ALMA Science Highlights

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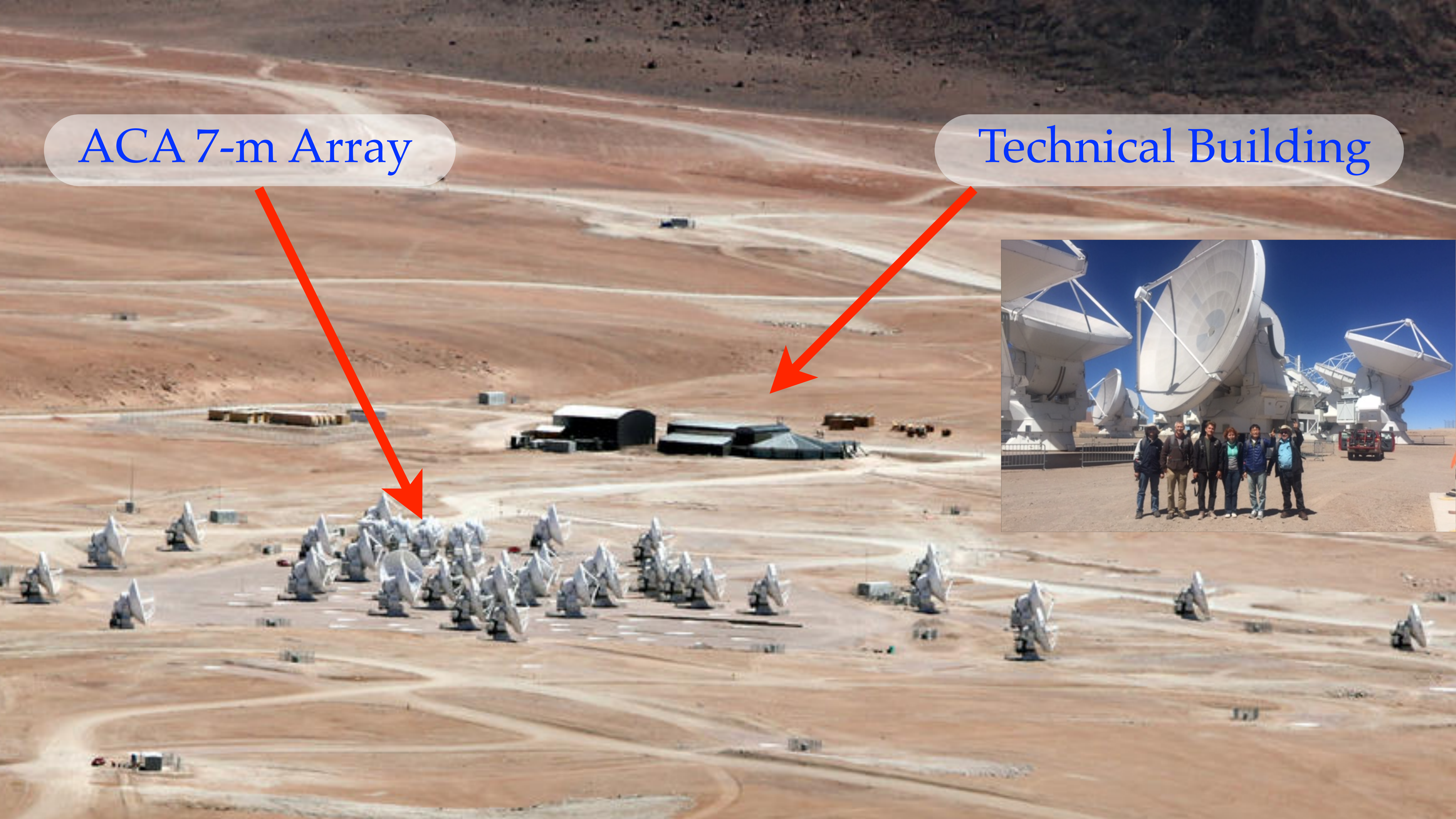
ALMA Town-hall meeting at KASI

March 20, 2019


ACA 7-m Array
Technical Building

ALMA Full Operations Specifications

	Specification
Number of Antennas	*50×12 m (12-m Array), plus 12×7 m & 4×12 m (ACA)*
Maximum Baseline Lengths	*0.16 - 16 km*
Angular Resolution (")	*~0.2" × (300/ν GHz) × (1 km / max. baseline)*
12 m Primary beam (")	*~20.6" × (300/ν GHz)*
7 m Primary beam (")	*~35" × (300/ν GHz)*
Number of Baselines	*Up to 1225 (ALMA correlators can handle up to 64 antennas)*
Frequency Coverage	*All atmospheric windows from 84 GHz - 950 GHz (with extension to ~30 GHz when Band 1 is deployed)*
Correlator: Total Bandwidth	*16 GHz (2 polarizations × 4 basebands × 2 GHz/baseband)*
Correlator: Spectral Resolution	*As narrow as 0.008 × (300/ν GHz) km/s*
Polarimetry	*Full Stokes parameters*

