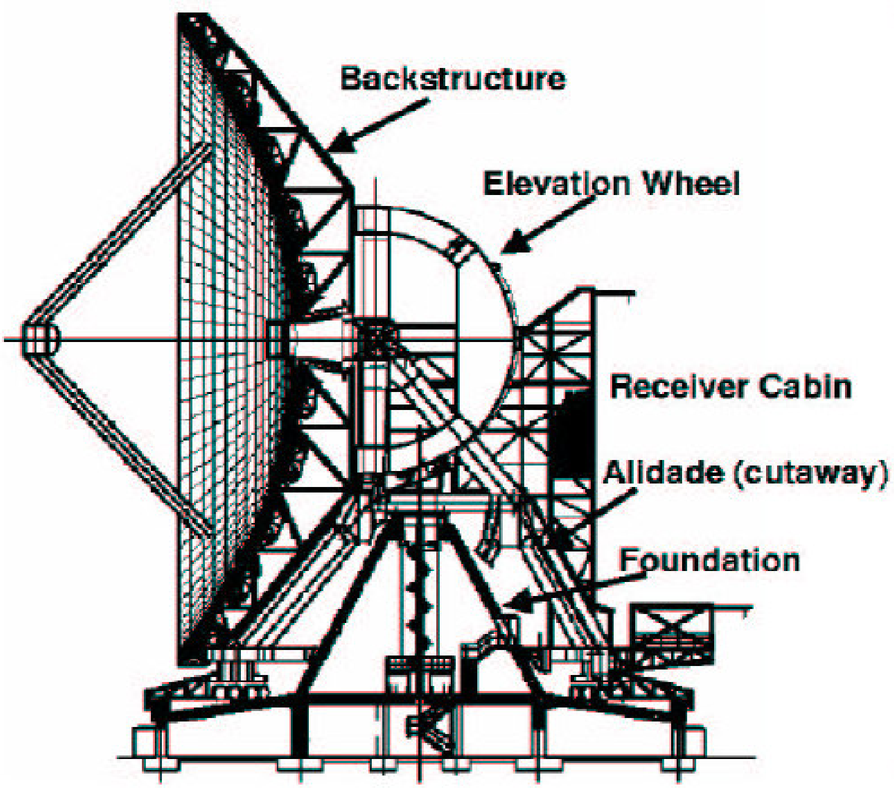
LARGE MILLIMETER TELESCOPE

VIENNA

FEBRUARY 2009

LARGE MILLIMETER TELESCOPE



Parameter	Specification	
Diameter	50 m	
Surface Accuracy	75 microns (Goal: 70)	
Pointing Accuracy	1.0 arcsec (Goal: 0.6)	
Predicted Performance		
Wavelength	3.0mm	1.2mm
Aperture Eff.	0.65	0.40
Sensitivity (Jy/K)	2.2	3.5
Beam FWHM	15"	6"

Figure 2. *Schematic of LMT structure and major performance metrics.*

- excelente apoyo logístico (cerca de pueblos grandes/ciudades)
- solo 2 horas de viaje desde el INAOE con 110 km de autopista y 13 km de carretera de acceso al observatorio

Localización del Gran Telescopio Milimétrico

latitud del GTM ~ +19 degs (como Mauna Kea, Hawai)

A view of the telescope site, with the access road to the right.

