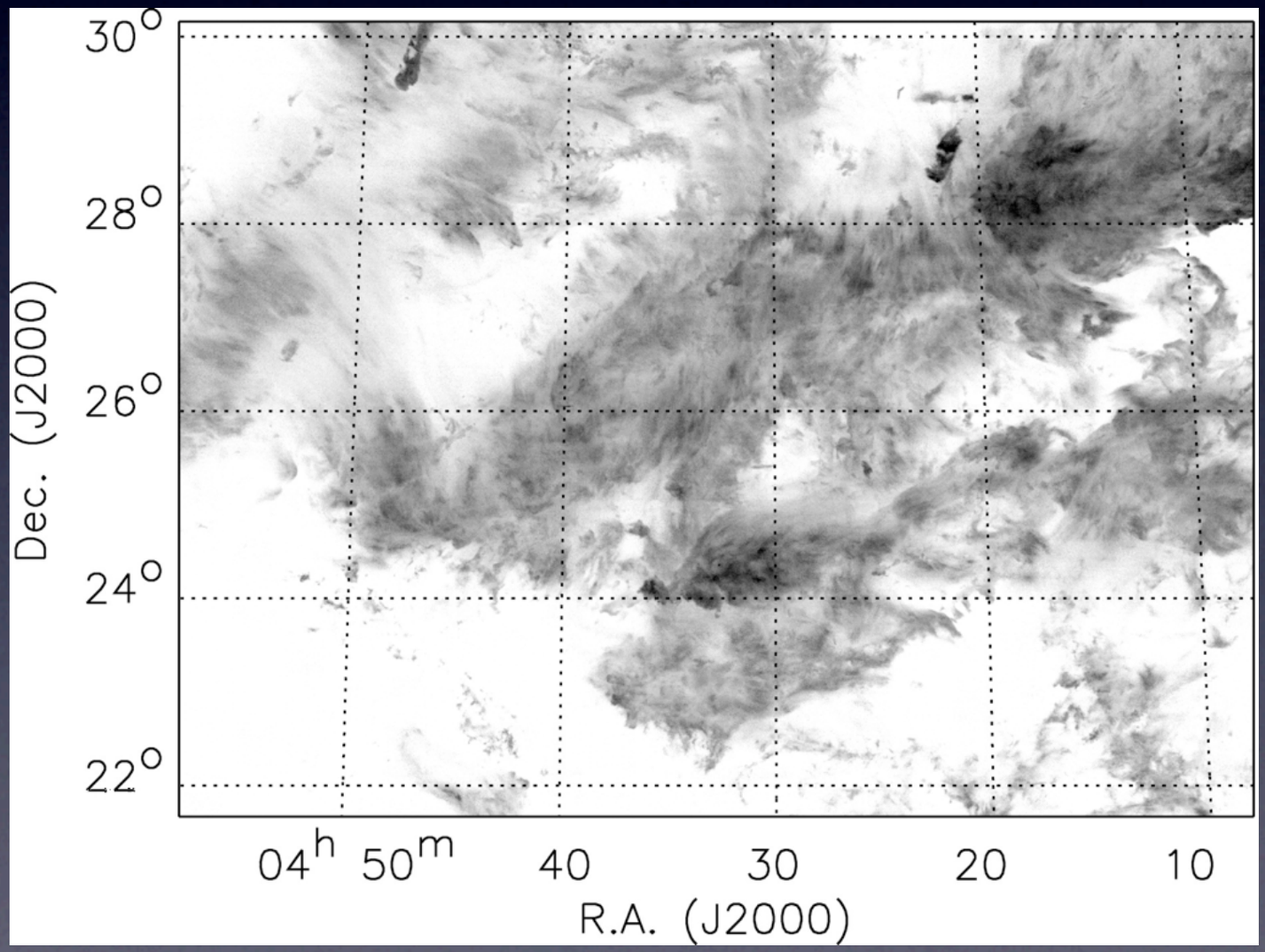
High Spatial Resolution, Large Scale Surveys with CCAT

John Carpenter (Caltech)

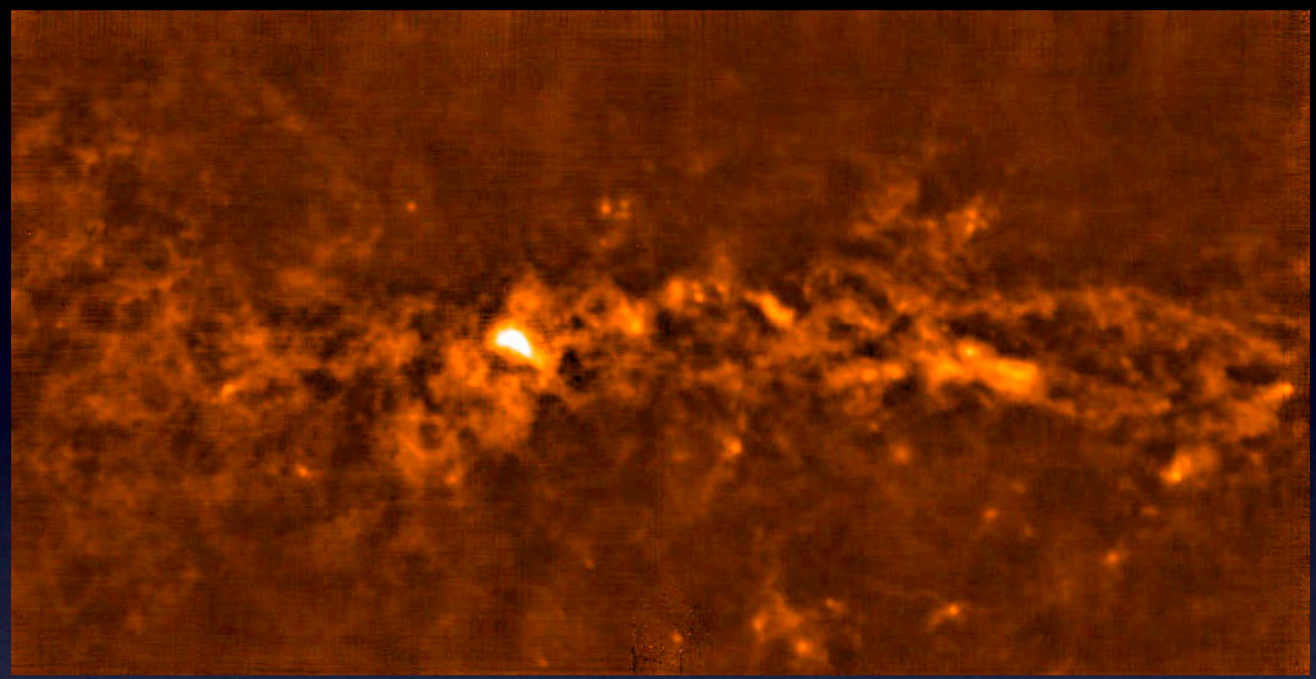


Goldsmith et al. (2008)

