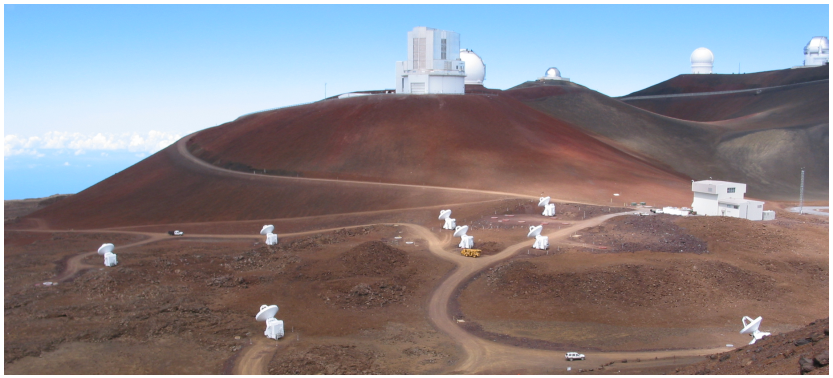
SMA/ALMA Synergies



David Wilner

landscape of mm/submm interferometers

SMA

8x6m

CARMA

6x10m+9x6m
+8x3.5m

IRAM PdBI

6(→12)x15m

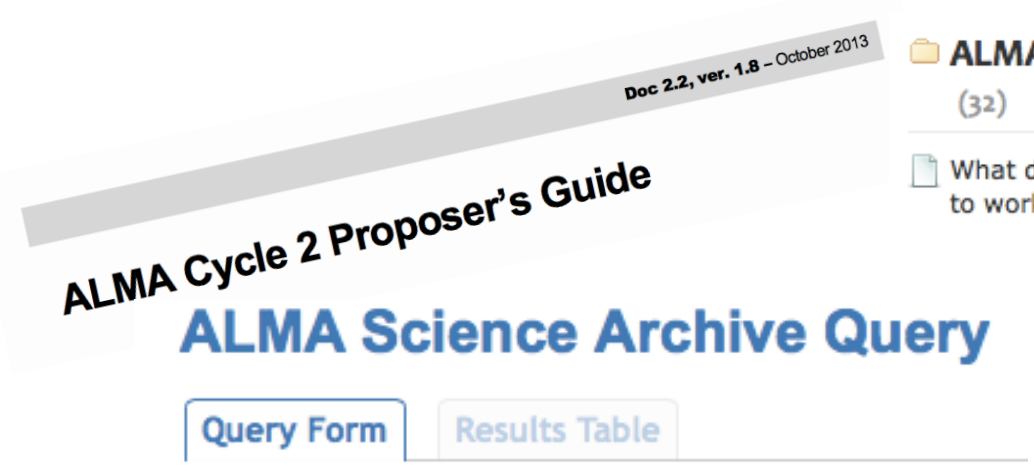
ALMA

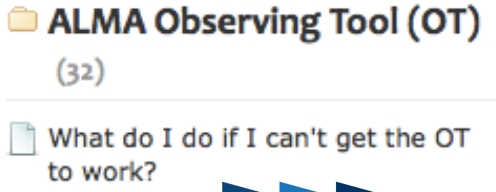
54x12m+12x7m

25x SMA sensitivity and resolution

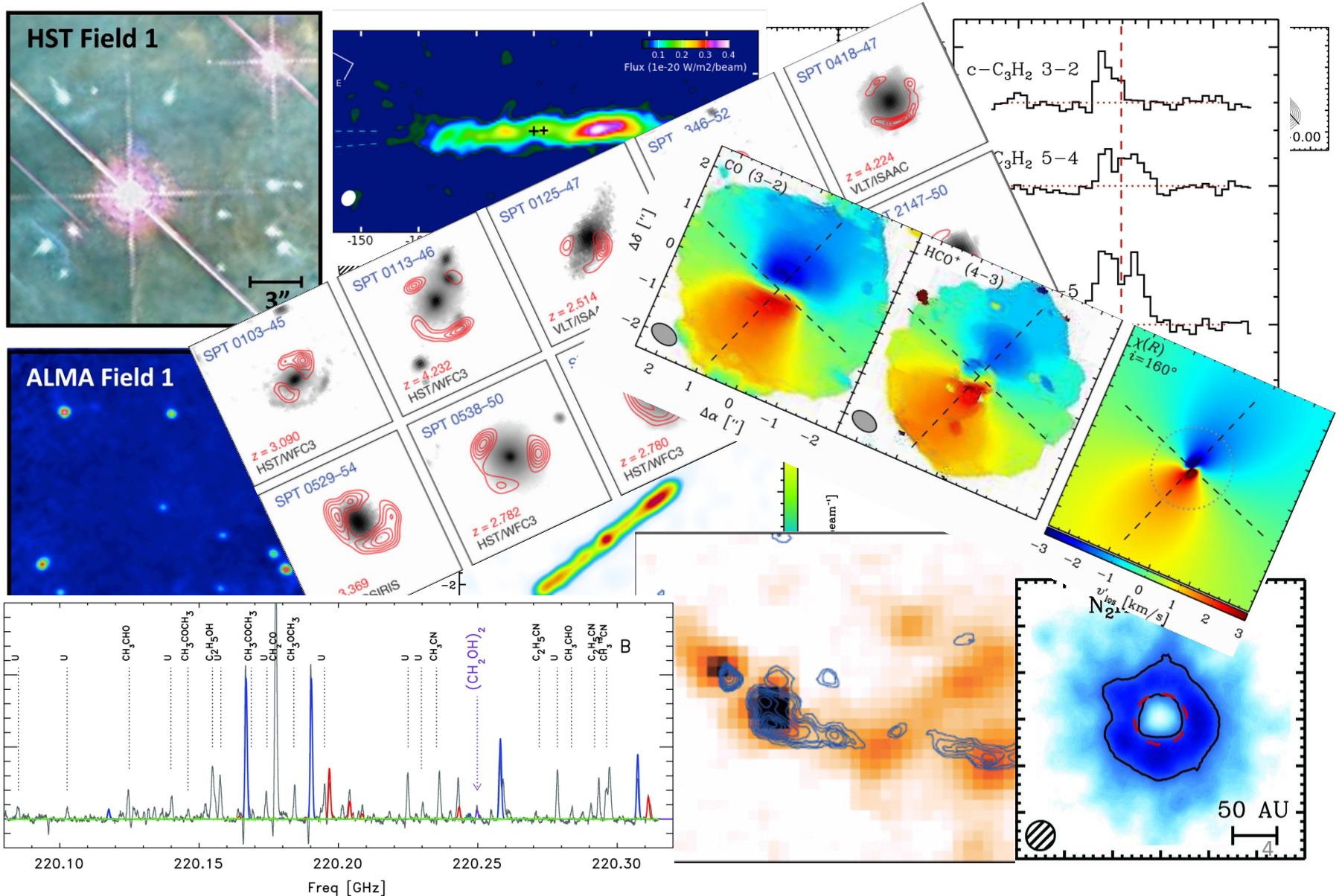
the ALMA Era is well underway

- 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

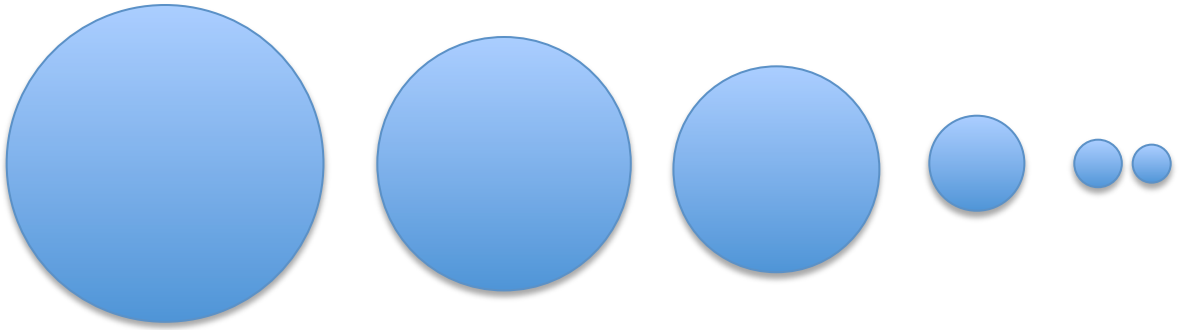