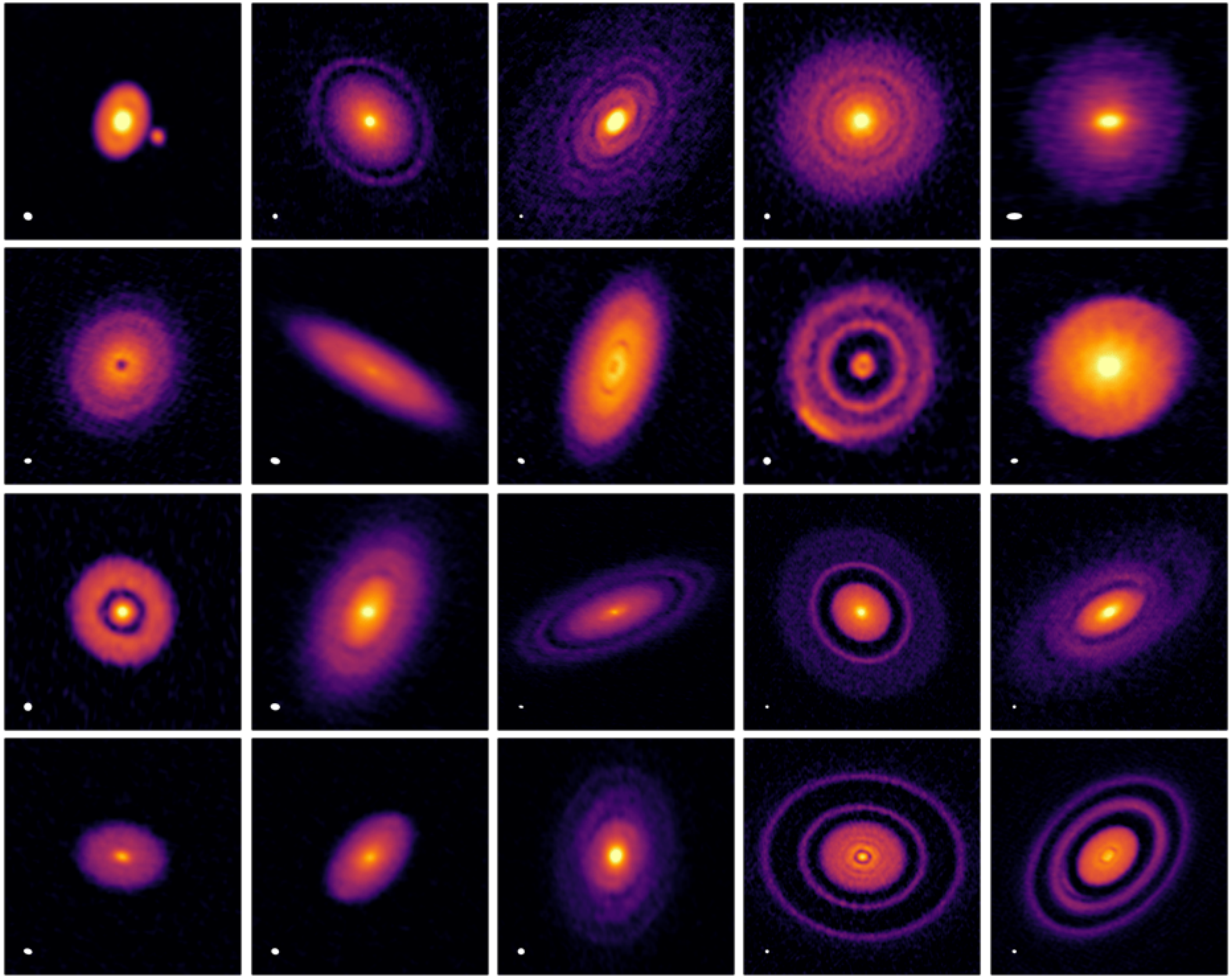
Level One Science Aims

- The ability to detect spectral line emission from CO or C^+ in a normal galaxy like the Milky Way at a redshift z=3, in less than 24 hours of observation.
- The ability to image gas kinematics in a solar-mass protostellar / protoplanetary disk at a distance of 150 pc, enabling one to study the physical, chemical, and magnetic field structure of the disk and detect the tidal gaps created by planets undergoing formation.
- The ability to provide precise images at an angular resolution 0.1".

→ ASAC reported that the aims were essentially achieved for the last five Cycles.