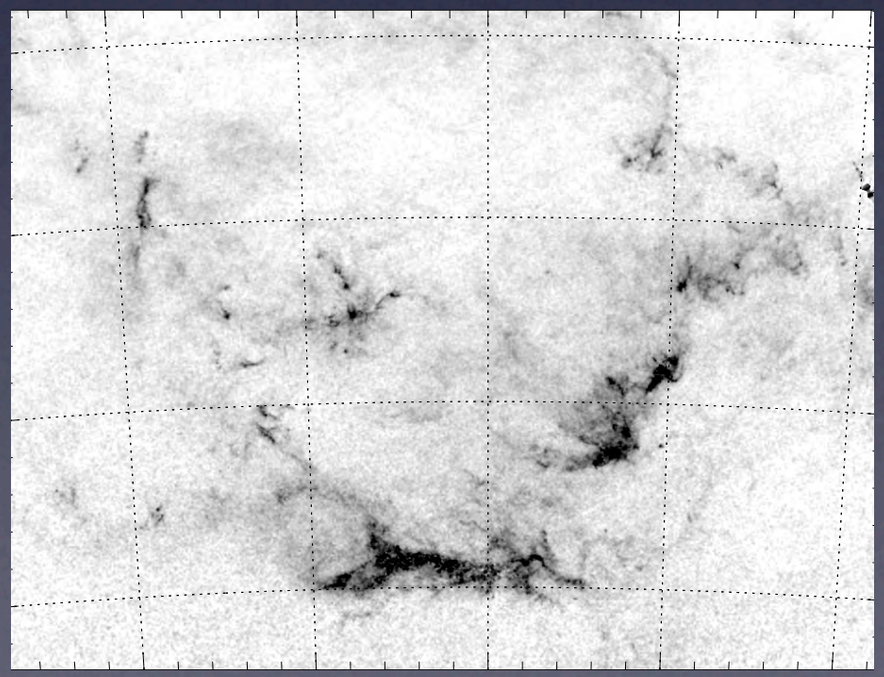
Dust

Herschel

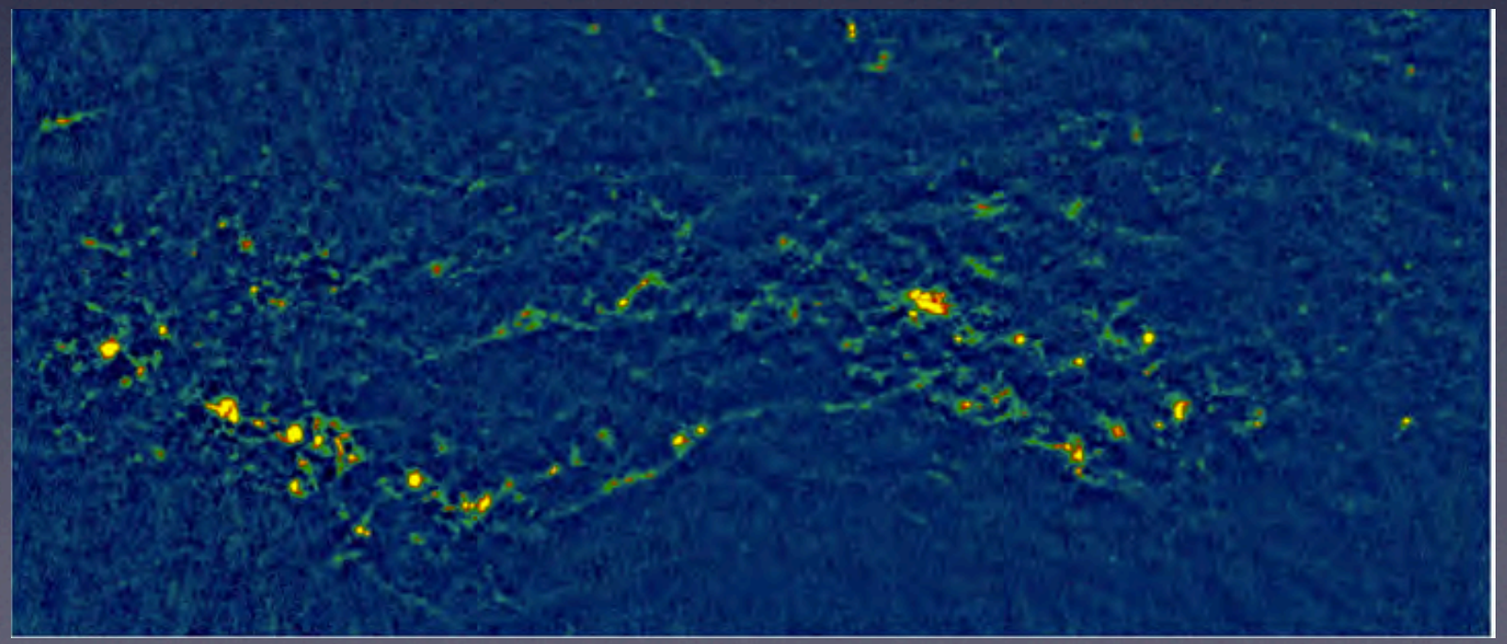
Bolocam



Extinction maps

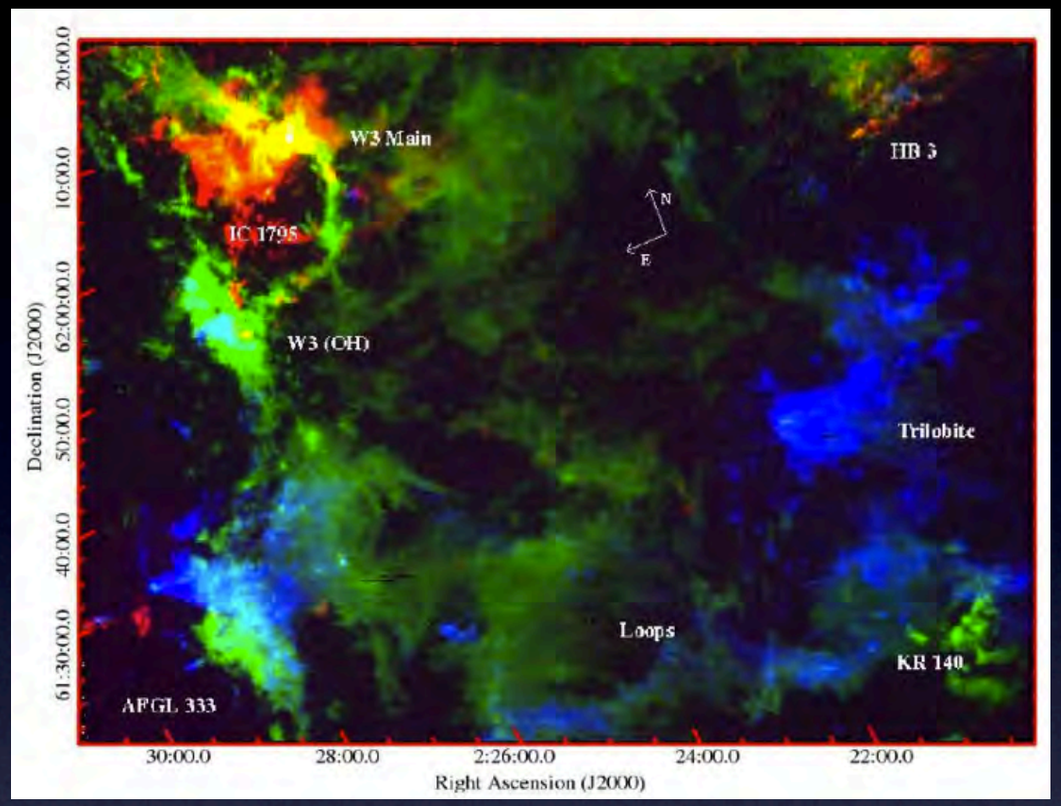


APEX

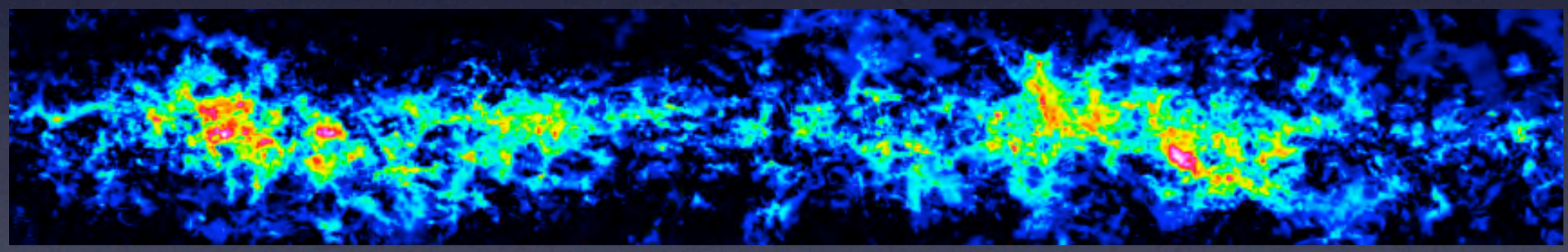


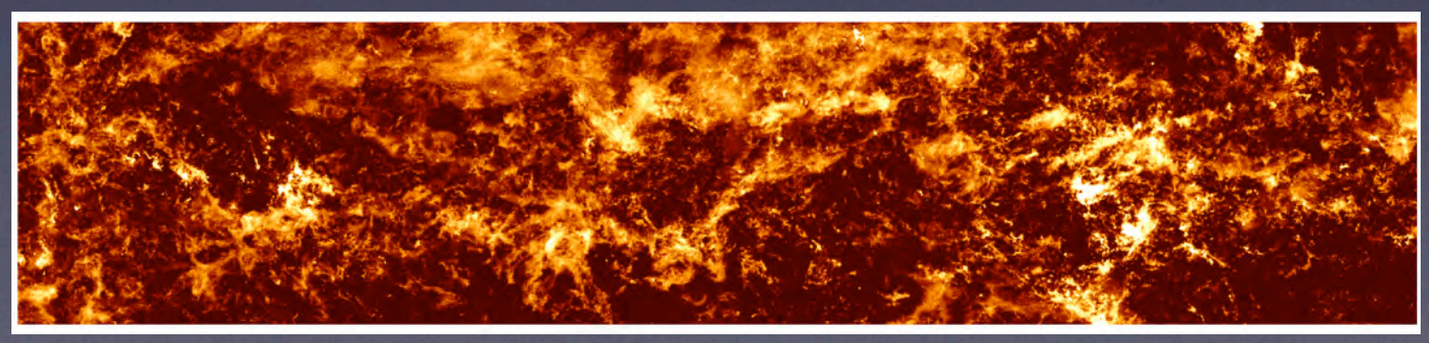
Gas

W3 in ^{12}CO J=3-2 (JCMT)