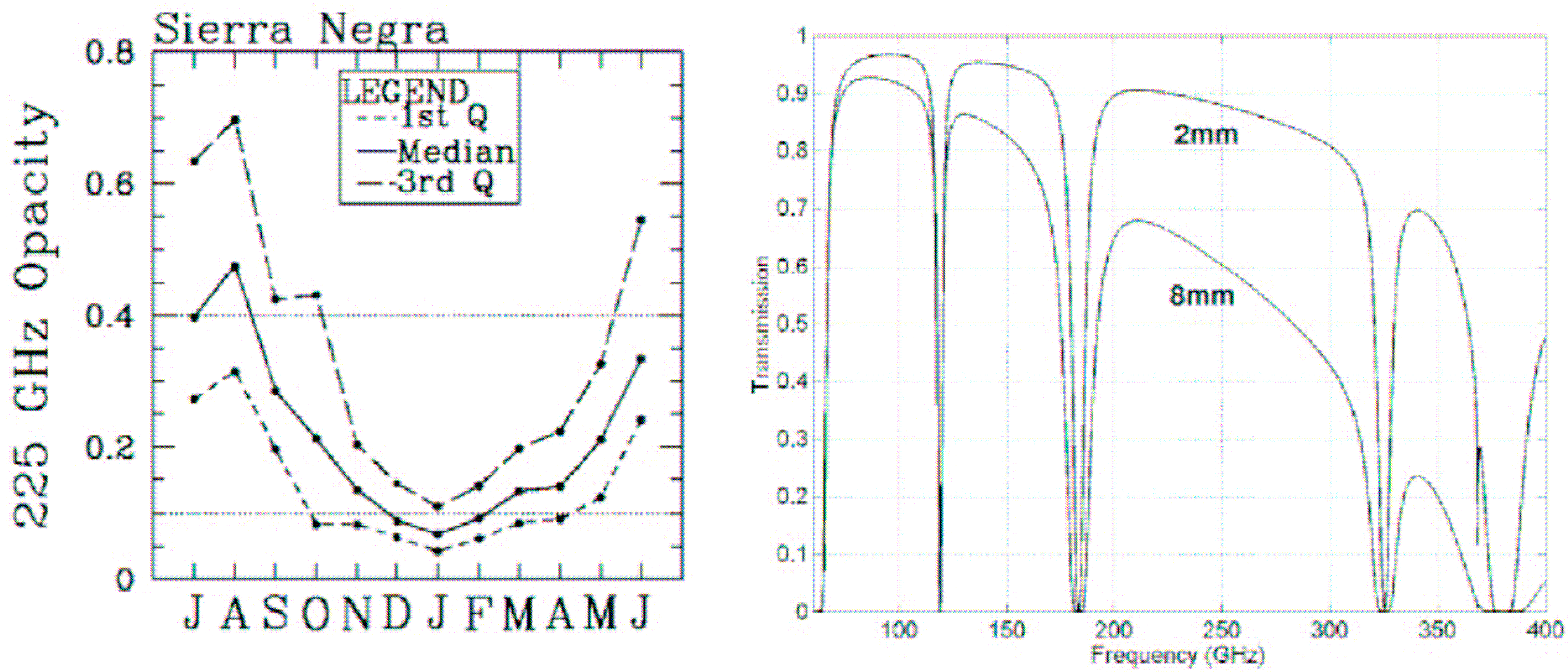
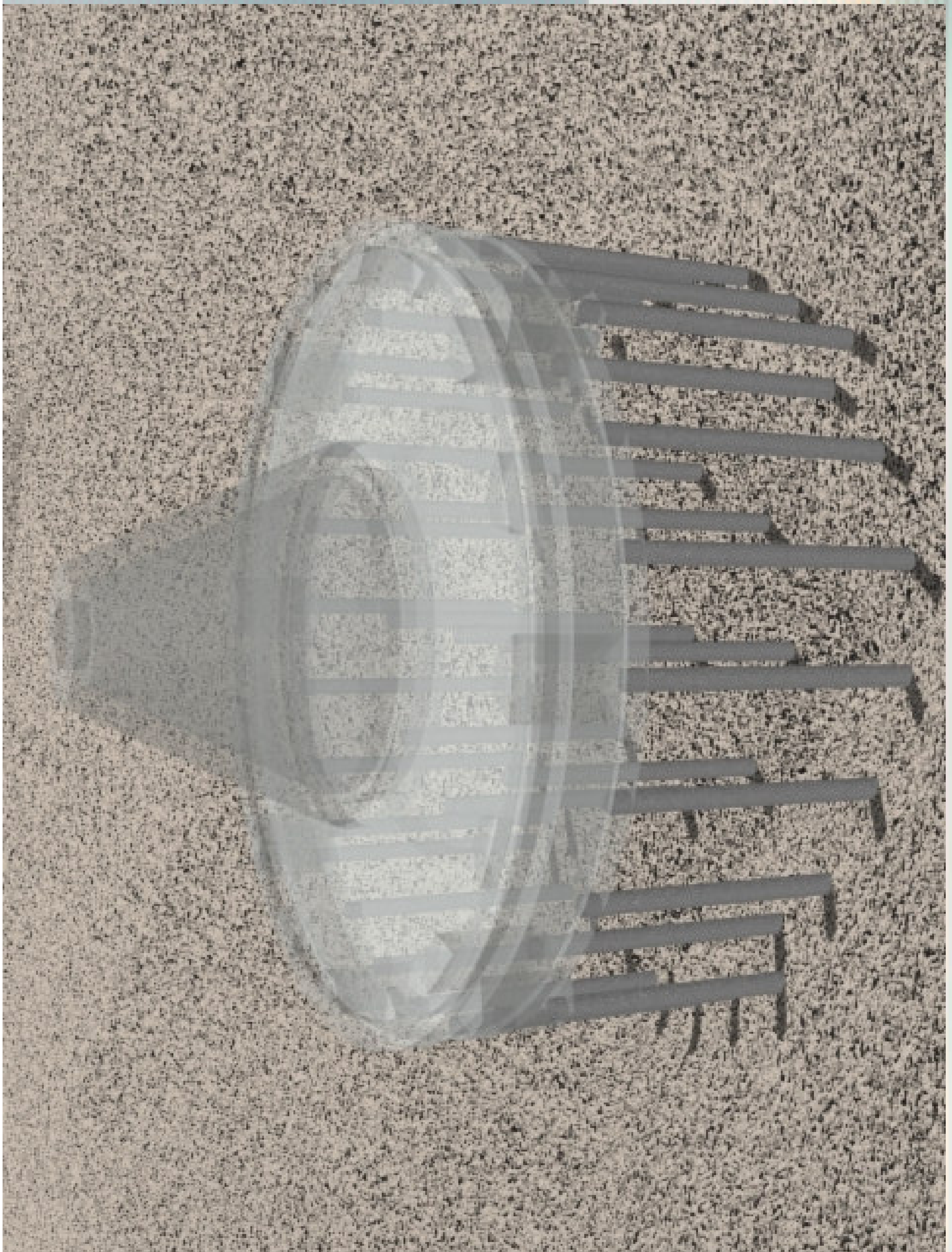
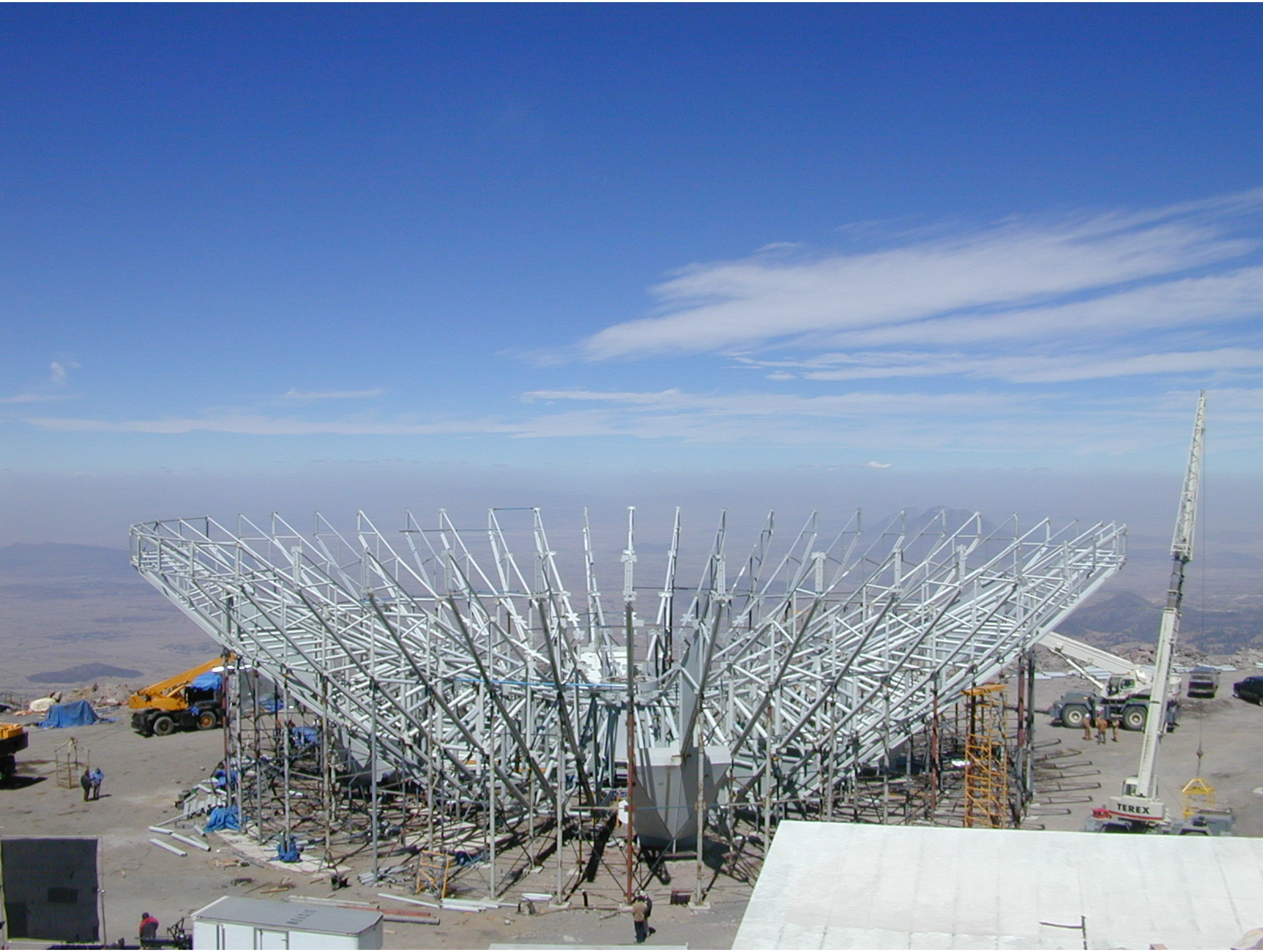


Figure 4. *(left) Results of site opacity measurements at 225 GHz during 1997-2002. Median and quartile values are shown. Dotted lines show approximate levels of 2mm and 8mm of precipitable water vapor. (right) Transmission curves corresponding to 2mm and 8mm precipitable water vapor cases.*