26/116 refereed ALMA papers from CfA authors



facilities of different scales coexist and thrive



Keck Gemini MMT/ Magellen CFHT FLWO

Optical
Near-IR

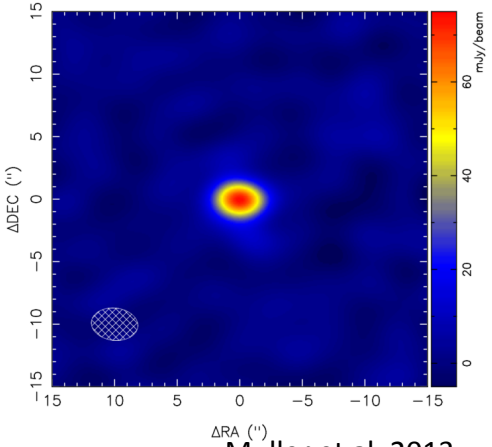
NSC Guangzhao DOE Oakridge Harvard SAO

High Performance Computing

SMA is Highly Productive and in Demand

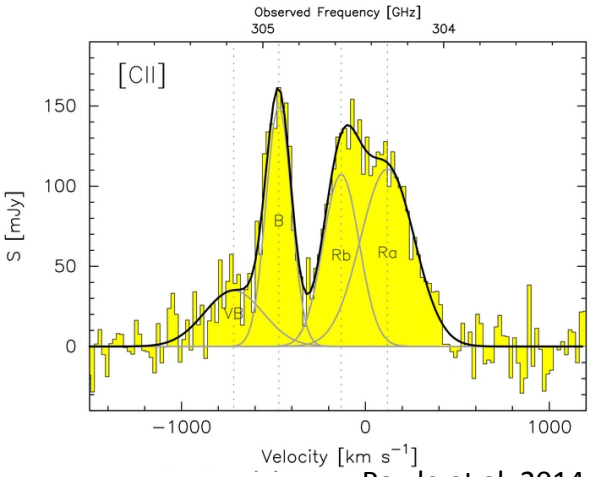
- high resolution imaging and spectroscopy at mm/submm wavelengths is required to address a broad range of key questions in astronomy (e.g. Astro2010 Science Frontier Panels)
