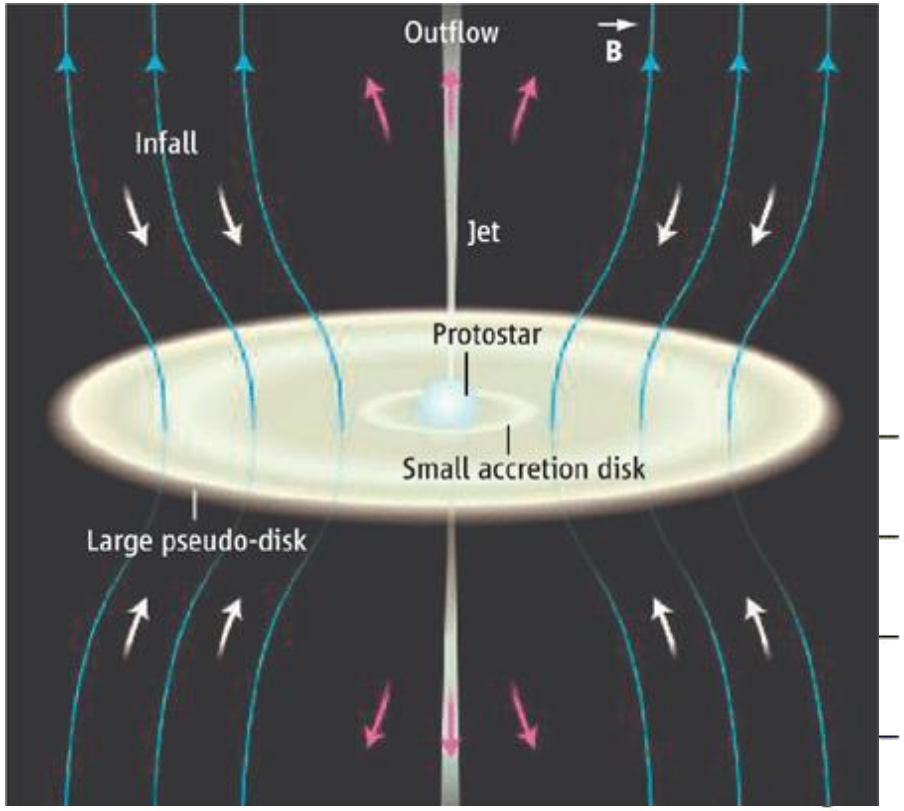
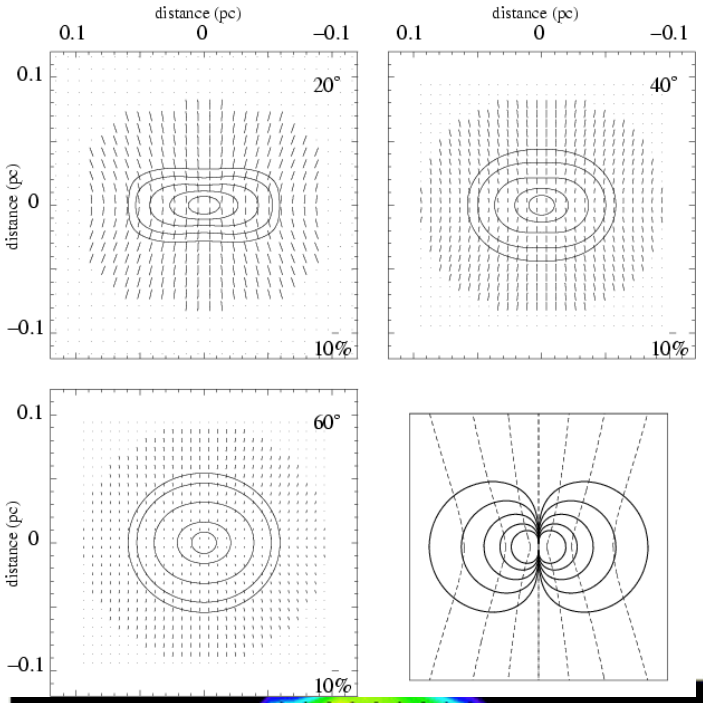
# Polarization Observations with the wSMA

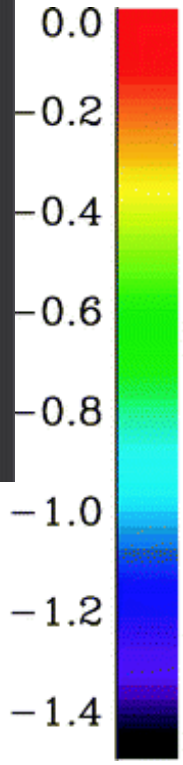
Thanks to all of the polarimetrists who used the SMA

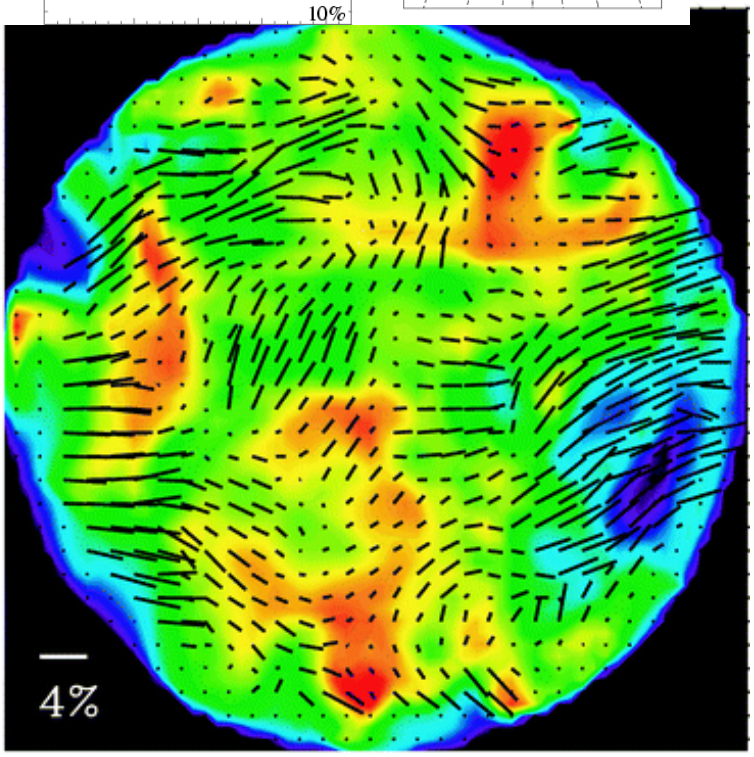
Ramprasad Rao (ASIAA)