BU/UMass Galactic Ring Survey

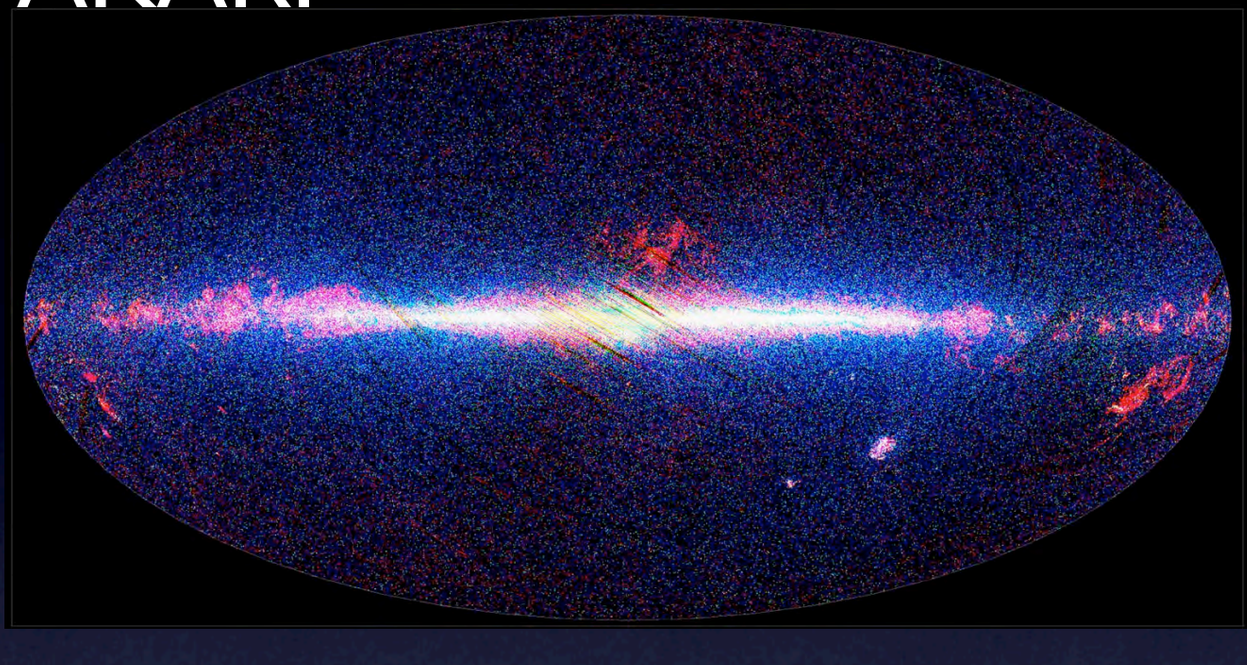




FCRAO Outer Galaxy Survey

Stars

AKARI

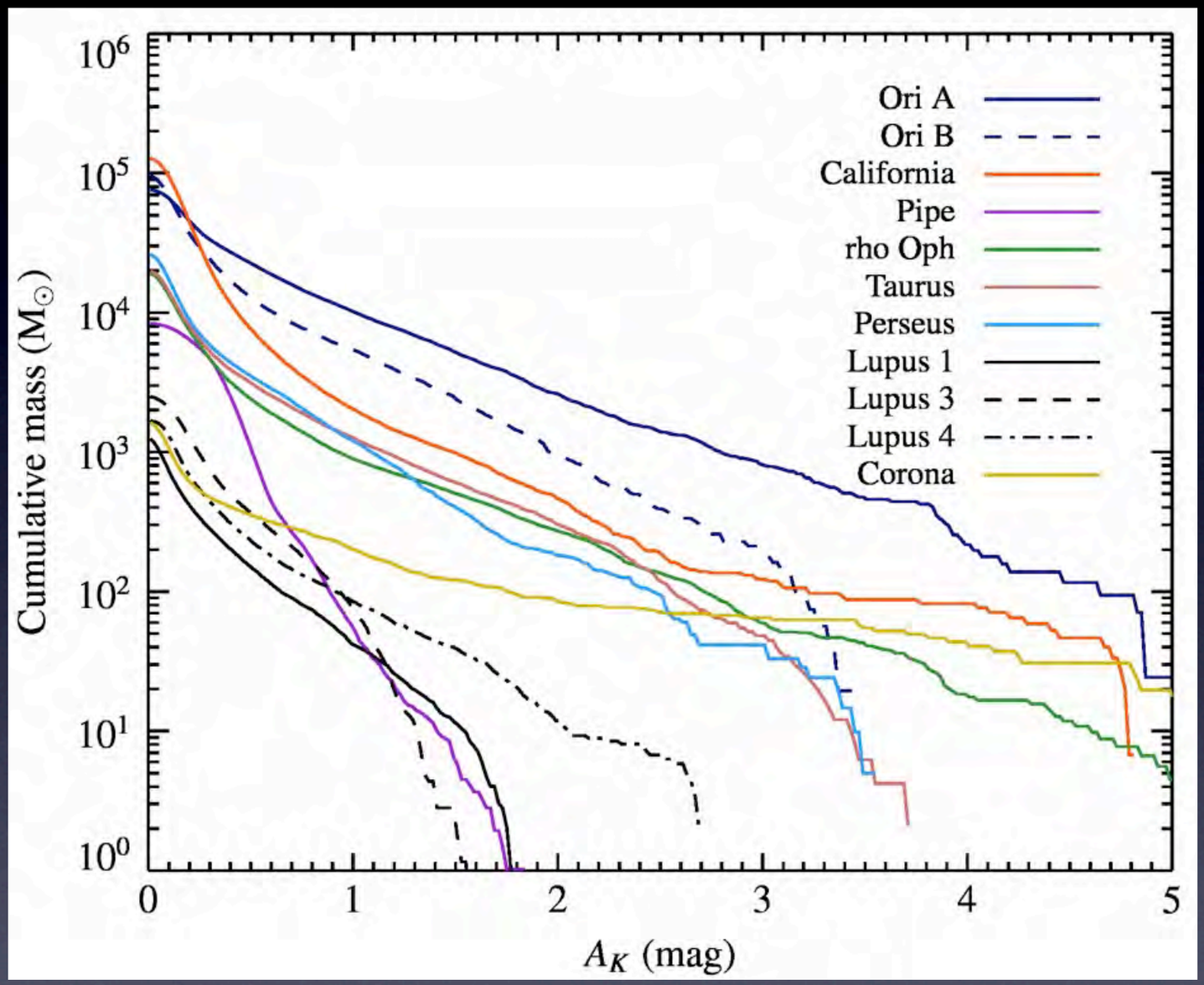


MSX

WISE

Spitzer

Star Formation in Clouds

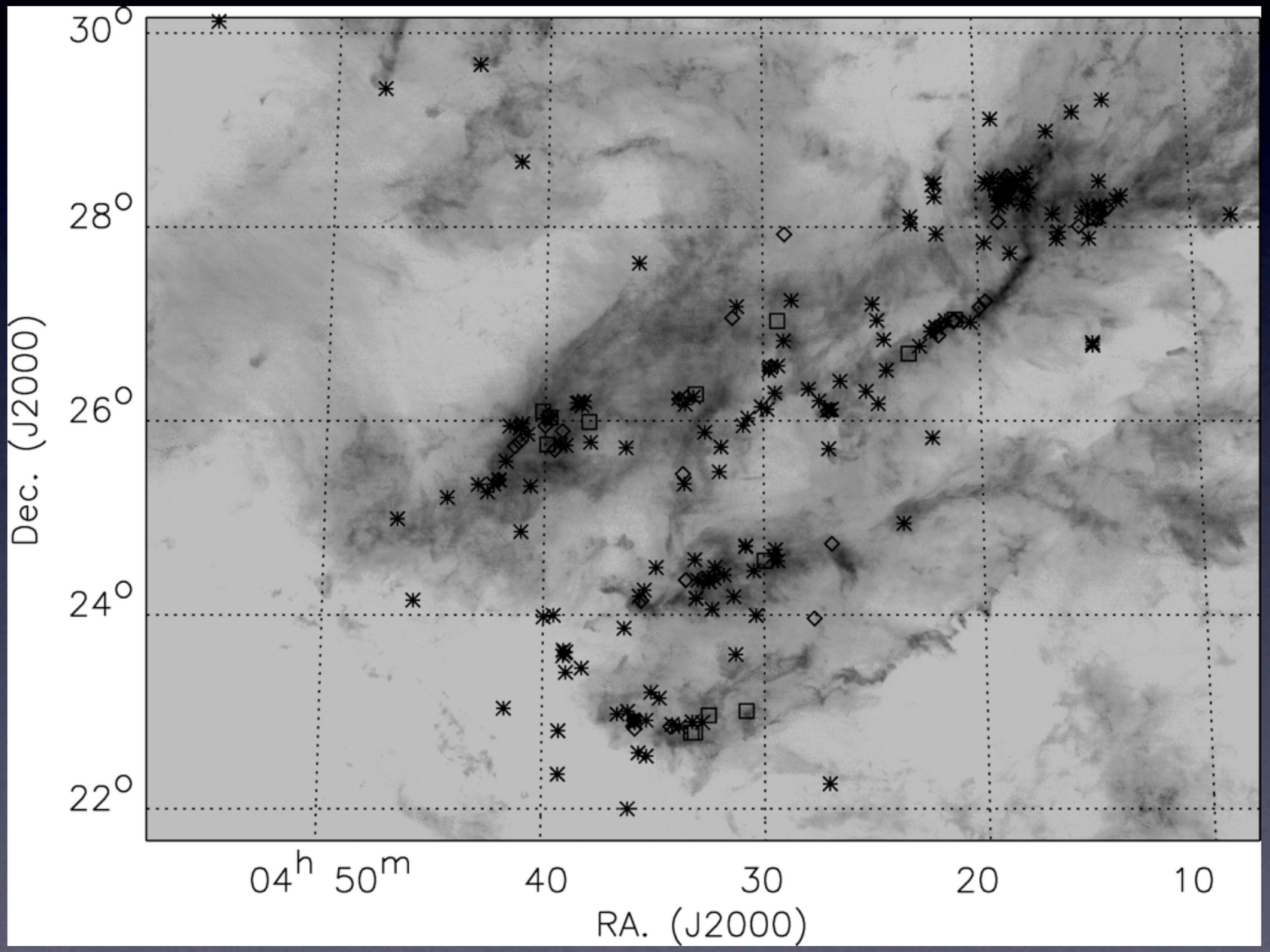


- Bulk of cloud mass has low column density
- What limits the conversion from diffuse to dense gas?

Lada et al. (2011)

Star Formation and Filaments

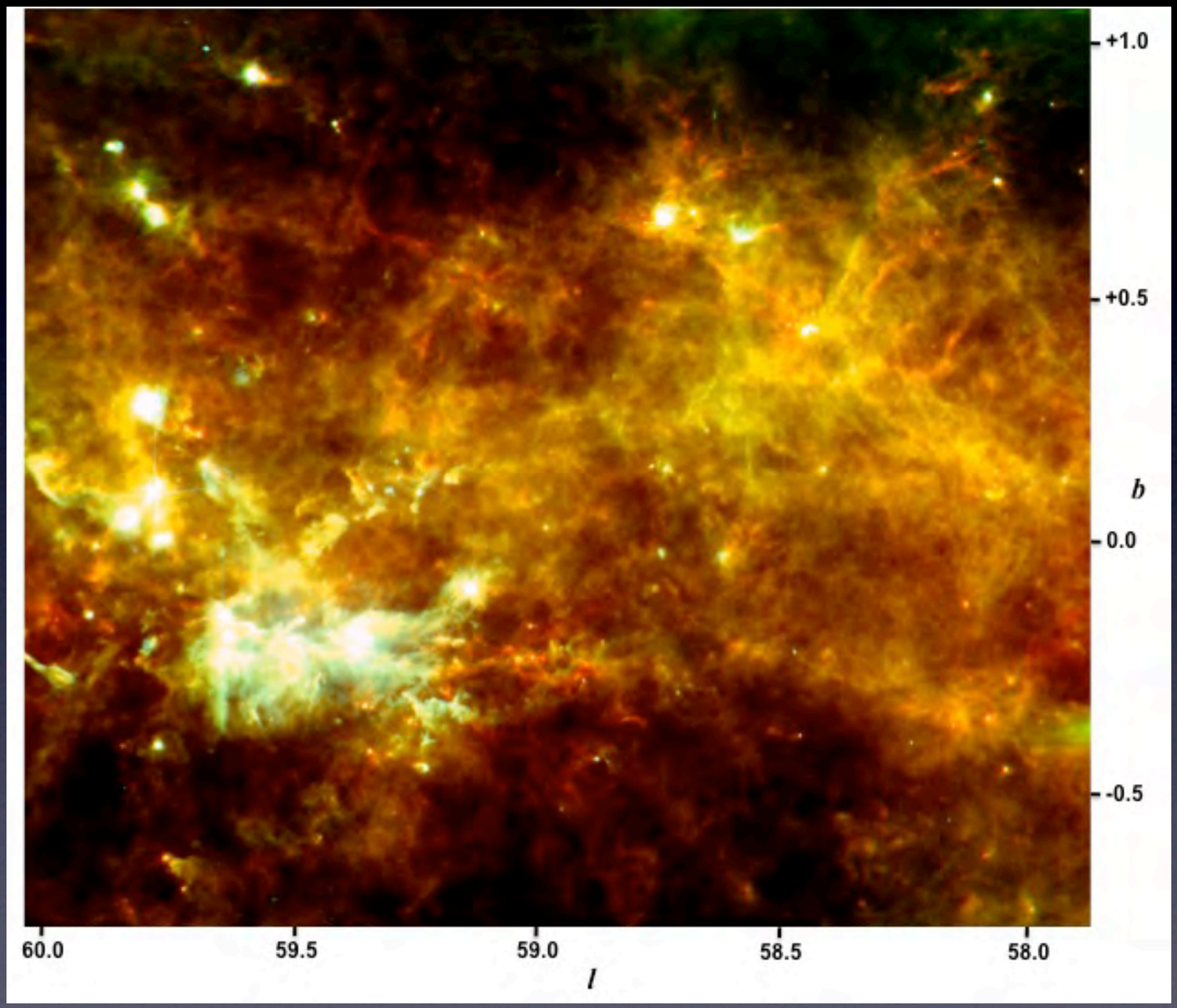
Taurus Molecular Cloud



Goldsmith et al. (2008)

