ALMA Overview and Status

ALMA Community Days 2015

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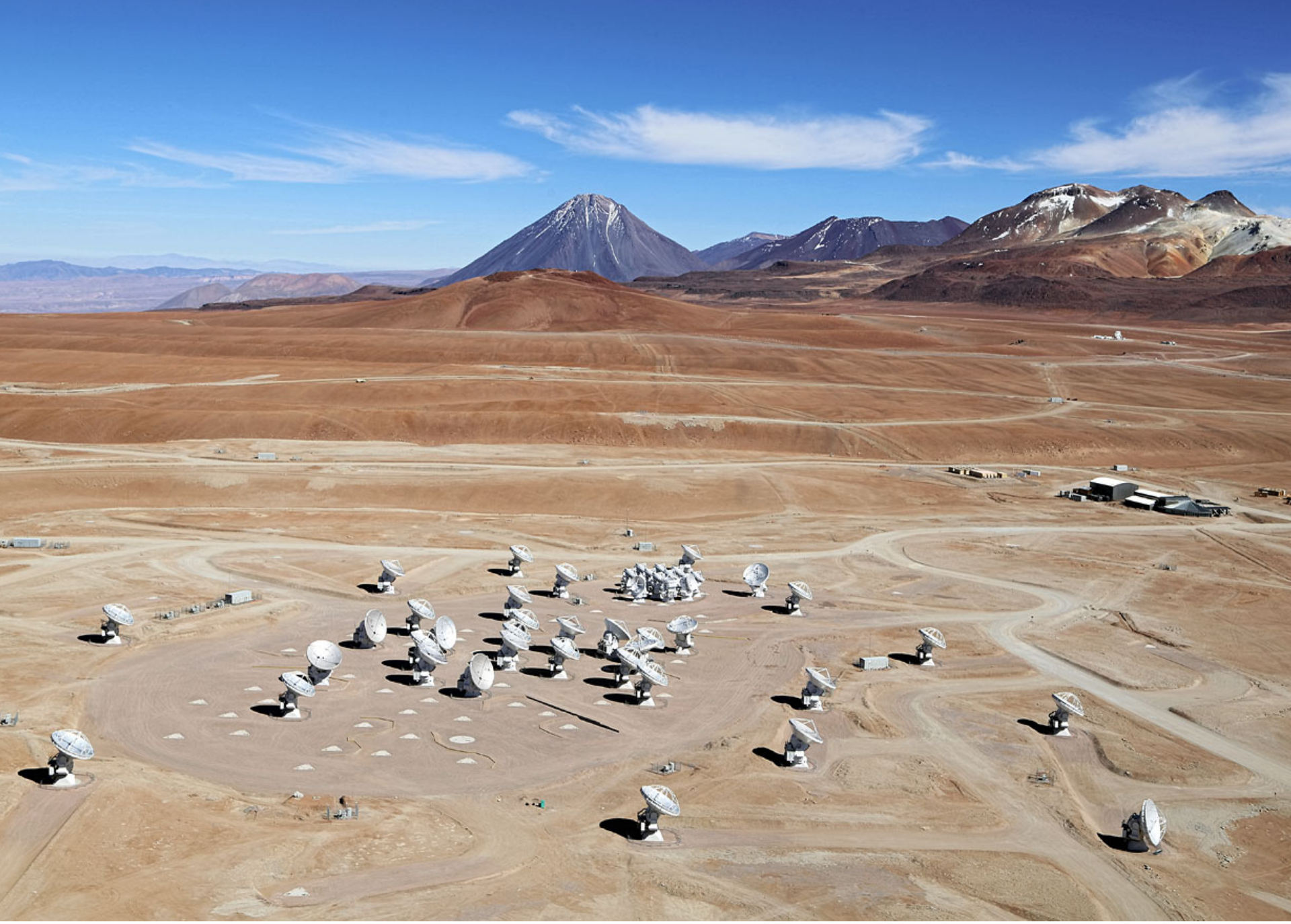
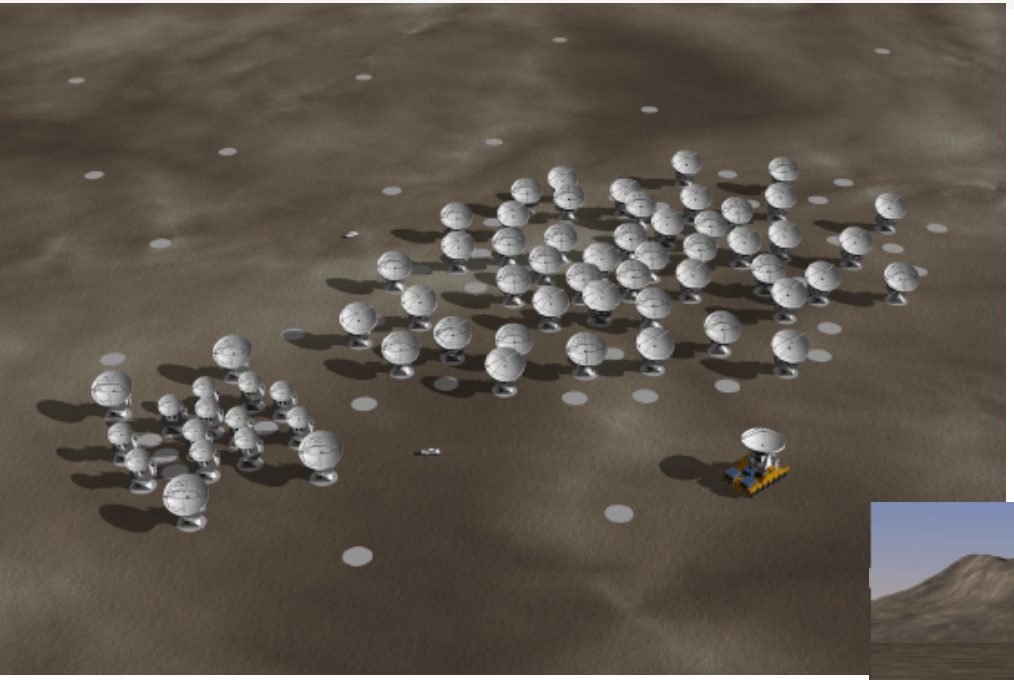
ALMA Overview

