Formation of proto-multiple systems in a magnetized, fragmenting filament

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National Radio Astronomy Observatory

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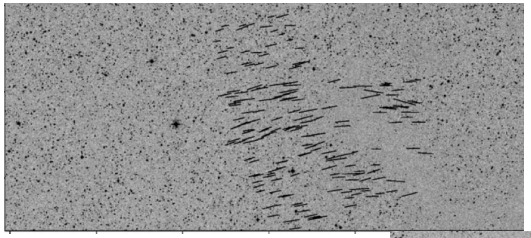
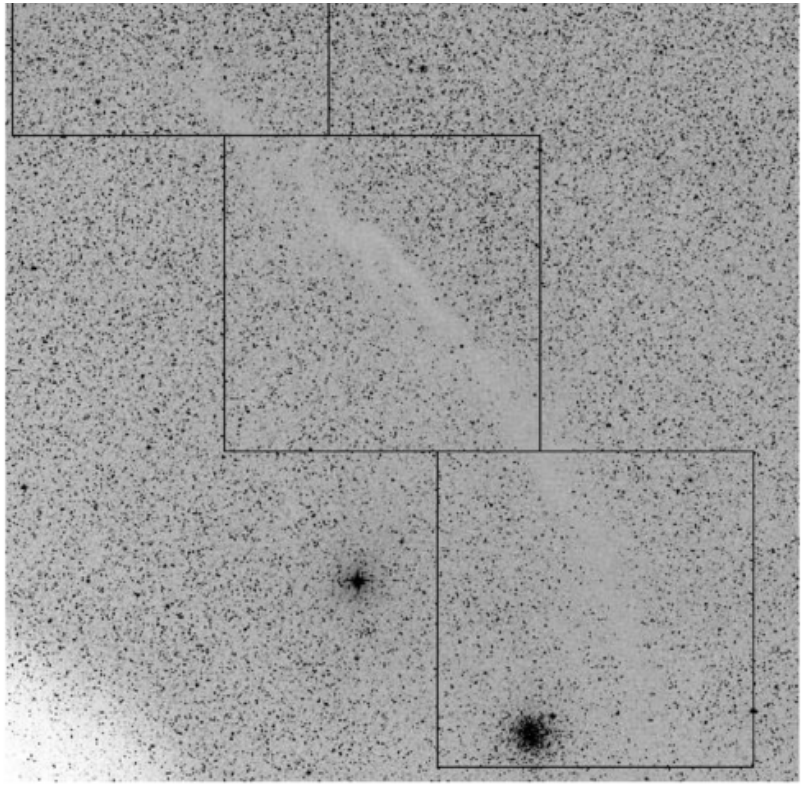
Magnetic Fields in the Universe V
Cargèse, Corsica, France

Intro:
Magnetized star formation

B-fields in large-scale filaments

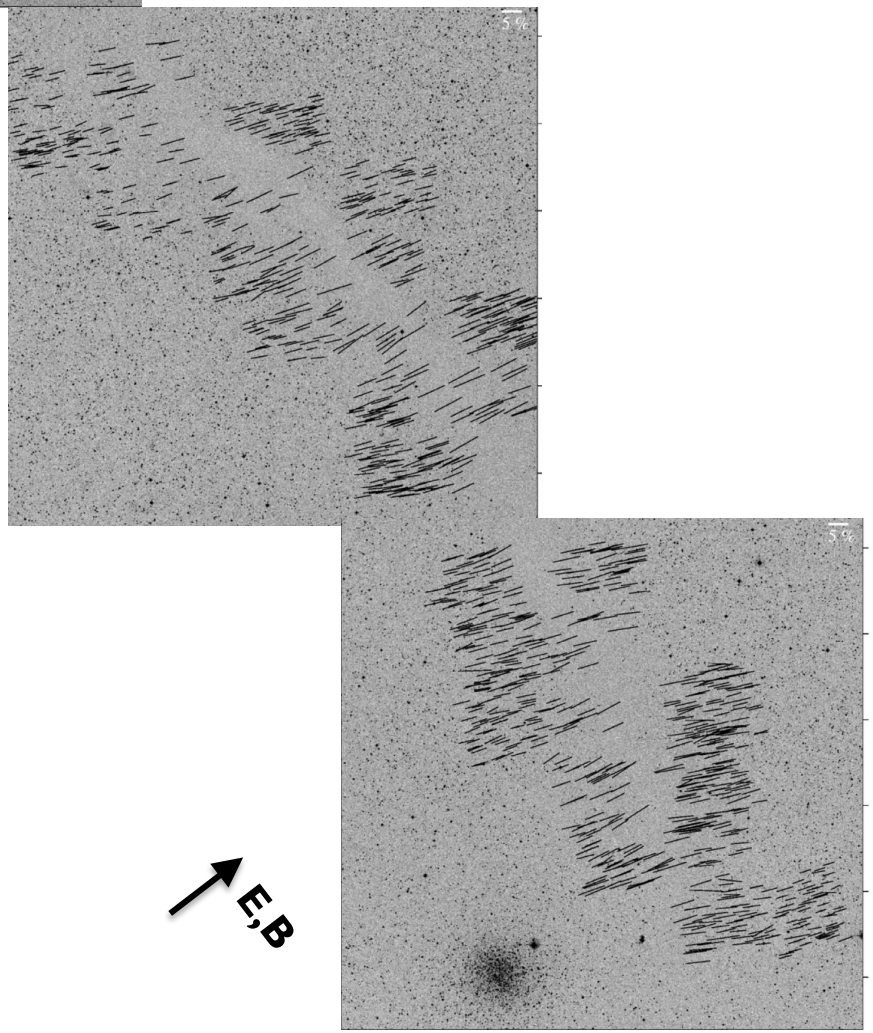


Musca dark cloud



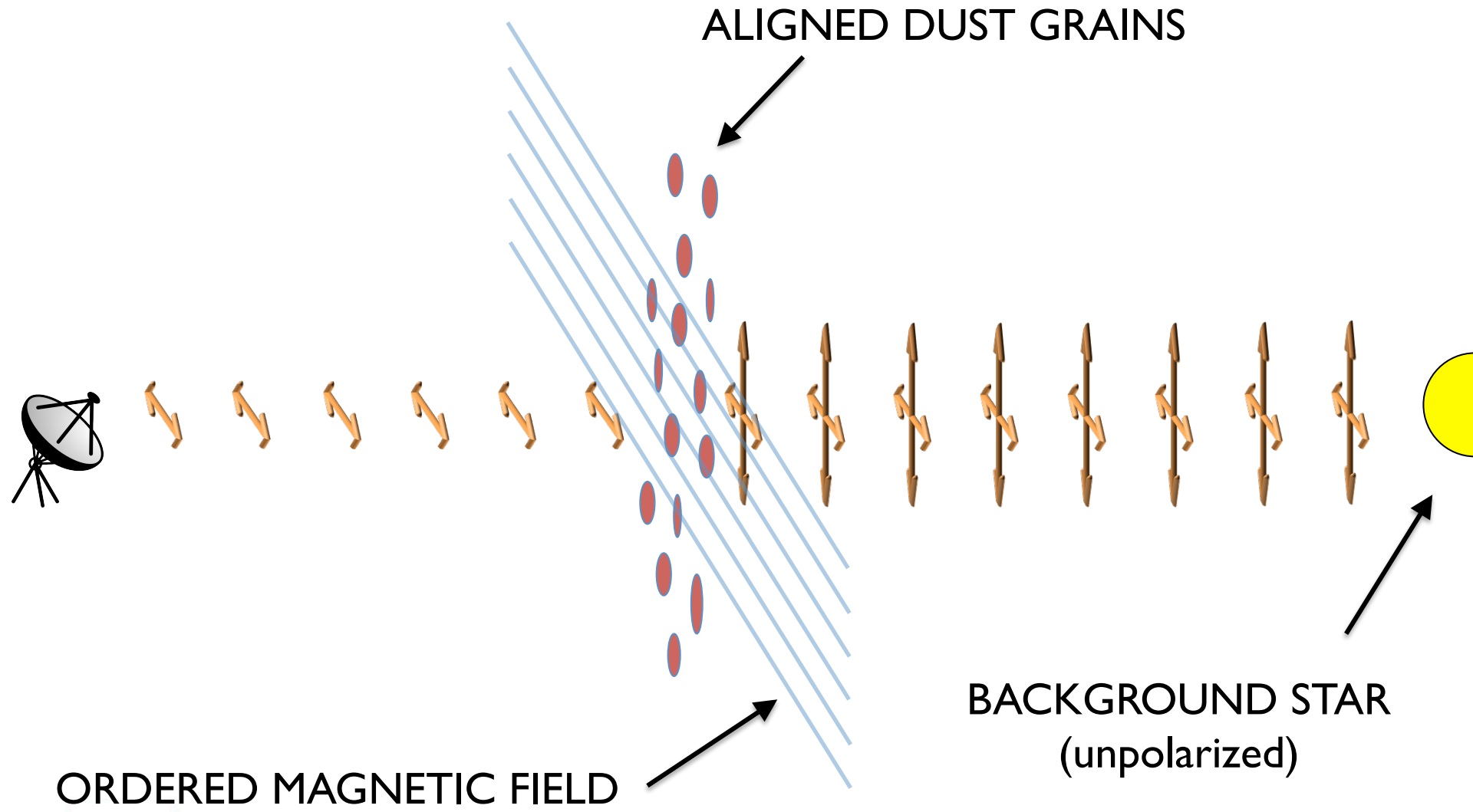
10 pc

Pereyra & Magalhães 2004

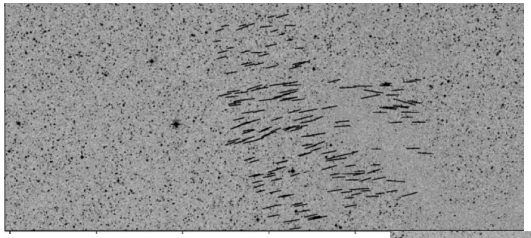


E,B

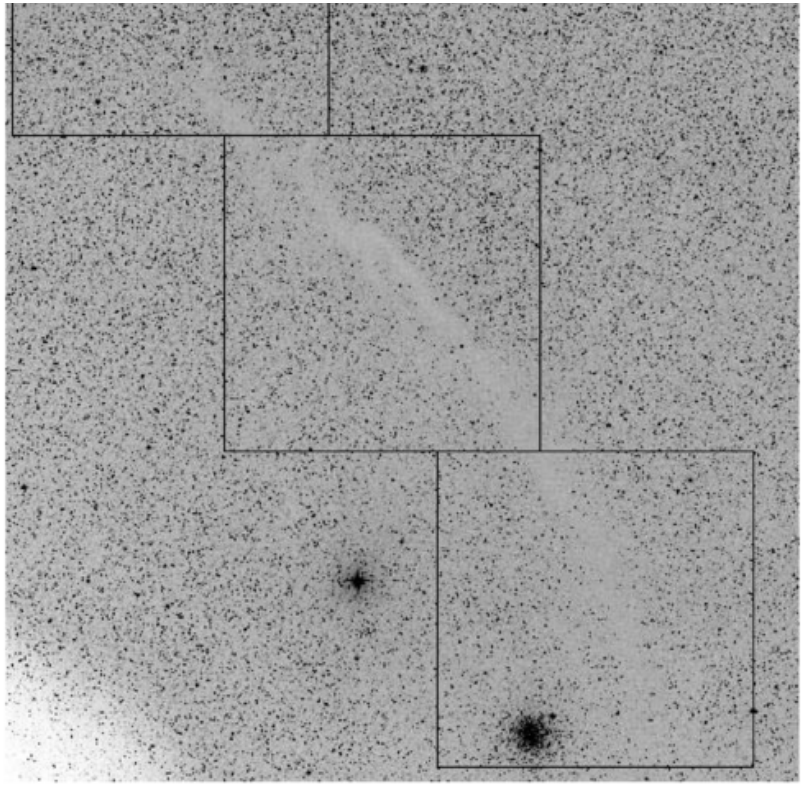
Polarization (via dust absorption)



