

SMA/ALMA Synergies



David Wilner

landscape of mm/submm interferometers

SMA



8x6m

CARMA



6x10m+9x6m
+8x3.5m

IRAM PdBI



6(→12)x15m

ALMA



54x12m+12x7m

25x SMA sensitivity and resolution

the ALMA Era is well underway

- early science observations started in September 2011
- overwhelming worldwide community interest
 - Cycle 0: 919 submitted proposals
 - Cycle 1: 1133 submitted proposals
 - Cycle 2: 1381 submitted proposals (most ever for any observatory)
- time allocation NA:EU:EA:CL = 34:34:22:10
- more than 100 projects archived and publicly available
- enhancement of capabilities to continue indefinitely



Doc 2.2, ver. 1.8 – October 2013

ALMA Cycle 2 Proposer's Guide

ALMA Science Archive Query

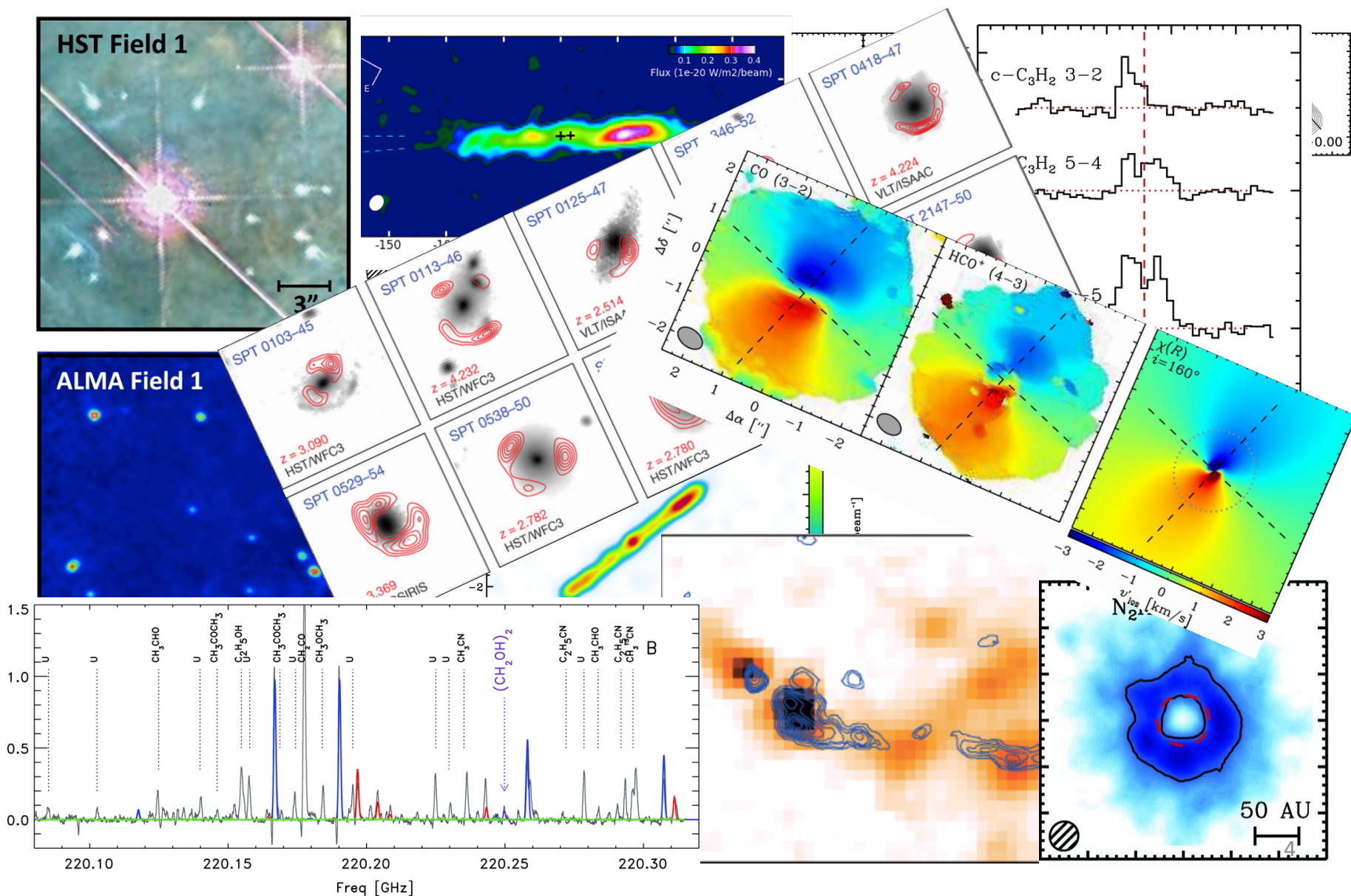
Query Form Results Table

ALMA Observing Tool (OT)
(32)

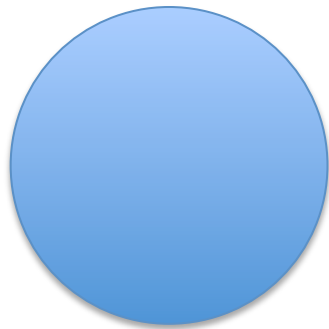
What do I do if I can't get the OT to work?