- scientific insight not always limited by sensitivity/resolution
- > 80 refereed papers per year
- > 100 proposals per semester

NEA 205 YU_{55} at 0.85 lunar distances



Muller et al. 2013

HLSJ091828.6+514223 at *z = 5.24*

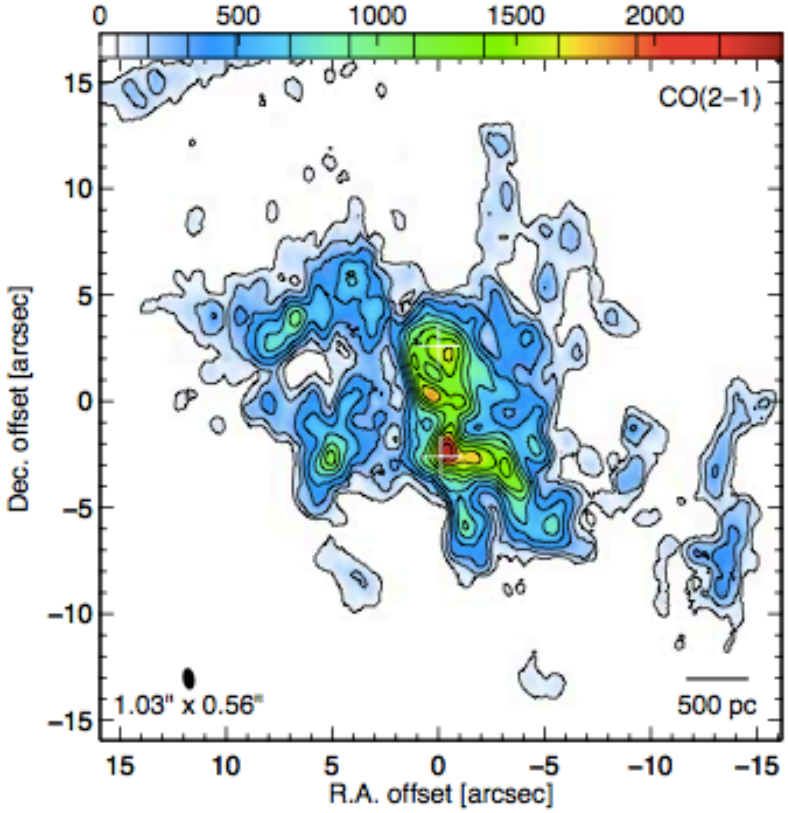


Rawle et al. 2014

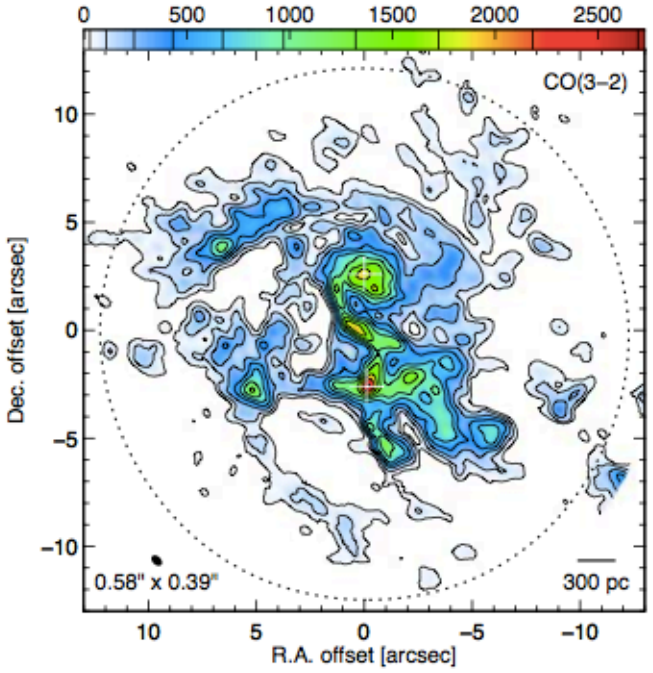
SMA Science in the ALMA Era

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)