# Importance of Magnetic Fields



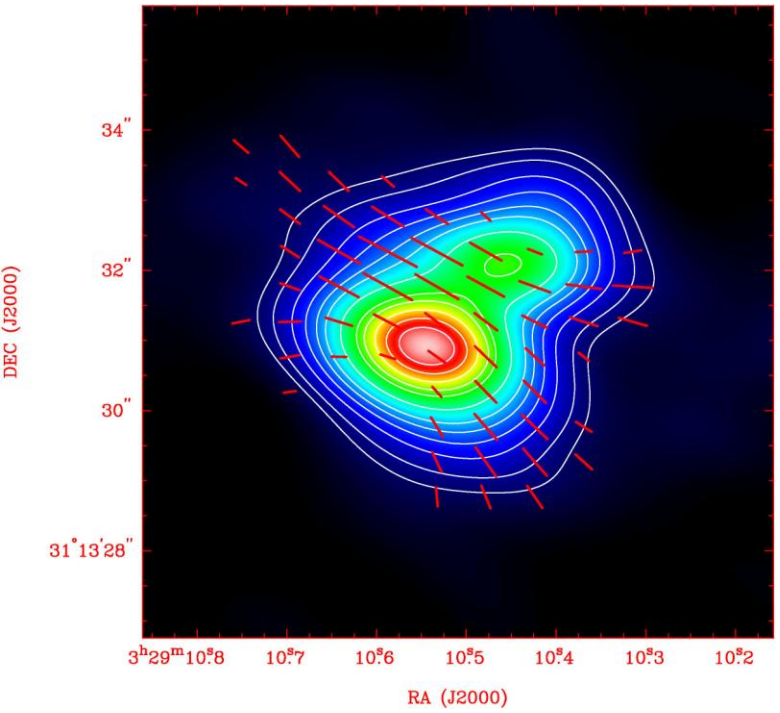



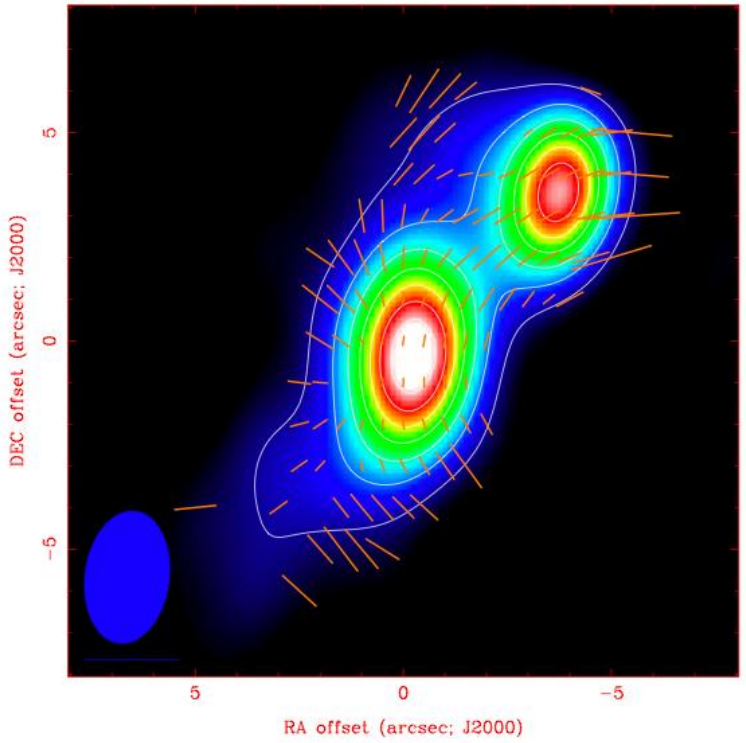




Crutcher+ 06; Goncalves+ 05; Bethell+ 07

# SMA B Field in Low Mass Stars

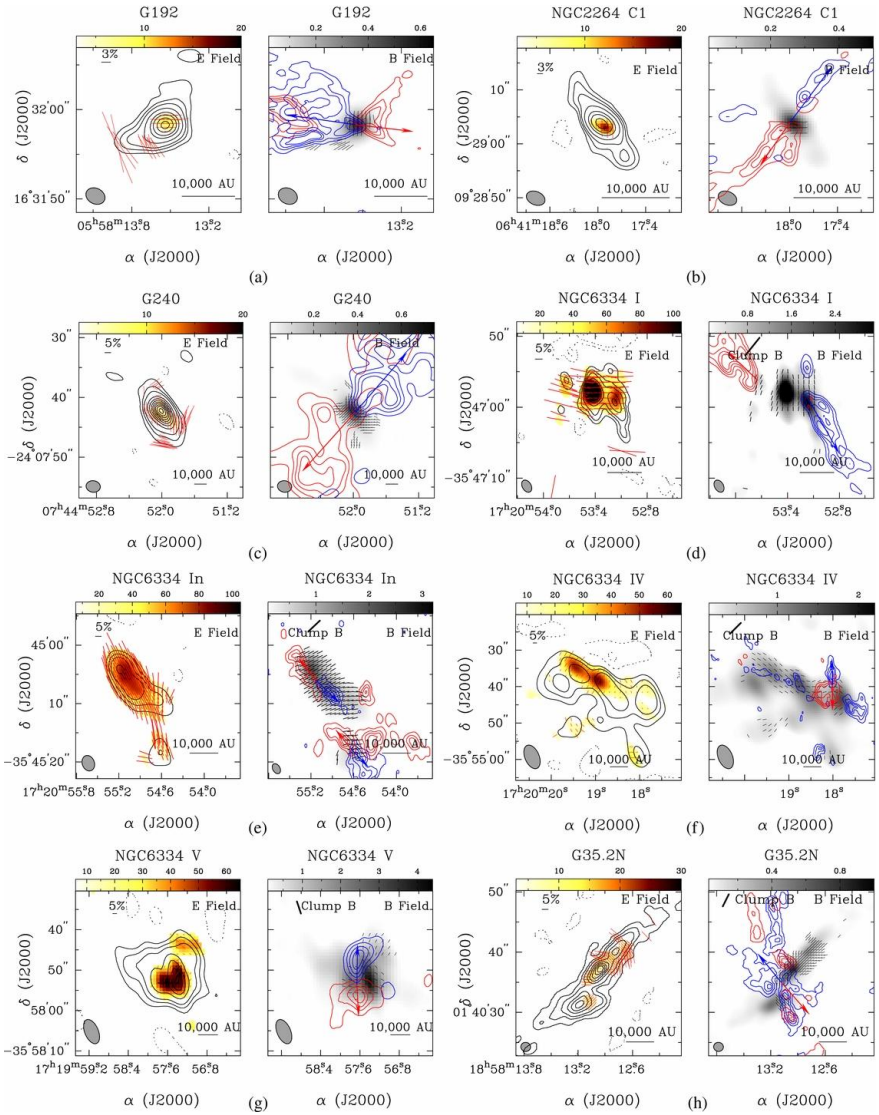



Girart+ 06




Rao+ 09

# SMA Legacy Survey – High Mass




Zhang+ 14

Statistics

- Cloud Orientation
- Cloud geometry
