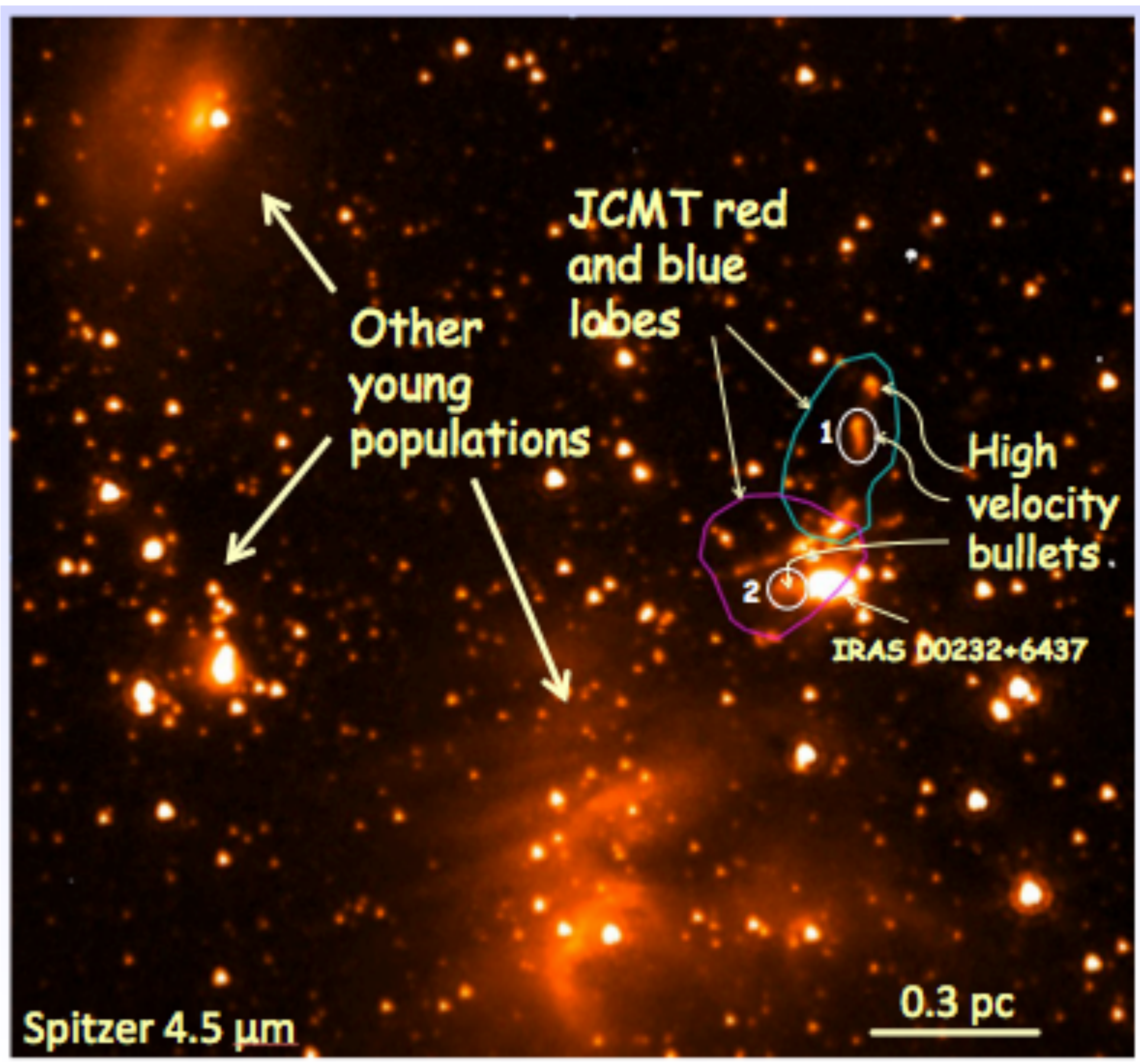
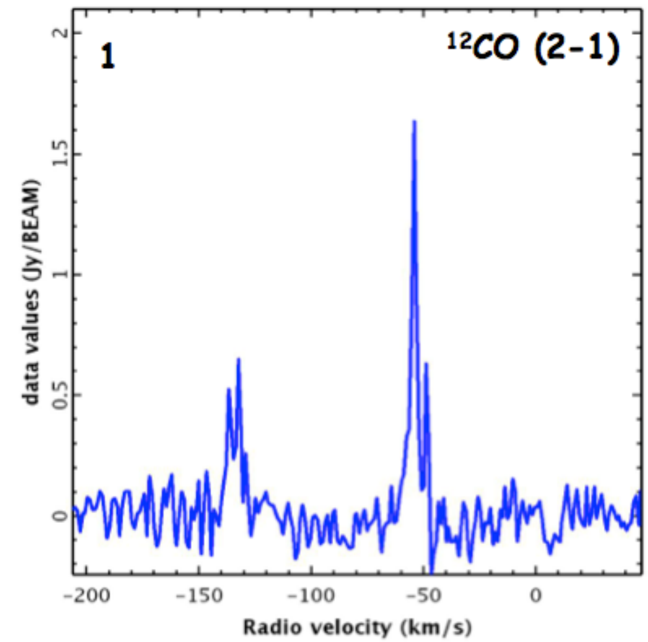
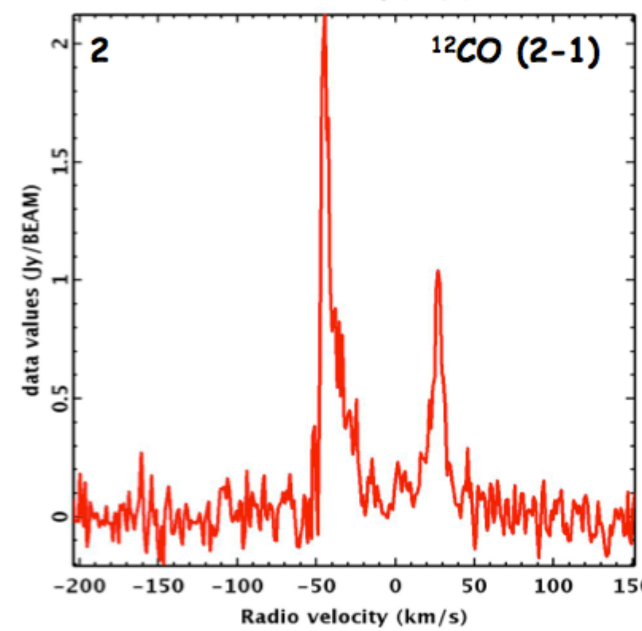
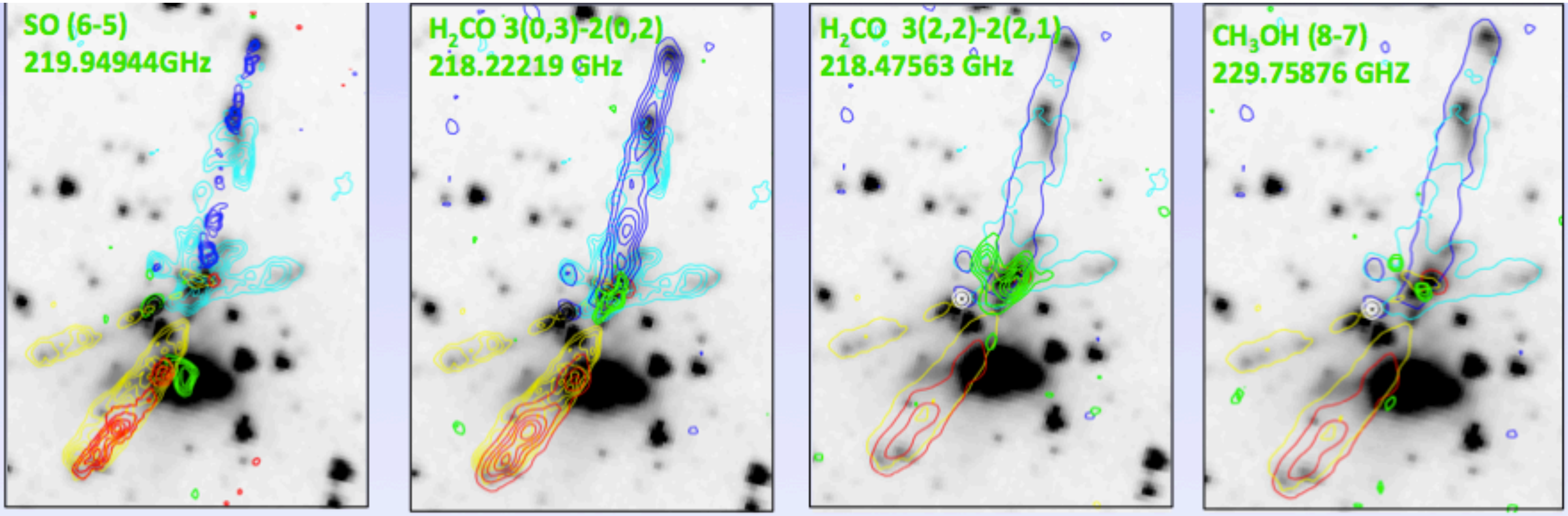
G120.248+2.165, Extremely High Velocity Outflow in Small Star Forming Association

Mohaddesseh Azimlu[1], Qizhou Zhang[1], Michel Fich, Carolyn McCoey

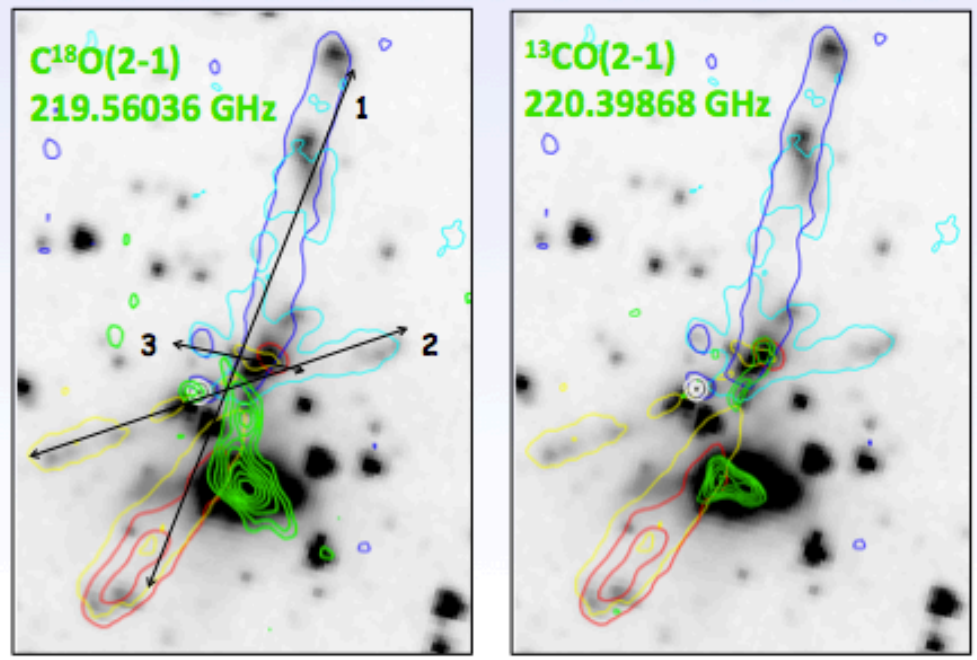








CO High Velocity Integrated -160 to -100 km s^{-1}
CO High Velocity Integrated +5 to +35 km s^{-1}
CO Low Velocity Integrated -70 to -55 km s^{-1}
CO Low Velocity Integrated -45 to -10 km s^{-1}
1.3 mm continuum

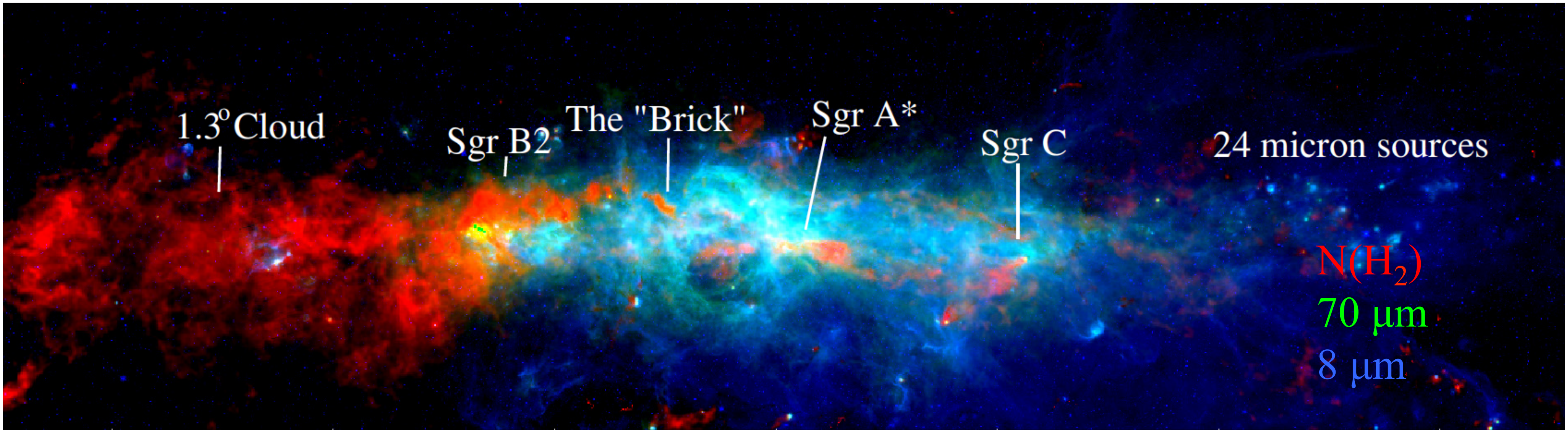


We suggest three separated outflows in this region:

#1: Extremely high velocity non-collimated

#2: Mid-velocity collimated

#3: High velocity along line of sight



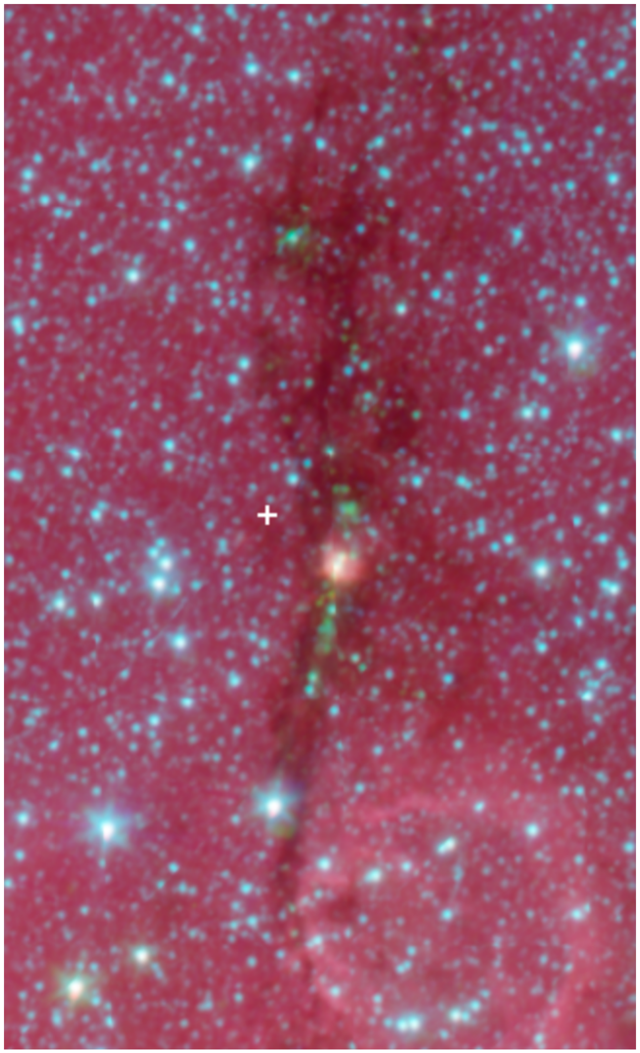
- The “wild west” of star formation: star and cluster formation in an extreme environment
- Where does gas enter CMZ?
- Tidal compression of gas by supermassive black hole?