ESEASA


TEREX

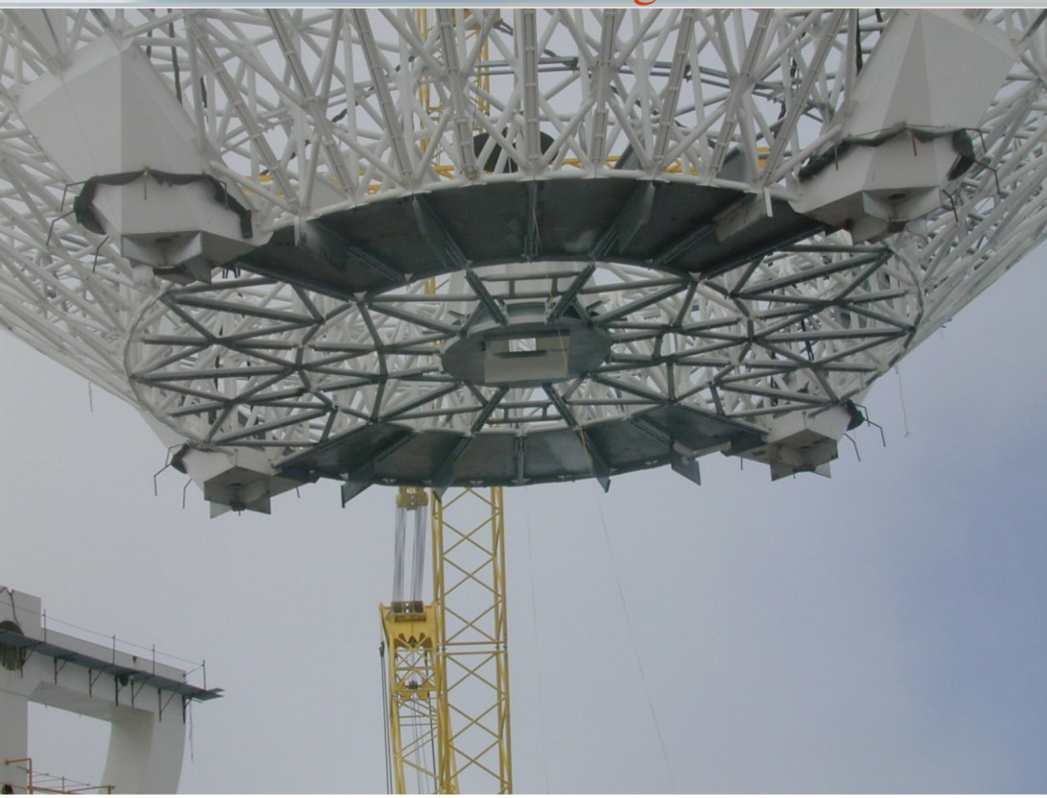

27. 11. 2002


11. 6. 2003

Track welded by Pailería de San Luis Potosí

The structure of the backstructure was aligned on the ground

Lifting the antenna structure on November, 2005



The cladding installation, which is the thermal protection, to cover the 2,183 ton steel structture