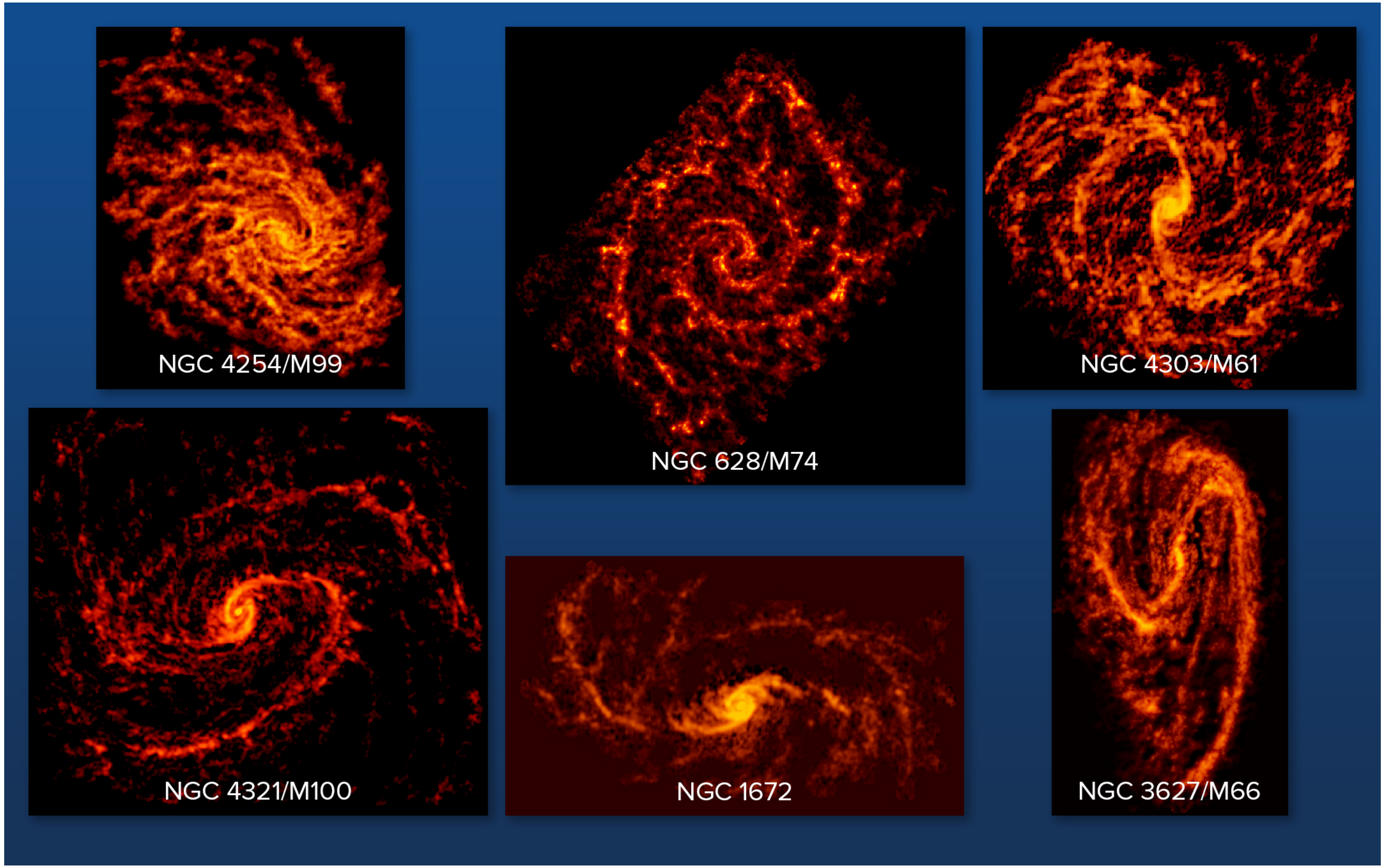
DSHARP

- Cycle 4 LP
- High-resolution (35 mas) survey of 240 GHz (1.25mm) continuum and ^{12}CO J=2-1 emission from 20 nearby PPDs
- 10 articles published in ApJL focus issue



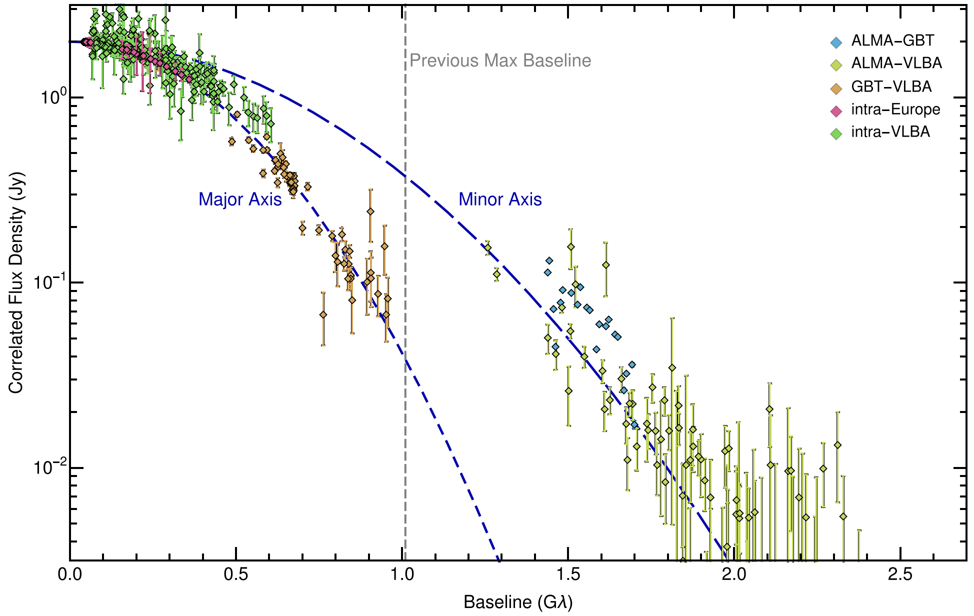
PHANGS; Cycle 5 LP
(Physics at High Angular Resolution in Nearby GalaxieS)

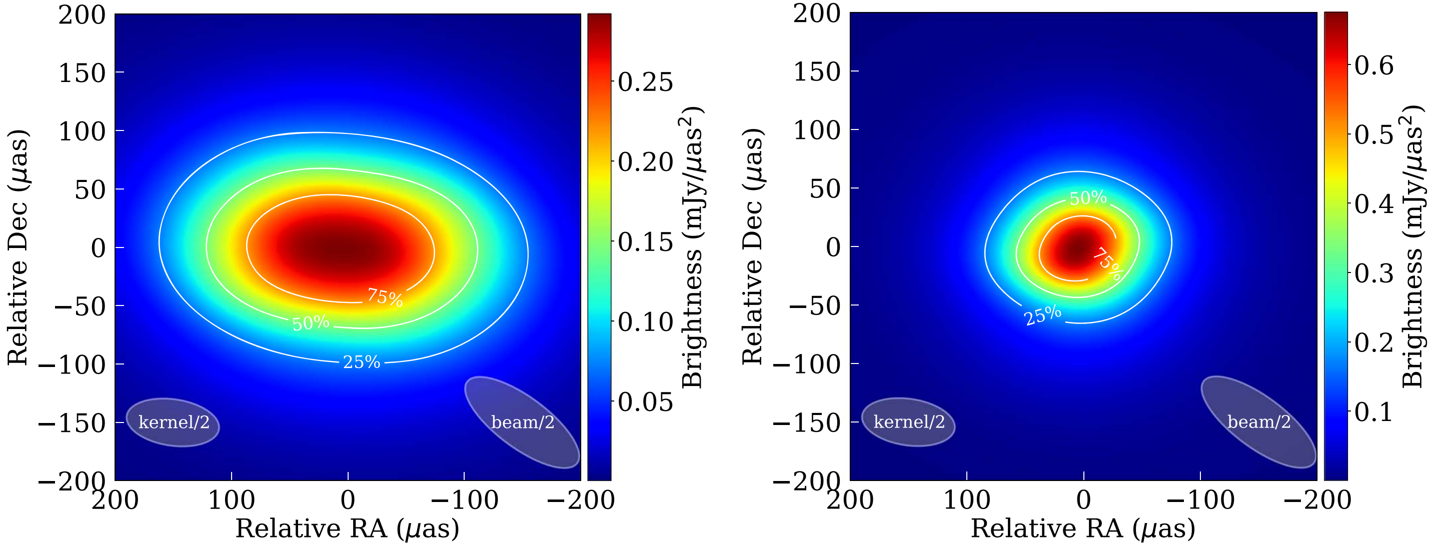
- 74 galaxies; 750h ALMA time
- Understand star formation changes on the size, age, and internal dynamics



