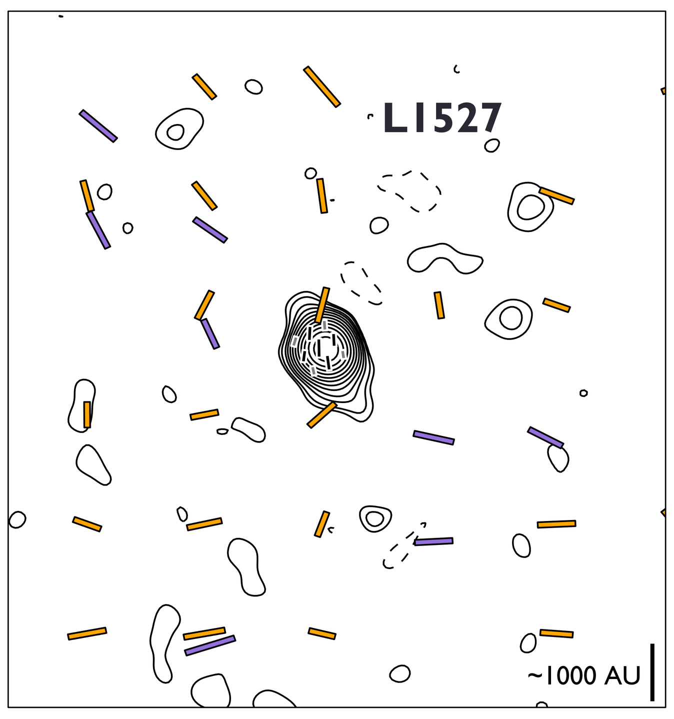
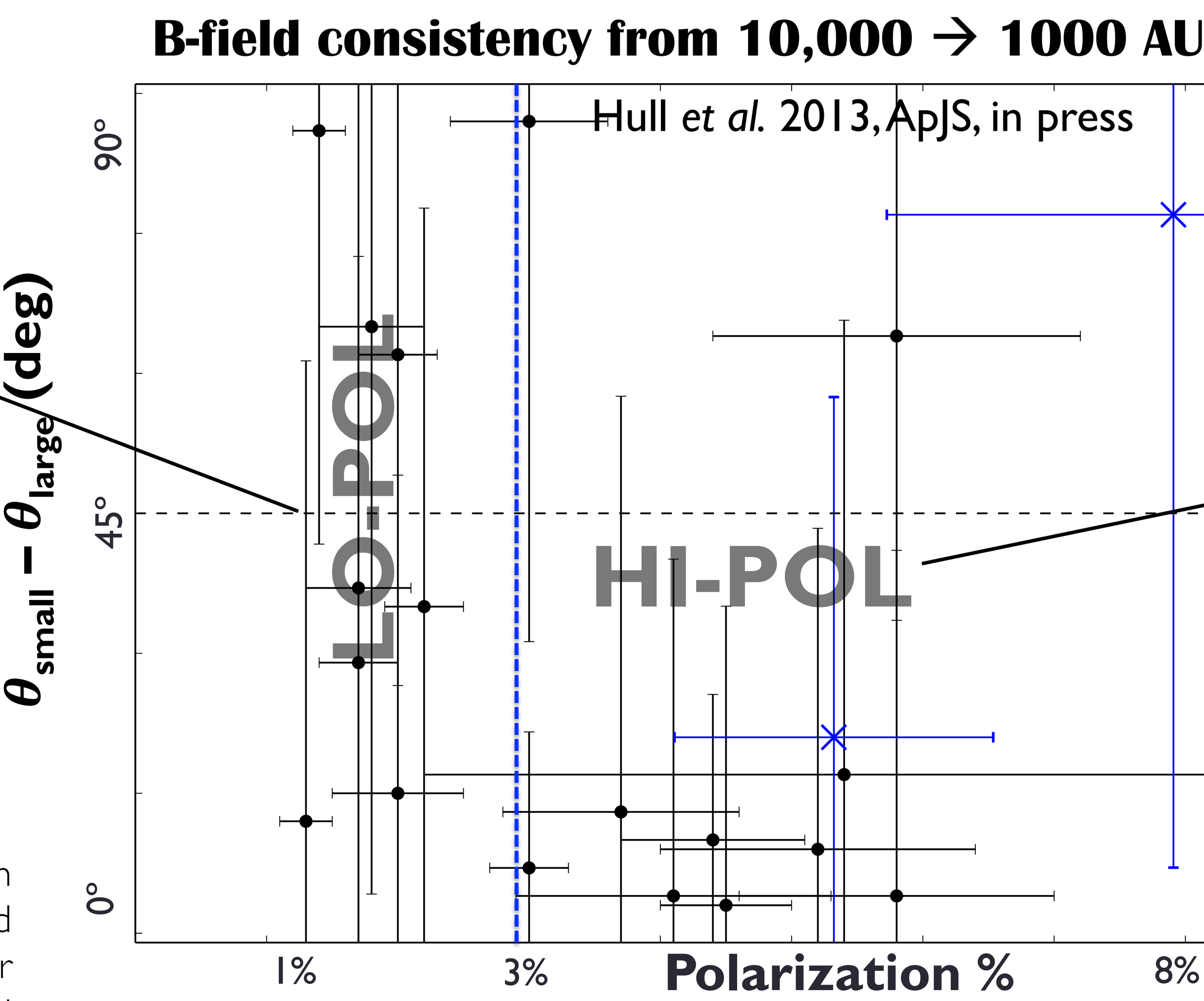
TADPOL polarization in protostellar cores

