ALMA reveals a hub of filamentary molecular clouds in Sgr B2(N)

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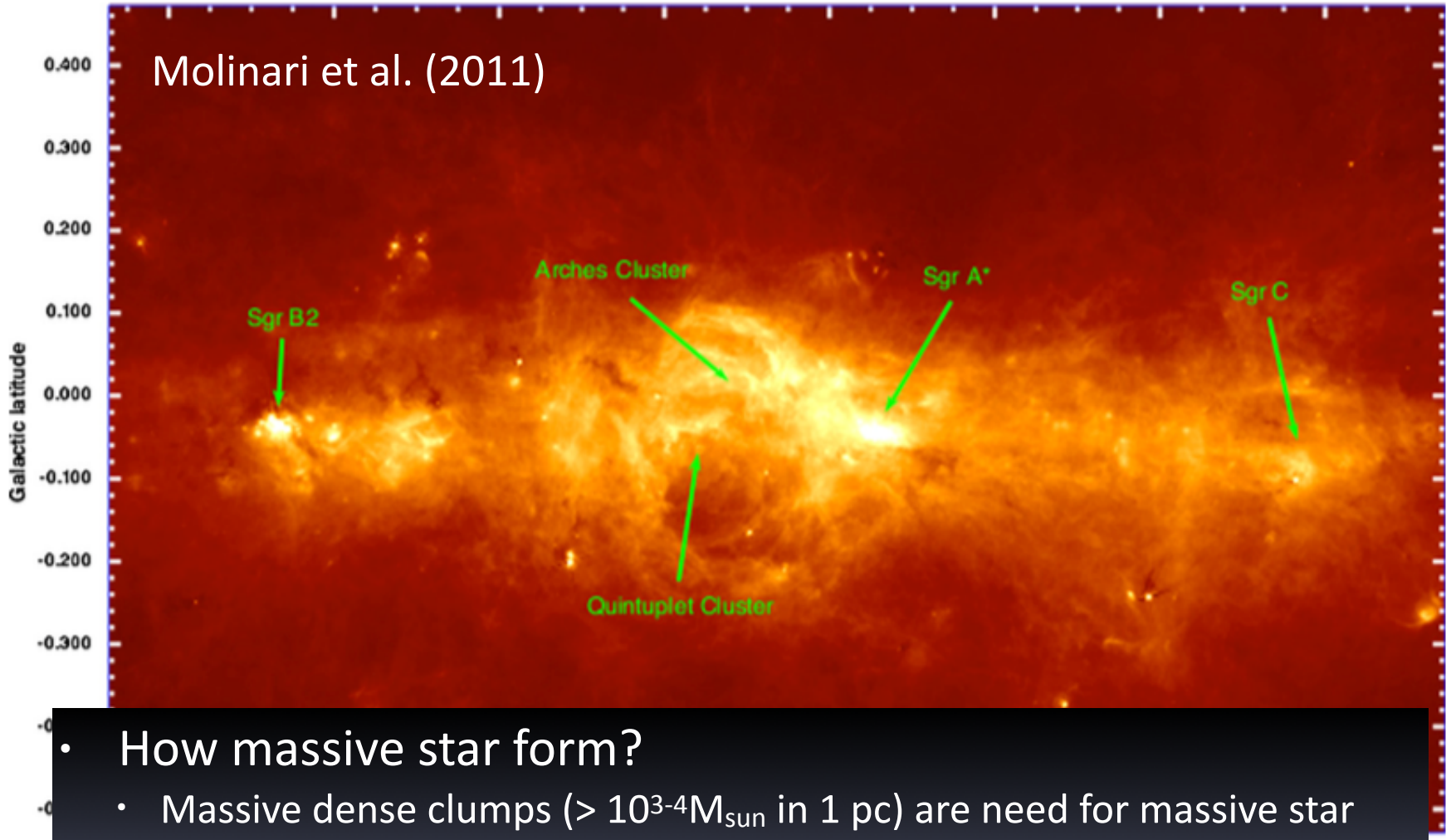
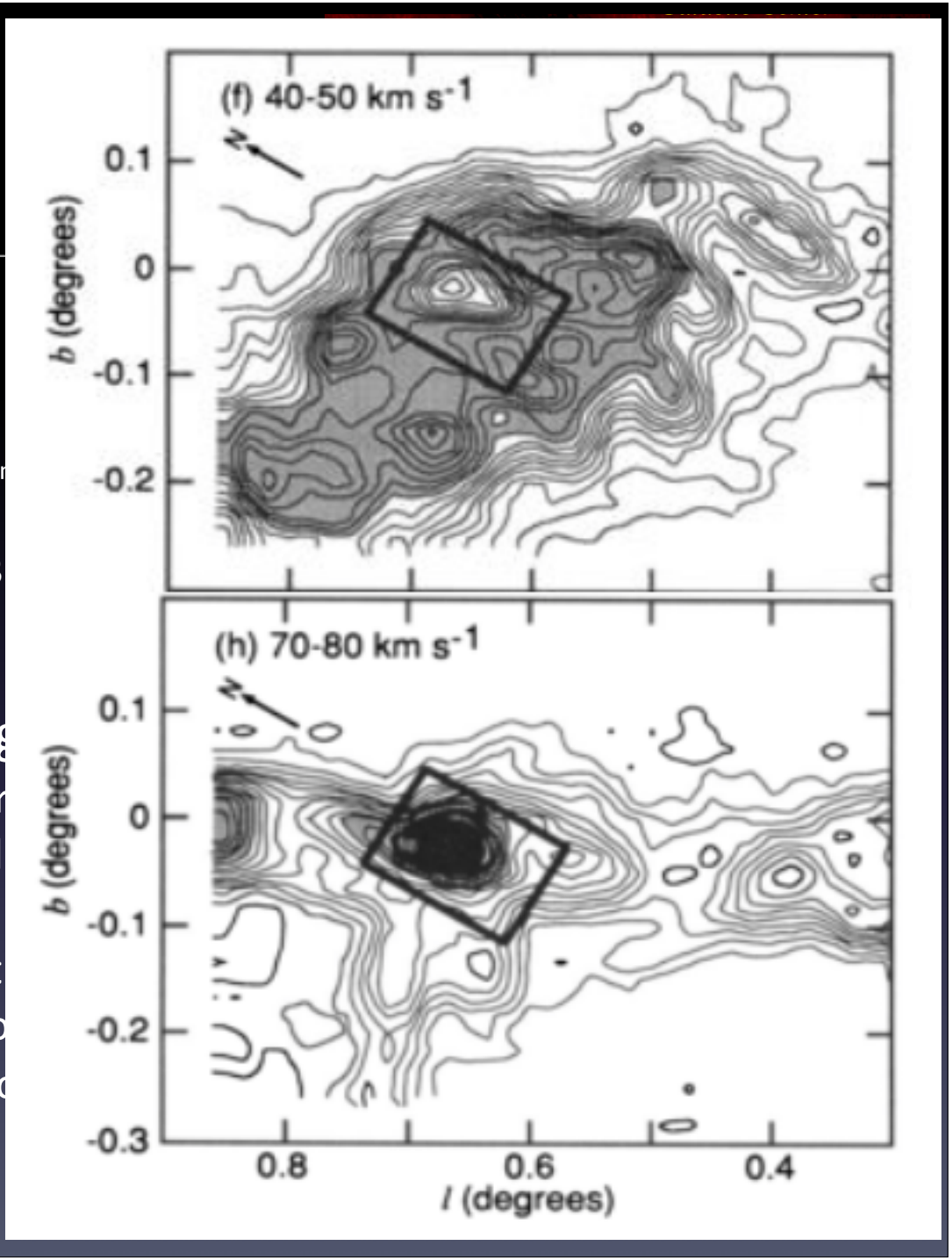
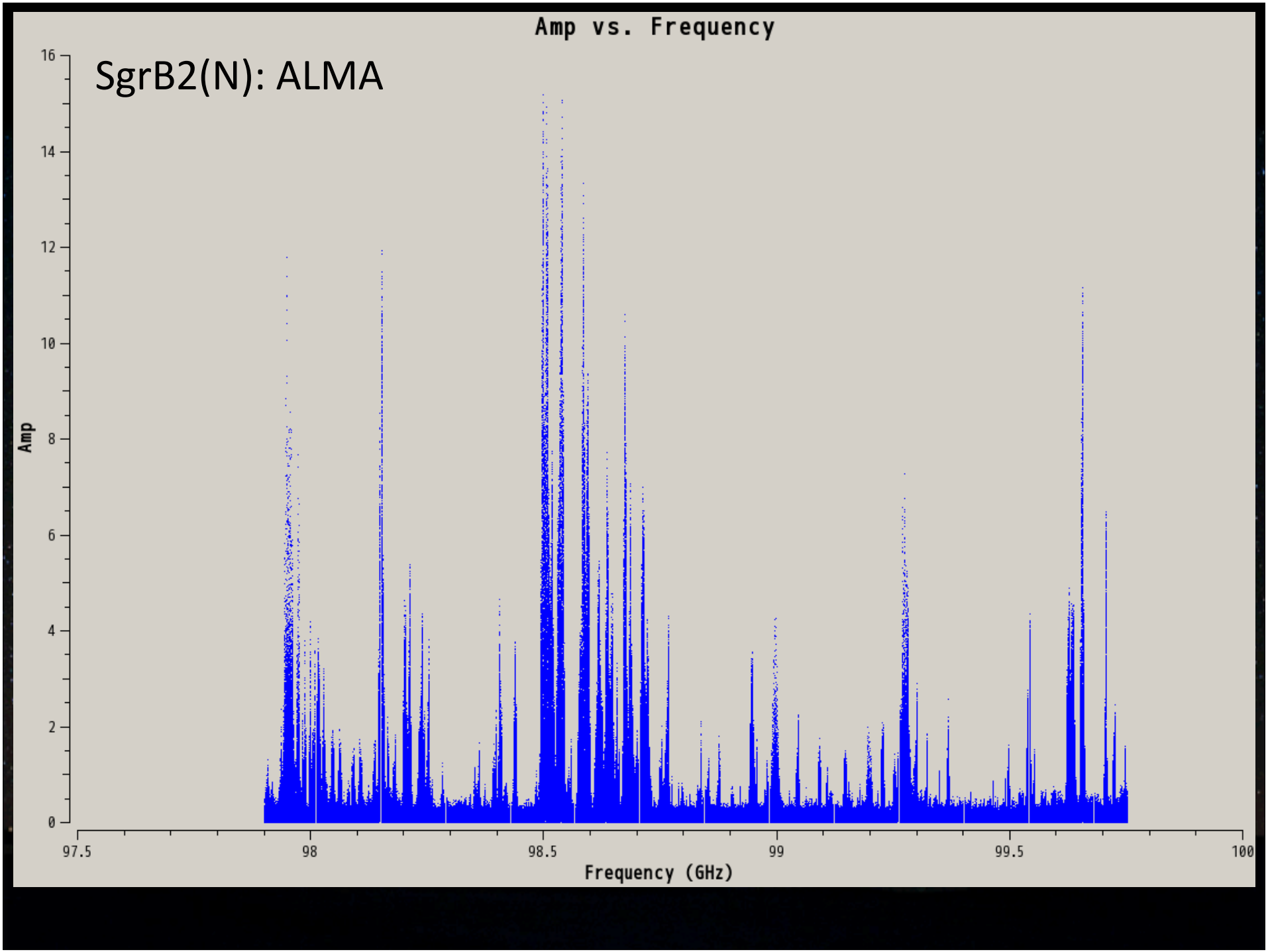