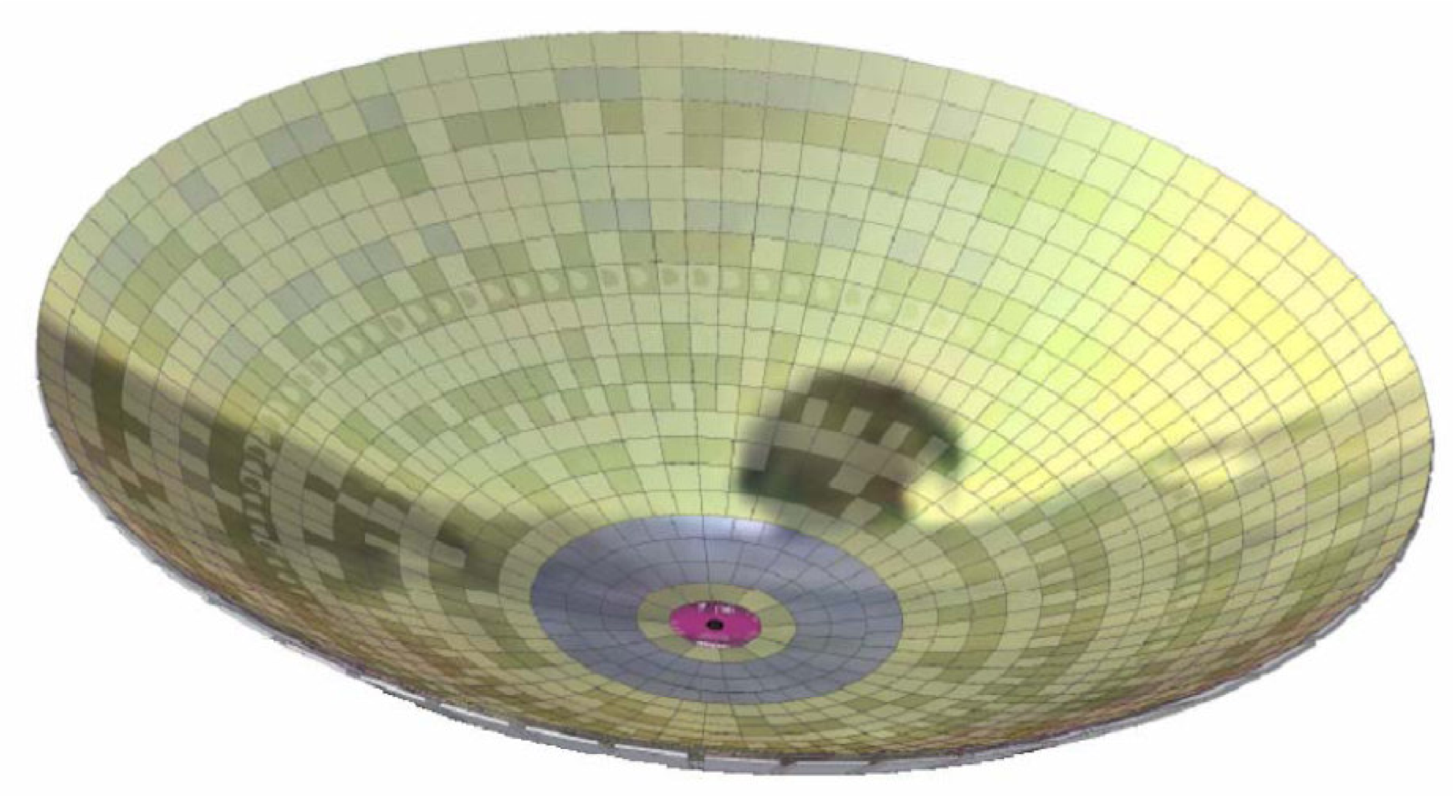
The elevation drives tested and working

Under test, the azimuth motion is done with only 8/16 motors

The working space under the concrete cone

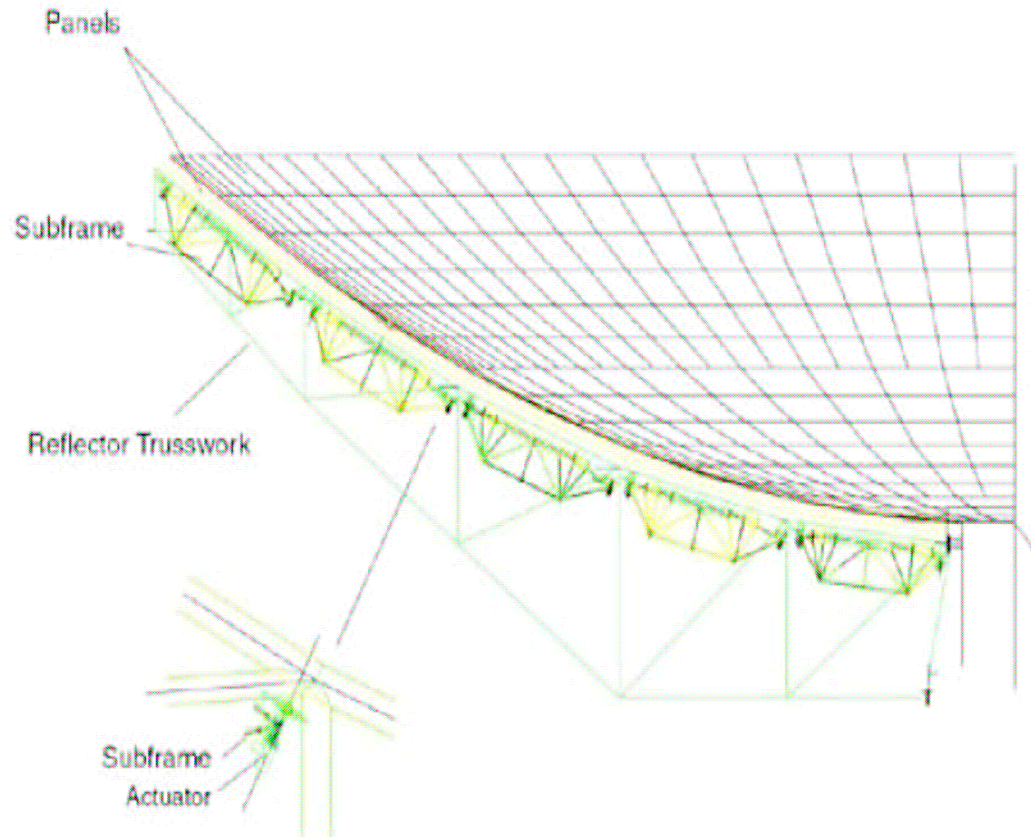
The main reflector is a 50 m diameter parabolic dish with the following parameters:

• Inner diameter	3.25 m
• Outer diameter	50 m
• Focal length	17.5 m

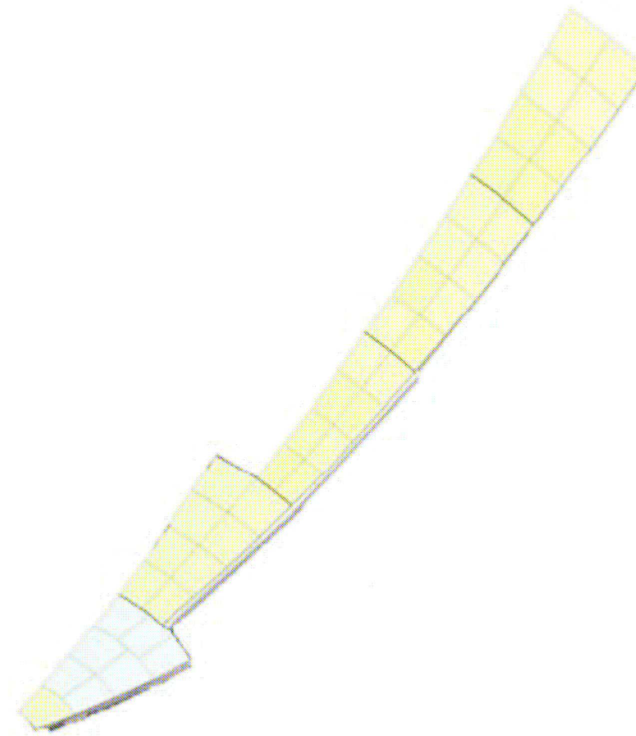


Main reflector surface

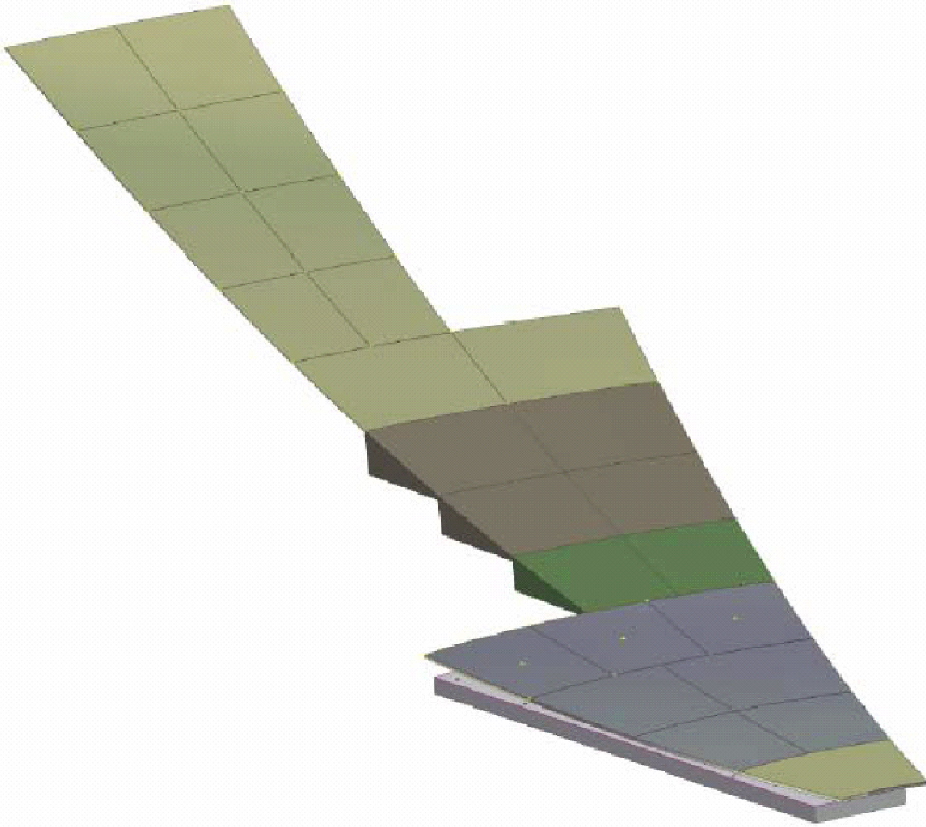
The primary reflector is subdivided in 5 rings, consisting of identical surface segments within each ring. The surface segments are composed of a sub-frame interfacing with the backup structure via a motorised alignment mechanism, a base plate and the reflector panels attached to the base plate via adjustable supports.