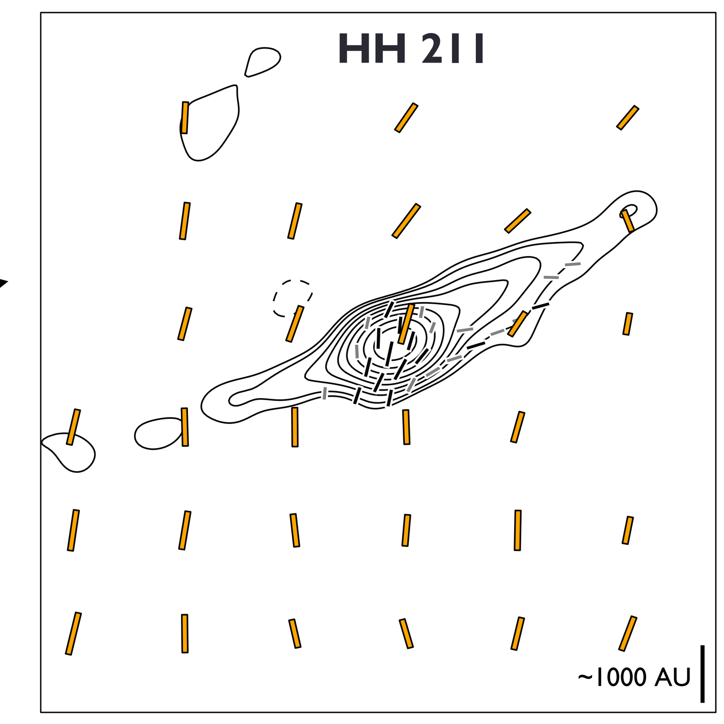
Chat Hull
UC Berkeley
chat@astro.berkeley.edu

Magnetic fields are (sometimes) consistent from core to envelope scales...



Sources with LOW polarization fraction (< 3%) have B-fields that are inconsistent from large to small scales



