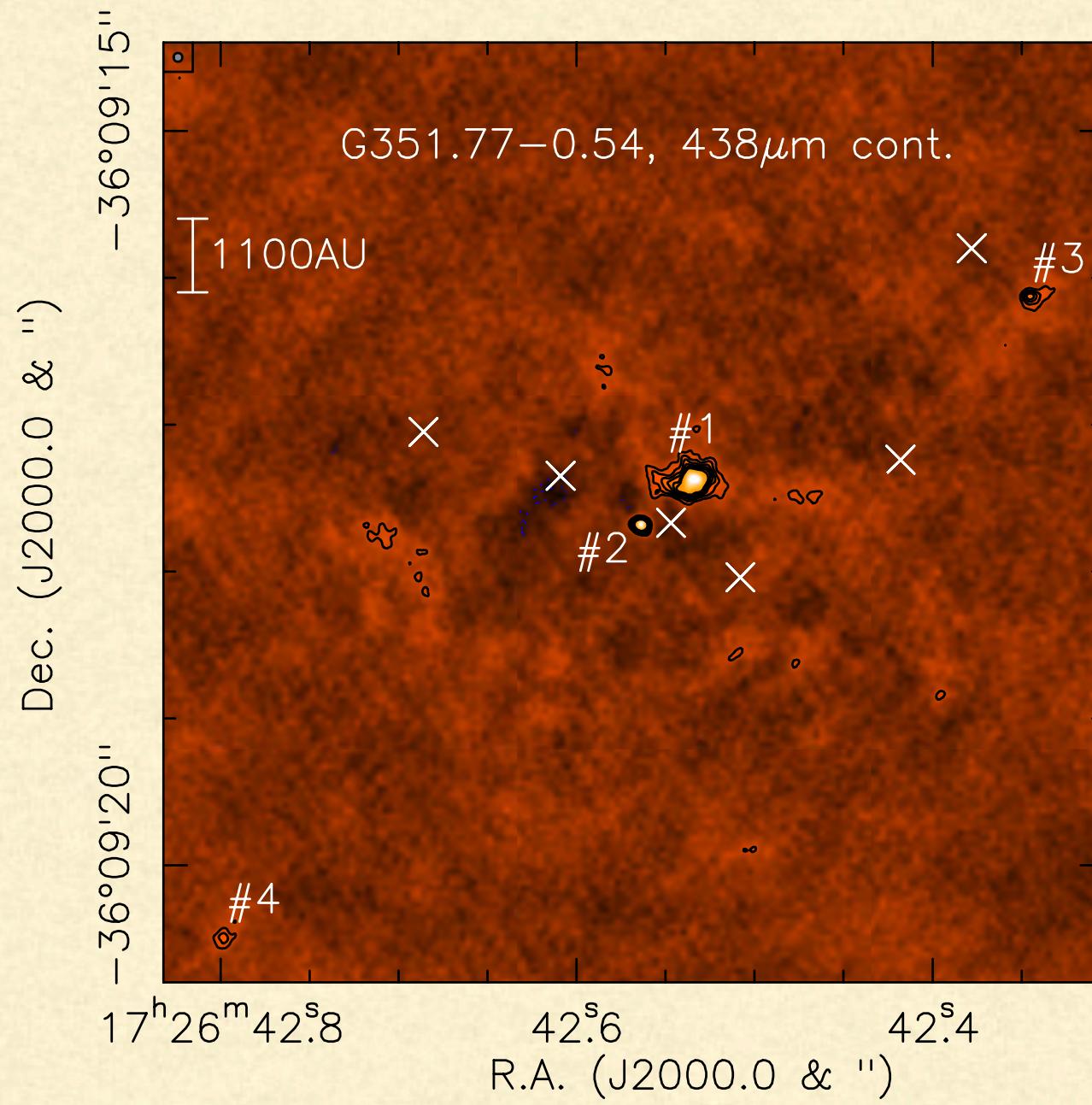




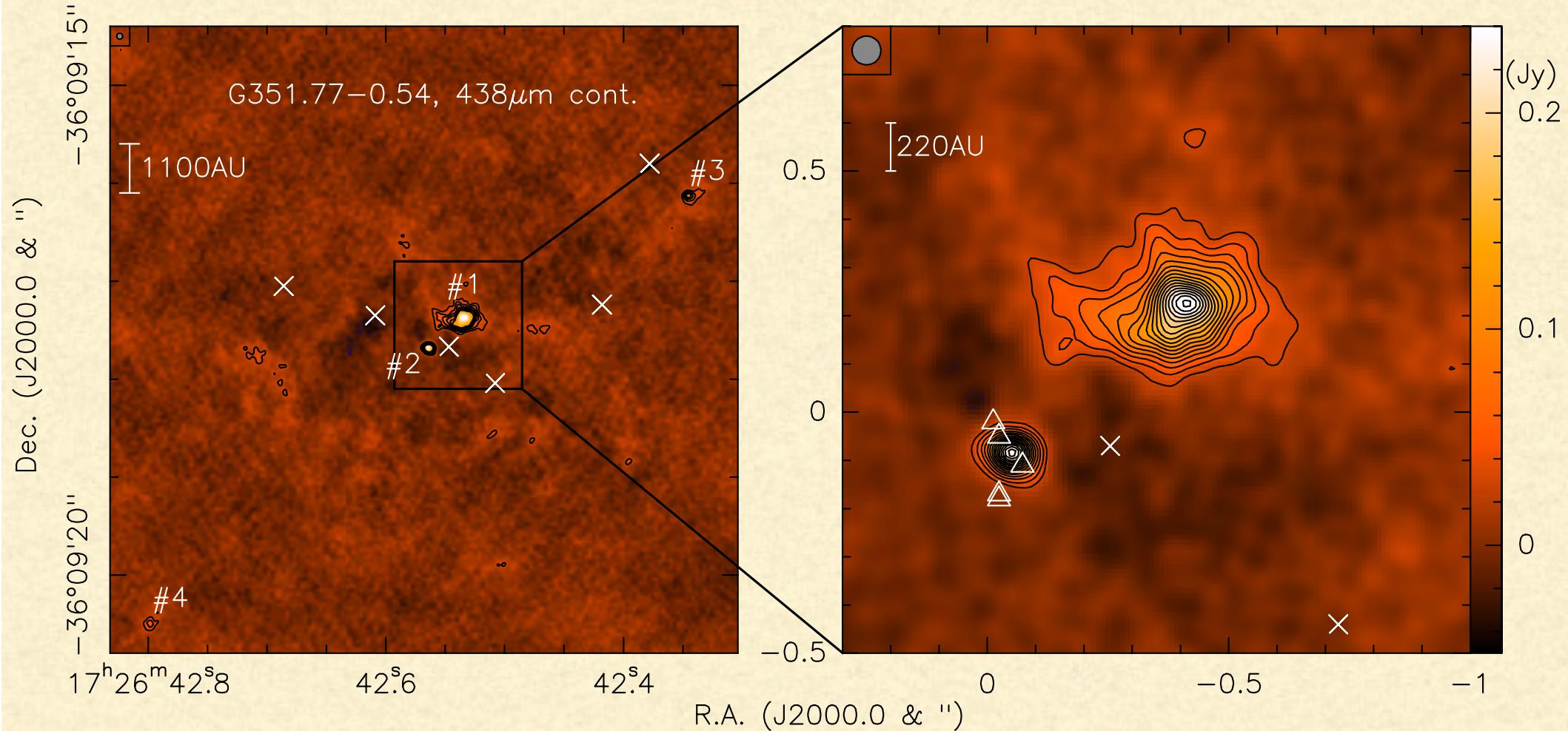
The hot core G351: ALMA@690GHz & 0.06"