- How massive star form?
  - Massive dense clumps (> $10^{3\text{-}4} M_{sun}$ in 1 pc) are need for massive star formation regardless the formation scenarios.
  - Triggering mechanism can be necessary.

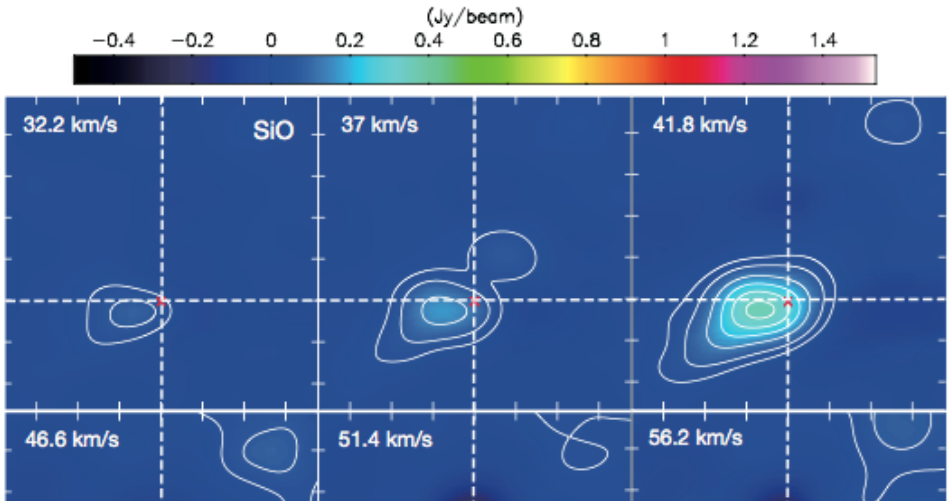
SgrB2

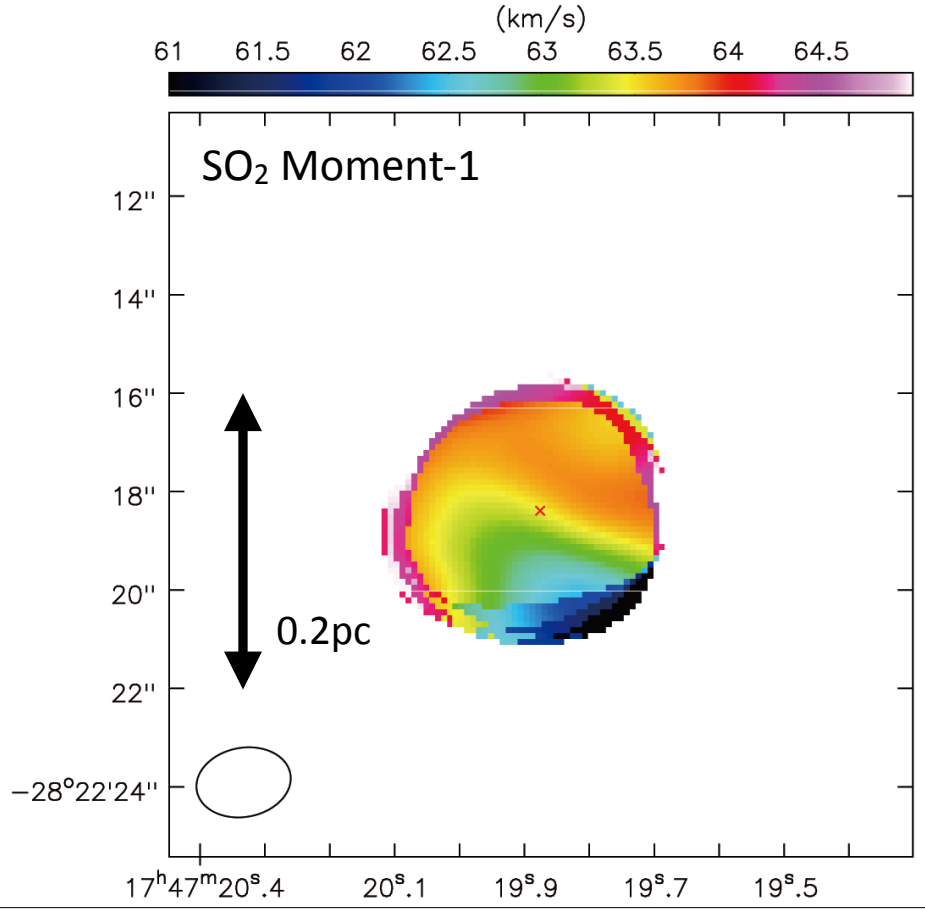
- Giant molecular cloud in th
  - D=7.8kpc (Reid et al. 2009)
  - T=50-100K; n=$10^{6\text{-}7}$cm^{-3}; M=$10^{7}M_{sun}$
  - Chemically rich complex
    - Line survey (Belloche et al. 2013
- Star forming activities in Sg
  - Site of massive star formation tr
    - Massive dense cores formed (Hasegawa et al. 1994)
  - SgrB2(N) -K2: massive stars at t
    - Particularly rich in complex o
    - Massive system of rotating to

