Atacama Large Millimeter/submillimeter Array

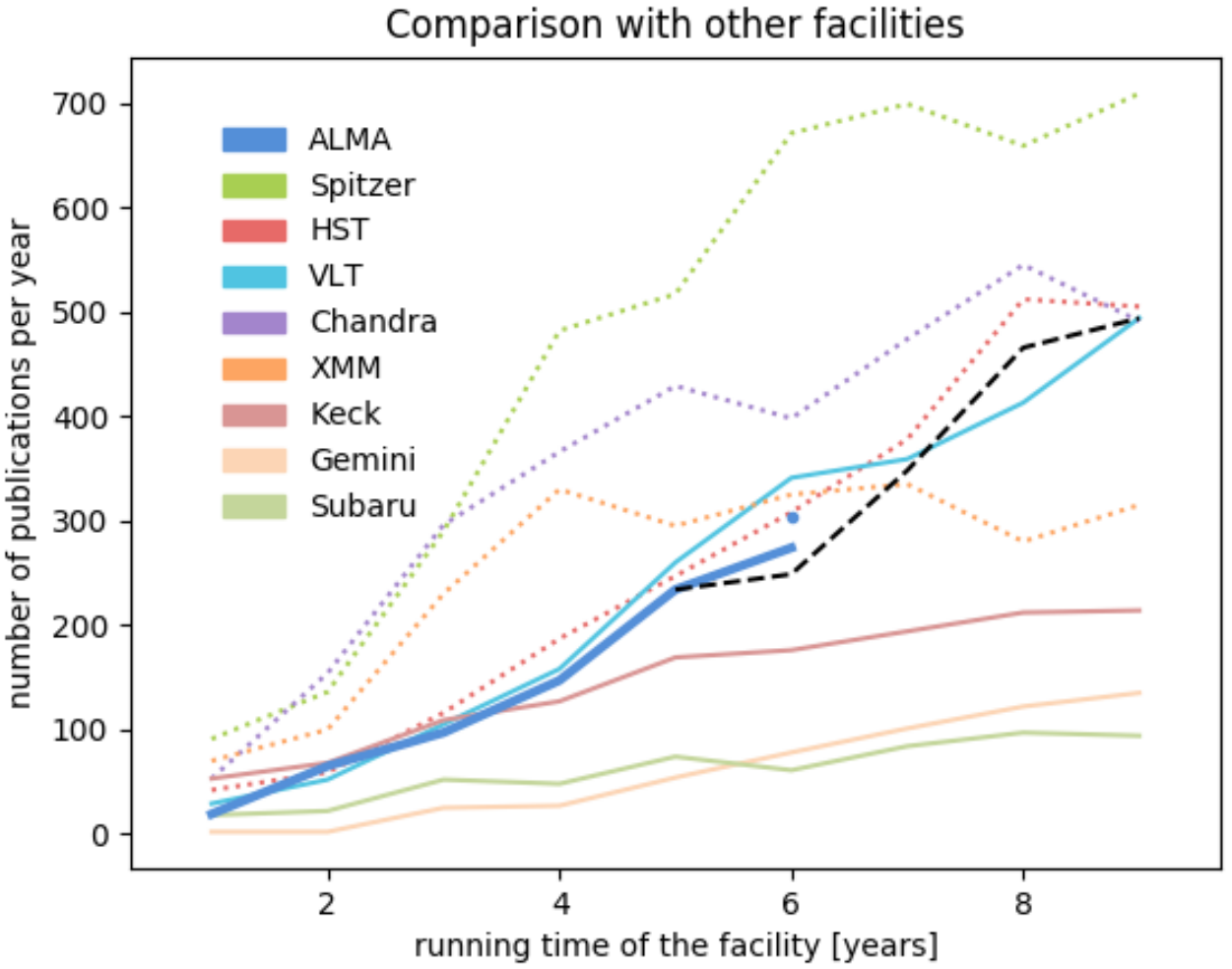
Welcome & ALMA Project Report

Satoru Iguchi

26 December 2017

National Astronomical Observatory of Japan

Science Papers – Output Rate



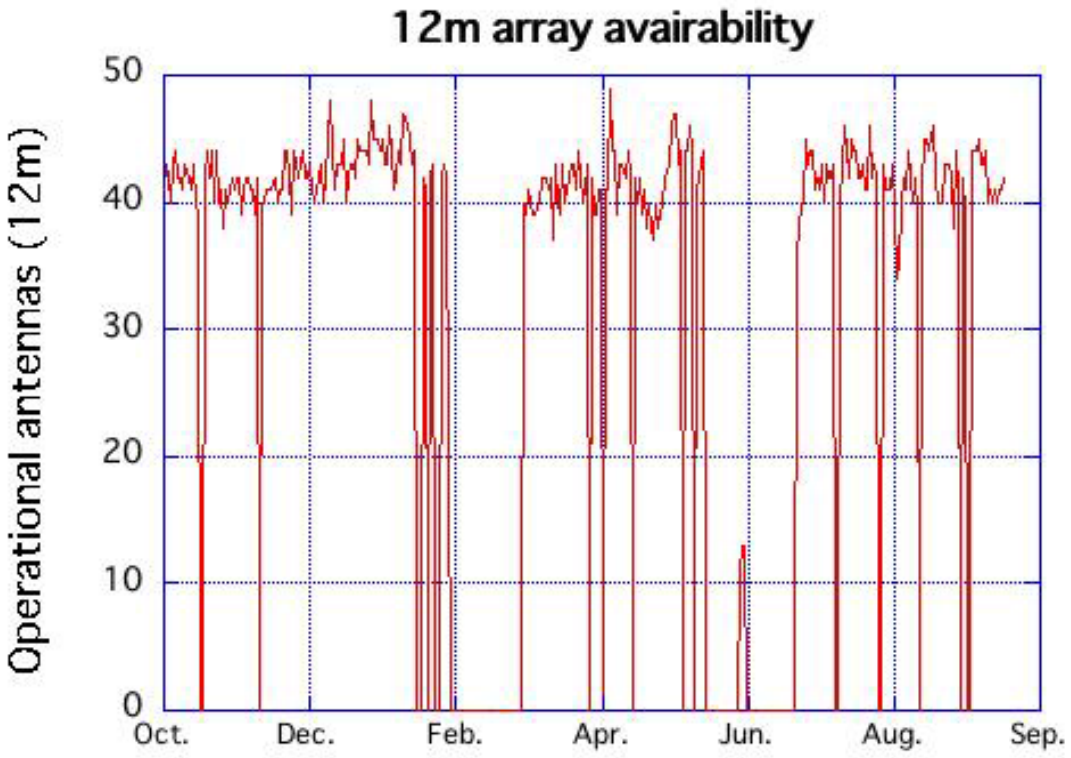
ALMA Project Report

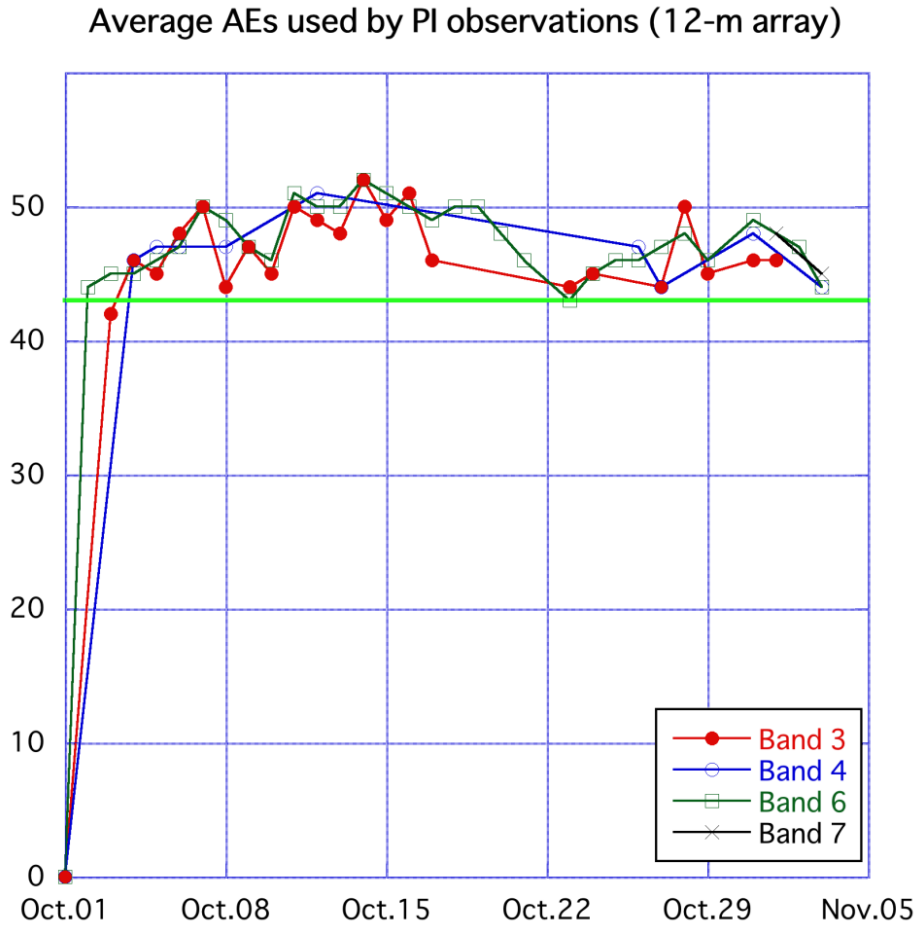