Structure of Molecular Clouds

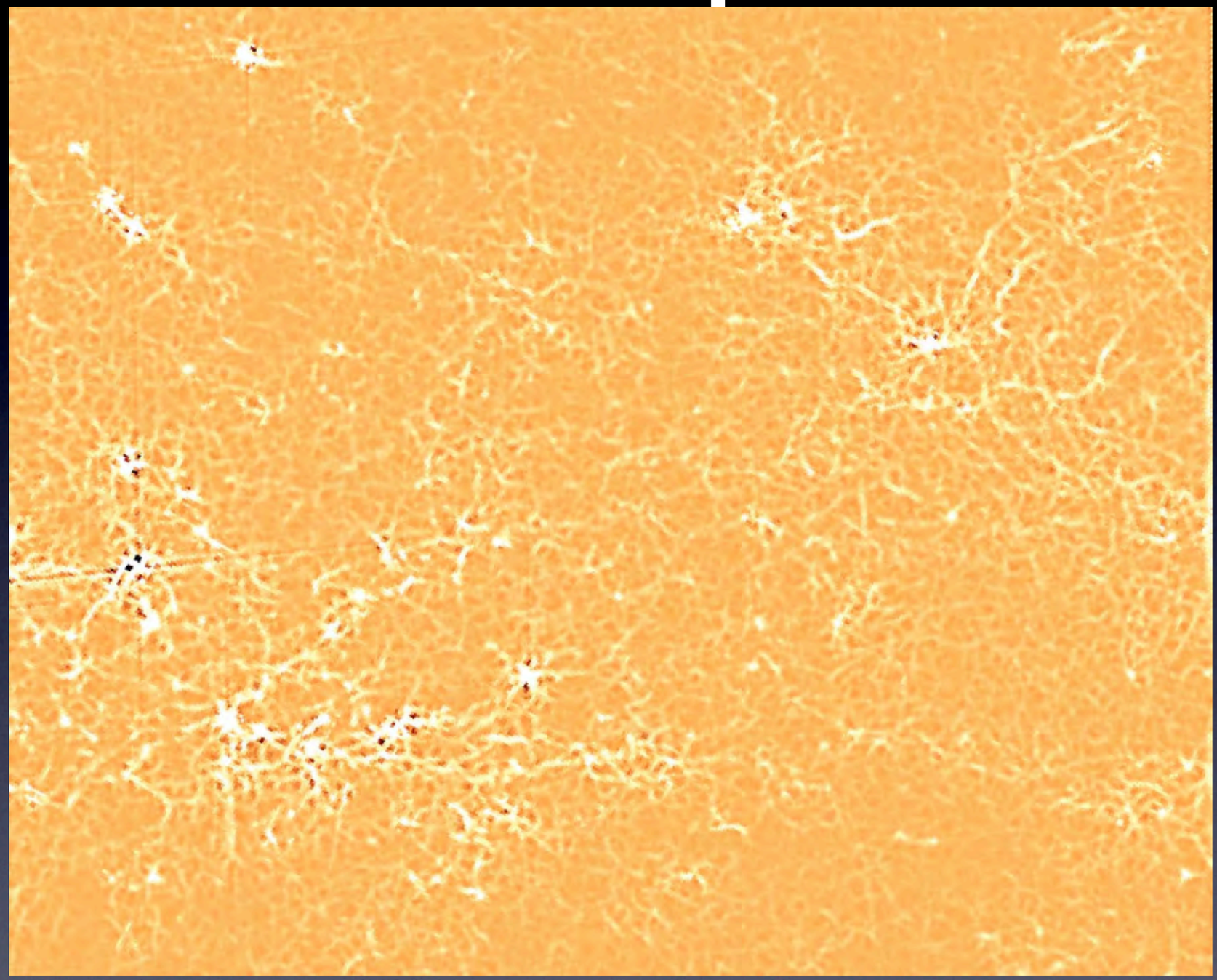
2 degrees



Molinari et al. 2010

Herschel 70μm, 160μm, and 350μm image at longitude = 59°

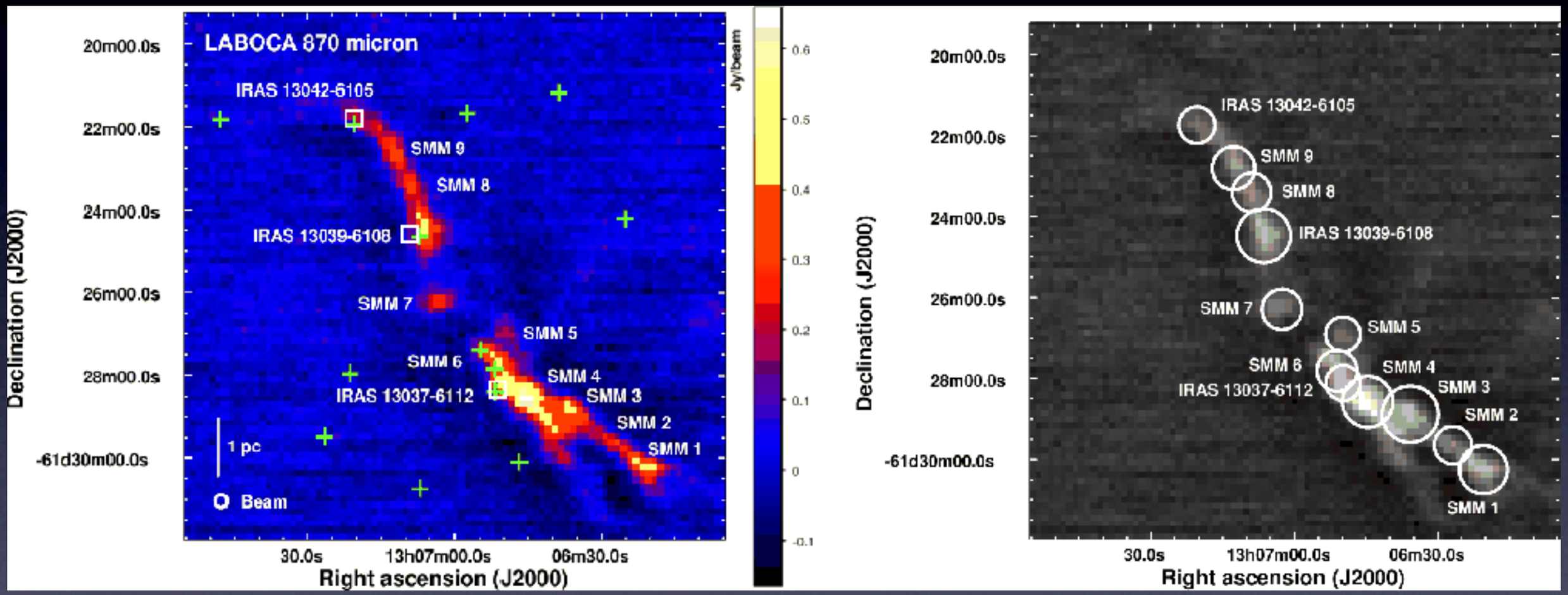
Filaments are pervasive...



Molinari et al. 2010

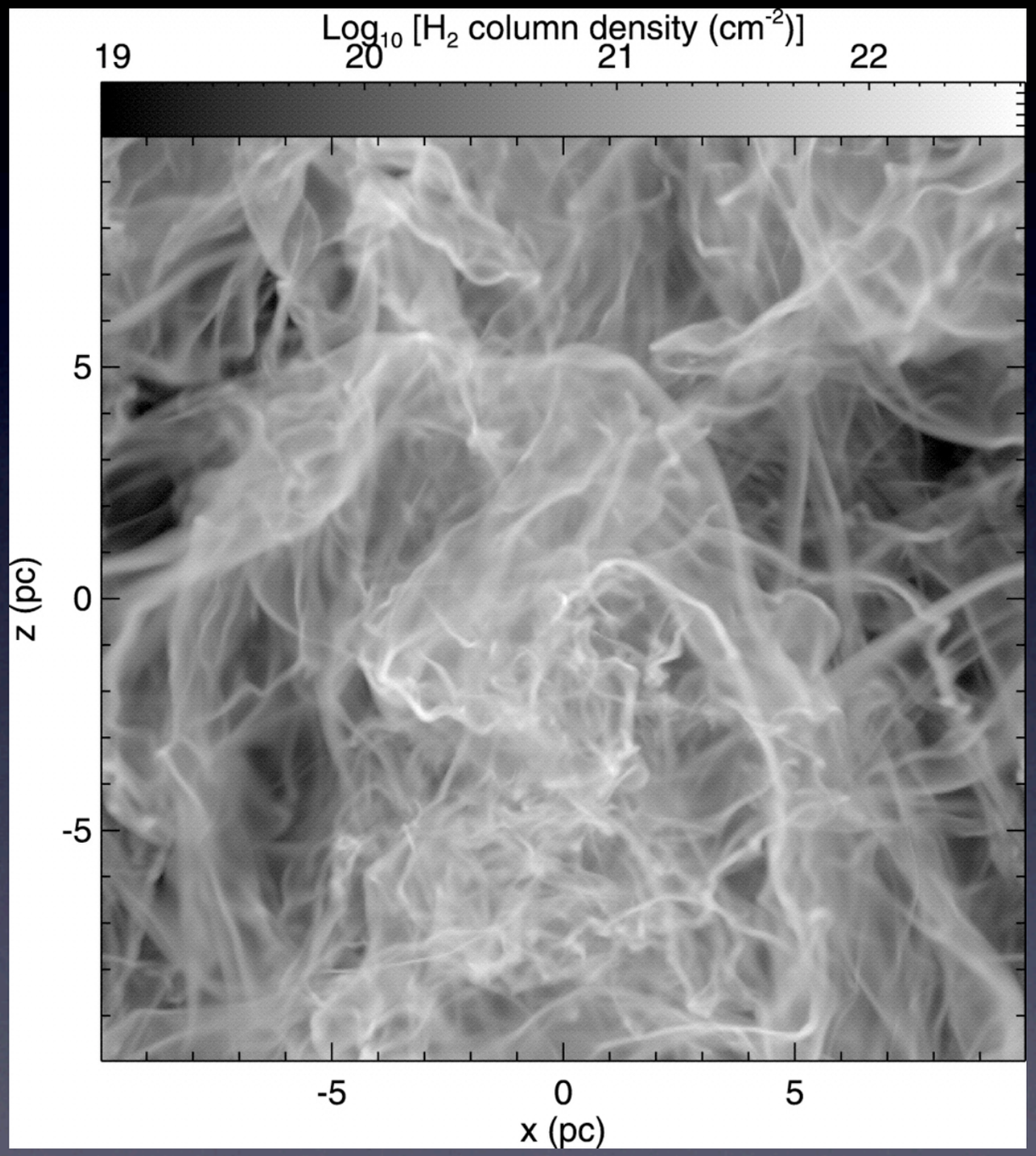
Filtered Herschel 250μm image at longitude = 59°