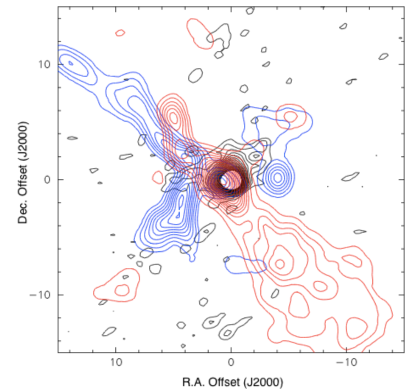
SMA Legacy Survey of the Central Molecular Zone

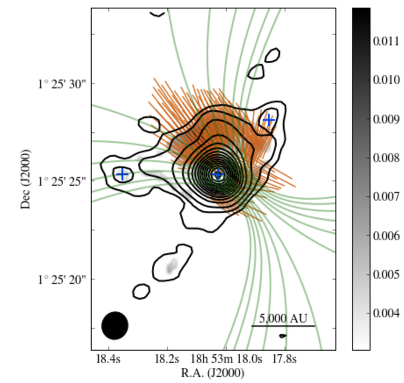
- 240 $arcmin^2$ (above $N(H_2) = 10^{23}\ cm^{-2}$ or $3x10^{22}\ cm^{-2}$)
- 60 tracks, compact + subcompact, 4” (0.2 pc) resolution
- 230 GHz, dust continuum + spectral lines

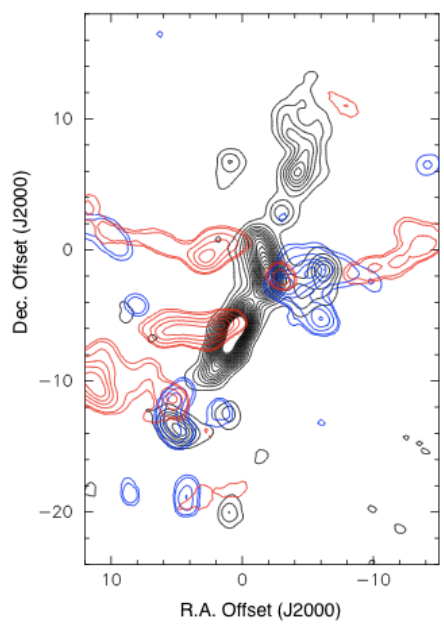
How-Huan Hope
Chen
Qizhou
Zhang

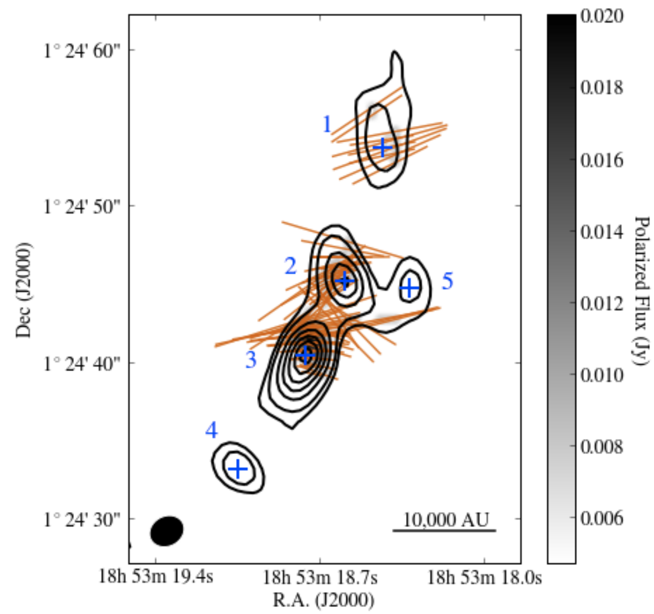
SMA POLARIZATION LEGACY PROGRAM: ANALYSIS OF G34.4+0.23 MM AND UCHII REGIONS





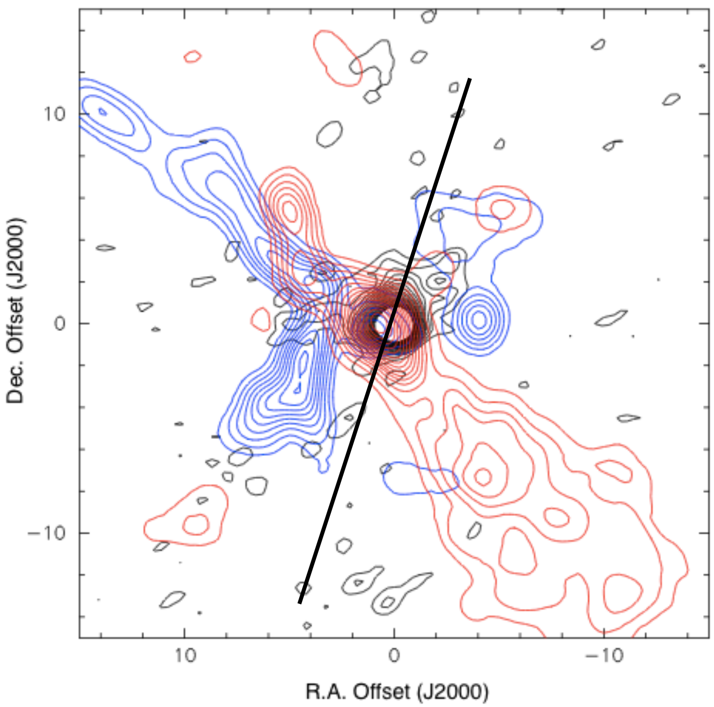


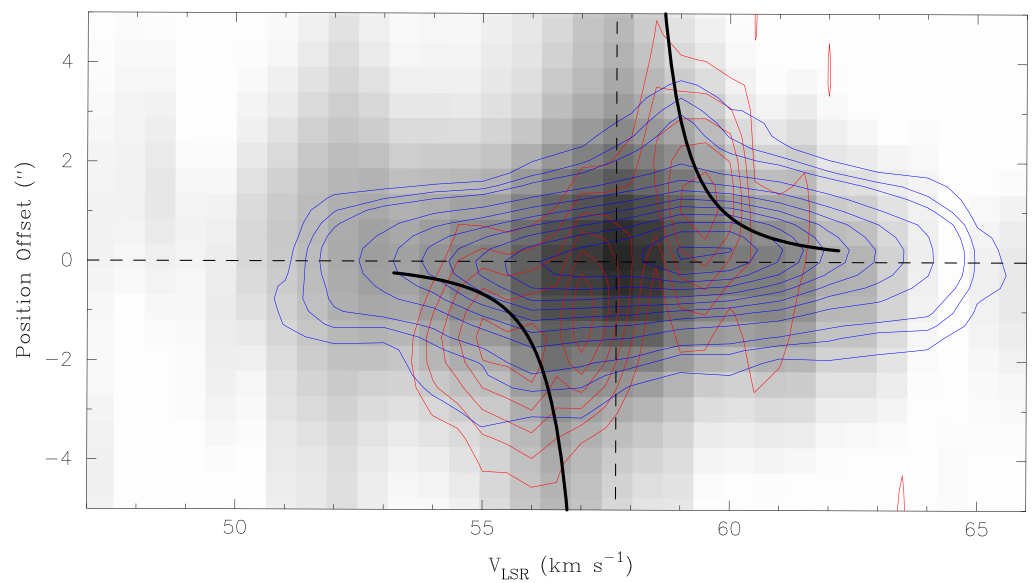




How-Huan Hope **Chen**
Qizhou **Zhang**

SMA POLARIZATION LEGACY PROGRAM: ANALYSIS OF G34.4+0.23 MM AND UCHII REGIONS

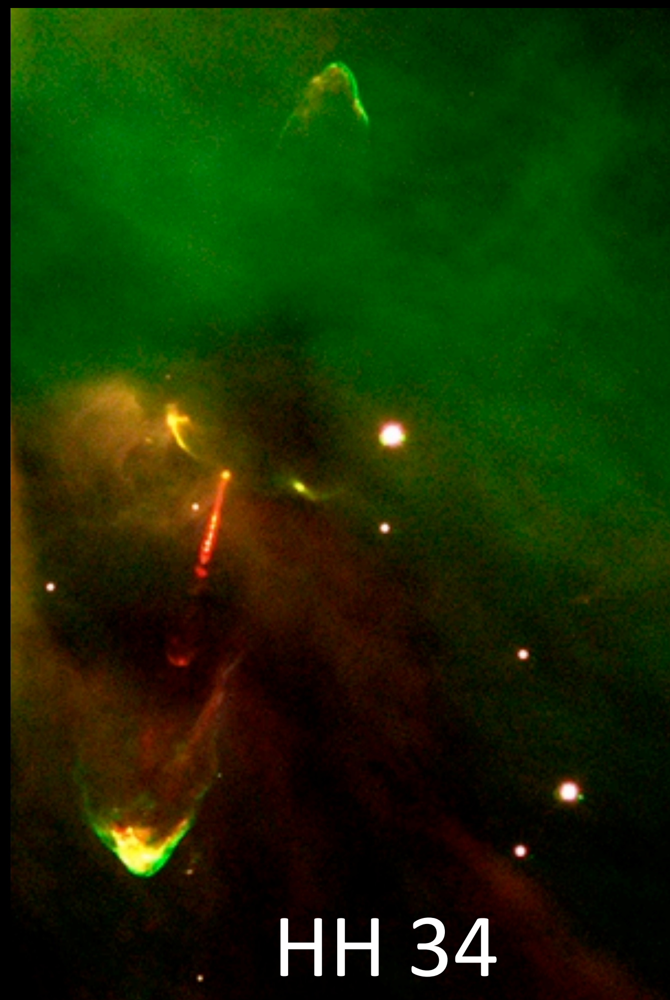




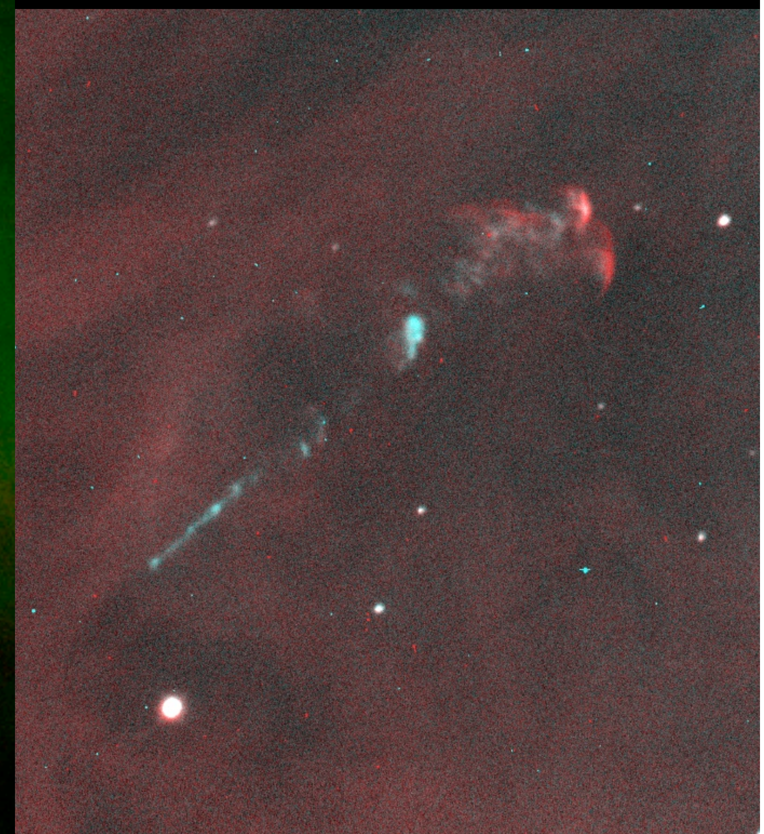
SMA Observations of the Driving Sources of Herbig-Haro Objects

Hsin-Fang Chiang (IfA, Univ of Hawaii)

HH 1-2



HH 34

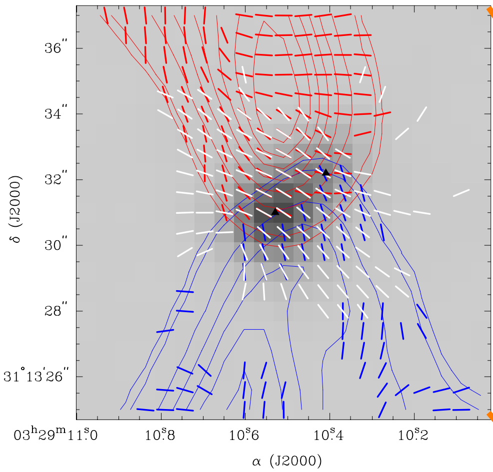


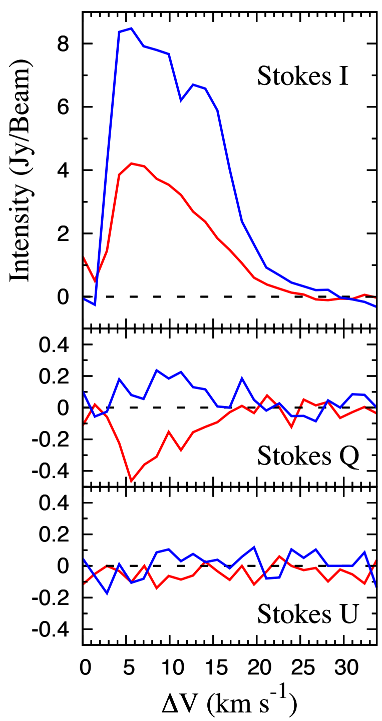
HH 92

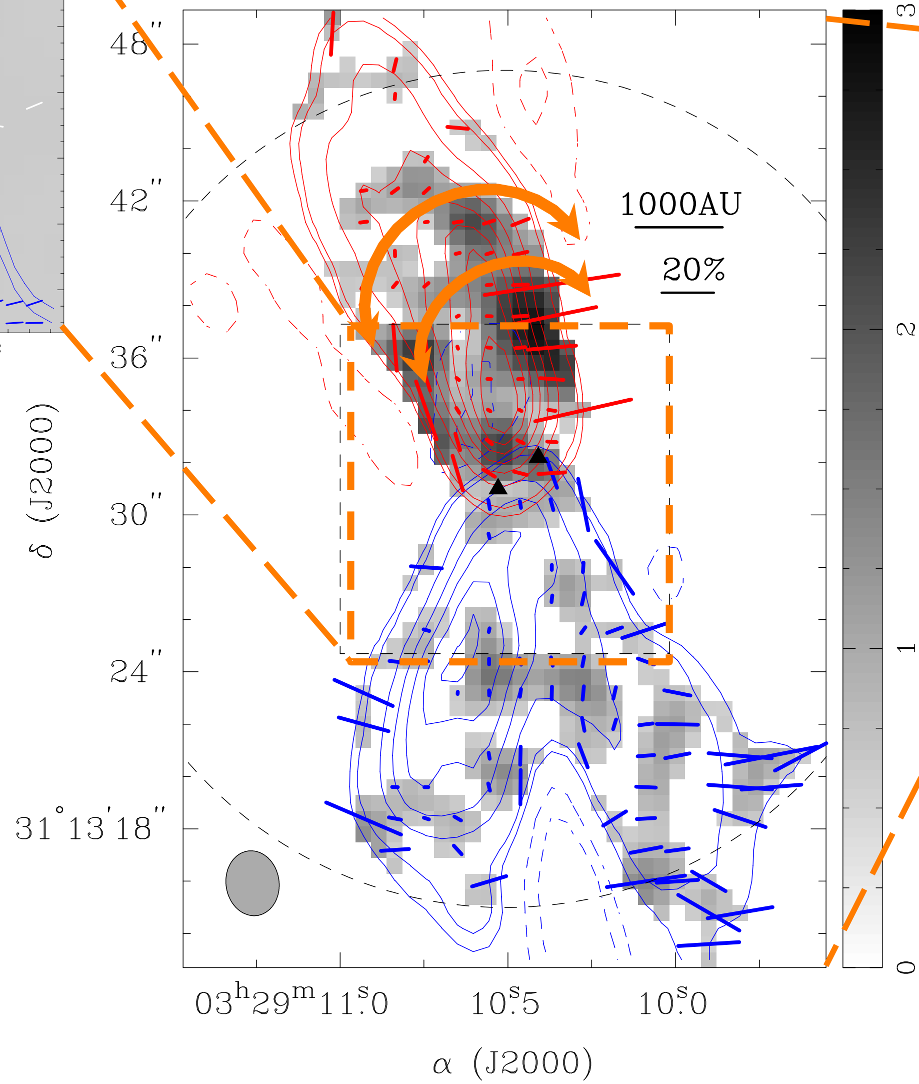
10,000AU

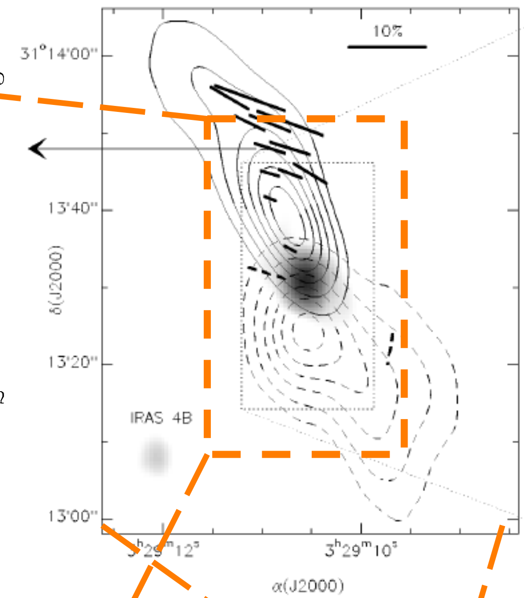
Magnetic Field Structure of the NGC1333 IRAS 4A outflows