ALMA Status – Summary 1

- ✓ Construction Project ended in Sep. 2014 (there are still a number of remaining construction items to be finished, e.g. the ***Residencia***, which was fully completed in 2017)

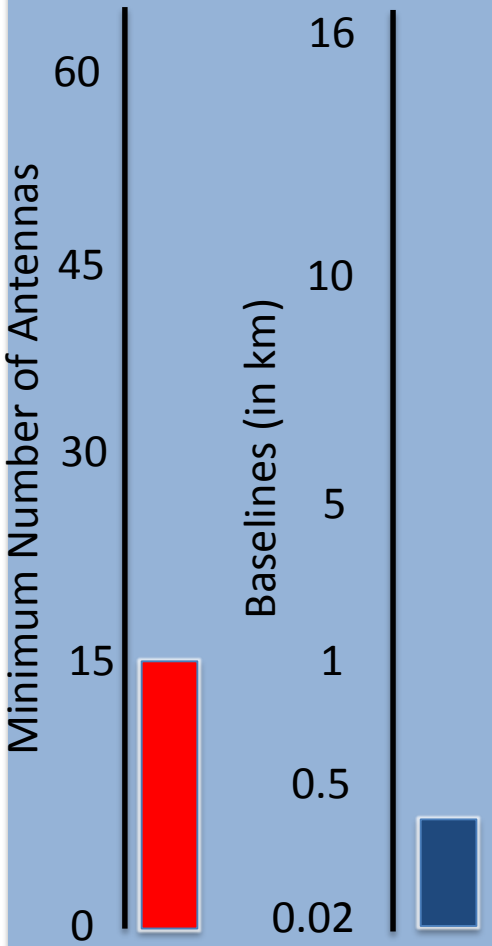
ALMA Status – Summary 2

Availability of Array Elements (October 2016 to September 2017)





