Magnetic Field Structure of the Filamentary Cloud IC5146

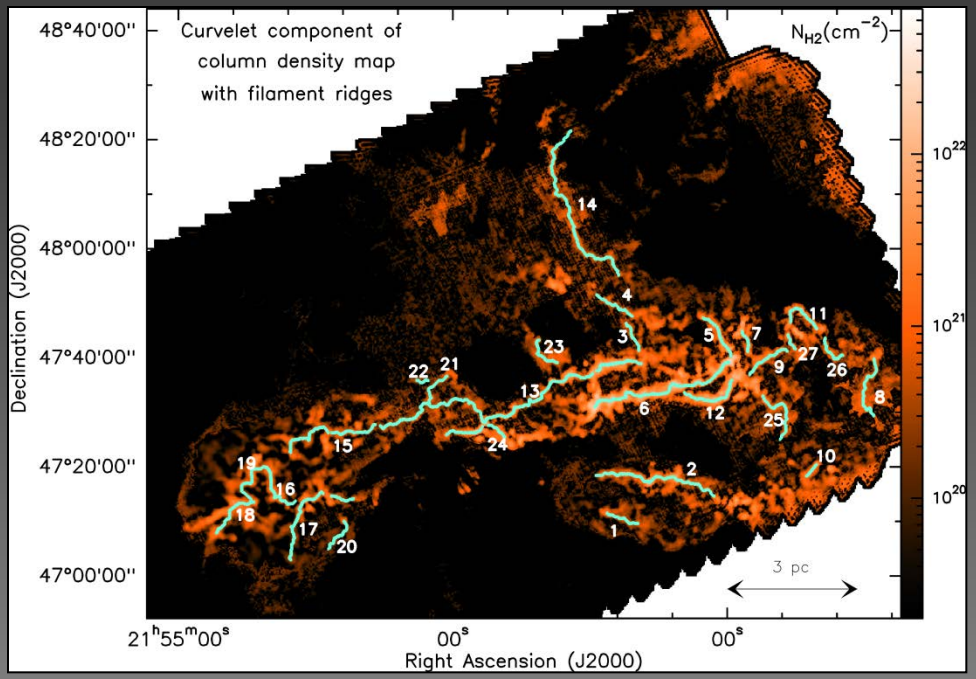
Jia-Wei Wang[1], Shih-Ping Lai[1], Chakali Eswaraiah[2,4], D. P. Clemens[3], Wen-Ping Chen[4] and Anil K. Pandey[2]

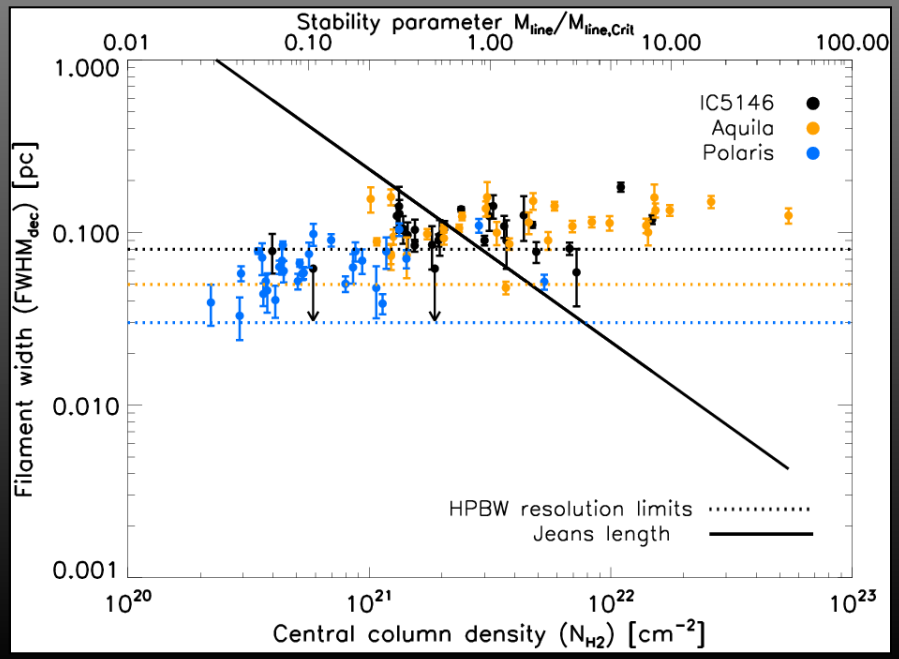
[1] Institute of Astronomy, National Tsing Hua University, Taiwan