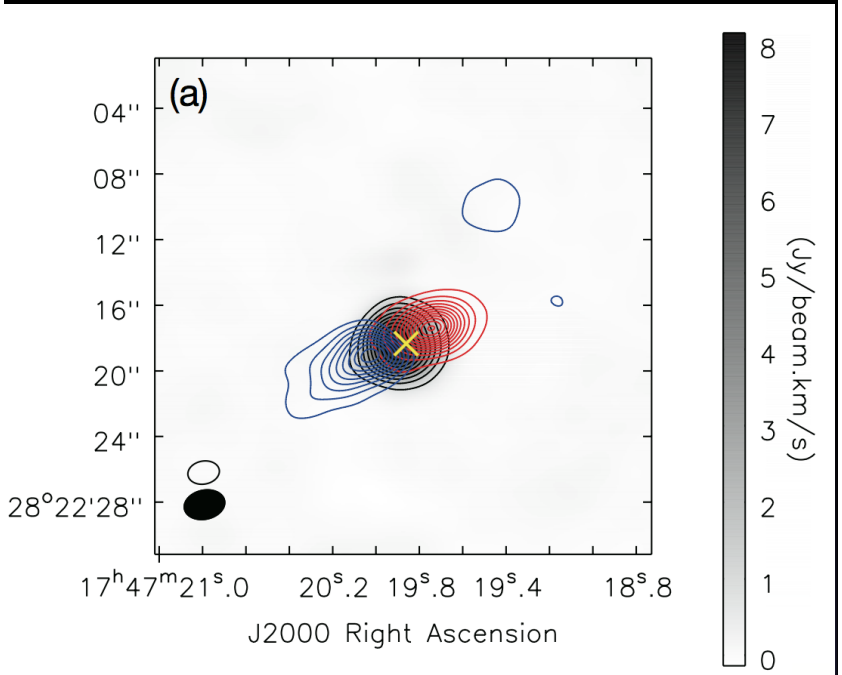


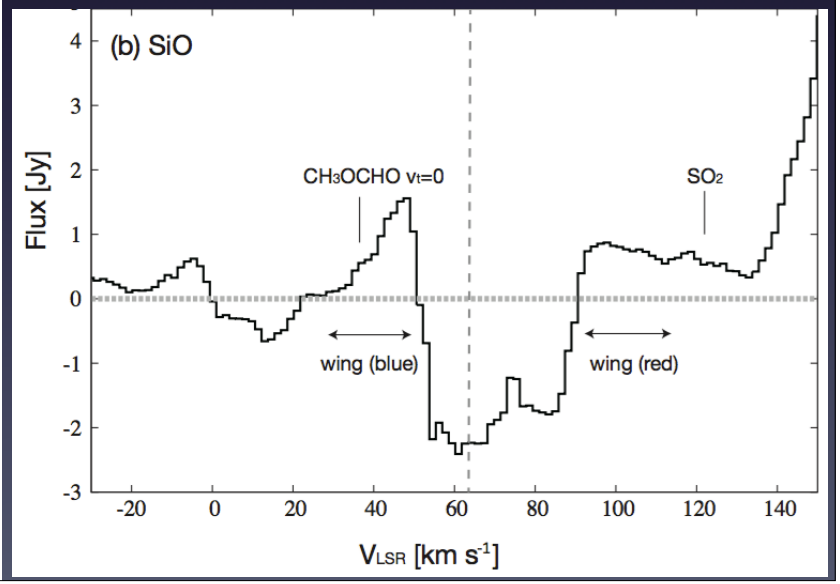

Amp vs. Frequency
SgrB2(N): ALMA
Amp
Frequency (GHz)
0
2
4
6
8
10
12
14
16
97.5
98
98.5
99
99.5
100

Higuchi et al. 2015(b)