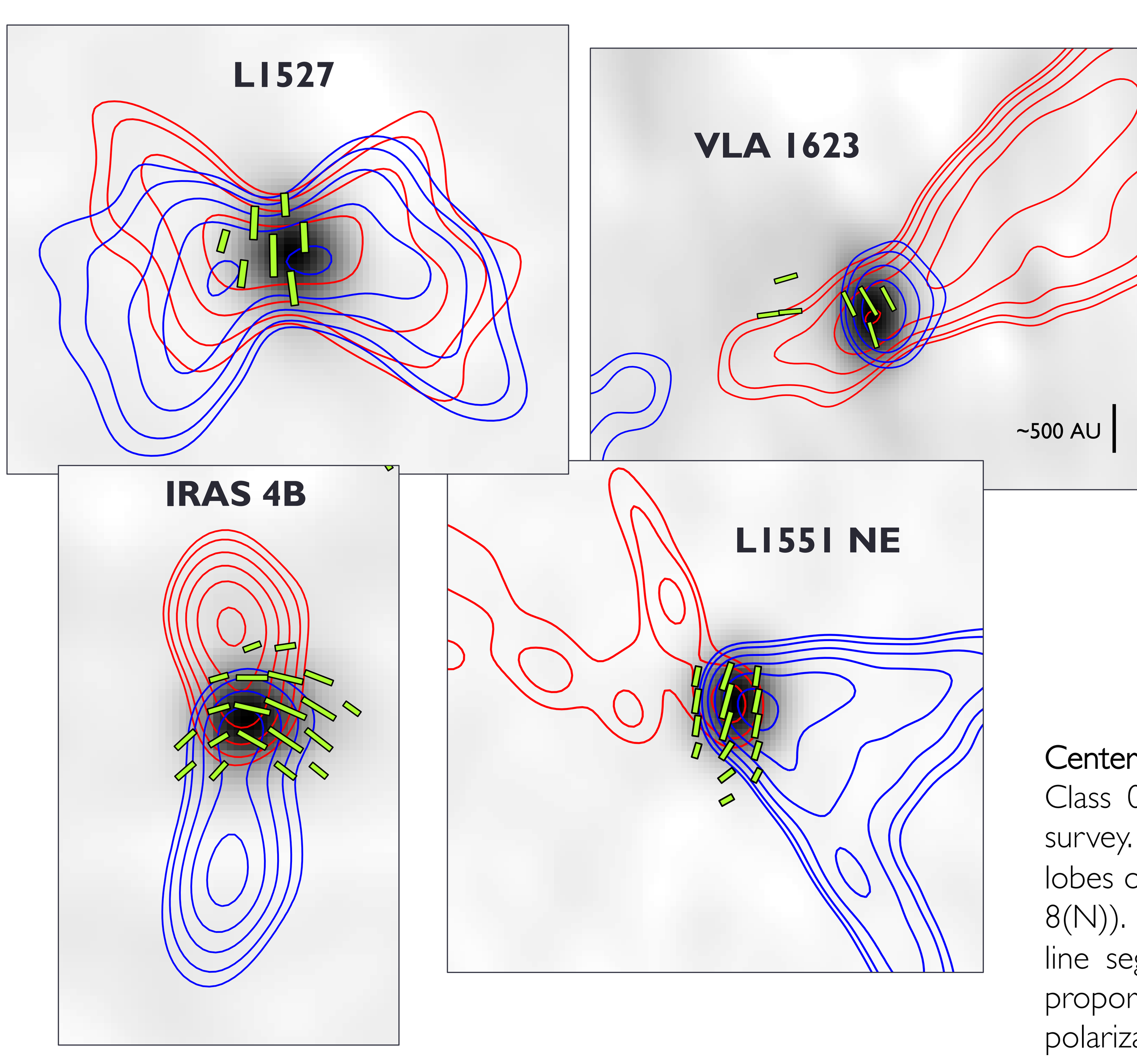


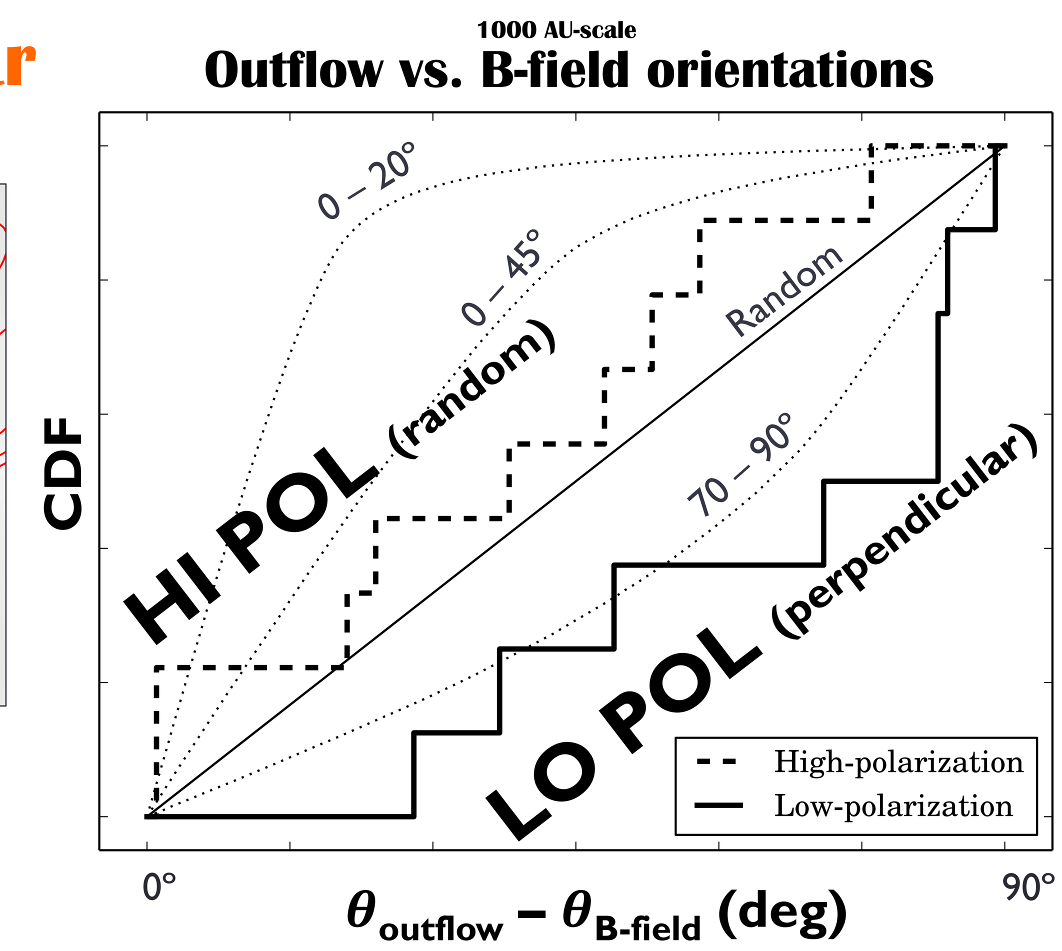
Sources with HIGH polarization fraction (>3%) have consistent large- and small-scale B-fields

Above/right: comparison of B-field orientations at large-scales (~10,000 AU, from SCUBA/CSO) and small-scales (~1000 AU, from CARMA). Center: B-field consistency vs. average dust polarization fraction in the core. Sources with higher polarization fractions have more consistent B-fields from 10,000 – 1000 AU scales. From Hull *et al.* 2014, ApJS, in press (arXiv:1310.6653)