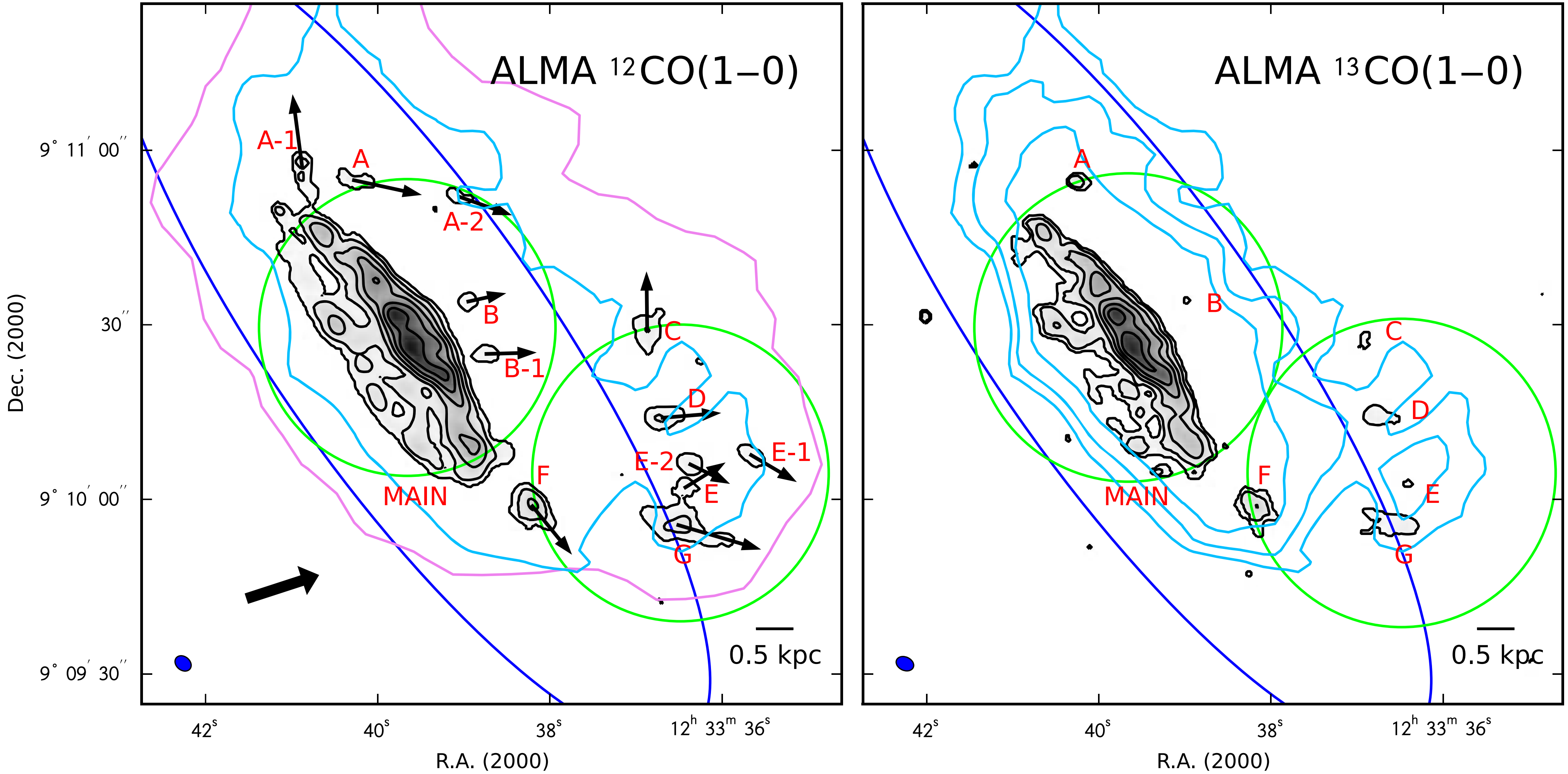
Sgr A*, First VLBI with ALMA

- 2019, ApJ, Issaoun+ (조일제, G.-Y. Zao)
- GMVA (VLBA,GB,YS,PV,EB)+ALMA(37 phased antennas) at 86 GHz (3.5mm), 5.76h integration time with ALMA
- 87 μas (factor of 2 improvement)
- Unscattered source has a major-axis size of 120 μas (12 μas Schwarzschild radii)