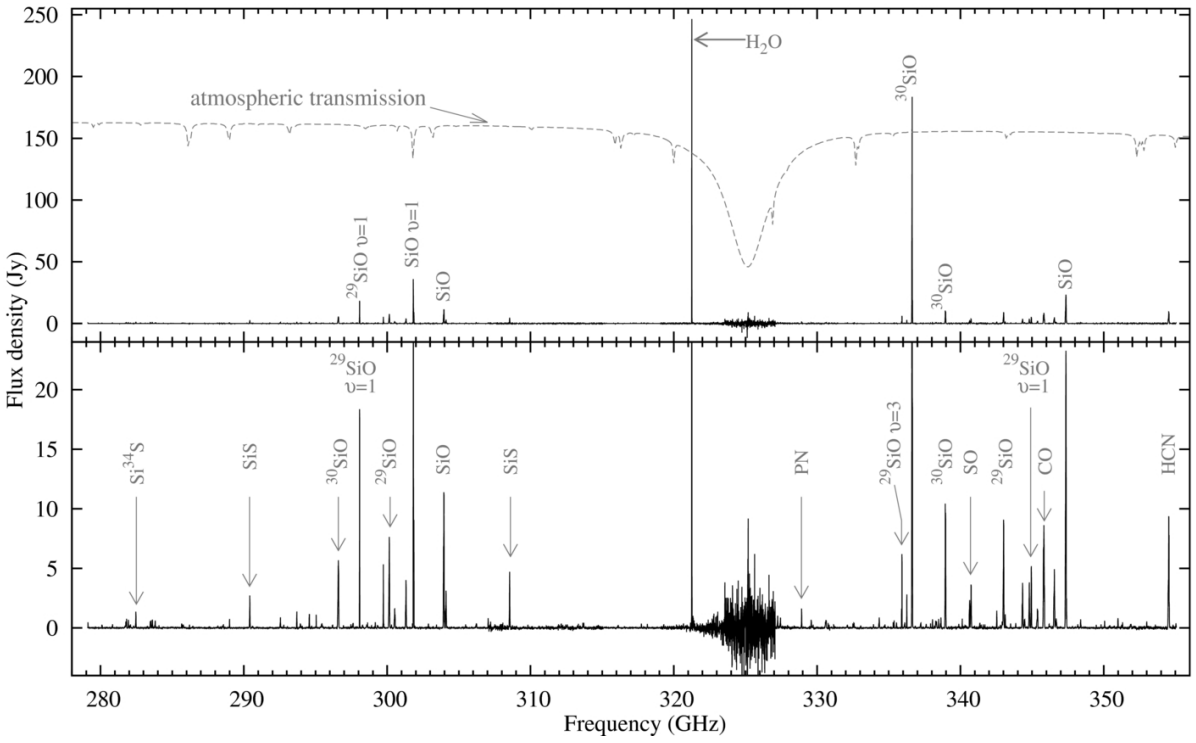
SMA CO 2-1
3 configurations (6-8 ants)
13h on-source