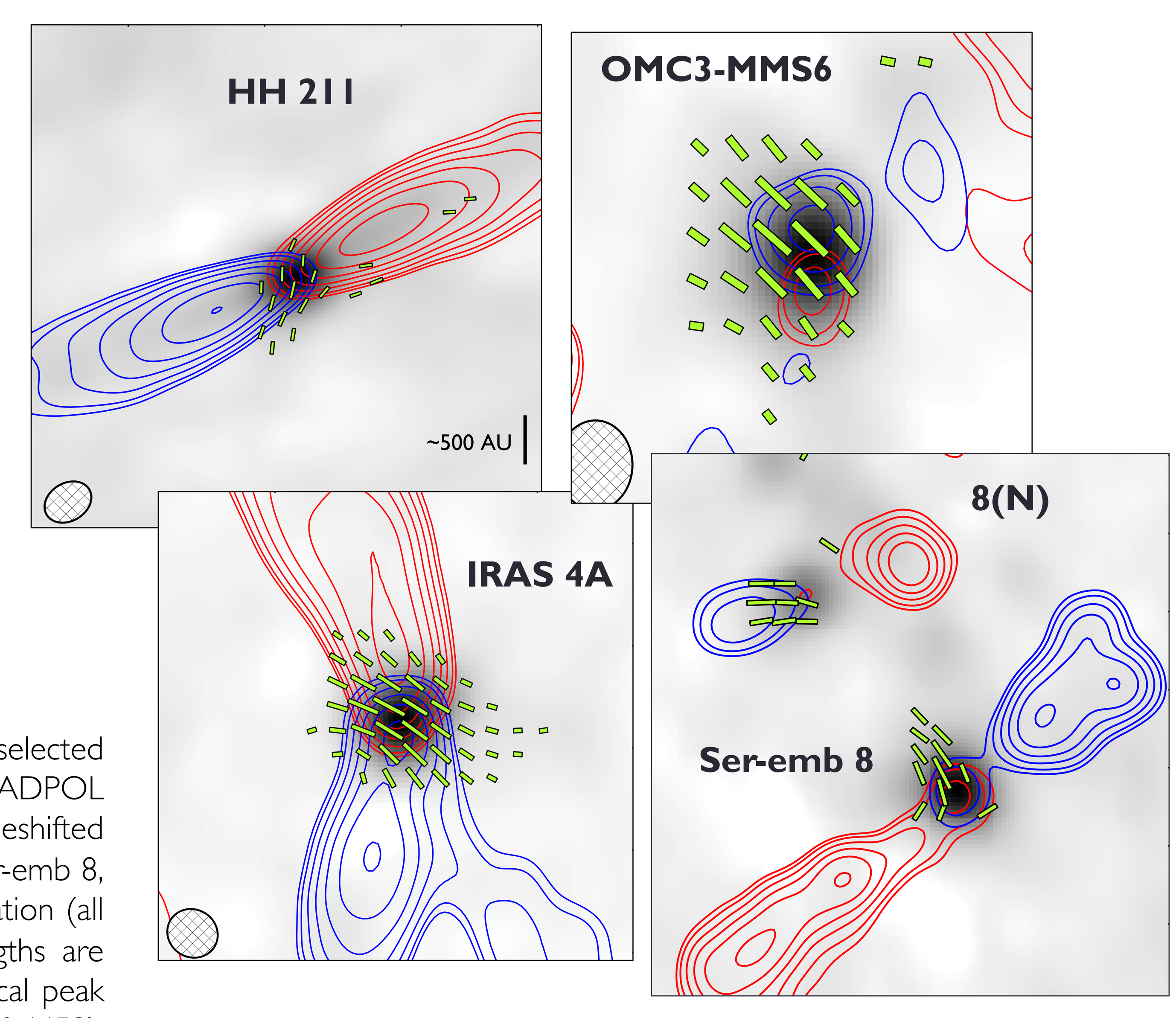
Yet...

LO-POL sources have outflows and B-fields that are preferentially perpendicular

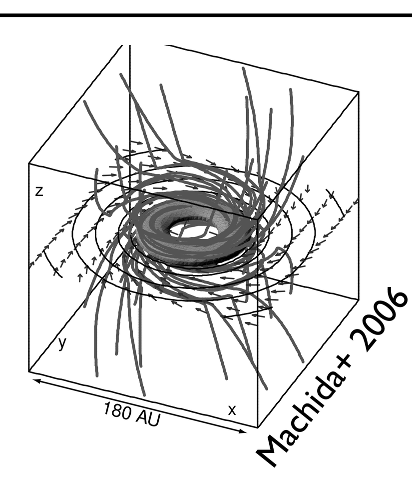




HI-POL sources have outflows and B-fields that are randomly aligned



Center: comparison of outflow vs. small-scale B-field orientations. Left/right: selected Class 0 protostellar cores mapped at 1.3 mm as part of the CARMA TADPOL survey. *Grayscale:* Stokes *I* thermal dust emission. *Contours:* red- and blueshifted lobes of the sources' bipolar outflows, mapped in CO(2–1) or SiO(5–4) (Ser-emb 8, 8(N)). *Line segments:* magnetic field orientations inferred from dust polarization (all line segments are rotated by 90° to indicate the B-field). Segment lengths are proportional to the square root of polarized intensity, not percentage (typical peak polarization is a few percent). From Hull *et al.* 2014, ApJS, in press (arXiv:1310.6653)

Future =  ?

Will ALMA see toroidally wrapped B-fields at ~100 AU disk scales in both low- and high-polarization sources?

Stay tuned for **ALMA Cycle 2** data!