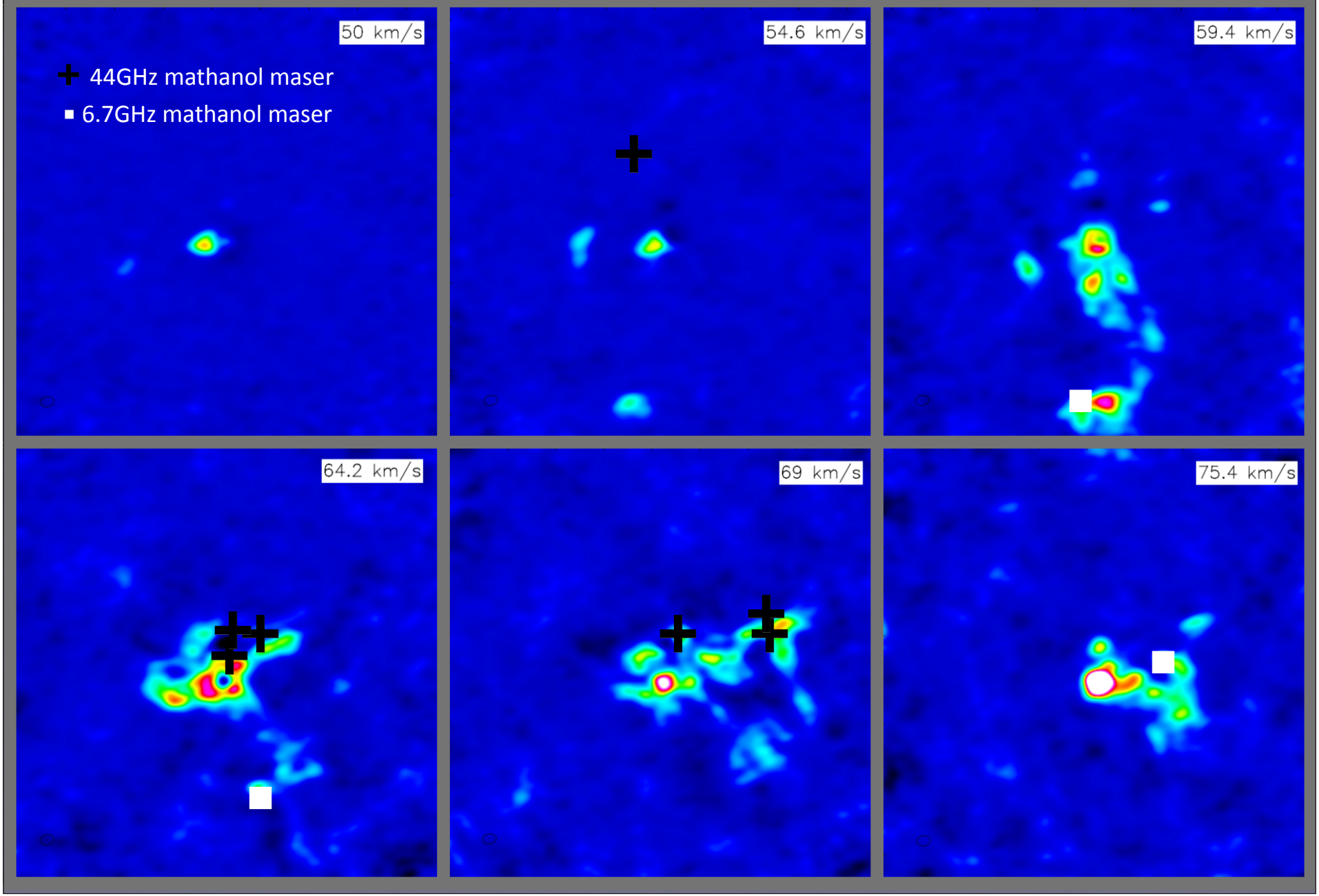






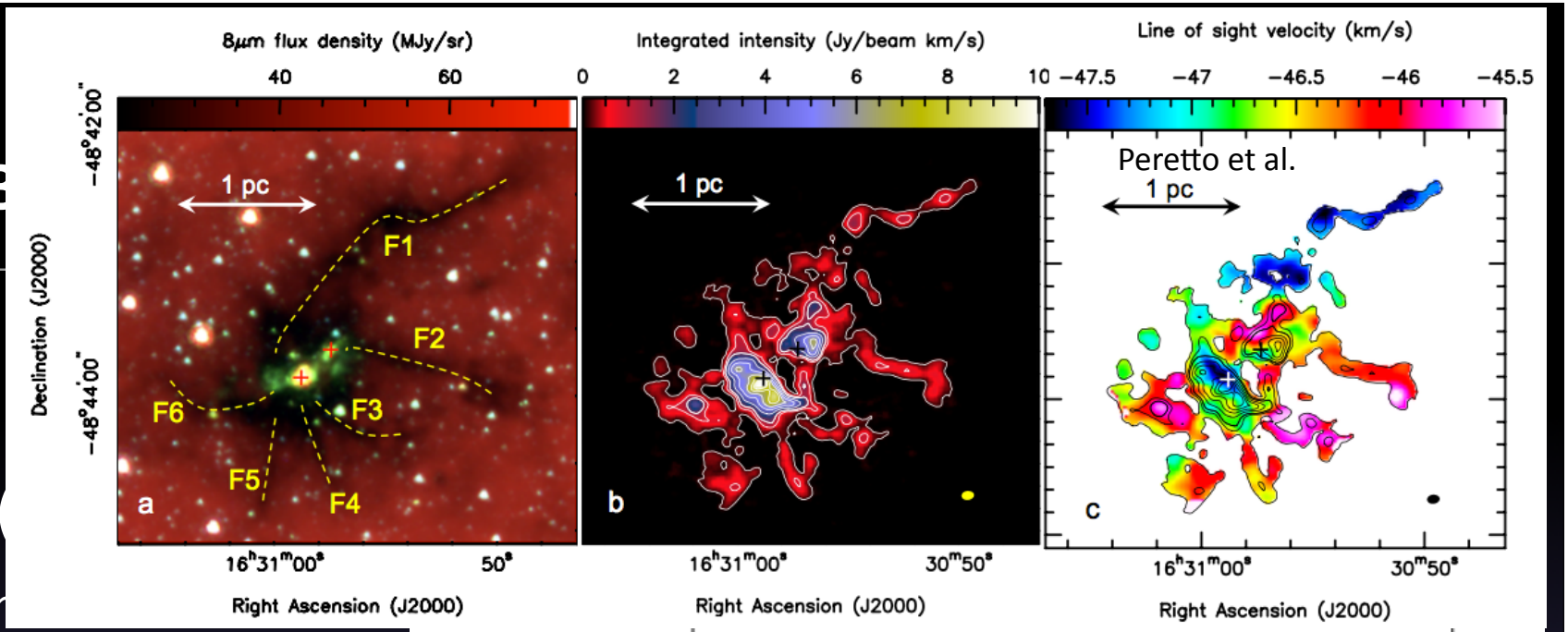


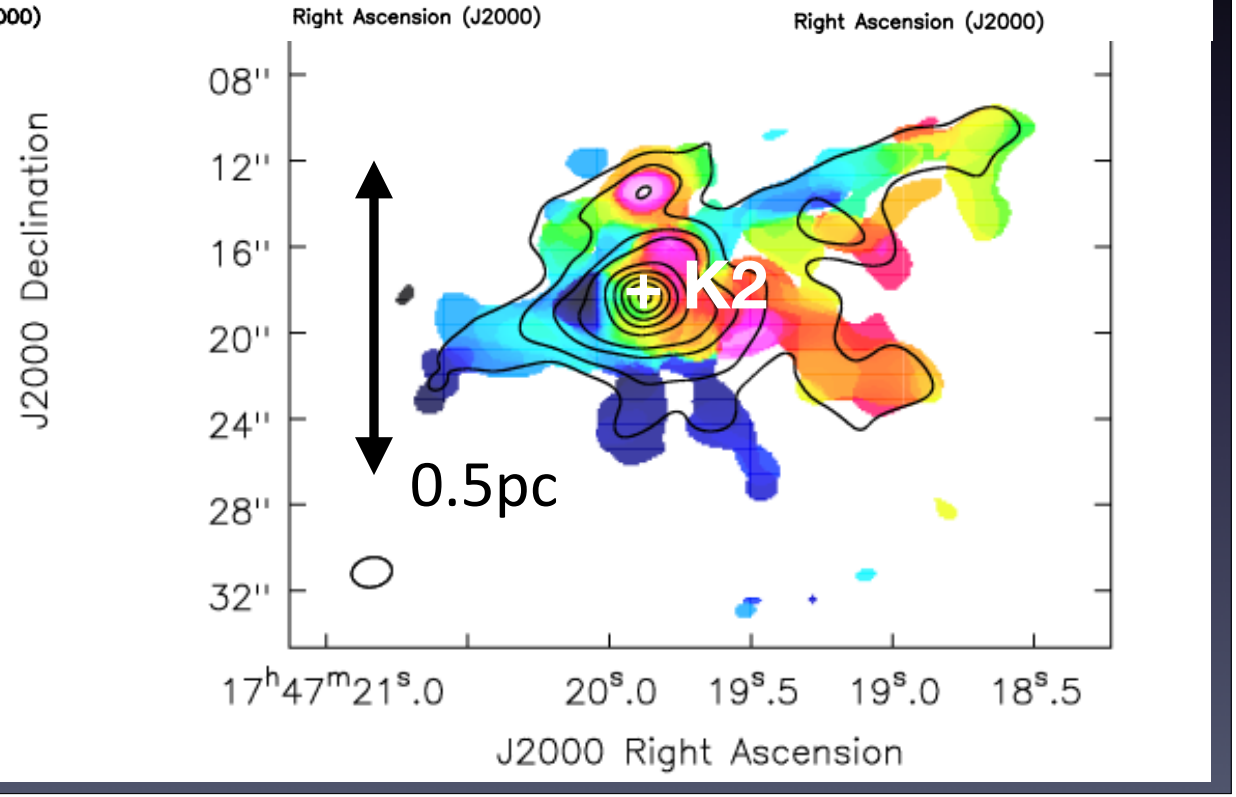
SgrB2(N): $C^{18}O$ filamentary structure