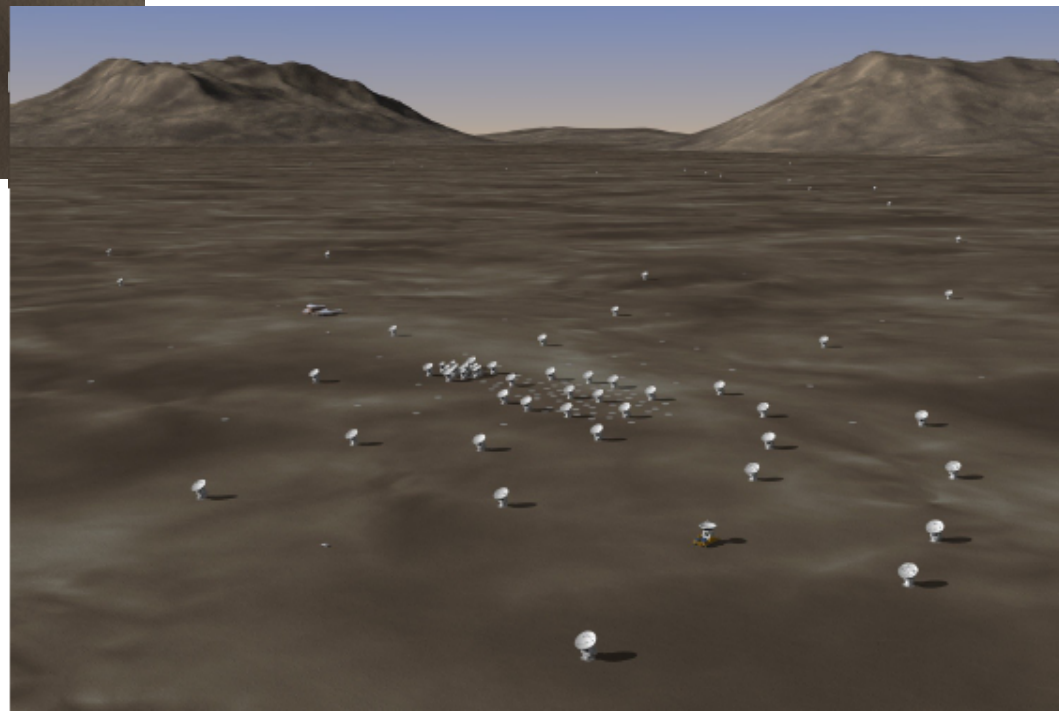
- Aperture synthesis array for (sub)mm wavelengths of 10 mm – 0.3 mm (35 – 950 GHz)
- High, dry site, Chajnantor Plateau, Chile (5000m)
- 66 antennas (54 x 12m + 12 x 7m)
- Baselines from ~15 m to 16 km
- Resolution/arcsec ≈ 0.2(λ/mm)/(max baseline/km)
  - 5 mas for highest frequency/longest baseline
- Field of view / arcsec ≈ 17 (λ/mm) [12m dish]
- Sensitive, wide-band (8 GHz) receivers; full pol.
- Flexible digital correlator giving wide range of spectral resolutions.