... and are where stars form

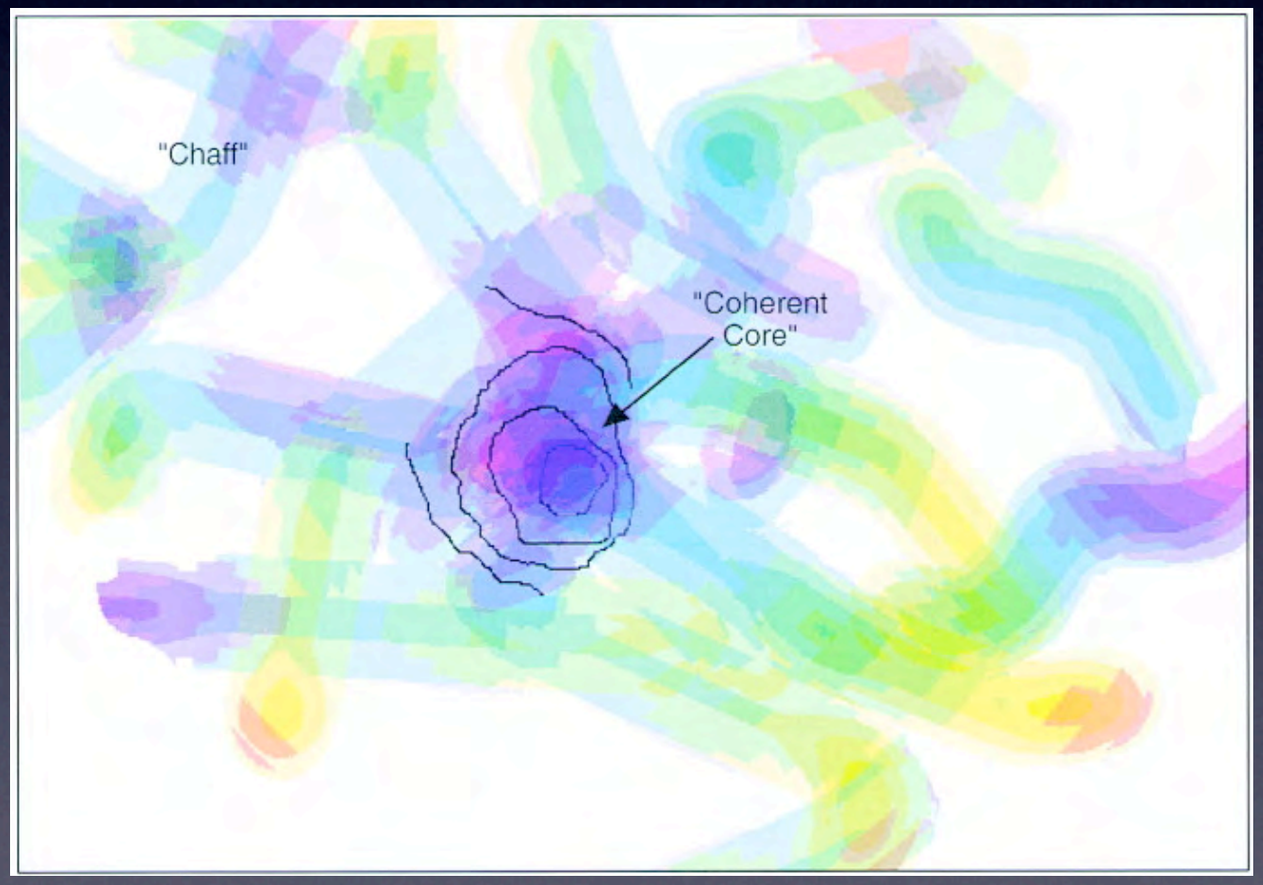


Miettinen & Harju (2010)

Emerging picture



- Cloud formation is a dynamic process



Glover & MacLow (2007)

Goodman et al. (1998)

Why CCAT? Resolution!

FCRAO 2.6mm

Herschel 250μm

JCMT 850μm

IRAM 1.1mm

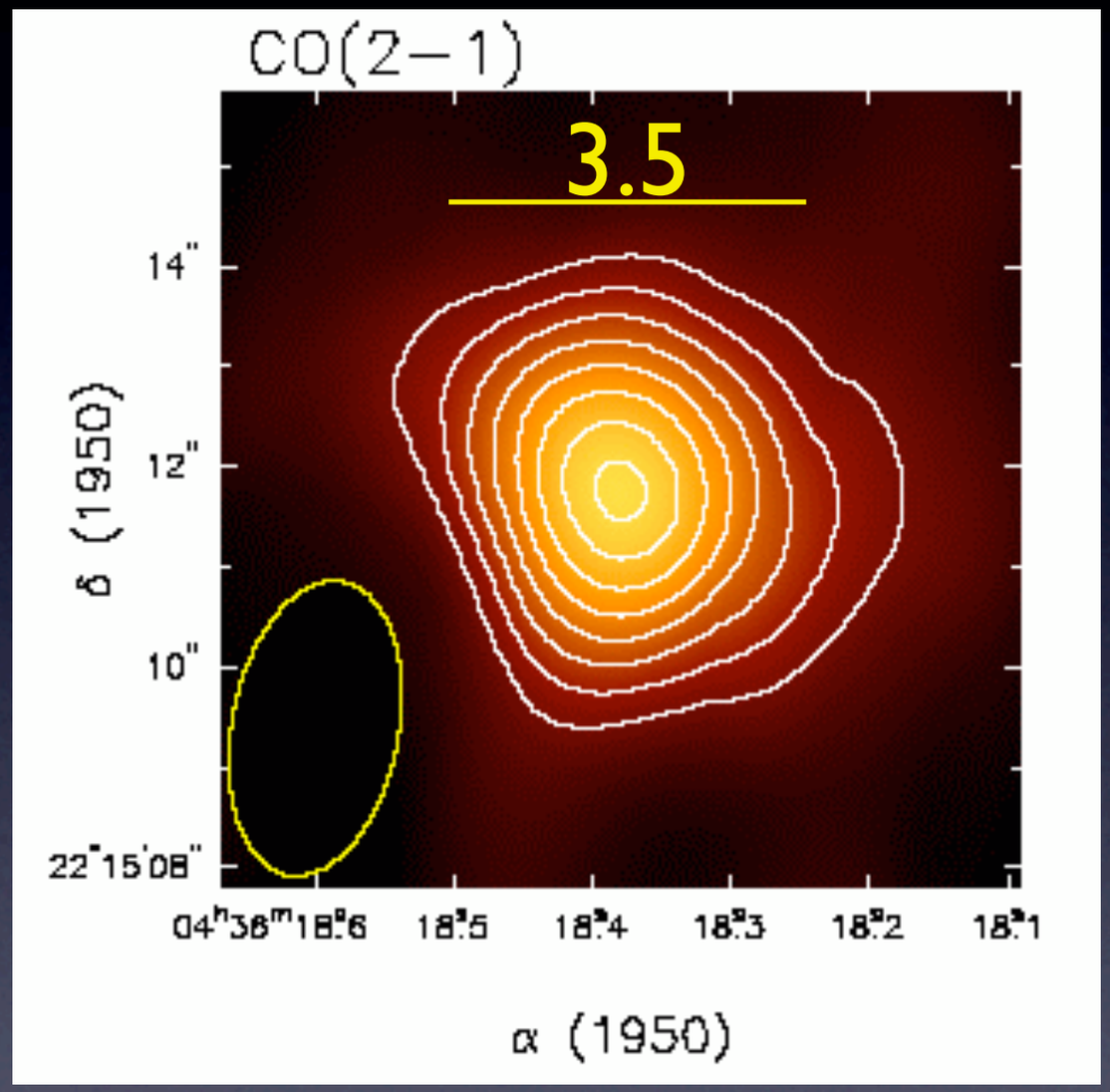
LMT 1.3mm

CCAT 350μm

3.5″

Why CCAT? Resolution!

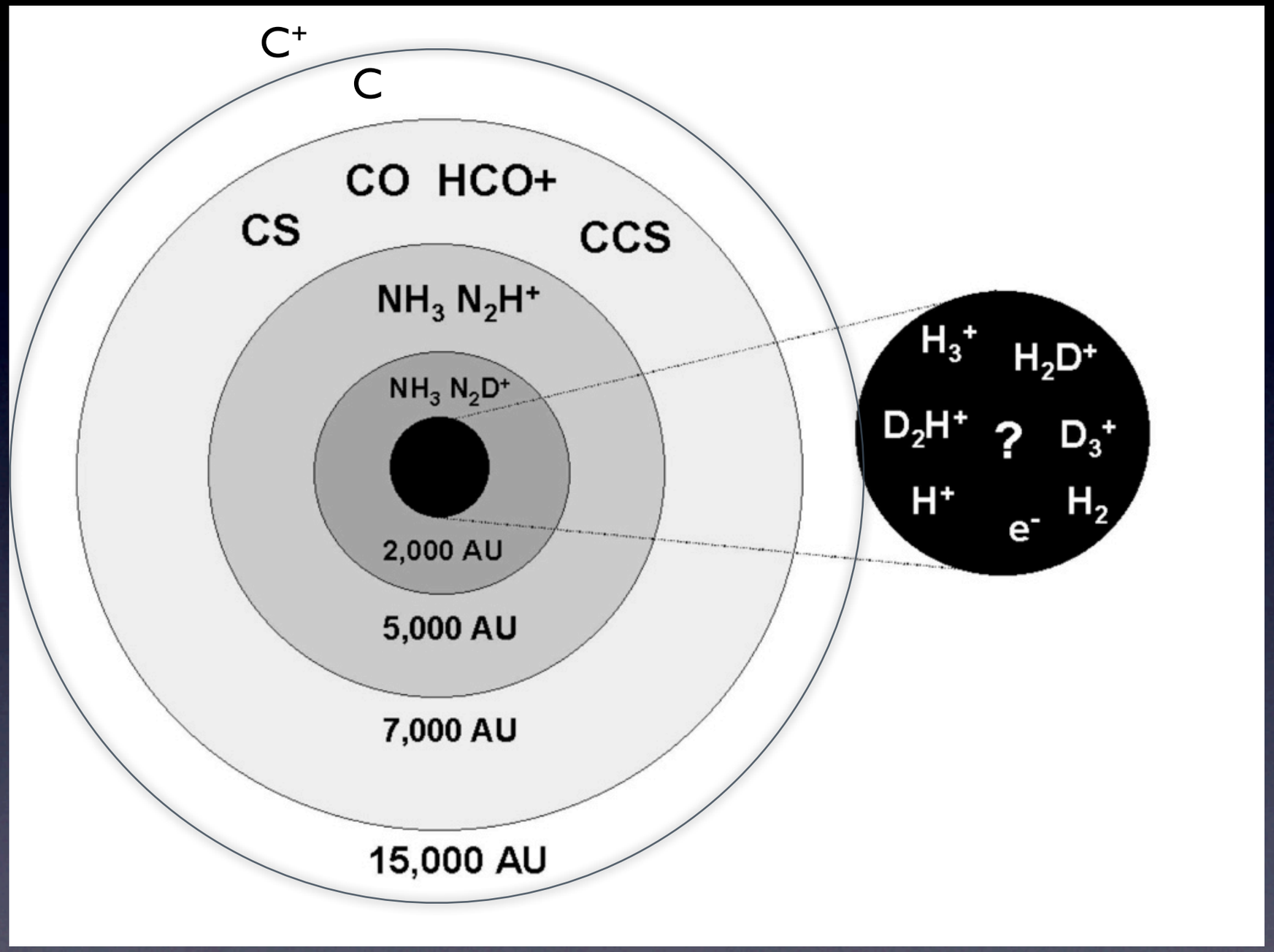
CO in LkCa 15



3.5″ = 490 AU @ 140 pc!