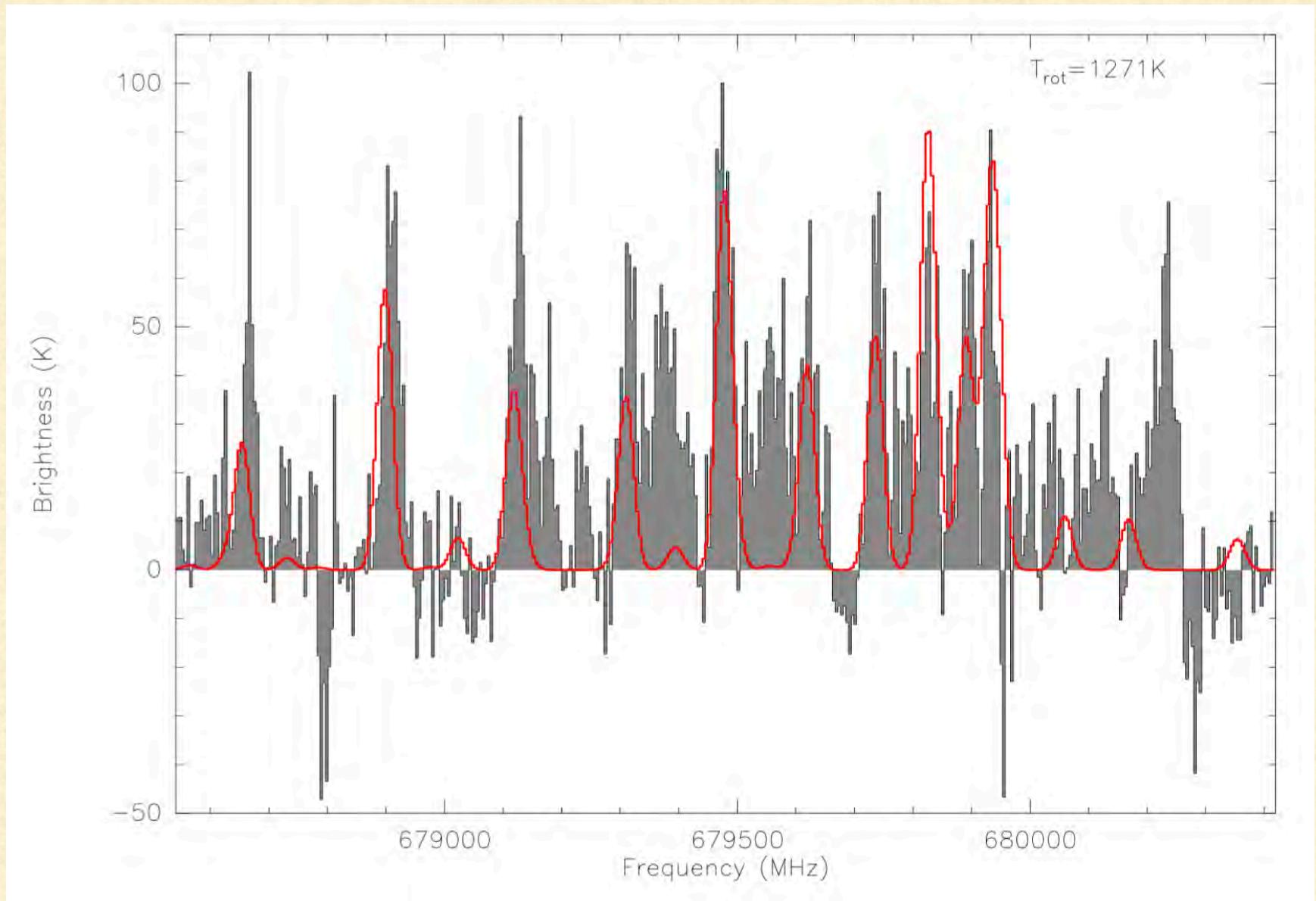
The hot core G351: ALMA@690GHz & 0.06"