- Outflow correlaion

Also Koch+ 2014

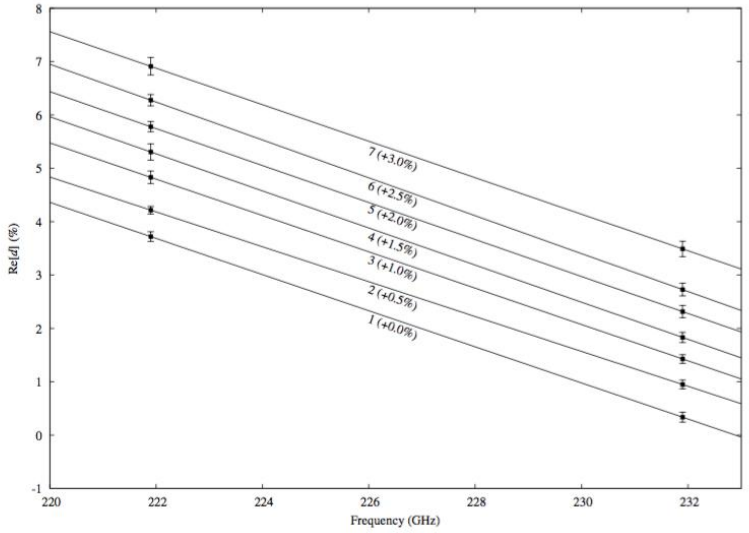
Intensity Gradient Analysis – correlate with Mass-to-flux ratio

# First Gen SMA Polarimetry System

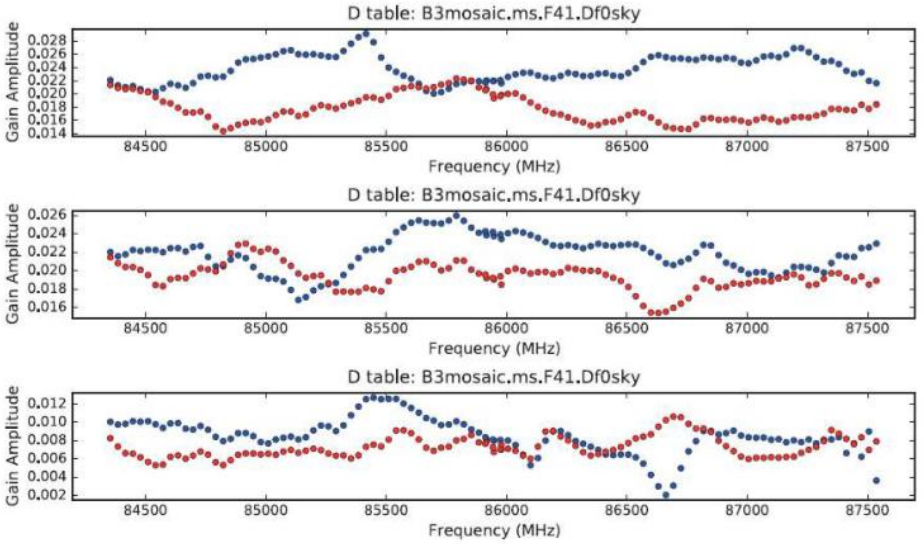
Dual Circular system with linearly polarized receivers and quarter waveplate for conversion is ideal for measuring dust polarization and magnetic fields.