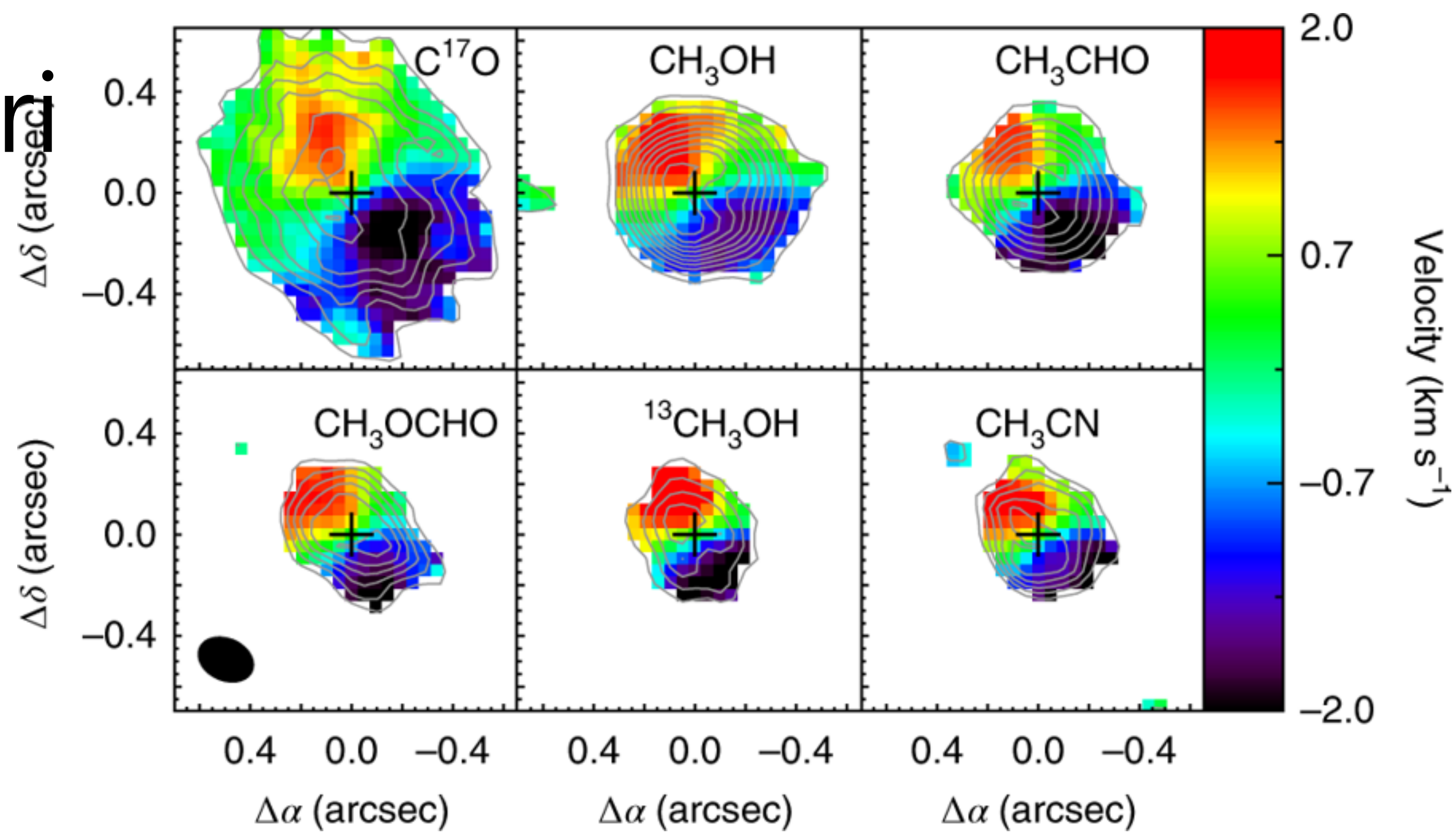


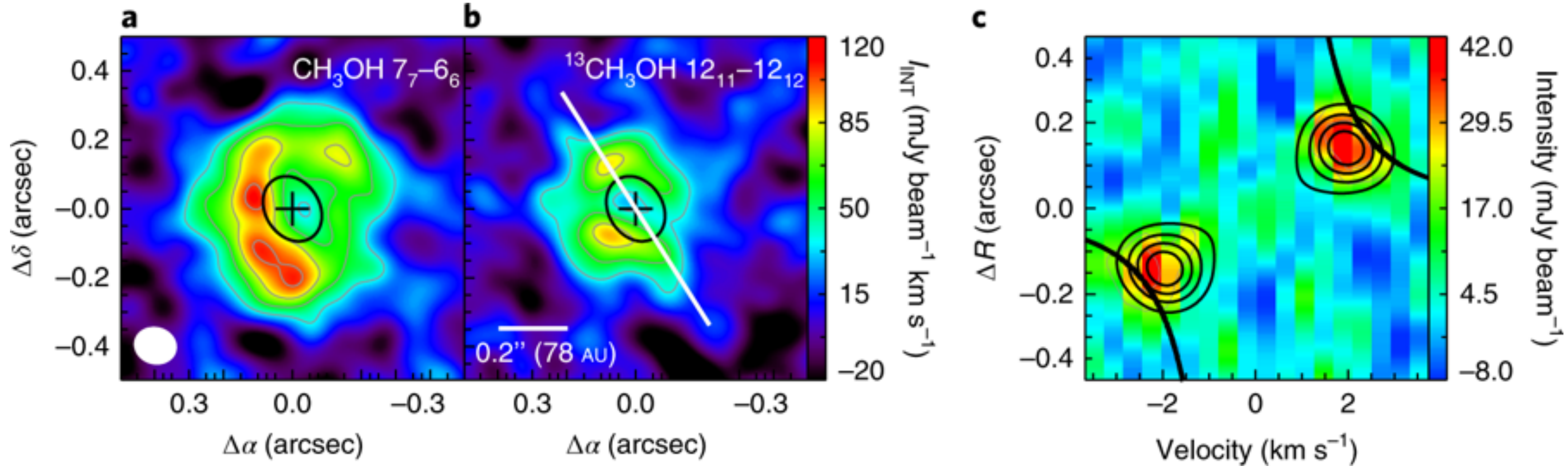
Extraplannar ^{13}CO in a Ram-pressure-stripped Galaxy 이범현+정애리 2018, ApJL



COMs in V883 Ori
이정은+, 2019, NA

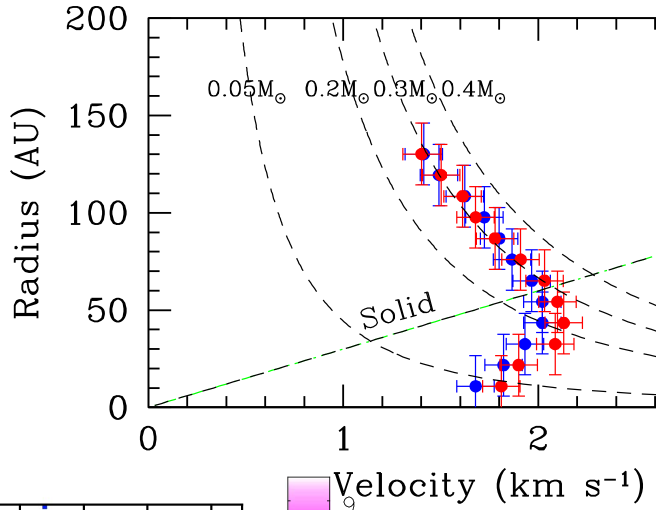
- V883 Ori, A FU Ori stat with mass of 1.2 Msun
- ALMA band 7, 0.03” continuum, 0.2” for COM emission

