



# Atacama Large Millimeter Array Project Status

M. Tarengi  
ALMA Director

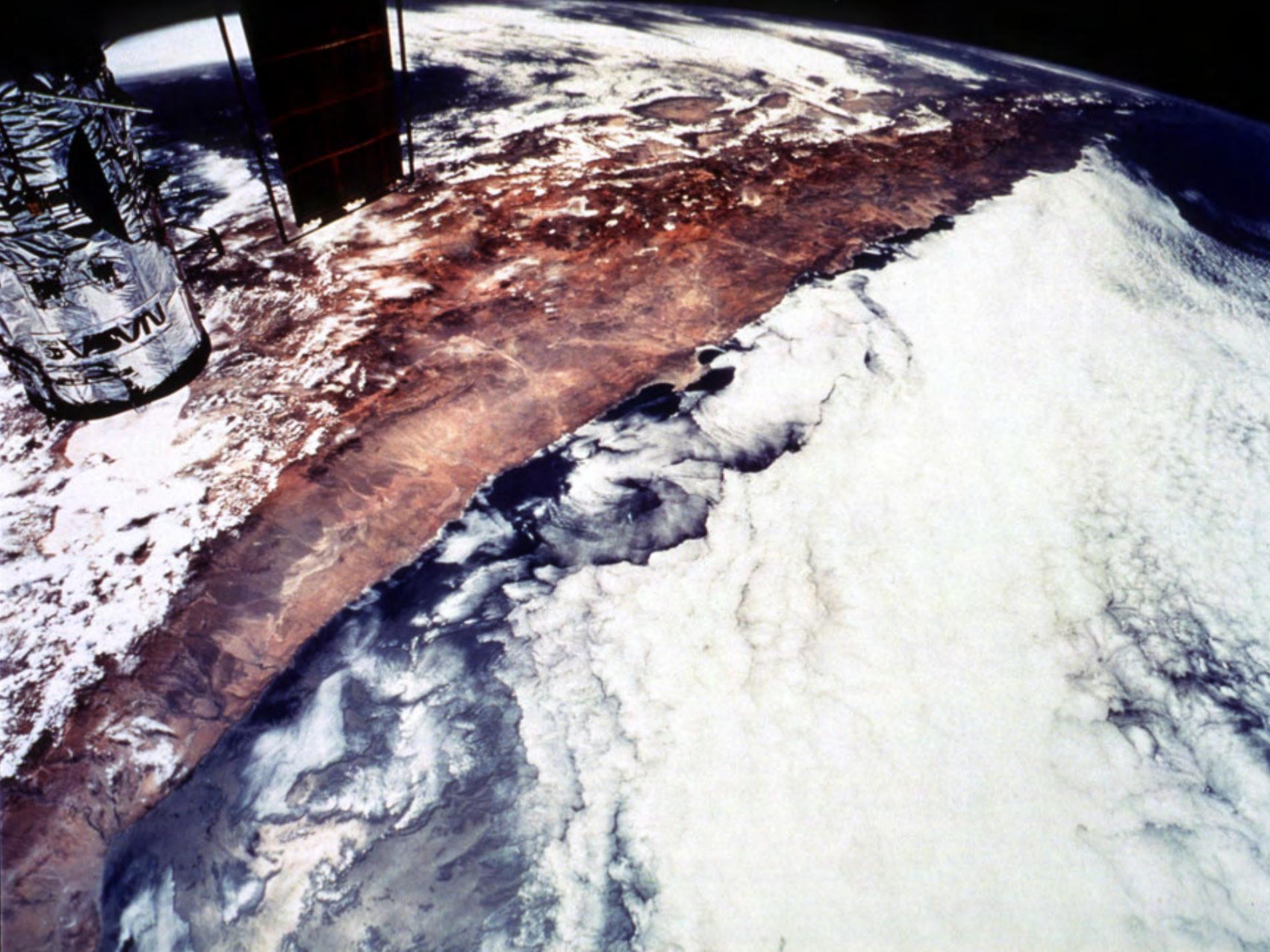


**Atacama Large Millimeter Array**



# Specifications

- Partners: US (NSF)+Canada (NRC) - ESO+Spain - Chile
- 64 12-m antennas, at 5000 m altitude site
- Surface accuracy  $\pm 25 \mu\text{m}$ , 0.6" reference pointing in 9m/s wind, 2" absolute pointing all-sky
- Array configurations between 150m to ~15km
- 10 bands in 31-950 GHz + 183 GHz WVR. Initially:
  - 86-119 GHz "3"
  - 211-275 GHz "6"
  - 275-370 GHz "7"
  - 602-720 GHz "9"
- 8 GHz BW, dual polarization
- Interferometry, mosaicking & total-power observing
- Correlator: 4096 channels/IF (multi-IF), full Stokes
- Data rate: 6Mb/s average; peak 60Mb/s
- All data archived (raw + images), pipeline processing