Surface segments

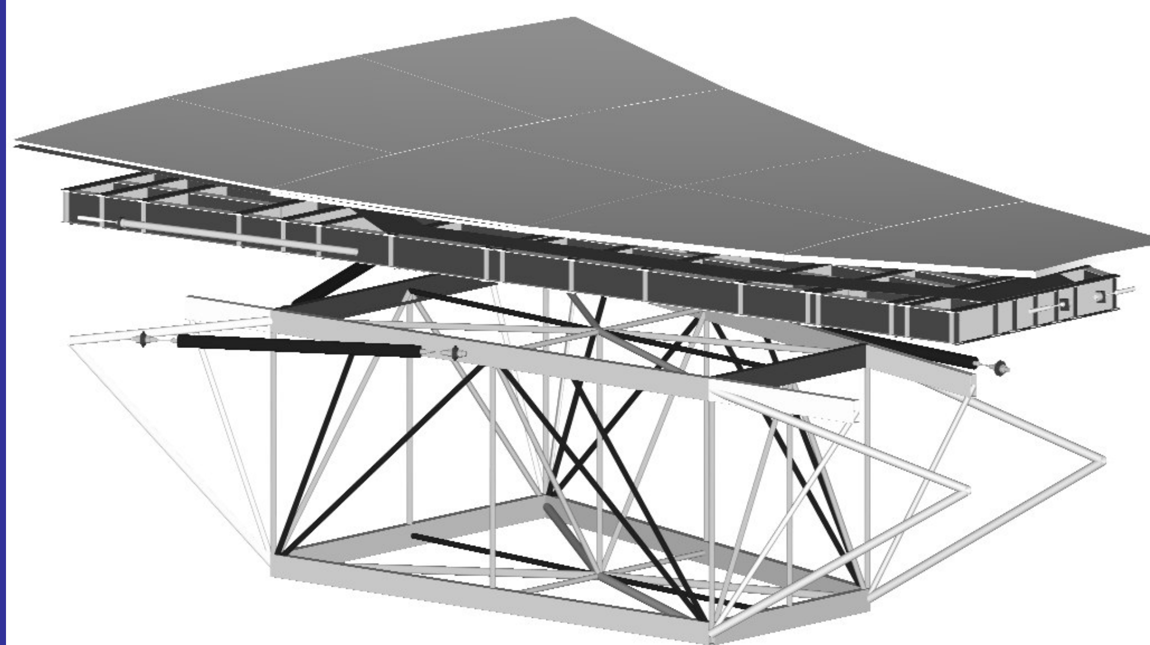


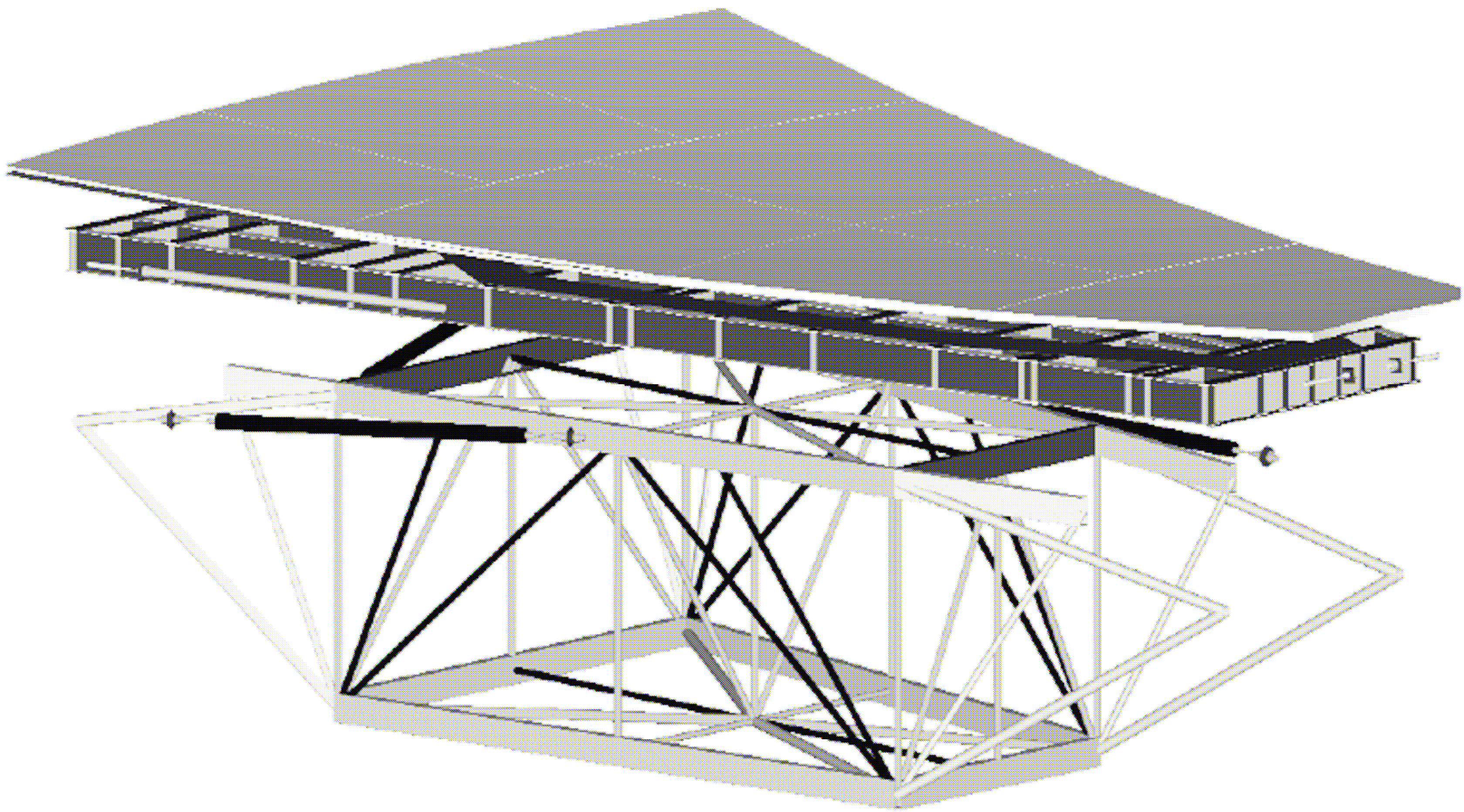
Sector of typical panels



The panels

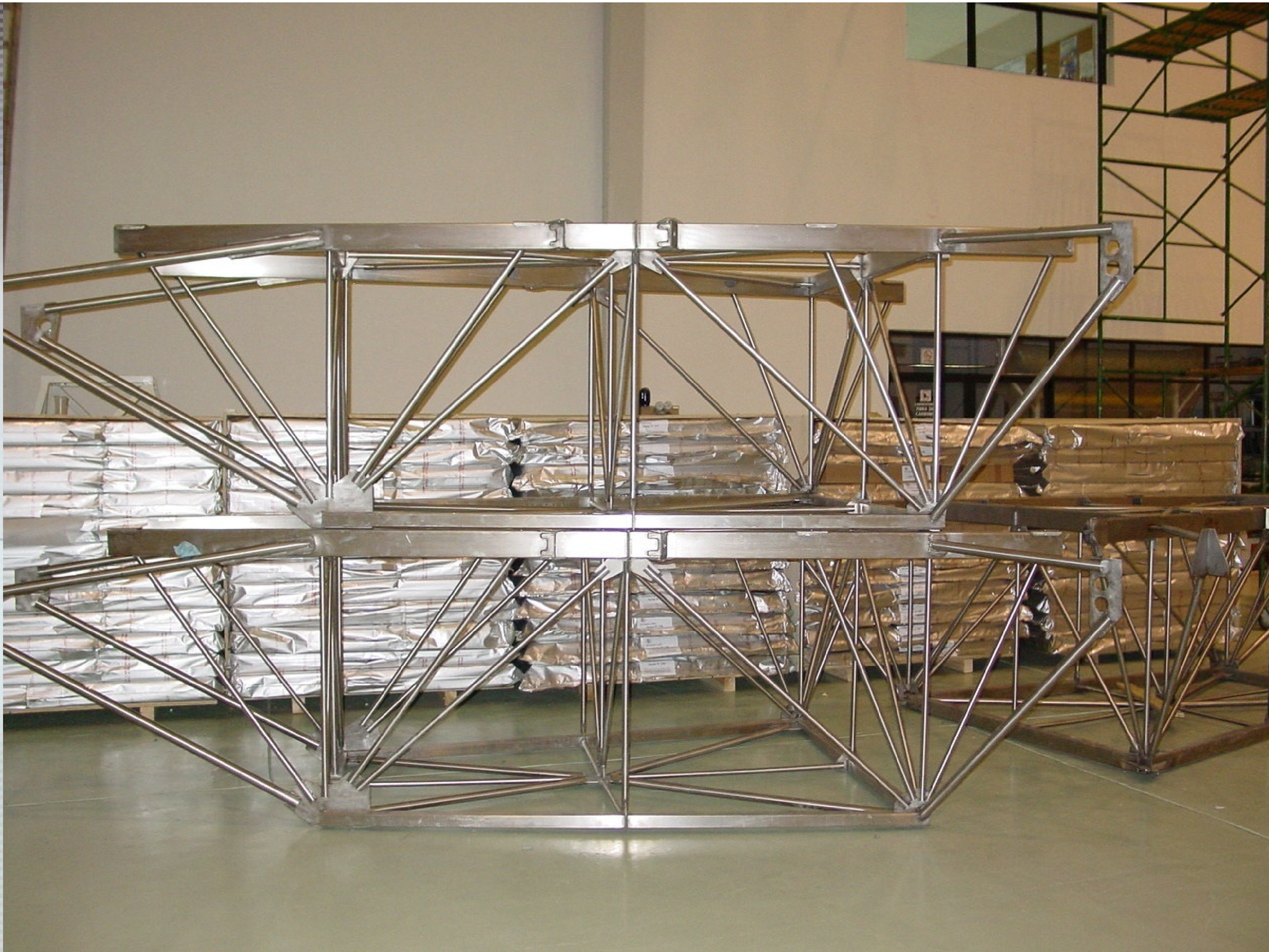
Design and basic geometry





Typical surface segment

