

Updates on ALMA

Jongsoo Kim

Korea Astronomy and Space Science Institute

Atacama

Large

Millimeter/

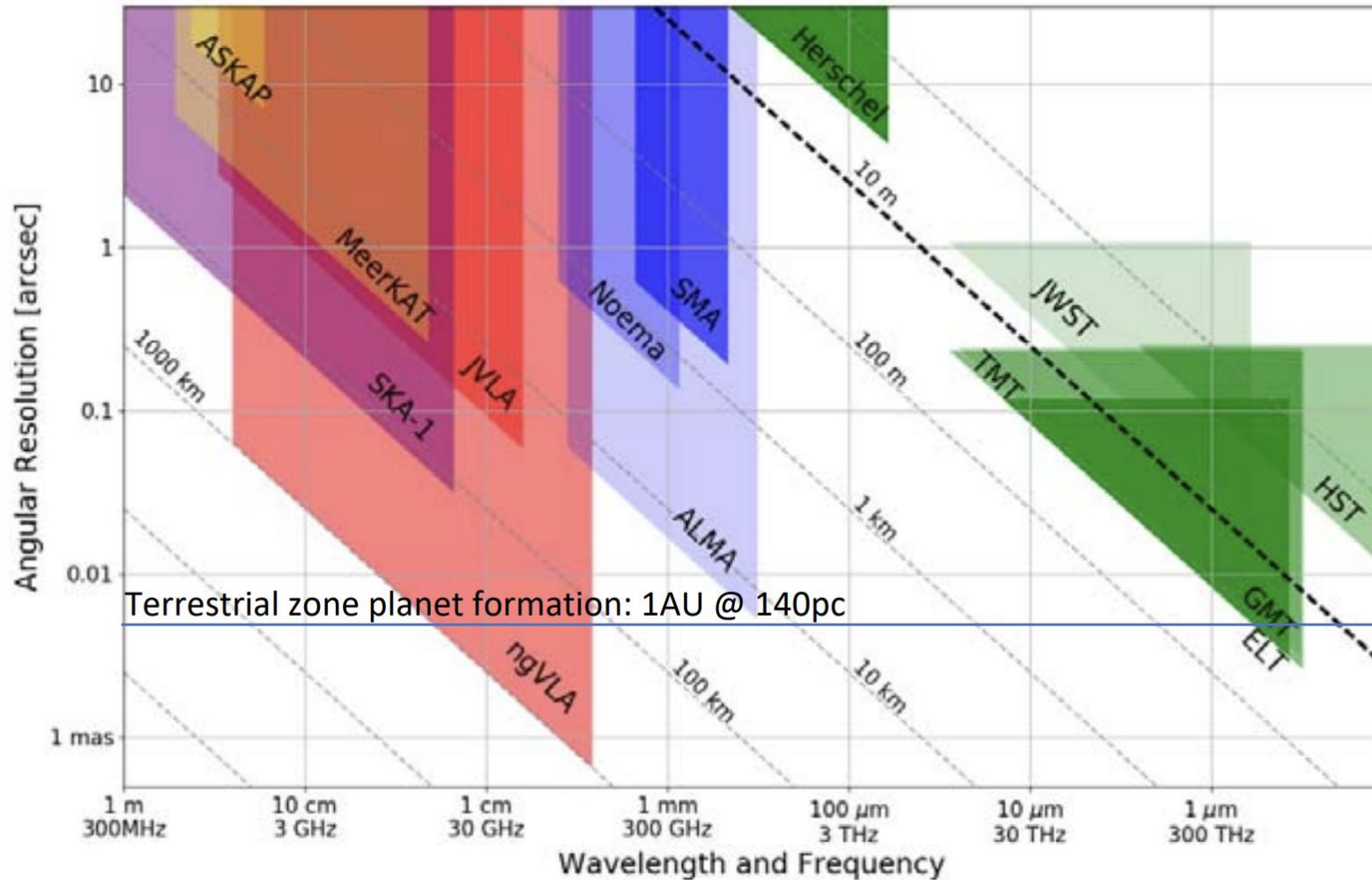
Submillimeter

Array

- 12m array: 50 x 12m antennas
- ACA array: 12 x 7m antennas + 4 x 12m antenna
- Longest distance between two antennas: 16 km



Angular resolutions of different telescopes



AGREEMENT

CONCERNING THE

OPERATIONS AND DEVELOPMENT OF THE

ATACAMA LARGE

MILLIMETER/SUBMILLIMETER ARRAY

(ALMA)