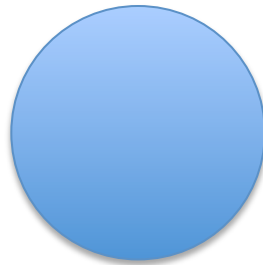
26/116 refereed ALMA papers from CfA authors



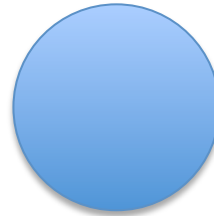
facilities of different scales coexist and thrive



Keck



Gemini



MMT/
Magellen

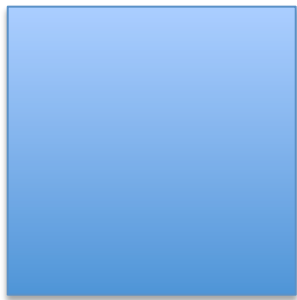


CFHT



FLWO

*Optical
Near-IR*



NSC Guangzhao



DOE Oakridge



Harvard



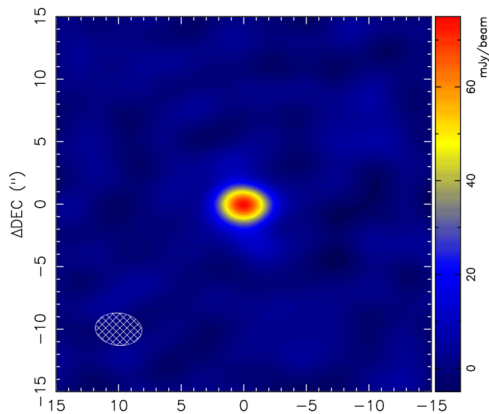
SAO

*High Performance
Computing*

SMA is Highly Productive and in Demand

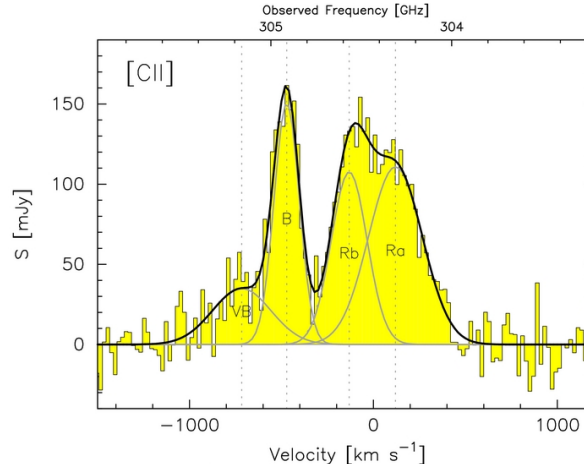
- high resolution imaging and spectroscopy at mm/submm wavelengths is required to address a broad range of key questions in astronomy (e.g. Astro2010 Science Frontier Panels)
- scientific insight not always limited by sensitivity/resolution
- > 80 refereed papers per year
- > 100 proposals per semester

NEA 205 YU₅₅ at 0.85 lunar distances



Muller et al. 2013

HLSJ091828.6+514223 at $z = 5.24$



Rawle et al. 2014

**THE SUBMILLIMETER ARRAY:
FIRST DECADE OF DISCOVERY**
Cambridge, MA, USA June 9 & 10, 2014
Marriott Courtyard Boston-Cambridge
<http://www.cfa.harvard.edu/sma/events/smaConf/>

Celebrating 10 years of research with the SMA and looking forward to the future, this conference focuses on submillimeter-wavelength science at high angular resolution. Topics to be covered include star formation, protoplanetary disks, nearby and distant galaxies, magnetic fields in the interstellar medium, high-energy and time-variable phenomena, our galactic center, the solar system, and submillimeter instrumentation.

CONFIRMED INVITED SPEAKERS

<p>Sean Andrews (CIA) Sheperd Dooleman (CA/MIT-Haystack) Izaskun Jimenez-Serra (ESO) Tomaz Karimski (MPIPR) Daniel Marrone (University of Arizona) Anastelle Maury (IRFU) Karl Menten (MPIPR) Arielle Moutlet (NRAO) Karin Oberg (CIA) Kamuhiko Sakamoto (ASIAA) Wei-Hao Wang (ASIAA) Ann Wehrle (SSI)</p>	
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LOC
Carolan Barrett
Arjun Dey
Shebi Hensler
Jenine Humber
Patricia Mailhot
James Moran (chair)
Margaret Simoncini

SOC
Raymond Blundell
Pierre Cox
Arjun Dey
Mark Garwell
Paul Ho
Eric Keto
Karl Menten
James Moran (chair)
Ewine van Dishoeck
Jonathan Williams
David Wilner
Qizhou Zhang