# Northern Chile





# CH23



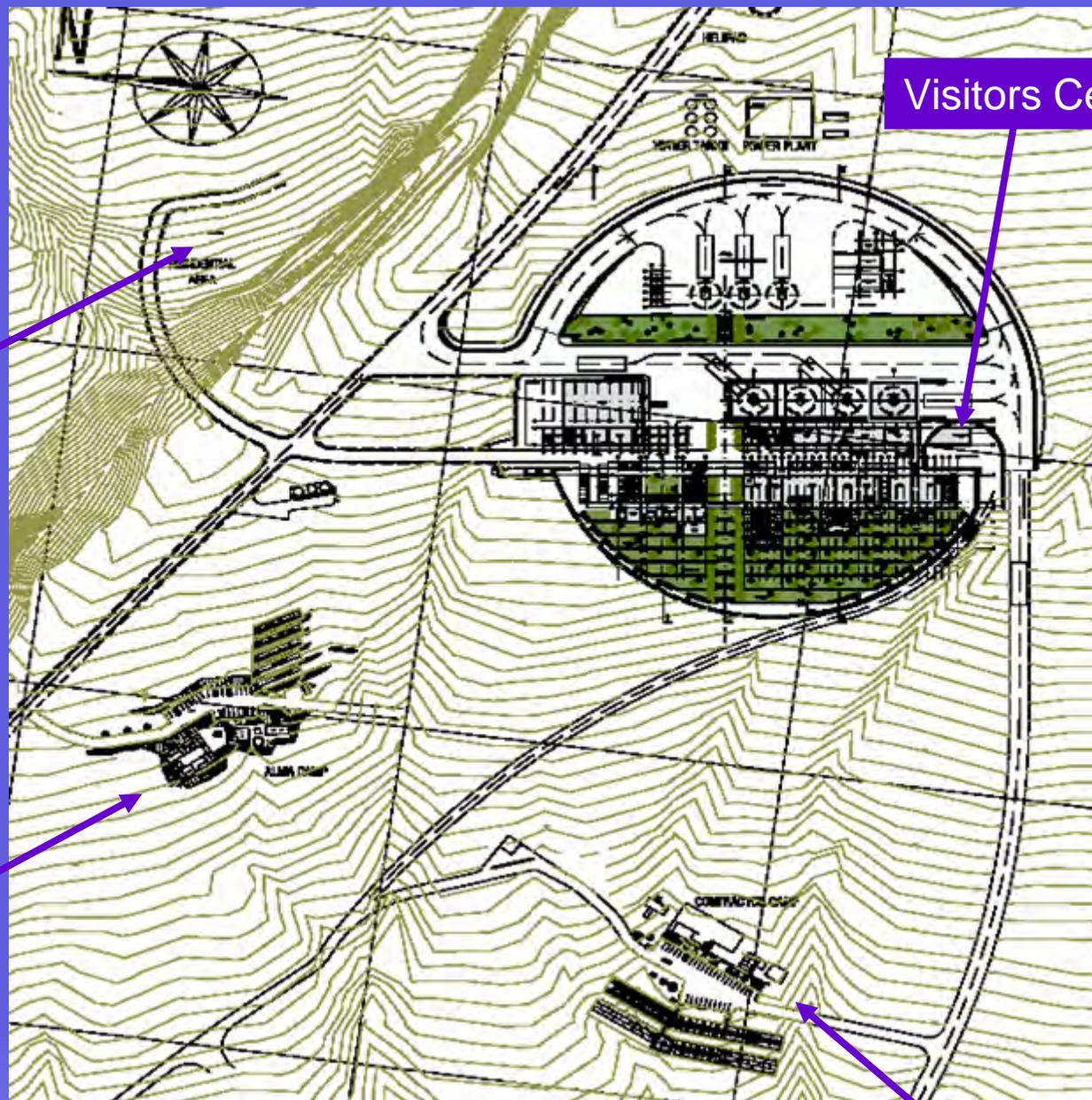
Operations  
Support  
Facility

Residence Area

ALMA Camp

Visitors Center

Contractors Camp





# ALMA Camp



# ALMA Camp



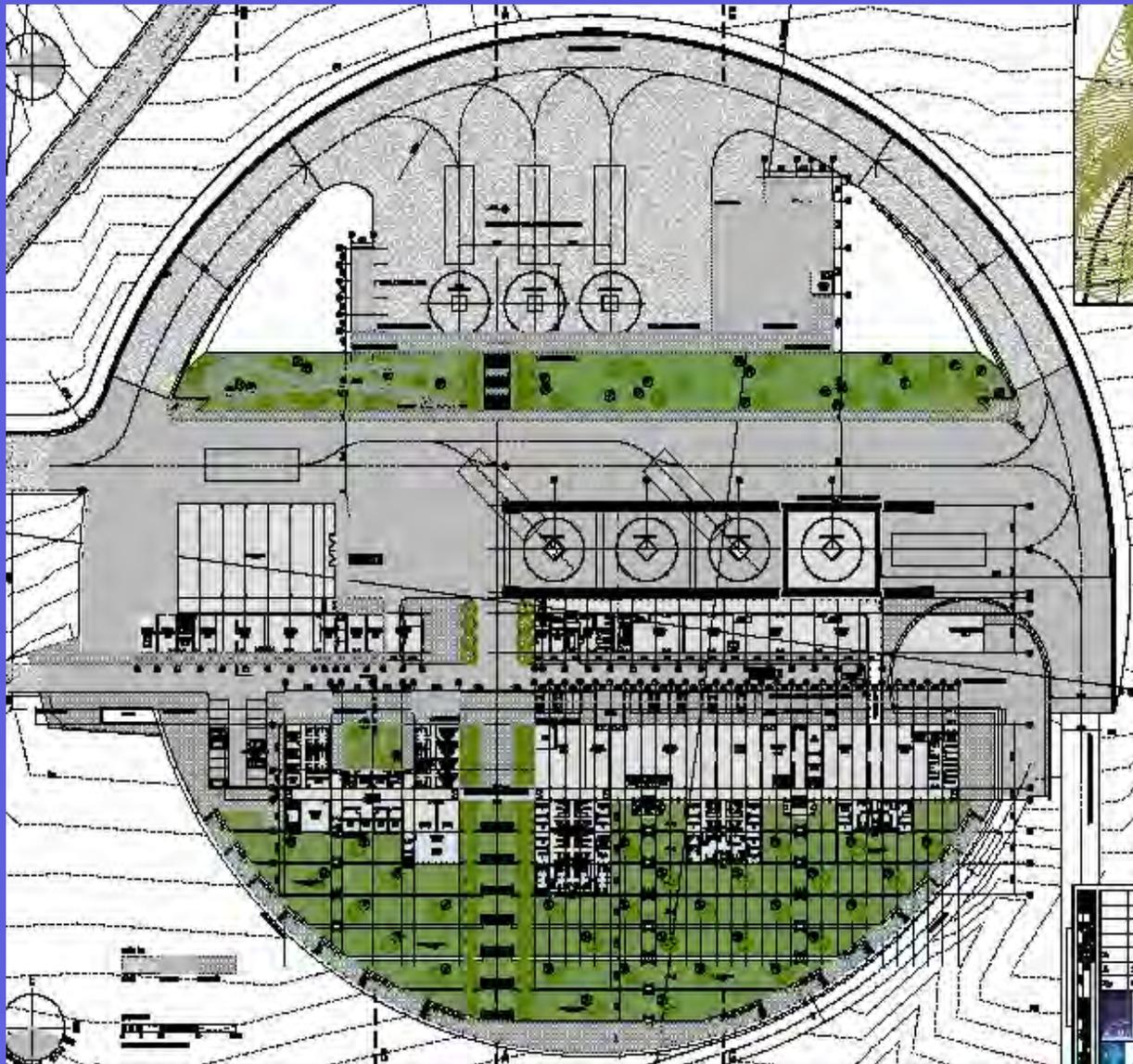
Inner Court



Typical Office



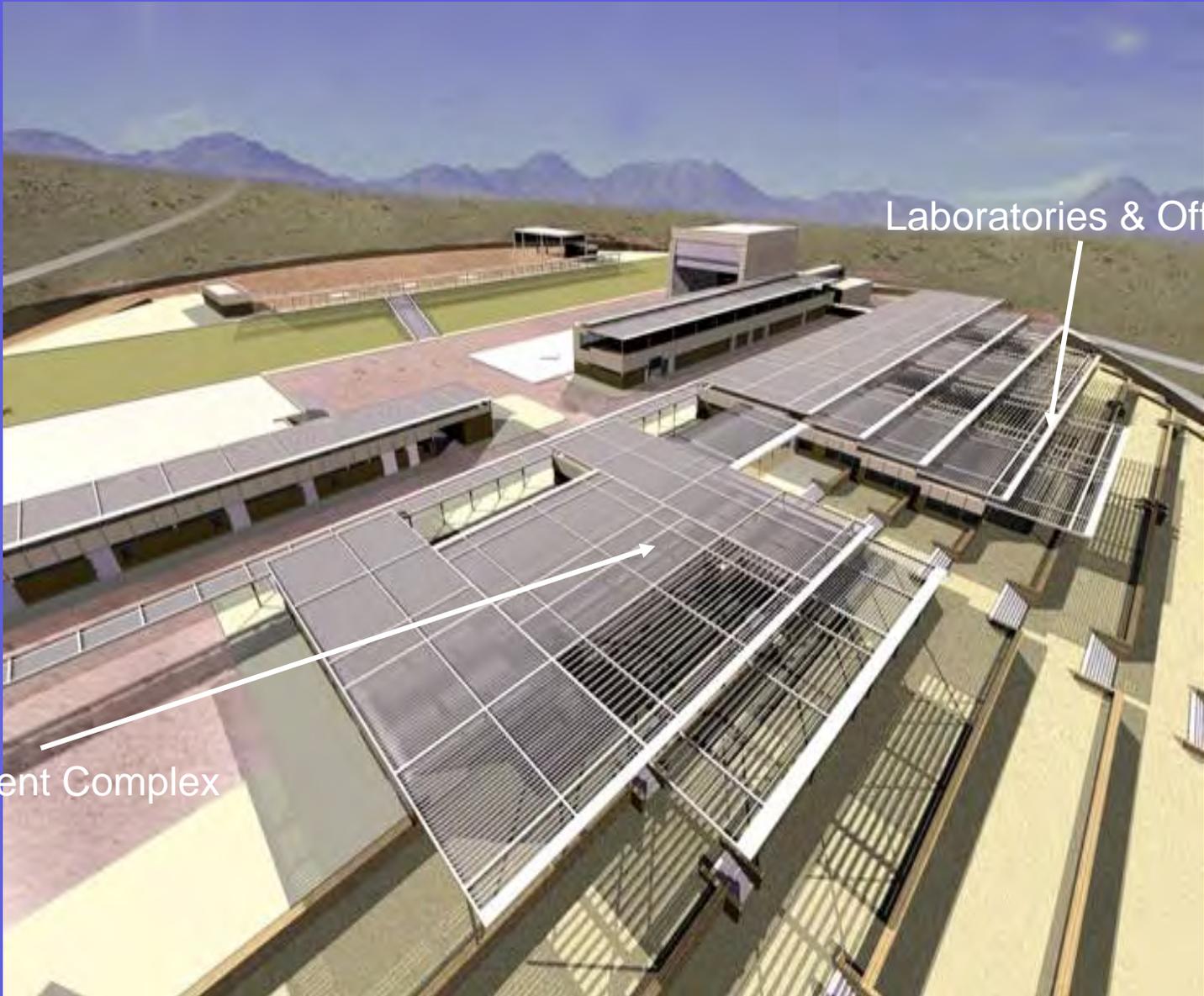
# Technical Facilities



Construction tender – February 2005



# Technical Facilities



Laboratories & Offices

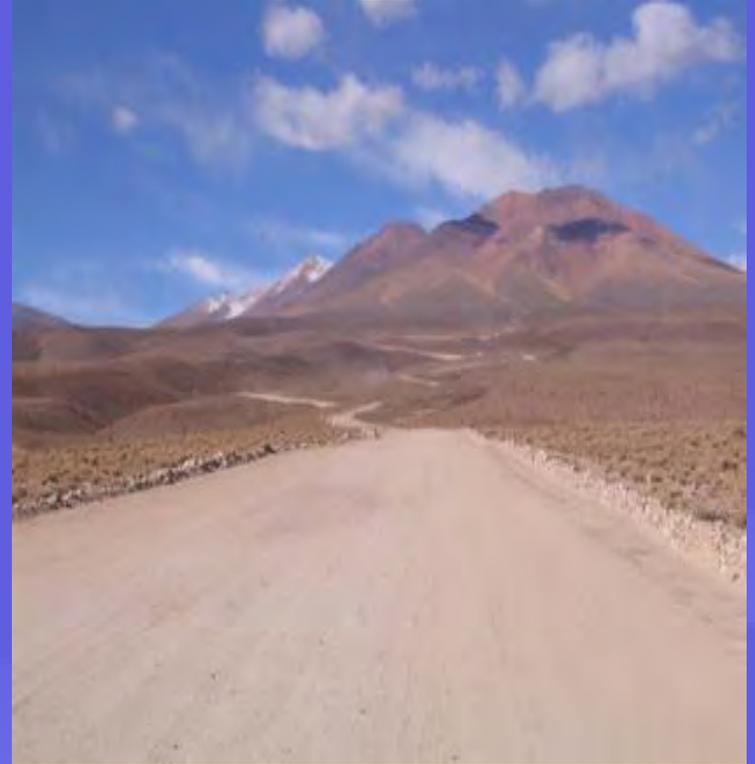
Management Complex



18km



**View West**



**View East**

# OSF→AOS roadwork (23-28km)

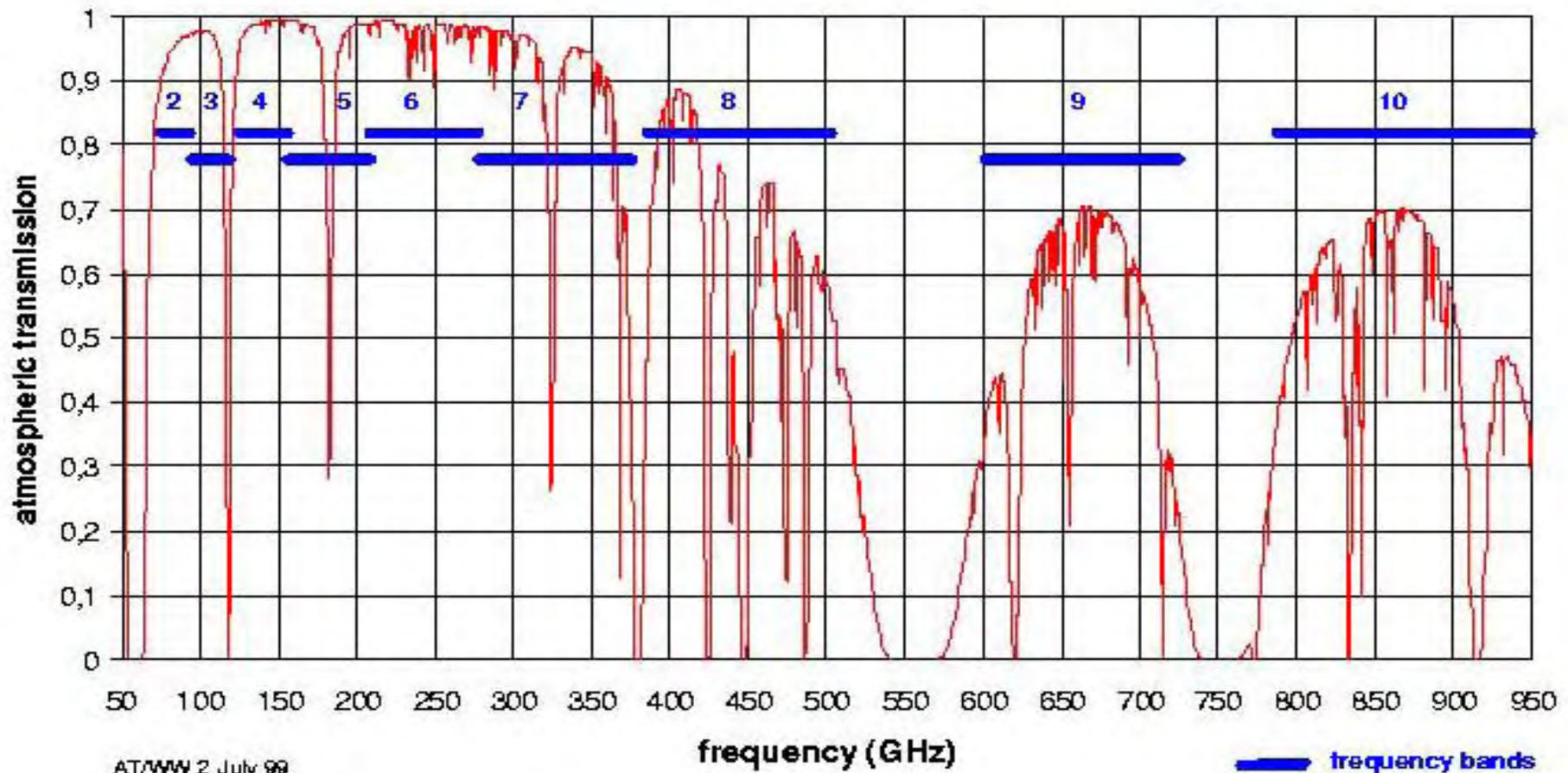