ALMA Configurations

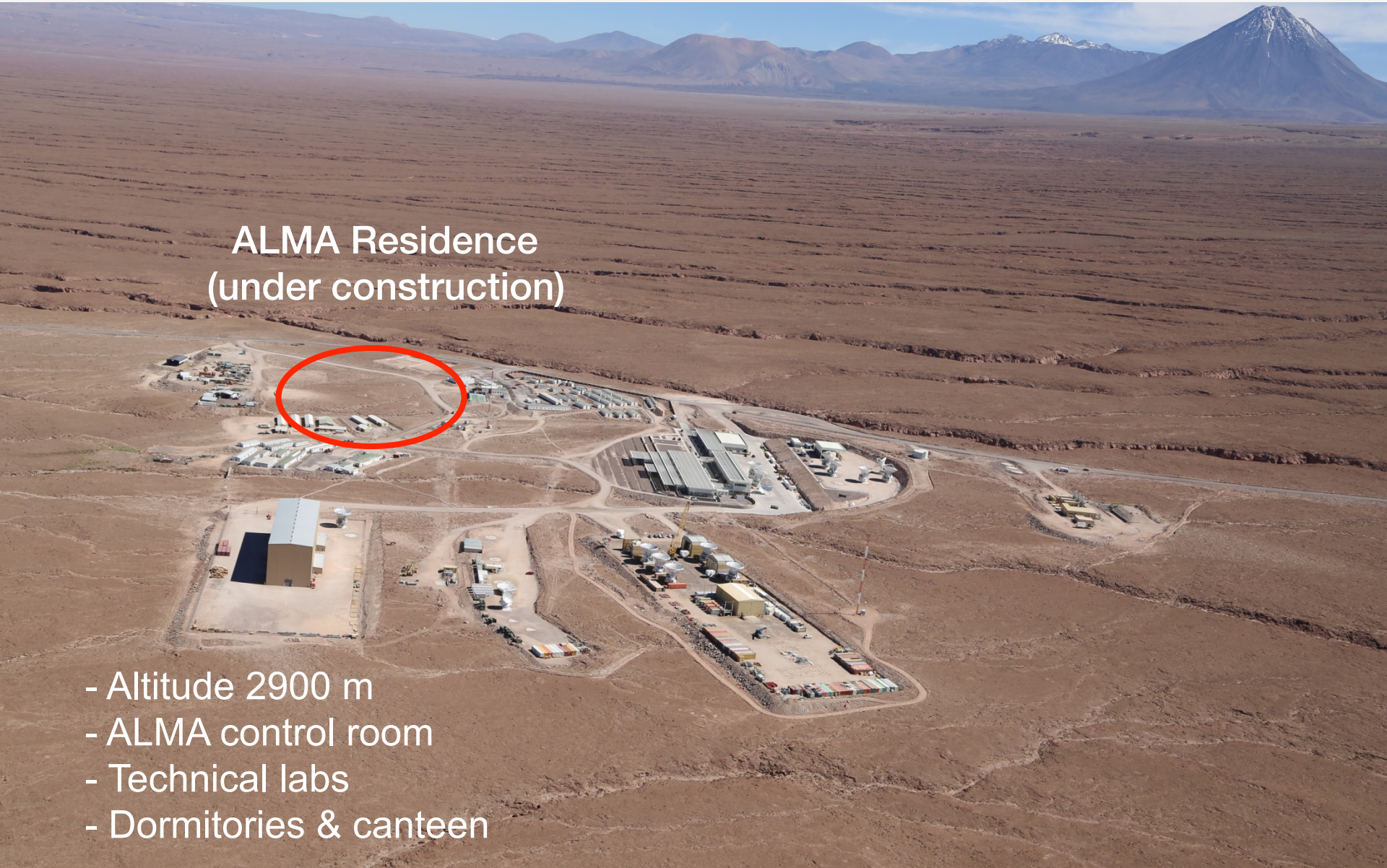


Most compact configuration
(d ~ 150m): 0.5” … 5”