[2] Aryabhatta Research Institute of Observational-Sciences (ARIES), India

[3] Institute for Astrophysical Research, Boston University, U.S.A

[4] Institute of Astronomy, National Central University, Taiwan



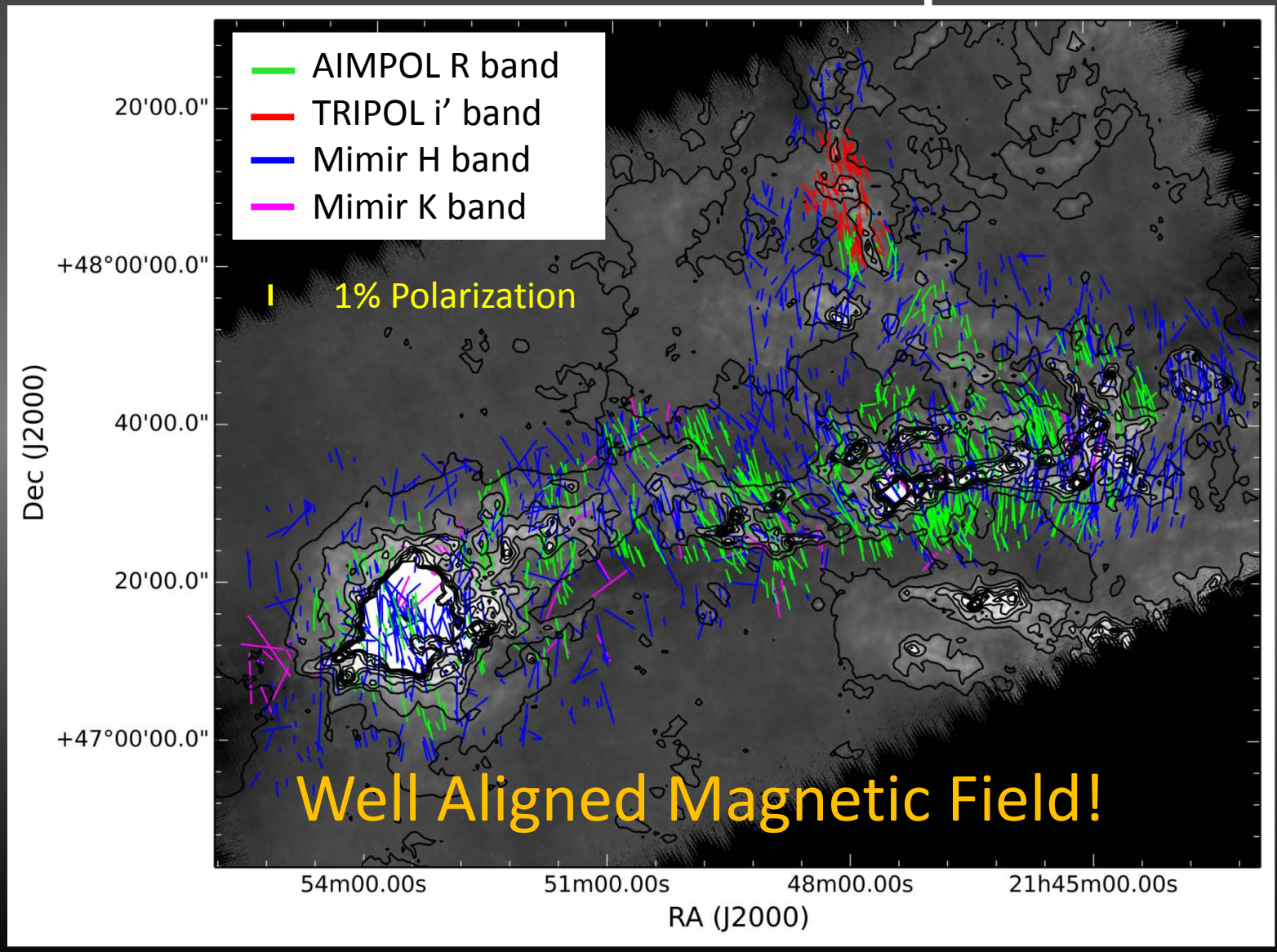


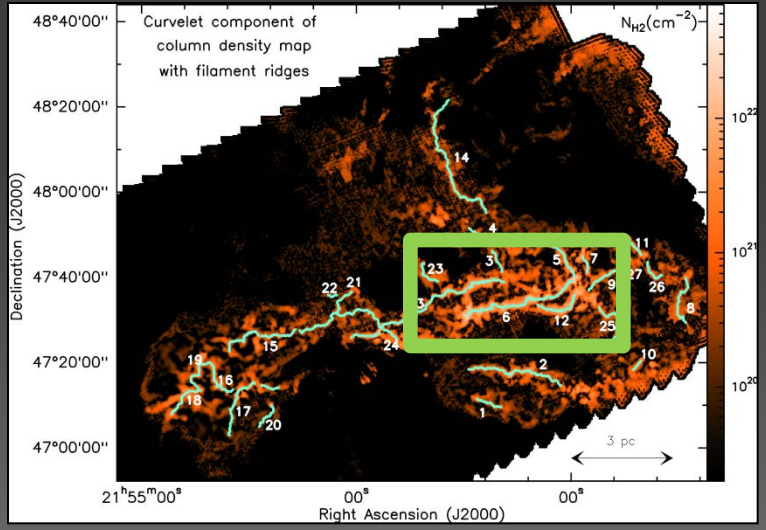
Review: IC5146

- Filamentary streamers extended from an HII region, Cocoon Nebula
- Complex network of filaments
- Share a common width ~0.1 pc
- Turbulence dominated?

Arzoumanian et al. (2011, 2013)