BETWEEN

THE NATIONAL INSTITUTES OF NATURAL SCIENCES of

JAPAN

AND

THE KOREA ASTRONOMY AND SPACE SCIENCE INSTITUTE

Katsuhiko Sato, President
National Institute of
Natural Sciences

Han Inwoo

Inwoo Han, President
Korea Astronomy and Space
Science Institute

Date

Date

KASI Daejeon

2014. 8. 17
KASI, Daejeon

Place

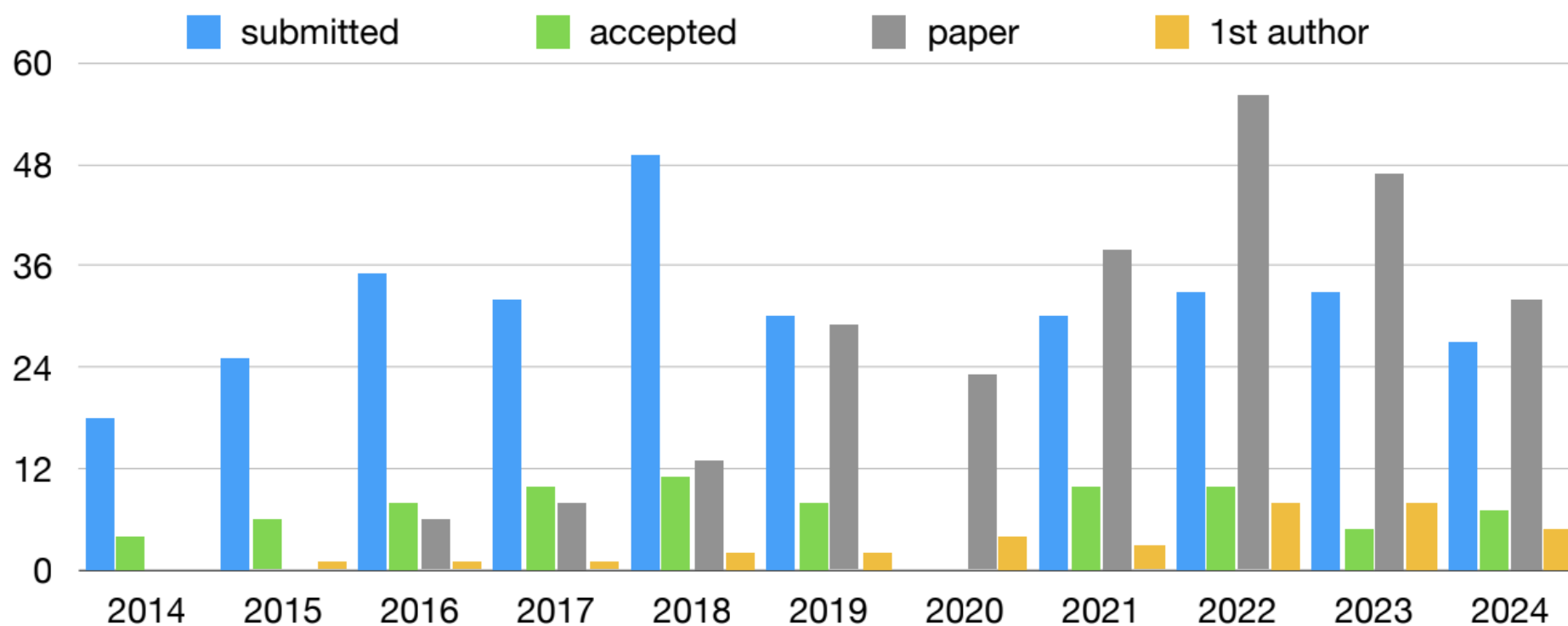
Place

MoA for ALMA in Aug '14



ALMA proposal statistics

- 27 submitted (1.5% of total), 7 accepted (5 A+B, 2 C), 1 DDT
- Accepted time - Main array: 82.6h, ACA: 45.1h, TP: 12.9h
- C.f. total 1712 proposal, MA:31744h, ACA:13018h, TP: 8929h, Subscription: EA 6.2, all 7.4)