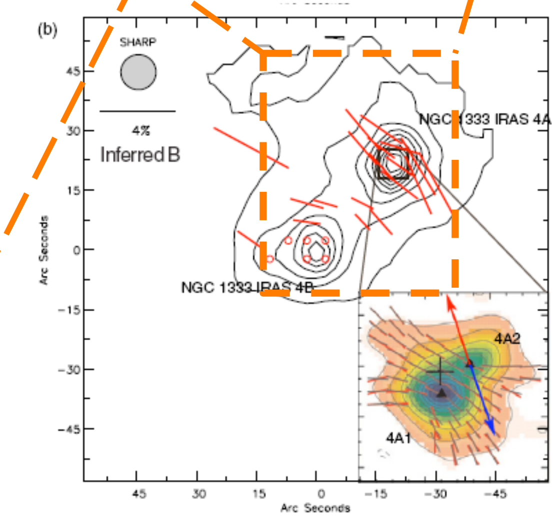
Tao-Chung Ching





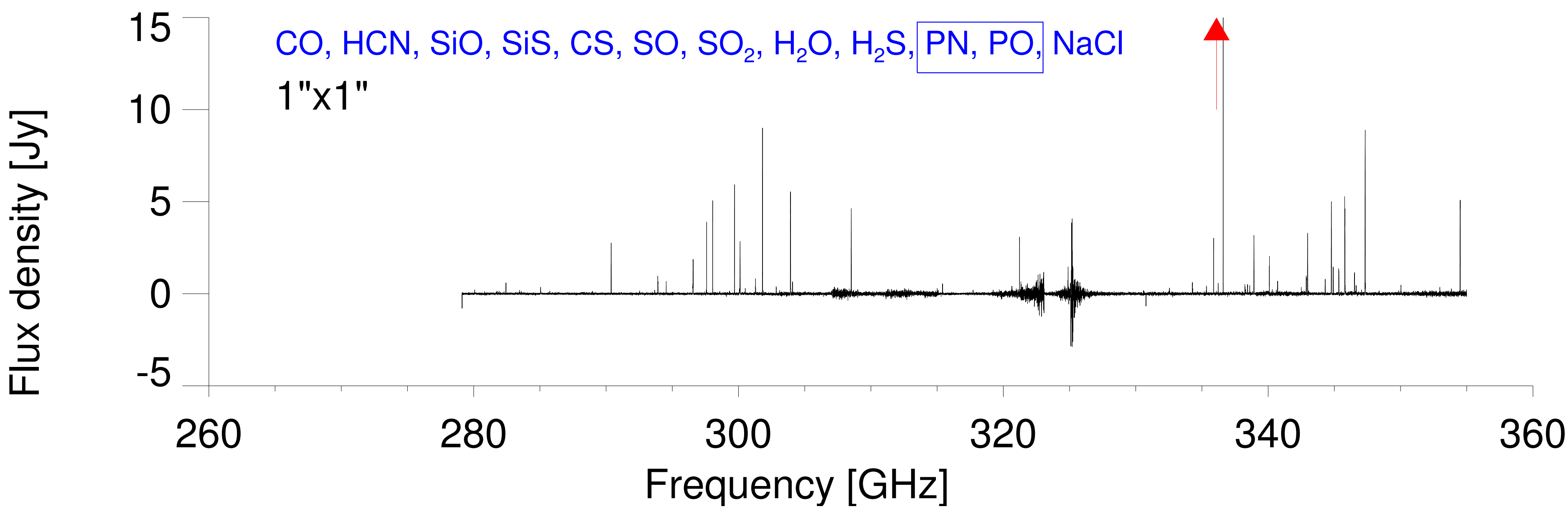


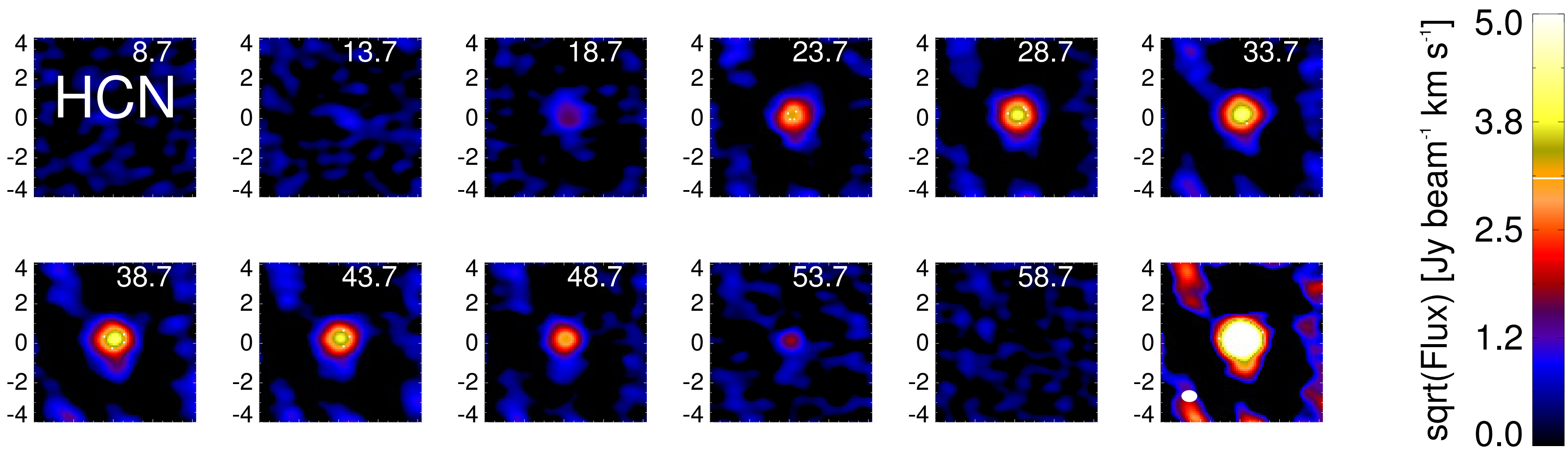




SMA spectral survey at 279-355 GHz of the AGB star IK Tau

Elvire De Beck [MPIfR, OSO], T. Kamiński, N. Patel, K. Young, C. Gottlieb, K. M. Menten

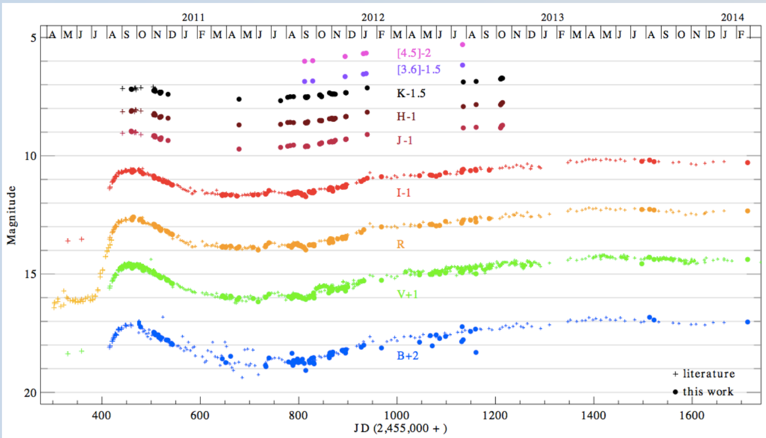




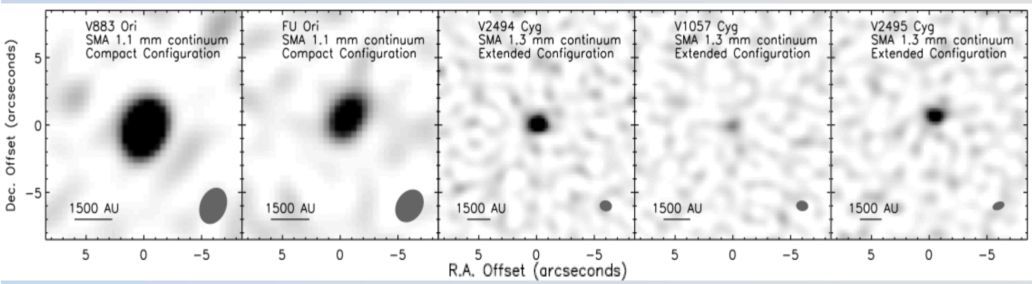
Disks Around Variably Accreting Young Stars

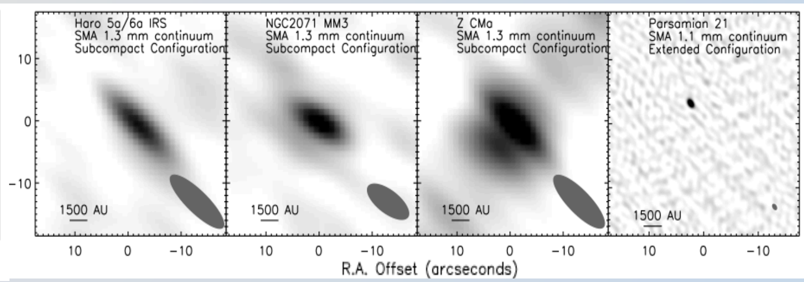
Michael M. Dunham (CfA, SMA Fellow)

Kospal et al., in preparation



- FU Orionis objects – young stars, flare by 4-5 magnitudes in the optical/NIR
- Enhanced accretion from circumstellar disk
- Proof of episodic accretion?
- Multiple driving mechanisms
- What are the disk properties?





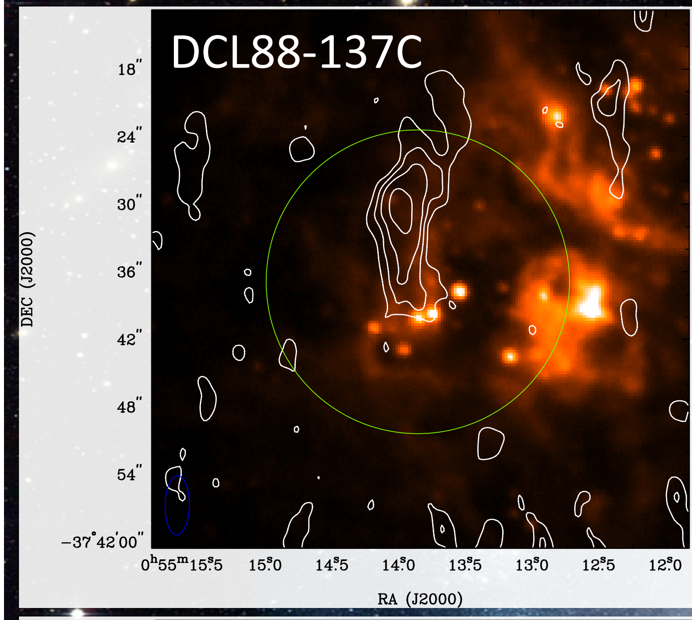
FU Orionis disks show great diversity – no typical disk evident
Some show evidence for very massive disks, others do no
Suggests diversity in driving mechanisms

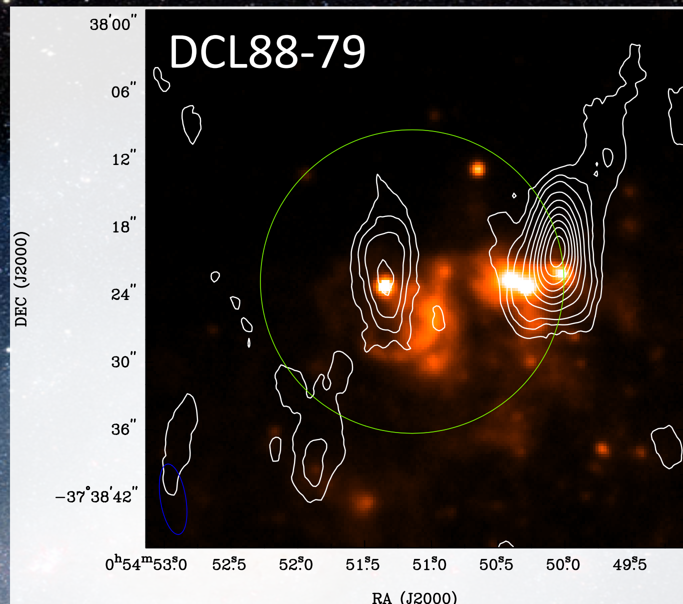
Collaborators: T. Bourke (SKA), J. Green (UT Austin), E. Vorobyov (Vienna), A. Kospal (ESA), S. Andrews (CfA), S. Corder (ALMA), S. Longmore (Liverpool)

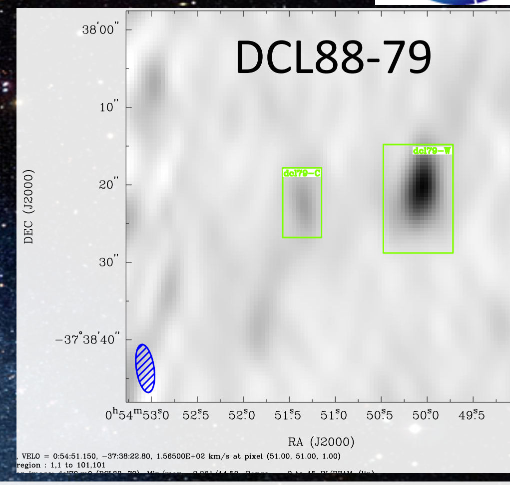
Resolving Molecular Clouds in Nearby Galaxies: NGC 300

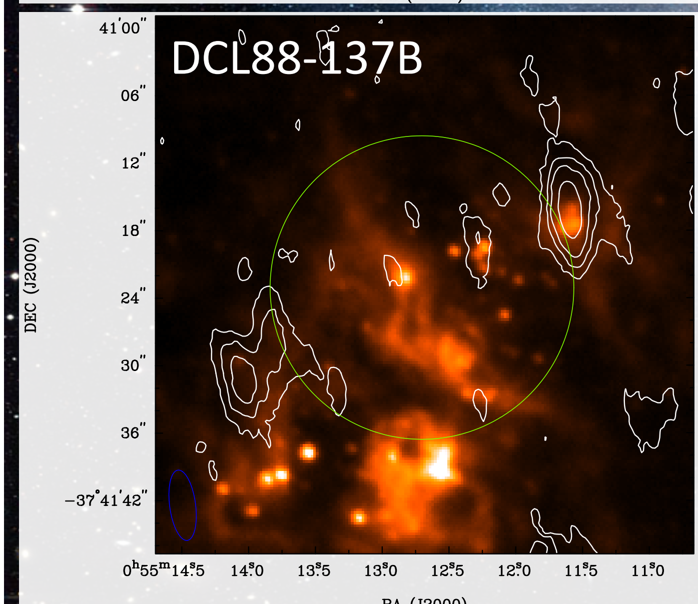
Christopher M. Faesi (CfA)