Marrone+ 06

# Leakage Frequency Variability



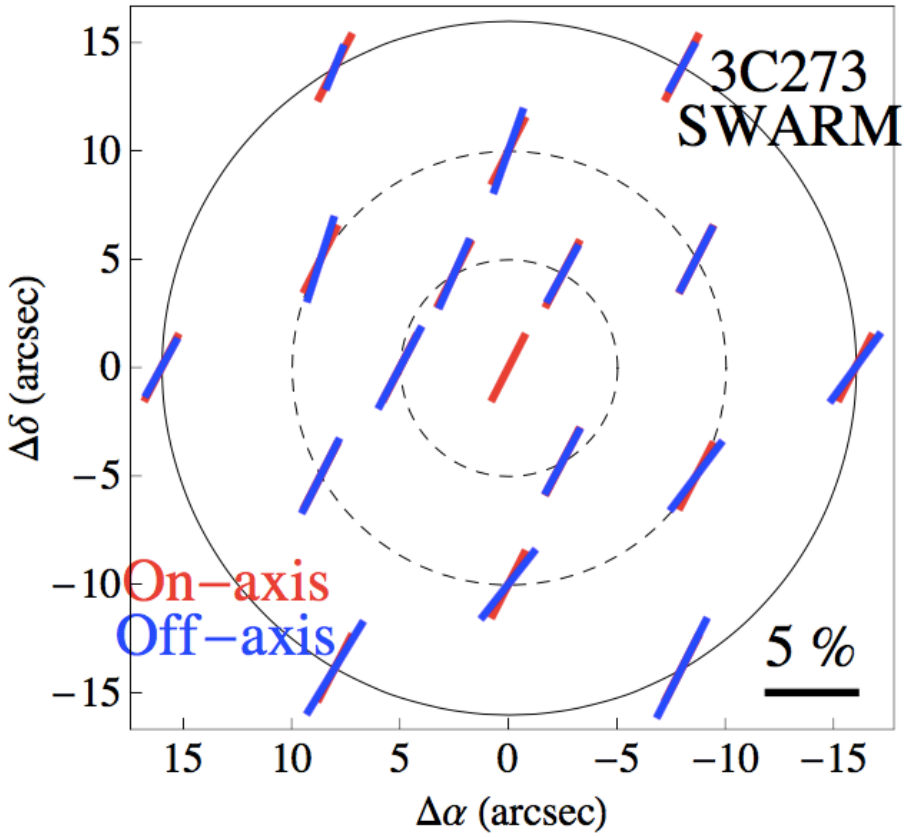

SMA; Marrone+ 06




D-terms at B3 for DA42, DV03 and PM01

ALMA Polarization

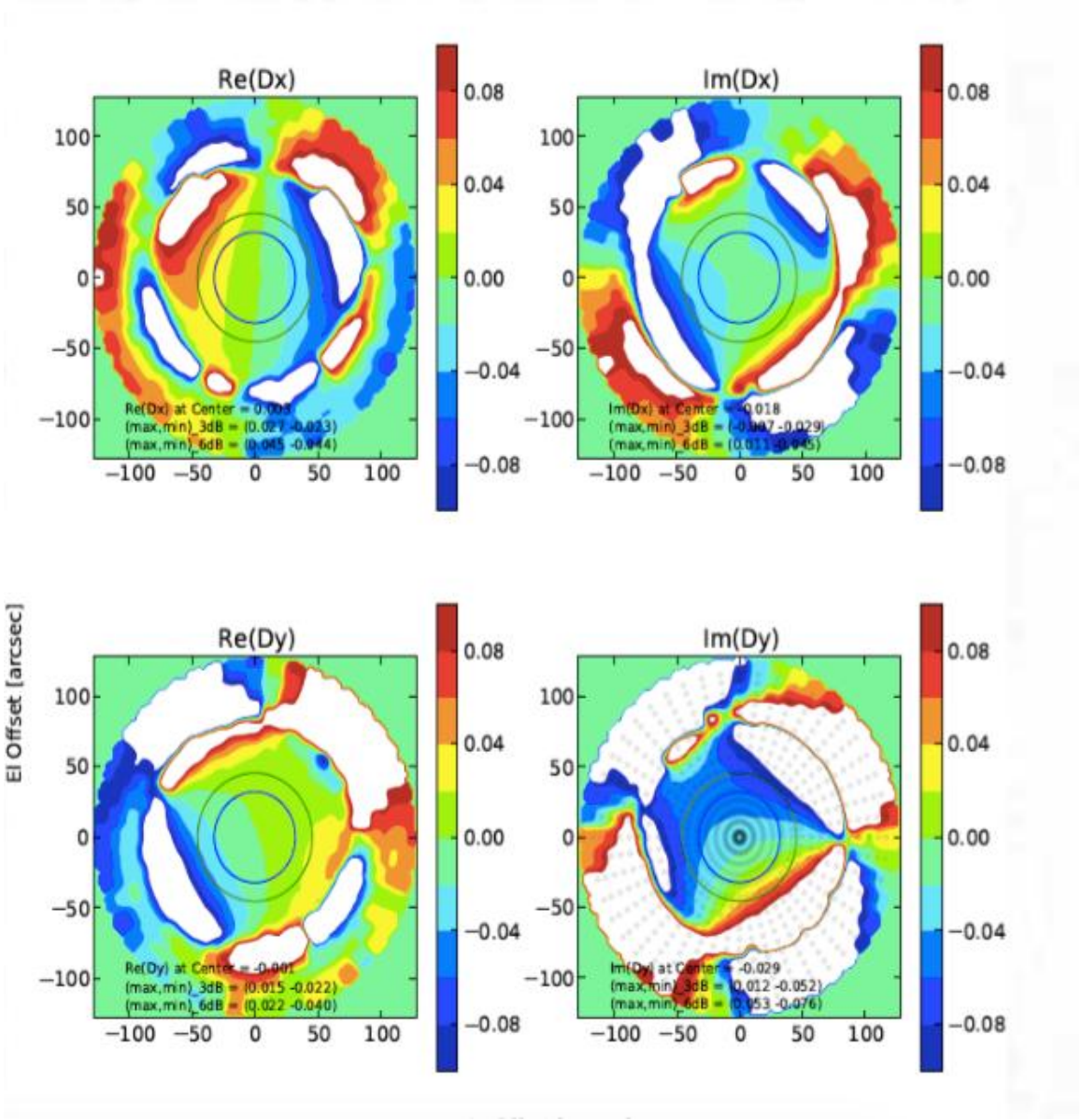
# SMA Primary Beam Polarization




SMA Off axis
Polarization < 0.5%

Ching+ (in prep)