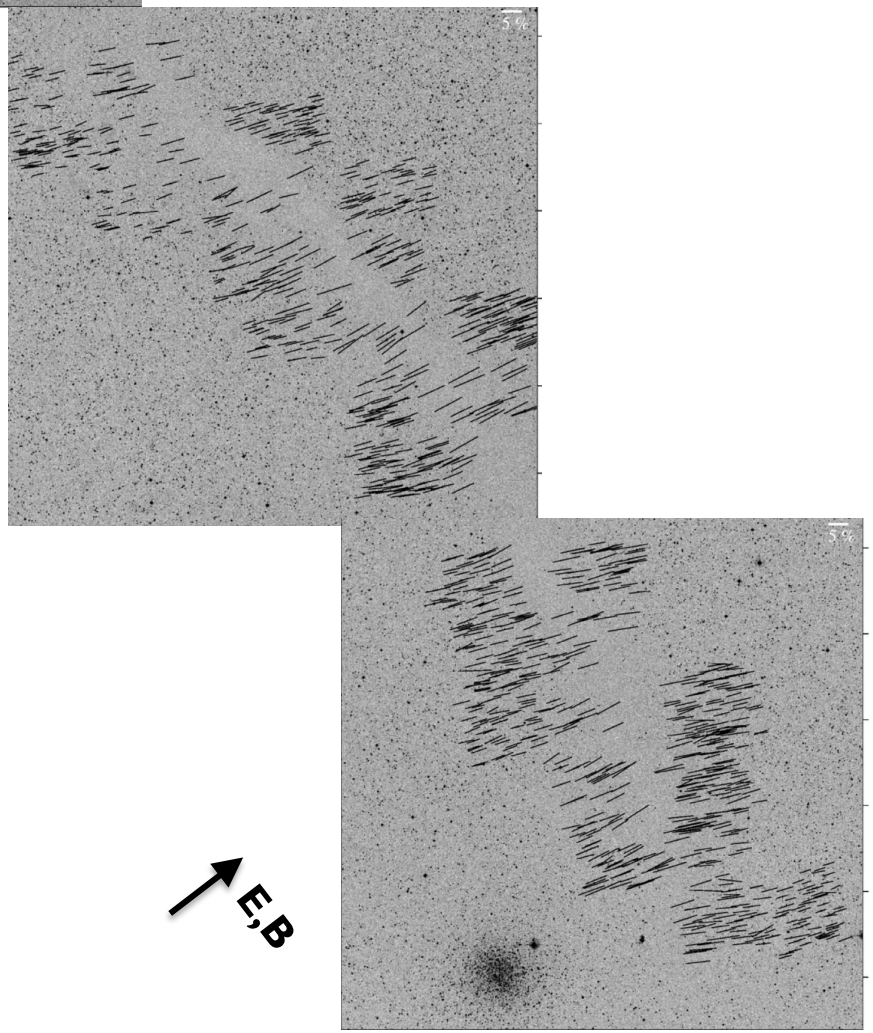
B-fields in large-scale filaments



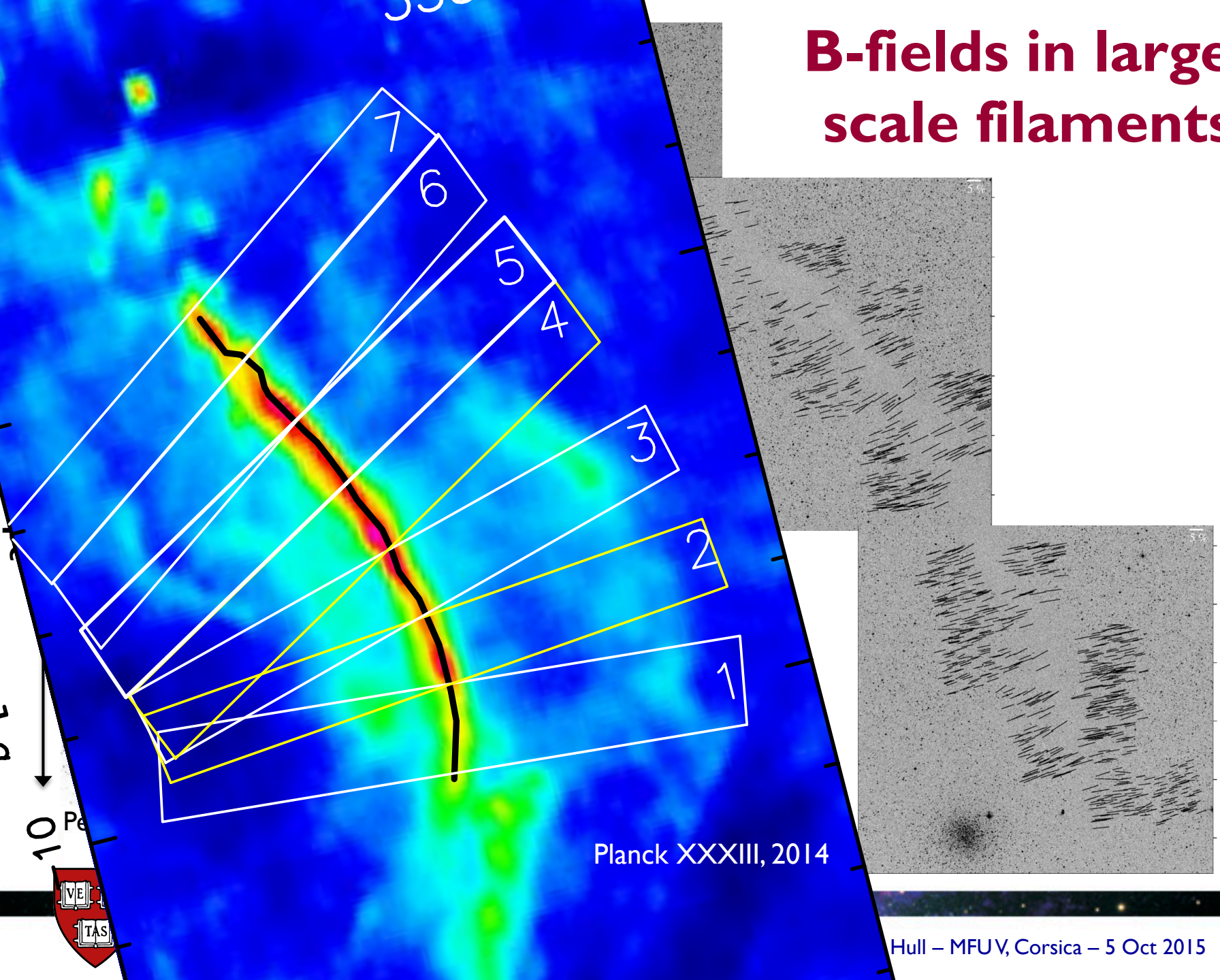
Musca dark cloud

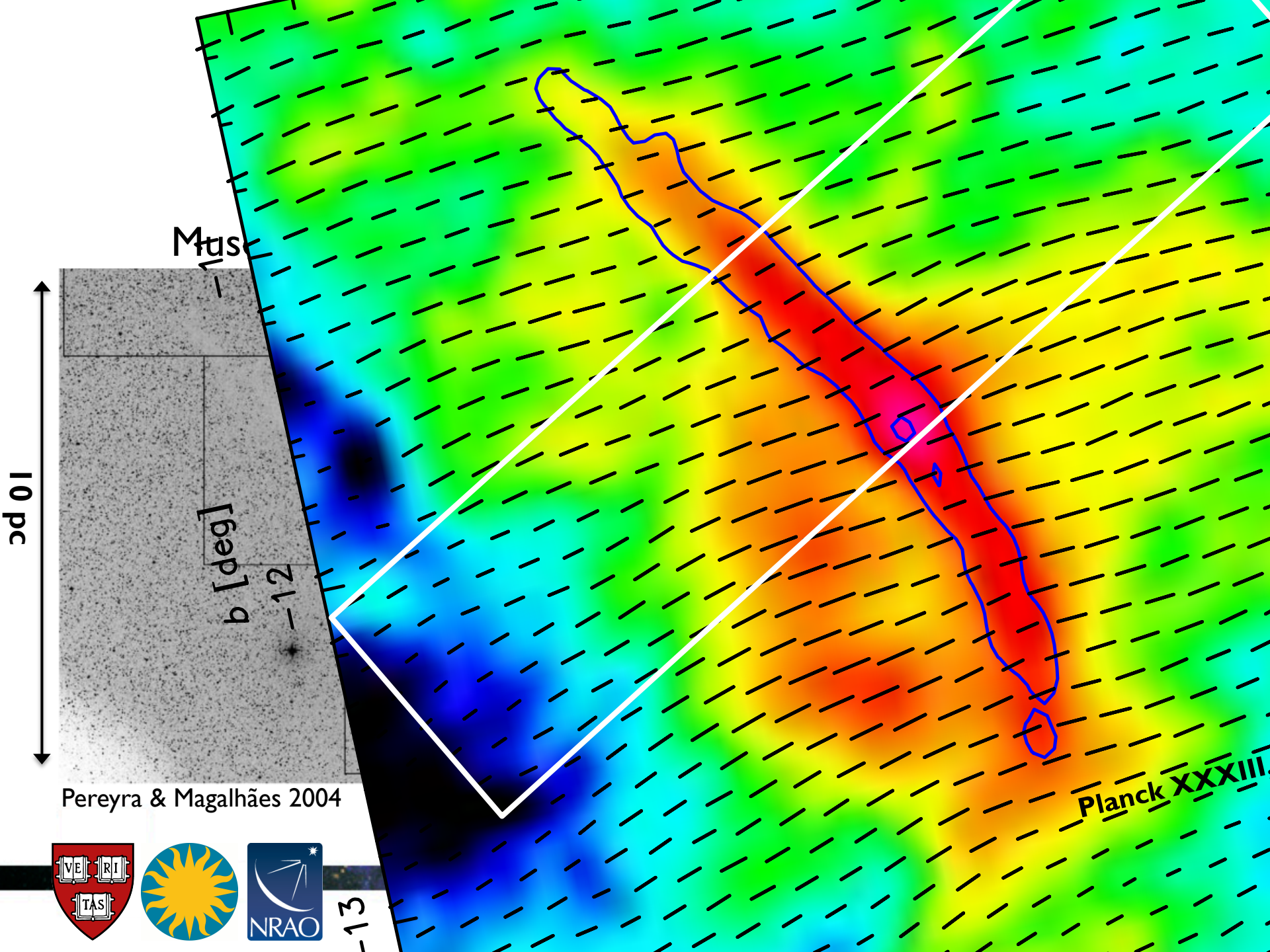


Pereyra & Magalhães 2004