MEETING SPONSORS

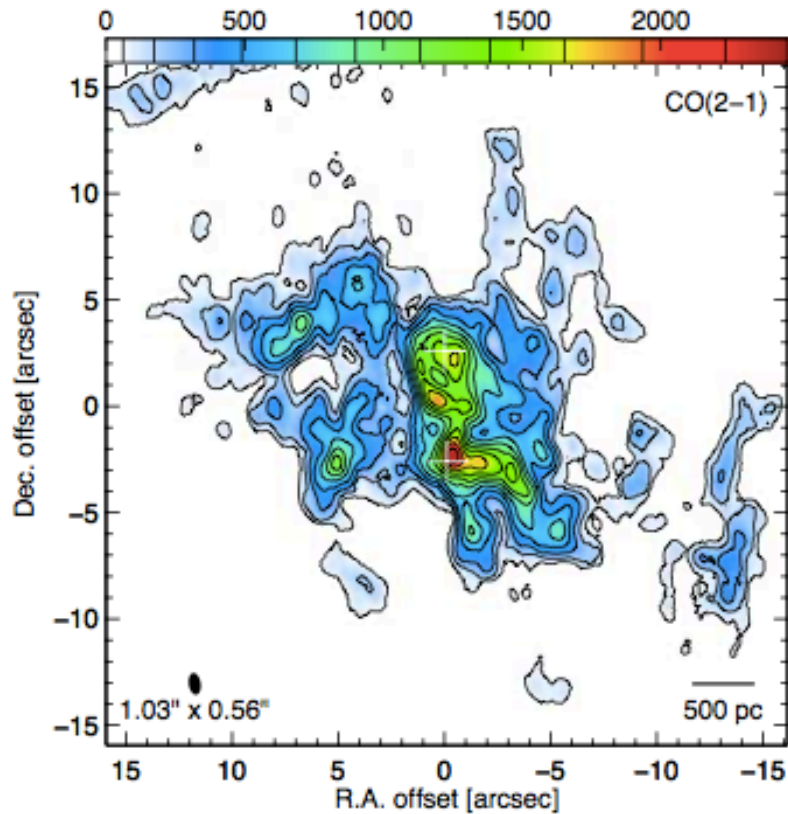
Smithsonian Astrophysical Observatory Academia Sinica Institute of Astronomy and Astrophysics	
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Direct inquiries to: sma10@cfa.harvard.edu

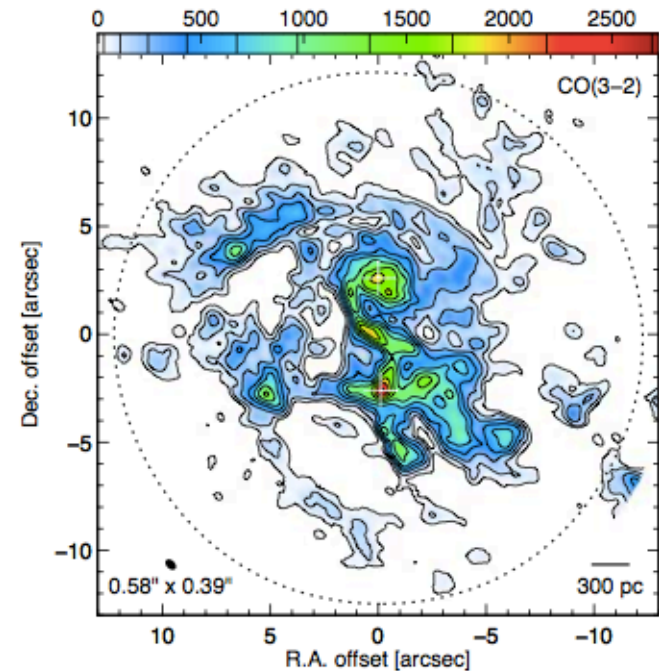
SMA Science in the ALMA Era

1. studies of “bright” targets
 - flexibility, spectral coverage, rapid response
 - expect continued discoveries and breakthroughs
2. focused large scale programs (Keto)
 - build samples to probe correlations, evolution, etc.
3. preparatory investigations for ALMA
 - select targets, refine methods, optimize return
4. access to northern sky
 - known (and unknown) important sources
5. key element of Event Horizon Telescope (Doeleman)
 - correlating directly with ALMA

NGC 3256 Infrared-Luminous Merger (dec -44)