Demonstrated in 2014:
most extended configuration
(max 16km): 0.005” … 0.05”

OSF – Operations Support Facility



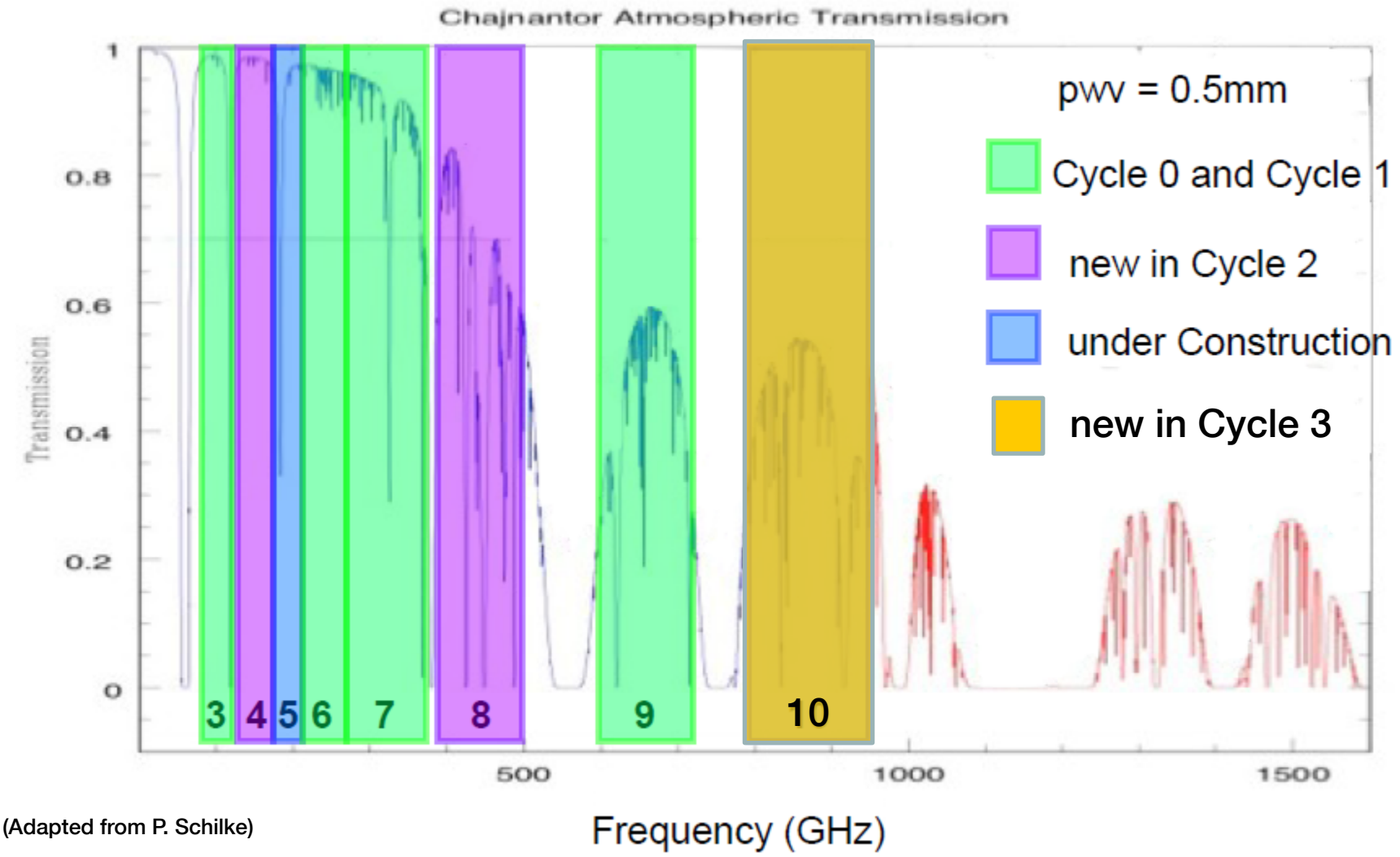
- Altitude 2900 m
- ALMA control room
- Technical labs
- Dormitories & canteen

