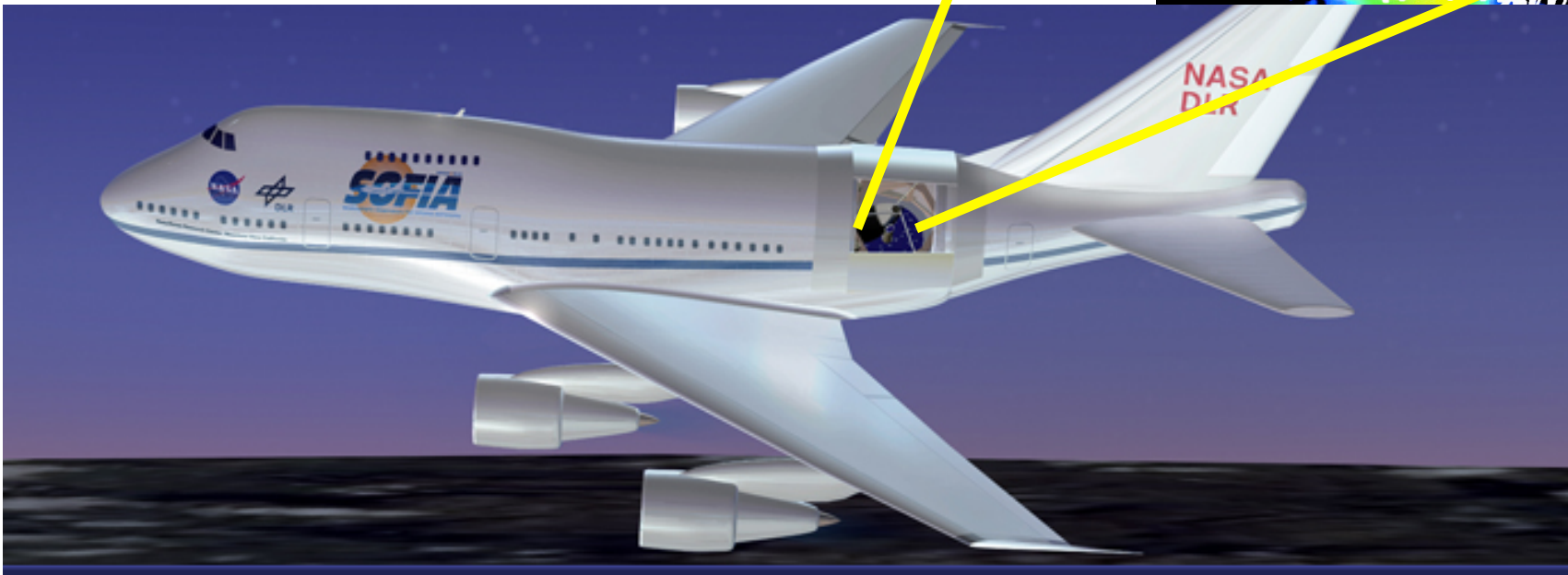
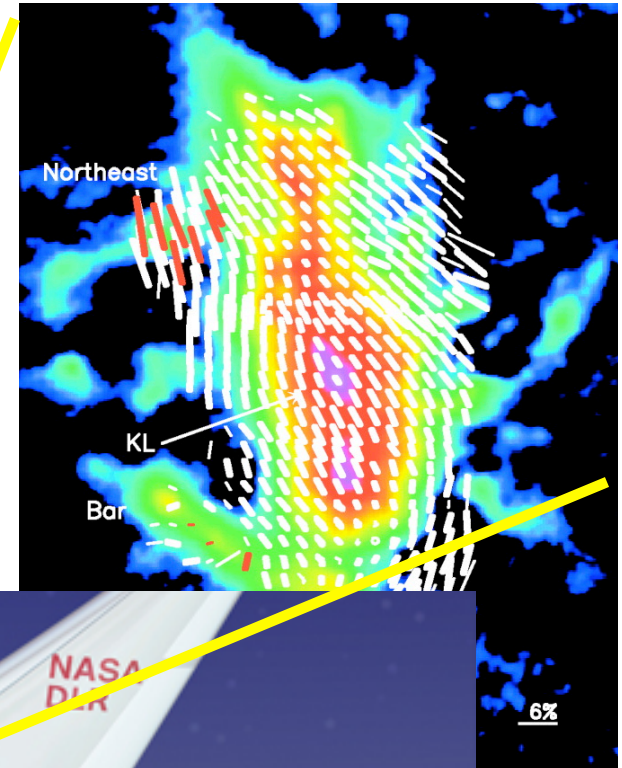


