

Polarization in forming stars



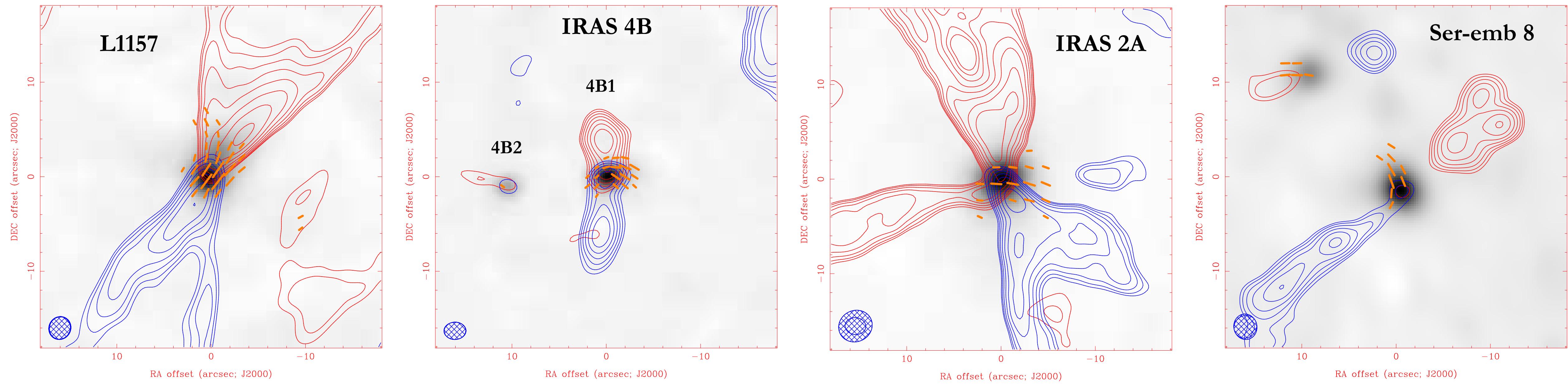
Credit: J. Hester (Arizona State), NASA

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Magnetic fields are dynamically important on large scales. However, below the dense-core scale...

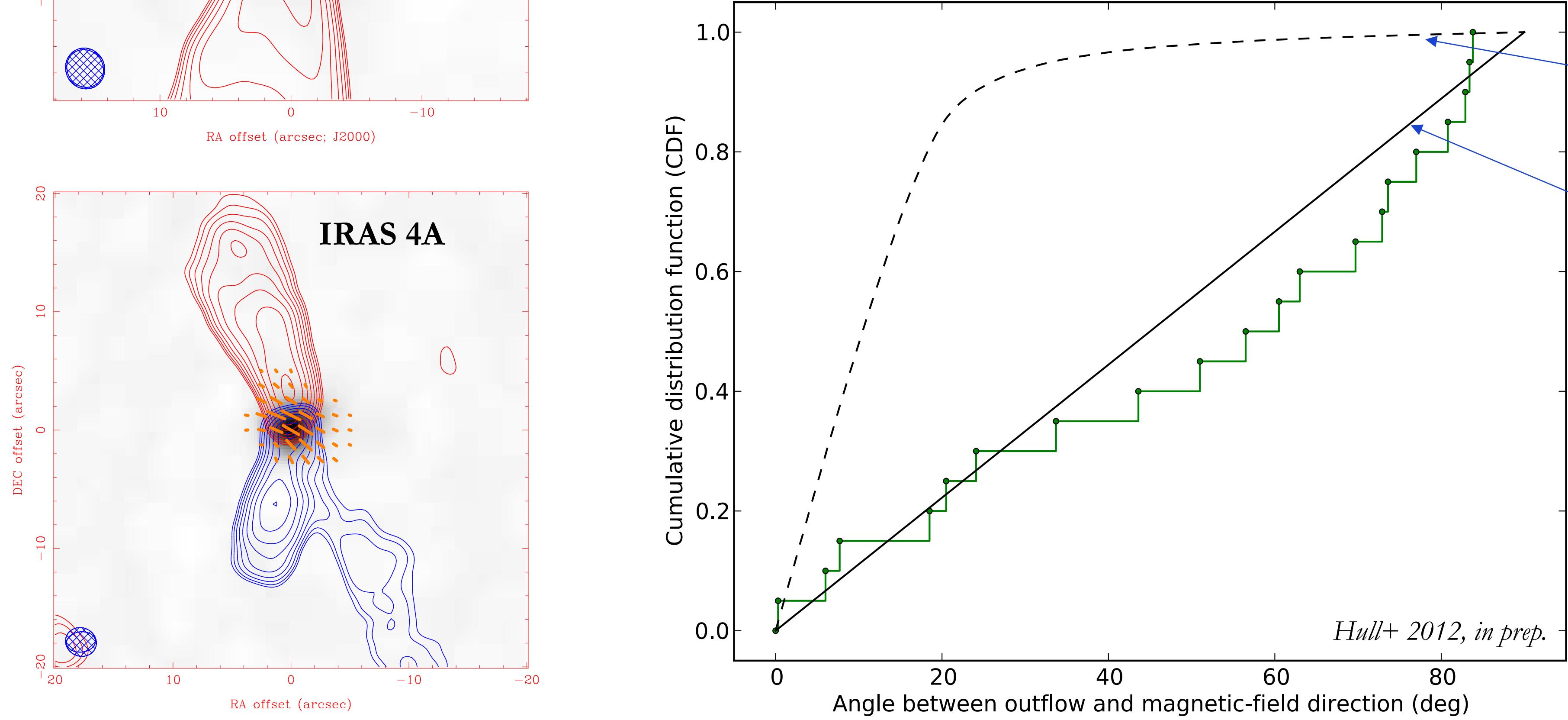
B-fields and outflows are not always aligned