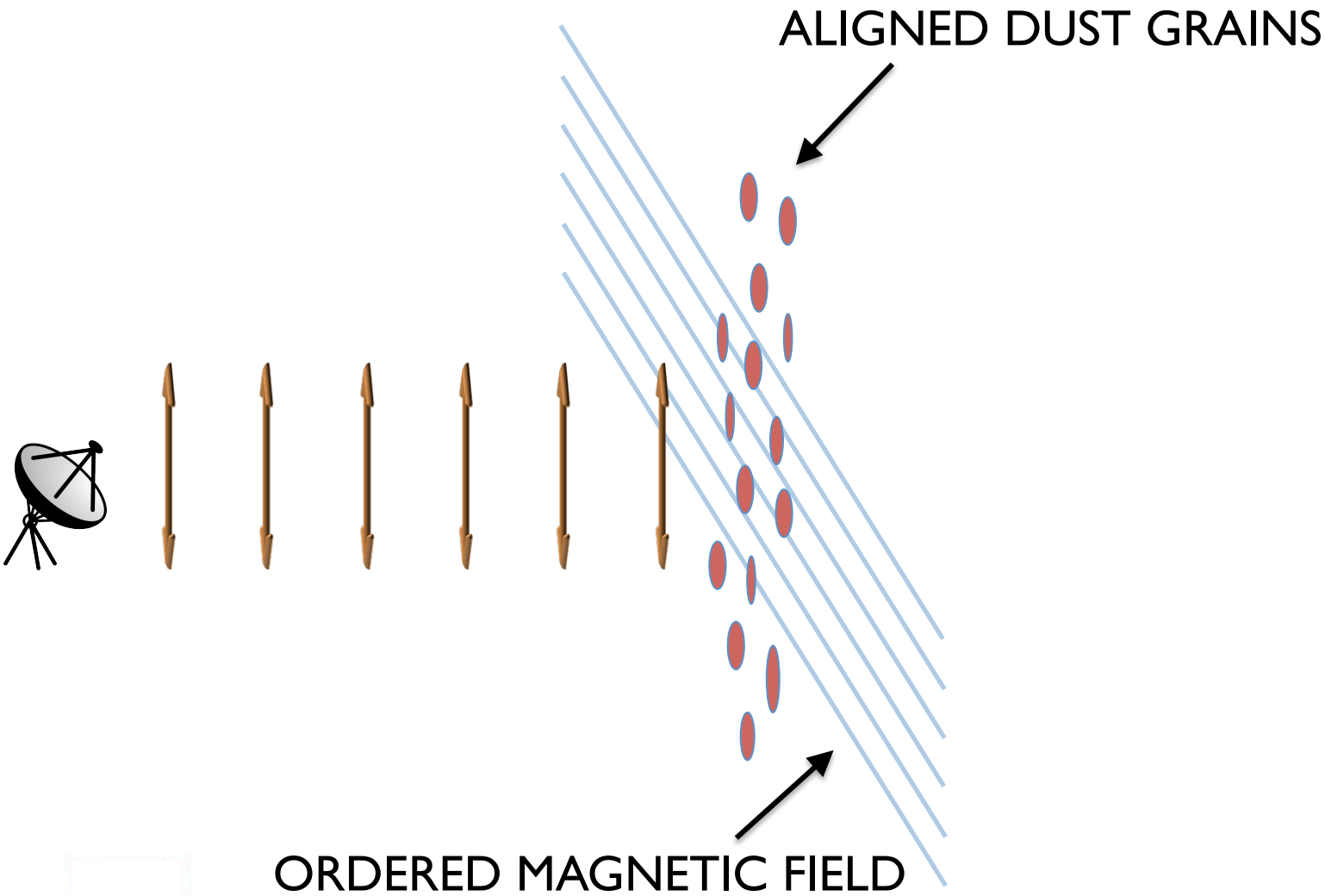


B-fields in large-scale filaments

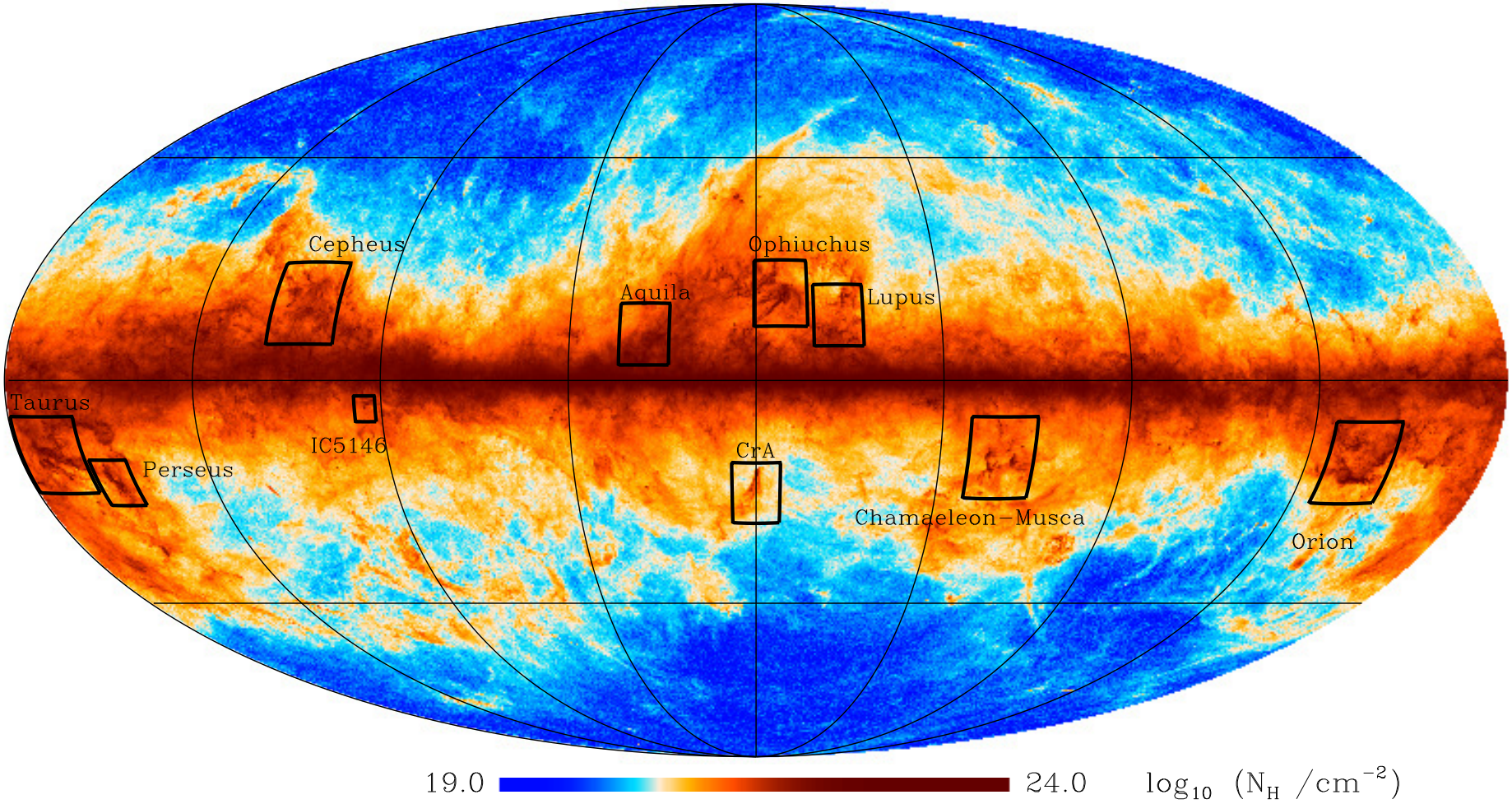



Mus
−11
b [deg]
−12
−13
10 pc
Pereyra & Magalhães 2004
Planck XXXIII

Polarization (dust emission)