Media Lario panels



The subframes in the laboratory ready for assembly

Adjusters

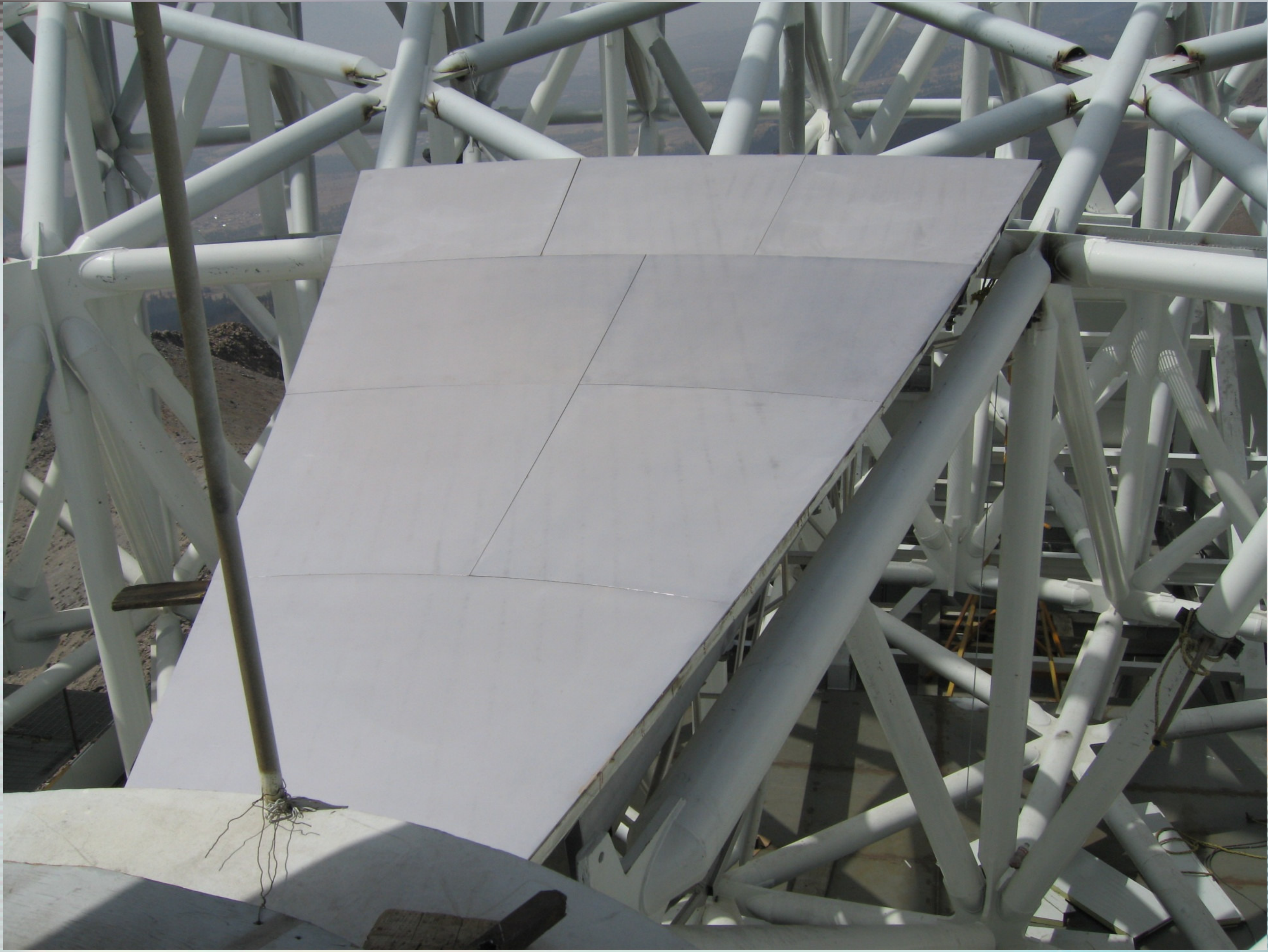
PANELS

The electroformed nickel panels

Lateral Bars

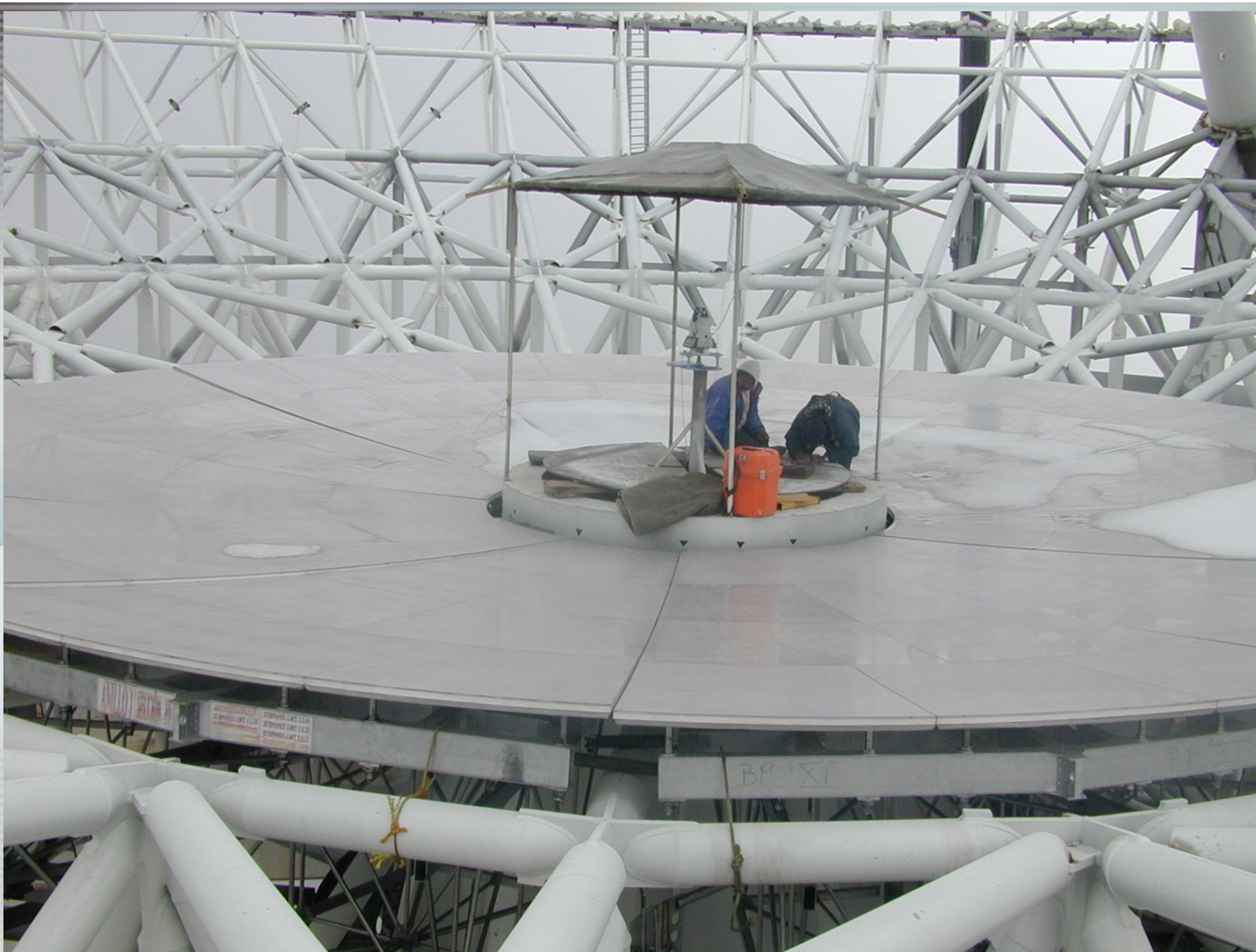
Adjusters

Axial Bars