# Polarimetry with SOFIA

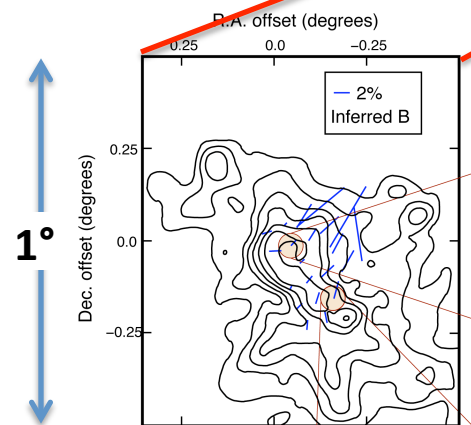
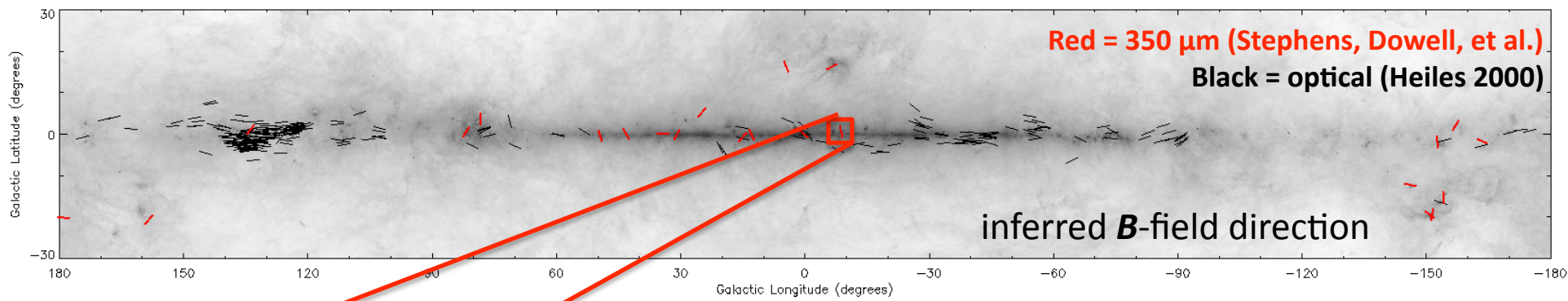
Broadest Goals:

- constrain the effect of magnetic fields on ISM evolution, from the scales of proto-stars to galaxies
- study the physics of interstellar grains, their properties, and their interaction with  $B$ -fields

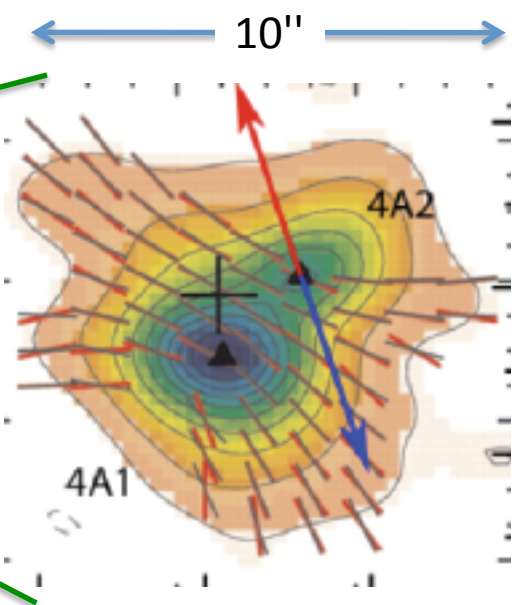
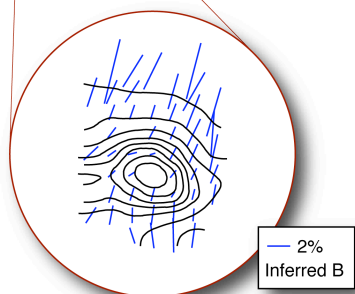
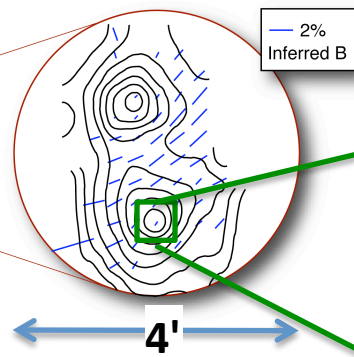
John Vaillancourt, Terry Jones, M. Berthoud, R. Crutcher, D. Dowell, R. Gehrz, A. Harper, P. Ho, M. Krejny, G. Novak, C. Packham, J. Staguhn, M. Werner, R. Hildebrand, et al.