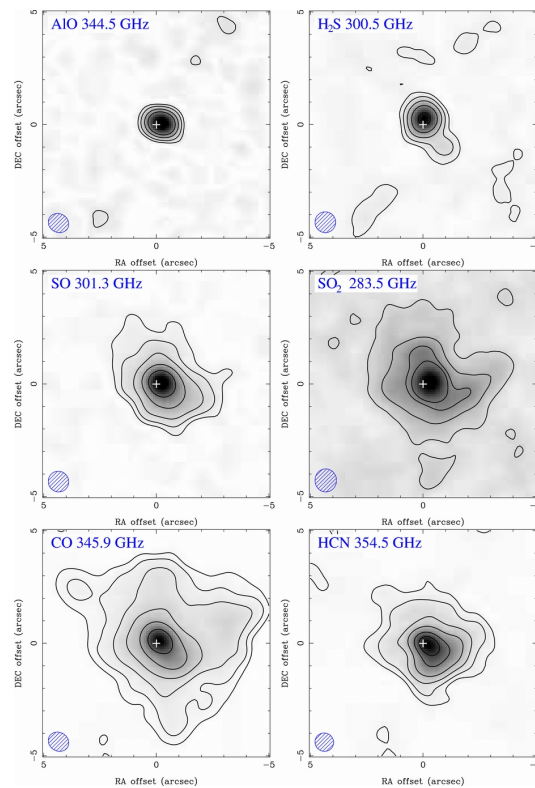
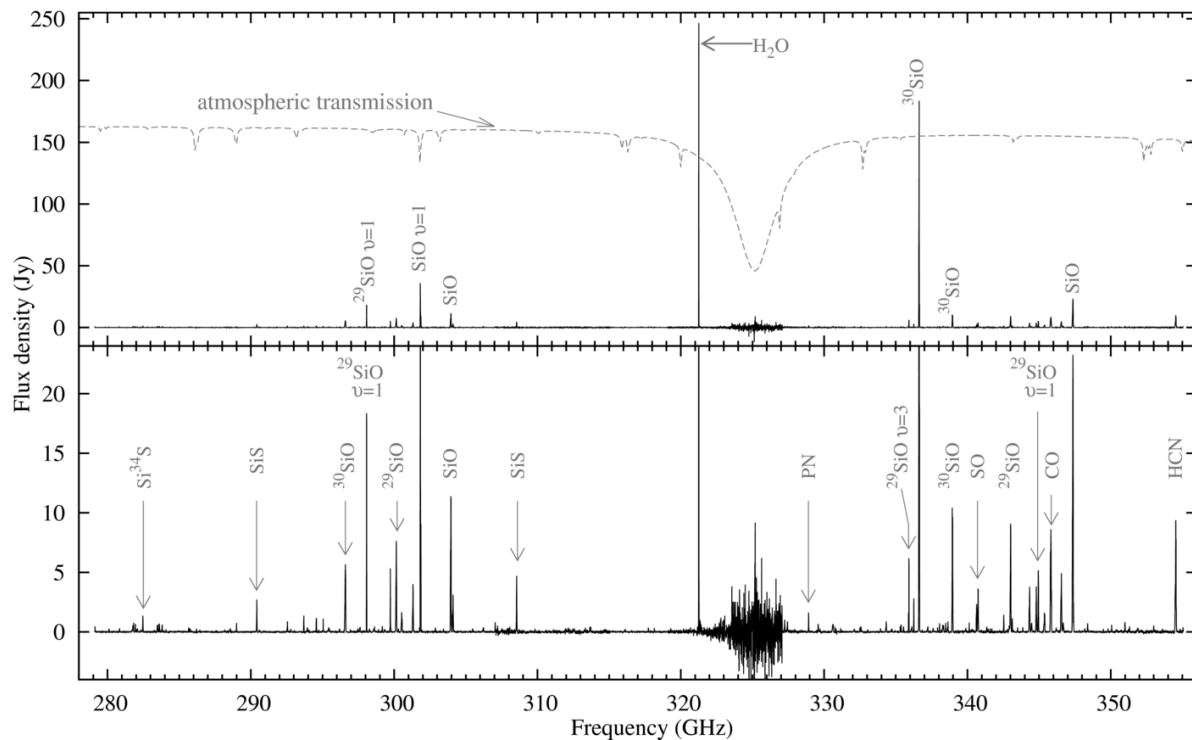
SMA CO 2-1
3 configurations (6-8 ants)
13h on-source