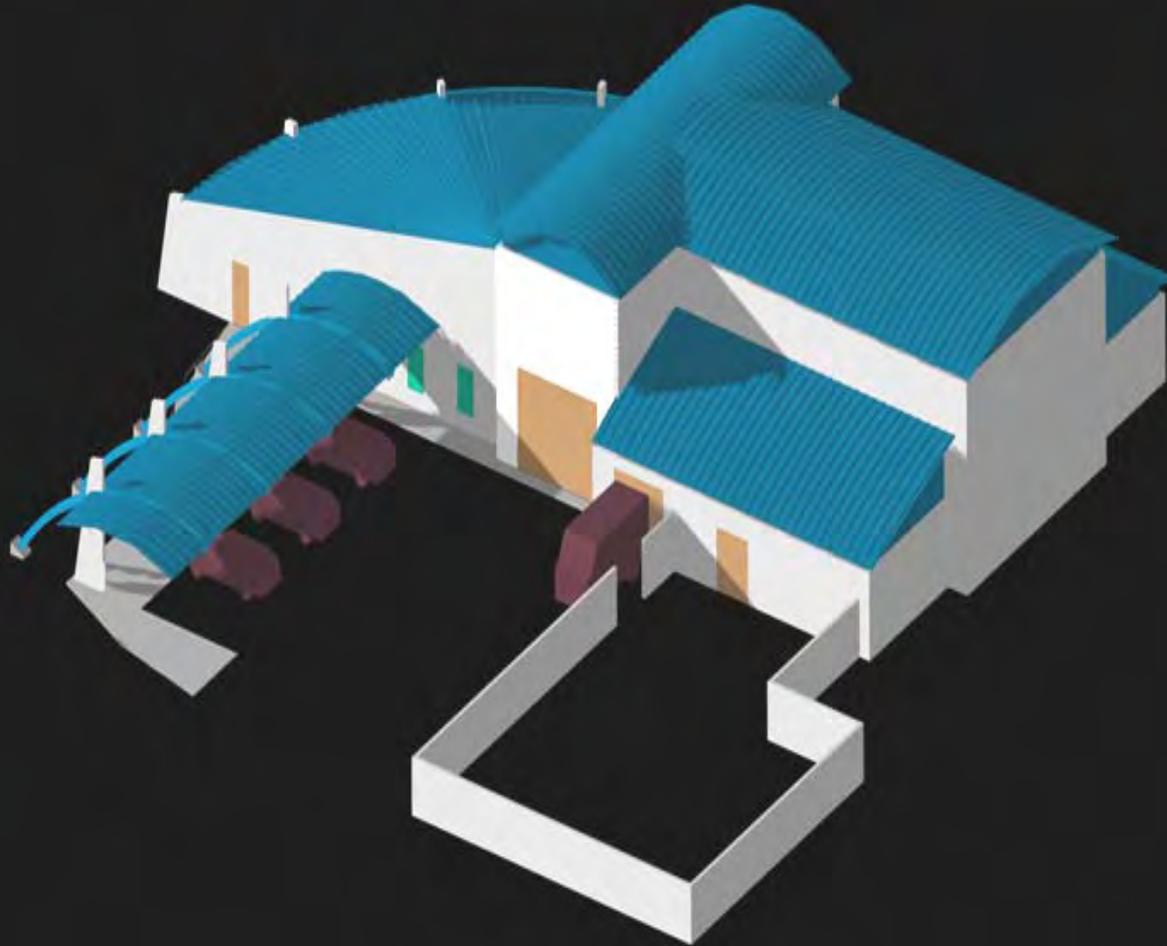
# 5000m Chajnantor site



# Atmospheric transmission at Chajnantor, $\text{pwv} = 0.5 \text{ mm}$

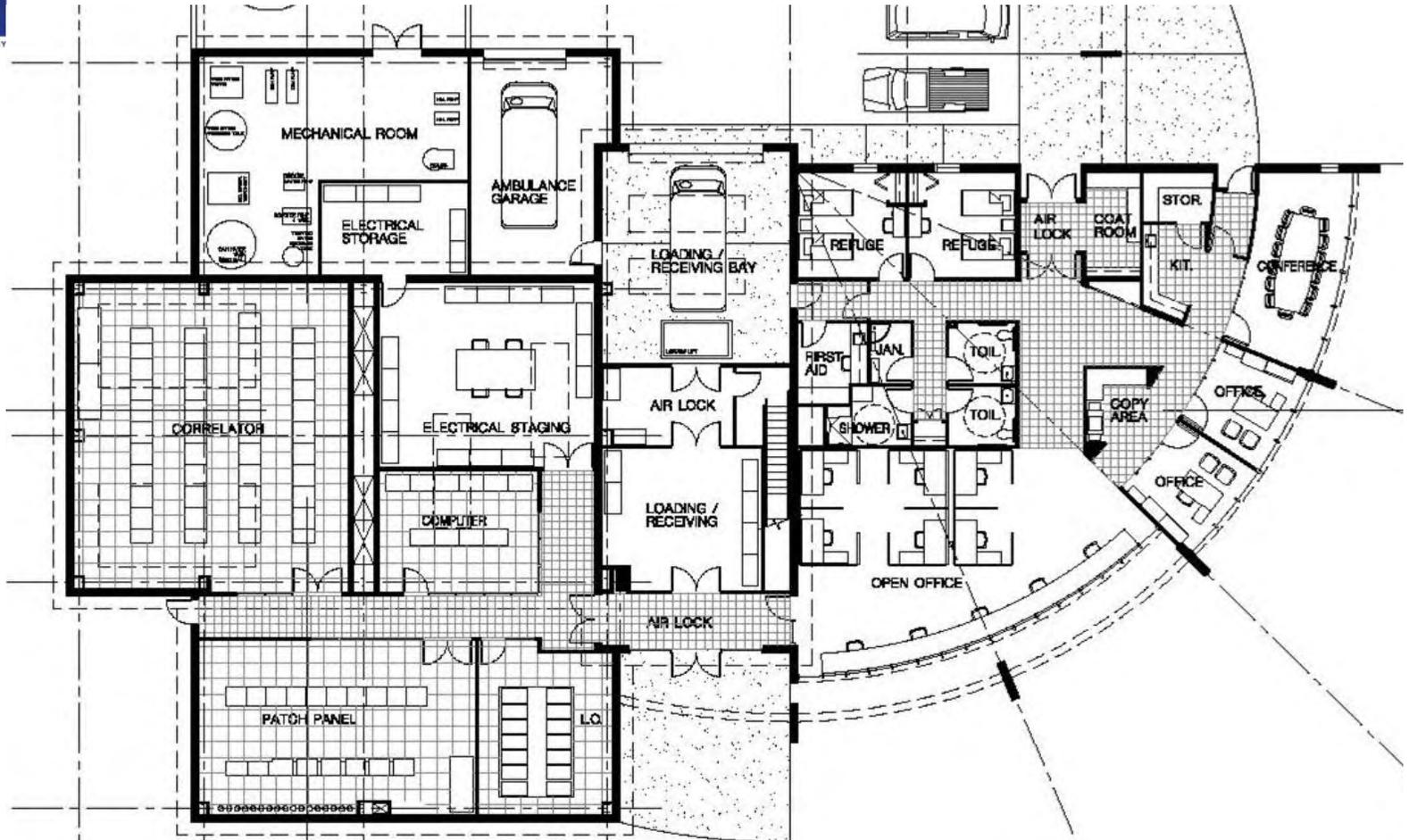


# Array Operations Site - Technical Building

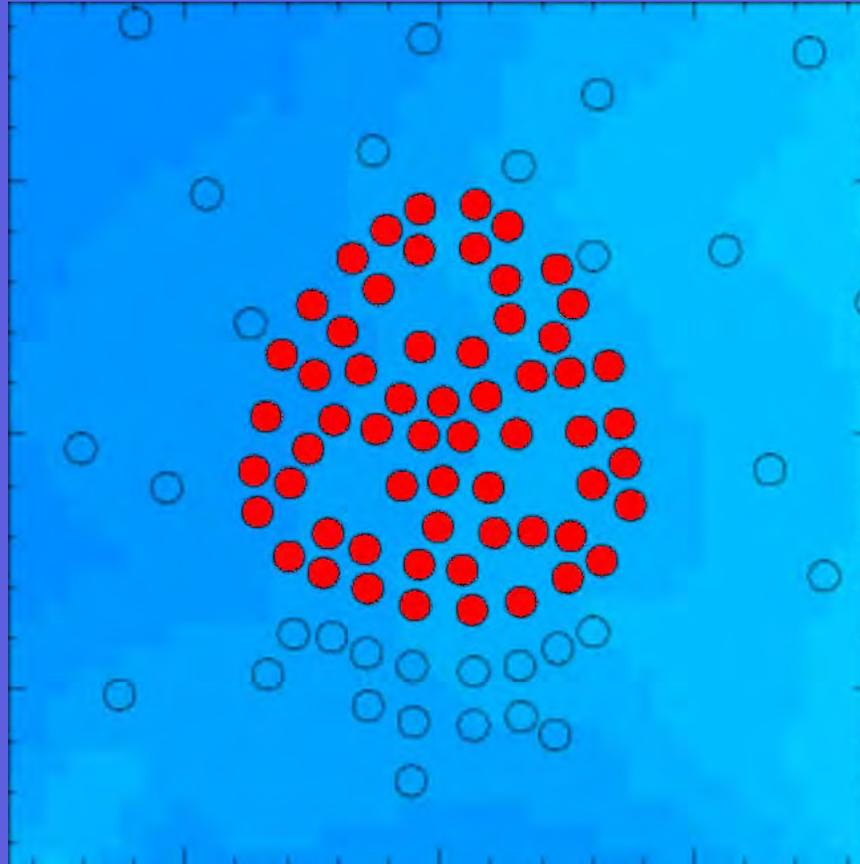


**Construction begins Q1 2005**

# AOS layout

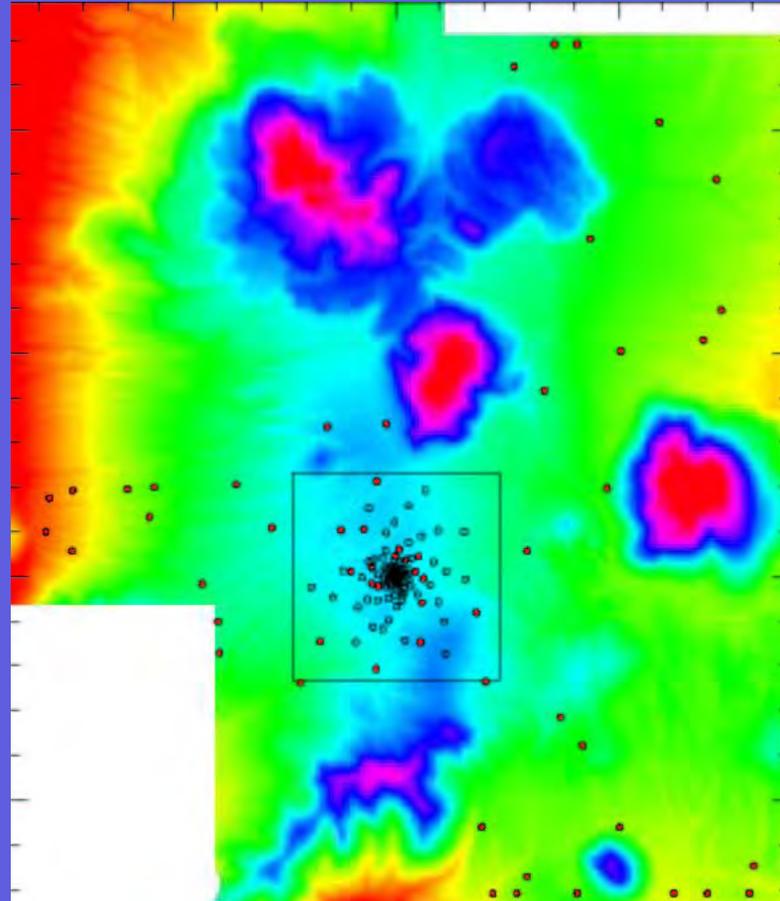


# Antenna Configurations (min)



150 m

# Antenna Configurations (max)



10,000m

4 mas @ 950 GHz

Site infrastructure (AOS/OSF) + inner array completed 2008



