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 correlation

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

ALMA Polarization
SMA Primary Beam Polarization

SMA Off axis
Polarization < 0.5%

Ching+ (in prep)
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 $\Rightarrow$ We can typically get 1-2 mJy/beam RMS at 345 GHz at best
- Hardware issues $\Rightarrow$ Polarization Switching with single receiver system.
- Dual independent receivers $\Rightarrow$ 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

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.