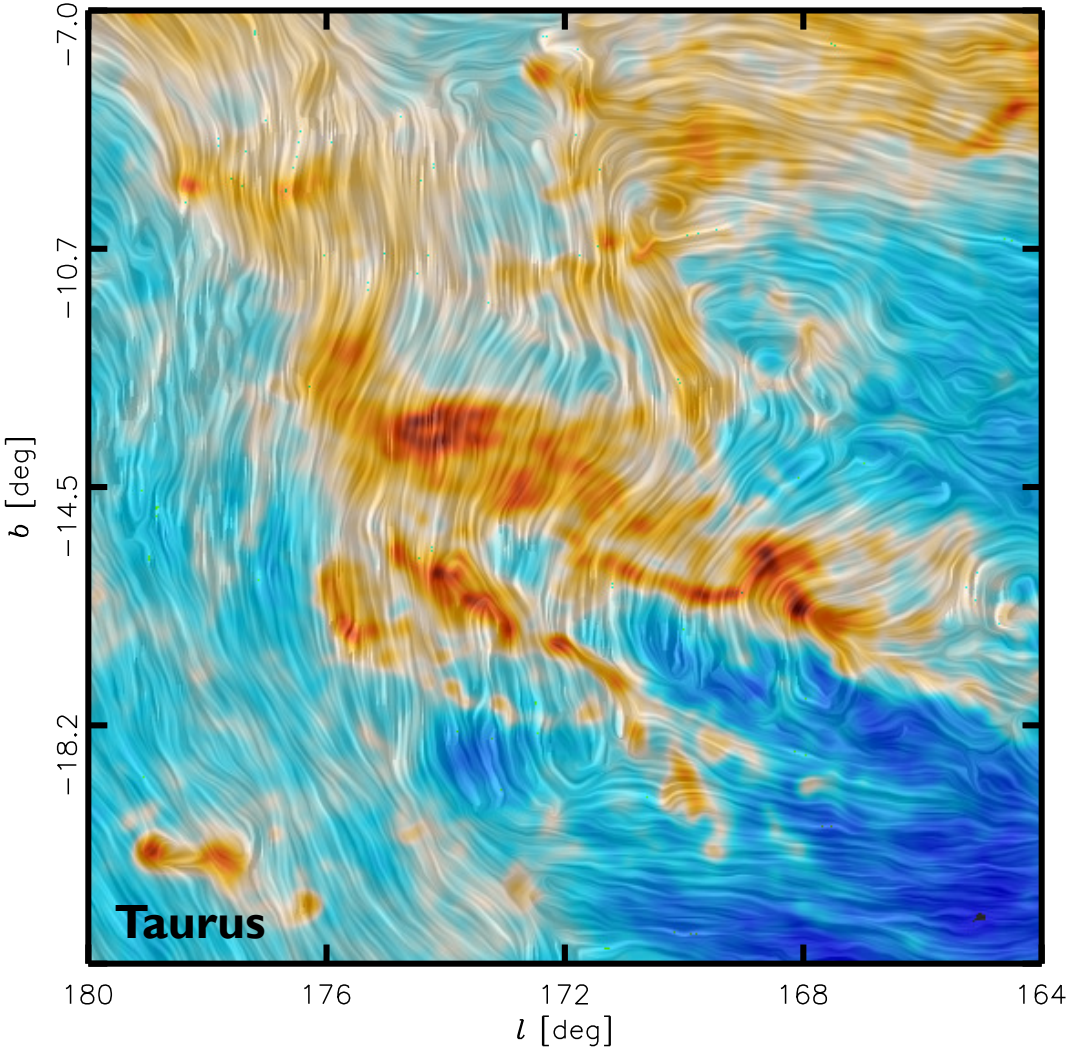


Musings on large (Planck) scales



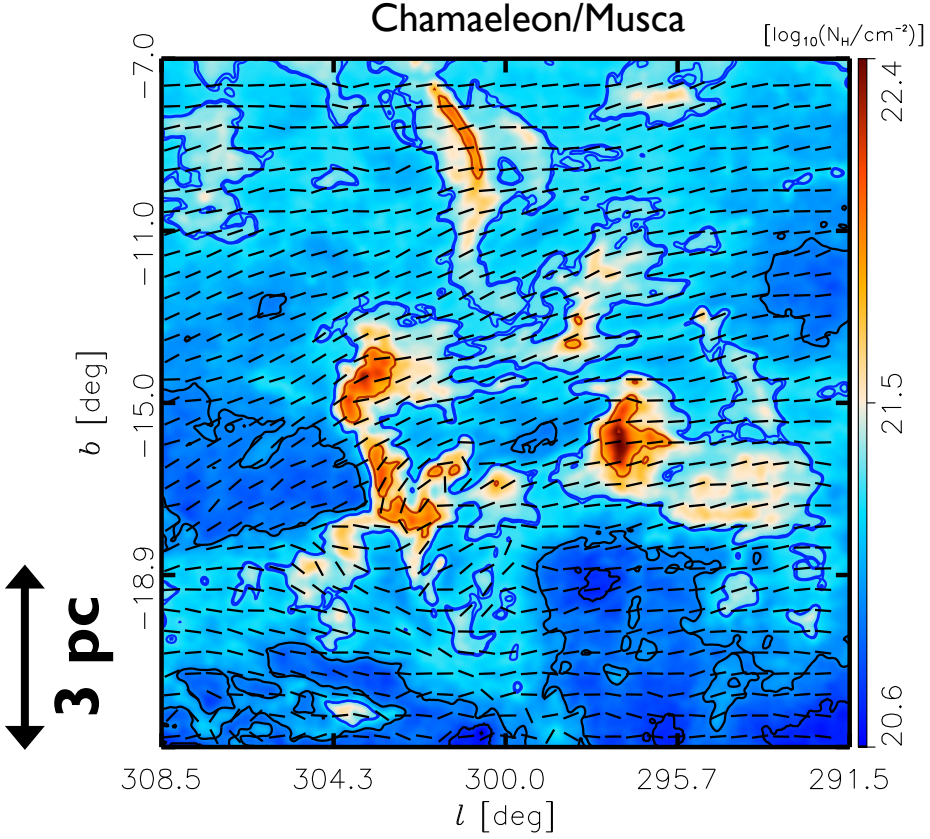
Planck Collaboration 2015, paper XXXV

Musings on large (Planck) scales



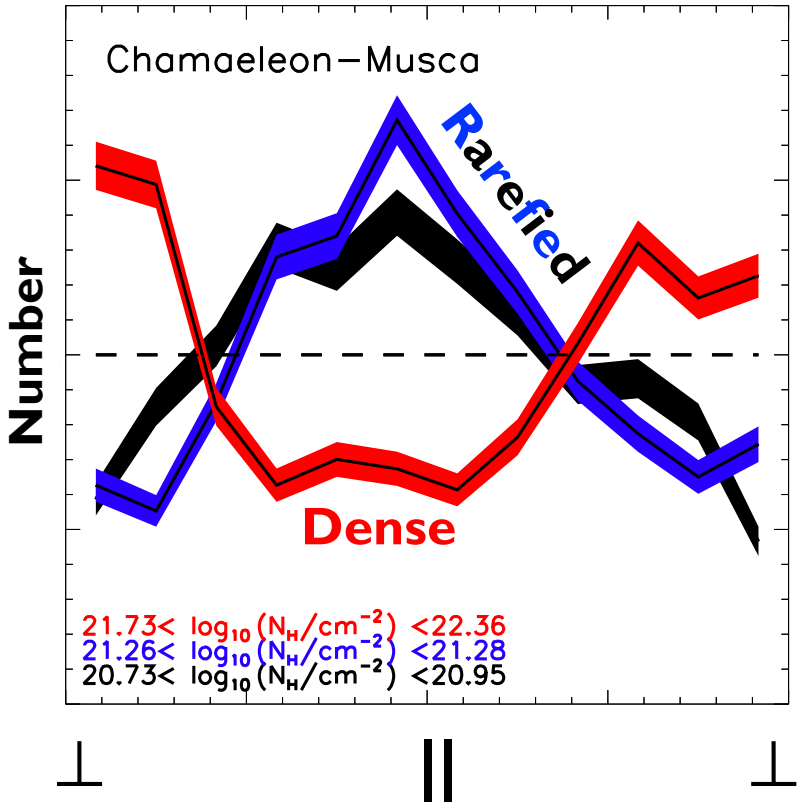
Planck Collaboration 2015, paper XXXV

Musings on large (Planck) scales



Planck Collaboration 2015, paper XXXV

Juan Soler's "Histogram of Relative Orientation" (HRO) analysis (see Soler+2013)



Alignment of B-field & filamentary axis

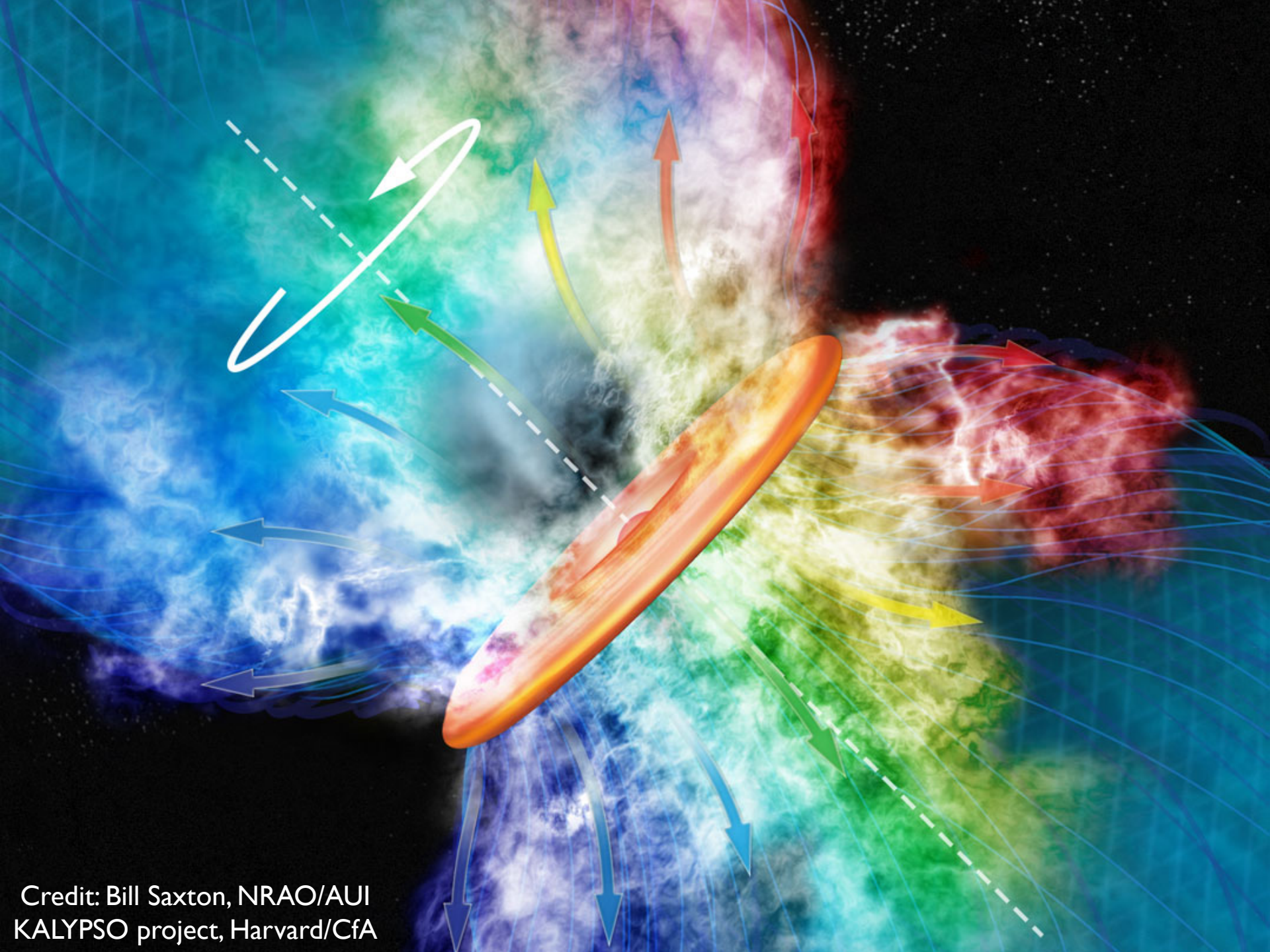
Musings on large (Planck) scales

Planck conclusions:

- B-fields in **dense** gas tend to be ⊥ filament axis
  - Formed by gravitation collapse along field lines?

- B-fields are important on large (~pc) scales
  - But what about small (~100 AU) scales?