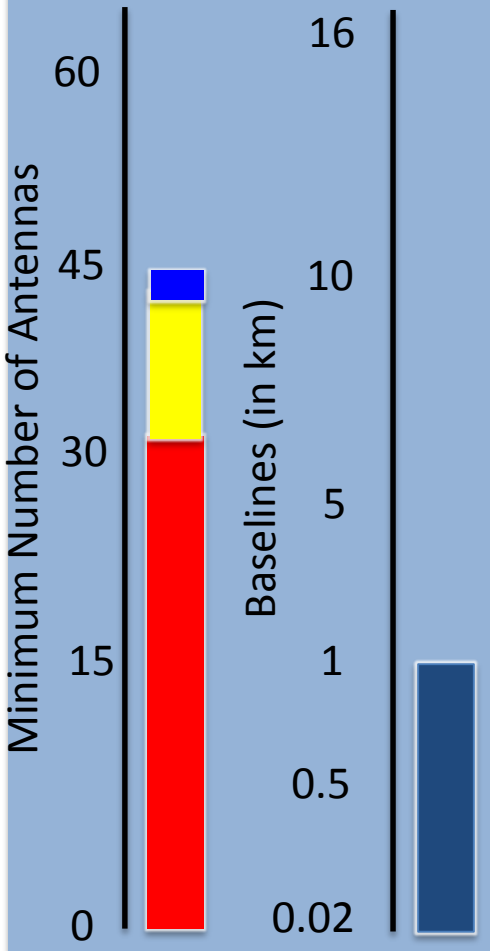
ALMA Capabilities from Cycle 0 to 5



- Band 3: 3 mm (84-116 GHz)
- Band 6: 1 mm (211-275 GHz)
- Band 7: 850 µm (275-370 GHz)
- Band 9: 450 µm (602-720 GHz)
  - Both single field interferometry and pointed mosaics
  - Up to four simultaneous spectral windows available with same bandwidth and resolution

Cycle 0 (~600 h) Sep. 2011

ALMA Capabilities from Cycle 0 to 5



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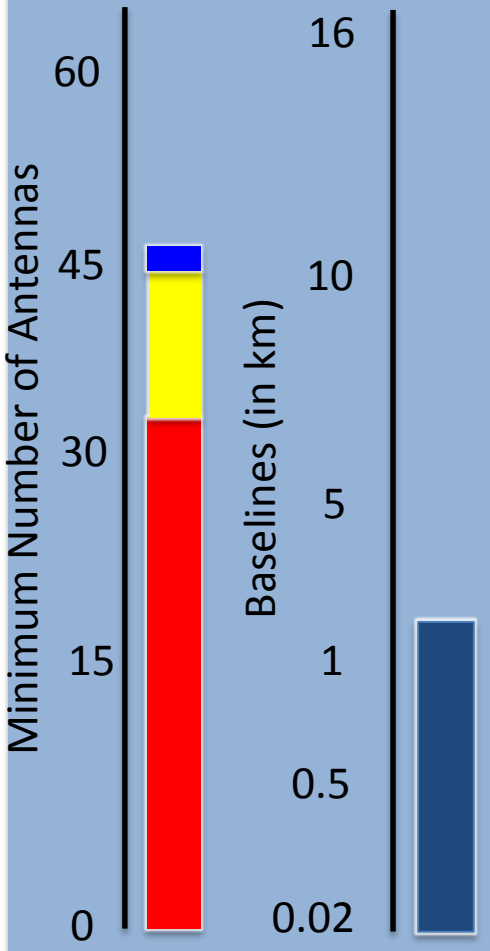
  - Both single field interferometry and mosaics
  - Mixed correlator modes (both high and low frequency resolution in the same observation)

Cycle 1 (800 h) Jan. 2013

ALMA Capabilities from Cycle 0 to 5



- Band 3: 3 mm (84-116 GHz)
- Band 4: 2 mm (125-163 GHz)
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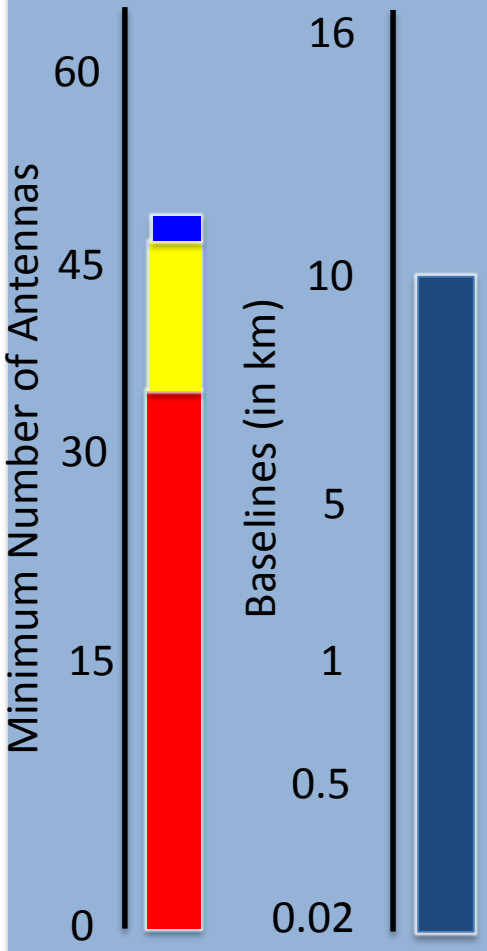
- Band 8: 650 µm (385-500 GHz)
- Band 9: 450 µm (602-720 GHz)