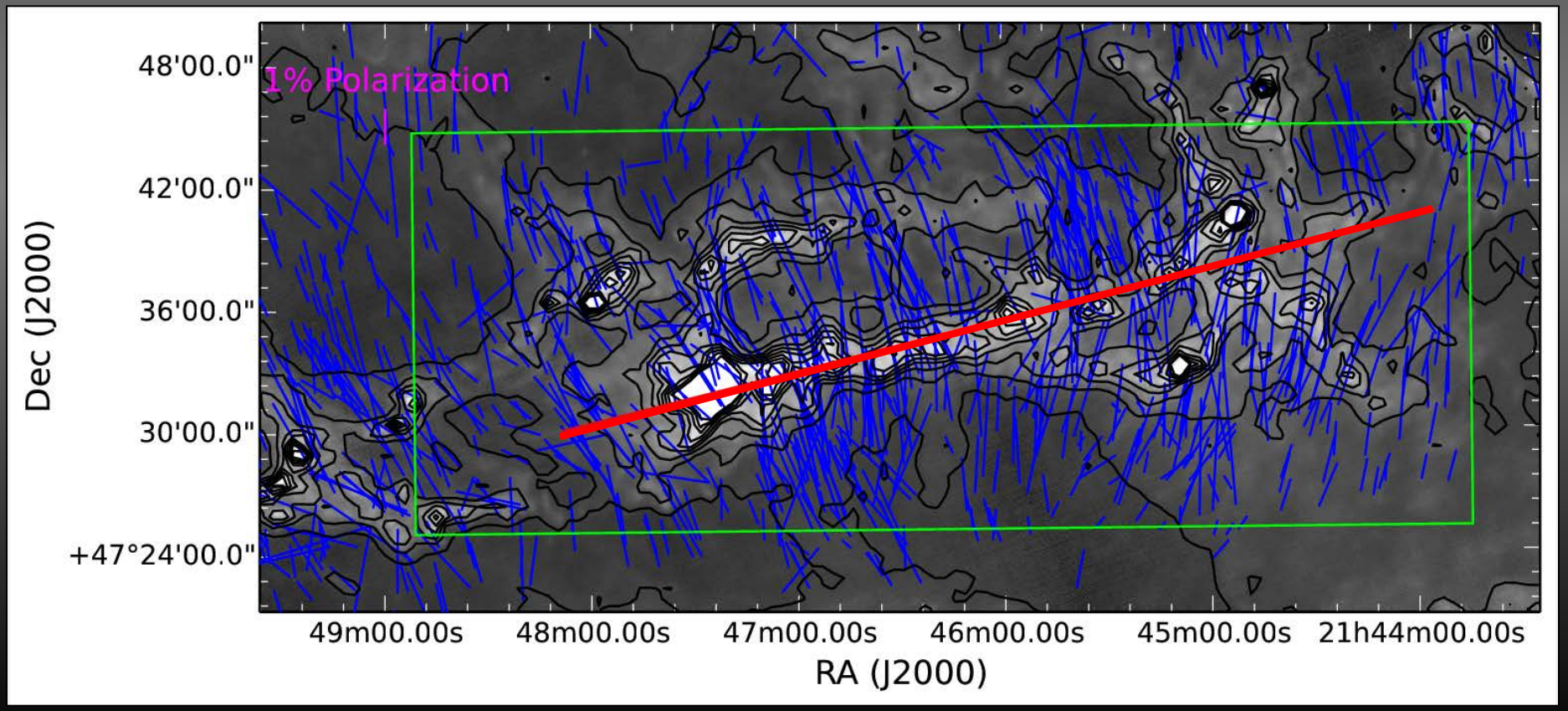
Polarization Map

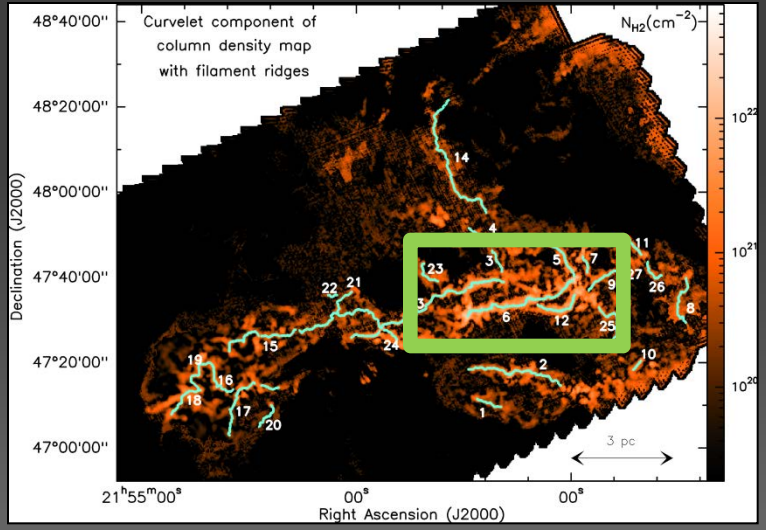




The Western Part of Main Filament

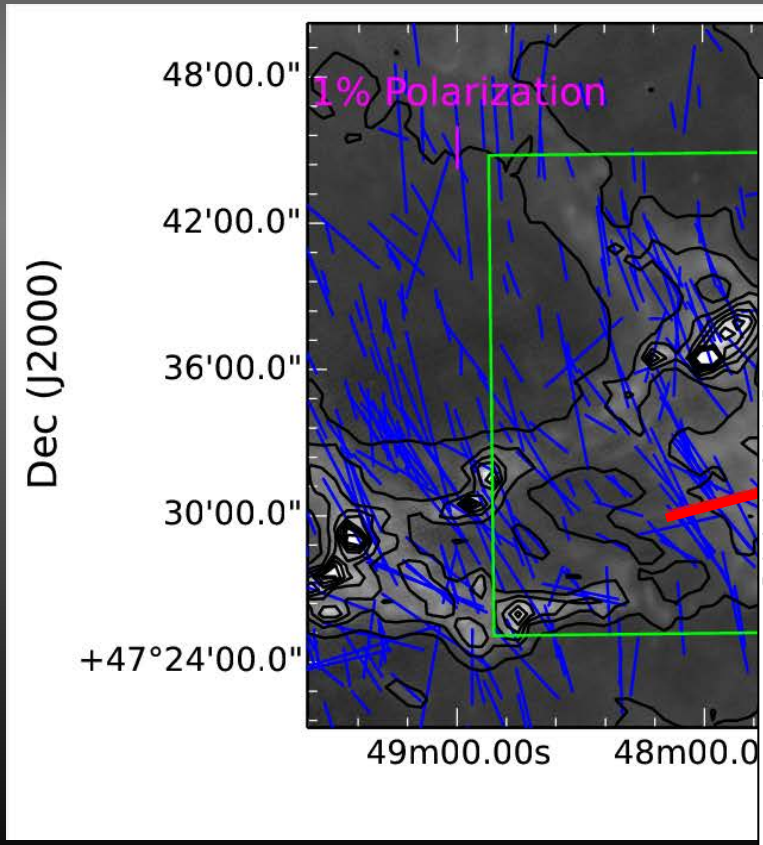
- Mass per unit length: ~150$M_{\odot}$/pc
  - ➢ Self-gravitating