- Trace gas from diffuse → filaments → cores → disks
- Probe the transition regions with CCAT

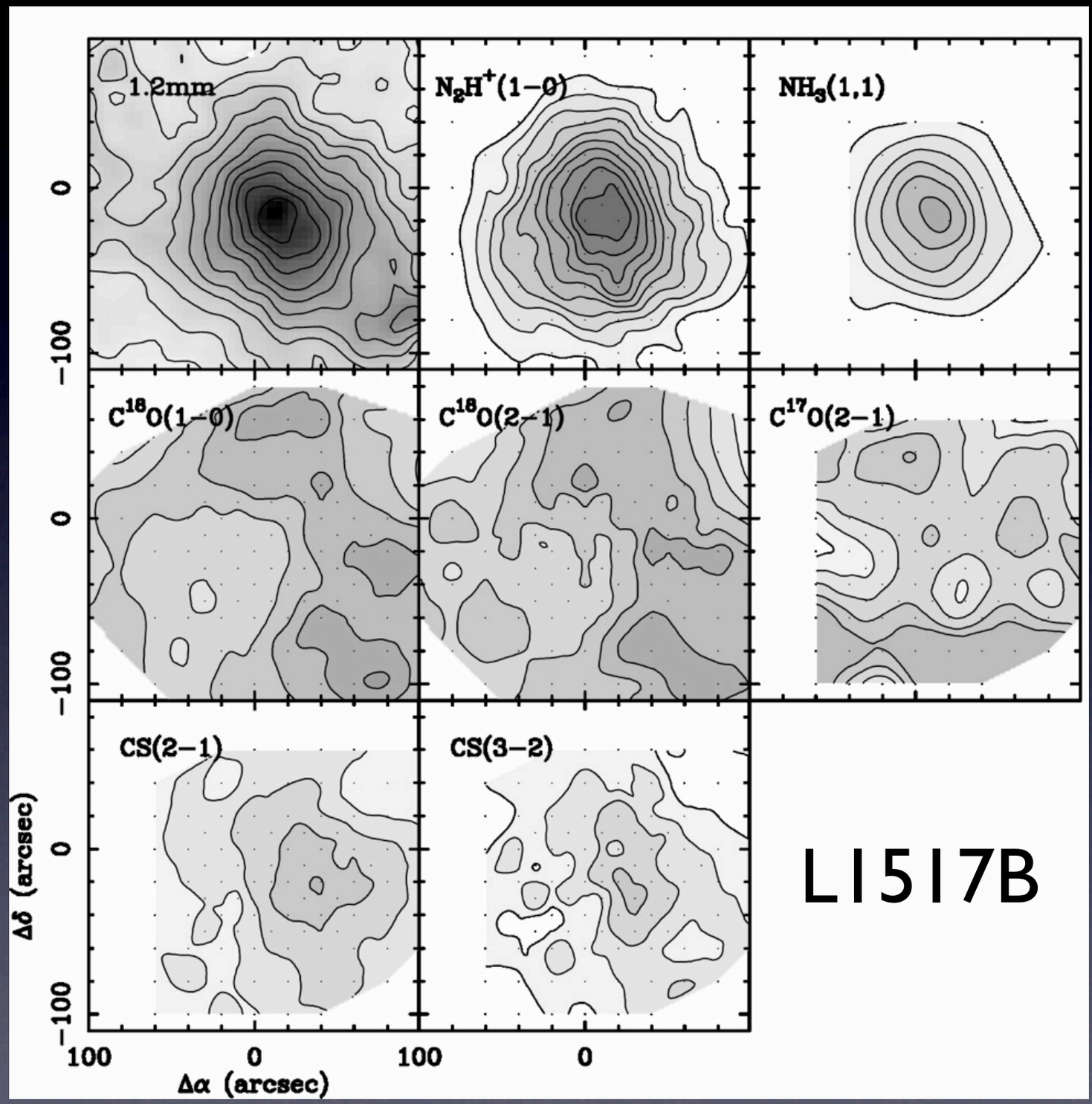
Not quite so simple...



Di Francesco et al. (2006)

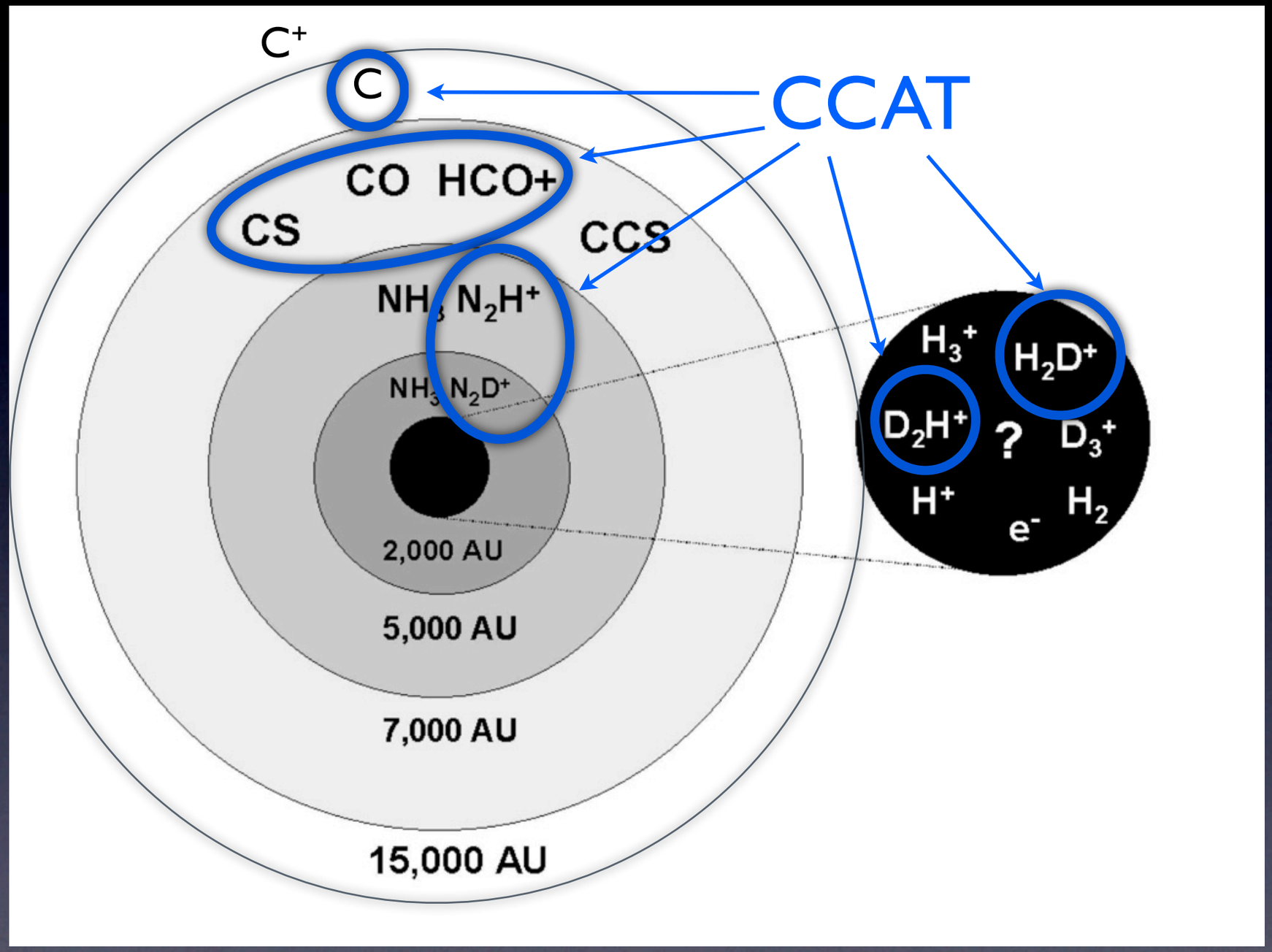
Nitrogen and deuterated species trace cold, dense gas

"Starless Cores"



Tafalla et al. (2004)

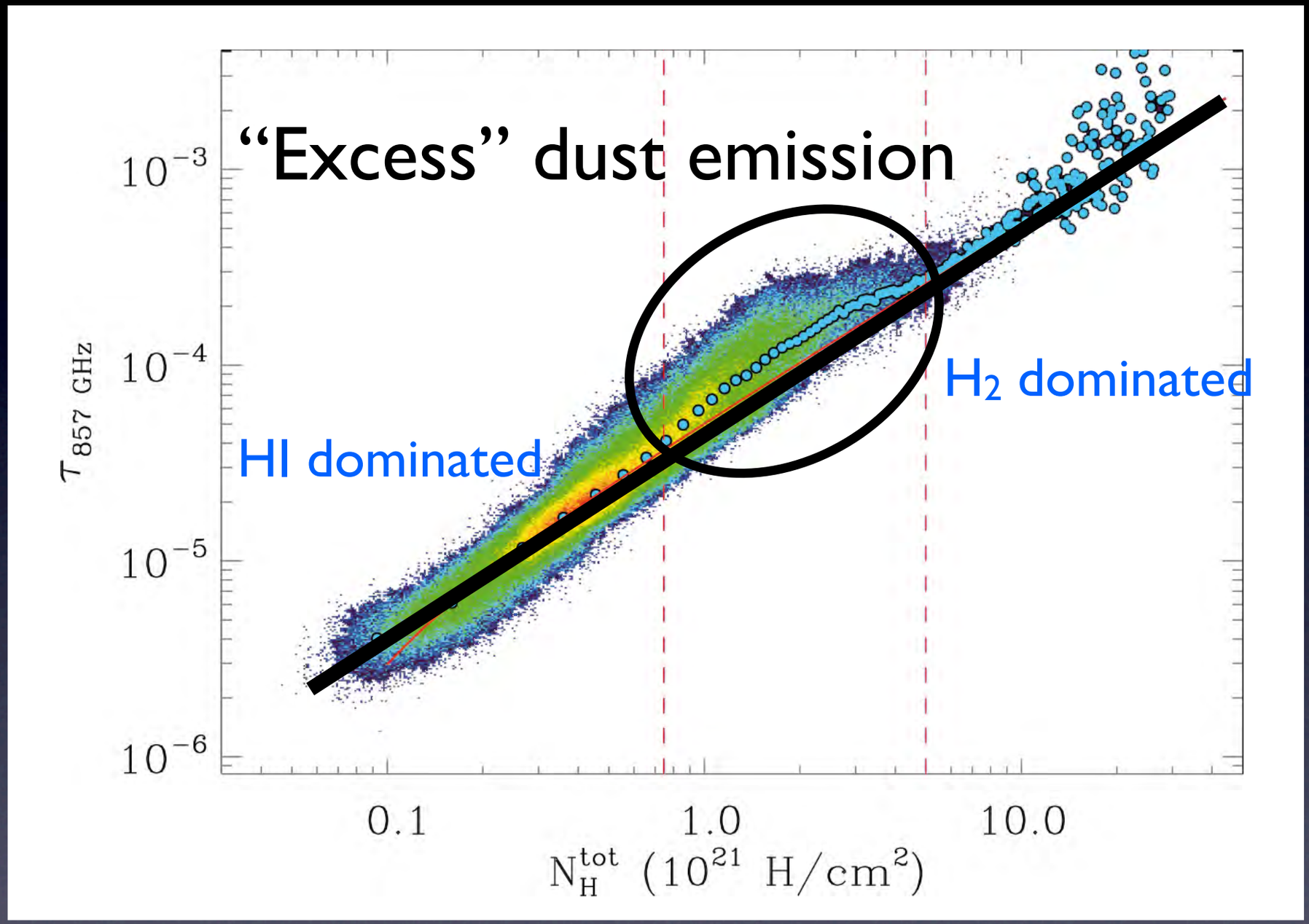
Not quite so simple...