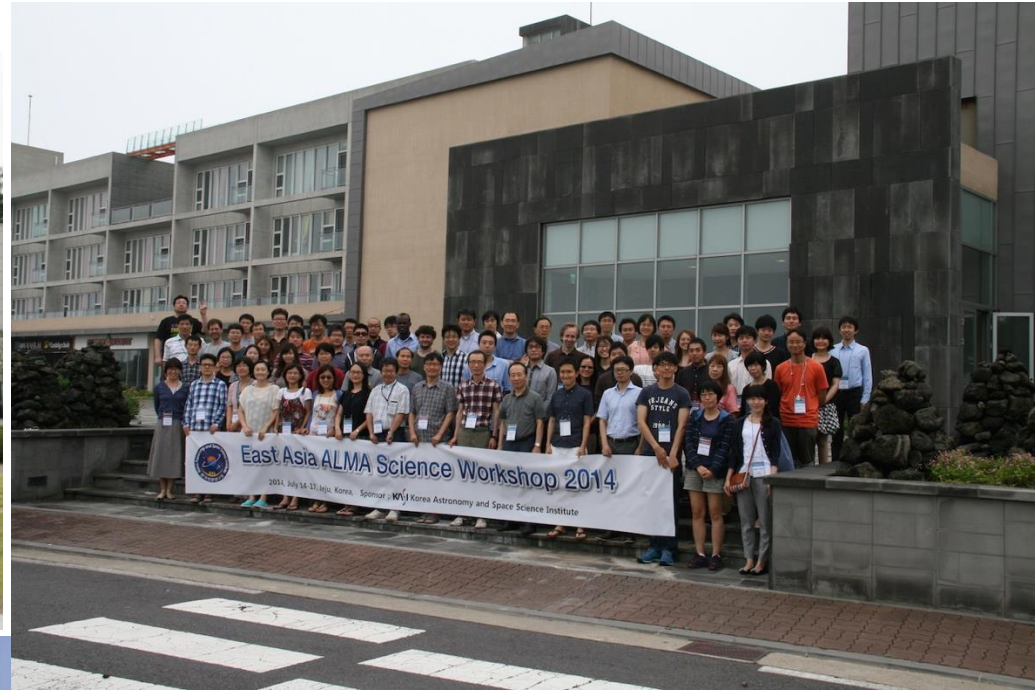


EA ALMA Science workshops organized by Korea

2012 Sep
KASI



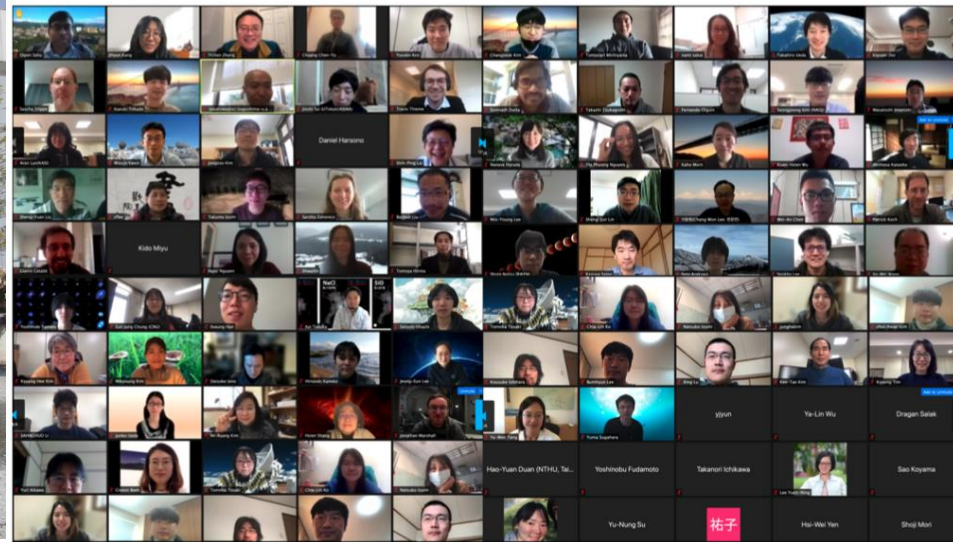
2014 Jul
Jeju



2017 Nov
KASI



2021 Feb
online



1st ALMA Summer School

21-25/August, 2017, Sobaek Observatory



ALMA proposal preparation workshop



- January 13-17, 2025 (5 days)

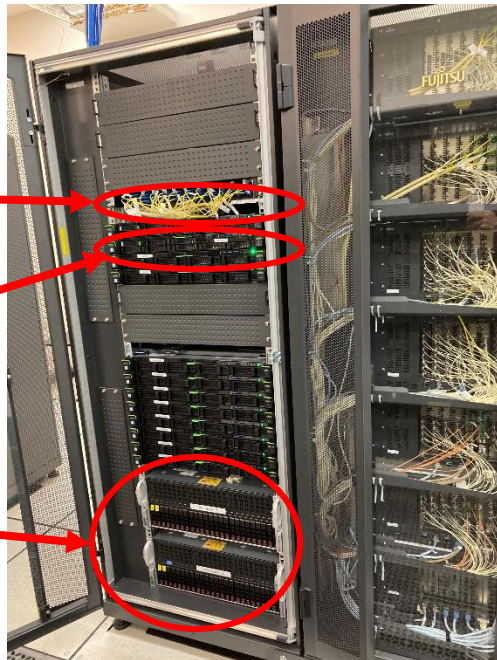
The ACA Spectrometer installed at AOS in Feb 2022