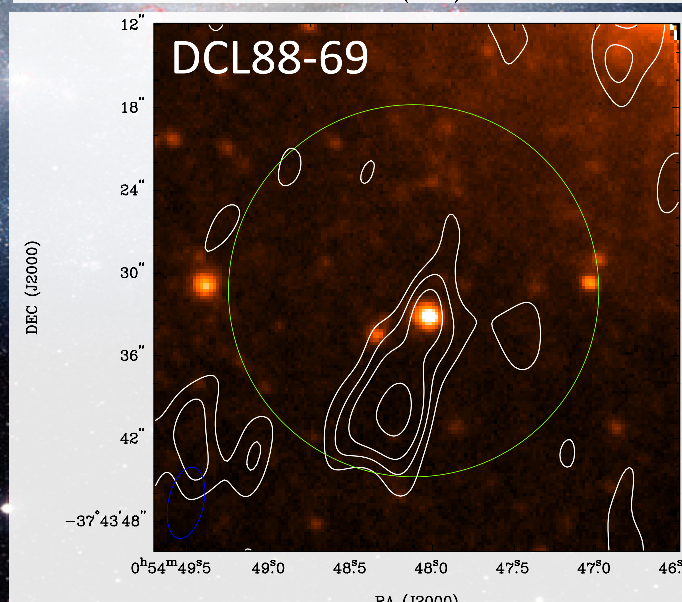
with Charles Lada (CfA) & Jan Forbrich (CfA/Univ. of Vienna)

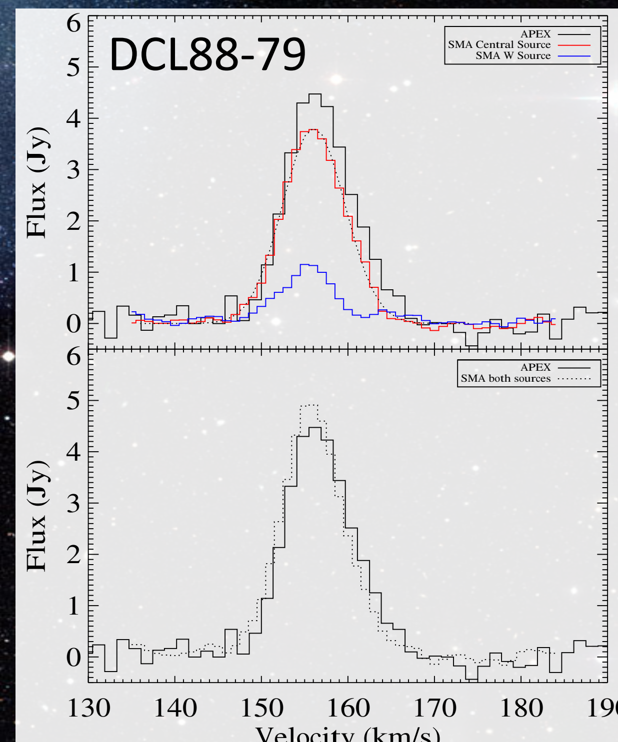








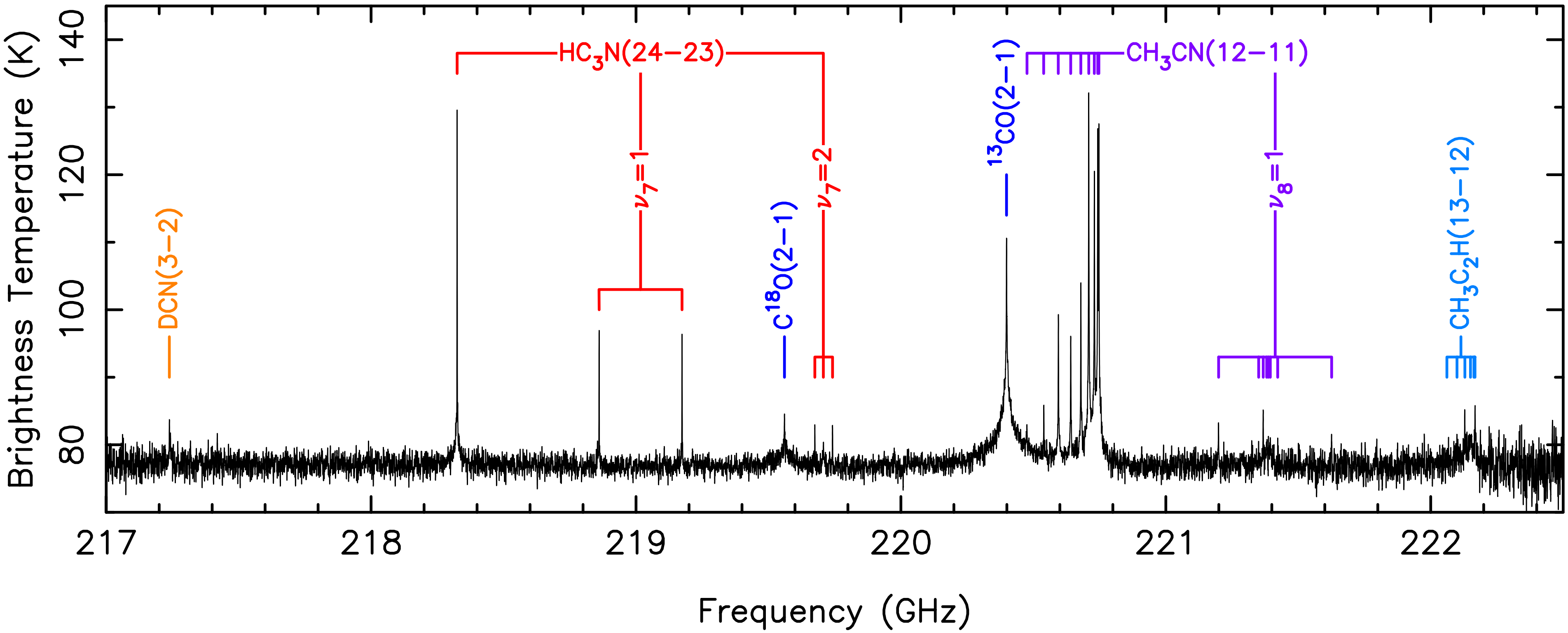




A Serendipitous Line Survey of Titan in the 1.3mm Band

Gurwell, Butler & Moullet

Poster A-1

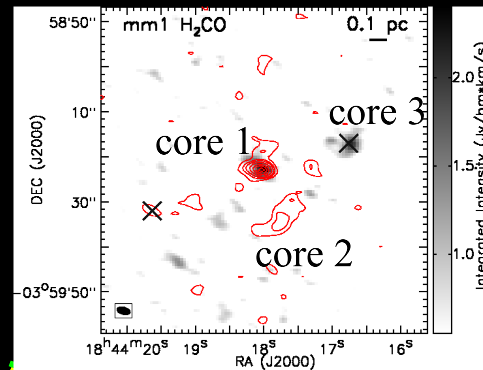


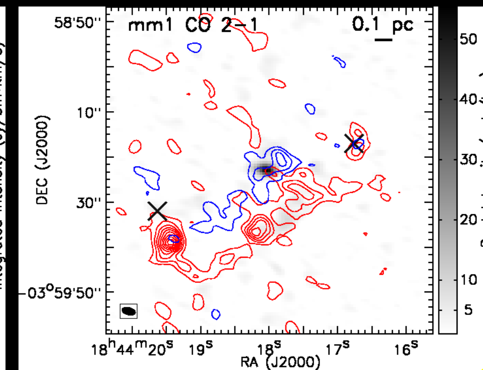
So. Much. Data.

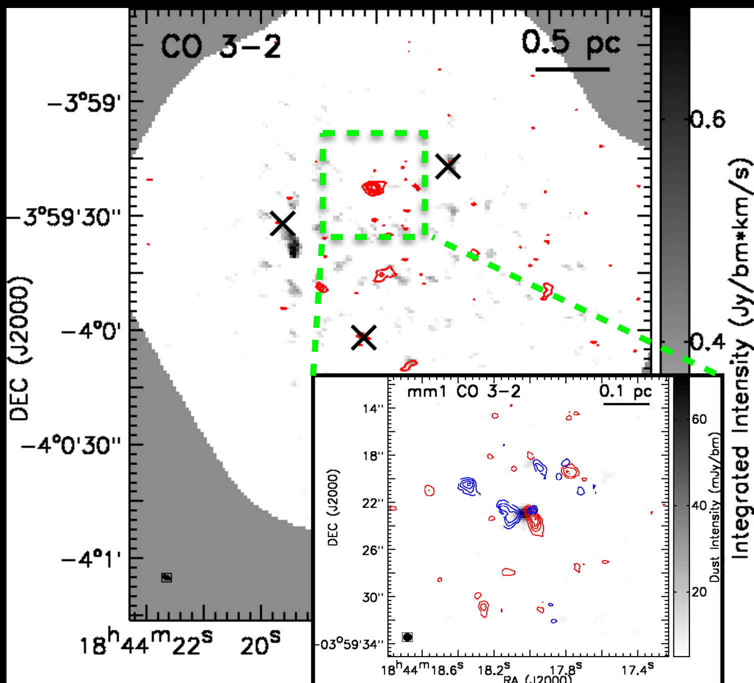
Poster F-8

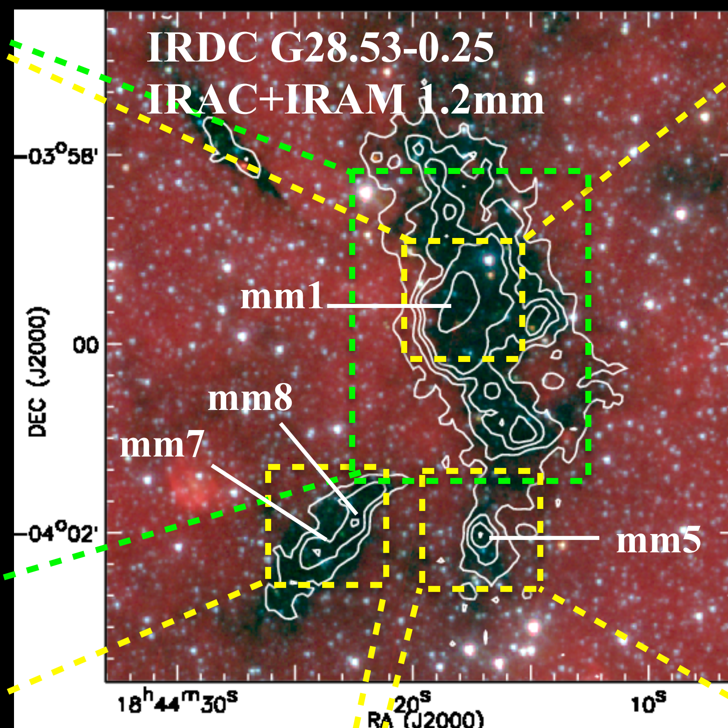
SMA 345 GHz & 230 GHz observations of IRDC G28.53-0.25

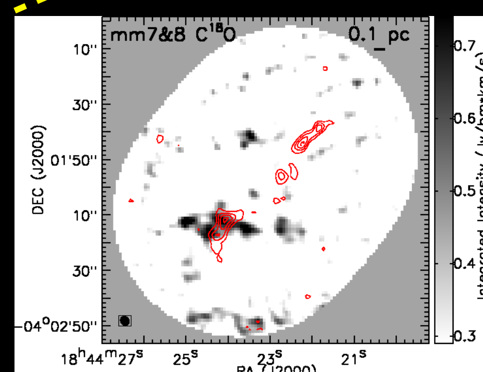
Xing Lu (CfA), Qizhou Zhang (CfA), Hauyu Baobab Liu (ASIAA)