The first panel in the process of being installed in ring 1

The panels of ring 1 in their way to the telescope

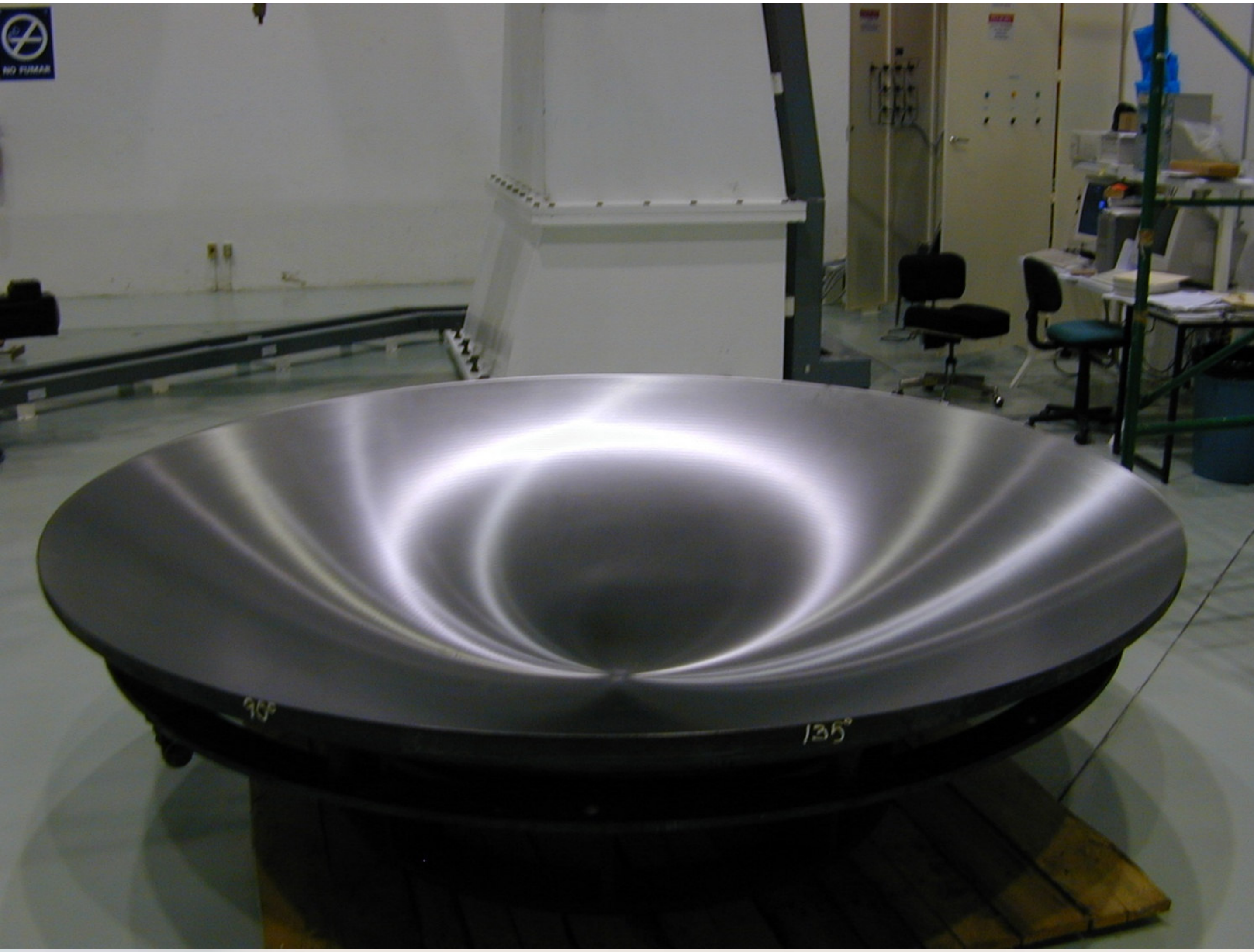


Ring 1 panels in the process of being aligned

INAOE

Polishing machine for the secondary reflector mold.