Di Francesco et al. (2006)

Nitrogen and deuterated species trace cold, dense gas

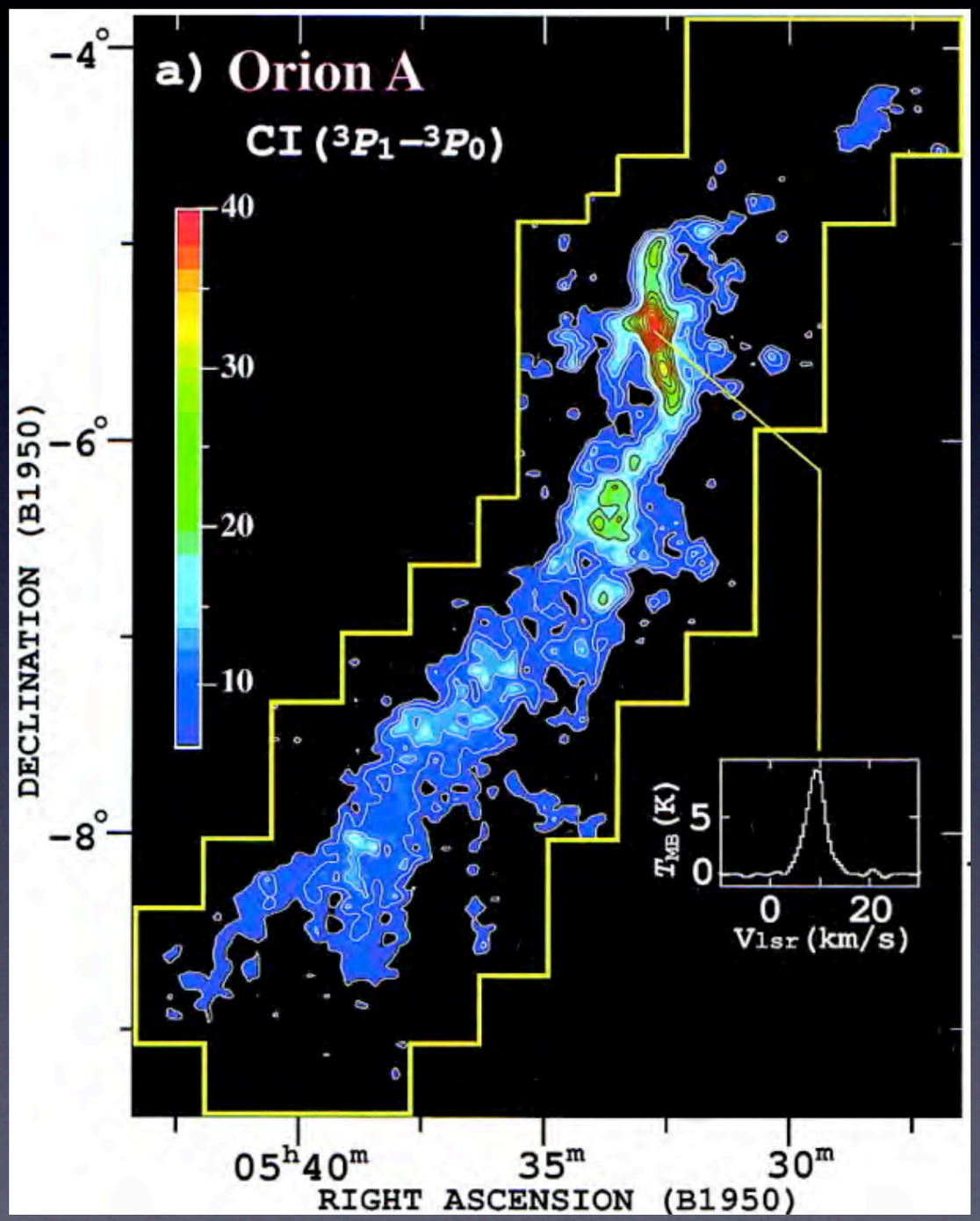
Dark Molecular Gas



- Gas content traced by HI and CO
- First seen with IRAS (Desert et al 1988; Reach et al. 1994)

Dark Molecular Gas

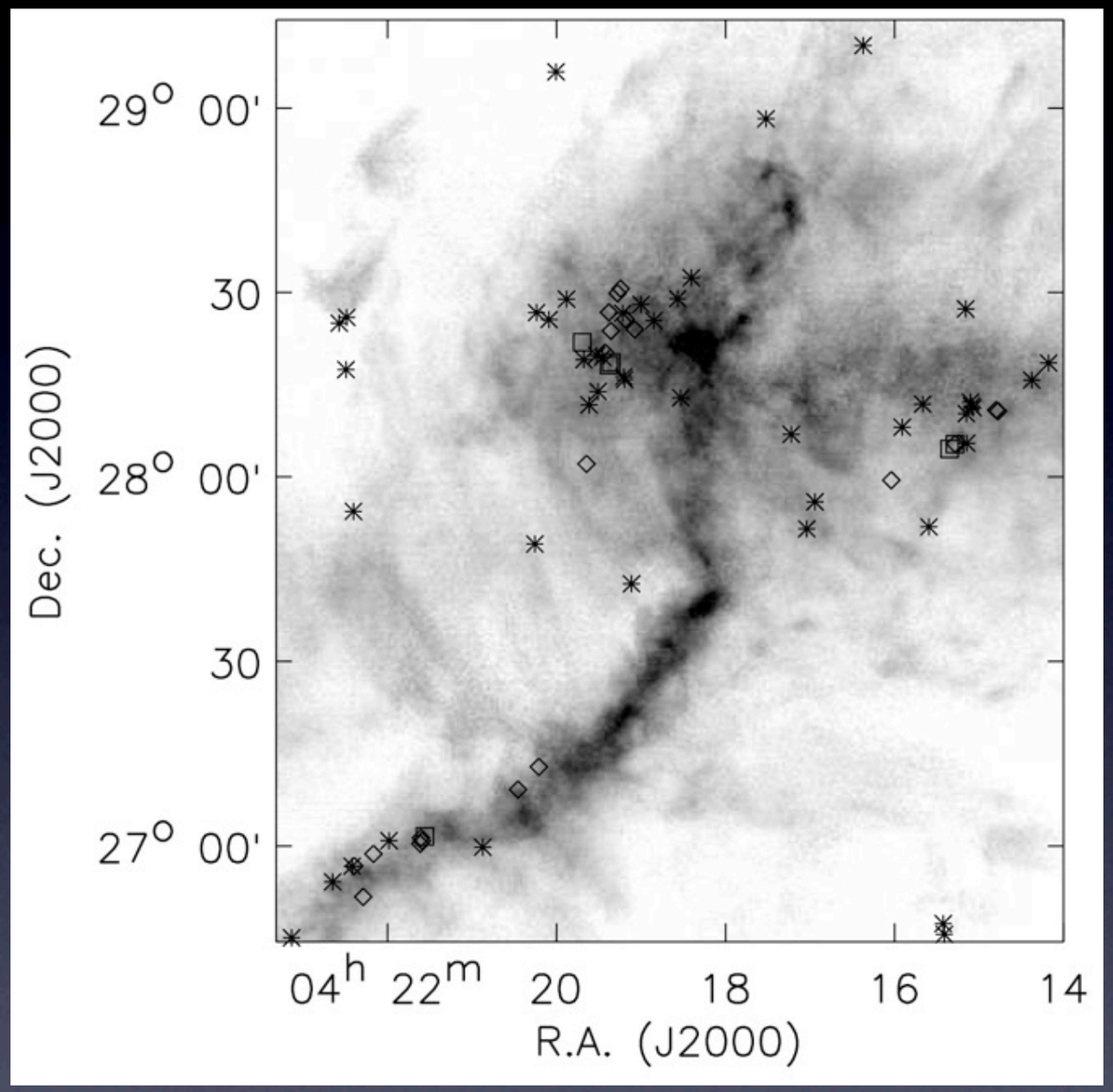
Orion



Ikeda et al. (2002)

- [CI] lines at 492 at 809 GHz
- Trace both cloud interior and transition between diffuse/ dense gas
- What are the variations in the kinematics/turbulence across this boundary?

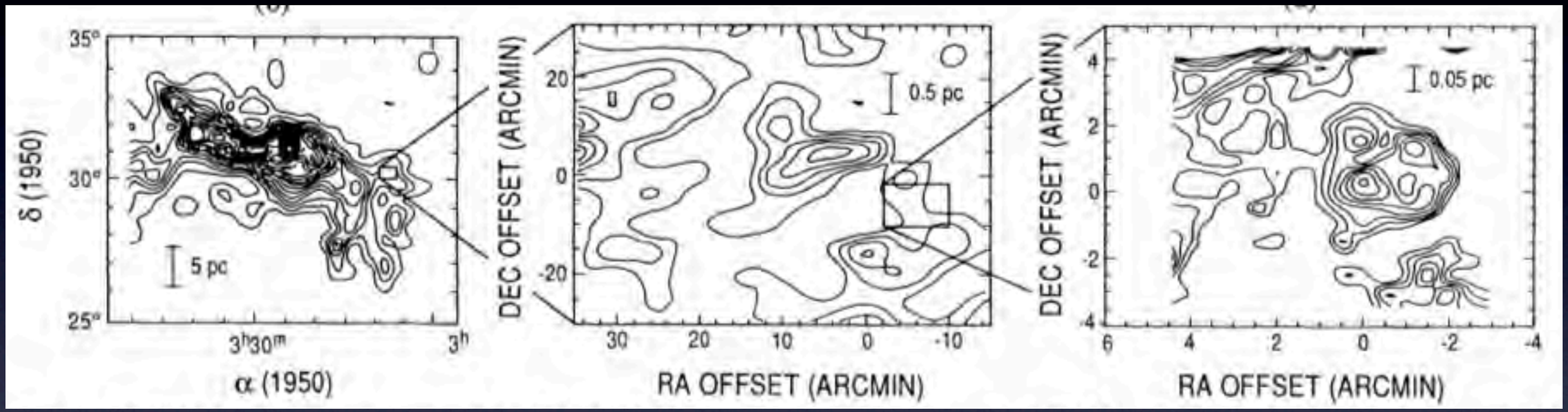
Filaments



Goldsmith et al. (2008)

- Gas infall onto filaments?
- Merger of filaments to form massive cores?
- Flow of gas along filaments?
- (Shocked?) dissipation of turbulence?