Receiver Bands

ALMA Band	Frequency Range (GHz)	Receiver Noise (K) over 80% of the RF band	Temperature (K) at any RF Frequency	produced by	Receiver Technology
1	31 - 45	17	26	tbd	HEMT
2	67 - 90	30	47	tbd	HEMT
3	84 - 116	37	60	HIA	SIS
4	125 - 163	51	82	NAOJ	SIS
5*	162 - 211	65	105	NOVA/OSO	SIS
6	211 - 275	83	136	NRAO	SIS
7	275 - 373	147	219	IRAM	SIS
8	385 - 500	196	292	NAOJ	SIS
9	602 - 720	175	261	NOVA	SIS
10	787 - 950	230	344	NAOJ	SIS

* Full Band 5 production from 2013 – 2017, Bands 1 and 2 TBD

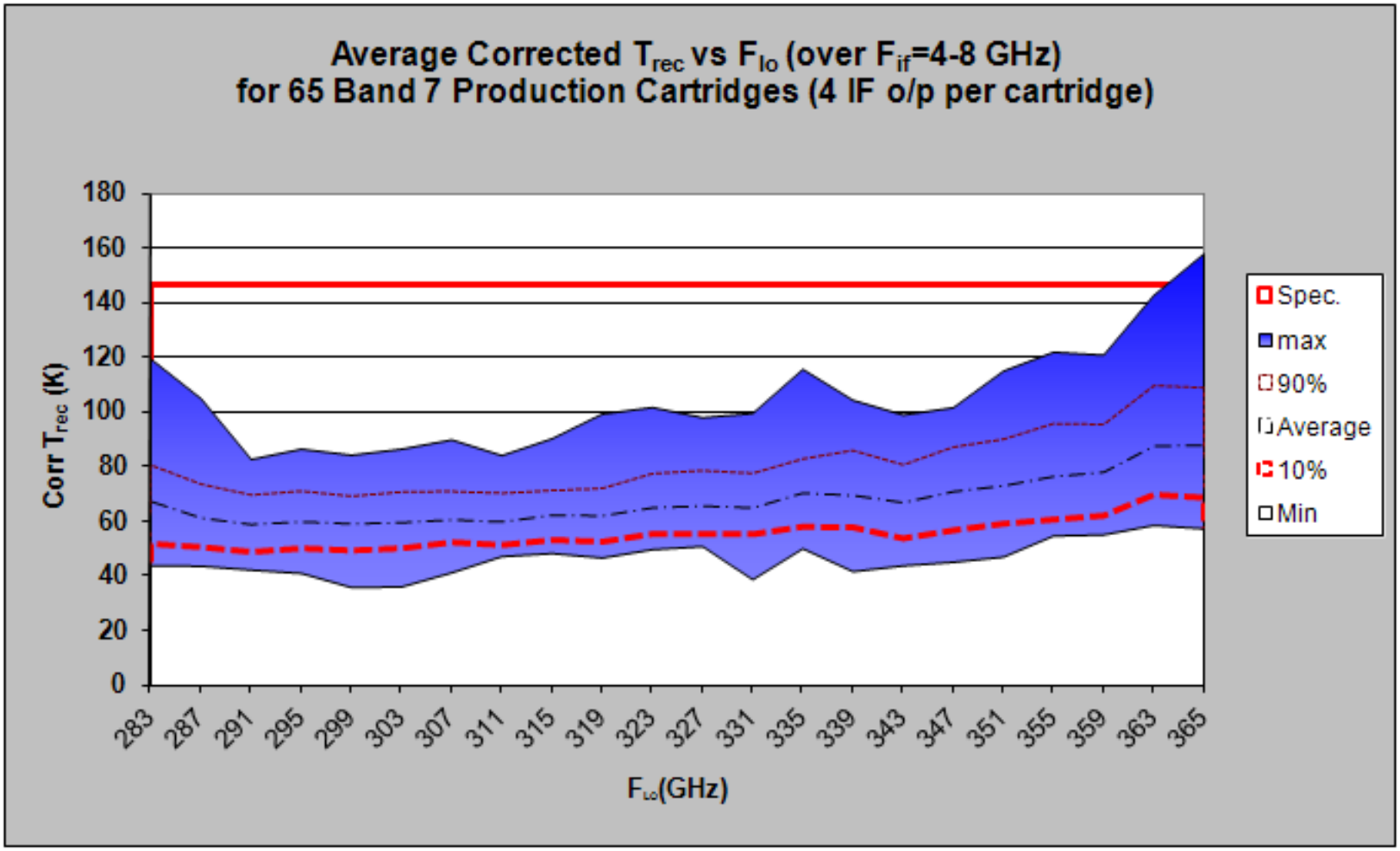
ALMA Bands & Atmosphere



(Adapted from P. Schilke)

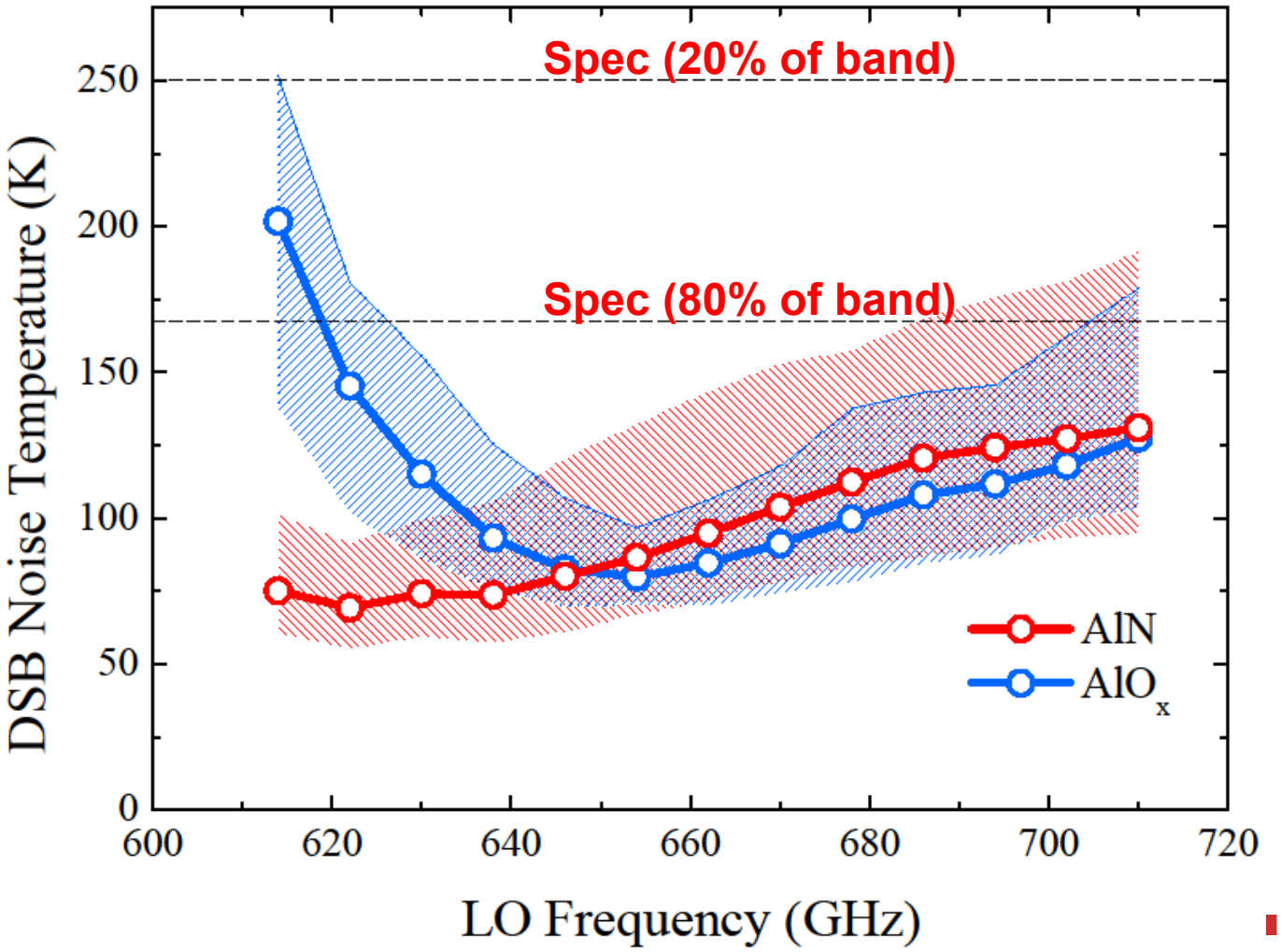
Band 7 Performance

- Sensitivity ~2 times better than specification



Band 9 Performance

- Sensitivity up to 2 times better than specification



Construction Status

- Construction formally finished end of 2014
  - All 66 antenna elements equipped with 7 rx bands
  - Construction accounts mostly closed
  - Manufacturer warranty mostly expired