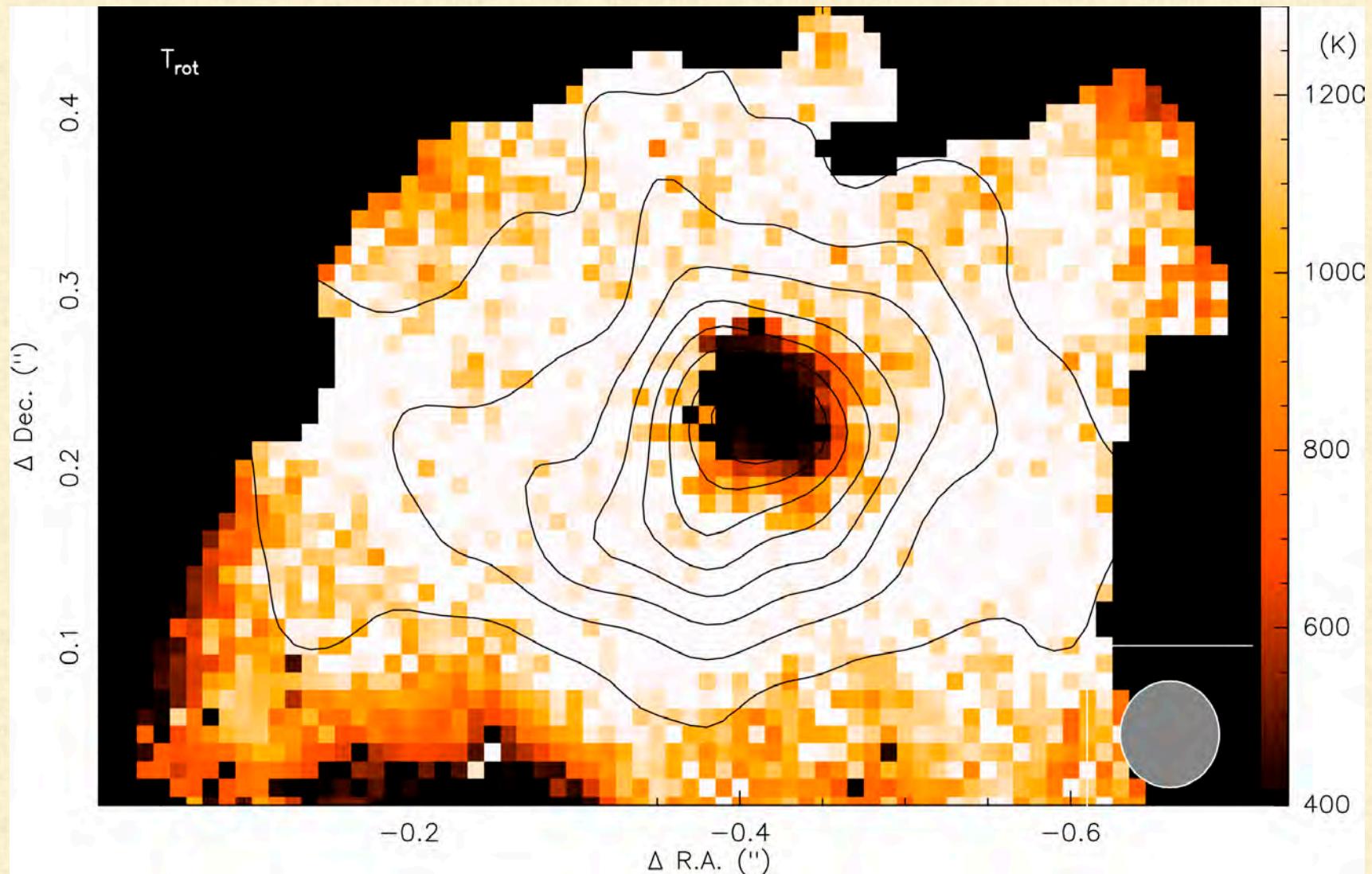
The hot core G351: ALMA@690GHz & 0.06"



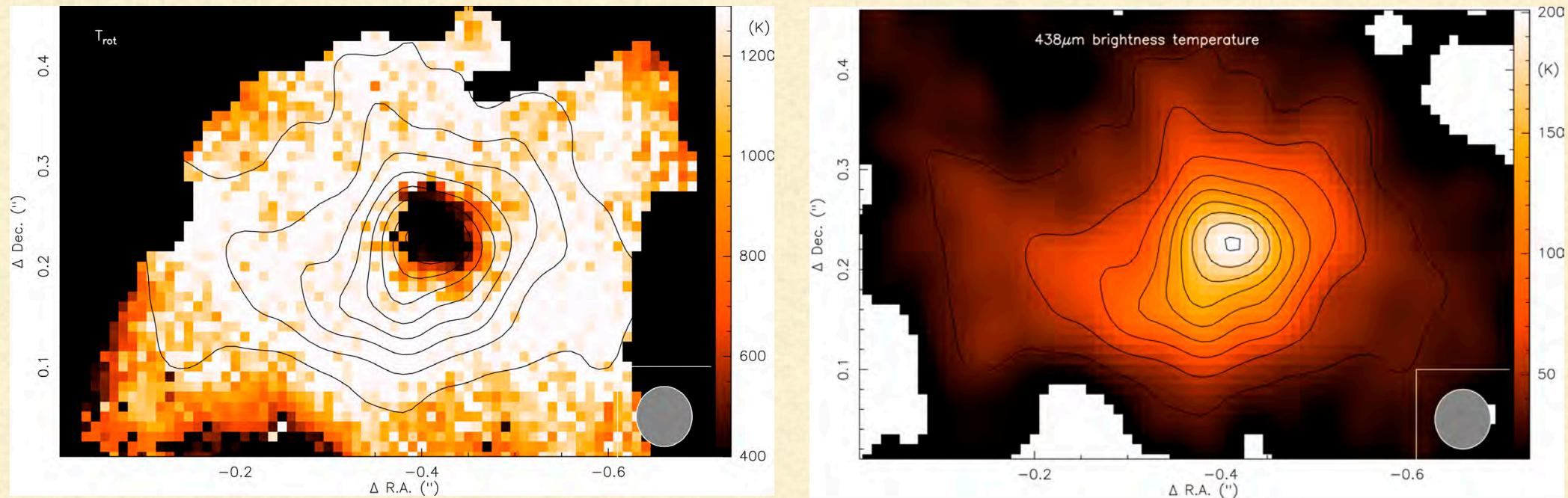
Temperature measurement



Temperature measurement



Temperature measurement



17^h26^m42^s5
-36°09'11" -36°09'20" -36°09'20"