Above & left: a subset of the isolated, low-mass Class 0 protostars mapped at 1 mm as part of the CARMA TADPOL survey. One of the TADPOL science goals is to probe the intrinsic (mis)alignment of magnetic fields and bipolar outflows in forming stars.

Grayscale: Stokes I thermal dust emission. **Contours:** red- and blueshifted lobes of the sources' bipolar outflows, mapped in CO(2-1) (L1157, IRAS 4B, IRAS 2A, IRAS 4A, CB230) or SiO(5-4) (Ser-emb 8). **Orange vectors:** orientation of the projected magnetic field, presumed to be perpendicular to the orientation of the polarized emission from dust grains. Vector lengths are proportional to polarized intensity, not percentage (typical peak polarization is a few percent). Vectors are plotted only where a $>3\sigma_{QU}$ polarization detection and $>2\sigma_I$ Stokes I intensity coincide; typical noise in the Stokes Q & U maps is $\sigma_{QU} \approx 0.5$ mJy. **Blue ovals:** size of the synthesized beam of the dust polarization and outflow maps.

RESULTS: distribution of outflow vs. B-field angle



Simulation: outflows & B-fields are aligned within a 20° cone (takes into account projection effects)
Simulation: outflows & B-fields are randomly oriented

KS test results

20° cone ruled out
(p-value $\sim 10^{-4}$)

Random orientations
cannot be ruled out
(p-value ~ 0.65)

TADPOL collaboration

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Observations powered by the CARMA 1 mm full-Stokes system