SgrB

- $C^{18}O$(
  - X-sh
    different velocities
  - Mass supply to cores through filaments has been suggested for other regions (e.g., N_2H^+ line by Peretto et al. 2013)
  - Early stage of cluster formation including high-mass stars

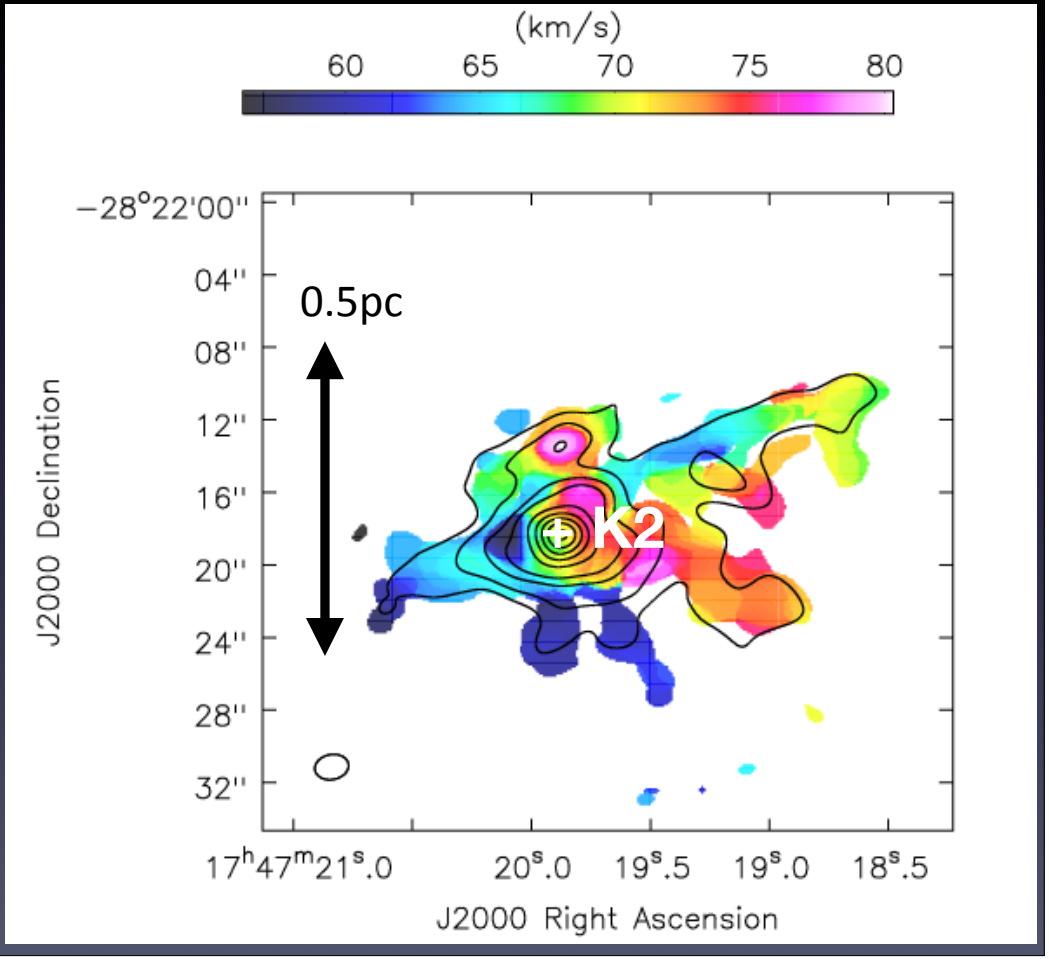




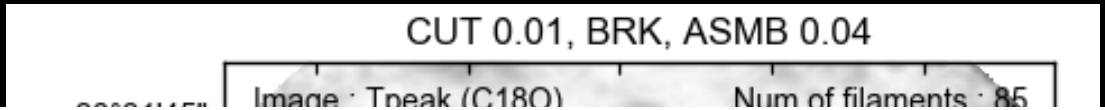
Does the core form from the filaments?

Physical condition of the filaments

- Filament width = 0.1pc, dv=1-2km/s
- Line mass= $10^2 M_{sun}$/pc : optically thin, LTE at T=100K, X($C^{18}O$)=10^{-7}
  - 50-60% of flux in the 16" beam of Nobeyama 45-m telescope is reproduced
  - Total filament mass ($10^3 M_{sun}$) is smaller compared with that of the core ($10^4 M_{sun}$)
- No rapid mass flow along the filaments discerned (within the limited velocity resolution of 1.2 km/s of the observations)