G351.77-0.54, 1.3mm

I1100/500AU

2

1

4

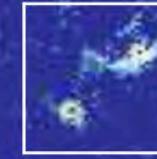
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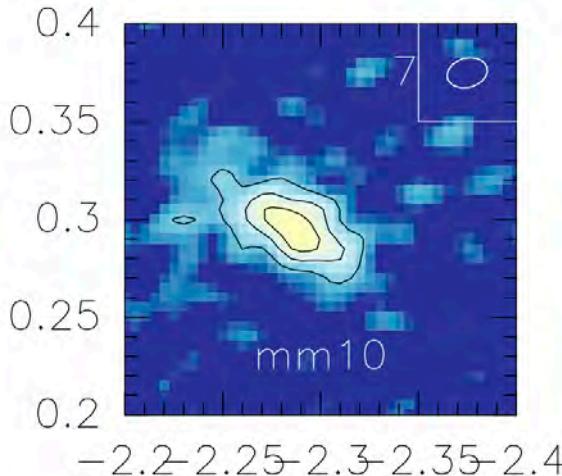
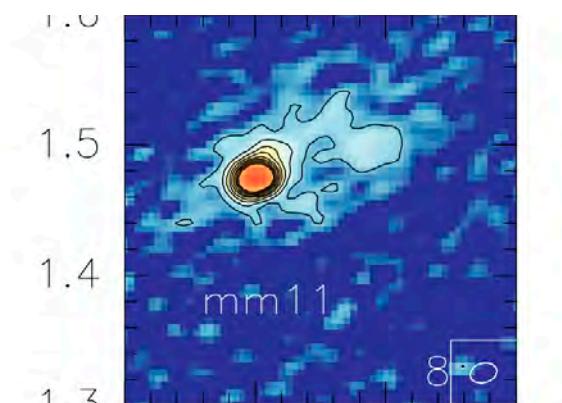
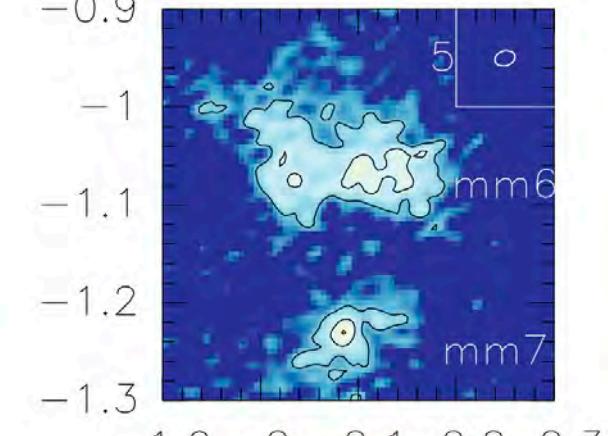
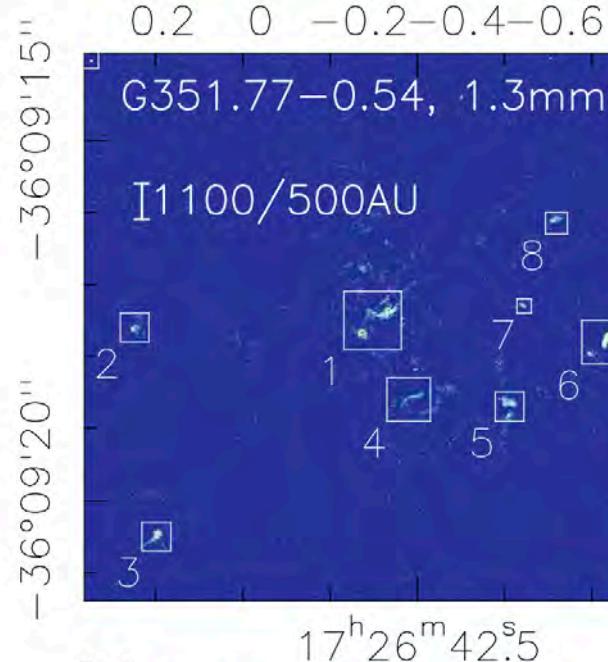
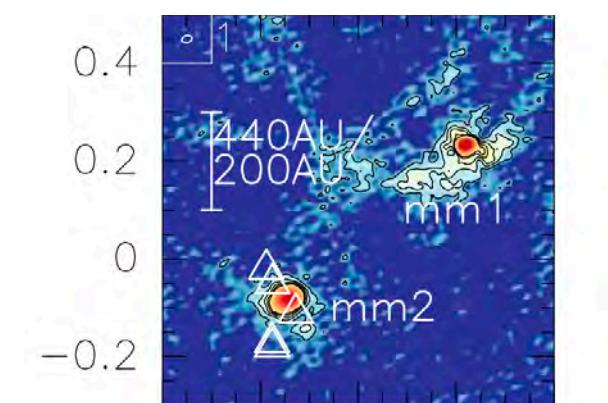
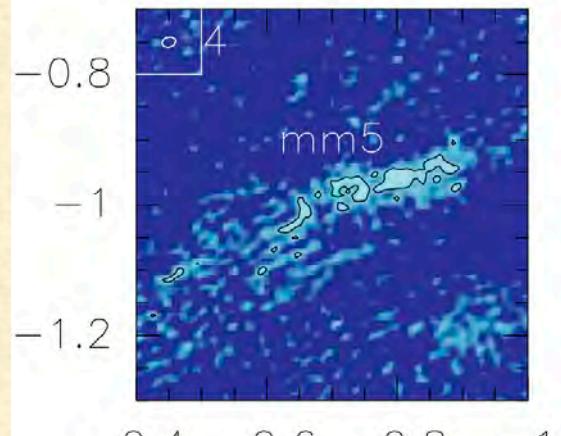