# ALMA Off Axis Polarization




Cortes+ 15

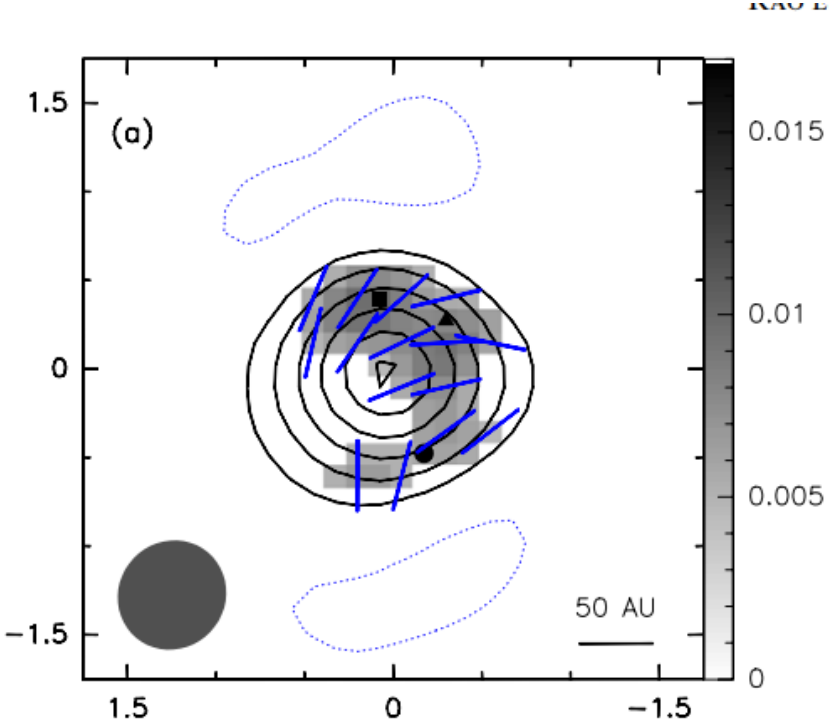
# Advantages of the SMA

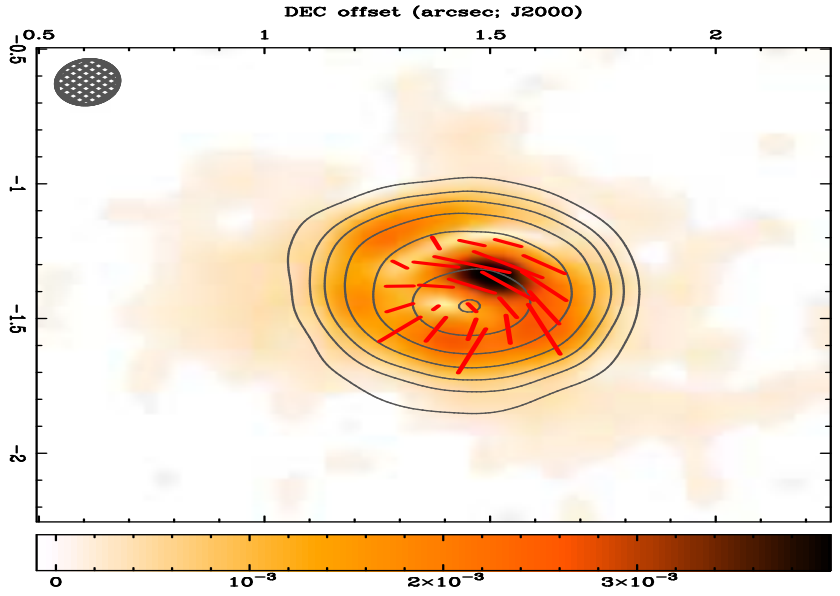
- Well behaved instrumental polarization with frequency (monotonic)
- Time stable instrumental polarization
- Fairly constant instrumental polarization across primary beam (See following talk by Ching).

# Limitations of the SMA

- Sensitivity starved → We can typically get 1-2 mJy/beam RMS at 345 GHz at best
- Hardware issues → Polarization Switching with single receiver system.
- Dual independent receivers → LO tracking and phase drift between systems.