Credit: Bill Saxton, NRAO/AUI
KALYPSO project, Harvard/CfA

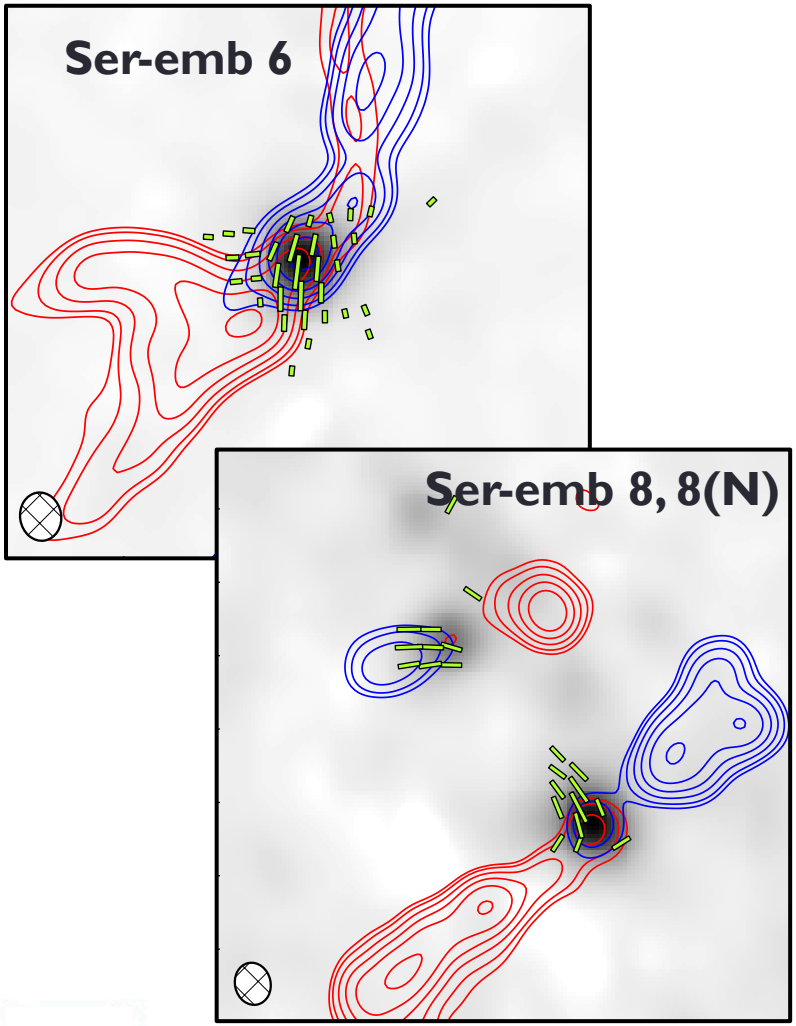
Magnetized filaments

Magnetized filaments

Low-mass star-forming cores

Ser-emb 8, 8(N)


Cycle 2 & 3 ALMA obs.



Hull+2014, ApJS, 213, 13

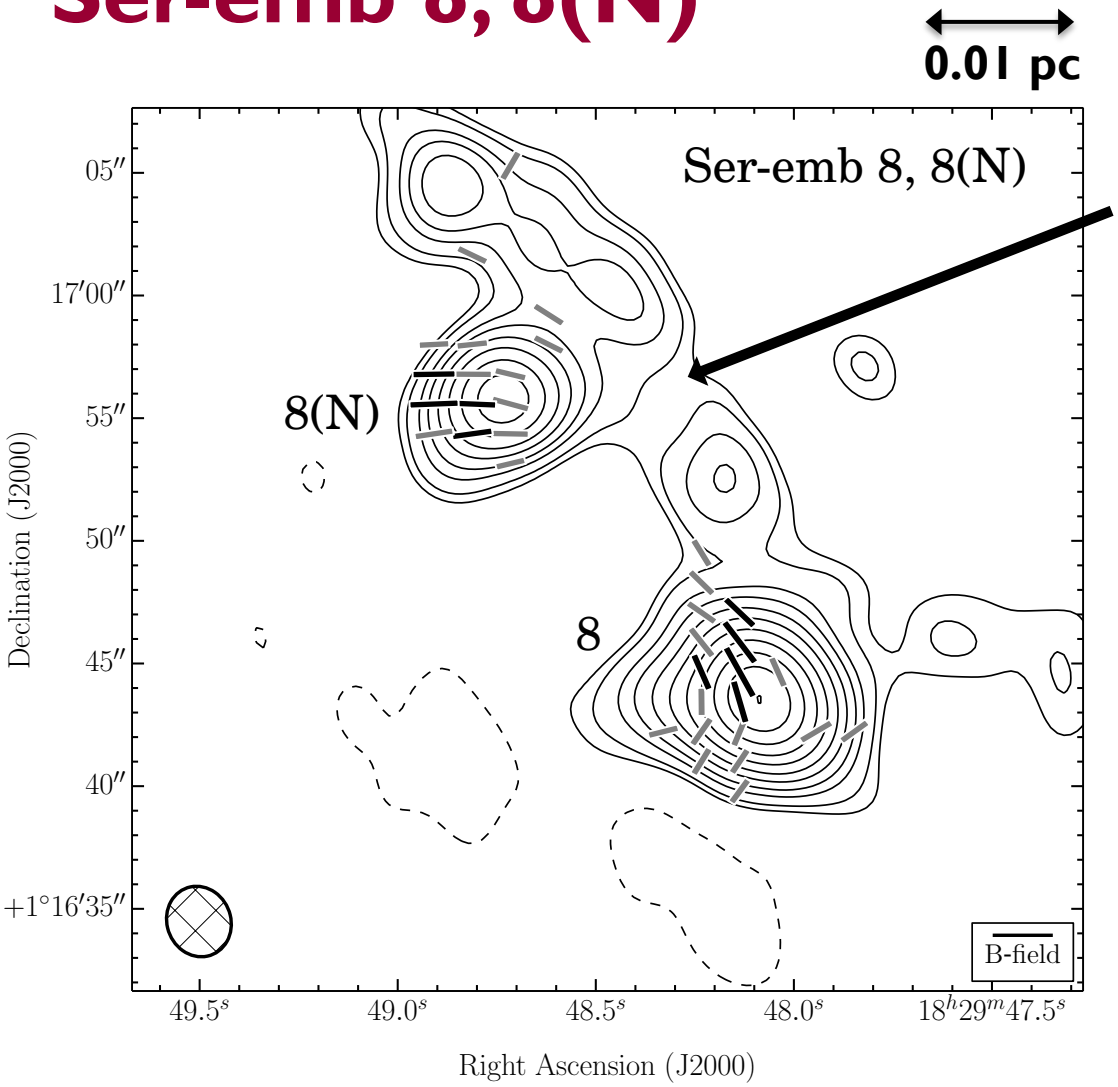
Class 0

CORE POLARIZATION

(PI: Hull, high priority)

- 0.36″ dust pol @ Band 7
  – **observed,** not delivered
- 0.36″ and 1″ spectral line & continuum @ Band 6 – **observed, delivered**
- **Cycle 3**: 0.15″ dust pol @ Band 7
- Probing **~1000 → 60 AU** env/disk scales

Ser-emb 8, 8(N)



Hull+2014, ApJS, 213, 13

- This filament is **small!** (d ~ 0.01 pc)
- How did this filament form?
- What does the B-field look like in (and between) the cores?

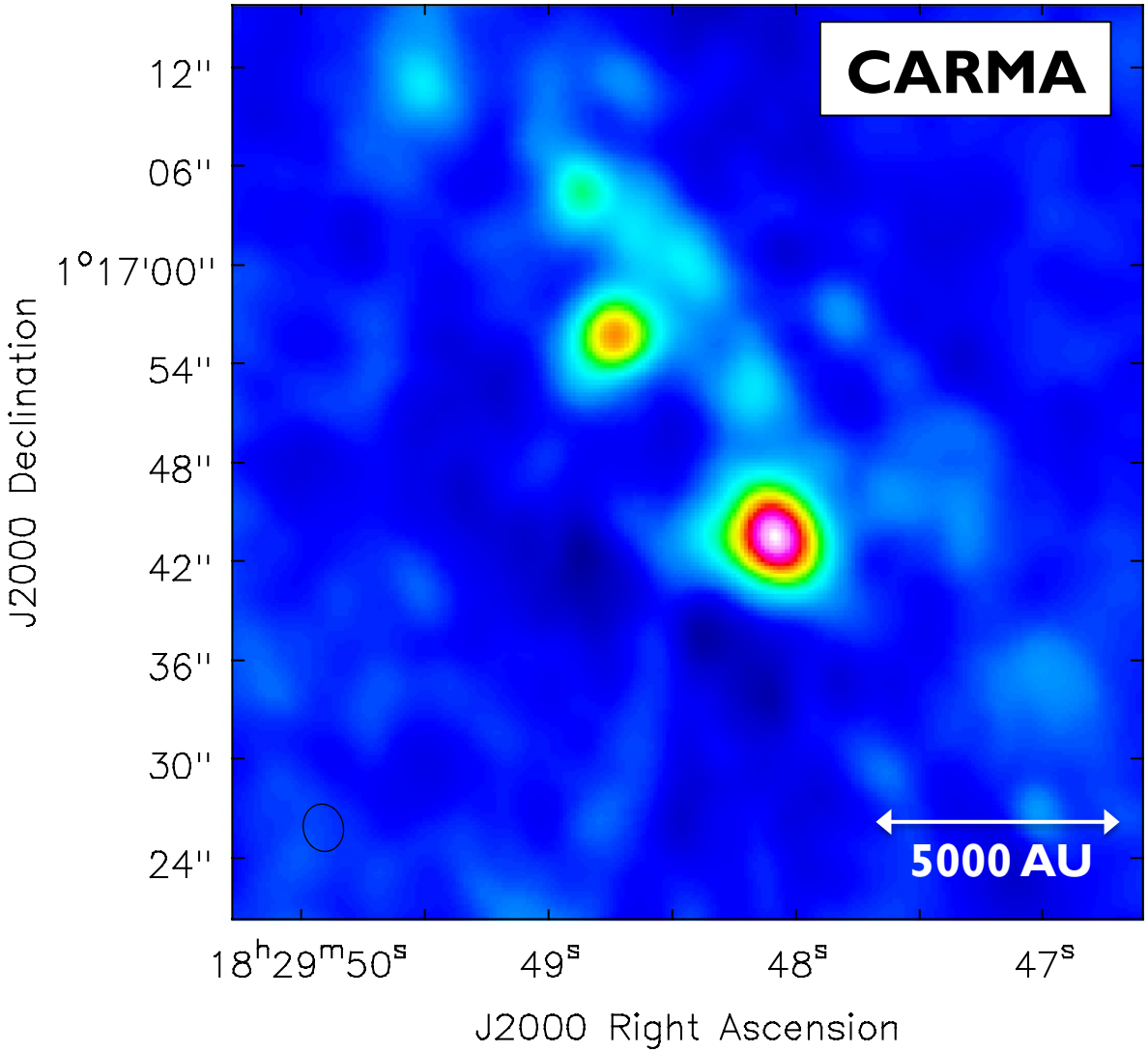
ALMA

ALMA polarization system

Ask me, P. Cortés, or J.M. Girart for details!