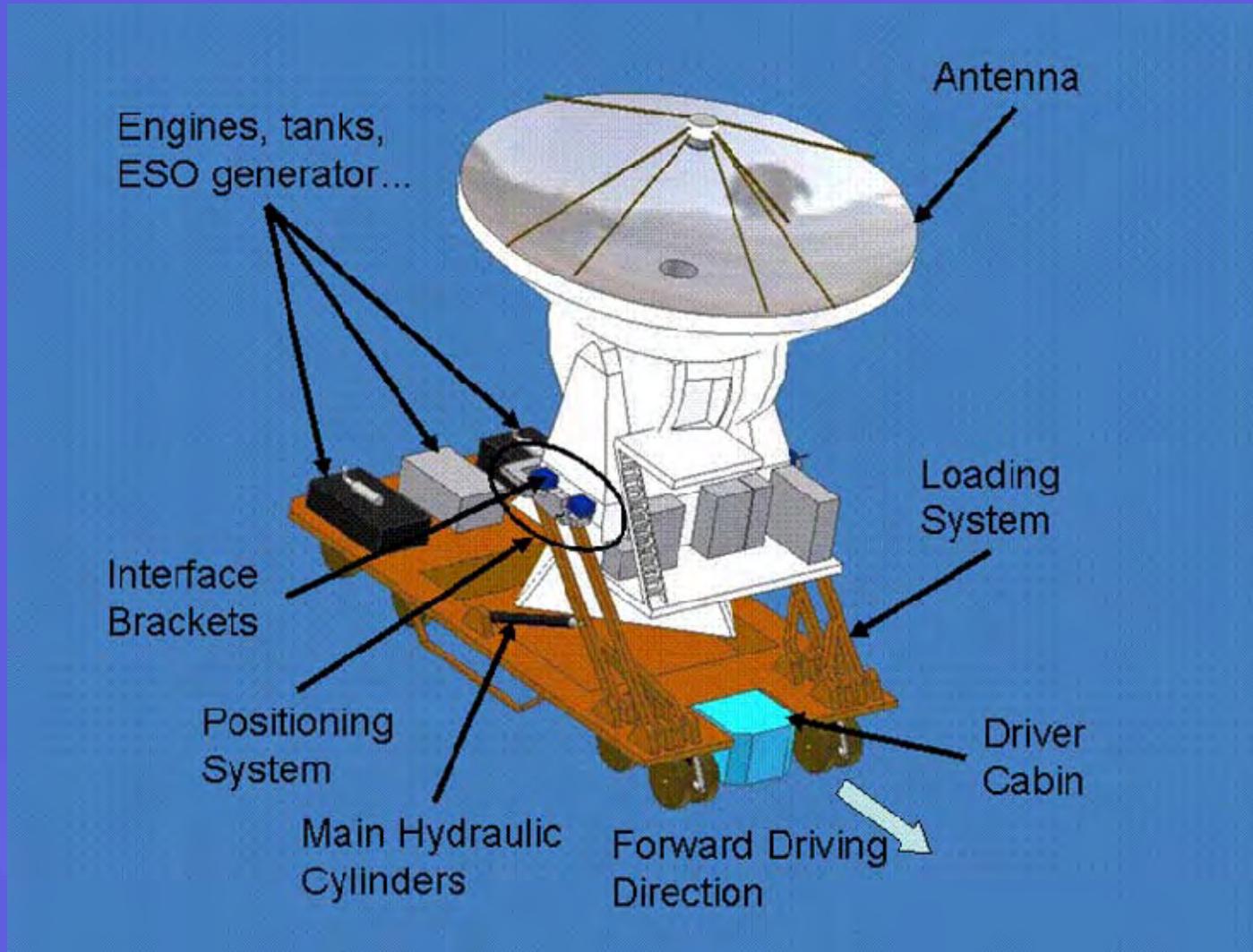
# Correlator Specifications

Item	Specification
Number of antennas	64
Number of IF pairs per antenna	4
Max. sampling rate per IF pair	2 x 4 GHz
Digitizing format	3 bit, 8 level
Correlating format	2 bit, 4 level
Max. delay range	30 km
Channels per IF pair	4096
Autocorrelation channels per baseline	1024
Polarization	Full stokes (4 products)

First quadrant of correlator approaching completion...



# Antenna Transporter



Construction tender – Q1 2005

# Antennas

- Demanding ALMA antenna specifications:
  - Surface accuracy (25  $\mu\text{m}$ )