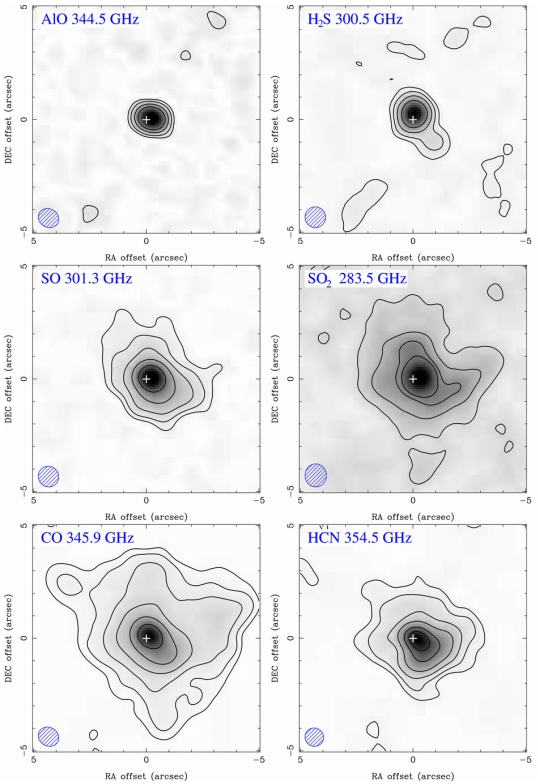


Sakamoto et al. 2014

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

SMA Spectral Line and Imaging Survey of VY CMa

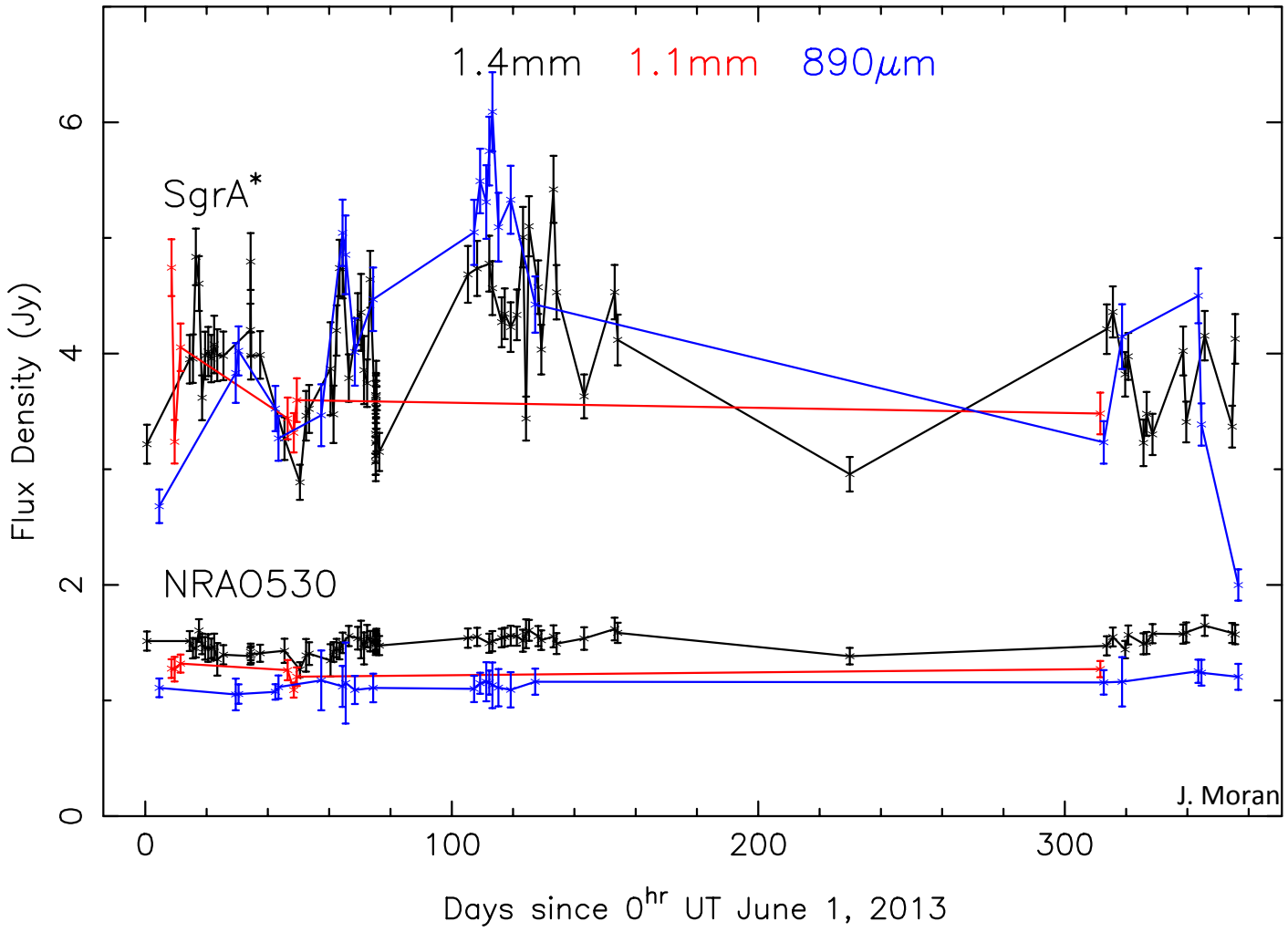




223 features from 19 molecules (including first detection of TiO_2) imaged at <1 arcsec resolution

Kaminski et al. 2014

SMA SgrA-G2 Flux Density Monitoring*



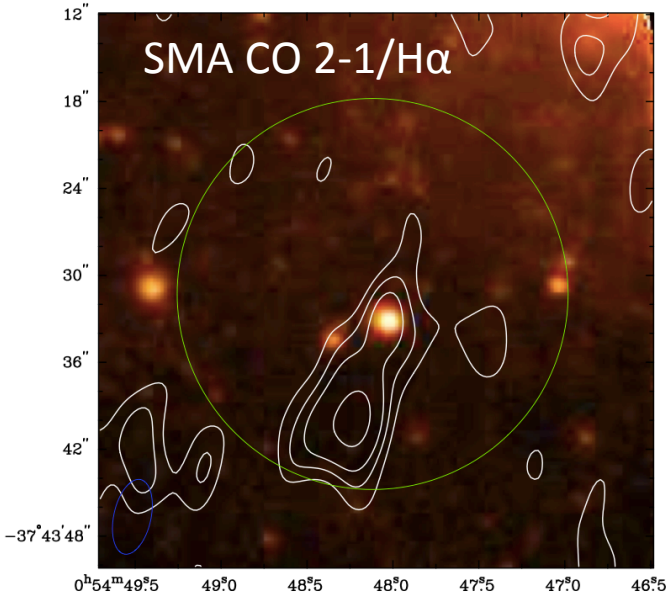
>100 dedicated observations in the past year