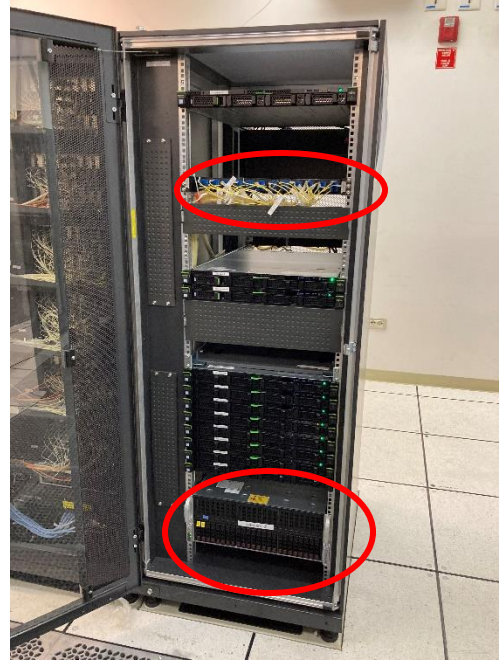
Optical Splitters

ASC

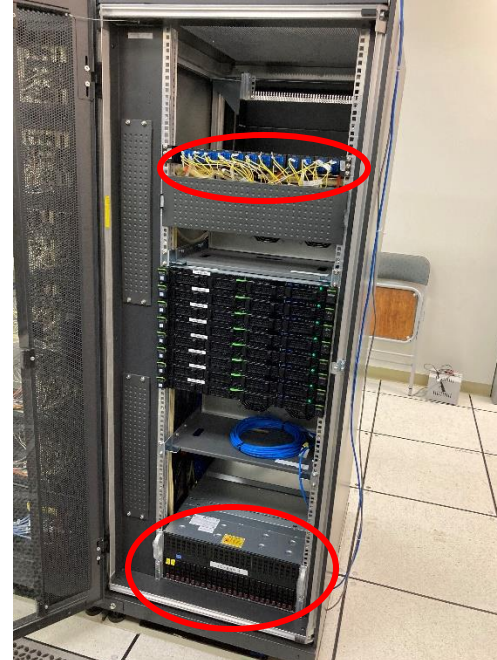
ASM



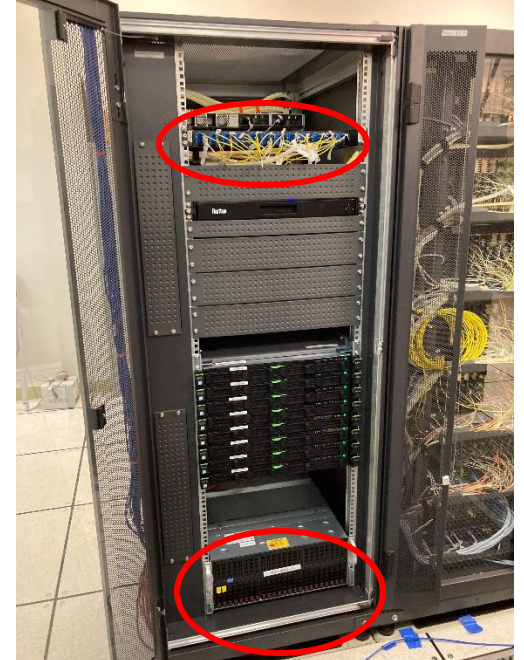
Q0 comp rack



Q1 comp rack



Q2 comp rack



Q3 comp rack

20:30 CLST Tue 22nd Mar 2022 / 08:30
JST Wed 23rd Mar 2022