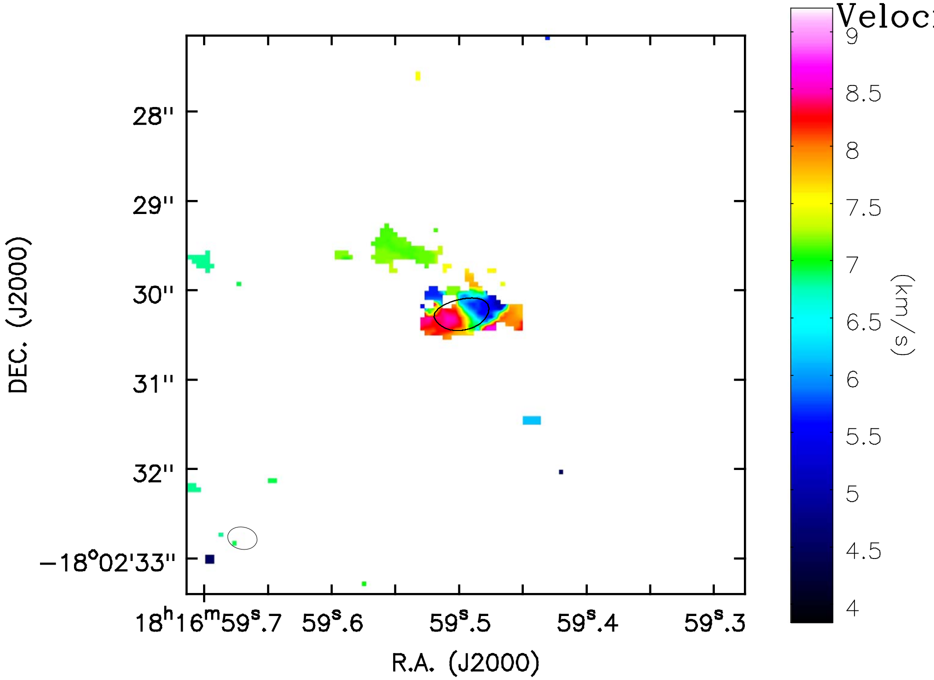


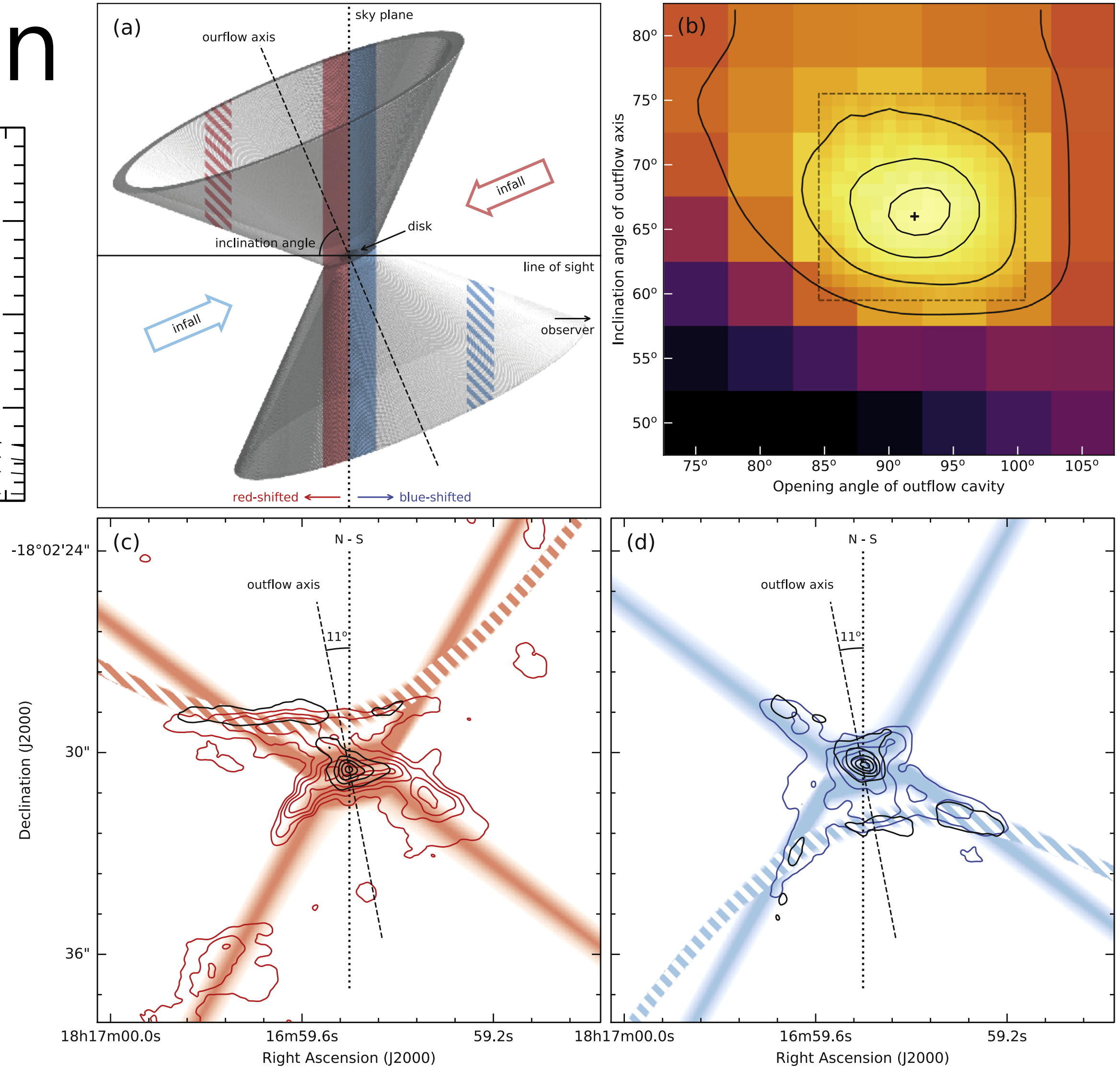


이창원+, 2018, ApJ

Mass of proto-brown dwarf
L328-IRS: 0.012-0.023 Msun



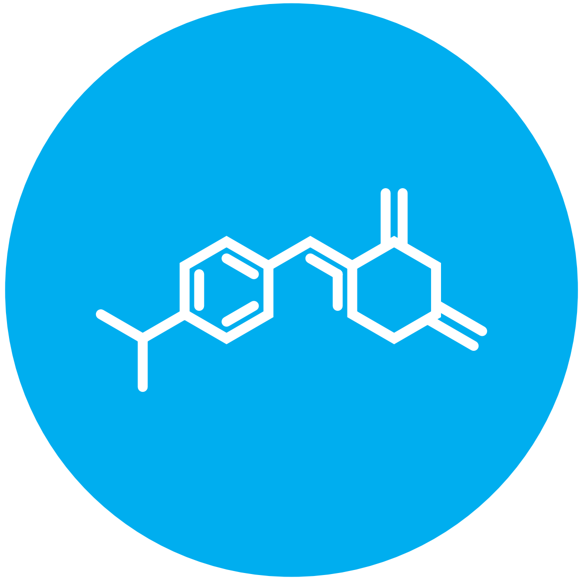




ALMA Development Roadmap

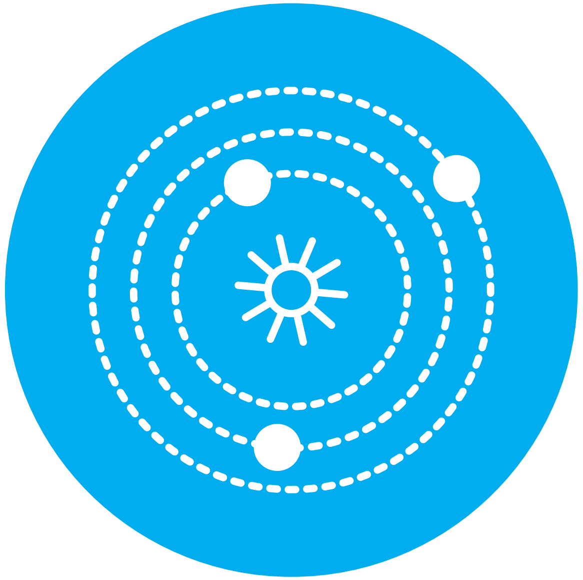
ORIGINS OF GALAXIES

Trace the cosmic evolution of key elements from the first galaxies (z>10) through the peak of star formation (z=2–4) by detecting their