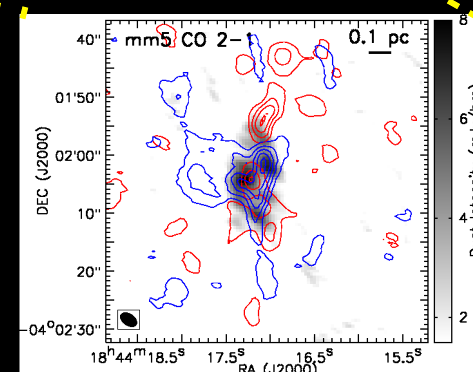






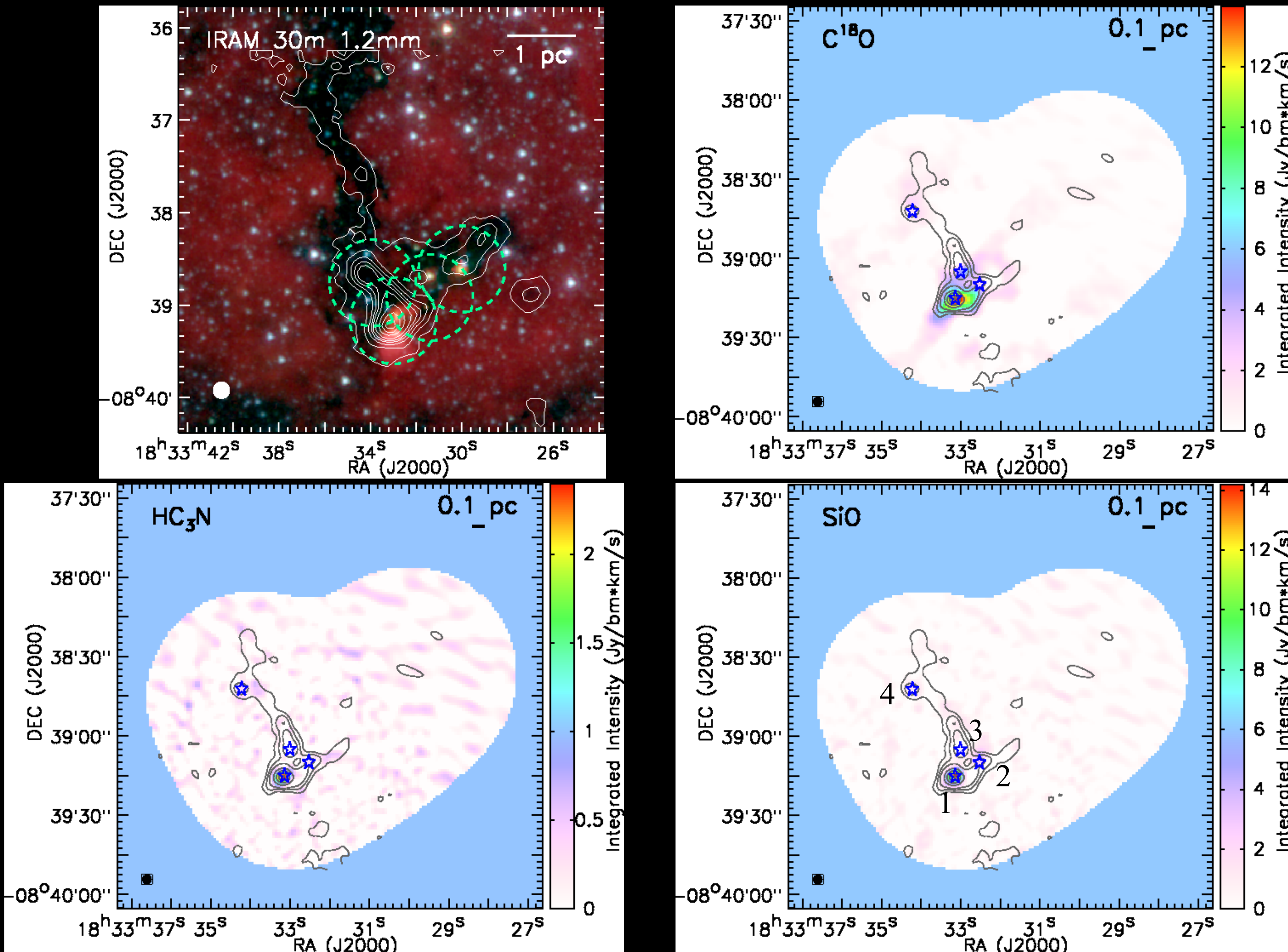






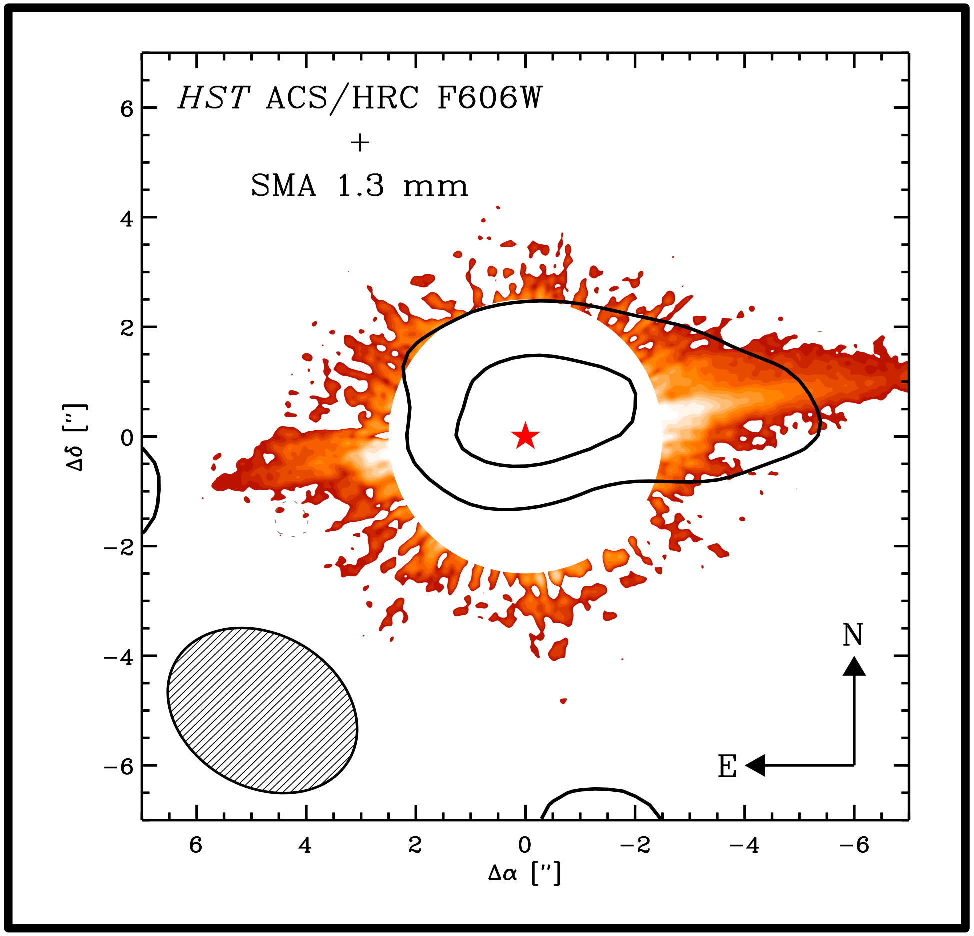
Core ID	r (pc)	M (Msun)	T (K)*	Δv(km/s)*	Mvirial (Msun)
mm1-core1	0.1	88	15.5	2.30	66
mm1-core2	0.1	55	15.5	2.30	66
mm1-core3	0.1	-	16.5	1.29	21
mm5-core1	0.15	156	13.5	1.01	19
mm7-core1	0.2	80	13.0	0.75	14
mm8-core1	0.15	66	14.0	0.85	14

SMA 230 GHz observations of IRAS 18308-0841



A New Millimeter Look at the HD 15115 Debris Disk

Meredith MacGregor (CfA), David Wilner (CfA), Sean Andrews (CfA), A. Meredith Hughes (Wesleyan)

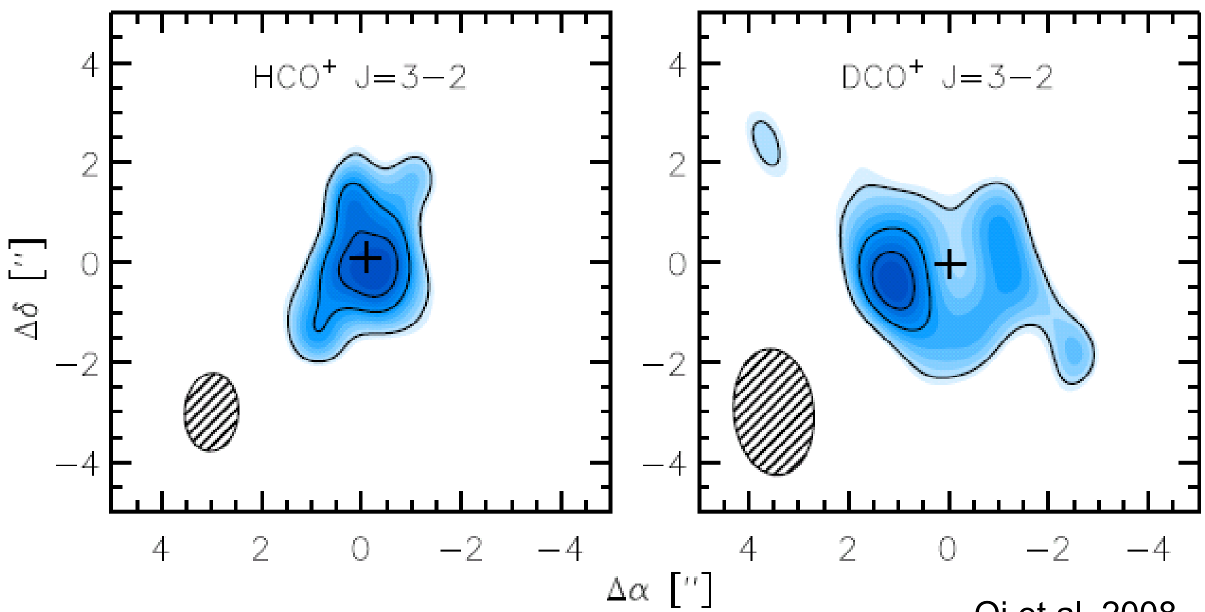


Poster B-2

We present observations of HD 15115 taken with the SMA that reveal a planetesimal belt and tentative evidence for an asymmetric extension of millimeter emission, coincident with the western feature seen in optical scattered light images.

Distribution of DCO^+ in Disks

Chunhua Qi, Karin Öberg, David Wilner(CfA) and Yuri Aikawa (Kobe U.)

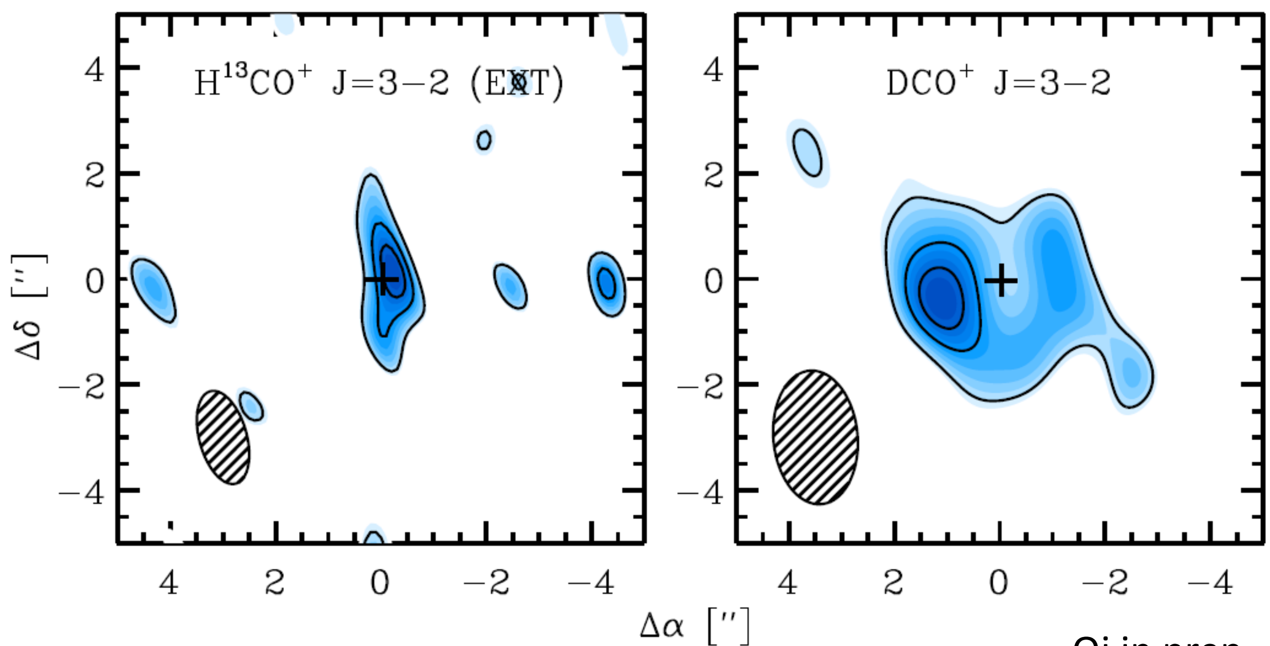


Qi et al. 2008

TW Hya

Distribution of DCO^+ in Disks

Chunhua Qi, Karin Öberg, David Wilner(CfA) and Yuri Aikawa (Kobe U.)



Qi in prep.

TW Hya

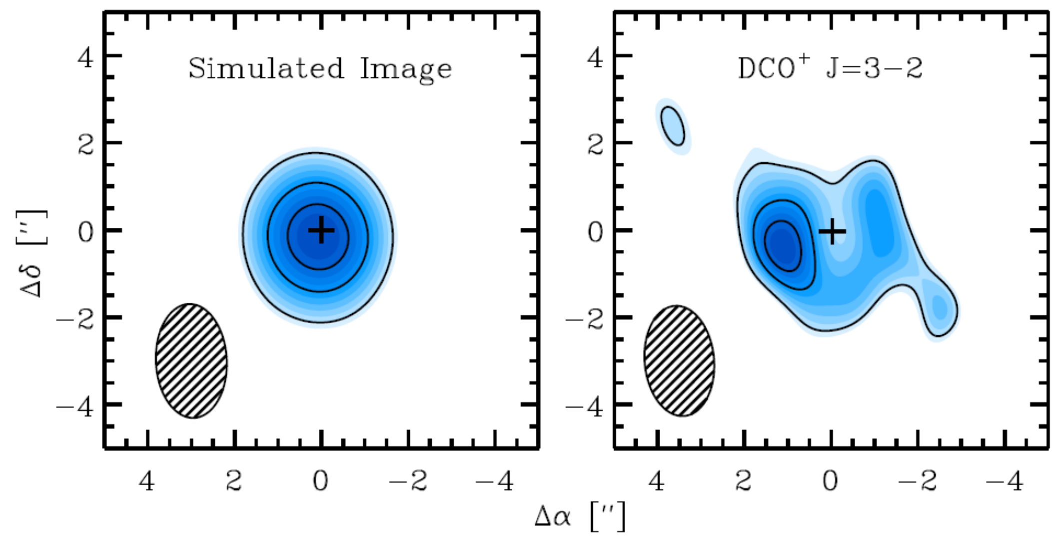
- **D/H enrichment at low temperature**
  - D-H exchange reactions

$H_3^+ + HD \rightarrow H_2D^+ + H_2 + 230K$

$H_2D^+ + CO \rightarrow DCO^+ + H_2$

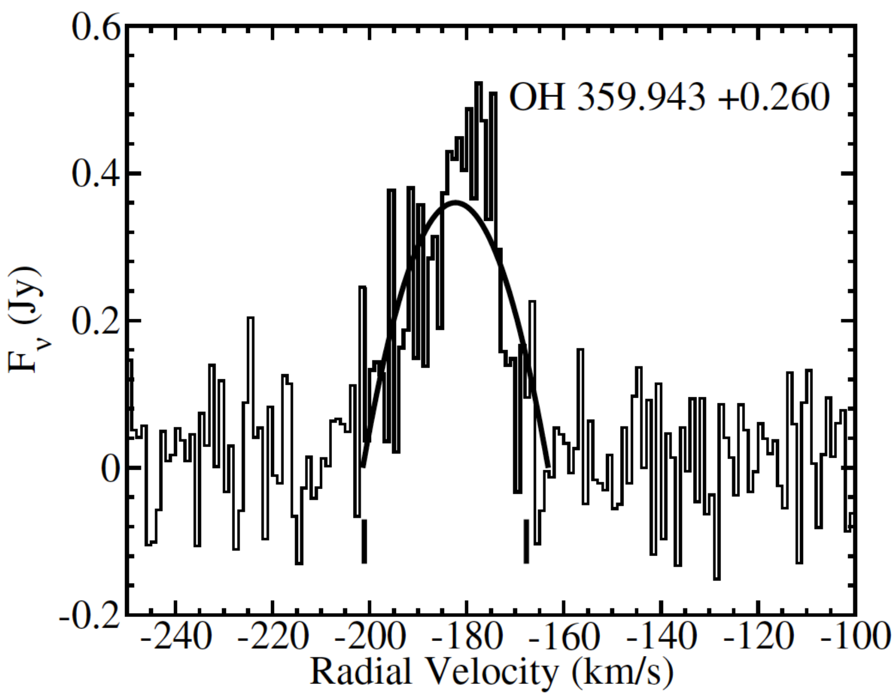
$H_2D^+ + e \rightarrow H_2 + D$

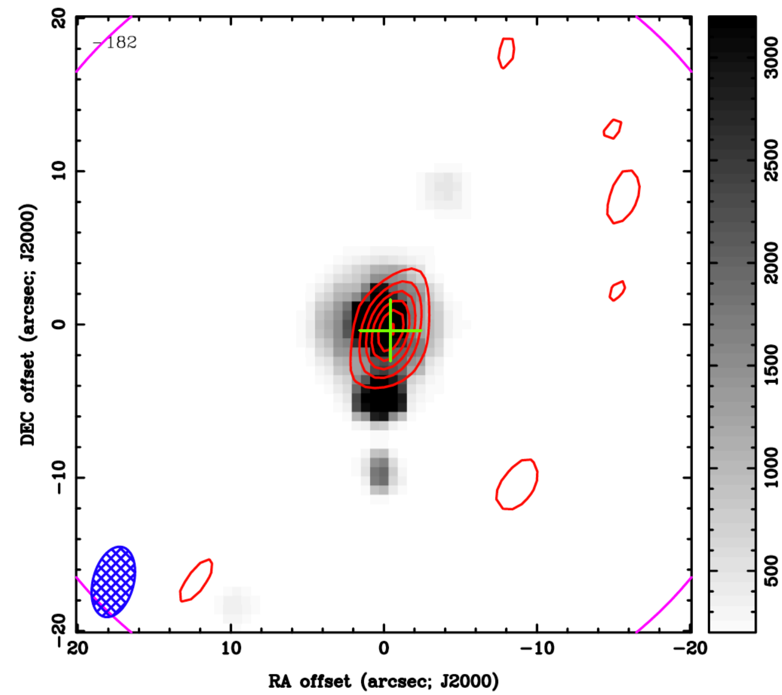
$$\frac{n(DCO^+)}{n(HCO^+)} \approx \frac{n(H_2D^+)}{n(H_3^+)} = \frac{k_1 n(HD)}{k_2 n(CO) + k_3 n(e)}$$



SMA Observations of Mass Loss from OH/IR Stars in the Galactic Bulge

B. Sargent, N. A. Patel, M. Meixner, M. Otsuka,
D. Riebel, S. Srinivasan, F. Kemper, J. Kastner





- SMA CO J = 2 – 1 (above, from Sargent et al 2013) and CO J = 3 – 2 data for OH/IR stars in Galactic Bulge
- Determine gas mass-loss rates, combine with modeling dust emission in infrared spectral energy distributions to determine stars' gas-to-dust ratios
- Eventually apply gas-to-dust ratios to studies of AGB stars in other galaxies

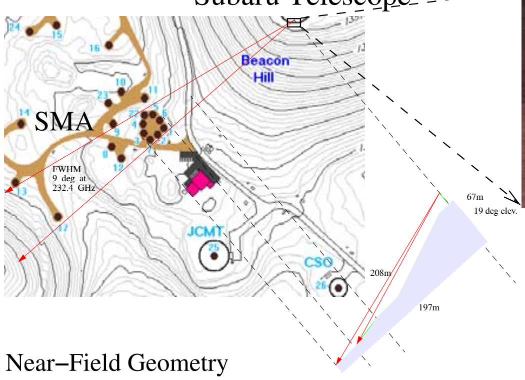
HOLOGRAPHIC ANTENNA VALIDATION MEASUREMENTS

T. K. Sridharan, M. Saito , N. Patel, Harvard–Smithsonian Center for Astrophysics

SMA specification: 12 micron rms for the primary surface

Combination of near–field and celestial measurements.