All-Hands Meeting

86 GHz SiO ($v=1, J=2-1$)

Orion

2022-02-22

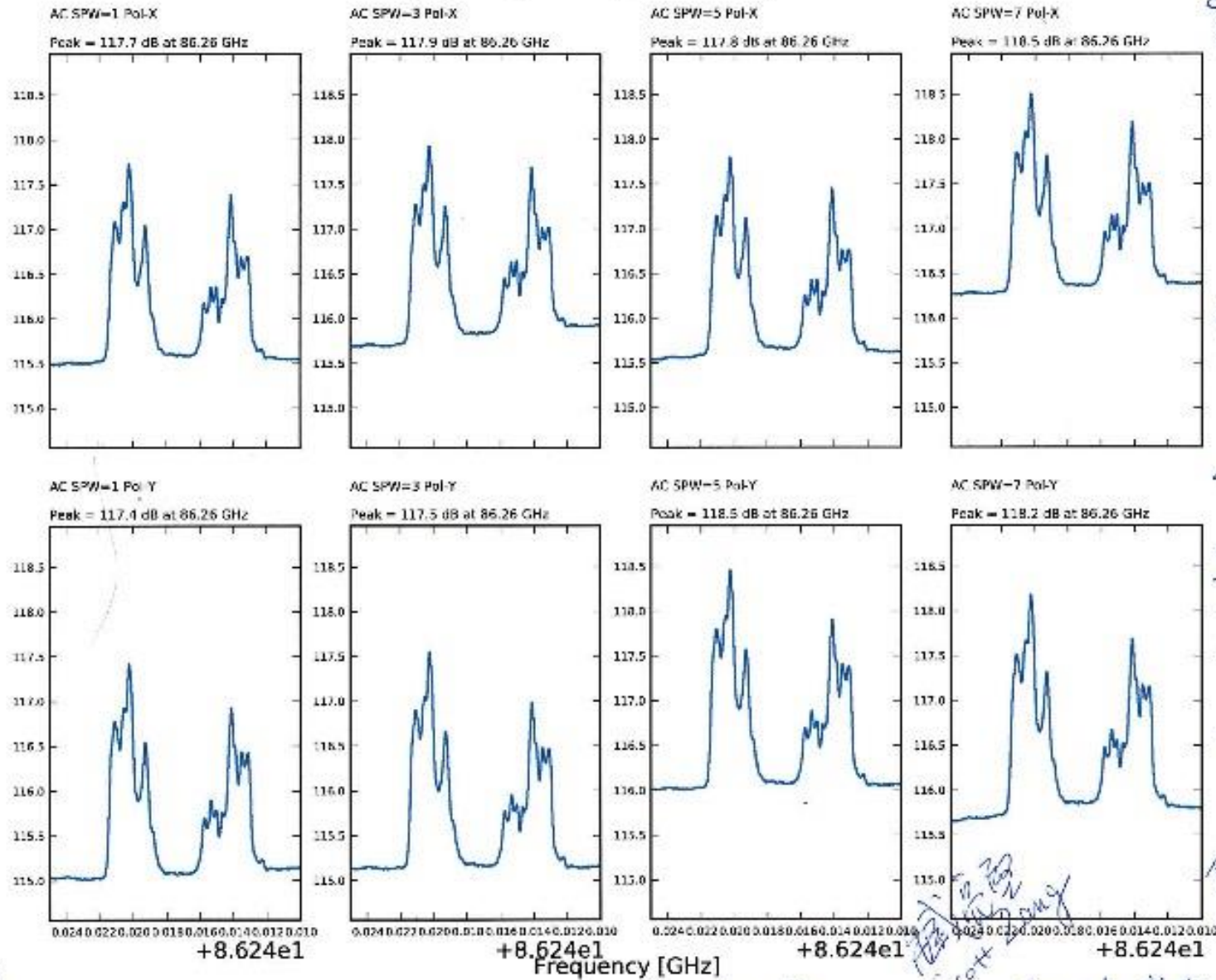
Handwritten notes:
 2022-02-22
 11:19:10 AM



Median a

Handwritten note:
 Congratulations on your achievement! :D
 Camilo Salazar

uid_A002_Xf59d27_X42 Power Spectra