ALMA CO 3-2
2 configurations (20+ ants)
1.5h on source

Sakamoto et al. 2014

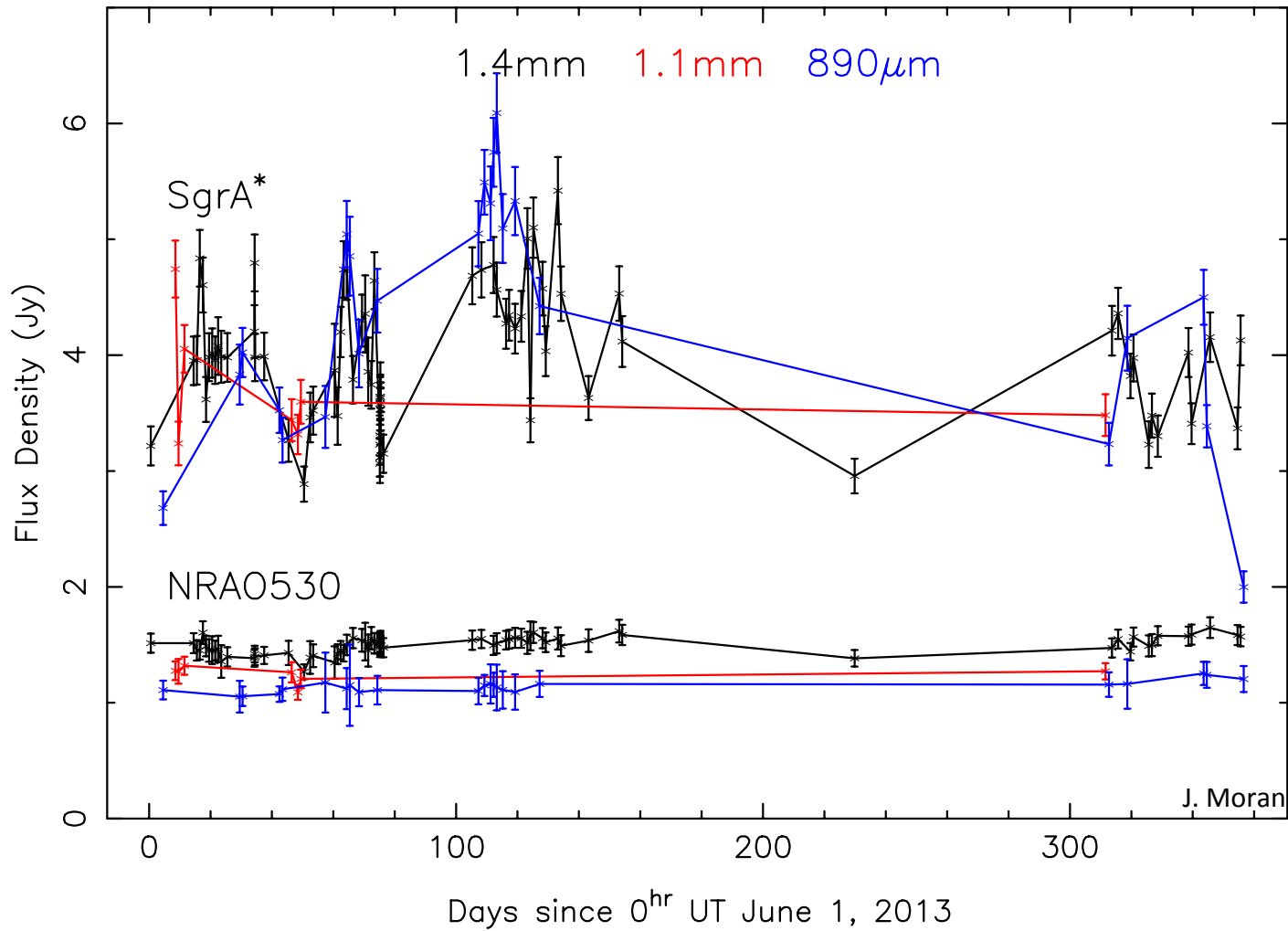
SMA Spectral Line and Imaging Survey of VY CMa



223 features from 19 molecules (including first detection of TiO₂) imaged at <1 arcsec resolution

Kaminski et al. 2014

SMA SgrA*-G2 Flux Density Monitoring



>100 dedicated observations in the past year

J. Moran

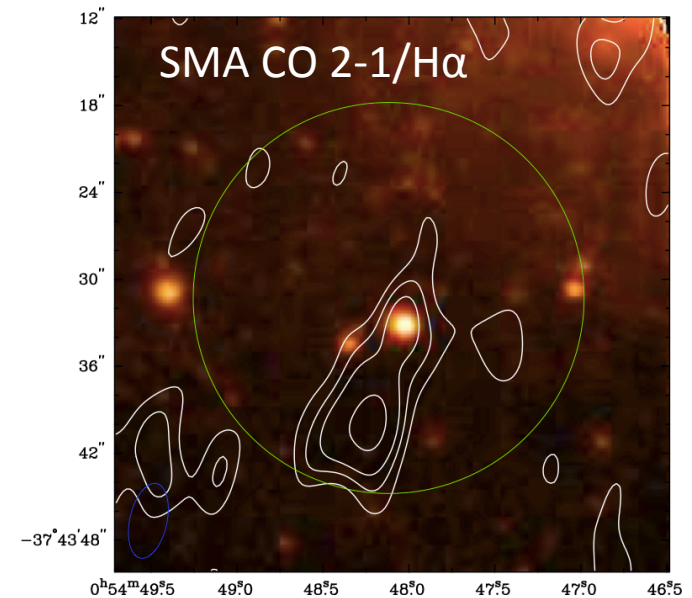
Preparatory Investigations for ALMA: Cycle 2 High Priority Programs

- 53/353 worldwide have CfA authors
- SMA data have played a pivotal role in Cycle 2 proposal development for CfA personnel
 - all 9 programs with a CfA PI
 - at least 23/44 programs with a CfA co-I
- similarly influential for programs with Taiwan PI's