Proposal **2013.1.00726.S**
PI: Hull, highest priority

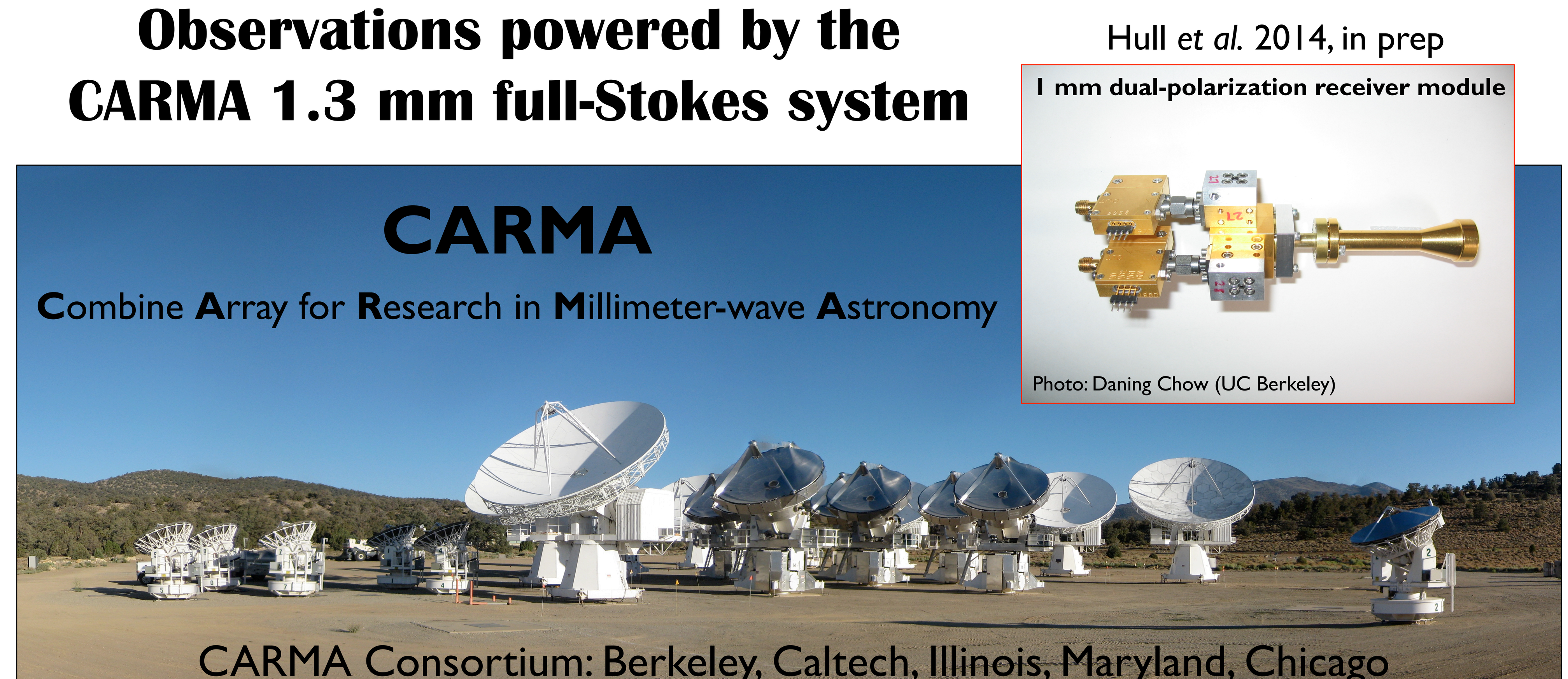
0.3″ (~150 AU) resolution dust polarization (@ Band 7)
Outflows & dense tracers (@ Band 6)

Conclusions

- **LO-POL:** B-fields may be wrapped up by envelope rotation
  - This could aid in disk formation
- **HI-POL:** B-fields may be remnants of the "global field" drawn in by gravitational collapse
  - Outflows are not tightly aligned with the B-fields in the cores out of which they formed (see Hull et al. 2013, ApJ, 768, 159)

Observations powered by the CARMA 1.3 mm full-Stokes system

Hull *et al.* 2014, in prep



TADPOL collaboration — tadpol.astro.illinois.edu