  - Absolute and offset pointing accuracy (2 arcsec absolute, 0.6 arcsec offset)
  - Fast switching (1.5 deg sky in 1.5 sec)
  - Path length (15  $\mu\text{m}$  non-repeatable, 20  $\mu\text{m}$  repeatable)
- To validate these specifications: two prototype antennas built & evaluated at ATF (VLA)





# AEC Prototype Antenna





# Vertex Prototype Antenna





- Prototypes accepted from manufacturers
- Final technical evaluations underway; bids undergoing financial and management evaluation in Europe/US
- Some delays in contract process (expected 28/7/04); important purchase...
- Progress expected Q2 2005

# Receivers/Front Ends

ALMA Band	Frequency Range	Receiver noise temperature		Mixing scheme	Receiver technology
		$T_{Rx}$ over 80% of the RF band	$T_{Rx}$ at any RF frequency		
1	31.3 – 45 GHz	17 K	28 K	USB	HEMT
2	67 – 90 GHz	30 K	50 K	LSB	HEMT
3	84 – 116 GHz	37 K	62 K	2SB	SIS
4	125 – 169 GHz	51 K	85 K	2SB	SIS
5	163 - 211 GHz	65 K	108 K	2SB	SIS
6	211 – 275 GHz	83 K	138 K	2SB	SIS
7	275 – 373 GHz	147 K	221 K	2SB	SIS
8	385 – 500 GHz	98 K	147 K	DSB	SIS
9	602 – 720 GHz	175 K	263 K	DSB	SIS
10	787 – 950 GHz	230 K	345 K	DSB	SIS