Cycle 2 (2000 h) June 2014

- Both single field interferometry and mosaics
- Spectral-line observations with all Arrays and continuum observations with the 12-m Array and the 7-m Array.
- Polarization (on-axis, continuum, selected frequencies in Band 3, 6 and 7, no ACA, no mosaics)
- Mixed correlator modes (both high and low frequency resolution in the same observation)

ALMA Capabilities from Cycle 0 to 5



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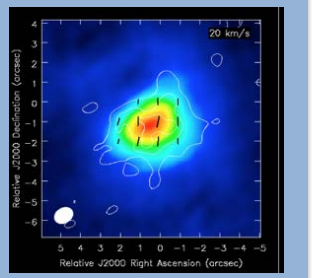
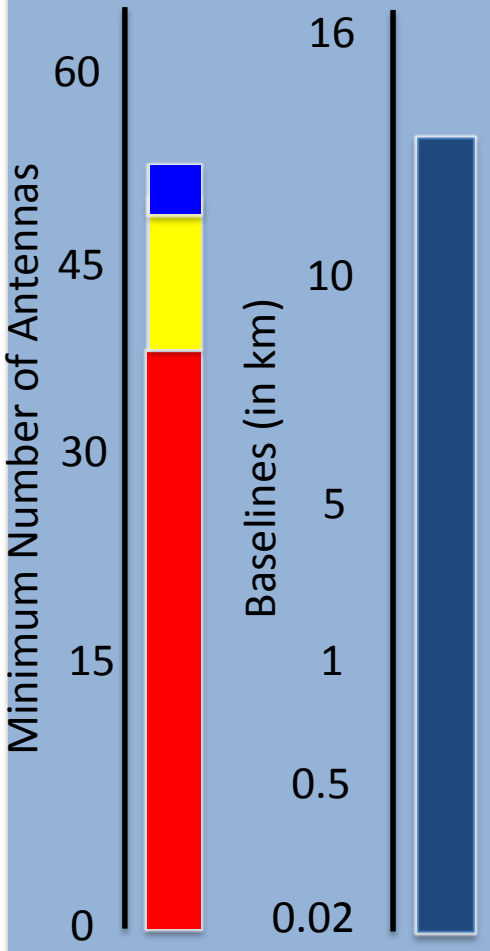
- Band 9: 450 µm (602-720 GHz))
- Band 10: 350 µm (787-950 GHz)

Cycle 3 (2100 h) Oct. 2015

- High-fidelity imaging, mosaicking
- Flexible correlator (up to 16 narrow spectral windows, or 8 GHz bandwidth)
- Polarization (linear polarization in continuum and spectral line)



ALMA Capabilities from Cycle 0 to 5



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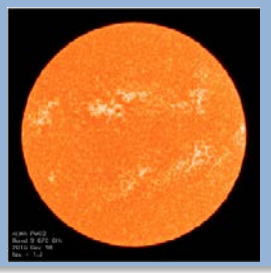
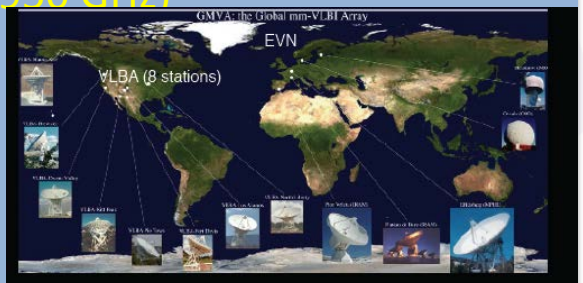
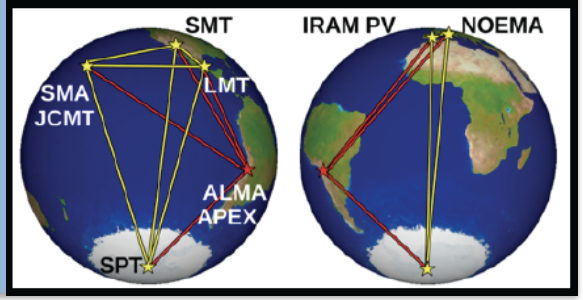
Cycle 4 (3000 h) Oct. 2016

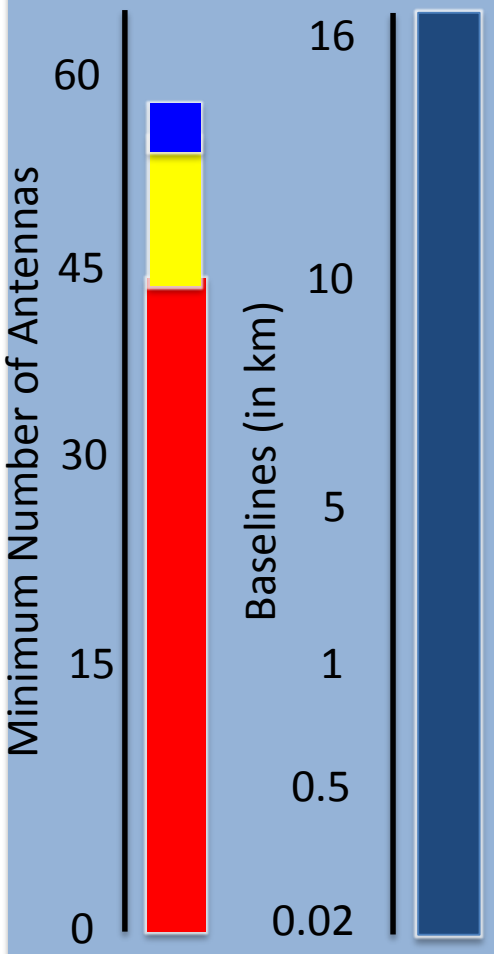
- Large program
- ACA standalone
- mmVLBI
- Solar Observation