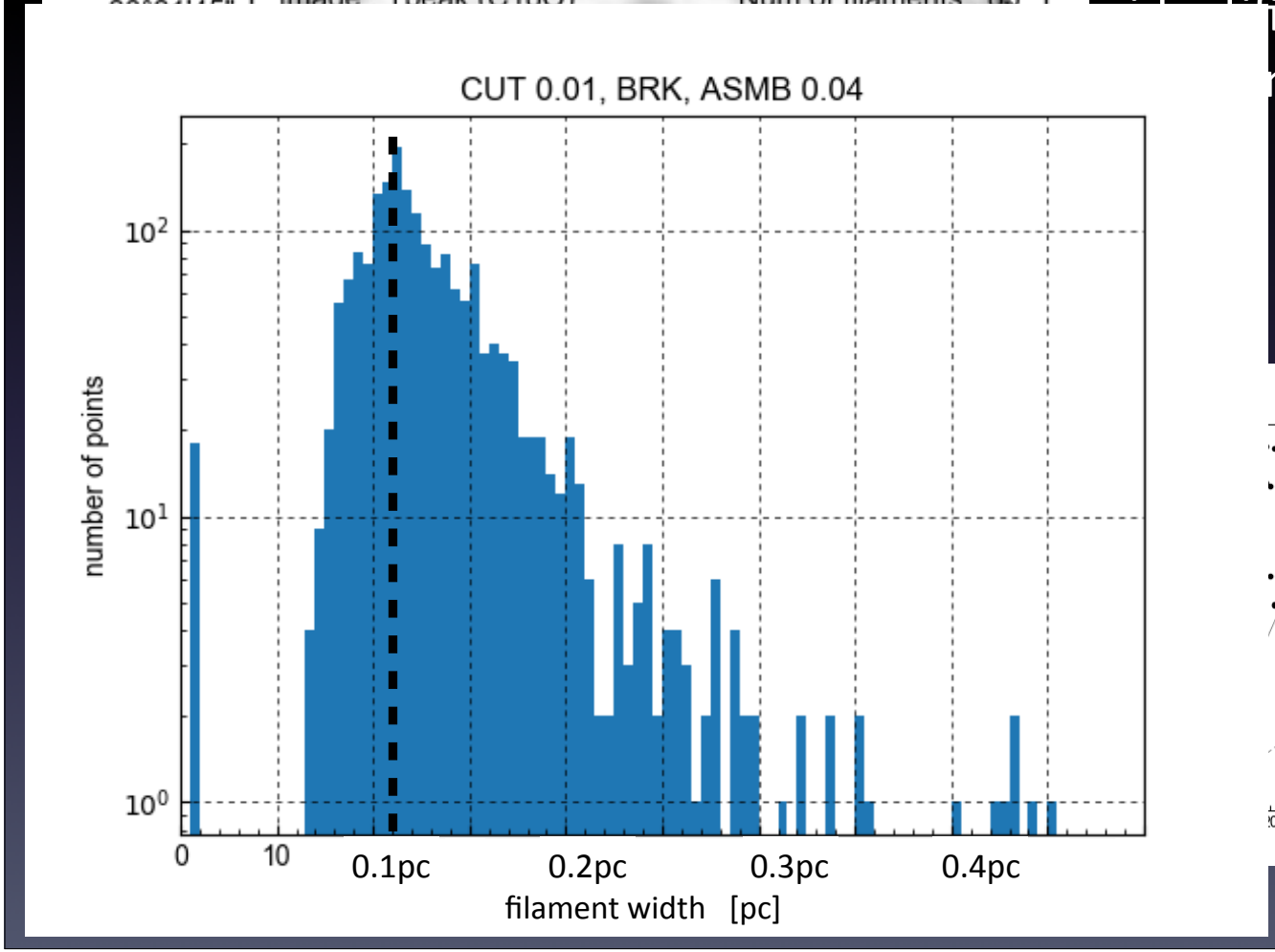
Identification of the filaments: by A. Nishimura

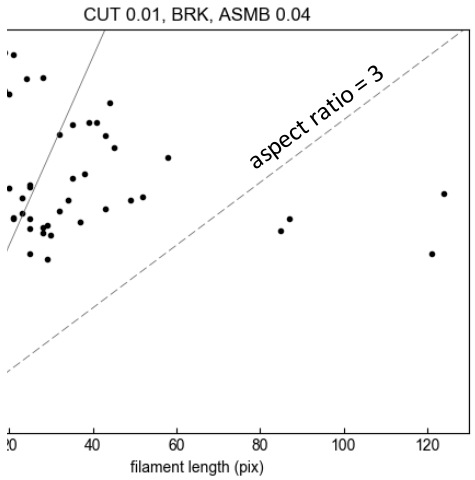


DisPerSE v0.9.24 (3D data)