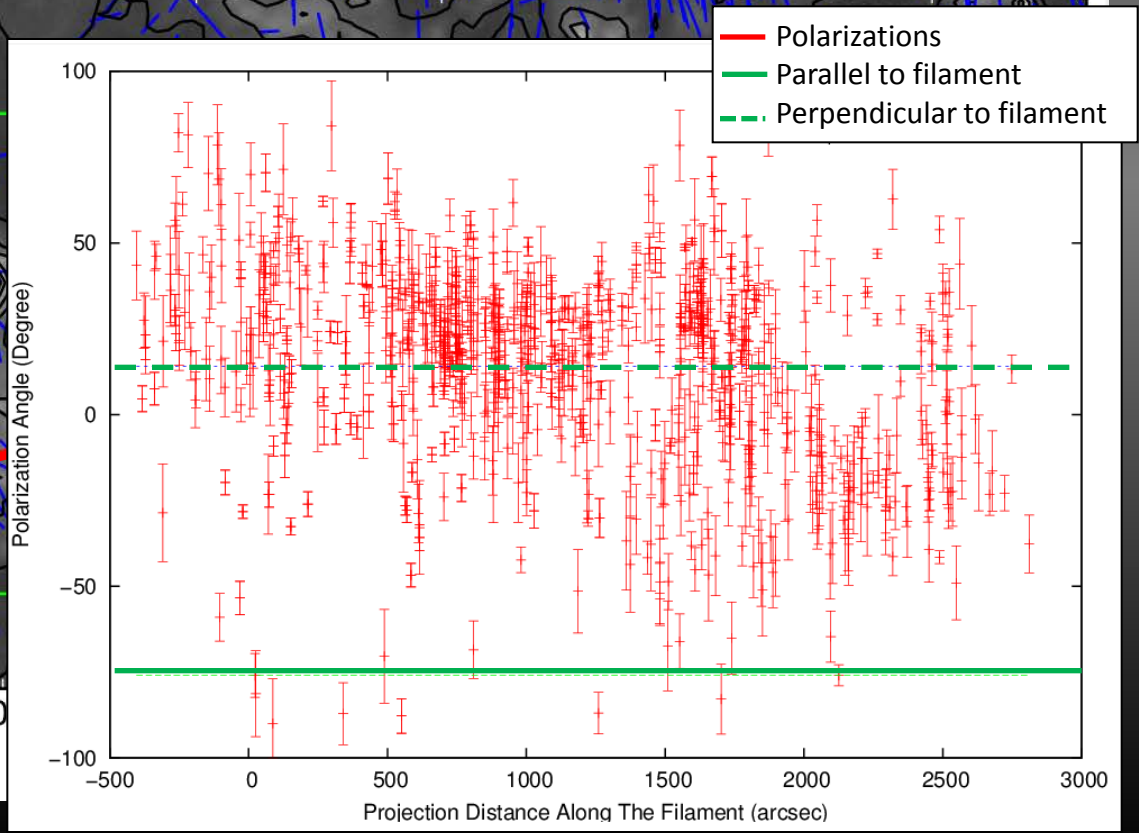


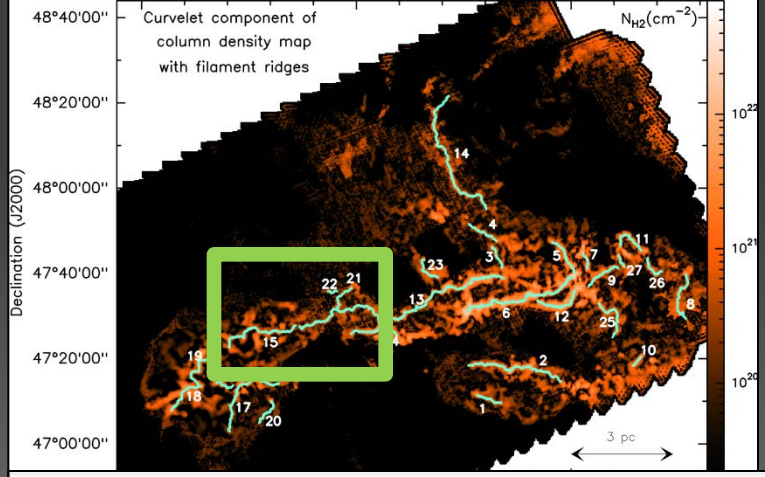


The Western Part of Main Filament

- Mass per unit length: ~150$M_{\odot}$/pc
  - ➢ Self-gravitating

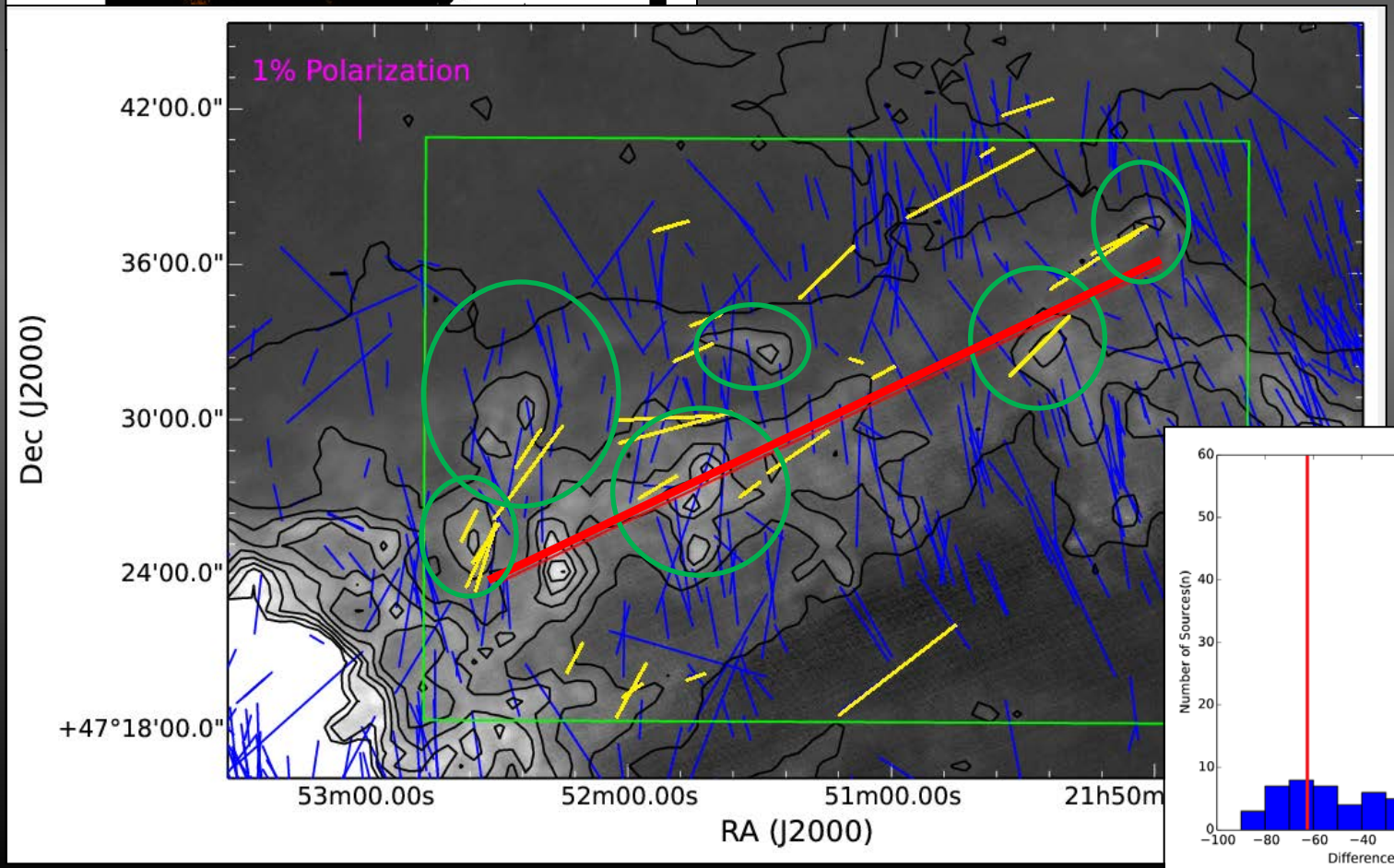


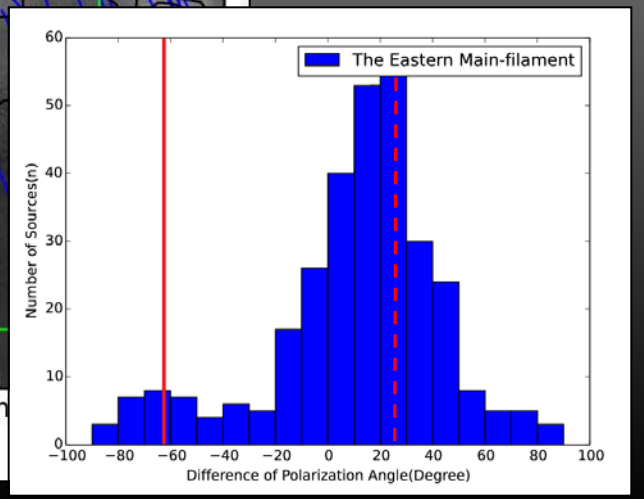