# SMA ALMA Comparison – IRAS16293B

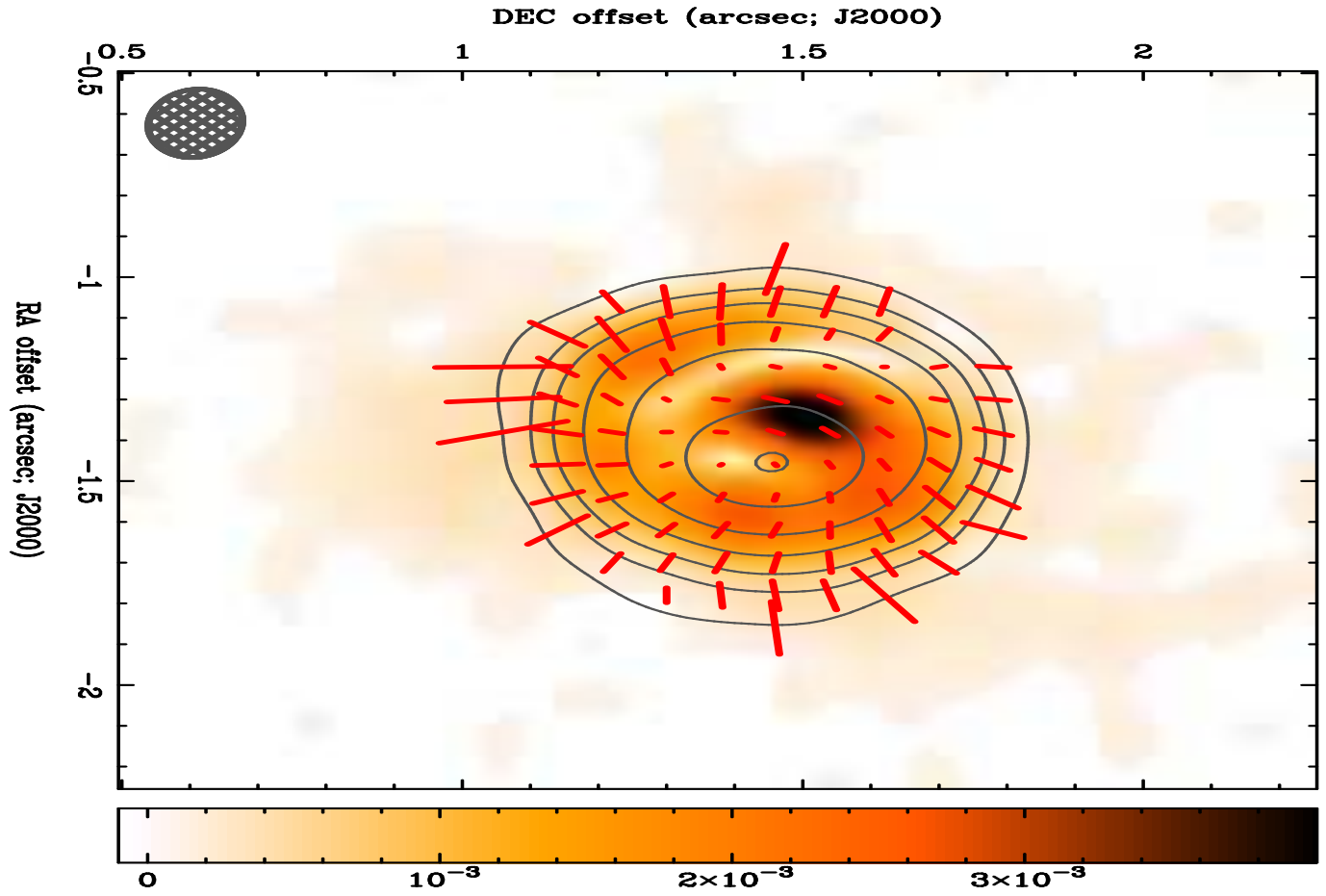



Rao+ 2014; SMA

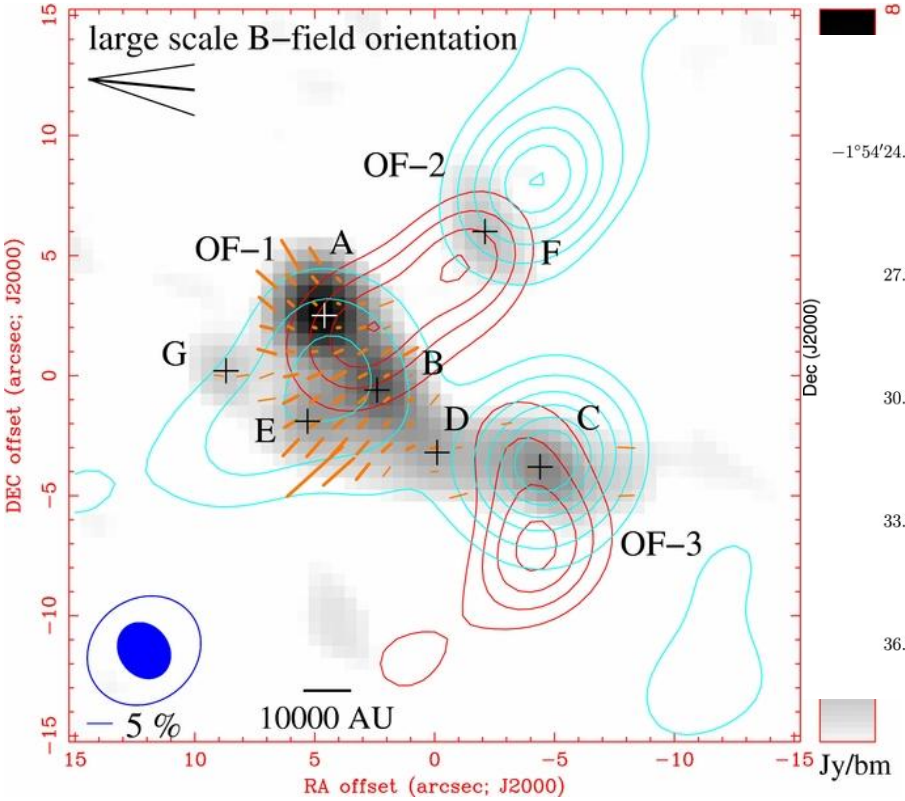
Rao+ In Prep; ALMA

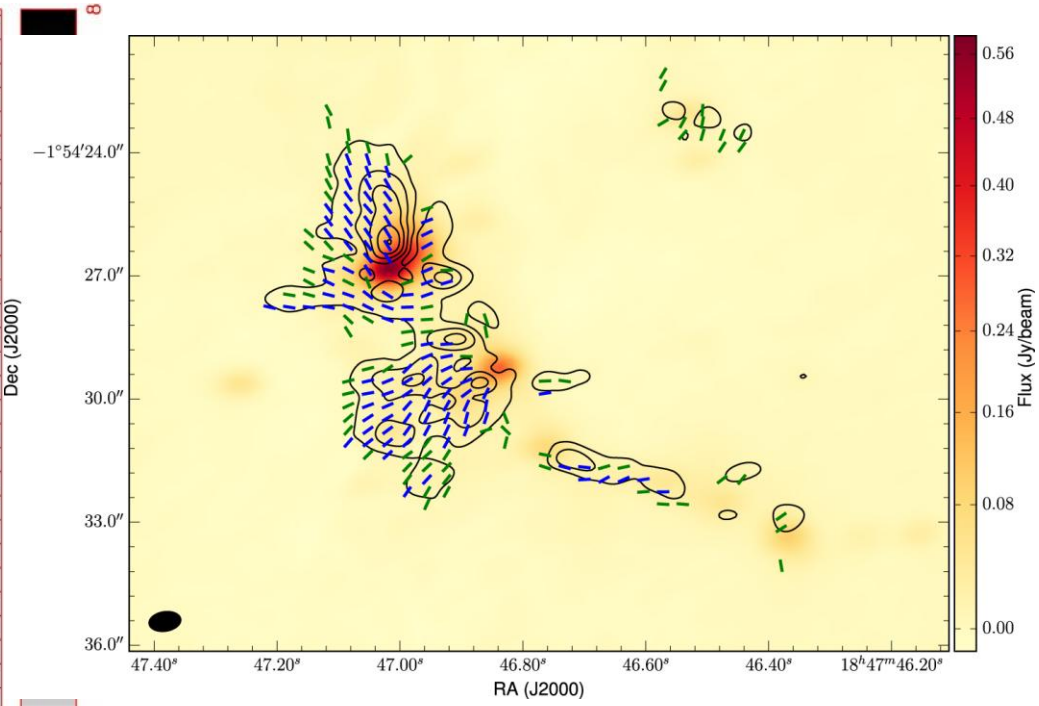
# IRAS16293B – ALMA sensitivity boost




Rao+ In Prep; ALMA

# SMA ALMA Comparison – W43N




SMA: Sridharan+ 14

ALMA: Cortes+ 16

# Next Gen wSMA Polarimetry

- Proposed design includes broadband designed OMT with quarter wave plate→ Issues with Polarization Spectral Response and stability
- New Optics cryostat design → Issues with off axis instrumental polarization