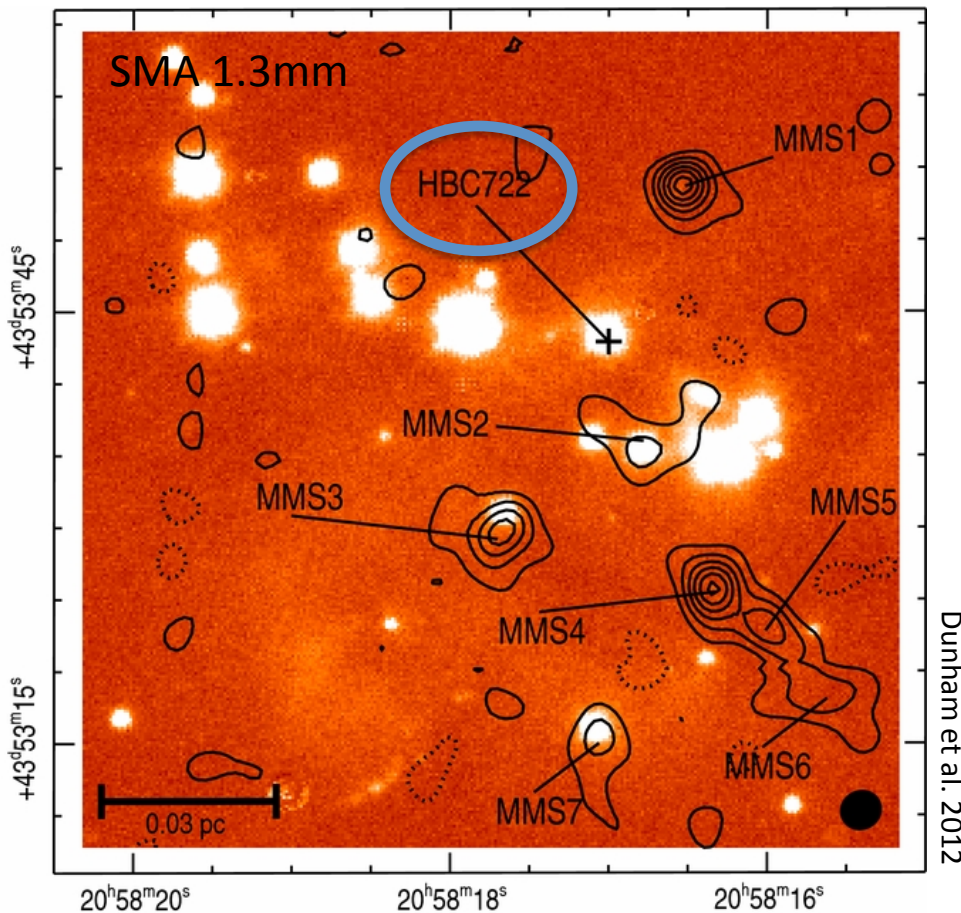
- Lada (2013.1.00088.S)

“Testing Schmidt’s Conjecture in NGC 300: Bridging the Gap between Galactic and Extragalactic Star Formation”



survey 48 CO clouds
to build up statistics

- Dunham (2013.1.00586.S)
 “The Mass Accretion Reservoir Surrounding a Variably
 Accreting Young Star”



FU Ori object
 HBC 722
 $M_{\text{disk}} < 0.02 M_{\odot}$

disk mass and
 burst
 mechanism?

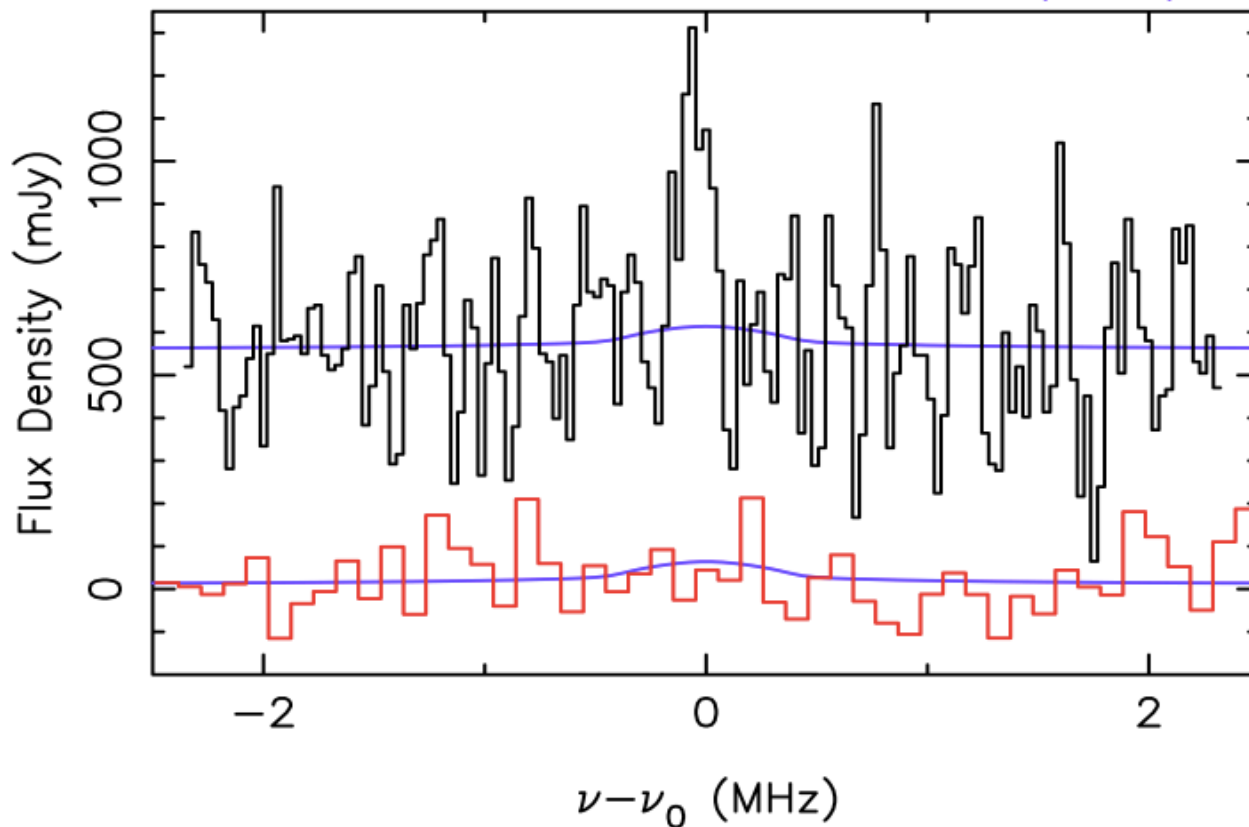
- Gurwell (2013.1.00446.S)