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)

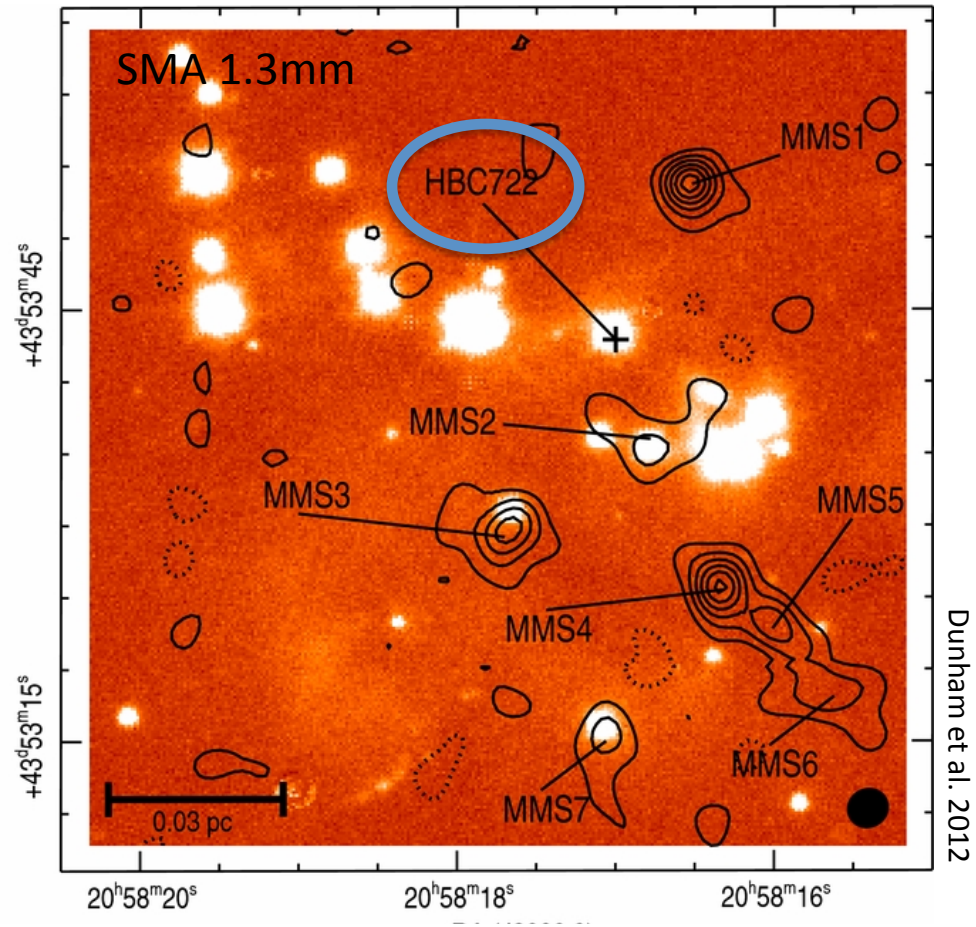
  “Testing Schmidt’s Conjecture in NGC 300: Bridging the Gap between Galactic and Extragalactic Star Formation”



survey 48 CO clouds to build up statistics

- Dunham (2013.1.00586.S)

  "The Mass Accretion Reservoir Surrounding a Variably Accreting Young Star"



