ALMA Wideband Sensitivity Upgrade (WSU)

Martin Zwaan

European ALMA Support Centre

ESO

ALMA: Atacama Large Millimeter/submillimeter Array

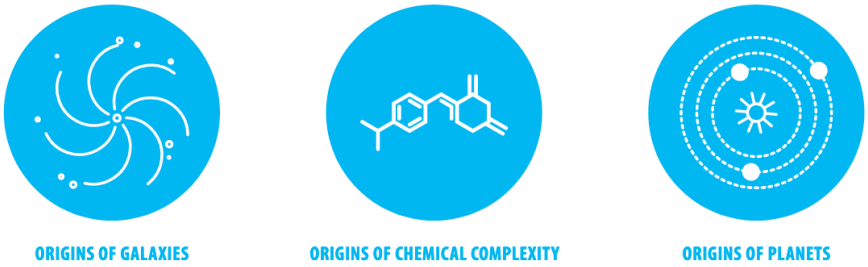
- ALMA is an interferometer for millimetre and submillimetre astronomy
- ALMA is built and operated by Europe (**ESO**), North-America (NRAO) and East-Asia (NAOJ)
- Baseline construction completed 2014
- Construction cost: $1500 million
- A very oversubscribed facility

10+ Years of Amazing ALMA Science

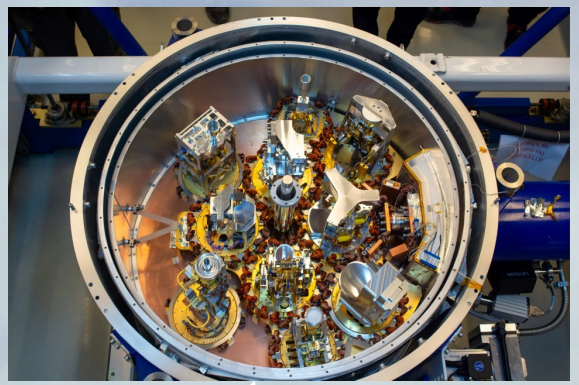
Cycle 1 started in January 2013

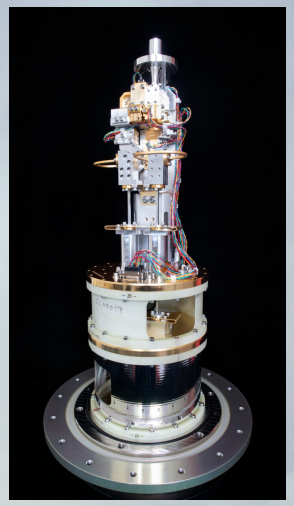
What is ALMA Wideband Sensitivity Upgrade (WSU)?

- Keep ALMA at the forefront! Technology now 20 years old. Upgrade will guarantee ALMA's long-term health
- Upgrade of the bandwidth (initially x2, eventually x4) and throughput of the ALMA system
  - Improved **sensitivity** (imaging speed: factor 3-6 in continuum, factor 2-3 for spectral line)
  - Improved **high-spectral resolution capabilities** (1-2 orders of magnitude)
- Major upgrade of the complete signal chain and related software
- Impact will span all astronomical topics that embodies ALMA's motto *"In Search of our Cosmic Origins"*

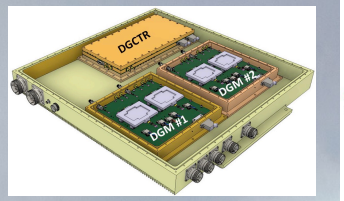


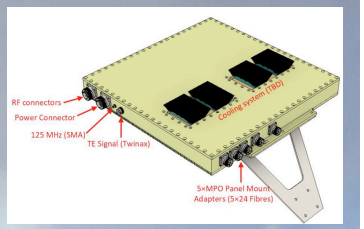
Array Operations Site in Chajnantor (5050 m)

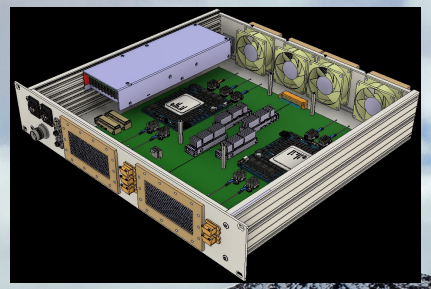




Upgrade of receivers







Upgrade of electronics (including digitizers, IF processors)

Data transmission system

Upgraded fibre optics connection to Operations Support Facility (3000m)

Operations Support Facility (3000 m)

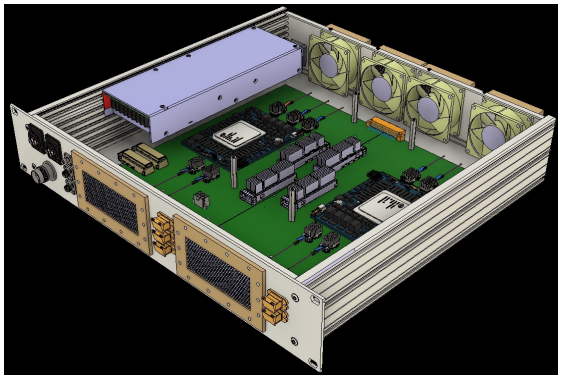
2nd generation correlator (ATAC) and upgraded ALMA Total Power GPU Spectrometer

New Correlator Room

ESO’s main WSU projects

Wideband IF Processor (WIFP) (with Bordeaux Uni)

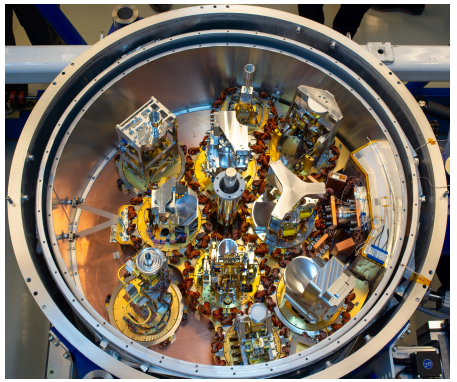
New antenna-based high-speed system to digitize analogue receiver outputs, and to process and format the resulting data stream



Band 2 receivers (with NOVA and partners)

RF bandwidth: 67-116 GHz, first wideband receiver (16 GHz per sideband)

Manufacturing and integration are ongoing



Fibre Optic Connection

New trenches and fibre optics cable between high and low site

ESO's *future* WSU projects

Most activity is directed to wideband receiver technology - 32 GHz IF bandwidth

Technologies investigated: SIS junctions, MMIC-based cryogenic low noise amplifiers (LNAs), integrated and scalable approaches to building the LNAs and mixers

ESO's priority bands: **Band 7 (~275-373 GHz) and Band 9 (~602-720 GHz)**

Timeline to start new project: ~2026 onward. **Band 7 is highest priority.**

Industrial and institutional collaboration with ESO member states welcomed

Thank you!

Martin Zwaan

mzwaan@eso.org

@ESOAstronomy

@esoastronomy

@ESO

european-southern-observatory

@ESOobservatory