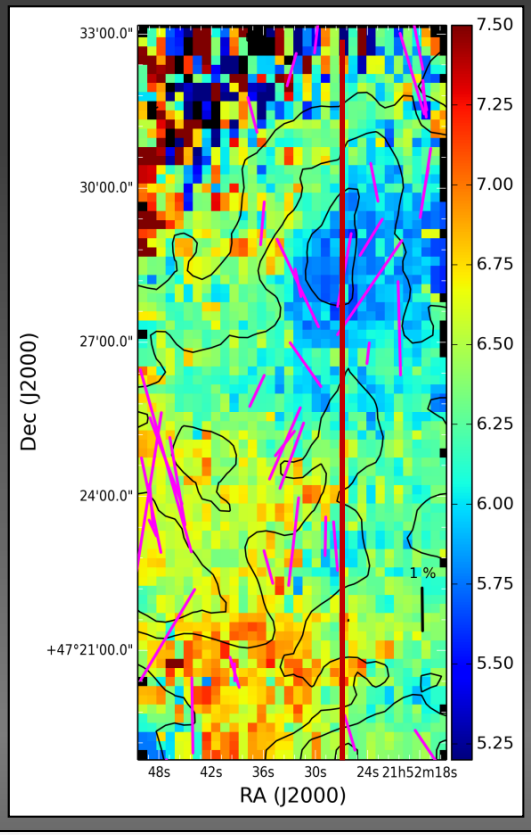


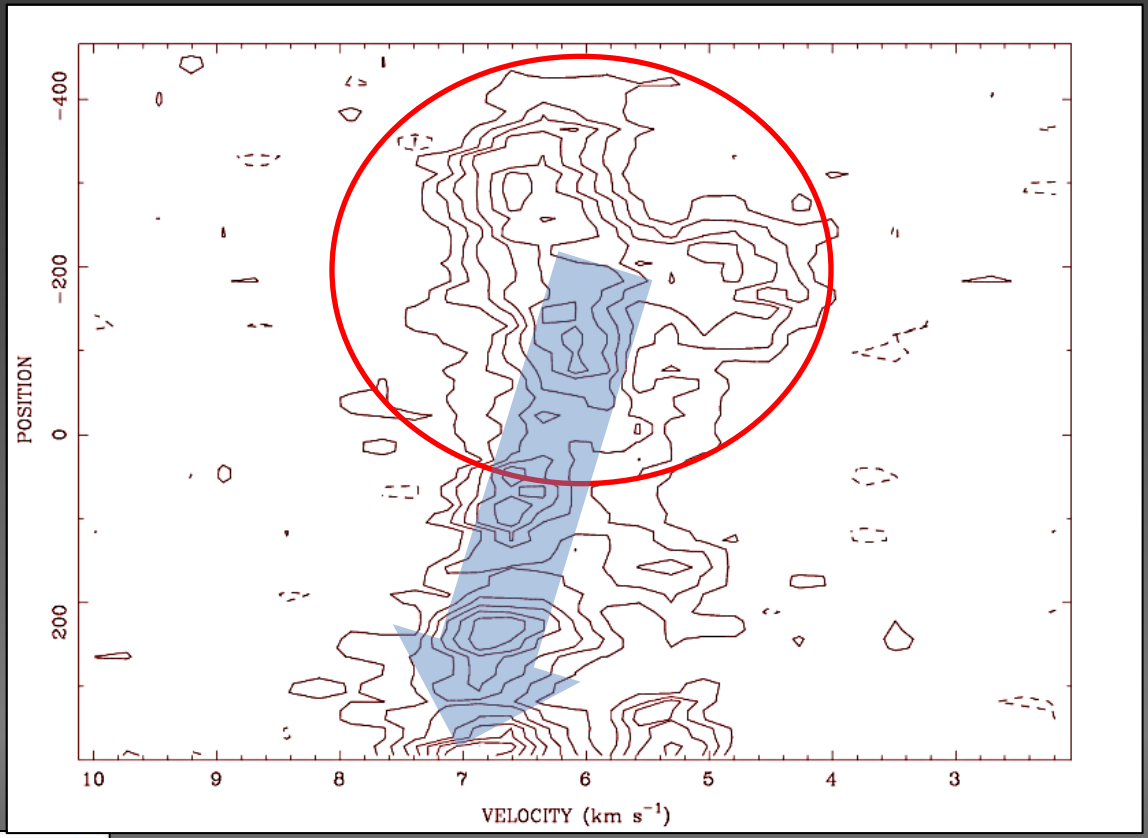
The Eastern Part of Main Filament

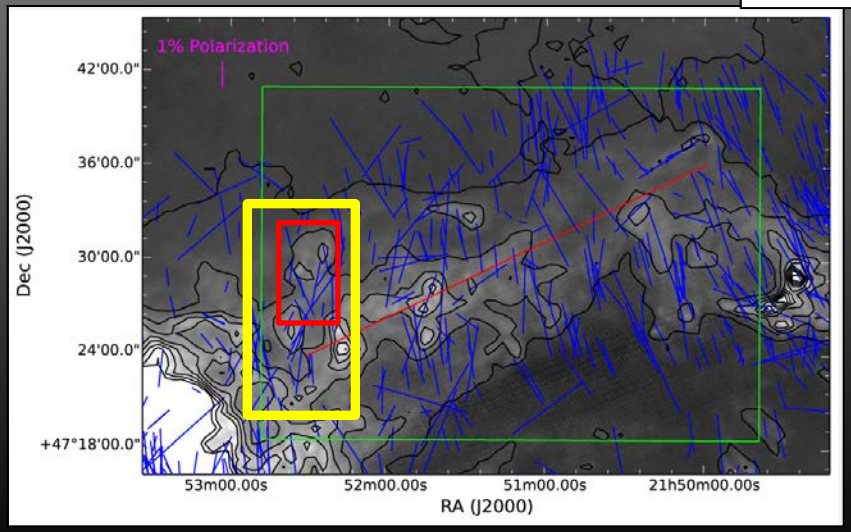
- Non-self-gravitating (~4$M_{\odot}$/pc)
- Two component of magnetic field due to small clumpy structure?







