Early ALMA Observations of Circumstellar Disks

North American ALMA Science Center

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Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Large Baseline Array
Overview of ALMA disks so far

• Science Verification: TW Hya
  Suggested by 7 people for science verification, data released in bands 3, 6, 7

• Cycle 0: Fomalhaut
  PI Aaron Boley

• These results already showcase some of ALMA’s extraordinary science potential
  (and they’re not paying me to say that!)

• There is a lot more amazing data from Cycle 0 about to be released…
TW Hya Background

- Closest known gas-rich disk (51 pc)
  Southern hemisphere, observed to death with the SMA

- Bright, isolated, seen nearly face-on

Dust
Gas
(Dust & Gas)
CO transitions
More molecules
Polarimetry
High spectral resolution

(etc.)
TW Hya CO J=3-2

- Data/model comparison – can you tell the difference?
TW Hya DCN

- Fine structure in a deuterated, nitrogen-bearing, triatomic molecule


Thanks to C. Qi
Fomalhaut Background

- Context: mm-wavelength interferometry of debris disks so far…

Maness et al. (2008)

HD 32297
CARMA 1.3mm

Corder et al. (2009)

Wilner et al. (2011)

Hughes et al. (2011)
Fomalhaut Background

• Context: mm-wavelength interferometry of debris disks so far…

• Fomalhaut: one of three directly-imaged planetary systems with a debris disk

Possible circumplanetary disk!

Kalas et al. (2009)
Fomalhaut Observations (PI: Boley)

(Three hours of data) ➔

(Holy cow)

Boley et al. (in prep)

~30 Arcsec
ALMA Cycle 0
Band 7 (870μm) continuum

(Yes, that’s the star: 2.1mJy)

~30 Arcsec
Coming soon from Cycle 0…

• Young disks (Orion proplyds, brown dwarfs, binaries, chemistry, winds, gas/dust structure, dynamics)
  PIs: Mann, Akeson, Ricci, Qi, Lin, Carpenter, Salyk, Chapillon, Walsh

• Old disks (debris, birth rings, Herschel cold disks)
  PIs: Rodriguez, Jordan, Carpenter, Boley, Wilner, Woitke

• In-between disks (gas-poor/dust-rich, gas-rich/dust-poor, gas in cavities, dust in cavities, unusually small/large disks)
  PIs: Dutrey, Andrews, Chapillon, Casassus, van Dishoek, Perez, Schreiber, Kospal

• Planet-disk interaction
  PIs: Jordan, Huelamo, Boley