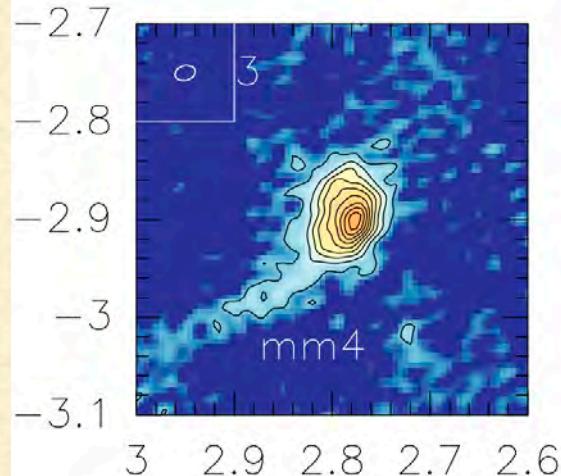
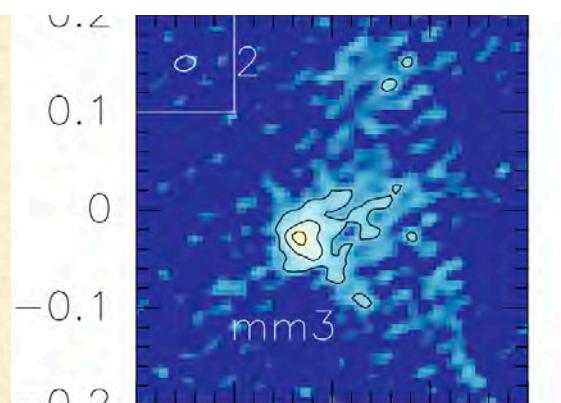
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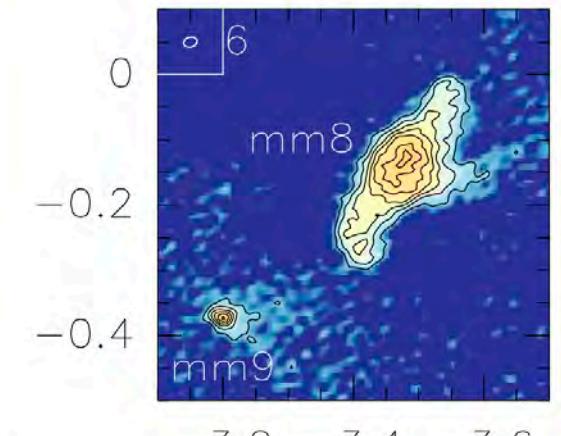
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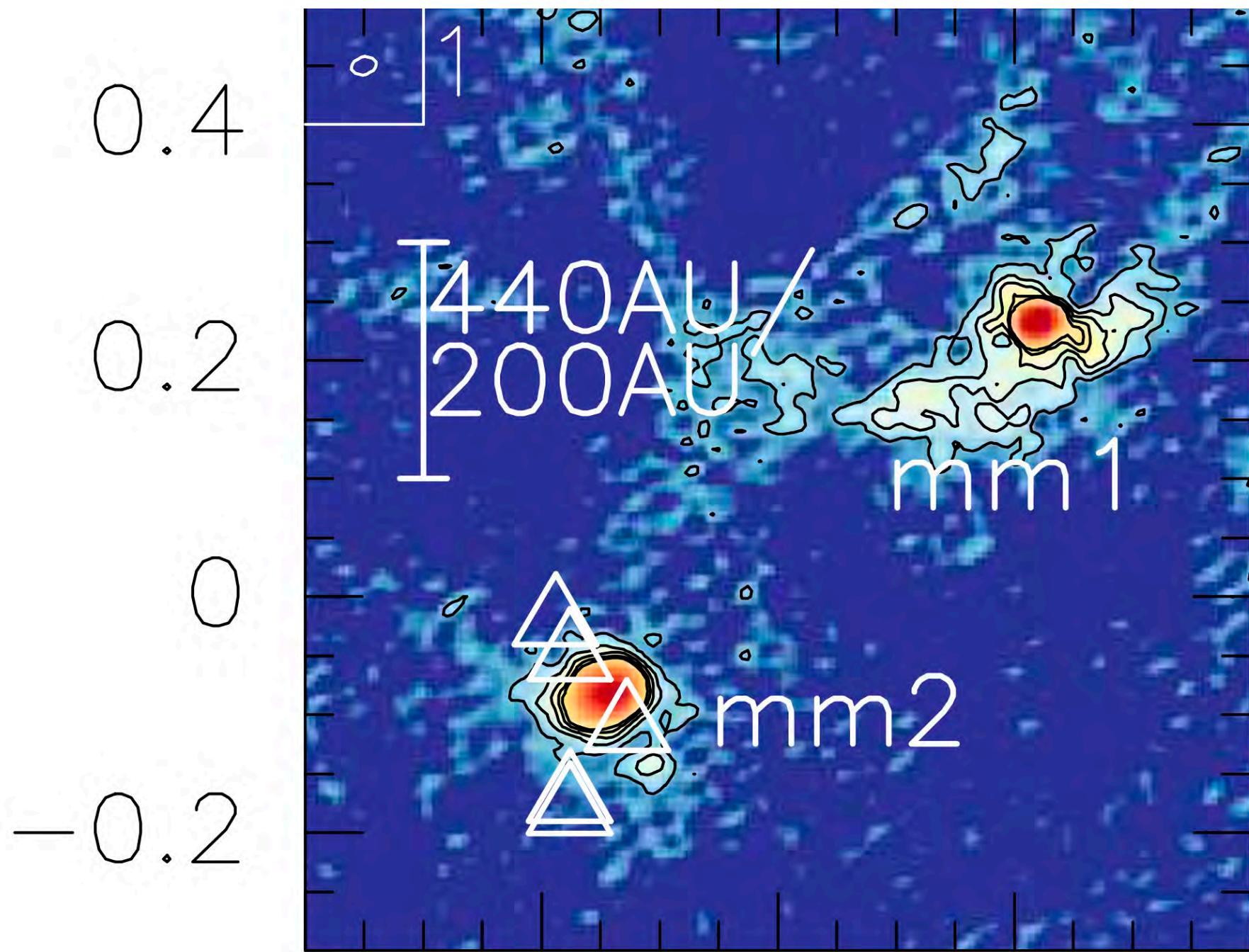
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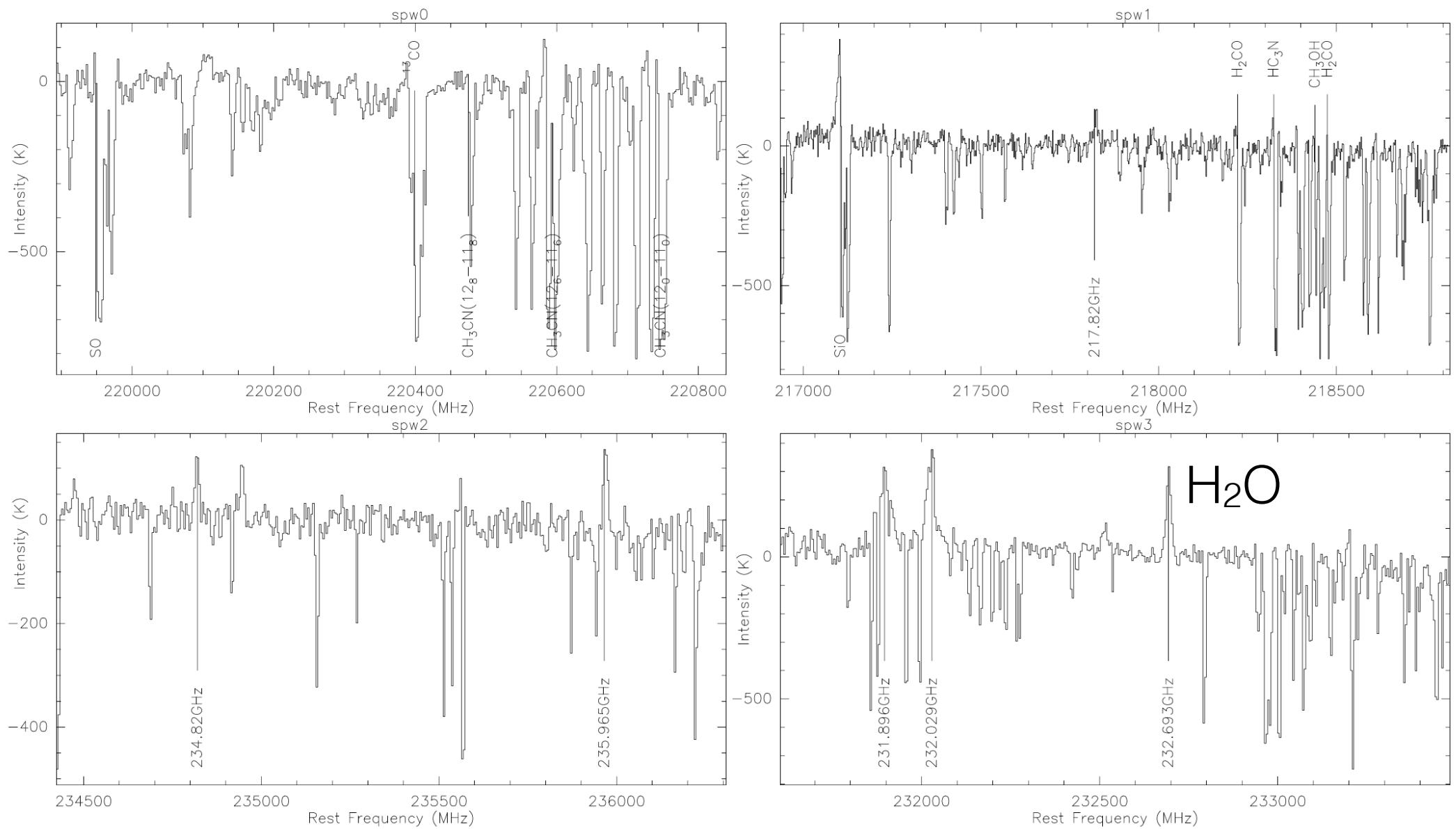
Beuther et al. in prep.