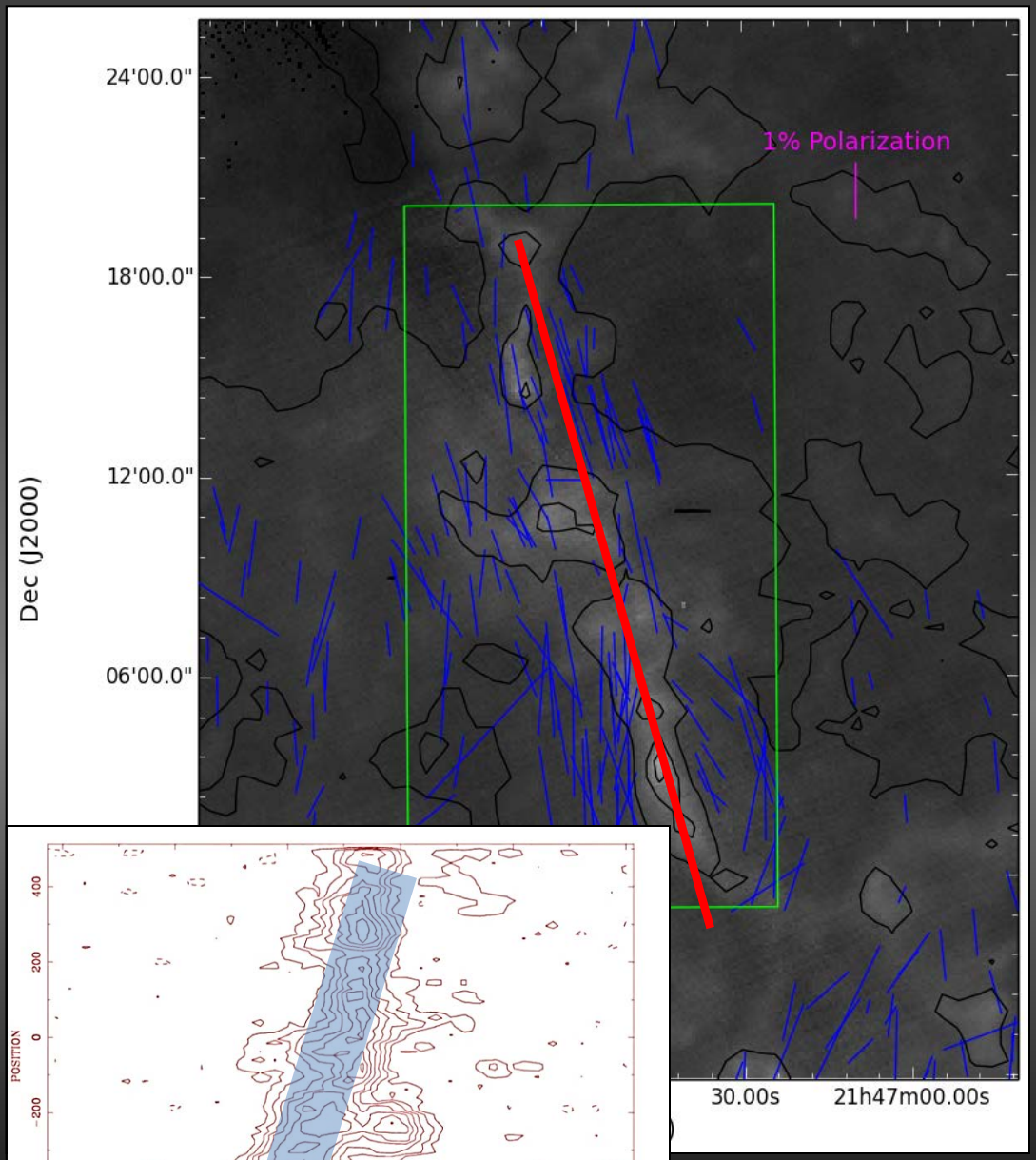


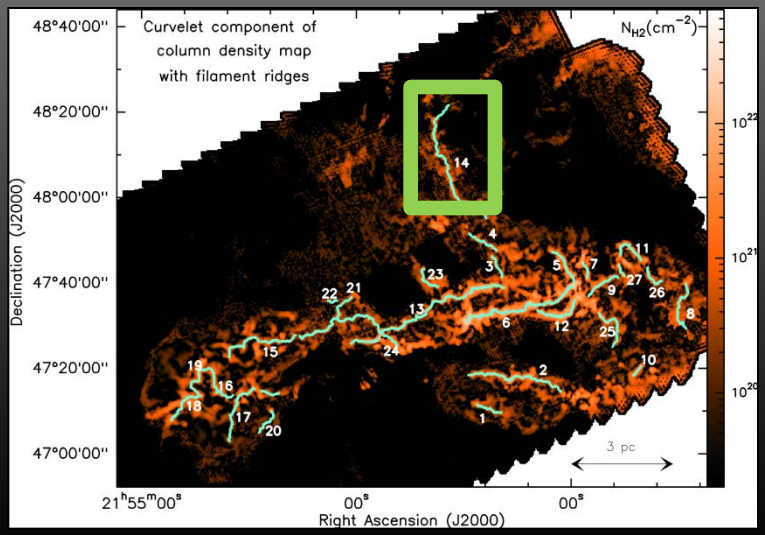


- ARO CO J=1-0 Data toward one of the sub-filament.
- Velocity gradient ~ 0.6 km s^{-1} pc^{-1}, slightly smaller than Taurus striation ~ 1 km s^{-1} pc^{-1} (Palmeirim et al. 2013).