Credit: ESO/S. Guisard – http://www.eso.org/public/images/potw1217a/

Filament: Ser-emb 8, 8(N)



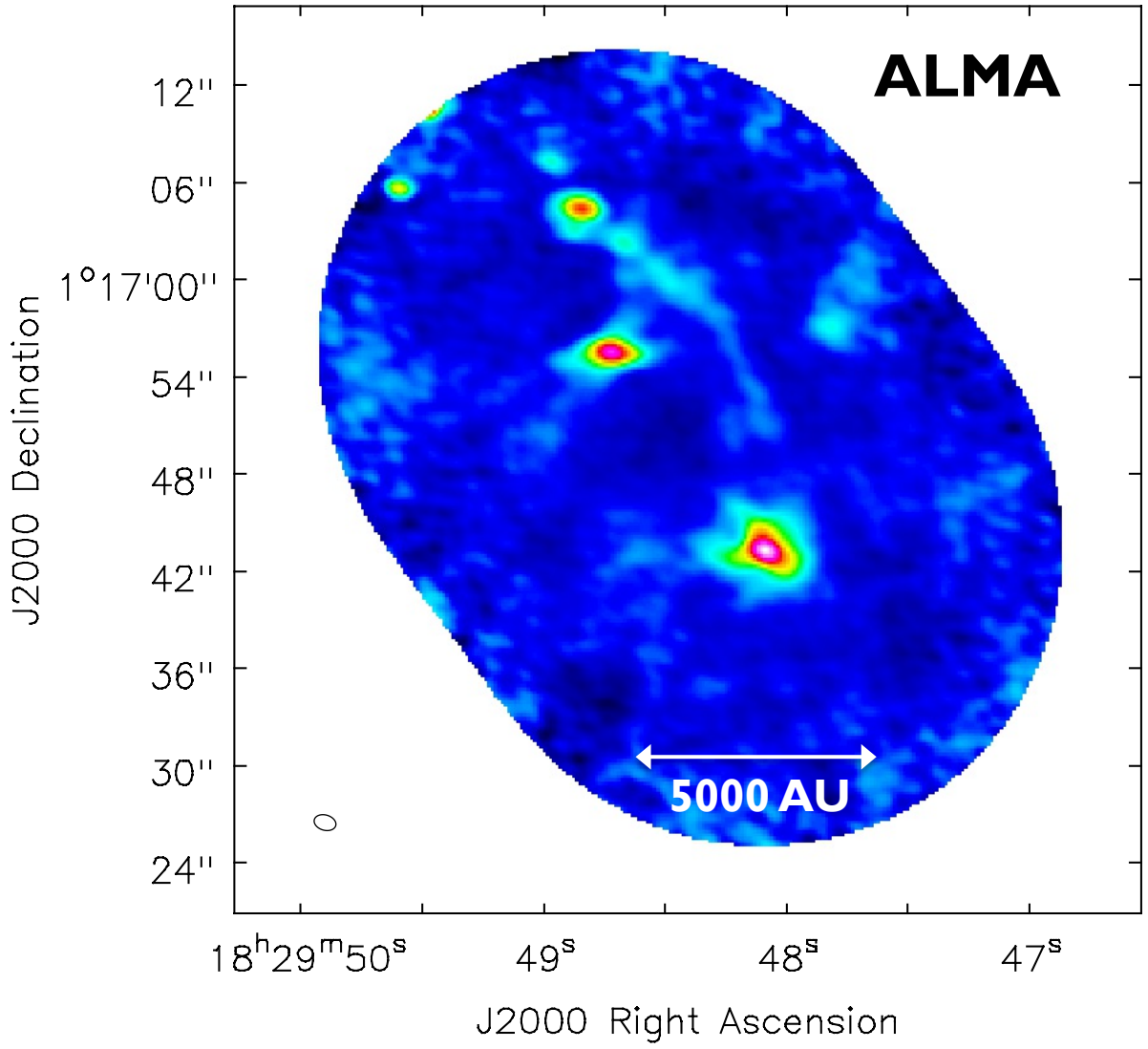
Dust continuum

1.3 mm (230 GHz)

d = 429 pc

beam ~ 3″ **(1300 AU)**

Filament: Ser-emb 8, 8(N)



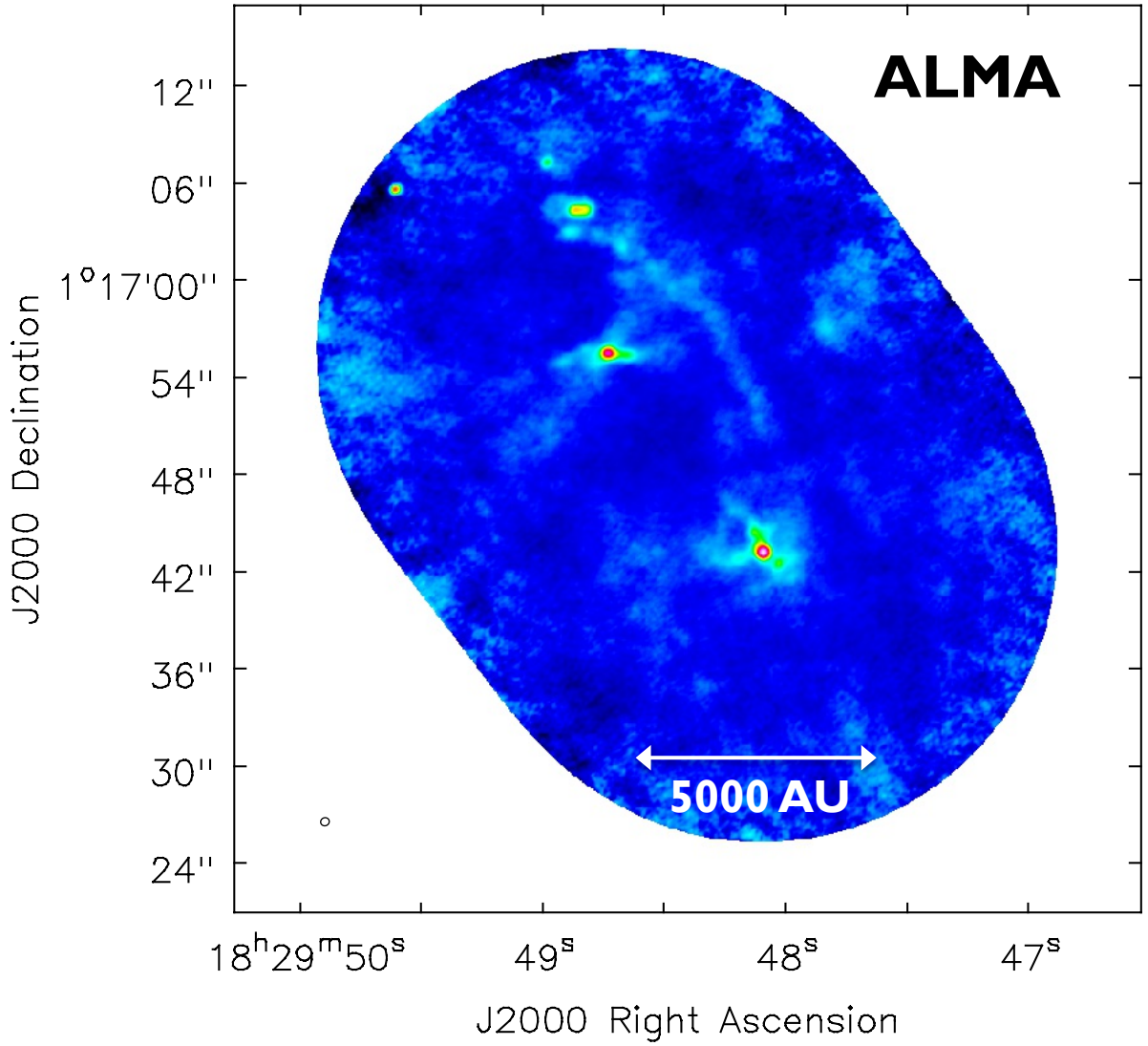
Dust continuum

1.3 mm (230 GHz)

d = 429 pc

beam ~ 1″ **(850 AU)**

Filament: Ser-emb 8, 8(N)



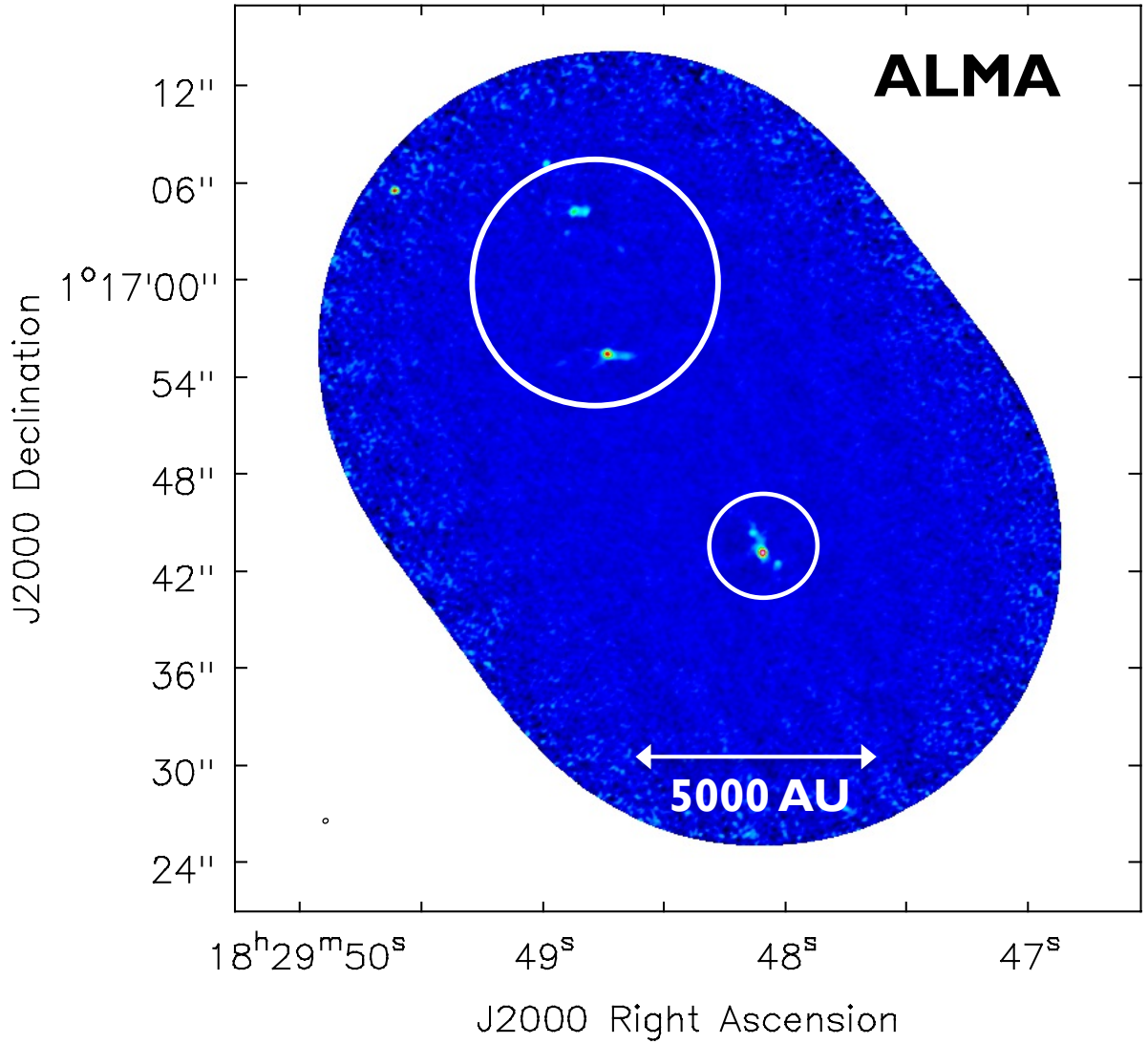
Dust continuum

1.3 mm (230 GHz)

d = 429 pc

beam ~ 0.5″ **(215 AU)**

Filament: Ser-emb 8, 8(N)