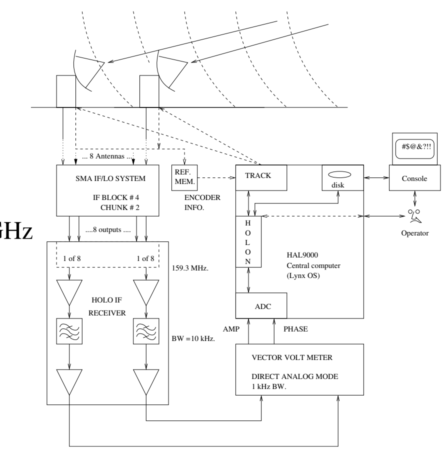
Subaru Telescope



Near–Field Geometry

The 232.4/332 GHz and 692 GHz beacons on Subaru

System Block Diagram

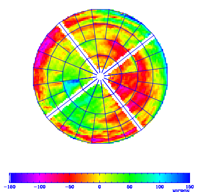


NEAR–FIELD MEASUREMENTS

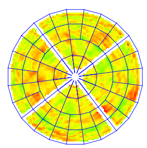
0

SURFACE ACCURACY ACHIEVEMENT

rms: 65 micron to12 micron



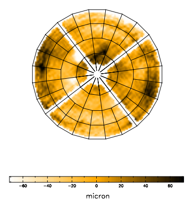
mechanical setting



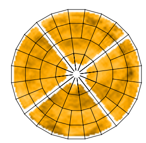
final holography setting

REPEATABILITY

4 yr: 24 micron 1.5 yr: 11 micron

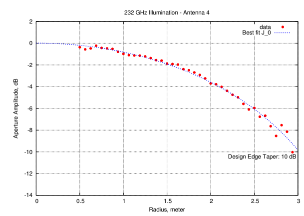


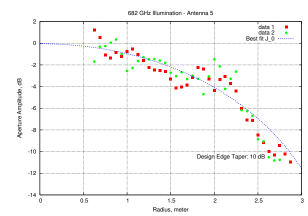
12 transports



2 transports

RADIAL ILLUMINATION PROFILE

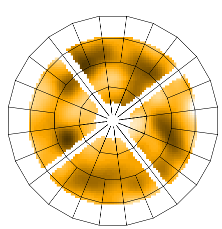




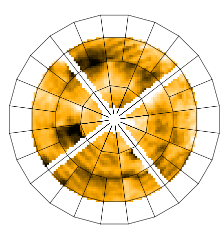
CELESTIAL MEASUREMENTS

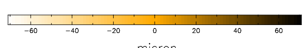
Antenna 6

Celestial



Near–Field

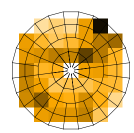




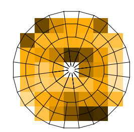
edge effects in 1 pixel outer ring masked

Antenna 2

Elevation: 57–34 rms: 9 micron

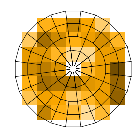


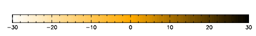
84–57 11 micron



Antenna 6

84–57 8 micron

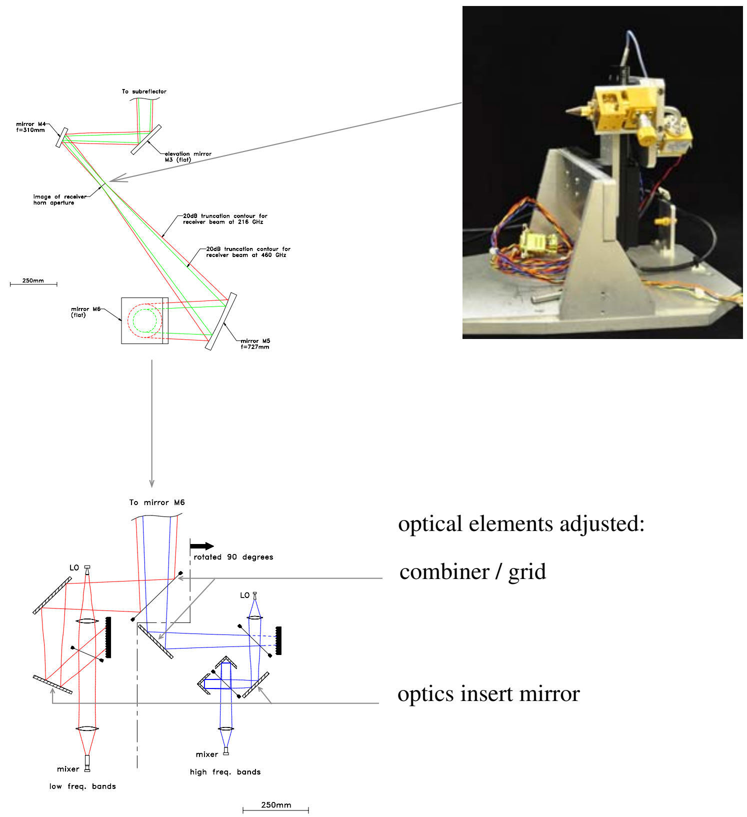


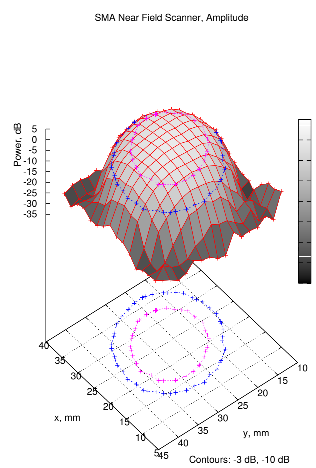


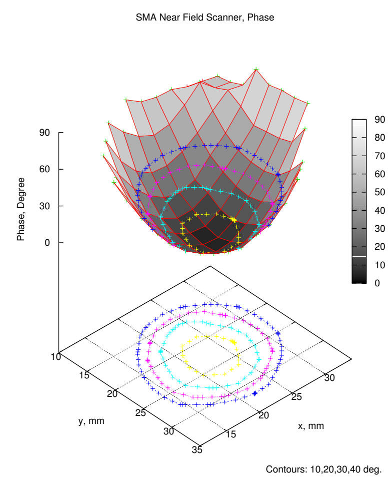
[1]currently at NAOJ, Japan

A VECTOR NEAR–FIELD SCANNER FOR INTER–BAND ILLUMINATION AND BEAM CO–ALIGNMENT

T. K. Sridharan, C. E. Tong, J. Test, R. Christensen, S. Leiker, Harvard–Smithsonian CfA; R. Rao, ASIAA




SMA Near Field Scanner, Amplitude
Power, dB
x, mm
y, mm
Contours: -3 dB, -10 dB


SMA Near Field Scanner, Phase
Phase, Degree
y, mm
x, mm
Contours: 10,20,30,40 deg.

HOT–CORE, OUTFLOWS AND MAGNETIC FIELDS IN W43–MM1

T. K. Sridharan, R. Rao, K. Qiu, P. Cortes, H. Li, T. Pillai, N. A. Patel, Q. Zhang

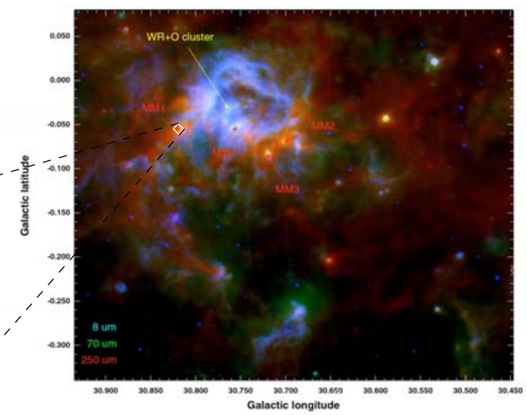
W43–MM1 is the brightest and the most massive core in the W43 mini–starburst region.

Distance ~ 5.5 kpc;

Luminosity ~ few x10^4 L_{sun}

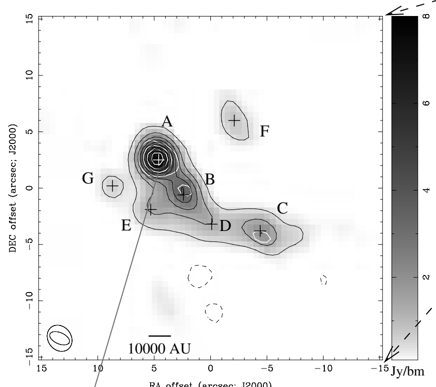
Mass ~ few x10^3 M_{sun}

CONTEXT

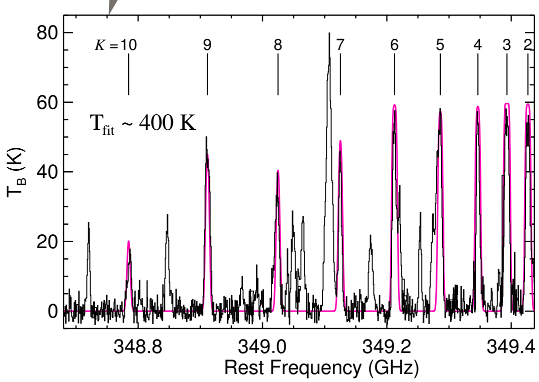


from Bally et al (2010), AA, 518, L90.

345 GHz CONTINUUM AND CH_3CN (19–18)



CH_3CN (19–18)



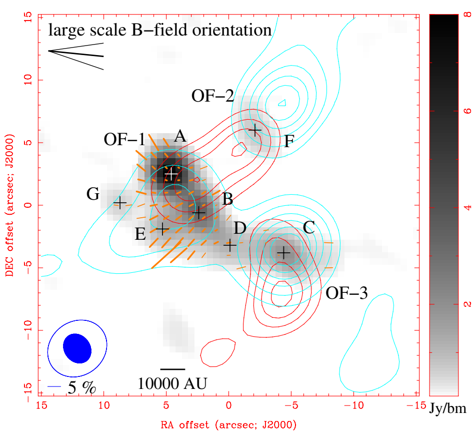
SMA observations in the 345 GHz band mapped polarized continuum and lines.

MM1 resolves into multiple massive cores: 1–10 Jy, 100–1000 M_{sun}

MM1–A harbours a hot core with a temperature of ~ 400 K.

11 K–components detected in CH_3CN (19–18)

OUTFLOWS AND B−FIELD



Three massive outflows detected in CO: ~ 10 M_{sun} ; age ~ 10^4 yr.

0.5−15% polarized continuum emission, ordered pattern.

B−field parallel to main outflow

Derived B−field: 6 mG (plane of sky) Mass−to−flux ~ 1

B−field direction varies on small scales, one outflow not aligned to other two. Large scale B−field is not aligned to either the outflow directions or the small scale B−field.

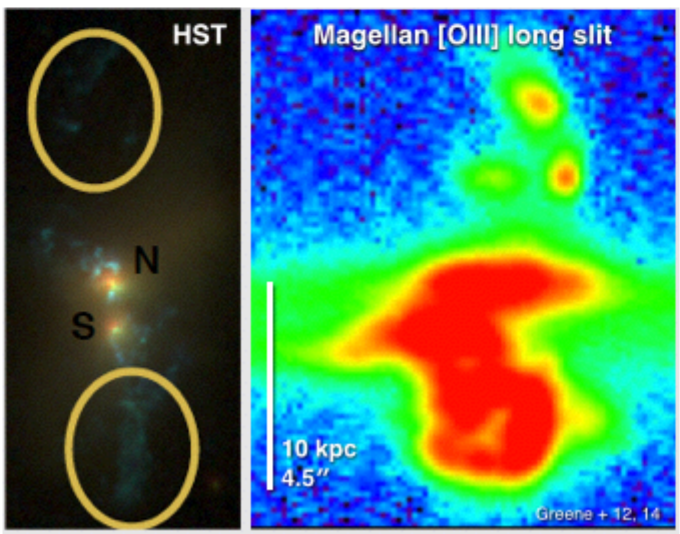
A simple picture of large scale B−field guiding collapse and disk rotation axes (measued by outflows) aligned to B−fields (by magnetic braking) is not supported.

ALMA Observations of a Candidate Molecular Outflow in an Obscured Quasar SDSS J1356+1026

Ai-Lei Sun, Jenny E. Greene, Nadia L. Zakamska, Nicole P. H. Nesvadba
Princeton University, Johns Hopkins University, Université Paris-Sud