- **Dual, linear polarization channels:**

- Increased sensitivity
- Measurement of 4 Stokes parameters

- **183 GHz water vapour radiometer:**

- Used for atmospheric path length correction

# Front End assembly

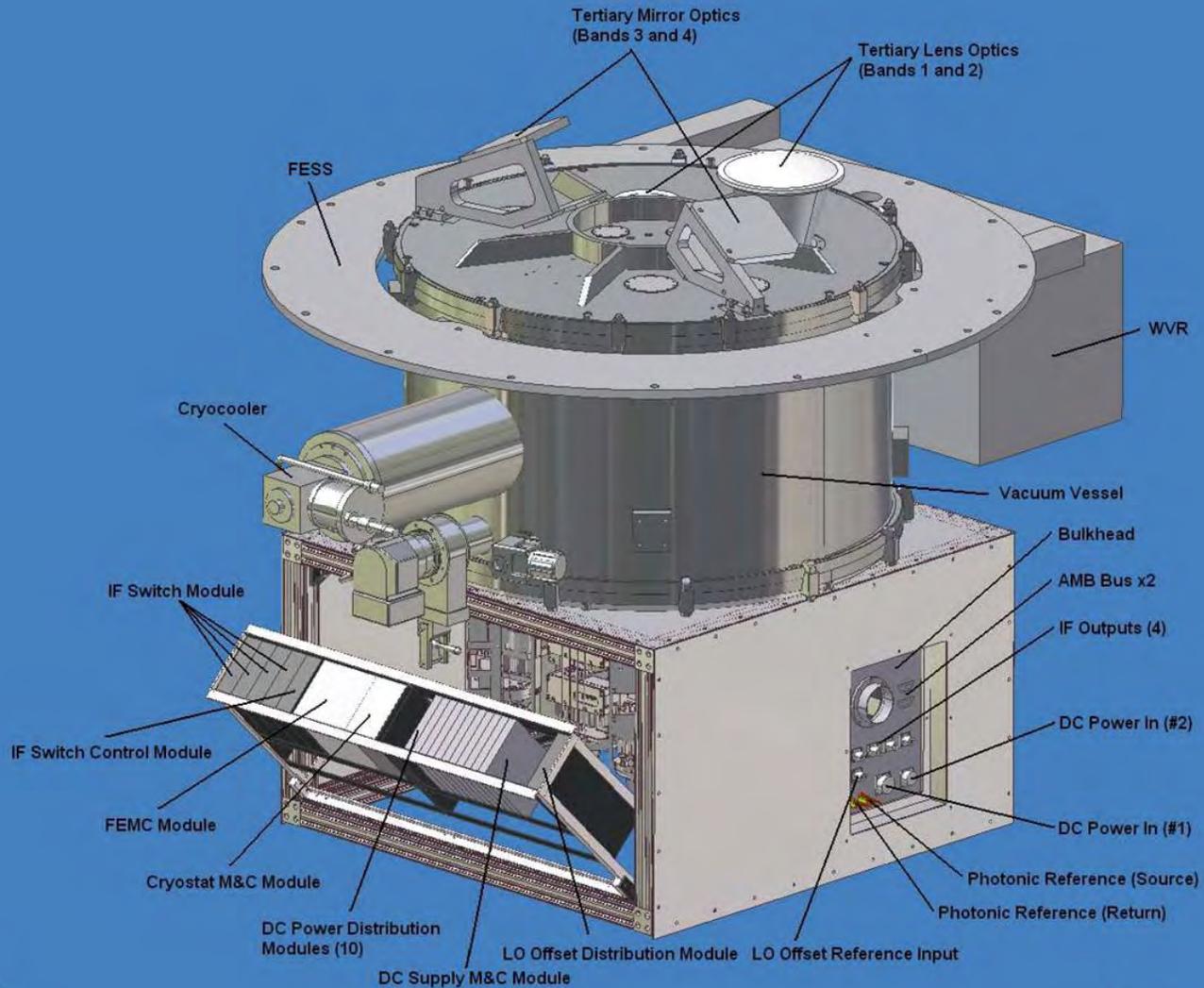
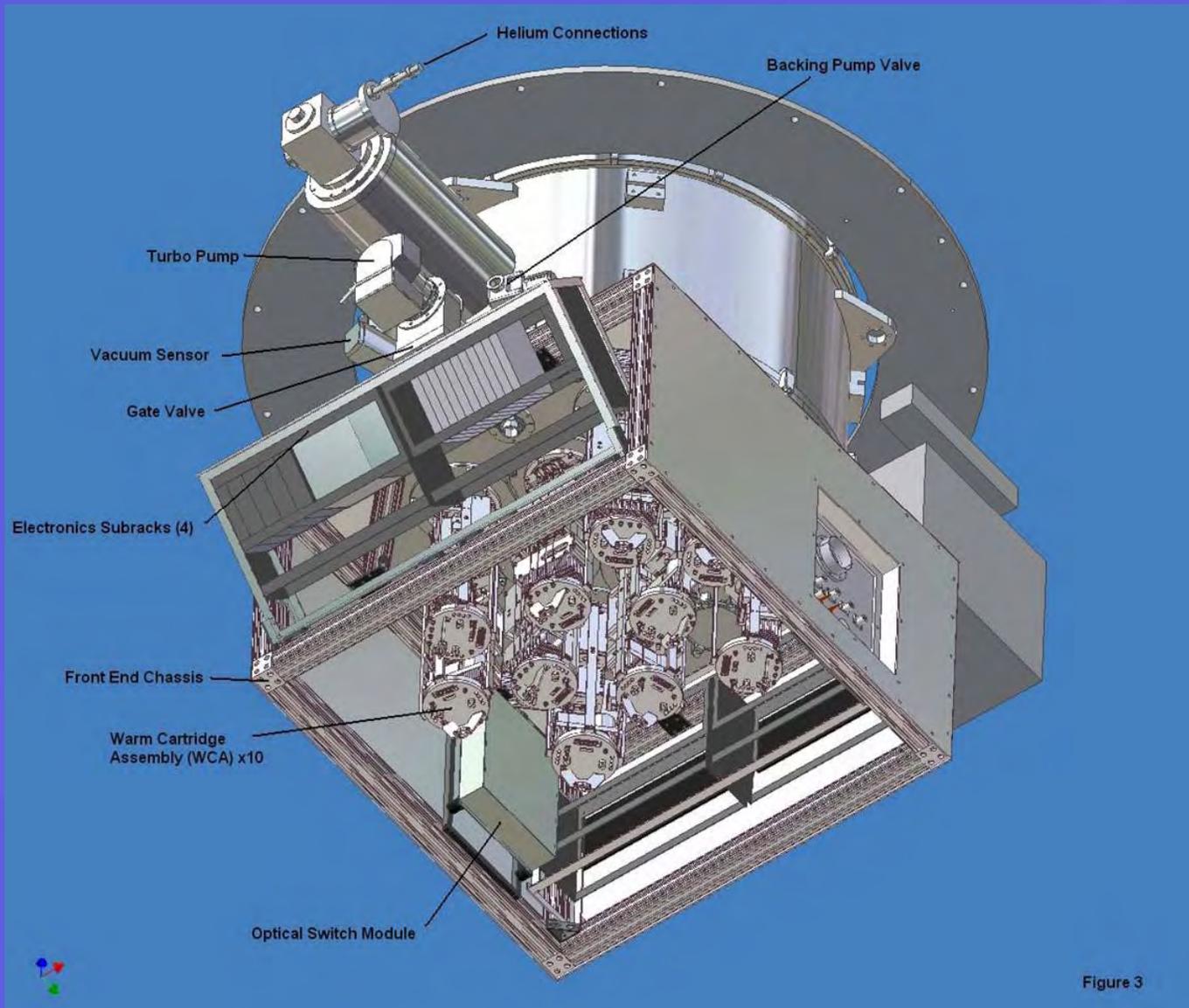