ified small number of

nts with aspect ratio > 3

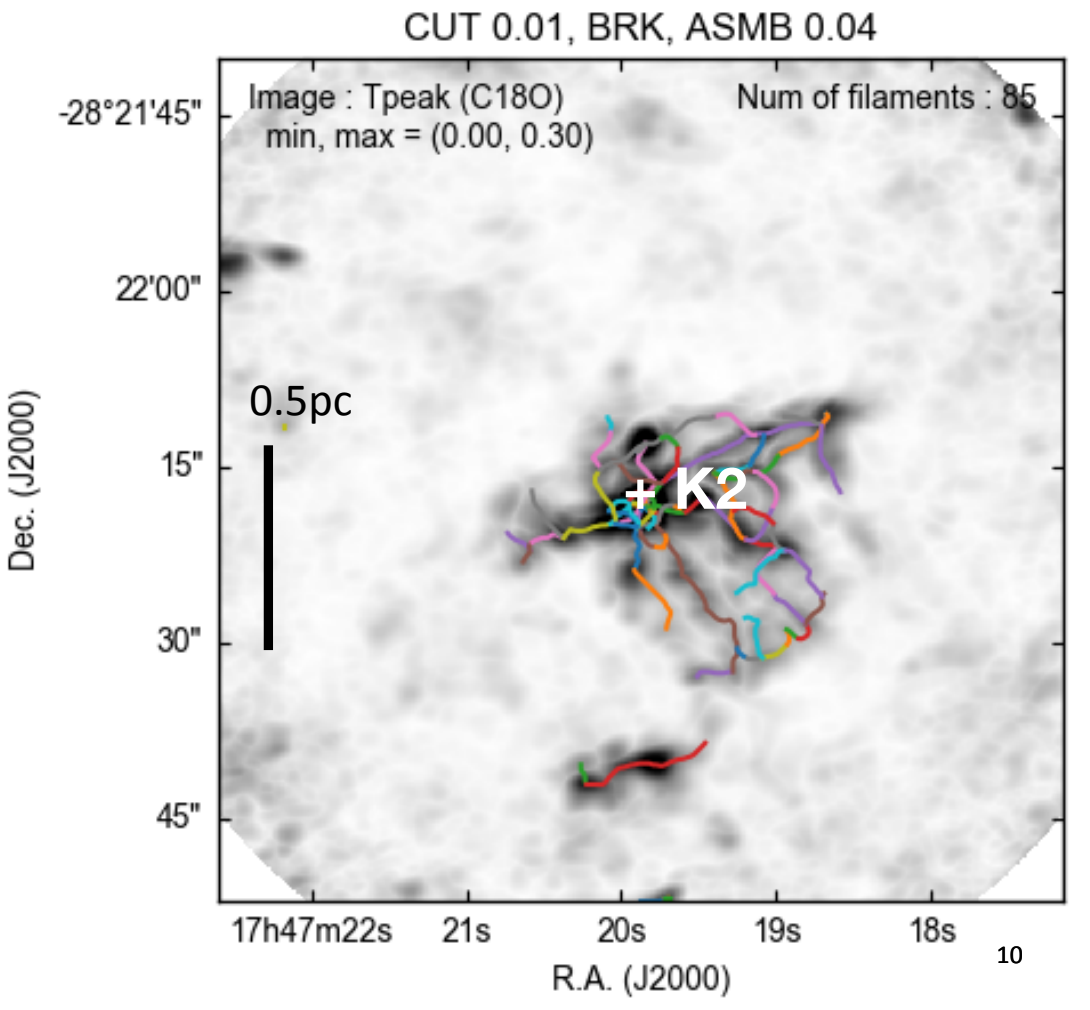




Identification of the filaments

Origin of the filaments

- SE-NW filament
  - results of interaction with the bipolar outflow (Higuchi et al. 2015b)
  - alignment with the outflow
- The other filaments
  - formed in a sheet with a large velocity sheer of -30 km/s/pc at the cloud collision interface

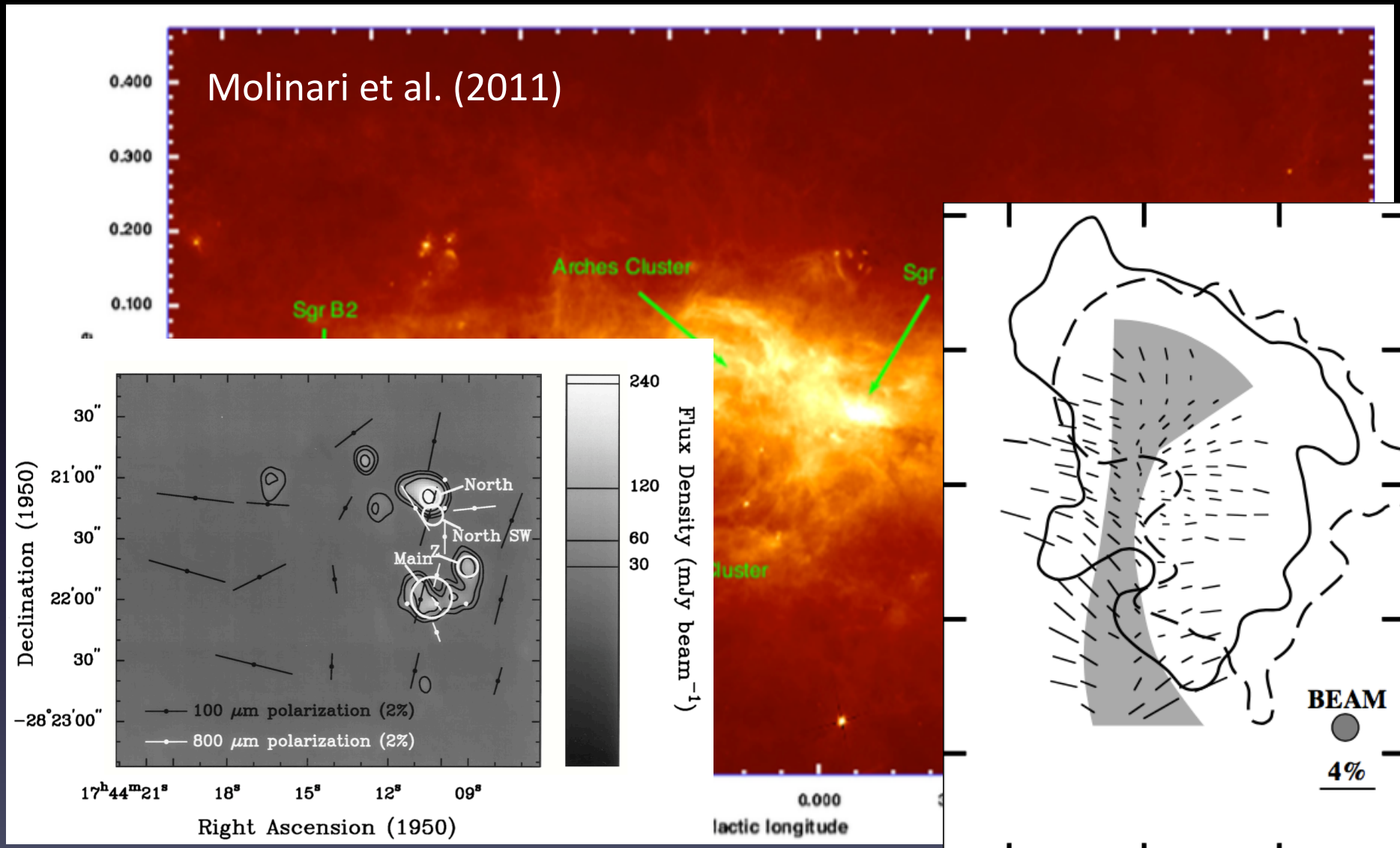


Summary

Physical condition of the filaments

- $C^{18}O$(1-0) 1.9”×1.4” (0.07×0.05 pc) resolution image (ALMA archival data without ACA)
  - 50-60% of flux in the 16” beam of Nobeyama 45-m telescope is reproduced
- A hub of 10 filaments centered at the massive-star forming hot core at K2
  - Filaments have the typical 0.1 pc diameter, but with relatively large line mass of 10^2 M_{sun}/pc
    - SE - NW filaments - may be a result of interaction with the massive bipolar outflow
    - The other filaments - may have formed in a sheet with large velocity sheer at the cloud collision interface
  - The total filament mass (10^3 M_{sun}) is small compared with that of the core (>10^4 M_{sun})
- Not a positive evidence for the core forming from the filaments

Magnetic field in SgrB2 region



Crutcher et al. (2003): - 0.5 mG
(VLA HI observation)

Sato et al. (2000)