# From large-scales to small-scales with SOFIA



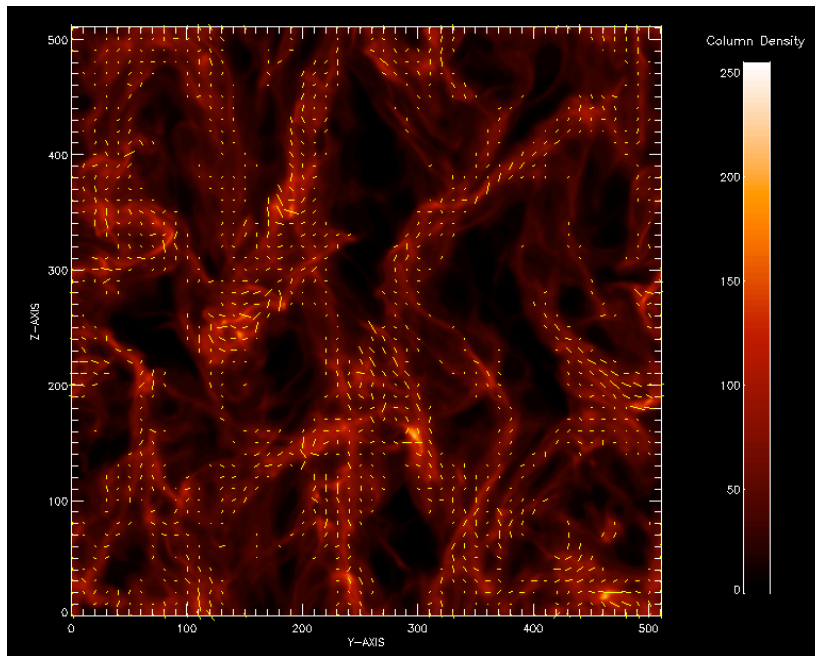
**NGC 6334**  
(Novak et al. 2009)



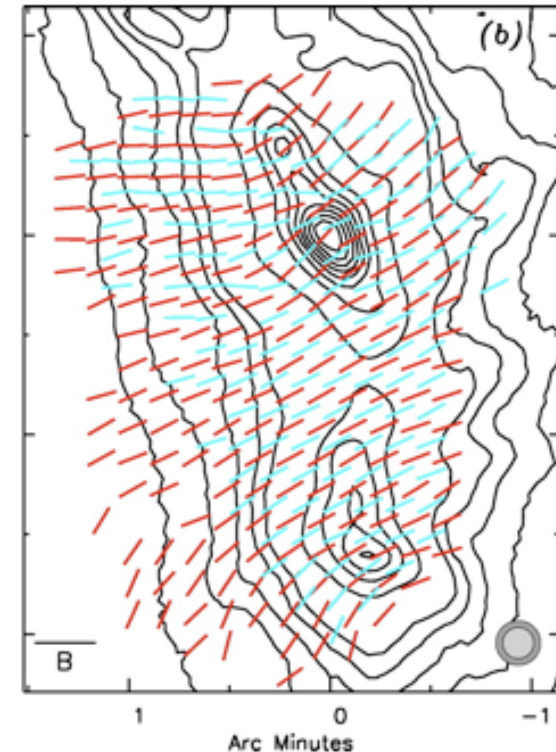
**NGC1333**  
SMA (Girart et al.)

# Turbulent Power Spectra & Polarization Angles

Numerical Simulations with MHD and self-gravity (Falcet-Gonçalves, Lazarian et al.)