cooling lines, both atomic ([CII], [OIII]) and molecular (CO), and dust continuum, at a rate of 1-2 galaxies per hour.



ORIGINS OF CHEMICAL COMPLEXITY

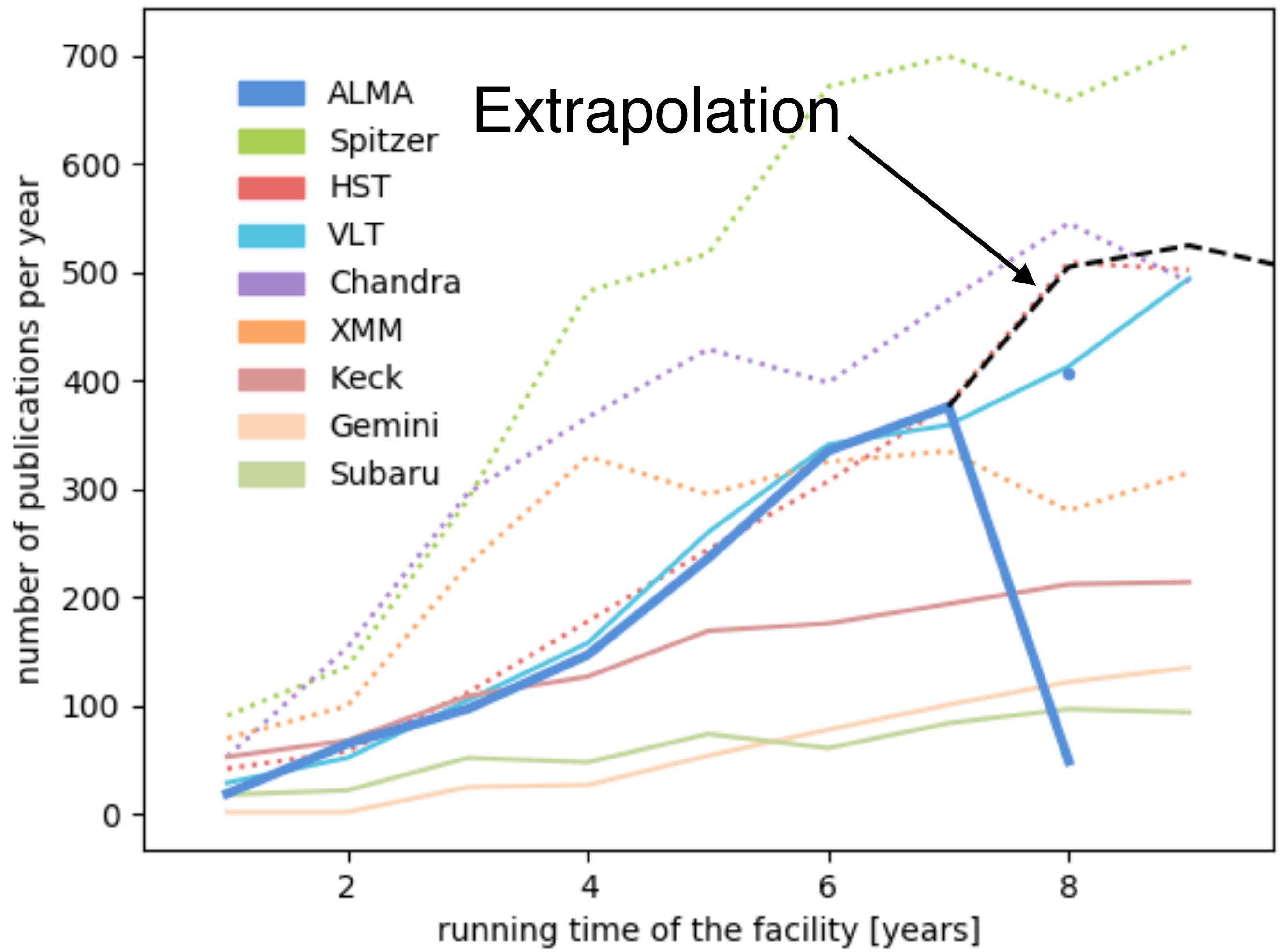
Trace the evolution from simple to complex organic molecules through the process of star and planet formation down to solar system scales (~10-100 au) by performing full-band frequency scans at a rate of 2-4 protostars per day.