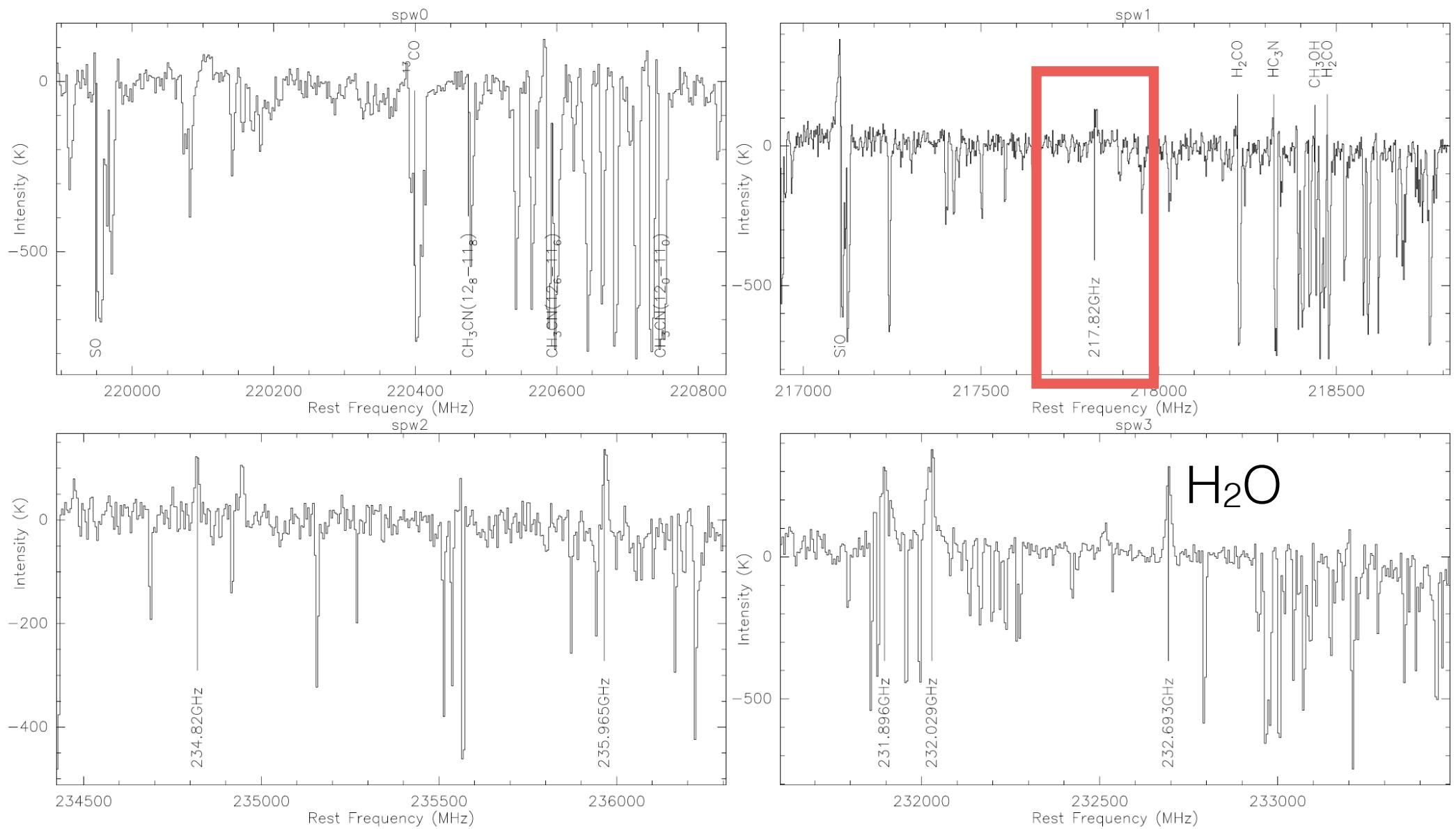


0.2 0 -0.2 -0.4 -0.6

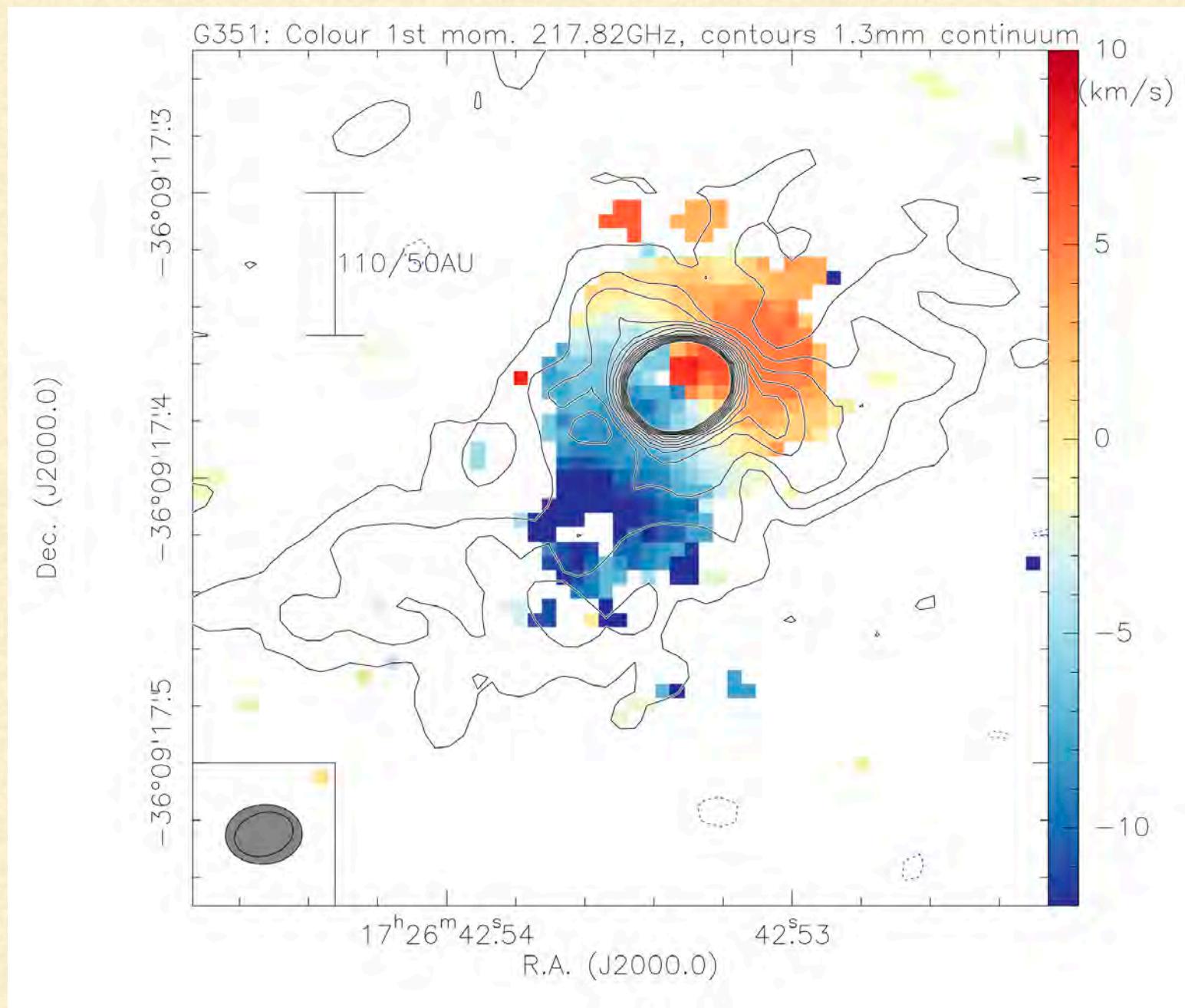