In a Luminous Quasar

SDSS J1356+1026

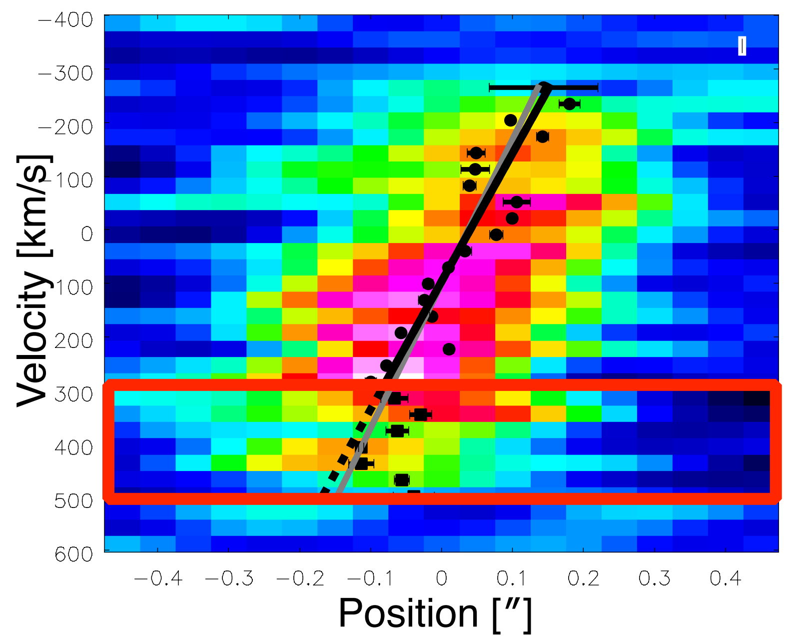


$L_{bol} \approx 10^{46}$ ergs s^{-1}

20 kpc Ionized Outflow

Signs of Molecular Outflow

CO (3-2) PV-Diagram



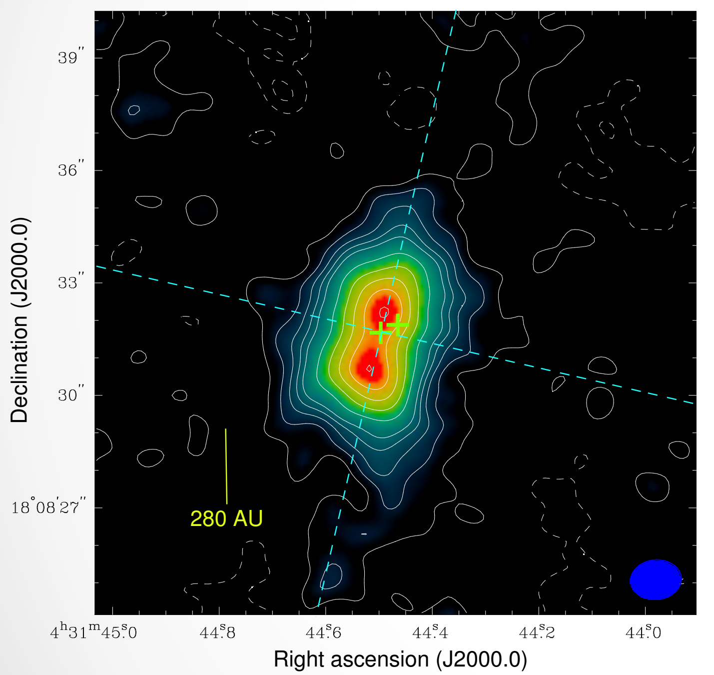
r ≈ 300 pc, v ≈ 500 km/s

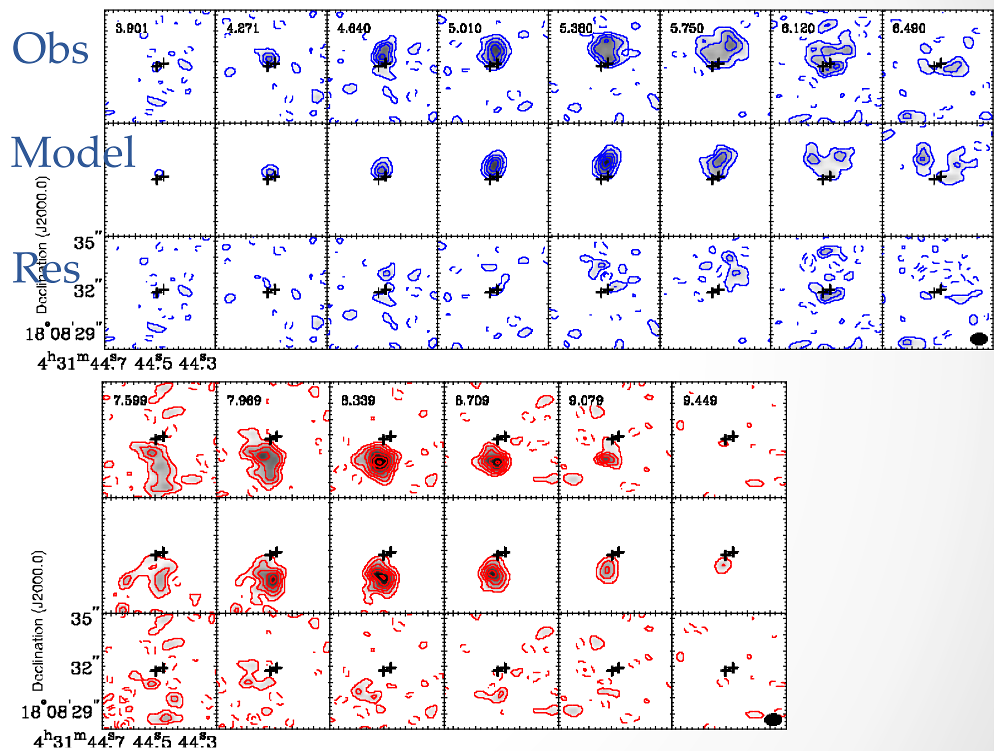
$\dot{M} \approx 350\ M_{\odot}/yr$

Direct SMA Imaging of the Transition from the Infalling Envelopes to the Keplerian Disks around L1551 IRS 5 and NE

Shigehisa Takakuwa (ASIAA) et al.

L1551 NE $C^{18}O$ (3-2) Moment 0 map

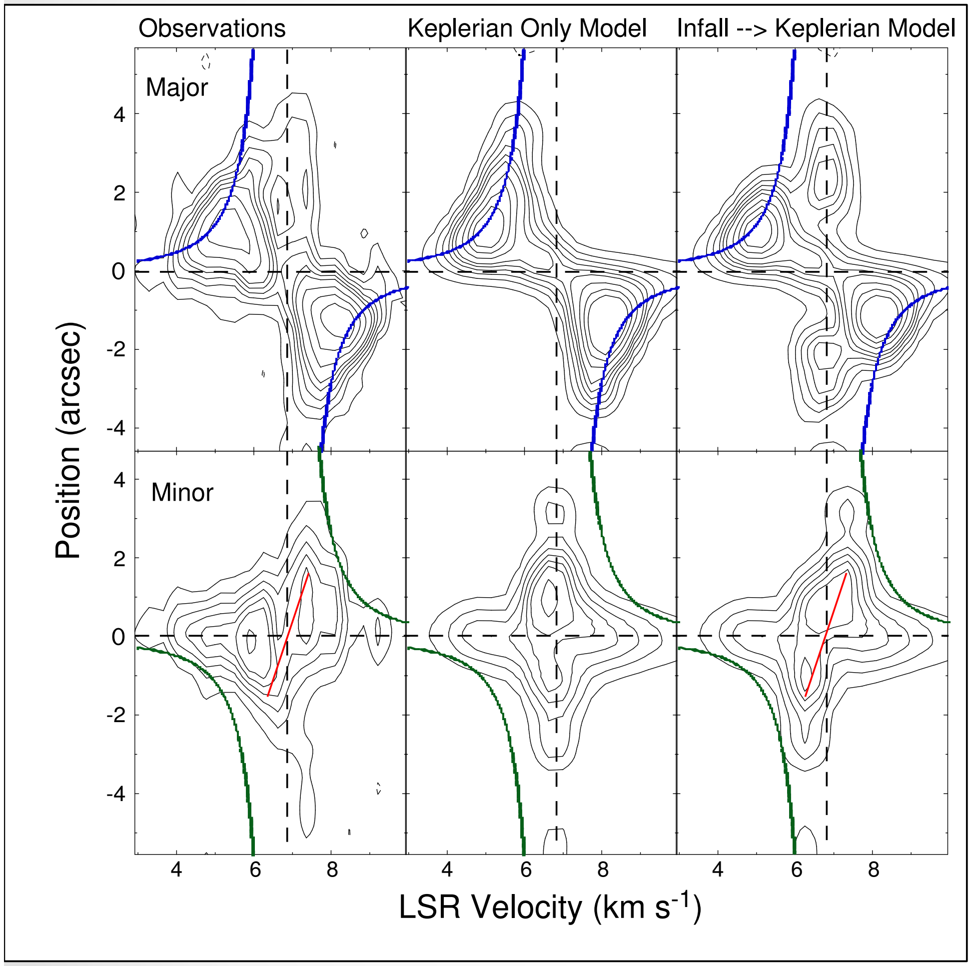




High Vel. (> 0.5 km s^{-1}) Component

→ Keplerian Disk around 0.8 M_{sun}

Low Vel. (< 0.5 km s^{-1}) Component
→ Outer Infalling Envelope with the Decelerated Infalling Velocity ?

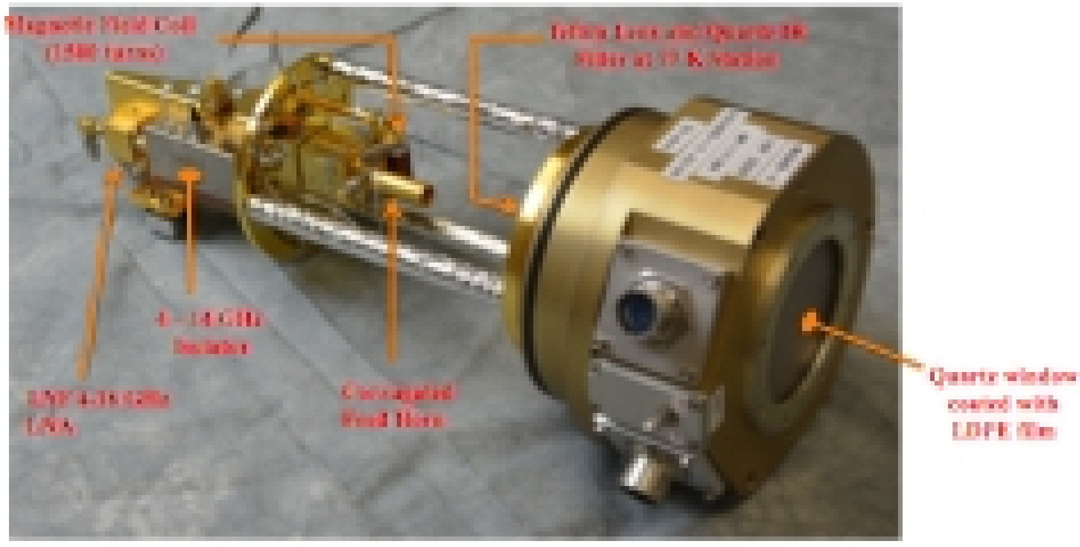


Keplerian-only model cannot explain the vel. grad. along the minor axis.

Infalling ``ring'' component,
r_{kep} ~300 AU
v_{inf}~0.6 km s^{-1}
No rotation

Wideband Receiver Upgrade for the Submillimeter

- **Original IF for the SMA was 4 – 6 GHz, but later expanded to 4 – 8 GHz.**
- **2nd generation SMA receivers are based on series-connected distributed SIS mixers.**
- **Upgraded SMA receivers can currently be operated over an IF of 4 – 12 GHz.**
- **Wideband receivers for 200 and 300 GHz bands have competitive on-sky noise performance and are currently used for routine astronomical observations in the SMA.**
- **SMA Wideband Astronomical ROACH2 Machine (SWARM) correlator will unleash full bandwidth capability of the SMA wideband receivers.**

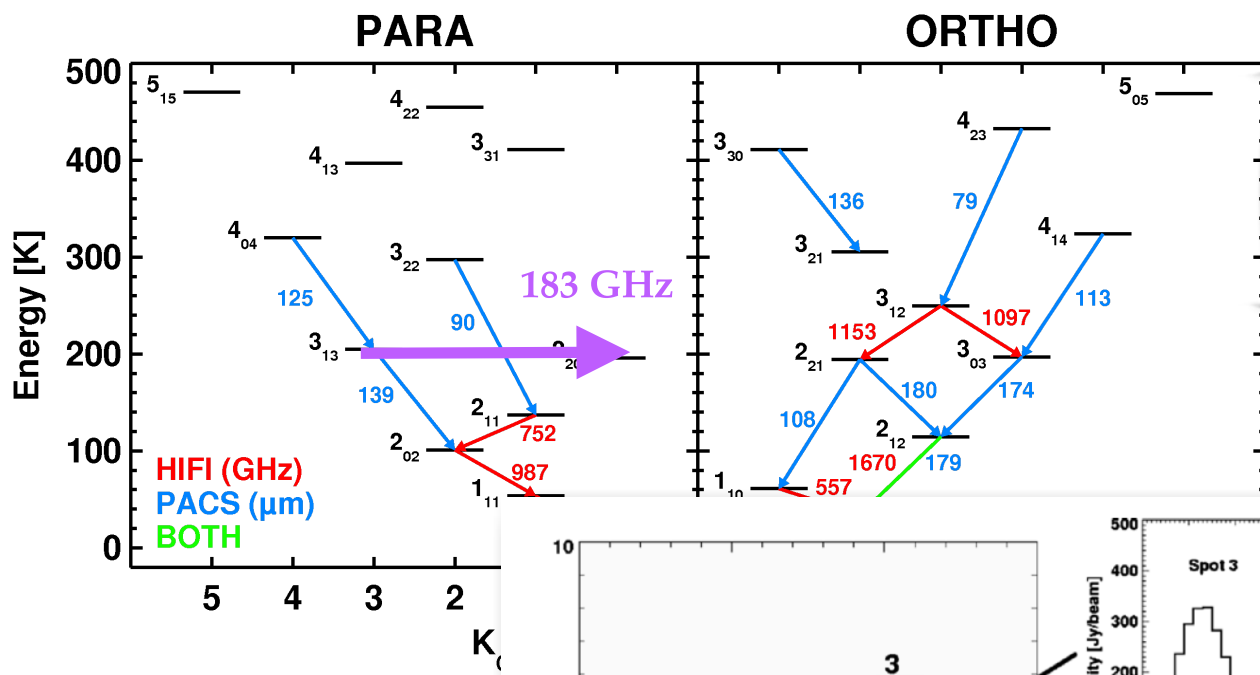


Presented by:

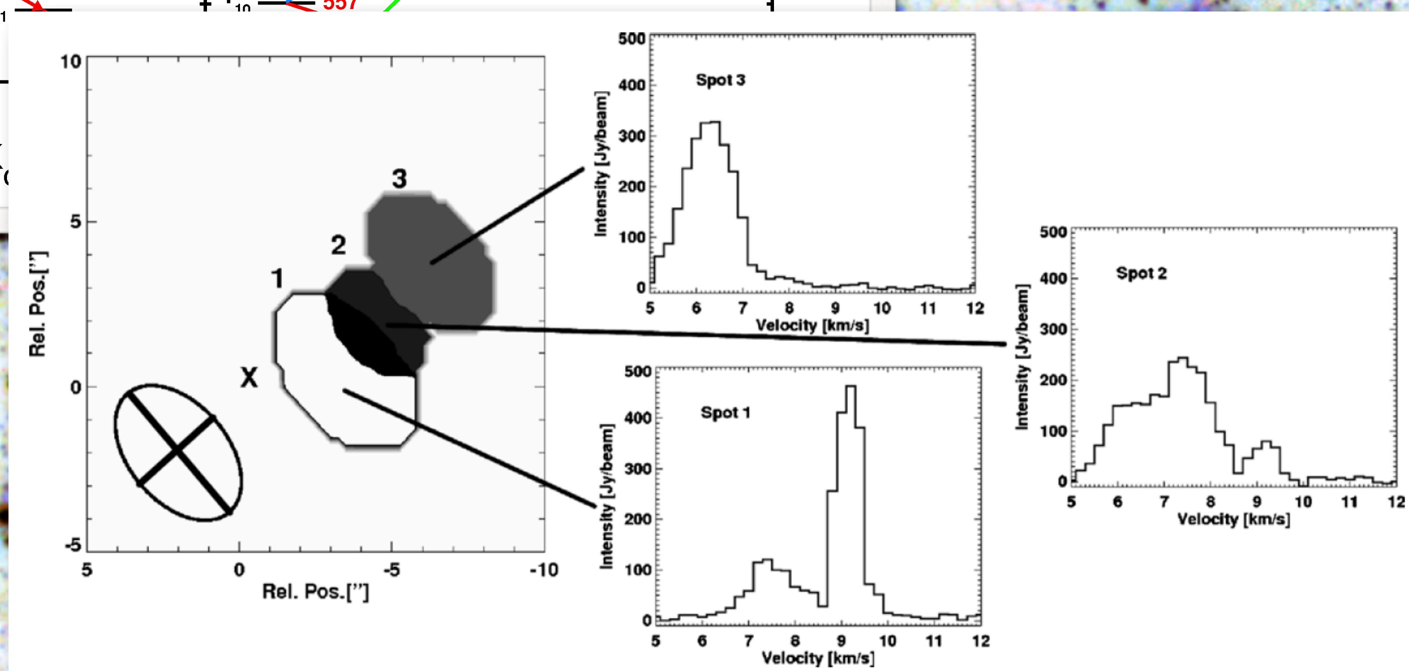
Edward Tong, Ray Blundell (SAO)
C.-C Han, T.-J Chen, W.-C. Lu, M.-J. Wang (ASIAA)
+ SMA Team

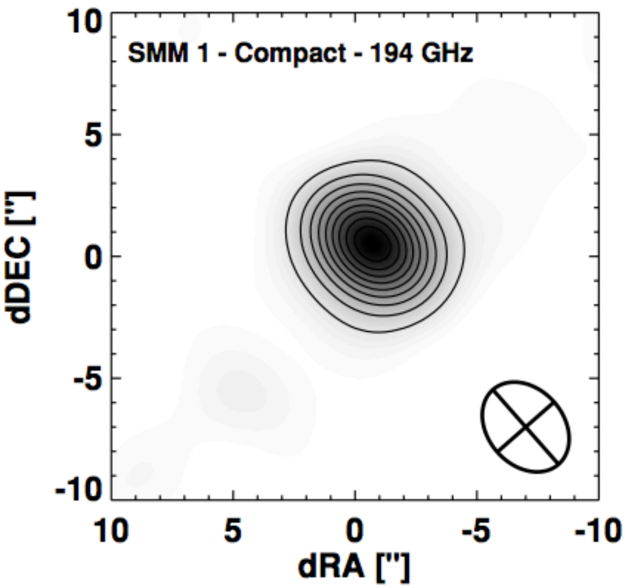
The first (and only) galactic detection of the 183 GHz water maser with an interferometer: The curious case of Serpens SMM1