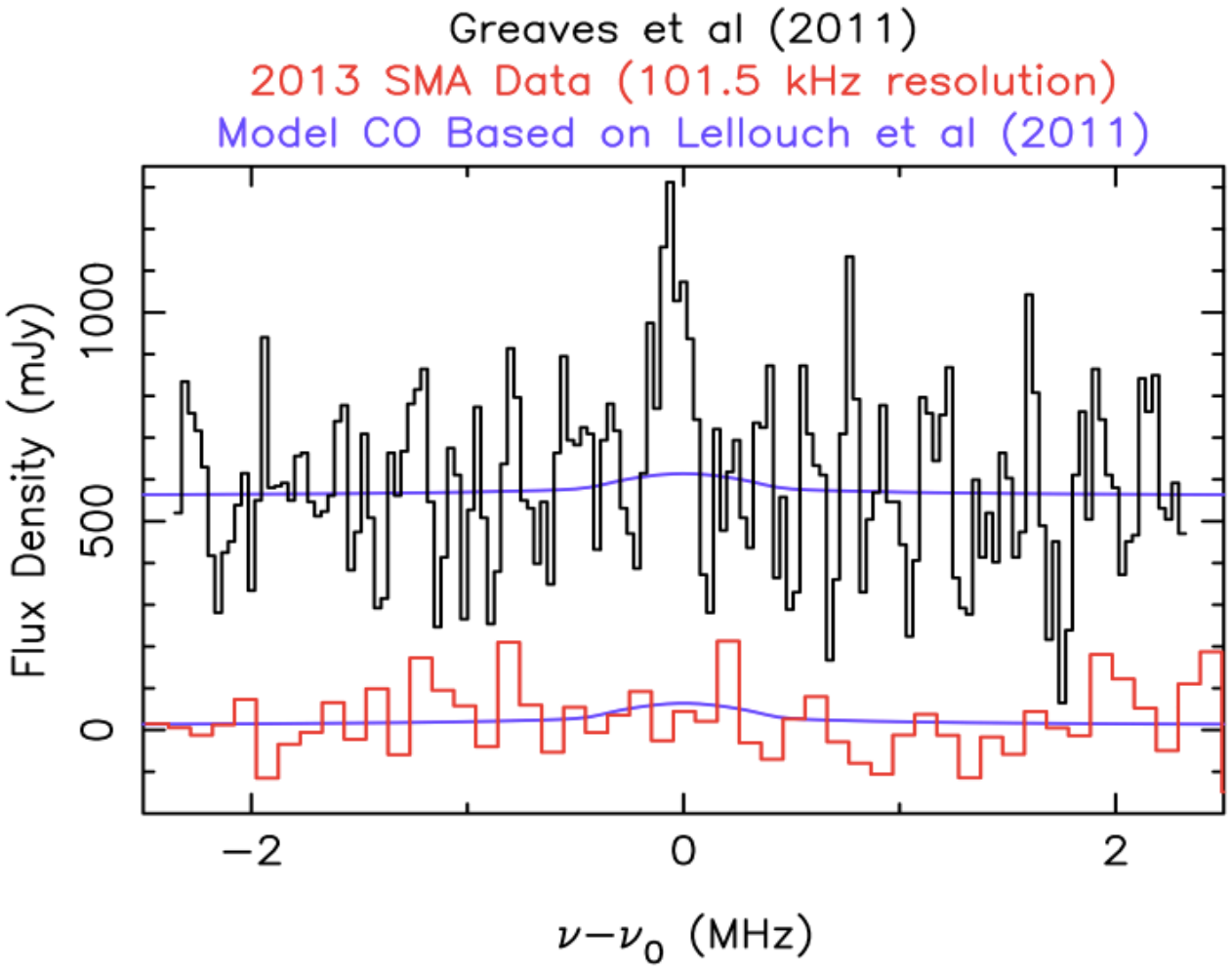
Dunham et al. 2012

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

disk mass and burst mechanism?

- Gurwell (2013.1.00446.S)

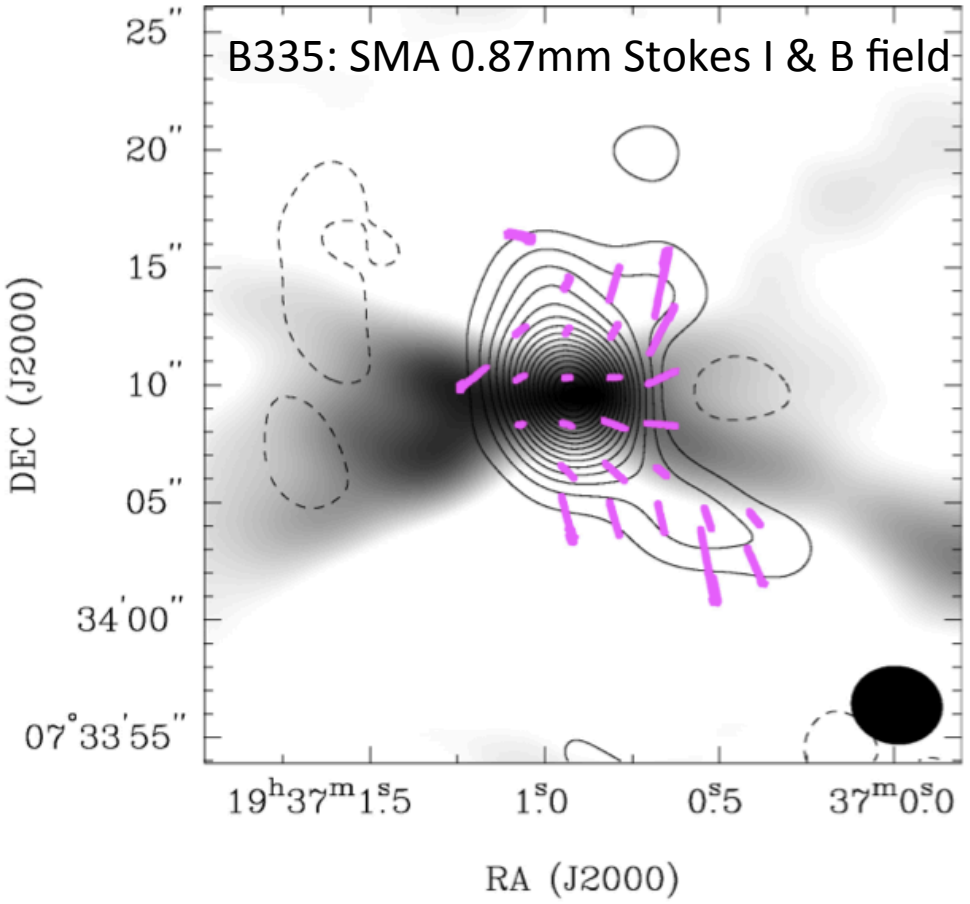
  “Characterizing the Atmosphere and Surface of Pluto’’