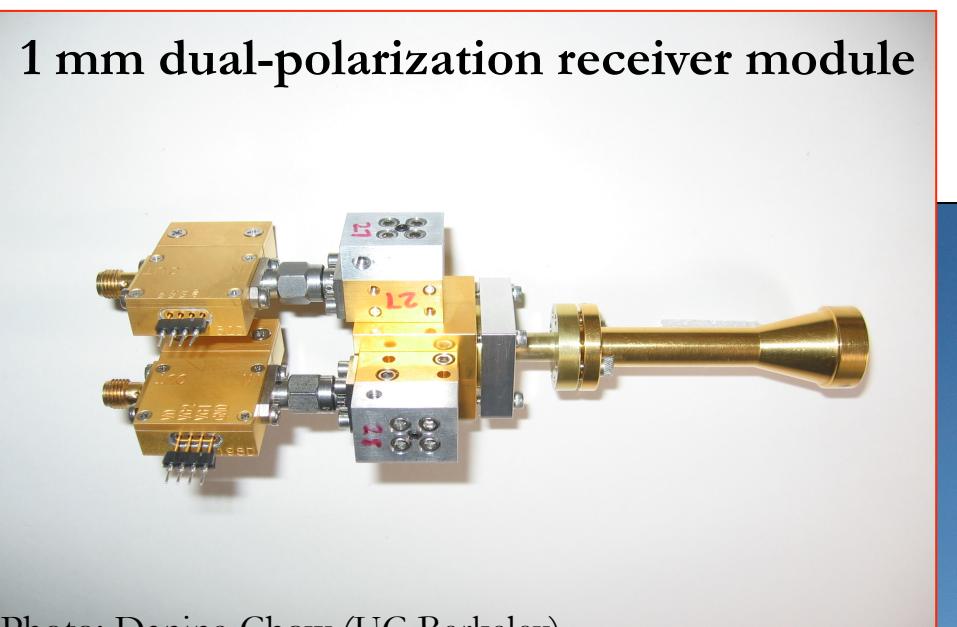
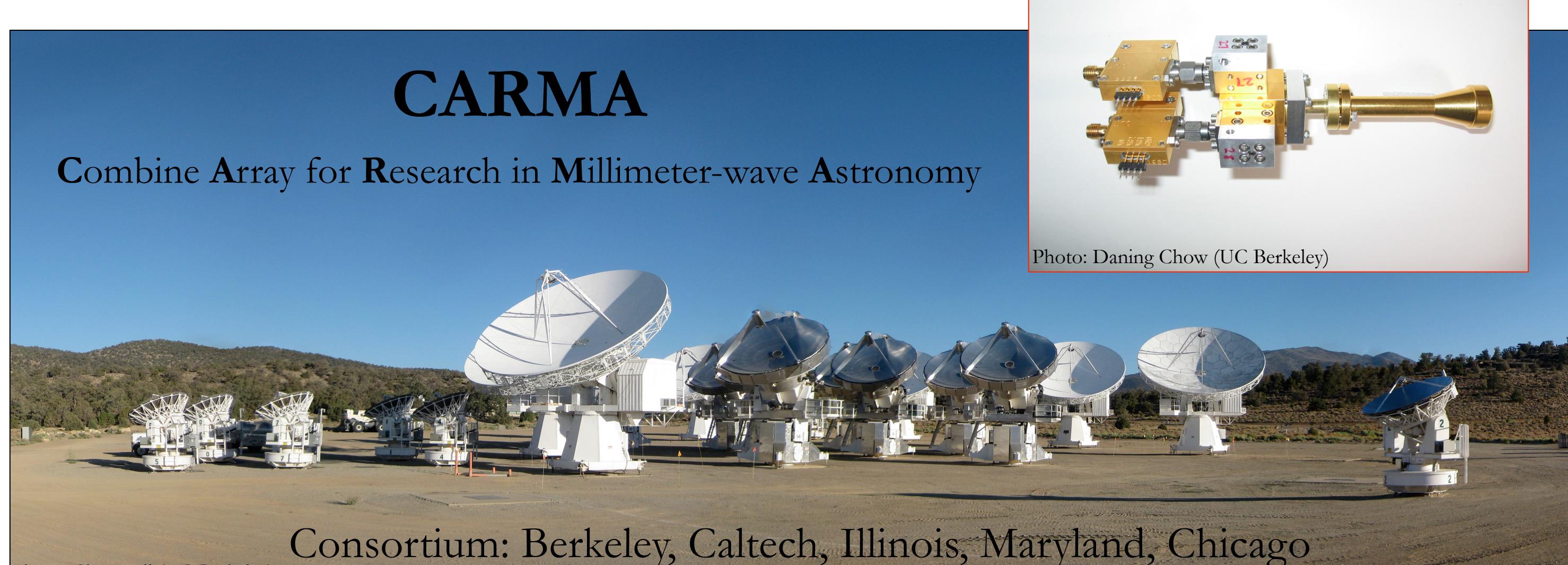


Photo: Daning Chow (UC Berkeley)