Spectral lines



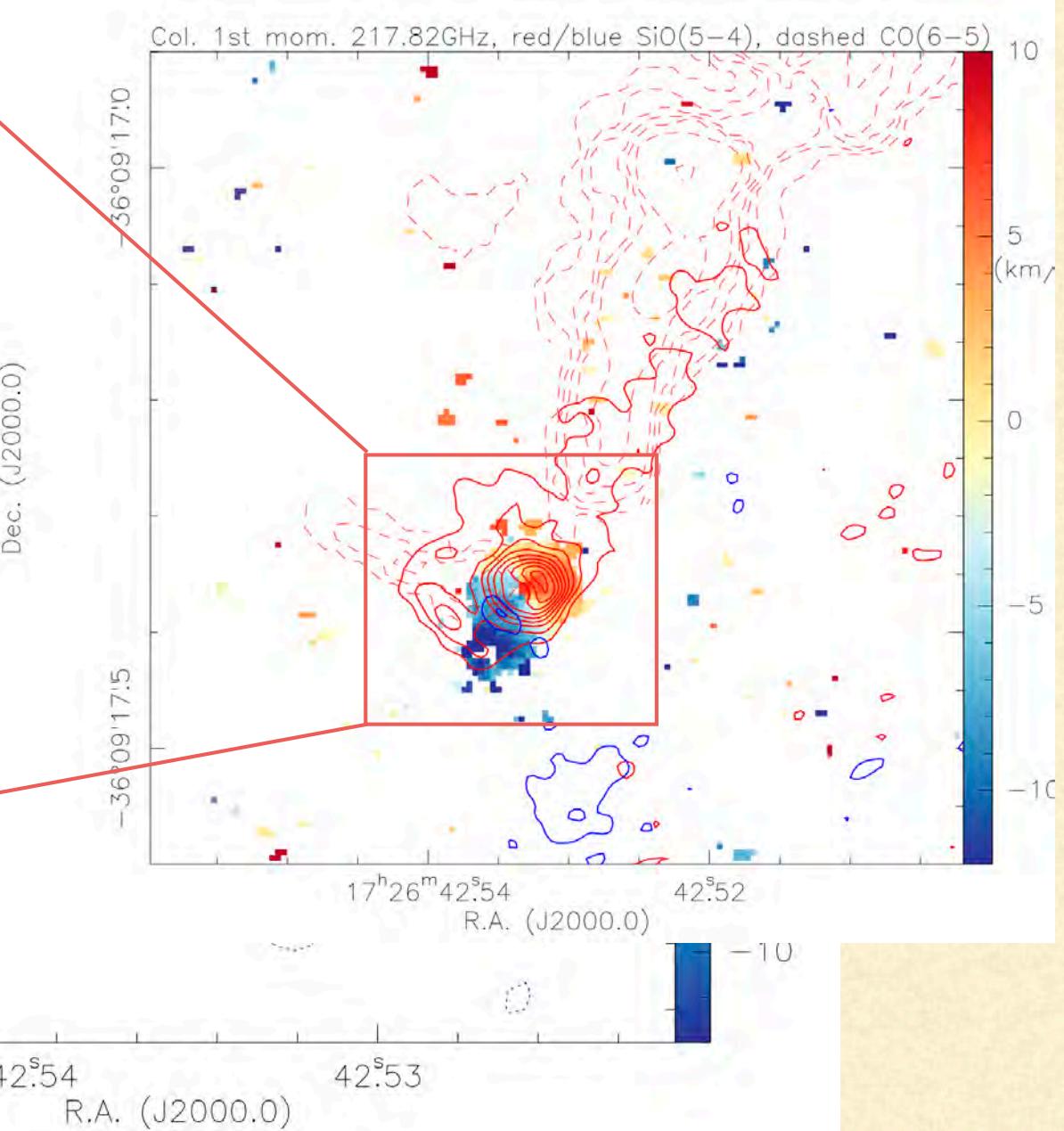
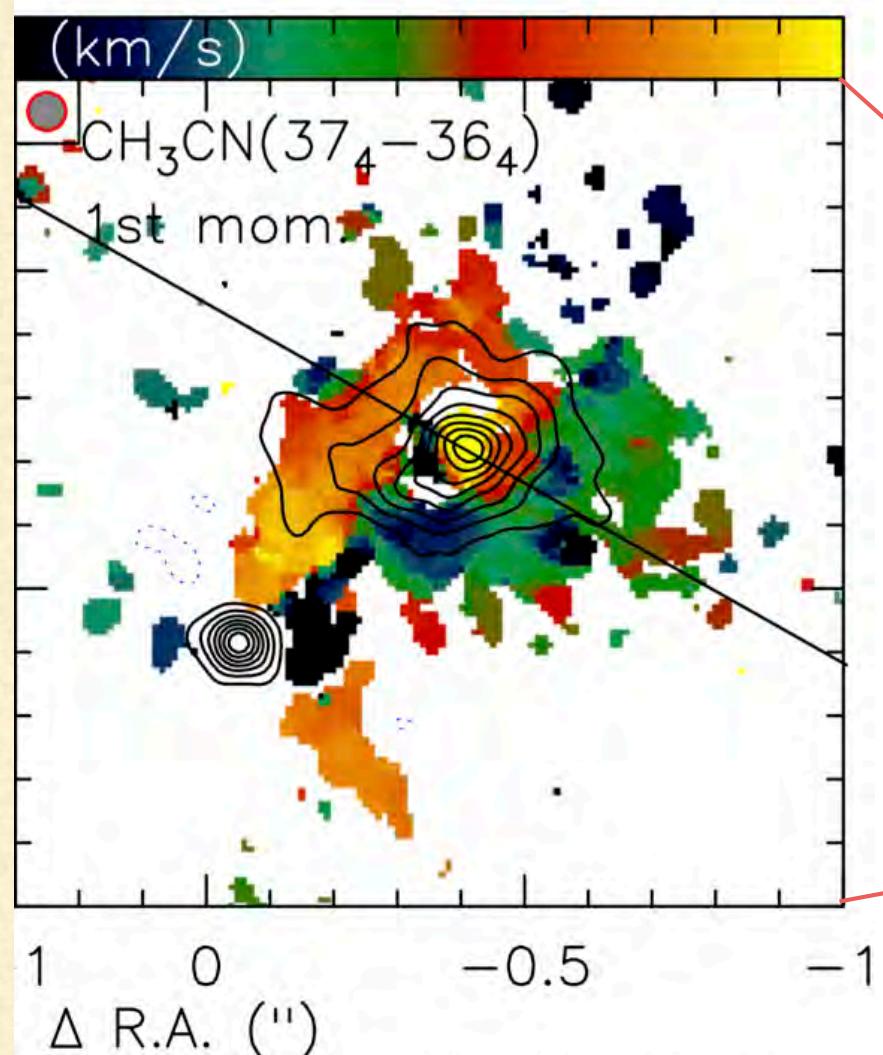
Spectral lines