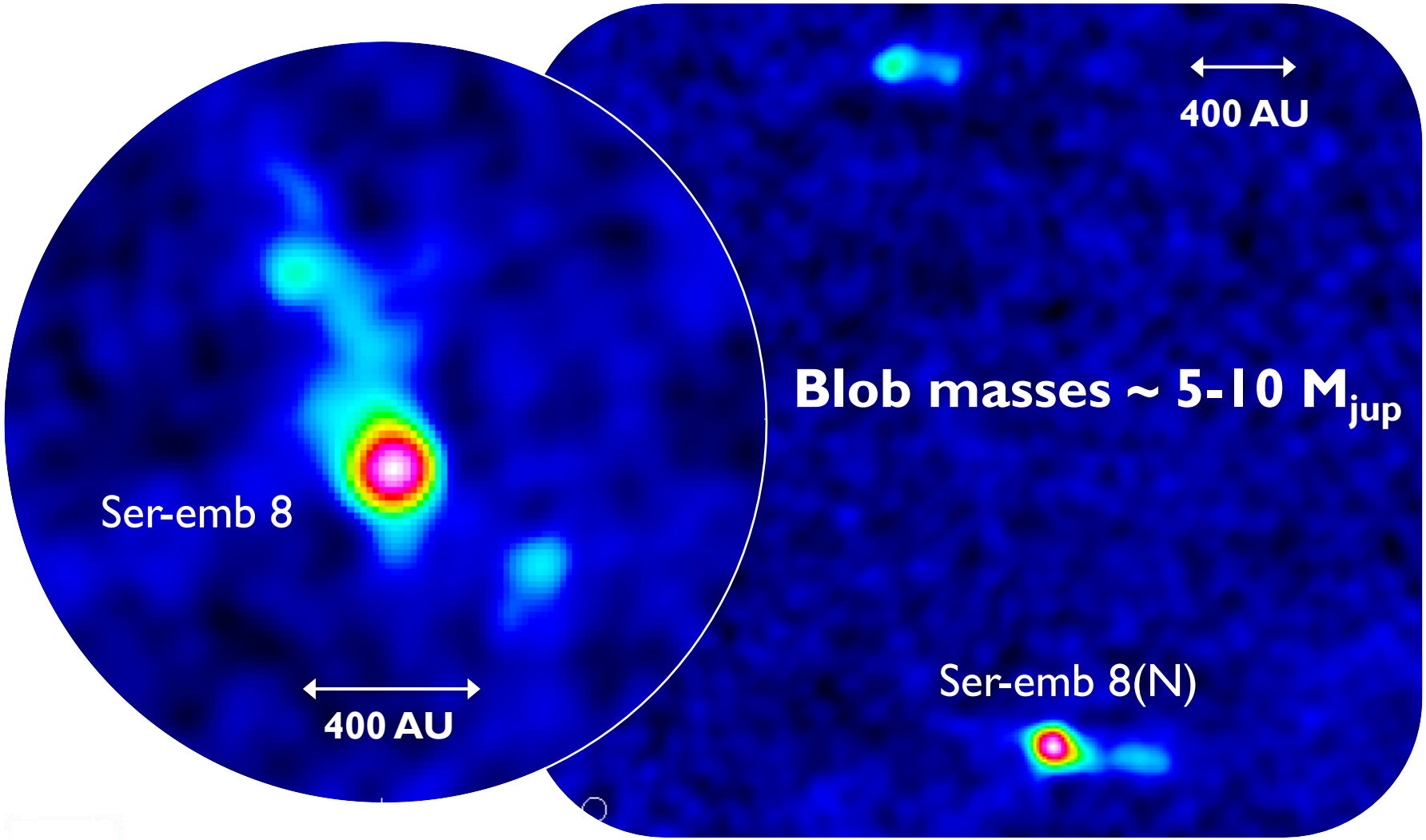
Dust continuum

1.3 mm (230 GHz)

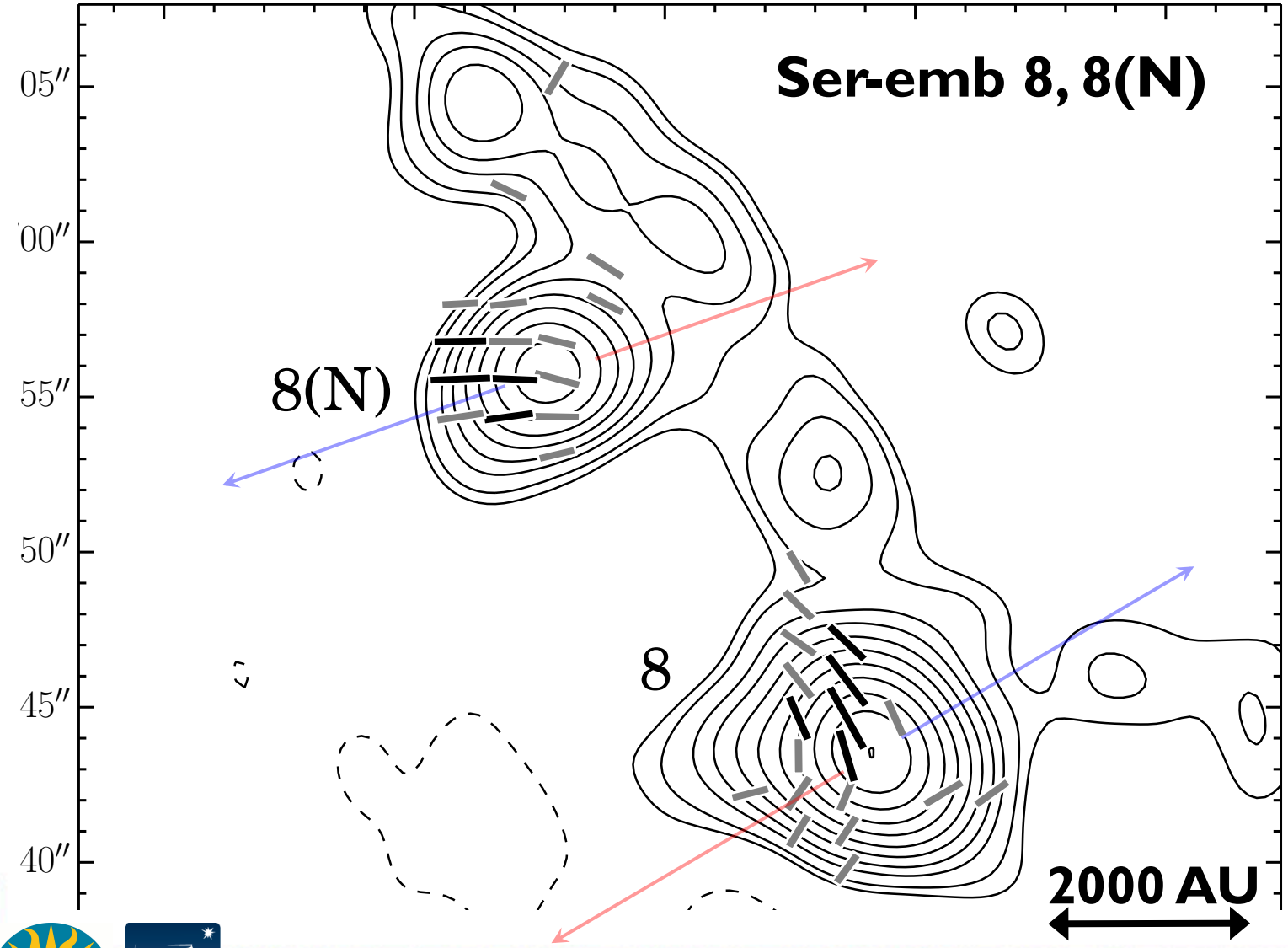
d = 429 pc

beam ~ 0.36″ **(150 AU)**

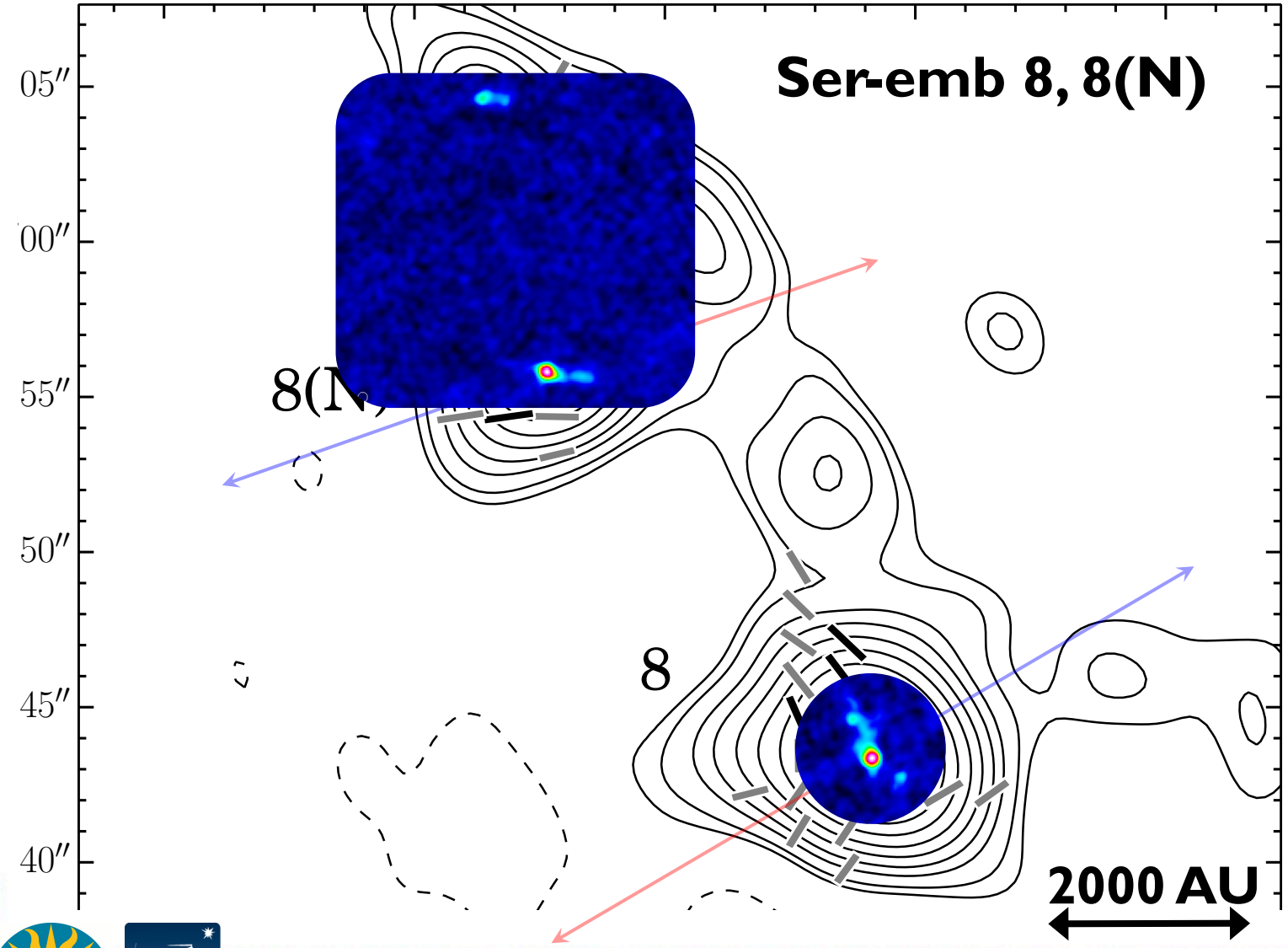
Proto-multiples?