- Dual receiver will provide some simplifications
- Sensitivity Boost to maybe 0.2 mJy/beam at 345 GHz.

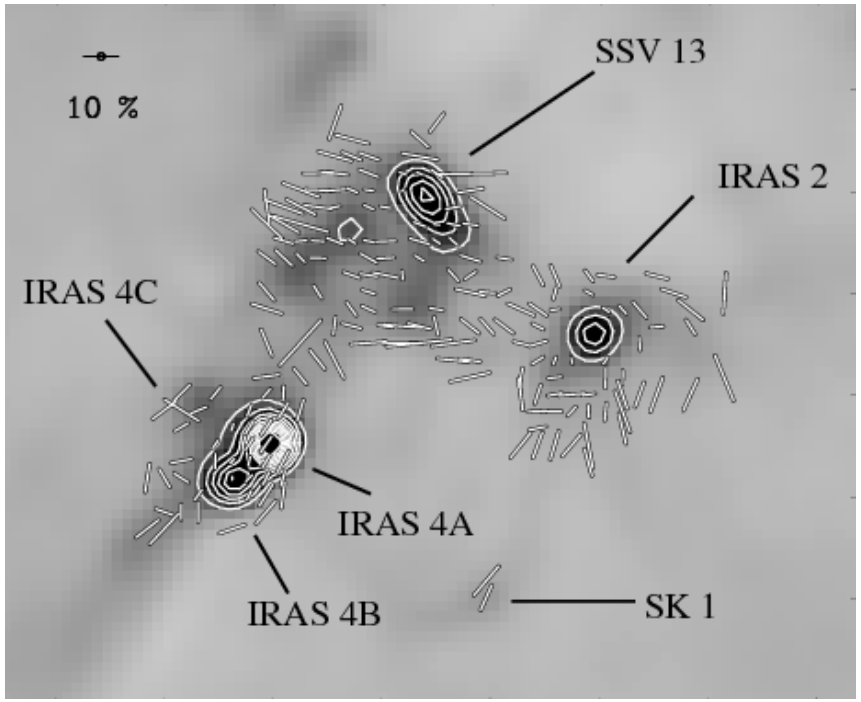
# Possible Observational Program

- Connect Large Scale Magnetic Fields with Small Scale Structure?

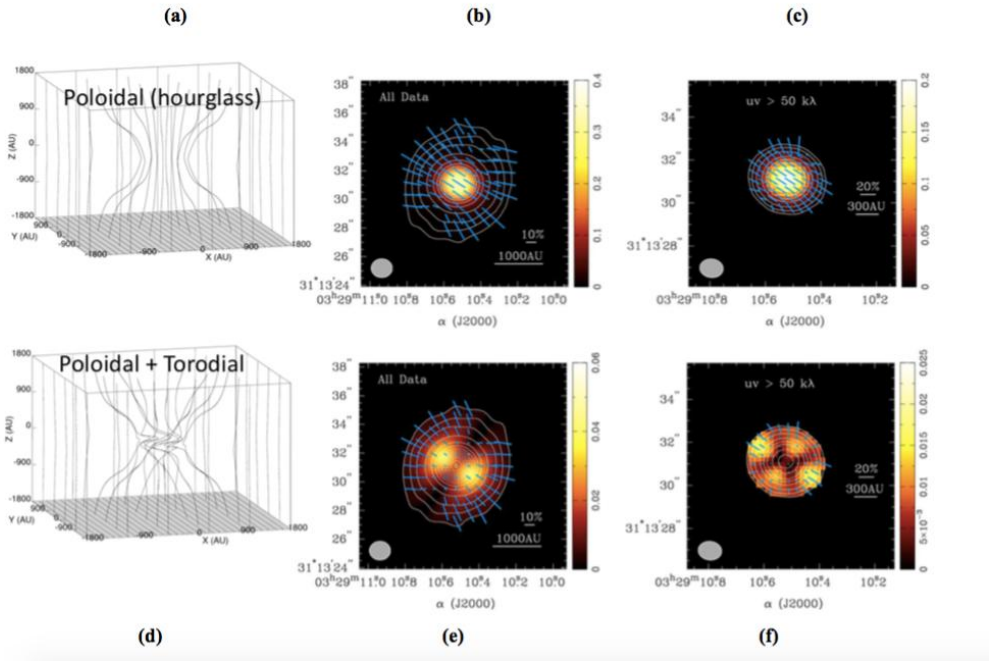
# Wide Field Images and Mosaics

- SMA Primary Beam is approximately 35” at 345 GHz (ALMA Band 7)
- ALMA restricted to 1/3 of Primary Beam which is approximately 6” (Band 7)
- *For extended sources ➔ Factor of 36 in mapping speed*