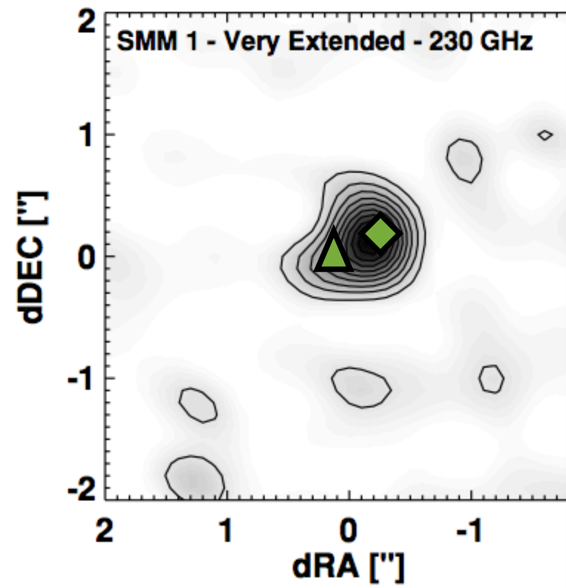
Tim van Kempen[1,2], David Wilner[2] & Mark Gurwell[2] [1]Leiden Observatory, [2]CfA

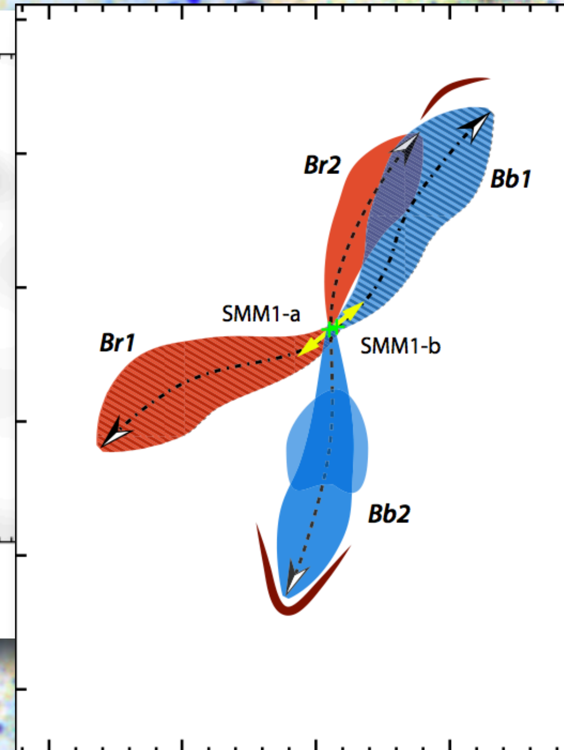


The 183 GHz water maser has the lowest energy level & most easily excited one

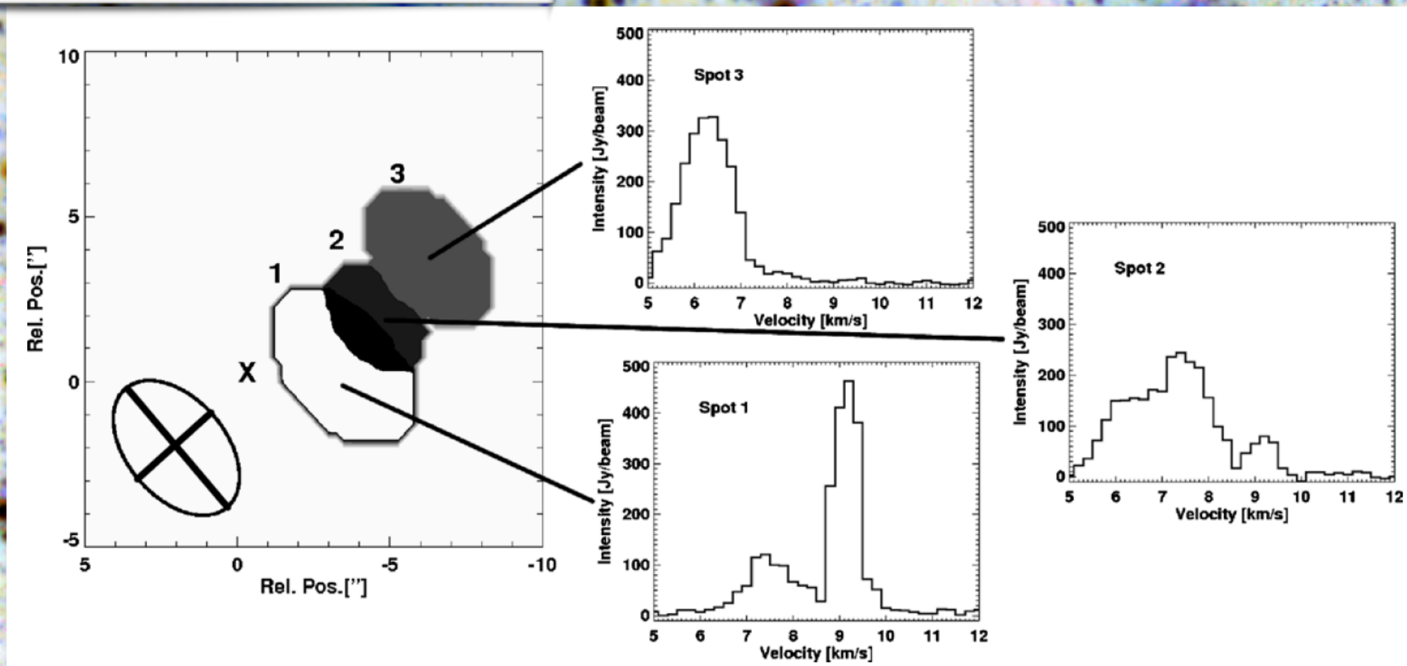


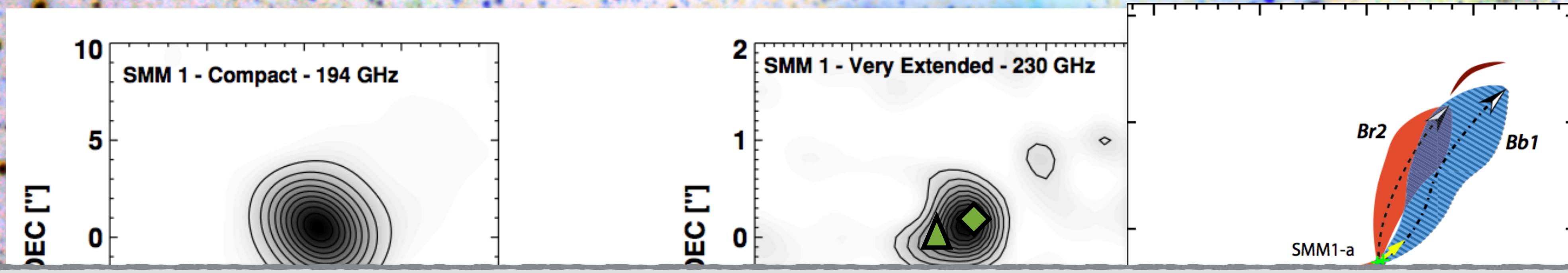






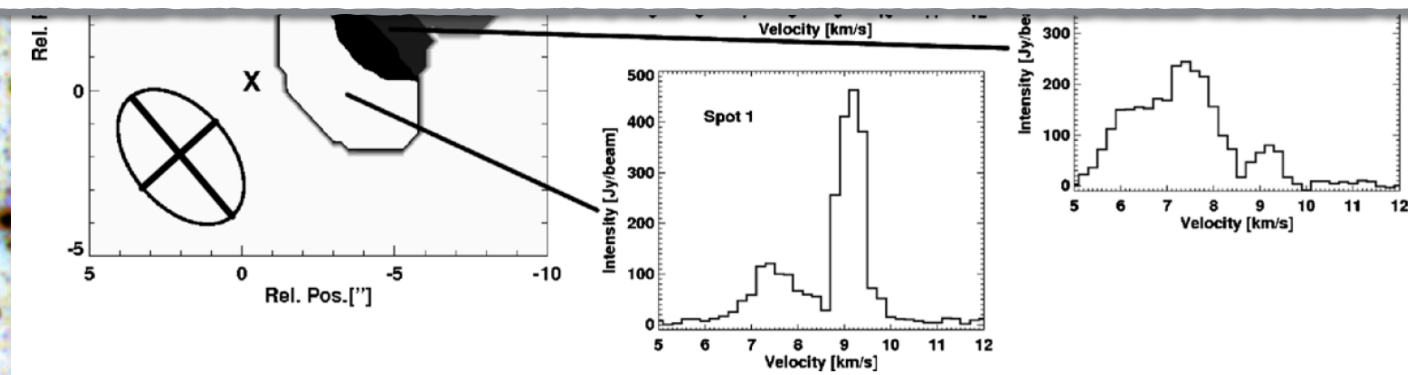
Maser perhaps associated with second protostar





Still only detected 183 GHz water in the Milky Way with an interferometer

(ALMA Band 5 is years away)

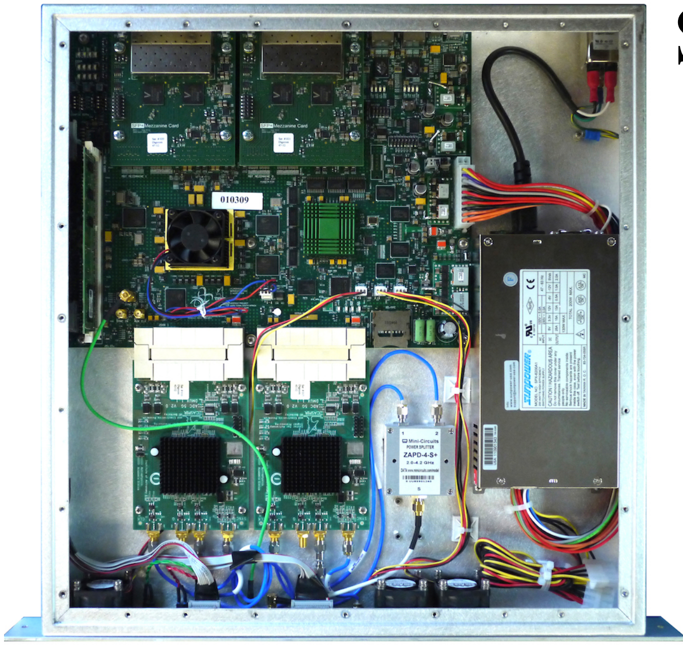


A Compact High Resolution Correlator and Wideband VLBI Phased Array

EDK

aka acronym zoo

VLBI



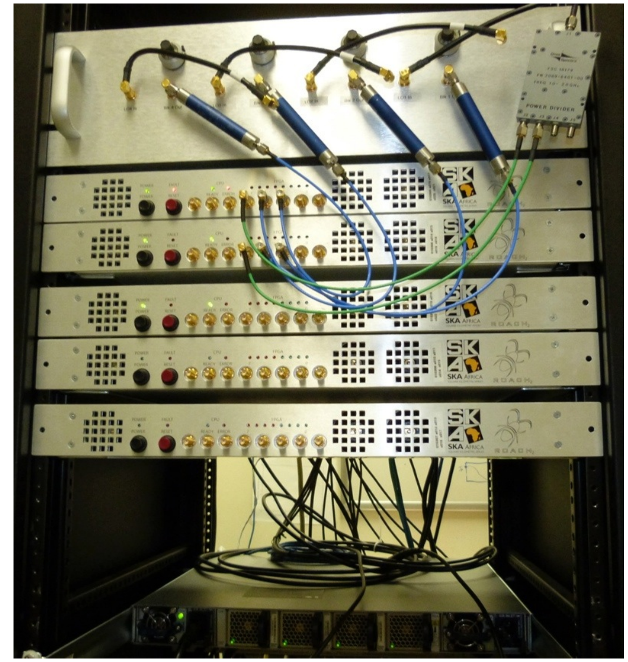
SgrA*

ROACH

Reconfigurable Open Architecture Computing Hardware

ATI

SFP+



PhRInGES BEE2 MSSGE NSF

EDK

MRI SAO SWARM M87 ISE Z-DOK

ASIAA

GBMF SMA IR&D

CASPER PFB 10GigE

ALMA FX CX-4

iBOB CfA BORPH DiFX CGPS

Poster location: J-8 The Extremely Final Row (window side)

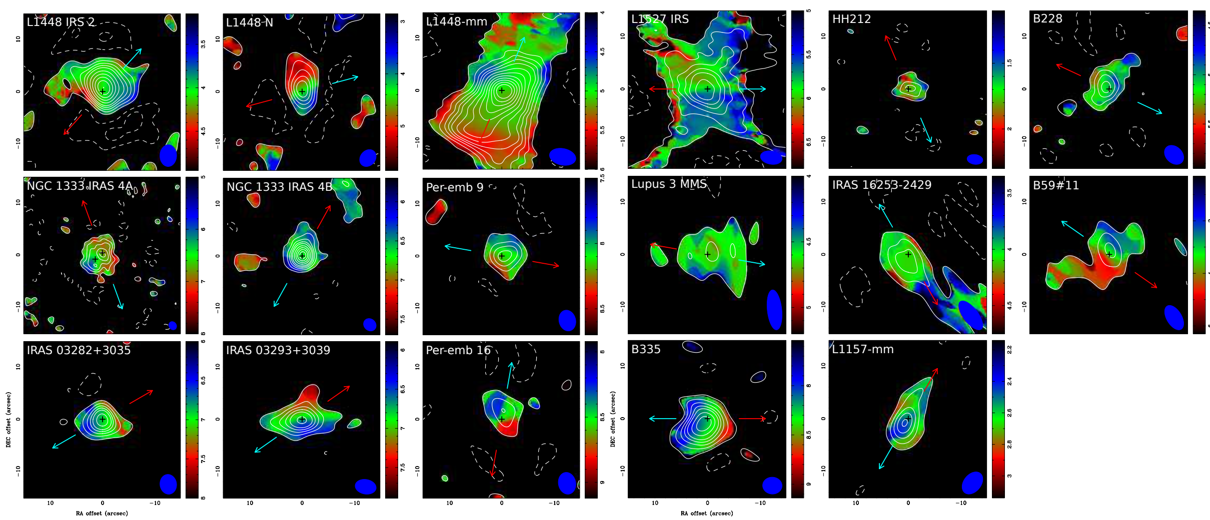
SMA Observations of Infall and Rotation around Class 0 Protostars To Investigate Disk Formation at the Early Evolutionary Stage

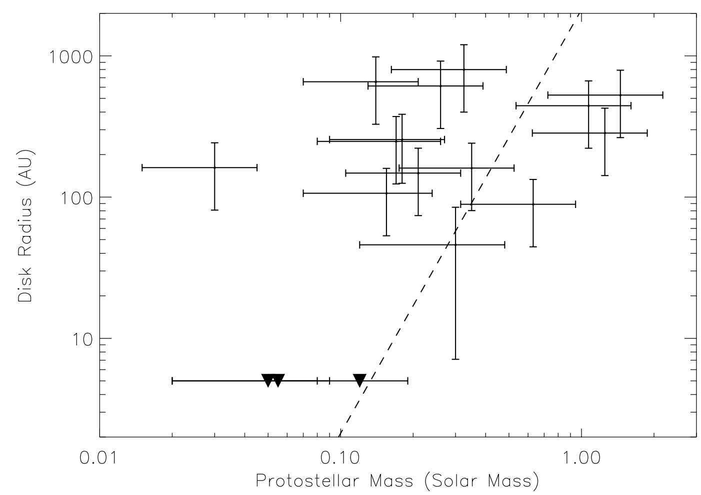
Hsi-Wei Yen et al. (ASIAA)

Q: Are circumstellar disks well developed around Class 0 protostars?

Method: Measure infall and rotation at 1000 AU scale with SMA at resolutions of 2” to 8” to infer the size of embedded disks.

Results:





Wide ranges of magnitude and orientation of velocity gradients observed.

Inferred disk sizes range from <5 AU to >500 AU.

Conclusion: The Class 0 stage is likely the stage to form large-scale disks.