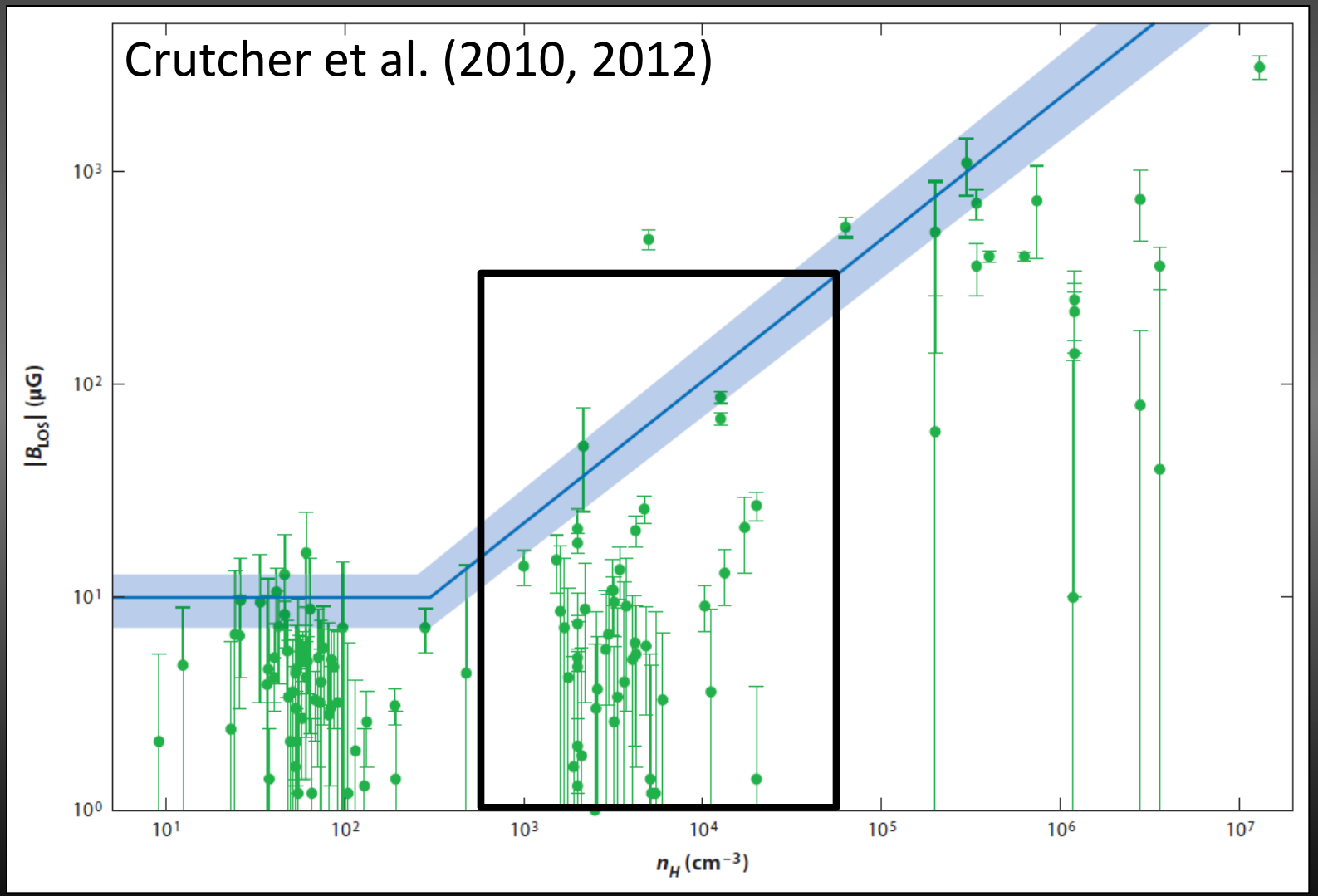
The Northern Streamer

- Non-self-gravitating (~13$M_{\odot}$/pc)
- Less clumpy than previous region
- Parallel to Magnetic field
- Large “sub-filament”?