- Some items are ongoing
  - CSV/EOC (Extension of Capabilities)
  - Construction of ALMA Residence (ESO)
  - Vertex antenna astigmatism (NRAO)
  - Front End Handling Vehicle (NRAO)
  - ACA correlator topics (NAOJ)

Finalization of Modes needed for Full Operations

(From: S. Corder et al., 2015, final draft, “ALMA Transition To Steady State and Full Operations”)

- Long baseline capability [COMPLETE]
- All construction bands [COMPLETE]
- Solar observing
- Final polarization modes
- Improvements needed at high frequency
- Final implementation of single dish capabilities
- Long integration capability (at least 24 hours)
- Repeatable precision observations

ALMA Residence

- Last deliverable of ESO
- Modular concept with 6 dormitory buildings

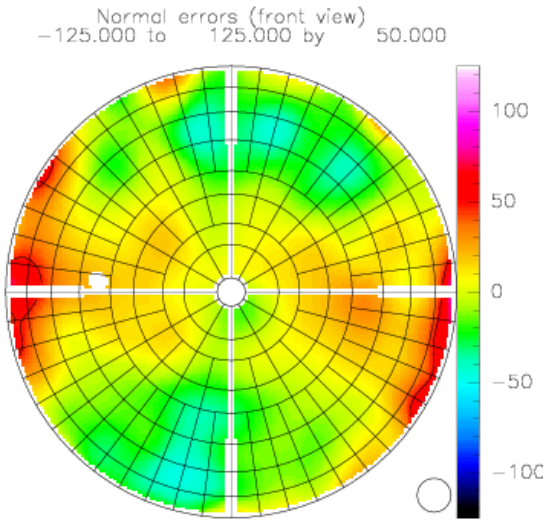
ALMA Residence

Residence Construction started

- In February 2015, the construction of the ALMA Residence has started, ongoing heavy earth works
- Construction duration ~18 months

Vertex Antenna Astigmatism

- 0 – 90º astigmatism, amplitude ∝ temperature
  - Cabin deformation + yoke
  - Known at acceptance, but coefficient underestimated
  - Correct value d(rms)/dT ≈ 0.7μm/K (tower and astro-holography) due to astigmatism alone
    - Antenna surfaces are optimized at ≈7C, rather than mean ops temp
    - Surface is typically out of specification (>25μm rms) at low temperatures (= best night-time conditions)
    - Efficiency typically ~20% lower than AEM/Melco antennas at 690GHz
- Corrective action
  - Optimize surface correctly for -5C
    - Antennas in specification under almost all night-time conditions
    - Straightforward at OSF
    - More efficient at AOS, but riskier
  - Use local heating to fix the problem
    - needed for daytime operation
    - under investigation



ACA Correlator

- Three technical issues (info from EA PM)
  - 3-bit linearity correction
  - Robustness improvement
  - Subarray mode
- Work is in progress
  - Verification at AOS (except subarray mode) ongoing, firmware problems found
  - No big impact for Cycle 2 obs. and science capabilities
  - Resolution before start of Cycle 3 (except Subarrays)
- Subarray mode
  - No issue for Cycle 3, plan to resolve it for Cycle 4

Development Projects

- Band 5 (167-211GHz) full production (EU-led)
  - NOVA/Chalmers/NRAO (2013-2017)
  - Integration of first cartridge at OSF this month
- Fibre connection OSF – Santiago (JAO-led)
  - Technically complete, permits pending
- ALMA phasing project/VLBI (NA-led)
  - Technical implementation ongoing, aim to offer it in Cycle 4, operations model under discussion
- Band 1 (EA-led)
  - Building & testing prototype receiver
- Band 2 prototype (NA), Band 2&3 study (EU)