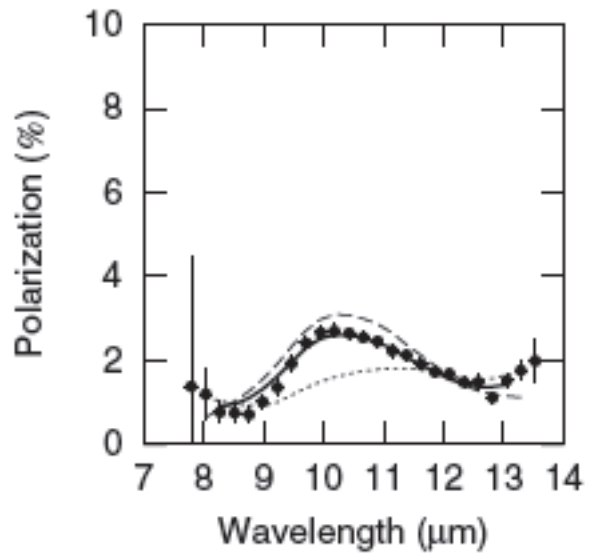
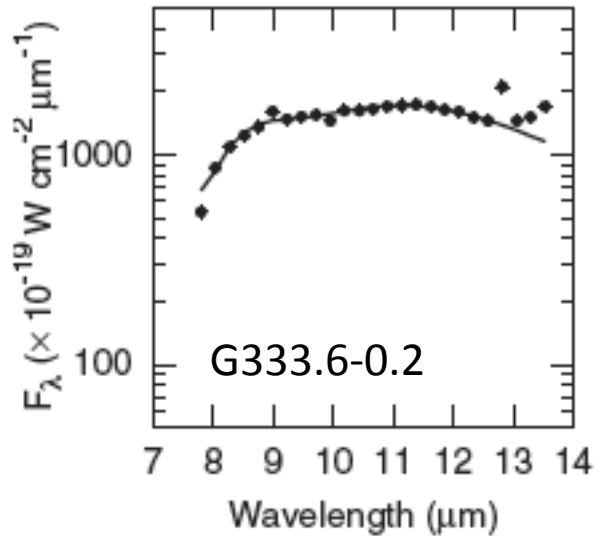


Measurements



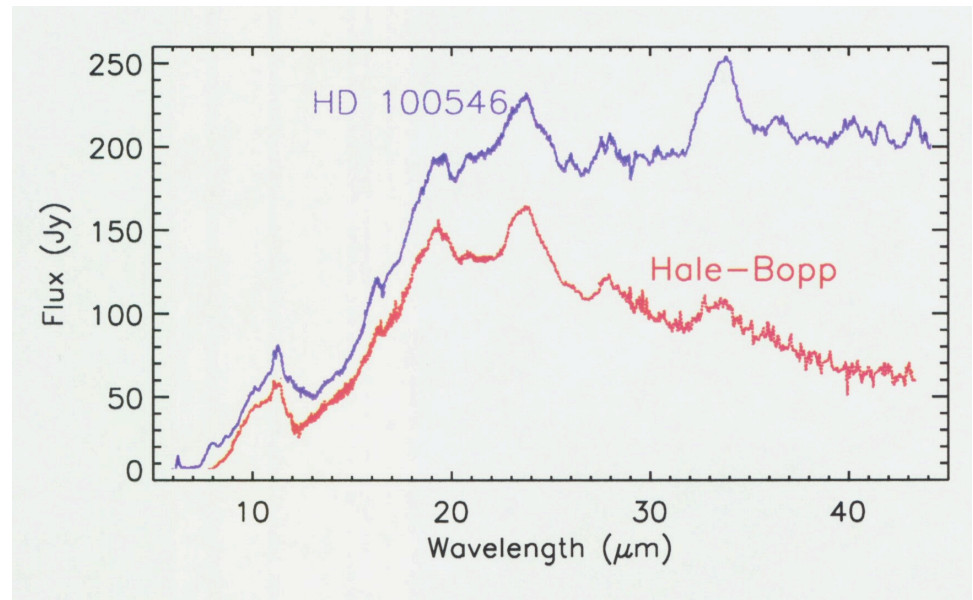
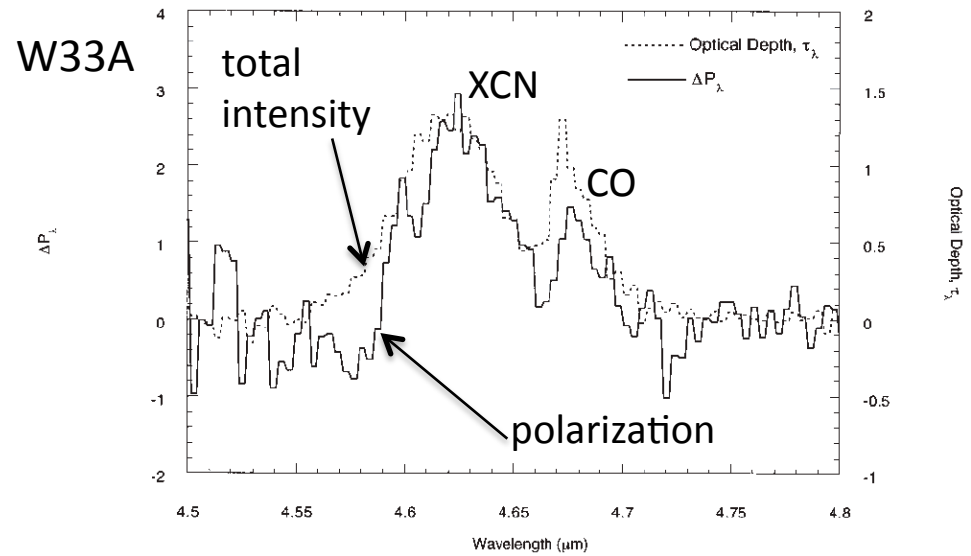
- compare angular power spectra: measurements test quantitative theory
- angle dispersion  $\rightarrow$  turbulent-to-mean-field ratio  $\rightarrow$  Chandrasekhar-Fermi method  $\rightarrow$  B-field strength
- good statistics needed  $\rightarrow$  high spatial resolution, wide fields, many vectors