# IRAS4A – Large to Small Scales



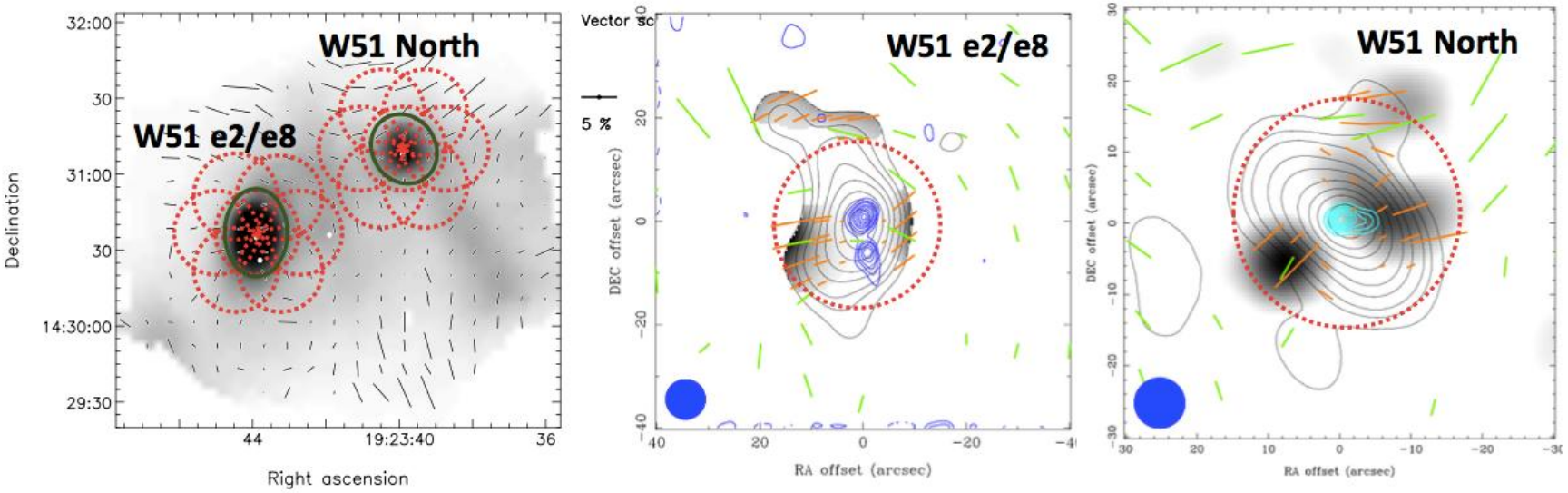

Matthews+ 09




Lai, Ching +

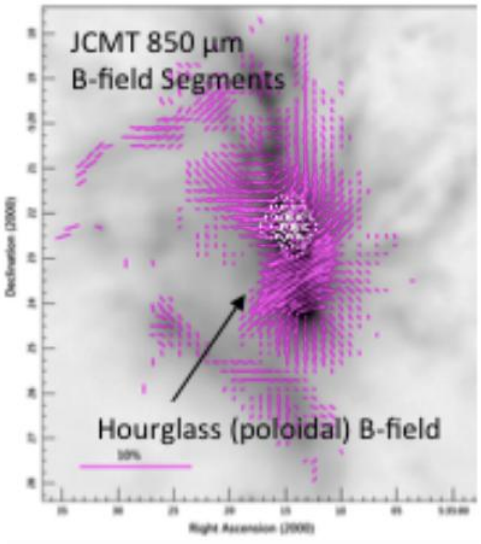
B Fields from 1000 AU to 200 AU scales

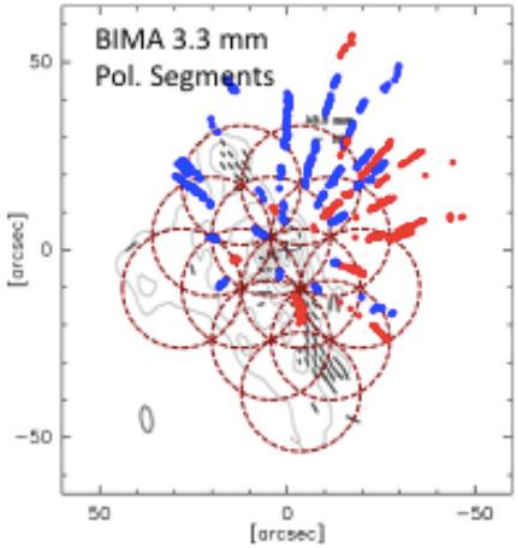
# Combine with Single Dish such as JCMT – W51

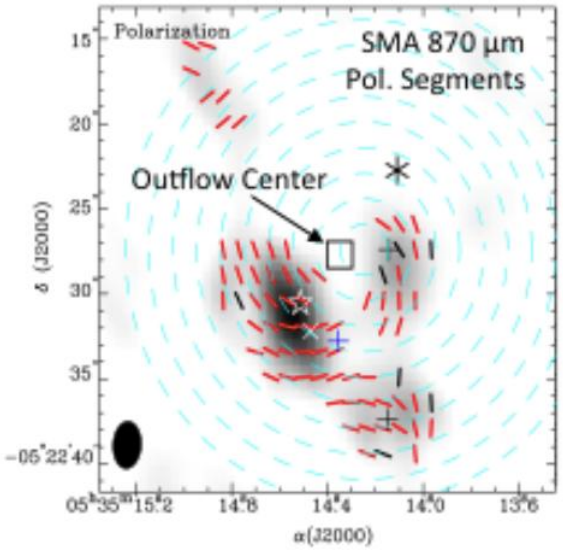



Ching, Yen +

# Orion Mosaic




Ching, Yen +

# Future SMA Polarization Observations

- SMA subcompact and compact configuration beam sizes 3-6” scales --> 100 to 2000 AU scales
- Combine with EAO/JCMT SCUBA2 Pol resolution ~11-15” → 5-1000 AU scales
- ~~What we can’t really do well → Disks with 10s of AU Resolution~~
- Focus on intermediate scale structures – competitive with ACA.