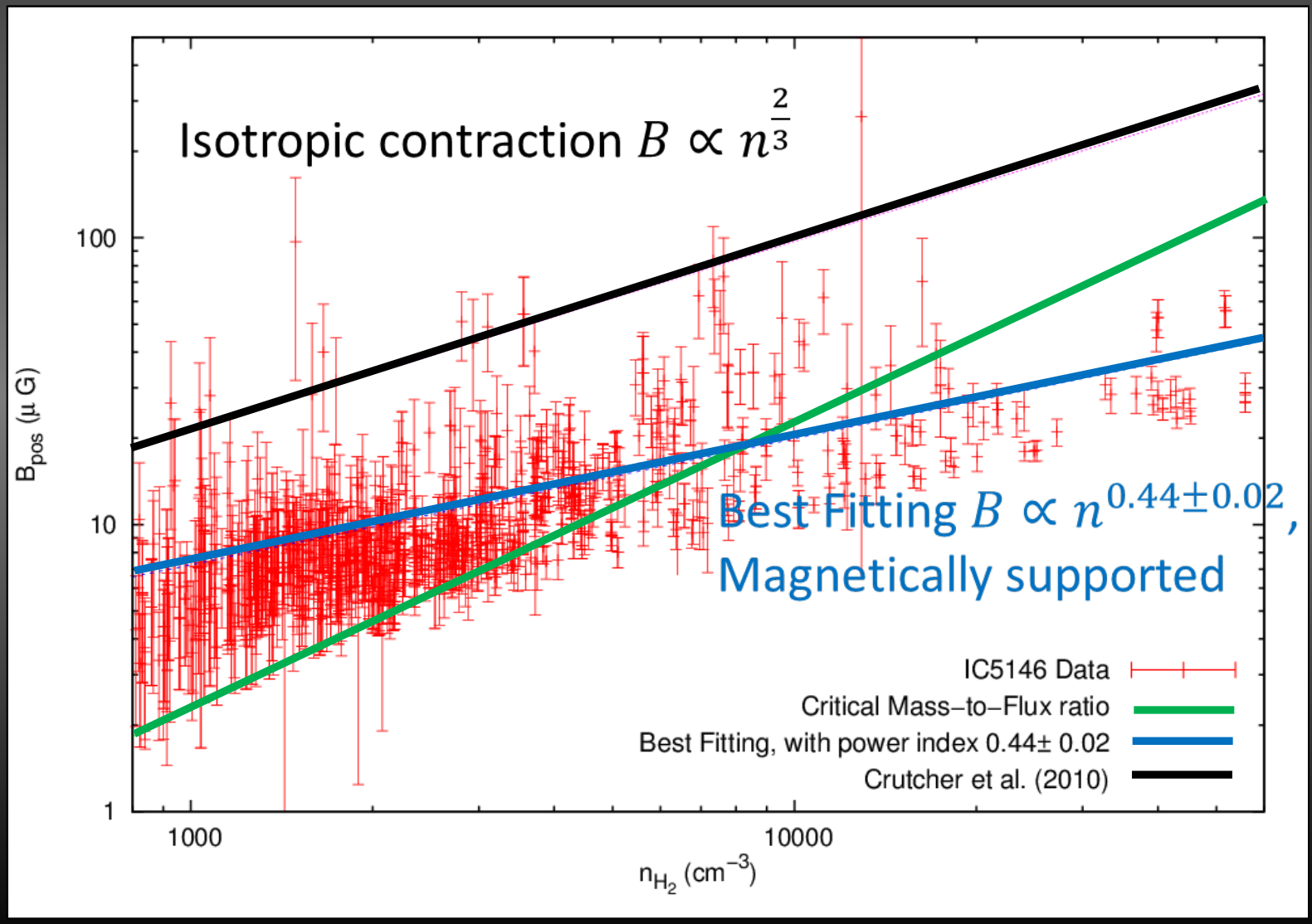




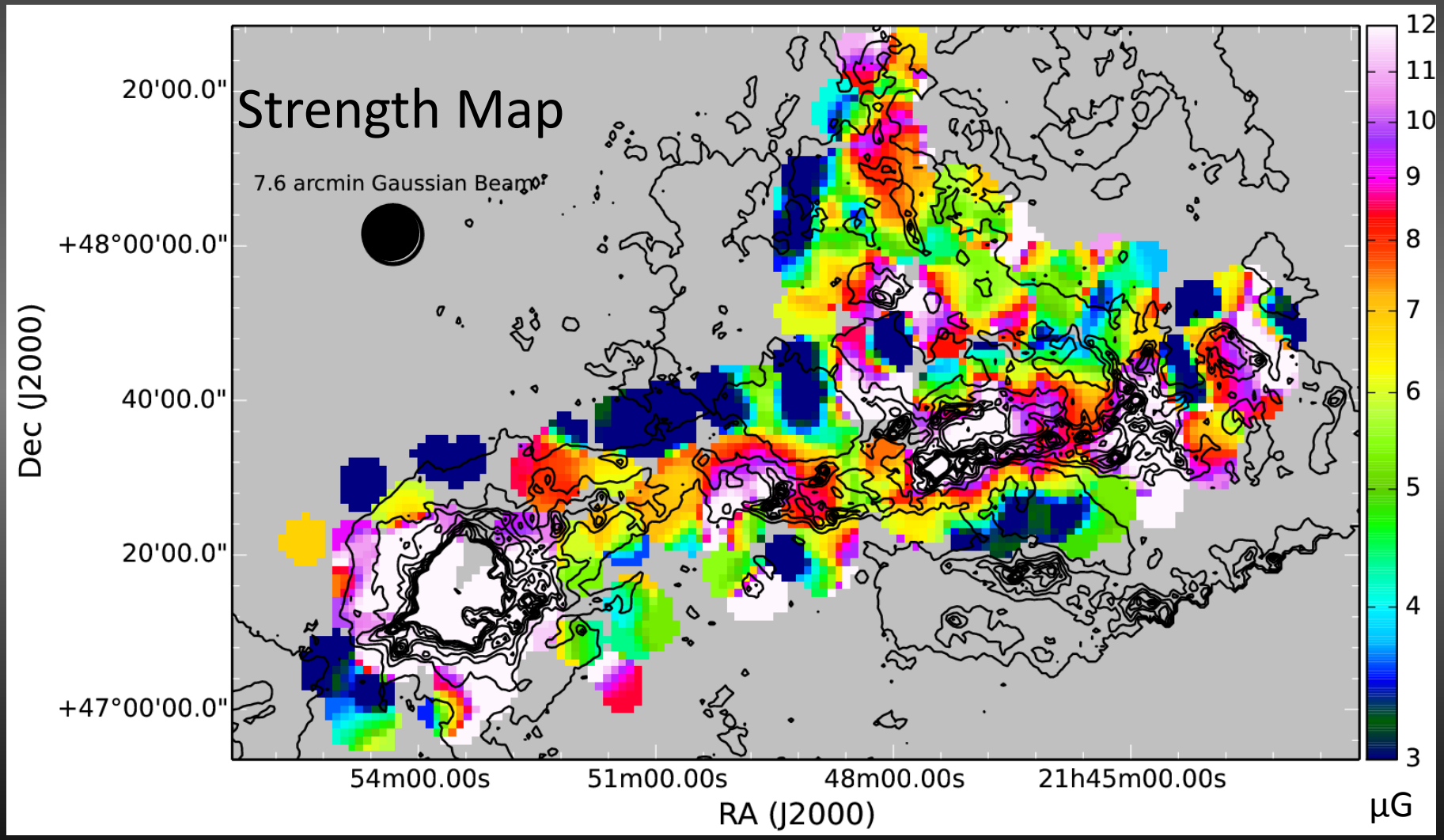
Magnetic strength with density



Magnetic strength with density



Spatially Smoothed Magnetic Strength Map



Summary and Conclusions

- Our optical and infrared polarization reveal the detail magnetic structure inside IC5146
  - Non-self-gravitating Filaments:
    - Sub-filaments structure flowing along magnetic field
    - Curved magnetic field in small scale, possibly due to local kinematics such as expanding clumps
  - Self-gravitating Filaments:
    - Smoothly curved magnetic field due to global gravity
    - From aligned to misaligned with magnetic field

- Magnetic Strength estimated by CF method
  - $\boldsymbol{B} \propto \boldsymbol{n}^{0.44 \pm 0.02}$, consistent with magnetically supported scenario
  - Significant magnetic enhancement can be seen even in the sub-filament flowing along magnetic field, possibly due to compression from turbulence, shock or cloud-cloud collision in early stage