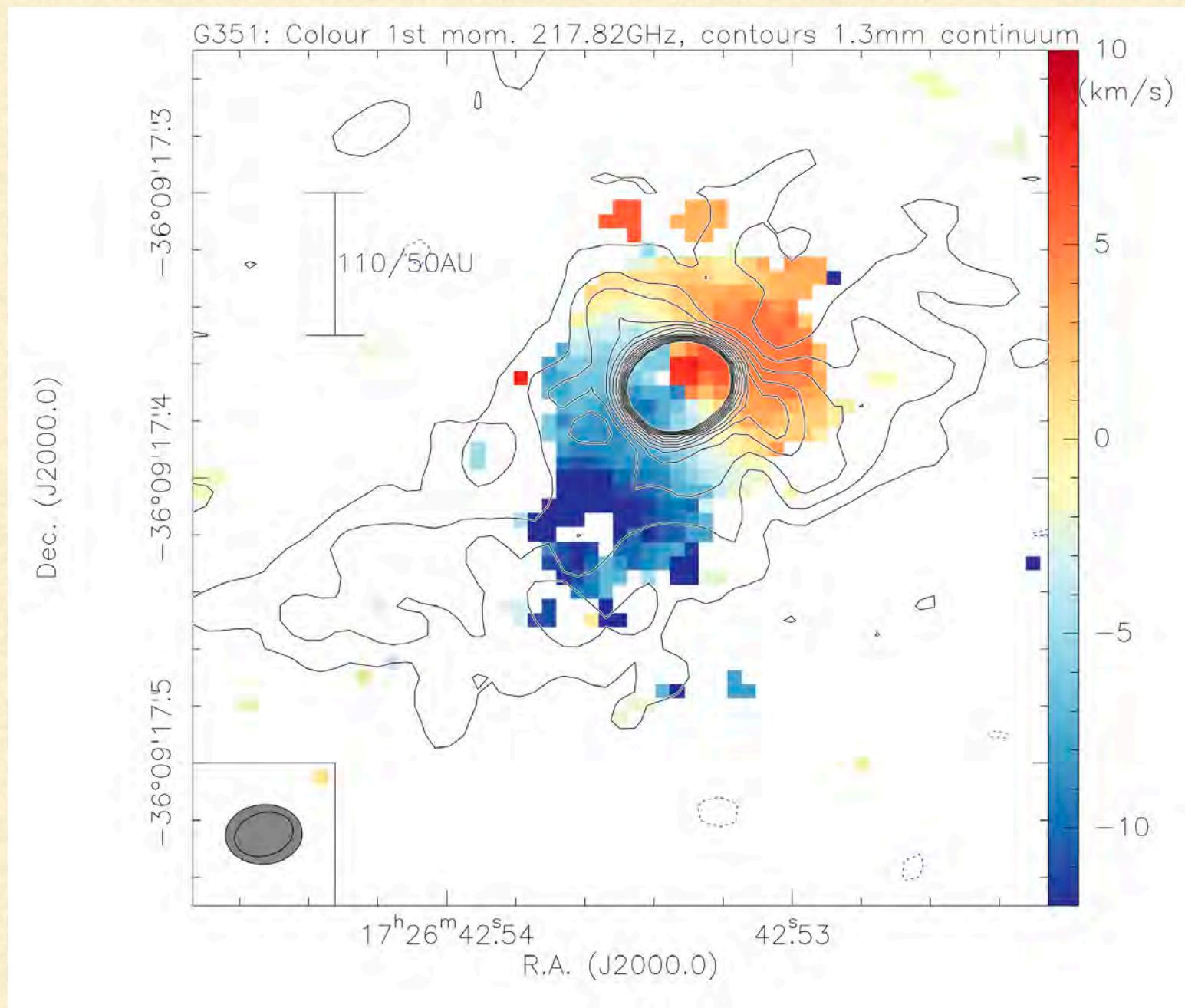
Gas velocities



Gas velocities



Gas velocities



Summary

- Keplerian disks for O-type stars still difficult, but early examples exist
- Accretion seems an episodic process, also visible in jets
- Jet-ionization degree is low, outflows rather isothermal
- Magnetic fields in toroids and envelopes, not yet in disks
- Regions split up on sub-1000AU scales
 - > disks seem often to be very small
 - > can be fed from the larger-scale reservoir by filaments

—> more statistical studies needed!