Handwritten note:
 Jongsoo Kim 2022-02-22
 I am happy to get these spectra. I appreciate many people to help this project.

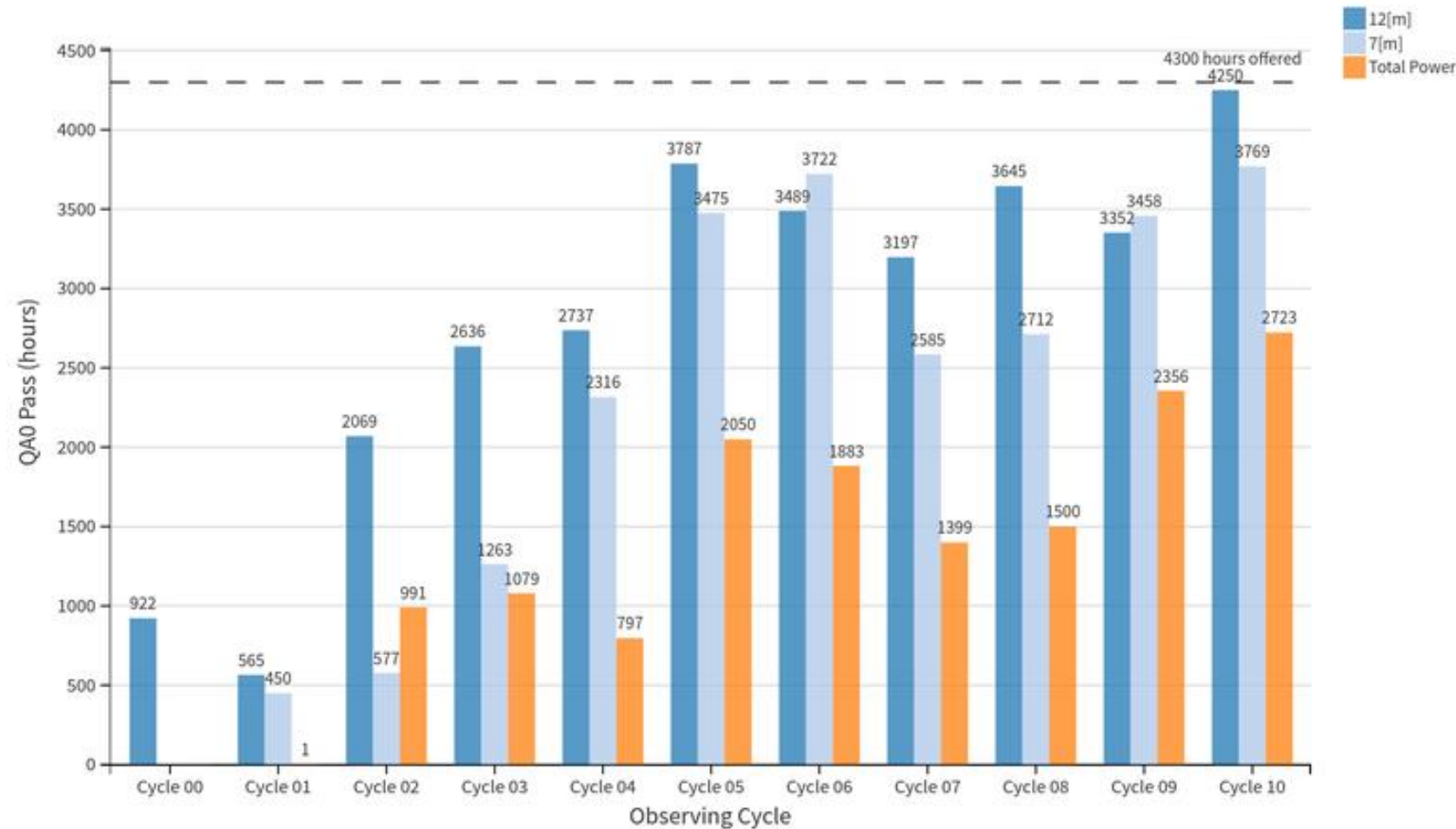
Handwritten note:
 Mandu Watanabe
 Unexpectedly great achievement. Congratulations to the Team!