# Mid-Infrared Spectropolarimetry

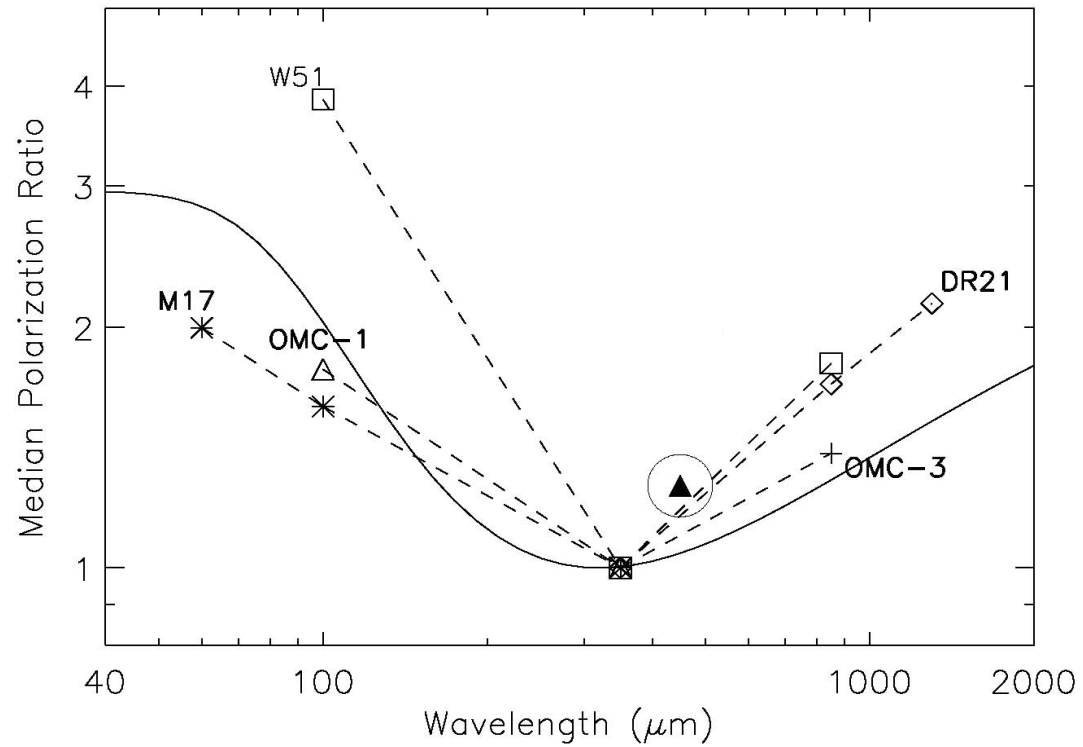
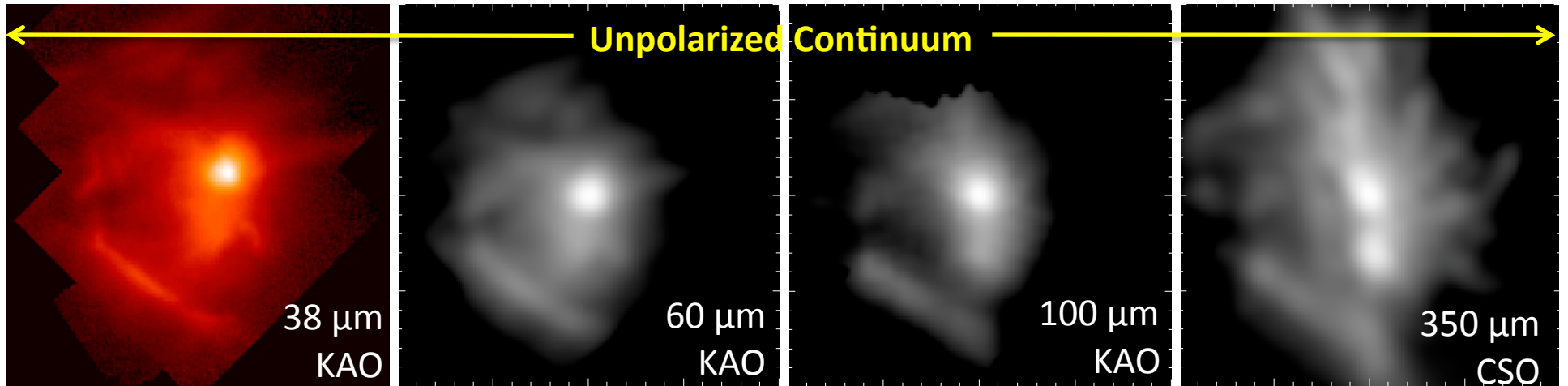


Fujiyoshi et al. (2001)

Chrysostomou et al. (1996)