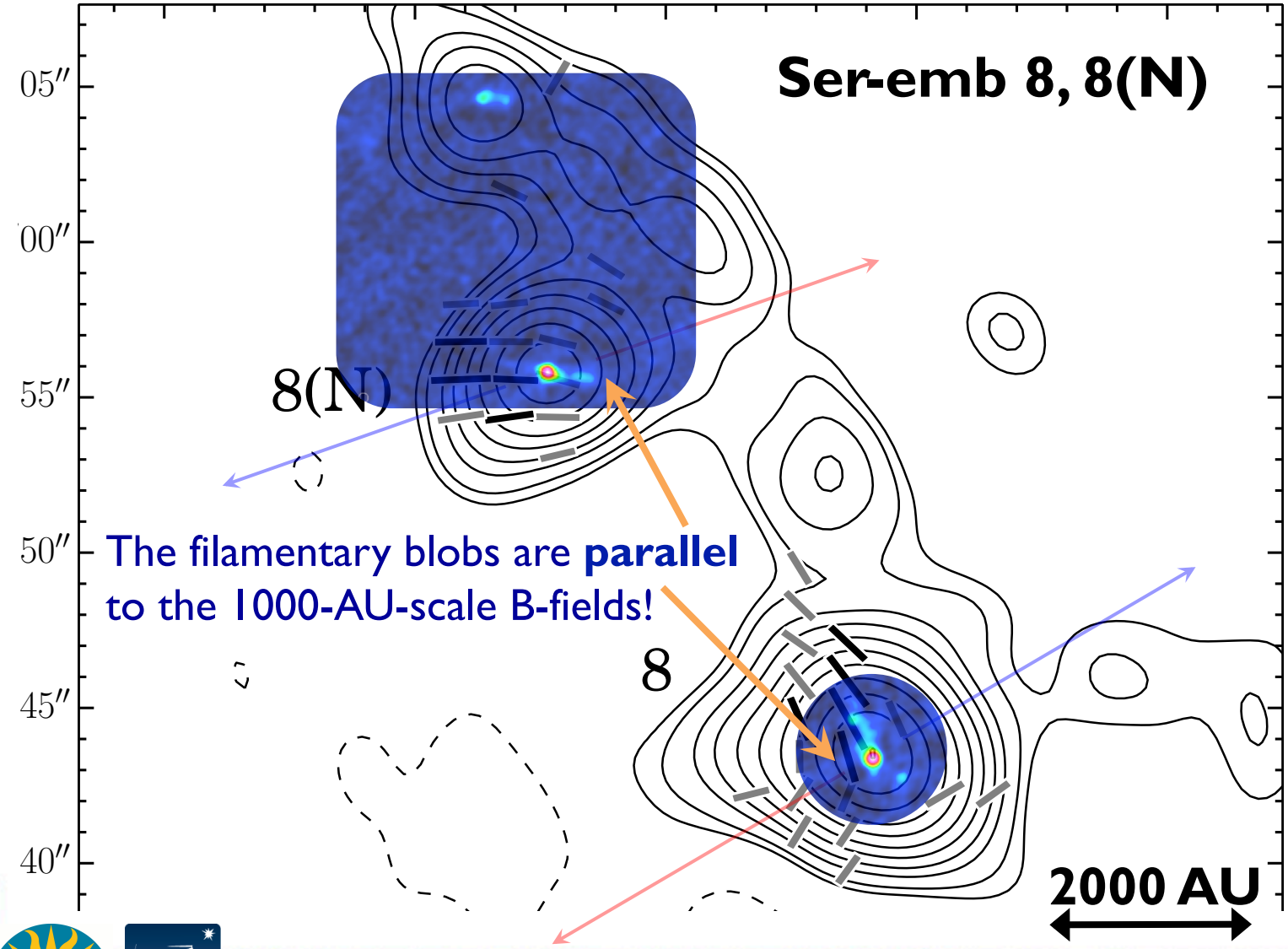
ALMA continuum + CARMA B-fields



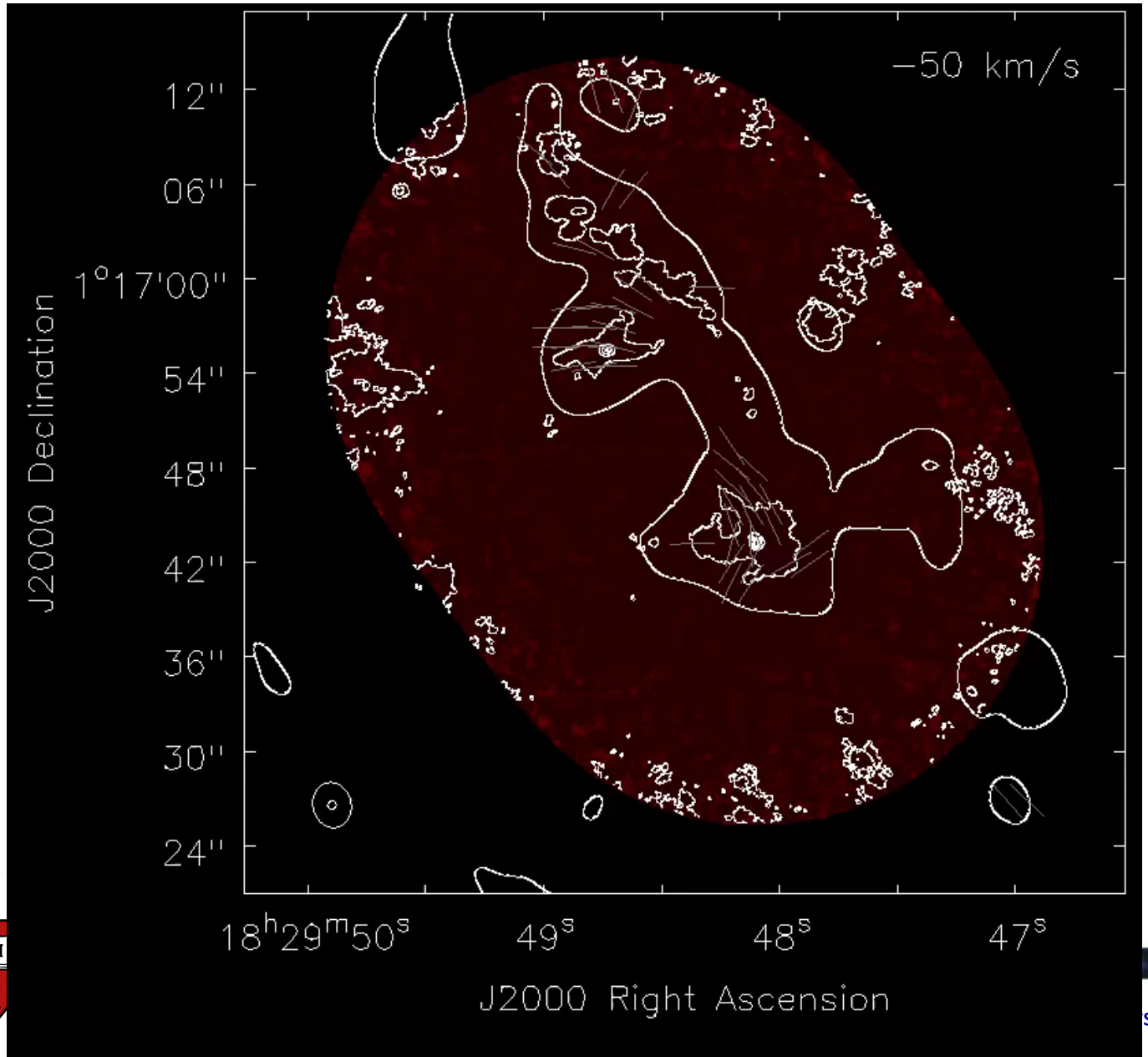
ALMA continuum + CARMA B-fields



ALMA continuum + CARMA B-fields



Does CO(2-1) correlate with B-field?



v_{lsr} = 9 km/s

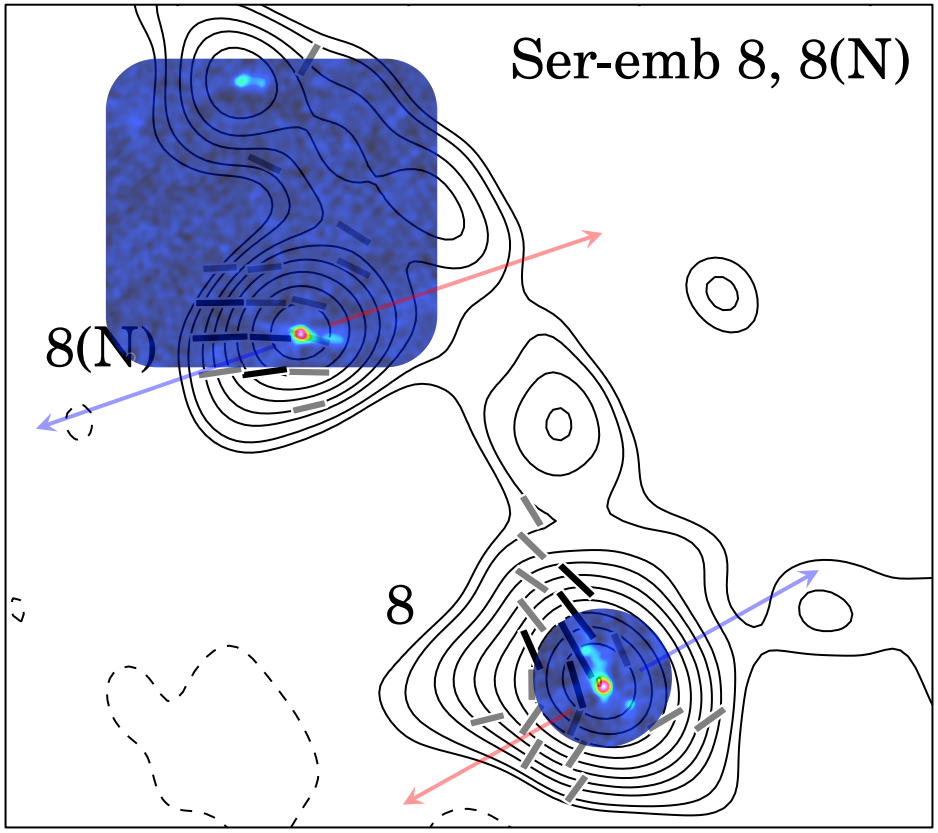
Filaments, B-fields, and blobs (oh my!)

- Implications for the formation of multiples
  - Do we expect such uneven fragmentation?

- What will the B-fields look like in the filamentary blobs?
  - Consistent with 1000 AU B-fields?

- What will the B-fields look like at hi-res in the cores?
  - Toroidally wrapped?


Summary



(1) Fragmentation at ~400 AU scales near low-mass protostars

(2) B-fields (CARMA) & blobs (ALMA) have consistent orientations

(3) Possible correspondence of B-fields (CARMA) with CO (ALMA)

(4) What will the ALMA polarization results show? Stay tuned…

More info

chathull.com

Fin