ALMA Capabilities from Cycle 0 to 5



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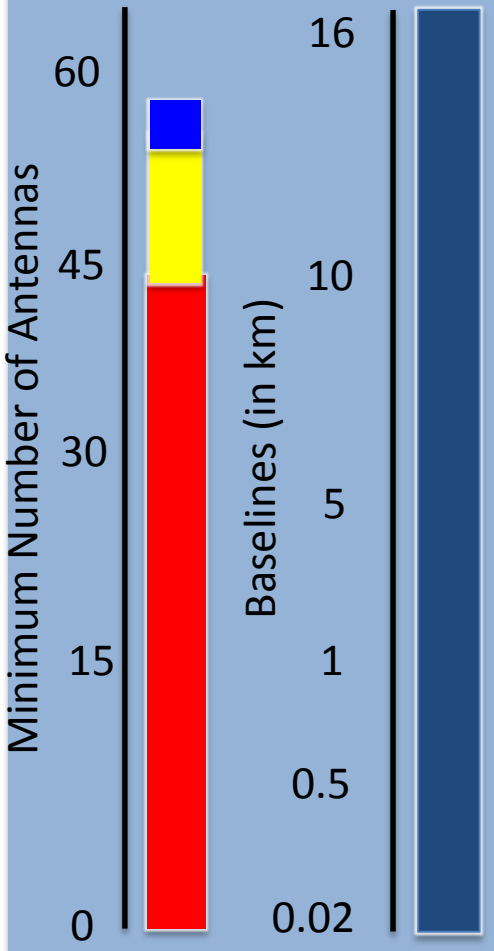
- Band 10: 350 µm (787-950 GHz)
- Band 5: 1.5 mm (163-211 GHz)

Cycle 5 (4000 h) Oct. 2017

- Maximum baseline length of 16 km at Bands 3, 4, and 6
- Band 5 at short baseline configuration only

Planned ALMA Capabilities of Cycle 6



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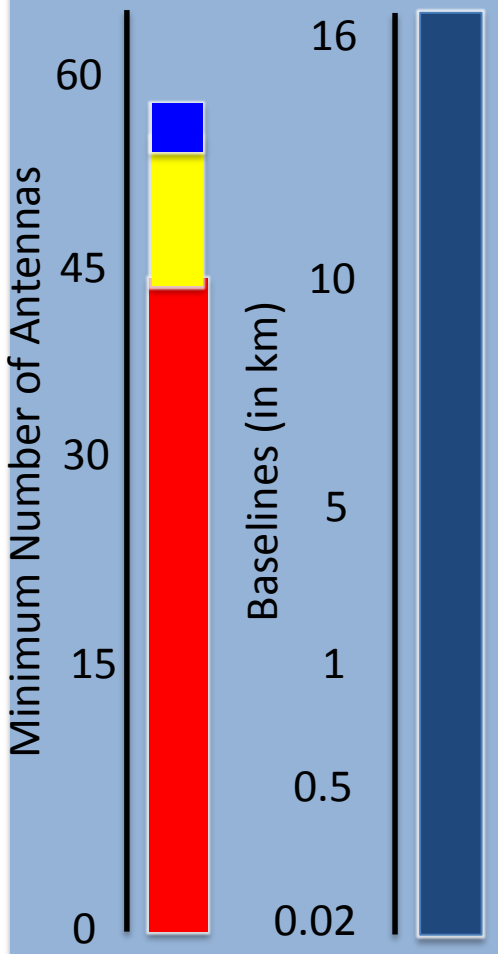
- Band 5: 1.5 mm (163-211 GHz)

Cycle 6 (~4300 h) Oct. 2018

- Maximum baseline length of 16 km at Bands 3, 4, 5, 6, 7?
- Band 8 as a standard mode
- Circular polarization (possibly)
- **Proposal deadline is on April 19**
- **APRC chair – Masao Saito**

Planned ALMA Capabilities of Cycle 7



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- Band 10: 350 µm (787-950 GHz)
- Band 5: 1.5 mm (163-211 GHz)

Cycle 7 (~4300 h) Oct. 2019

- Maximum baseline length of 16 km at Bands 3, 4, 5, 6, and 7
- Circular polarization (possible for Cycle 6)
- Wide-field mosaicking in polarization
- Single-dish spectral line by Band 9&10
- Total Power Continuum
- **APRC chair – Masao Saito**

ALMA Status: Receivers

Receiver Bands currently installed on all antennas,
in construction and under study:

- Band 1: 6 mm (35-52 GHz)
- Band 2: 4 mm (65-90 GHz)
- Band 3: 3 mm (84-116 GHz)
- Band 4: 2 mm (125-163 GHz)
- Band 5: 1.5 mm (163-211 GHz)
- Band 6: 1 mm (211-275 GHz)
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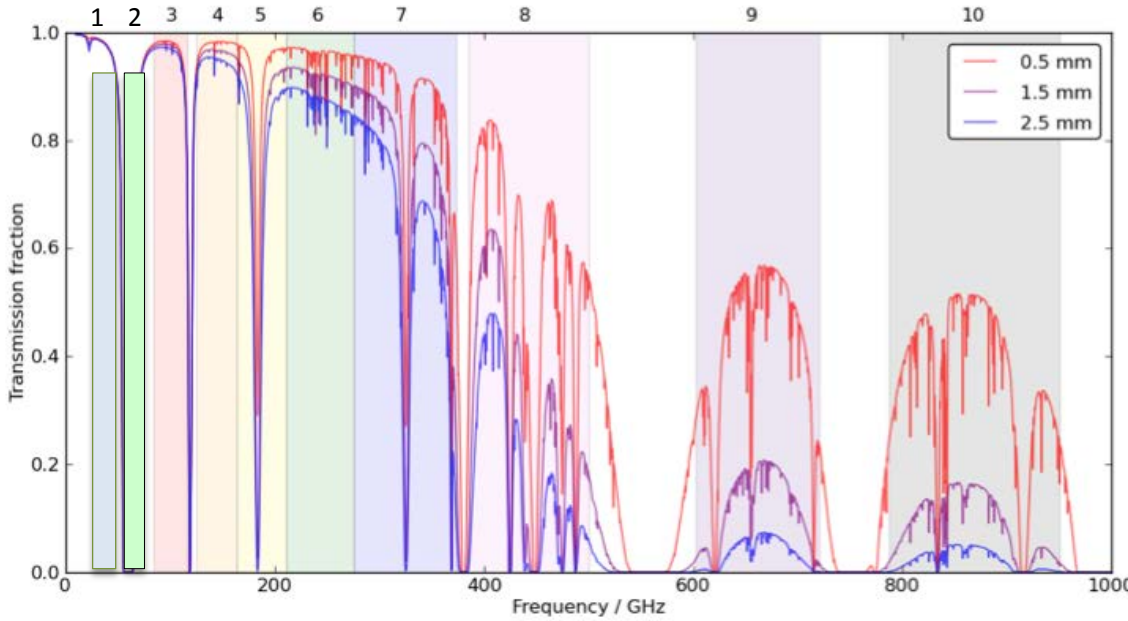


Steady State Operations and Beyond

- Performance based milestone
  - 7300 hours scheduled for science activities annually
    - Successful hours offered ~ 4300 (85% of array elements at a given time of 5000)
    - ≤970 h for weather and array calibration each
    - ≤320 h for technical issues
    - Testing and further development ~730 hours
  - Minimum of 56 antennas in service (daytime)
    - 43 12-m + 10 7-m + 3 SD
- Challenges
  - Weather recovery; Antenna/receiver uptime (corrective maintenance)
- Capability Driven Milestone
  - 7300 hours scheduled for science activities annually
  - Single Dish: continuum and high frequency
  - Polarization: Stokes V and wide fields
  - Long Baseline: Band 7 maximum baseline length

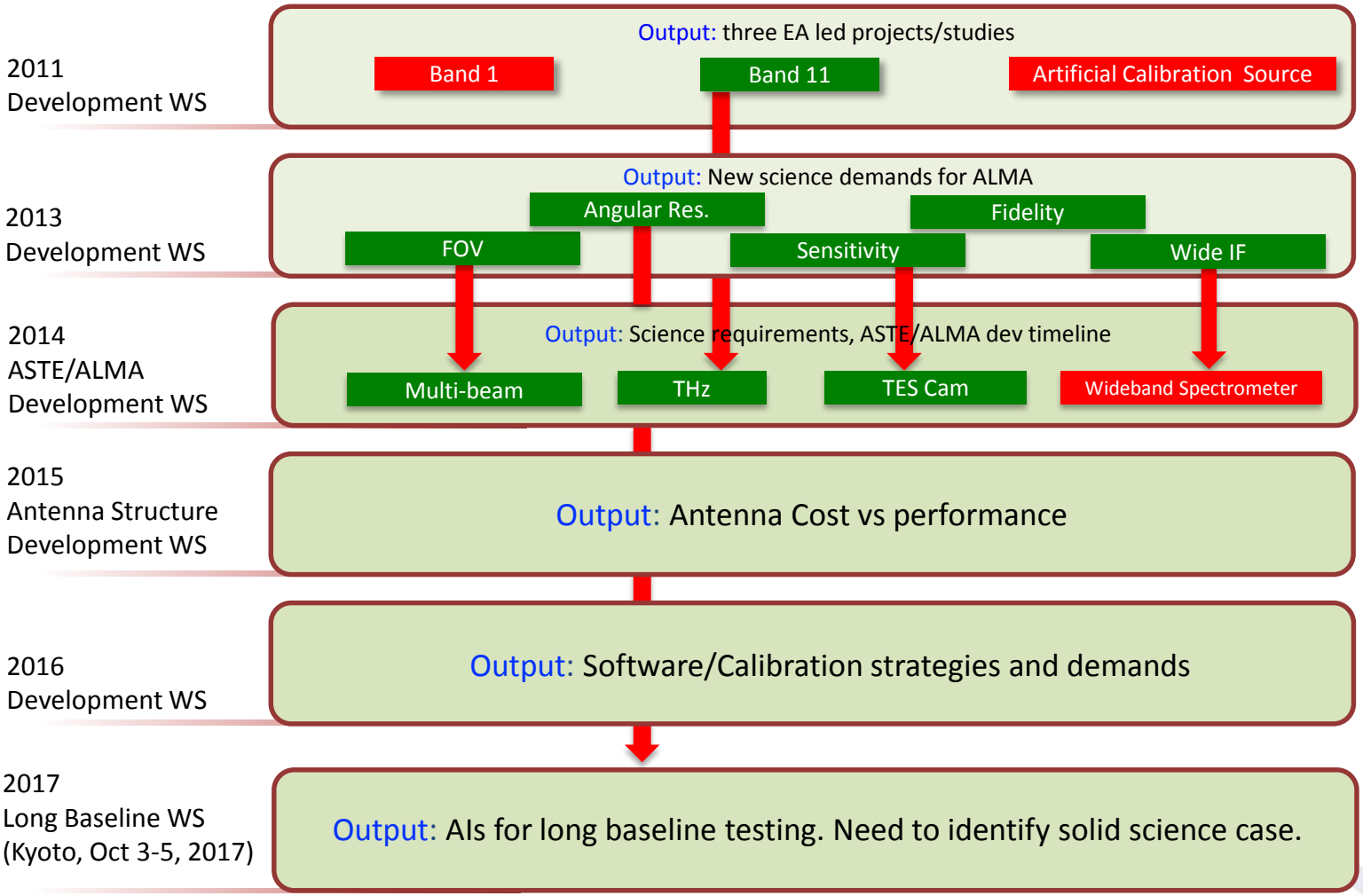
ALMA Status – Summary 3

- ✓ Bring ALMA to Full & Stable Operations
- ✓ Increase the new science capabilities