“Characterizing the Atmosphere and Surface of Pluto”

Greaves et al (2011)

2013 SMA Data (101.5 kHz resolution)

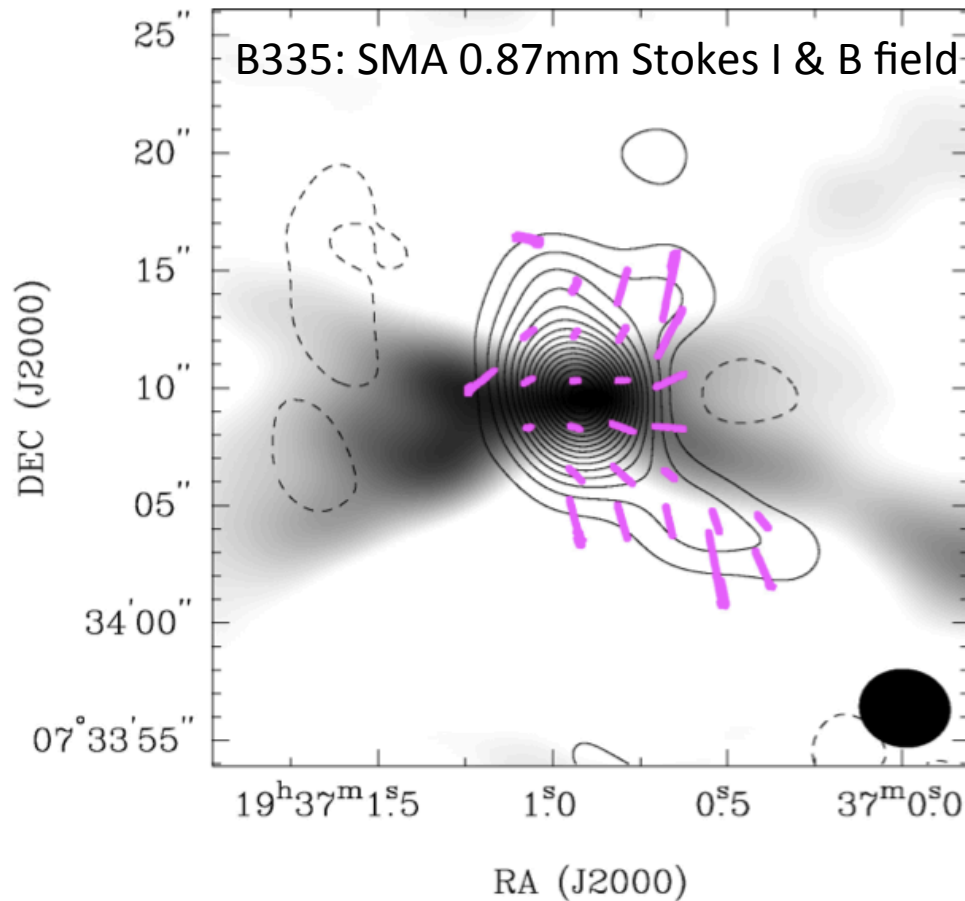
Model CO Based on Lellouch et al (2011)



CO 2-1 emission
expected based on
infrared ice obs.