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

- Maury (2013.1.01380.S)

  “Testing Magnetic Breaking in the Class 0 B335’’

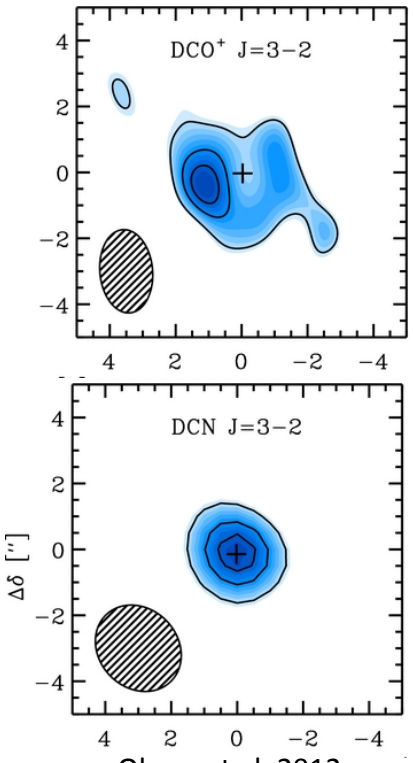


angular momentum dissipation for young protostars?

- Oberg (2013.1.00226.S)

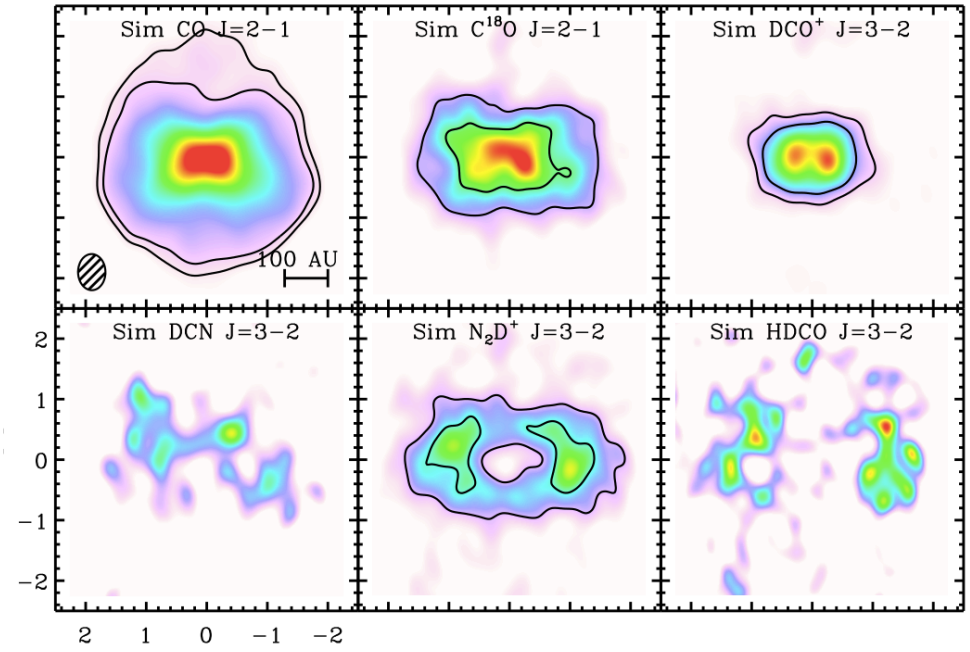
  “A Survey of Deuterium Chemistry in Protoplanetary Disks

TW Hya



Oberg et al. 2012

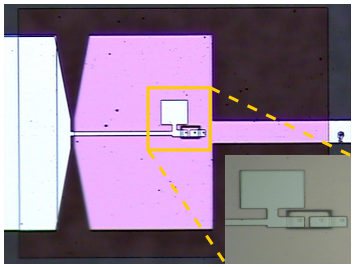
chemical network + radiative transfer simulations



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 →

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