Handwritten note:
 To # 452
 Shun Ishii

Handwritten notes:
 Great
 Jongsook
 Seon-jun Kamano

ALMA Cycle 10: Record-Breaking Observation Hours

- 12-m: 4250 hours
- 7-m Array: 3769 hours
- **Total Power Array: 2723 hours**

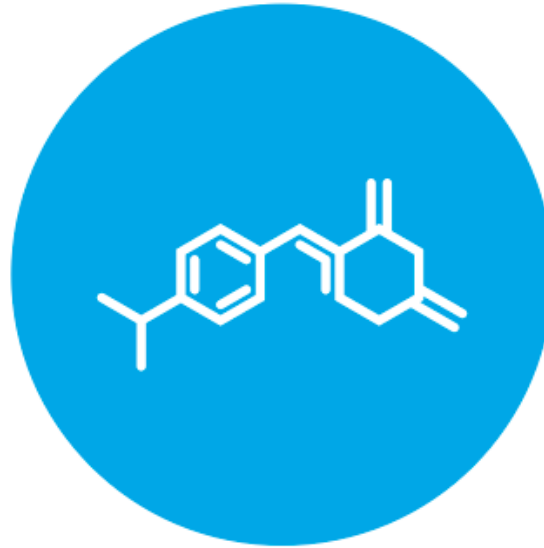


ALMA Development Roadmap 2030



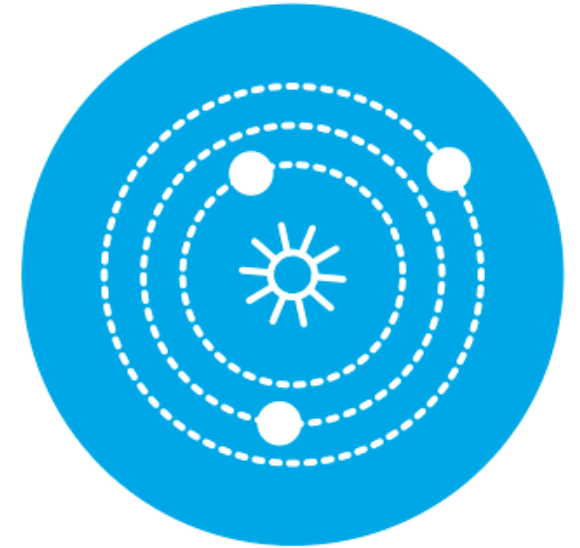
ORIGINS OF GALAXIES

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

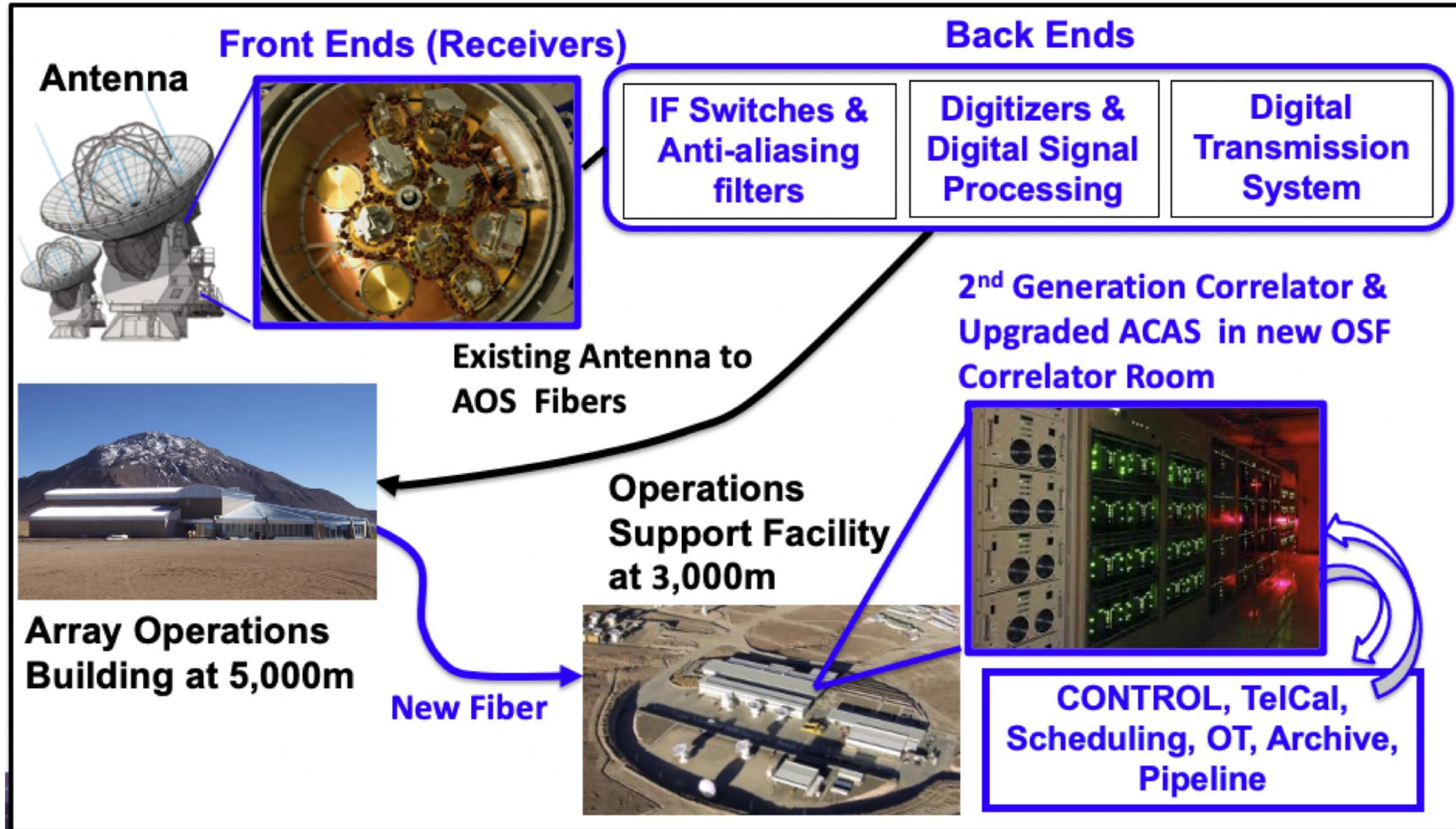
Trace the evolution from simple to complex organic molecules through the process of star and planet formation down to solar system scales ($\sim 10-100$ au) by performing full-band frequency scans at a rate of 2-4 protostars per day.