- Roadmap for Future Developments in next 10-20 years that will enable ALMA to extend the frontiers of science even further

ALMA Upgrade Planning

EA ALMA Development Workshops – Status –



http://alma-intweb.mtk.nao.ac.jp/~diono/meetings/EA_Development_Meeting/

http://alma-intweb.mtk.nao.ac.jp/~diono/meetings/ASTE_ALMA_2014/

http://alma-intweb.mtk.nao.ac.jp/~diono/meetings/NRO_ALMA_2015/

http://alma-intweb.mtk.nao.ac.jp/~diono/meetings/NRO_ALMA_2016/

http://alma-intweb.mtk.nao.ac.jp/~diono/meetings/longBL2017/

First five year Science Goals of ALMA Operations

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

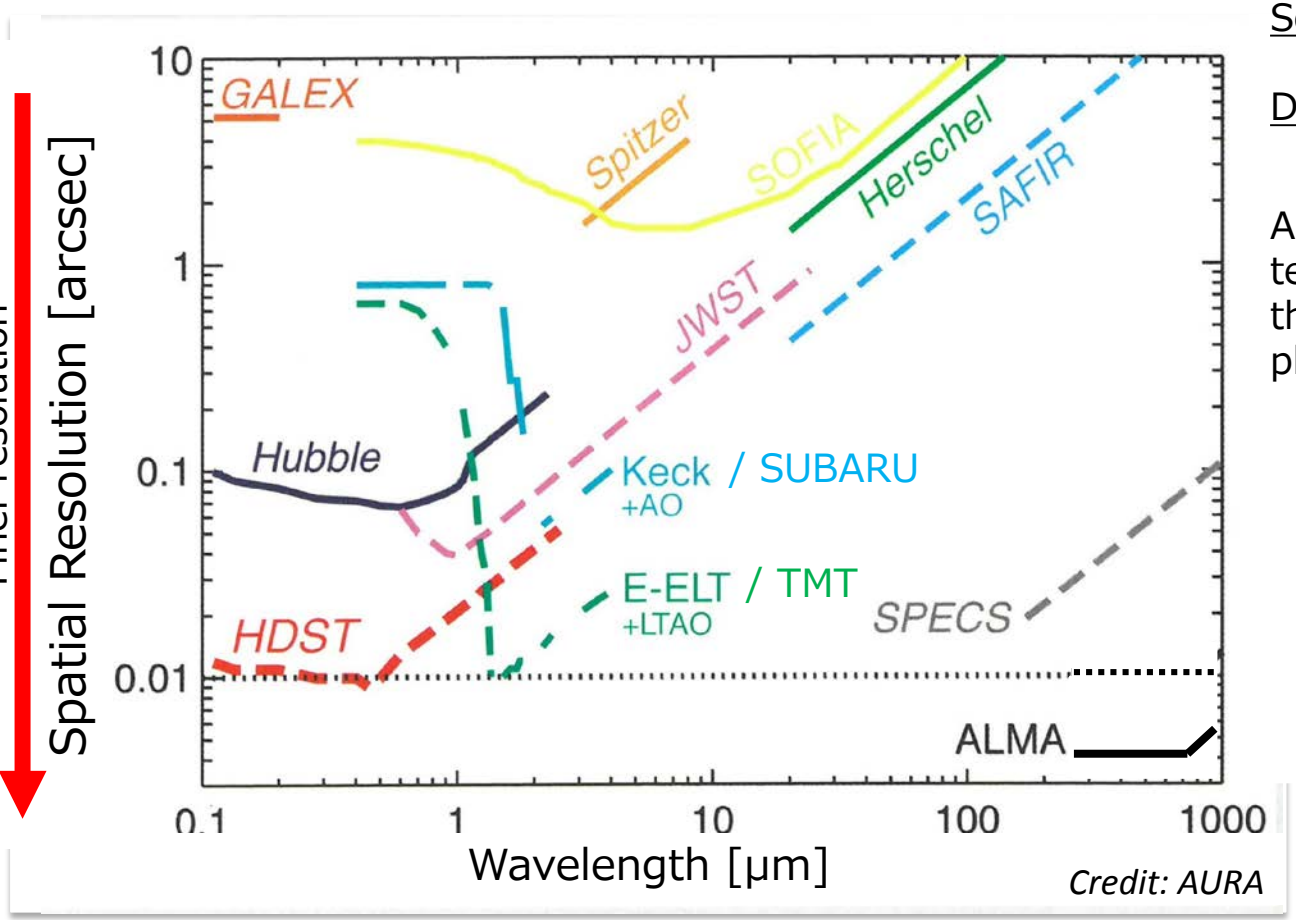
ALMA Long Baseline Workshop

- Organized by D. Iono

http://alma-intweb.mtk.nao.ac.jp/~diono/meetings/longBL2017/

  - Participants: more than 80

ALMA Potential Performance



Solid lines : under operation or terminated
Dashed lines : under construction or planning

ALMA will continue to be the forefront telescope in spatial resolution among the next generation telescopes planning in the coming 30 years.

0.01 arcsec corresponds to 1 AU at the distance of ~300 light yrs where many protoplanetary disks are present.