Figure 2

# Front End assembly

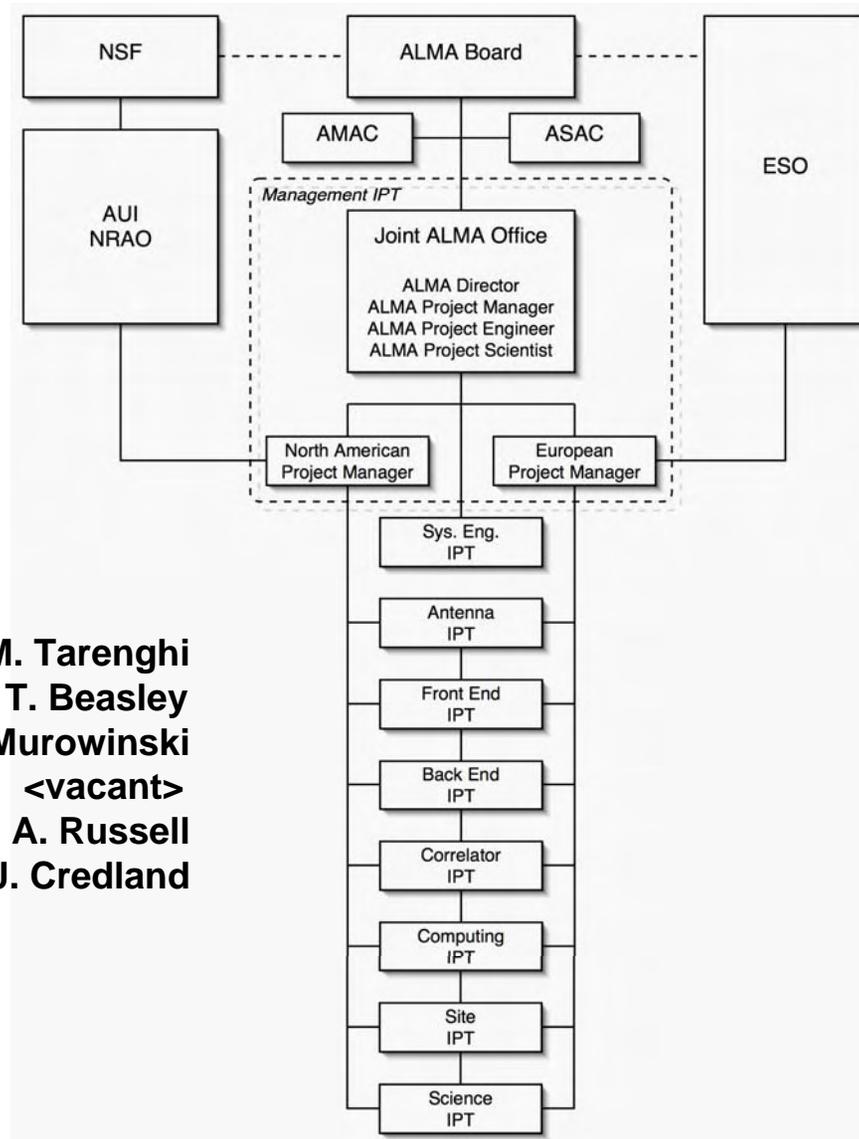


# Cartridges (Bands 3 & 6)





# ALMA Project Organization



<b>Director:</b>	<b>M. Tarengi</b>
<b>Project Manager:</b>	<b>T. Beasley</b>
<b>Project Engineer:</b>	<b>R. Murowinski</b>
<b>Project Science:</b>	<b>&lt;vacant&gt;</b>
<b>Project Manager (NA):</b>	<b>A. Russell</b>
<b>Project Manager (EU):</b>	<b>J. Credland</b>



# Schedule

June 1998	Phase I: Design & Development
November 2001	Prototype antennas at VLA site
December 2001	US/European ALMA Agreement
September 2004	Enhanced ALMA Agreement
2005	Antenna Contract Awarded
2005	Prototype System Testing
2007	AOS/OSF completed
2007 - 2008	Commissioning & early science operations
2012	Full Operations

# Japan

- New partner: Agreement signed NSF-ESO-NINS 14 Sept 2004; further definition expected mid 2005
- Enhanced ALMA:
  - Four additional 12-m antennas (total power)
  - Eight 7-m diameter antennas in compact configuration: **Atacama Compact Array**
  - Separate ACA correlator
  - Receiver: Bands 4, 8... 10
- Significantly improves low surface brightness sensitivity of ALMA...

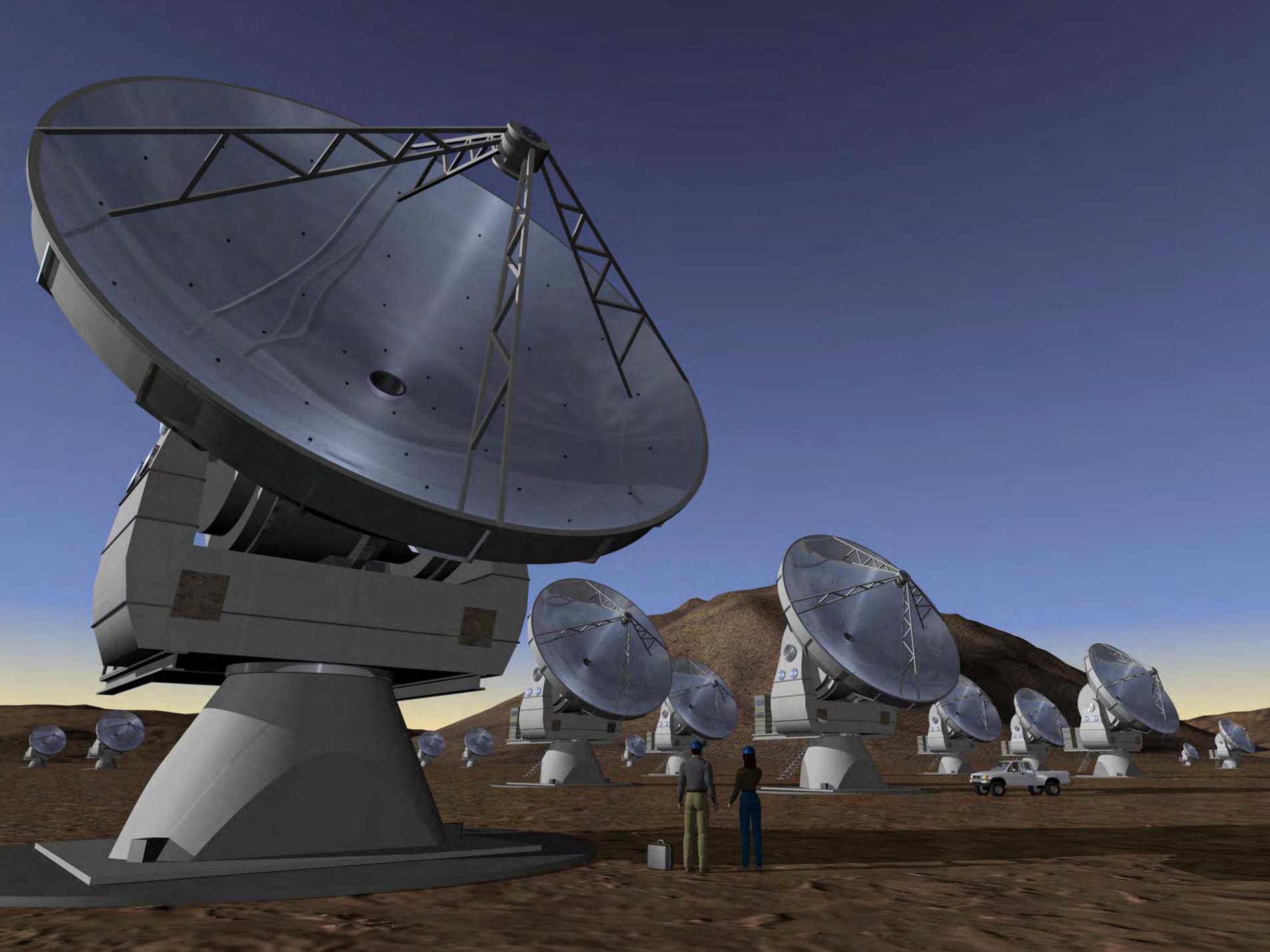


# ALMA + ACA



First ACA 12m – Dec 2007, 7m – Nov 2008







[www.alma.info](http://www.alma.info)

The Atacama Large Millimeter Array (ALMA) is an international astronomy facility. ALMA is an equal partnership between Europe and North America, in cooperation with the Republic of Chile, and is funded in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC), and in Europe by the European Southern Observatory (ESO) and Spain. ALMA construction and operations are led on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI), and on behalf of Europe by ESO.





# Simulation (Tatematsu, Tsutsumi et al.)