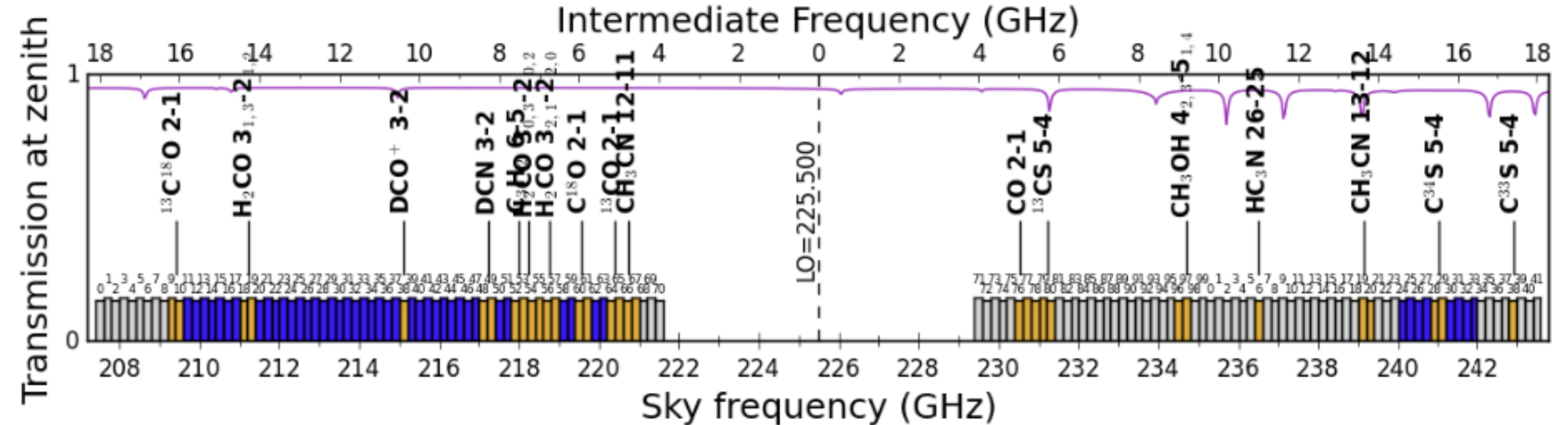
ORIGINS OF PLANETS

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.

ALMA2030 Wideband Sensitivity Upgrade



Band 6v2 (IF=4~18 GHz) science setup



Comparision between ACAS and TPGS

Requirements	ACAS	TPGS	Improvement factor
Maximum Correlated Bandwidth (Max CBW)	8 GHz per pol	32 GHz per pol	4
Maximum # of spectral windows	4 x 4	160	10
# of channels (per pol) dual pol	4 x 4096	160 x 14880	145
# of channels (per pol) full pol	4 x 2048		291
Channel width at Max CBW dual pol	488 kHz	13.5 kHz	36
Channel width at Max CBW full pol	976 kHz		72
Finest channel width dual pol	15.25 kHz	13.5 kHz / 16	18
Finest channel width full pol	30.5 kHz		36

GPU technology developments

- **Upgrade of PCIe Standard**
 - PCIe Gen 5 (Hopper): Supports up to 400 GE
 - PCIe Gen 6 (Blackwell): Supports up to 800 GE
- **GPU-centric approach, DOCA GPUNetIO**
 - GPUDirect async kernel-initiated network (GDAKIN) communications to allow a CUDA kernel to directly control the NIC
- **Wider Bandwidth Connections**
 - NVLink C2C: Provides 900 GB/s bandwidth, which is 7 times greater than PCIe Gen 5.
 - **NVLink (GPU-to-GPU):** Achieves 1.8 TB/s bandwidth, critical for improving cross-correlation performance.
- **Performance improvement**
 - Grace Hopper 200 NVL2: 134 TFLOPS for FP32 computations
 - **Grace Blackwell 200 NVL2: 180 TFLOPS for FP32 computations**

AOS

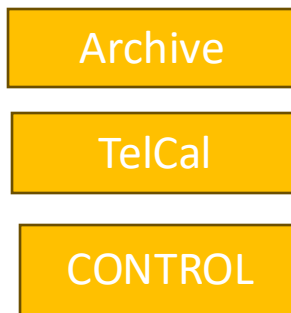
OSF

4 400GE connections
per antenna. 1 / POL / SB

Raw data rate per connection:
 $40\text{GSps} * 6\text{b} = 240\text{ Gbps}$



32 ports
400GE switches
supplied by ATAC



CDP 400 GbE switch



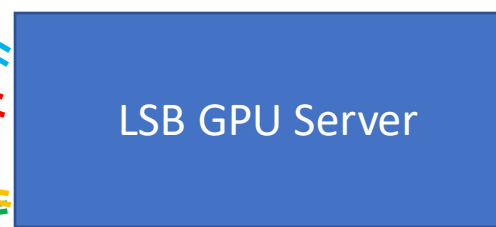
200 GbE



M&C S1



USB GPU Server



LSB GPU Server

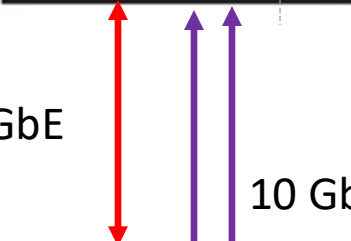
8 * 400 GbE ports

10/100 GbE switch

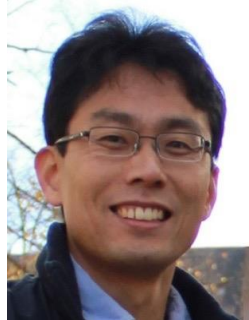
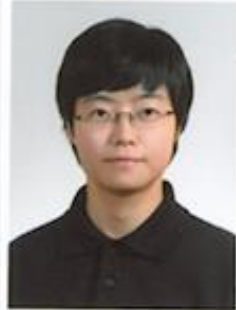


100 GbE

10 GbE



Current and Past members of the Korean ALMA projects



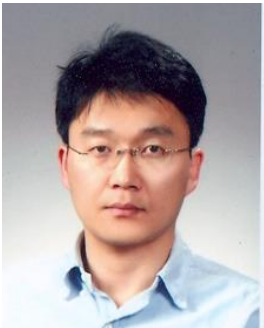
SNU

Sejong Univ



CNU

India



MPIfRA