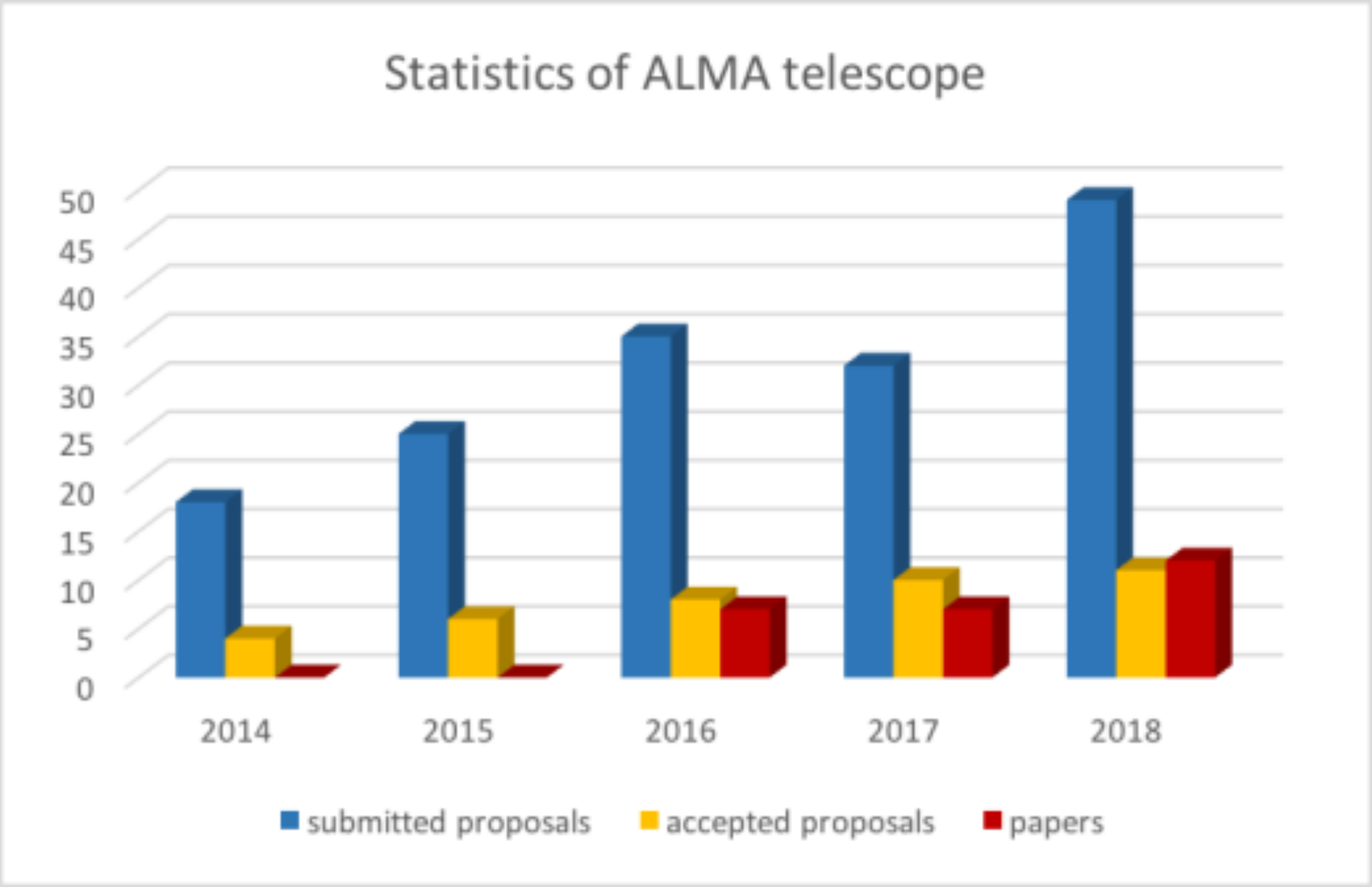
ORIGINS OF PLANETS

Image protoplanetary disks in nearby (150 pc) star formation regions to resolve the Earth forming zone (~ 1 au) in the dust continuum at wavelengths shorter than 1mm, enabling detection of the tidal gaps and inner holes created by planets undergoing formation.

ALMA paper productivity



ALMA proposals and papers



- ‘17→ ‘18
- Submitted proposal: 32→49
- Accepted proposal: 10→11
- Published paper: 7→13