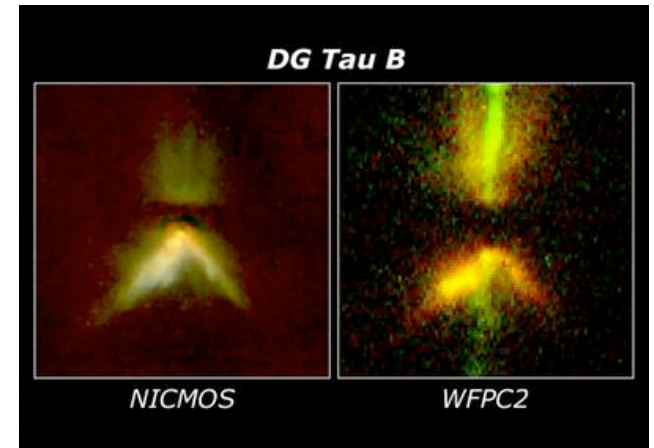


# Far-Infrared Spectropolarimetry



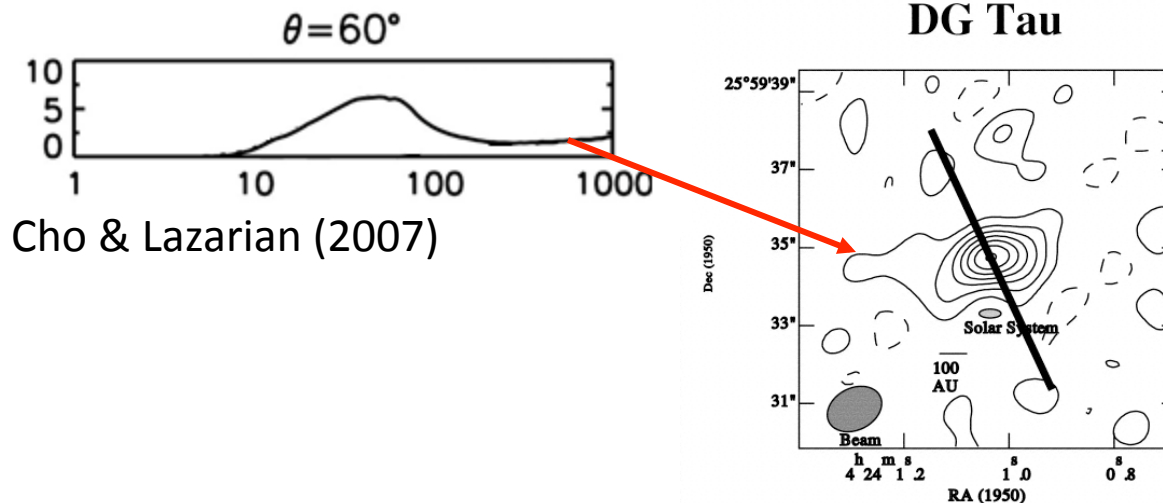
# Far-IR Polarimetry of Protostellar Disks

- Class II protostellar disks are considered to be sites of very early planet formation
- Only two detections of submm polarization exist for these disks.



$3\sigma$ , 850  $\mu\text{m}$   
polarization detection

Tamura et al 1999



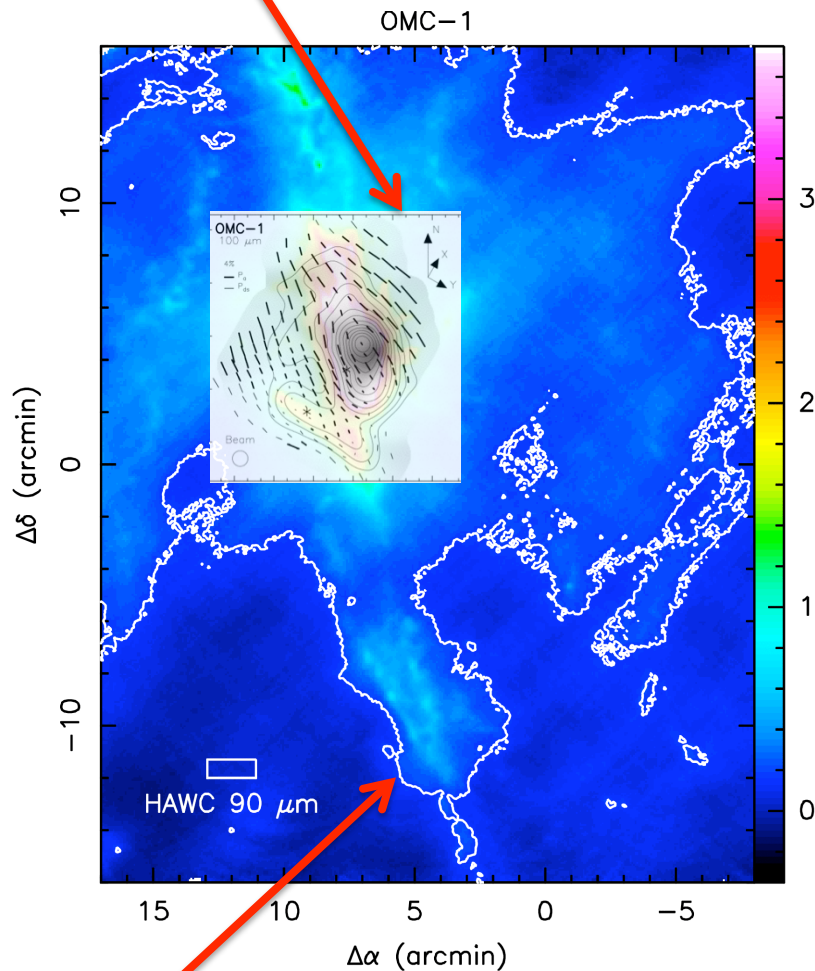
Cho & Lazarian (2007)

Mid- and far-IR polarization with SOFIA can:

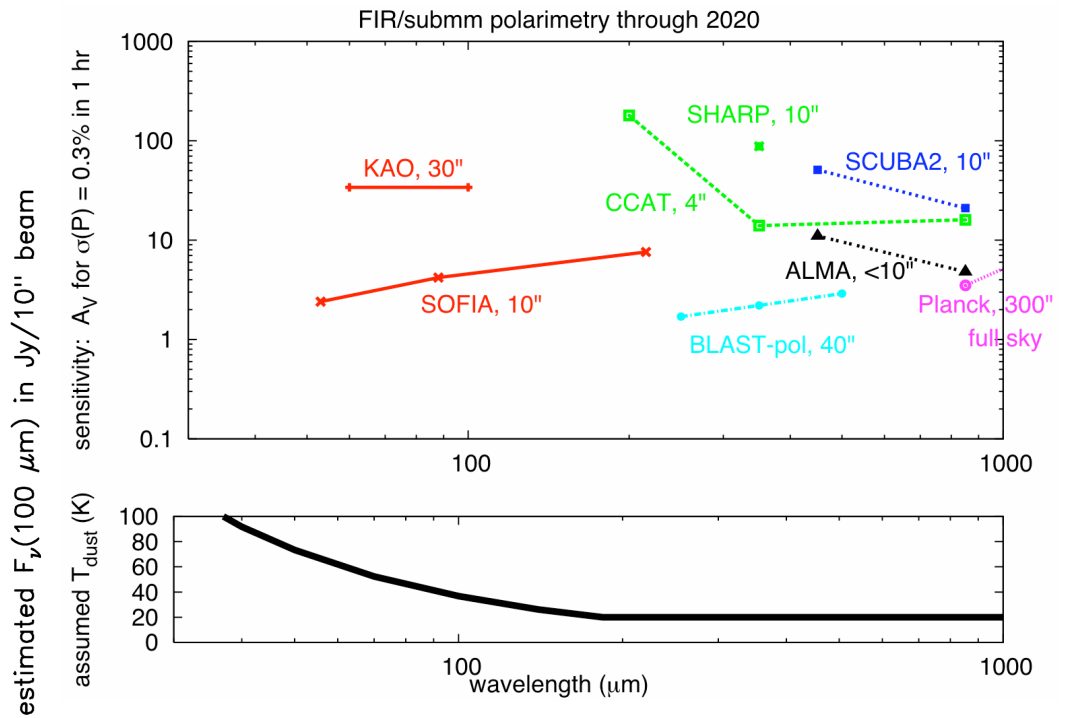
- Provide constraints on grain size distribution and polarization mechanism of dust in the disk
- Determine geometry of global magnetic field (if polarization is caused by thermal emission)

# SOFIA Polarization coverage & sensitivity

KAO polarization map:  
Schleuning (1998)



contour: pointings where  $\sigma(P) < 0.3\%$   
in 4 minutes with SOFIA



A SOFIA polarimeter will measure polarizations with uncertainties as low as 0.3 % for source intensities of a few Jy/beam. This is comparable to the sensitivity of other instruments expected to come online in the next decade. A SOFIA polarimeter will provide important complementary short-wavelength coverage.

# *Additional Observations*

- The Galactic Center
- Nearby starburst galaxies
- AGN
- Evolved stars, AGB
- Grain alignment, grain physics, polarization mechanisms
- Spectral line polarimetry (Goldreich-Kylafis effect, Zeeman effect, ice features)



## *Summary*

- SOFIA polarimetry will open an unexplored discovery space
- No other observatory, existing or in active development (orbital, sub-orbital, or ground), will have MIR/FIR polarization capabilities
- SOFIA polarimetry will have unprecedented sensitivity and wavelength coverage

## *Contacts & more info.*

- SOFIA Community Task Force presentation by Giles Novak and Darren Dowell
  - [http://homepages.spa.umn.edu/~gehrz/SOFIA\\_Community\\_Task\\_Force/Presentations\\_to\\_the\\_SCTF/12\\_16\\_09\\_Novak-Dowell\\_Polarimetry\\_with\\_SOFIA.ppt](http://homepages.spa.umn.edu/~gehrz/SOFIA_Community_Task_Force/Presentations_to_the_SCTF/12_16_09_Novak-Dowell_Polarimetry_with_SOFIA.ppt)
- papers by Vaillancourt et al. and Packham et al.
  - (2007, SPIE, 6678, 66780D and 66780F)

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