- Maury (2013.1.01380.S)

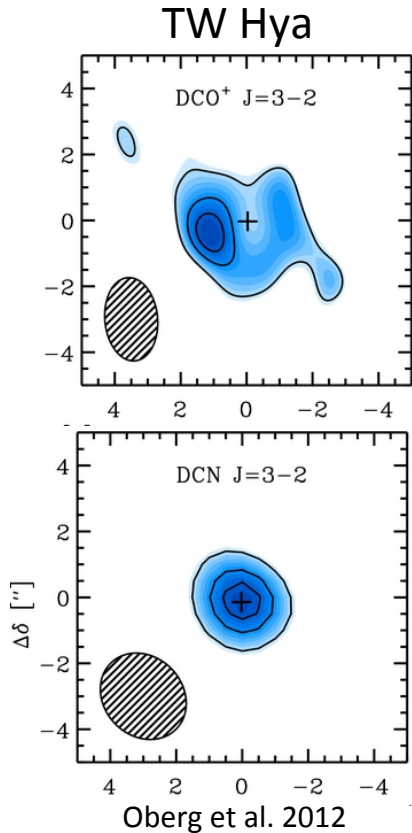
“Testing Magnetic Breaking in the Class 0 B335”



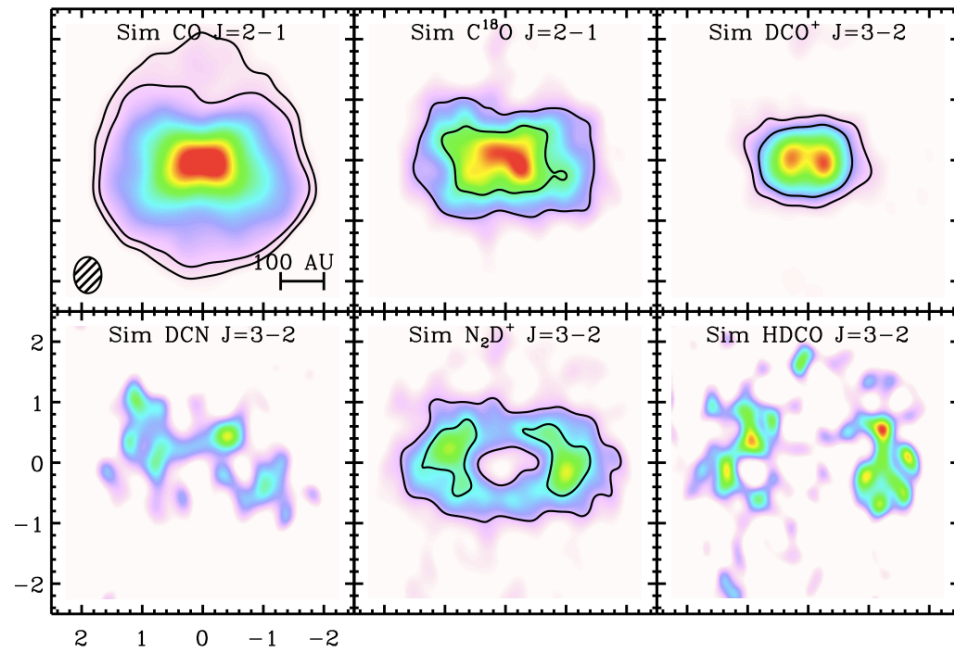
angular momentum
dissipation for young
protostars?

- Oberg (2013.1.00226.S)

“A Survey of Deuterium Chemistry in Protoplanetary Disks



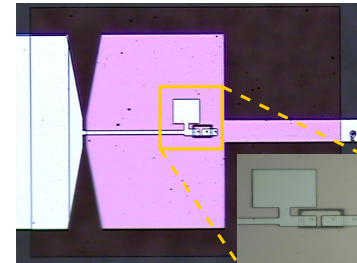
chemical network + radiative transfer simulations



DCO⁺ and DCN distributions in 6 sources selected from SMA disk chemistry survey

Testbed for Technologies and Techniques

- CfA mm/submm leadership, experience, expertise
- modest scale allows SMA to drive/adapt to innovation
 - 2x2x4→8 (→??) GHz bandwidth with high spectral resolution
- wideband, high frequency receivers (Tong)
 - e.g. series connected distributed SIS mixers
- SWARM correlator (Weintroub)
 - based on CASPER ROACH-2 FPGA boards
- CASA flux calibration for ALMA
 - SMA informs models for Titan (Gurwell), Galilean moons, Ceres, Uranus/ESA 4; ALMA Memo #594 “Butler-JPL-Horizons 2012”
- NSF ALMA development funds opportunity
 - ALMA Phasing Project (Doeleman)
 - Next Generation Image Viewer (Goodman)

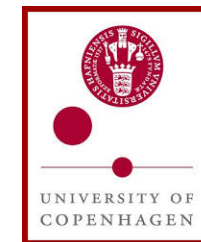


Expert Education and Training

- hands-on, all aspects, in the CfA environment
- former postdocs and students →



Max-Planck-Institut
für Radioastronomie



not complete!

SMA/ALMA Synergies

- SMA science in the ALMA era
 - studies of “bright” objects
 - focused large scale programs
 - preparatory investigations for ALMA
 - access to northern sky
 - Event Horizon Telescope (with ALMA)
- testbed for hardware/software development
 - modest scale allows SMA to drive/adapt to innovation
- expert education and training
 - mm/submm astronomy and technology, interferometry

END