ALMA Management Structure

ALMA Top Management
– 2017 Dec: ALMA Management Team (AMT) –

- ALMA Top Management

JAO: Stuartt Corder (Acting Director)

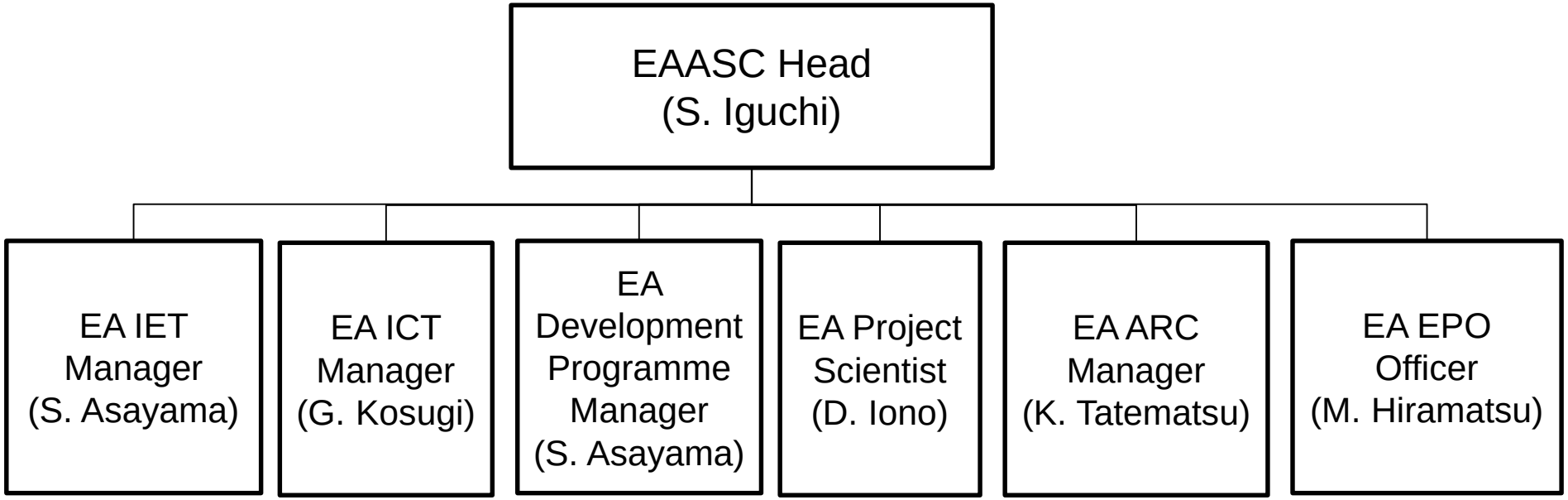
Sean Dougherty

EA: Satoru Iguchi

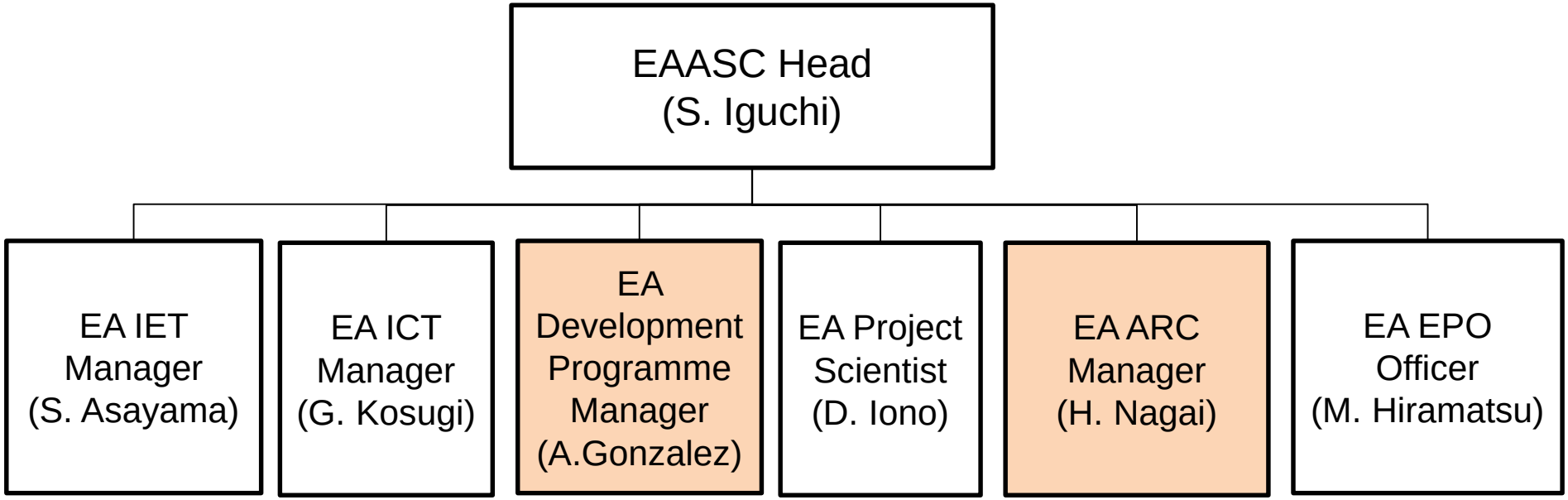
EU: Leonardo Testi (Interim)

NA: Phil Jewell

EA ALMA Support Center (EAASC) – Previous Organization Structure –



EA ALMA Support Center (EAASC) – New Organization Structure –



The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of ESO (representing its members states), NSF (USA) and NINS (Japan), together with NRC (Canada), NSC and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ. The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under the cooperative agreement by Associated Universities Inc. We than all those who have contributed to making the ALMA project possible.