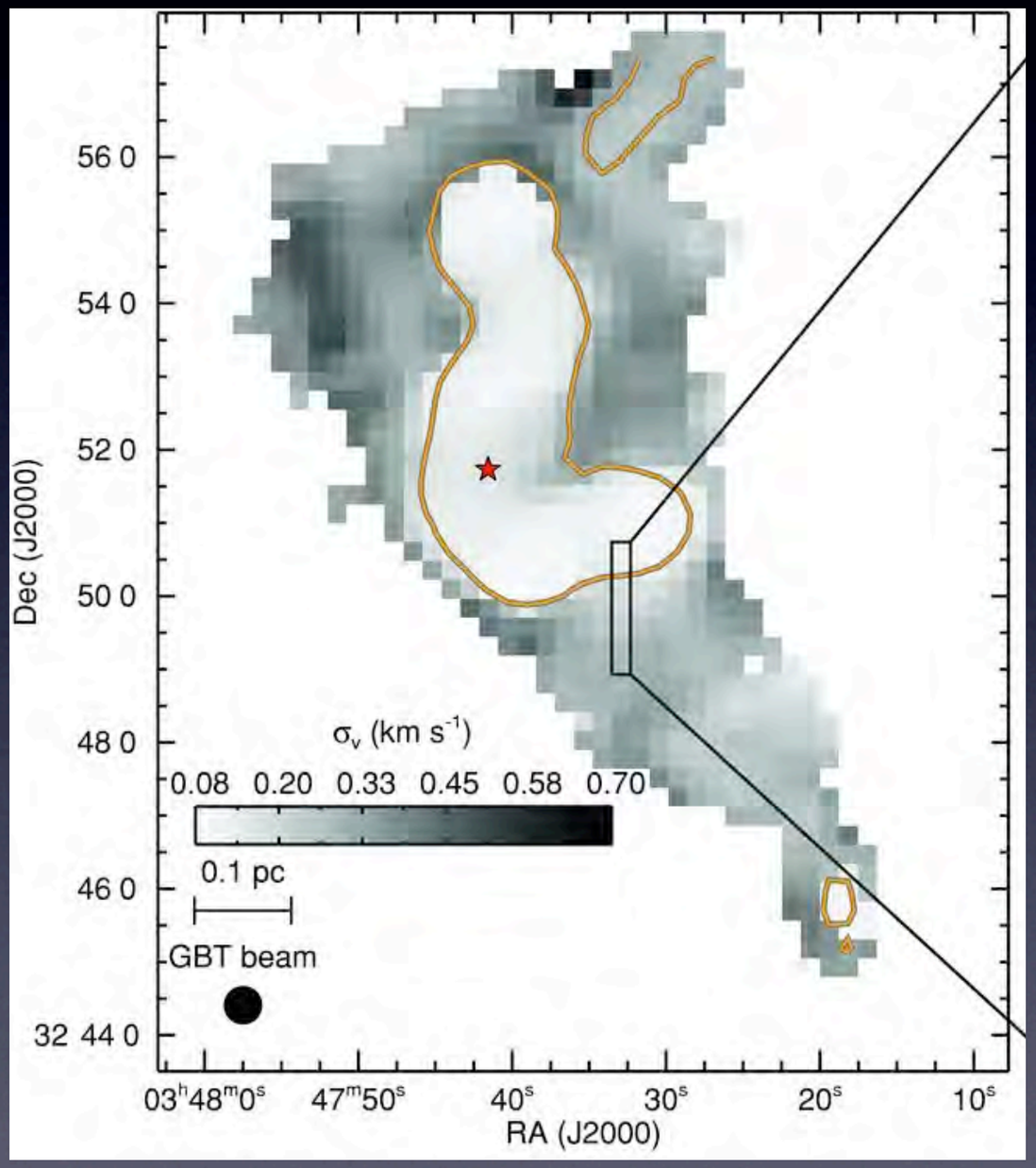
Self-similar structure



Falgarone et al. (1991)

“Coherent Cores”

linewidth



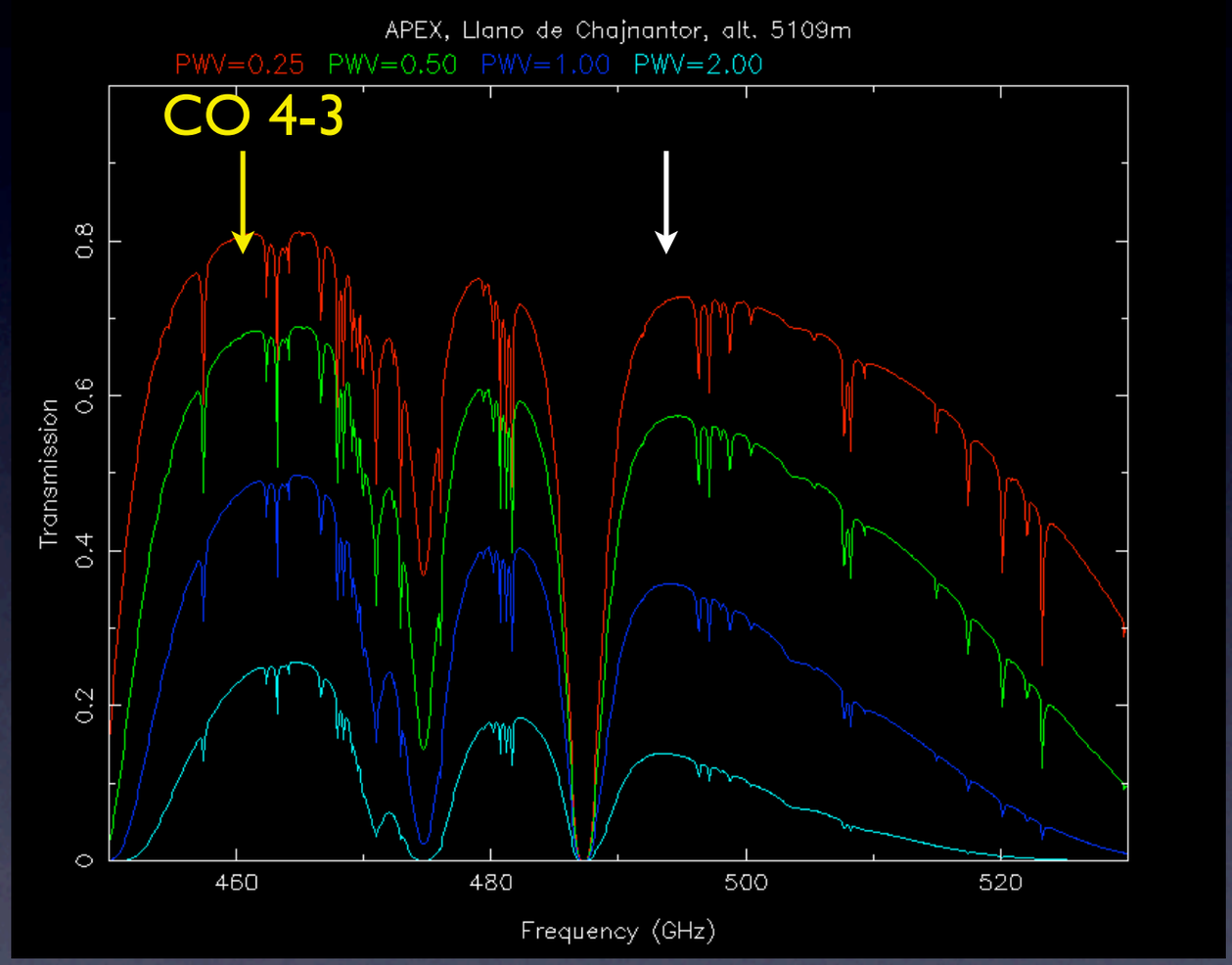
Pineda et al. (2010)

- Can we resolve the dissipation region?
- Can we detect the shocked zones (see Andy Pon’s talk)?

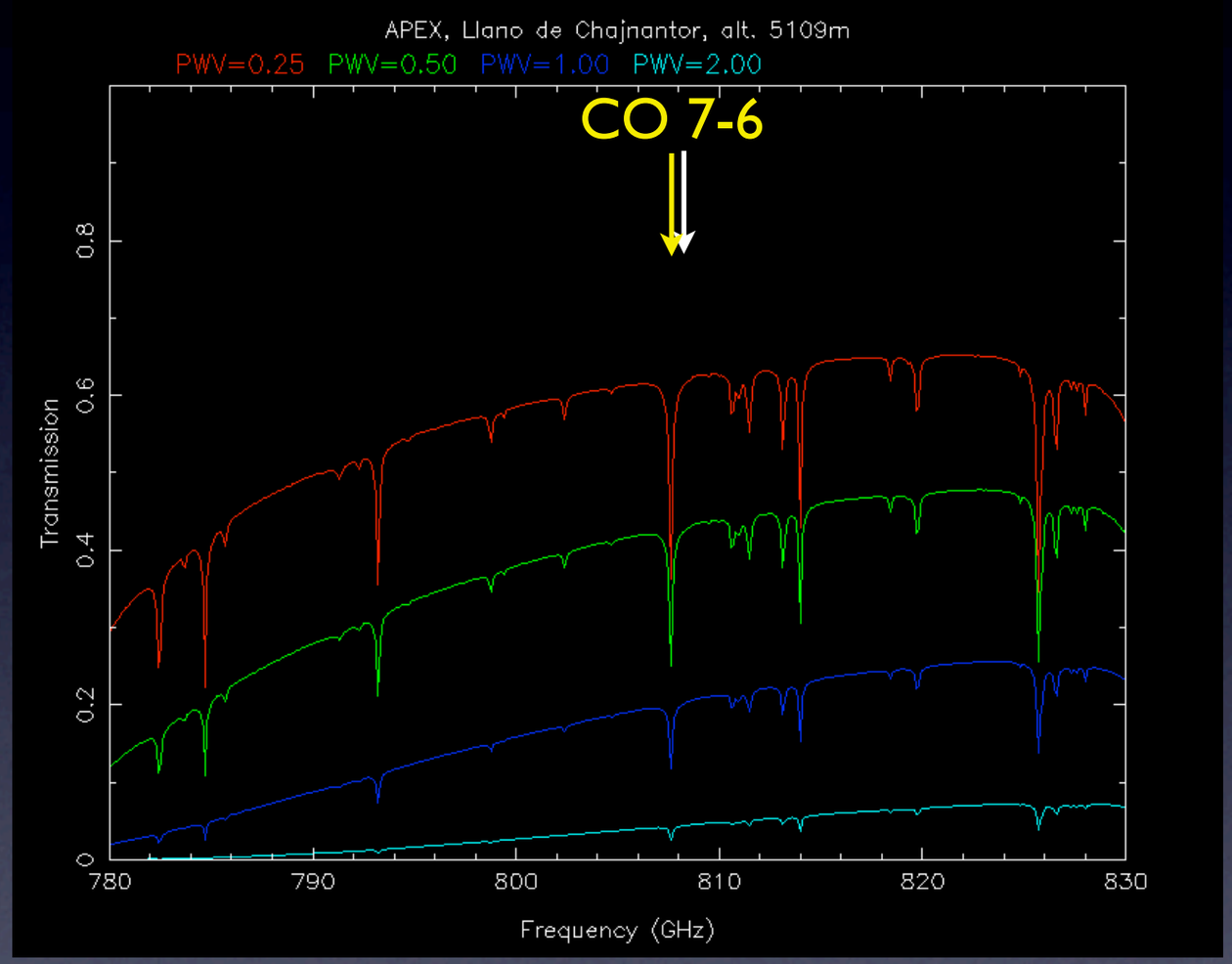
B5 dense core @ 250 pc
31” resolution

Summary: Which band is "best"?

[CI] 492 GHz



[CI] 809 GHz



Dual frequency "ideal" to provide resolution and excitation in Carbon and CO