The mold accuracy is 9.5 µ rms

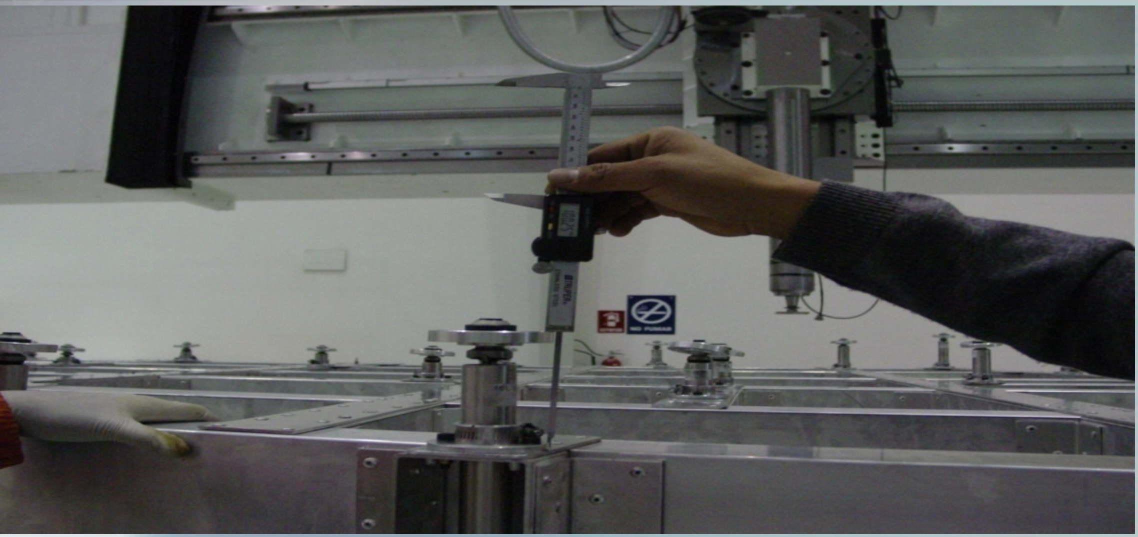


INAOE

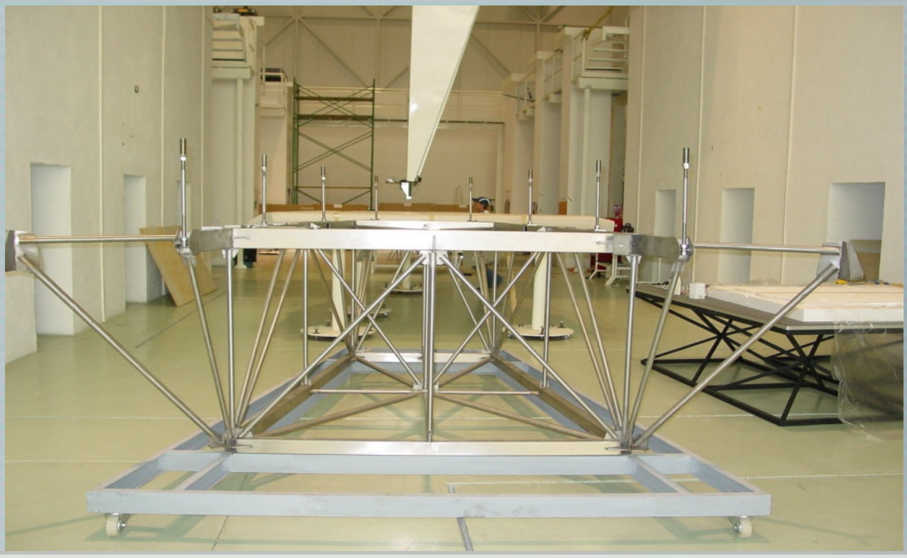
The INAOE to construct the secondary reflector.

Metrología

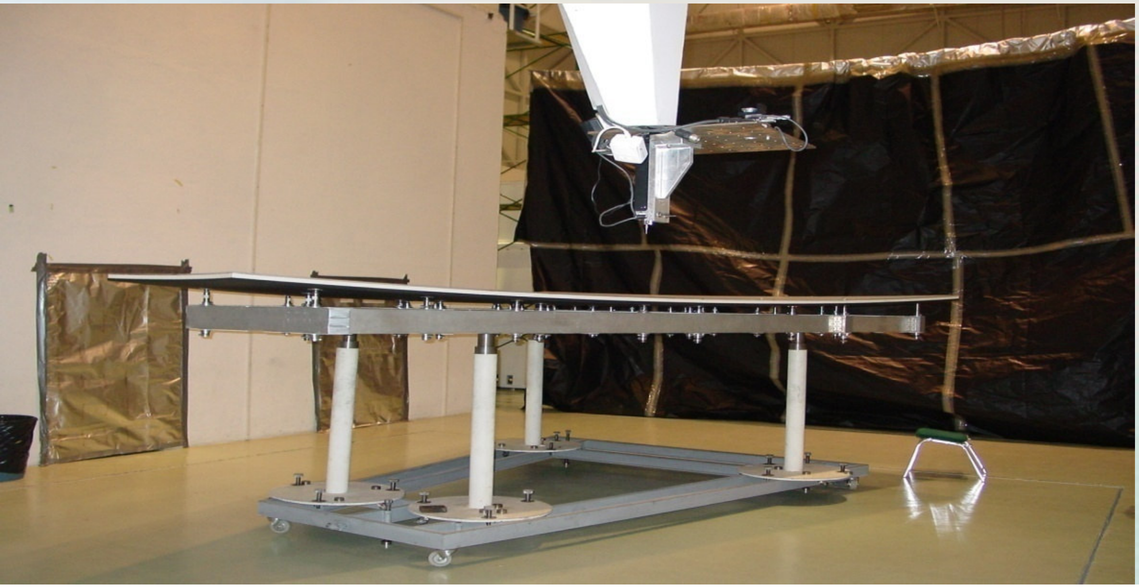
Ajustadores



Subframes



Alineación con máquina de medición tridimensional certificada



Baseplates

INAOE

The coordinate measuring machine

The secondary reflector has been manufactured with RCFP

The rear of the secondary reflector with its mounting support structure

The 2.61 m diameter secondary reflector already finished, being packed for the Al deposition.

Dr. Gustavo Chapela, Director General of CONACYT, witnessing a test in may 2006

Science Instruments

SEQUOIA: The FCRAO's 32-pixel focal plane array for the 85-115 GHz frequency band, SEQUOIA, will be one of the initial scientific instruments on the LMT. SEQUOIA has been in regular use on the FCRAO 14m telescope for "on-the-fly" mapping of molecular spectral lines in a variety of celestial sources.

Narrow Band Spectrometer: The FCRAO's new correlator for the SEQUOIA array, which is also in routine operation on the 14m, will be moved to the LMT as part of the initial science instrumentation. This spectrometer provides two narrowband (50 MHz) IF inputs per SEQUOIA array pixel and will also be used by the 1mm receiver and other future arrays.

Wide Band Spectrometer: A wideband spectrometer is required for the SEQUOIA focal plane array, as well as for any future focal plane arrays developed for the LMT at other frequencies. Construction of a 32 input correlator with 800 MHz of bandwidth is underway at FCRAO.

AZTEC: The Astronomical Thermal Emission Camera (AzTEC) is a large-format bolometer array camera constructed at the University of Massachusetts, in collaboration with the BOLOCAM instrument team at CalTech, JPL, the University of Colorado and the University of Cardiff. The instrument's detector array is comprised of 144 silicon nitride micromesh bolometers fabricated on a single wafer of silicon, that is nearly identical to that used in the BOLOCAM instrument.[3] While AzTEC is, in concept, a copy of the original BOLOCAM instrument now operating on the Caltech Submillimeter Observatory, many significant modifications have been implemented to improve performance and simplify its operation. AzTEC was completed and commissioned at the JCMT in Spring 2005. It has been included as an available instrument in the JCMT's call for proposals since that time and it is in regular use at JCMT until the Spring of 2006.

Redshift Receiver: The Redshift Search Receiver is a novel new instrument designed to search for molecular spectral line emission from objects at high redshift. The system is an ultra-wideband receiver capable of analyzing 36 GHz of instantaneous bandwidth to cover nearly the complete 3mm atmospheric window from 75-111 GHz. The receiver "front-end" consists of four sets of low noise amplifiers with noise temperatures between 50-65 K across the full 75-111 GHz band. The complete front end system has been finished and mounted on the 14m telescope for testing during the spring of 2006. A photograph of the completed front end is shown in Figure 10, along with initial test observation of a 6 GHz portion of the spectrum of the galaxy IC342 to demonstrate the potential performance of the system.

SPEED: Where AZTEC is an instrument designed for continuum imaging at a single wavelength, the Spectral Energy Distribution Camera (SPEED) is designed to complement AZTEC by enabling efficient measurements of the complete SED of objects using all the LMT millimeter and submillimeter bands. SPEED will use 16 frequency selective bolometers (FSB) to sample the 2.1, 1.4, 1.1, and 0.86 mm bands *simultaneously* at four sky positions. This novel bolometer technique will enable improved removal of atmospheric fluctuations, resulting in a factor of two improvement in sensitivity over conventional bolometer arrays. The SPEED instrument is expected to be field-tested at the Heinrich Hertz Telescope in Arizona, where it will remain for scientific applications until commissioning of the LMT begins.

1mm receiver: The 1.3mm atmospheric window is expected to be the "workhorse" frequency band for the LMT. Thus, it is important to instrument the telescope for observations at these wavelengths as soon as possible. We are building a dual-polarization SIS receiver for the 210-275 GHz frequency band as a precursor

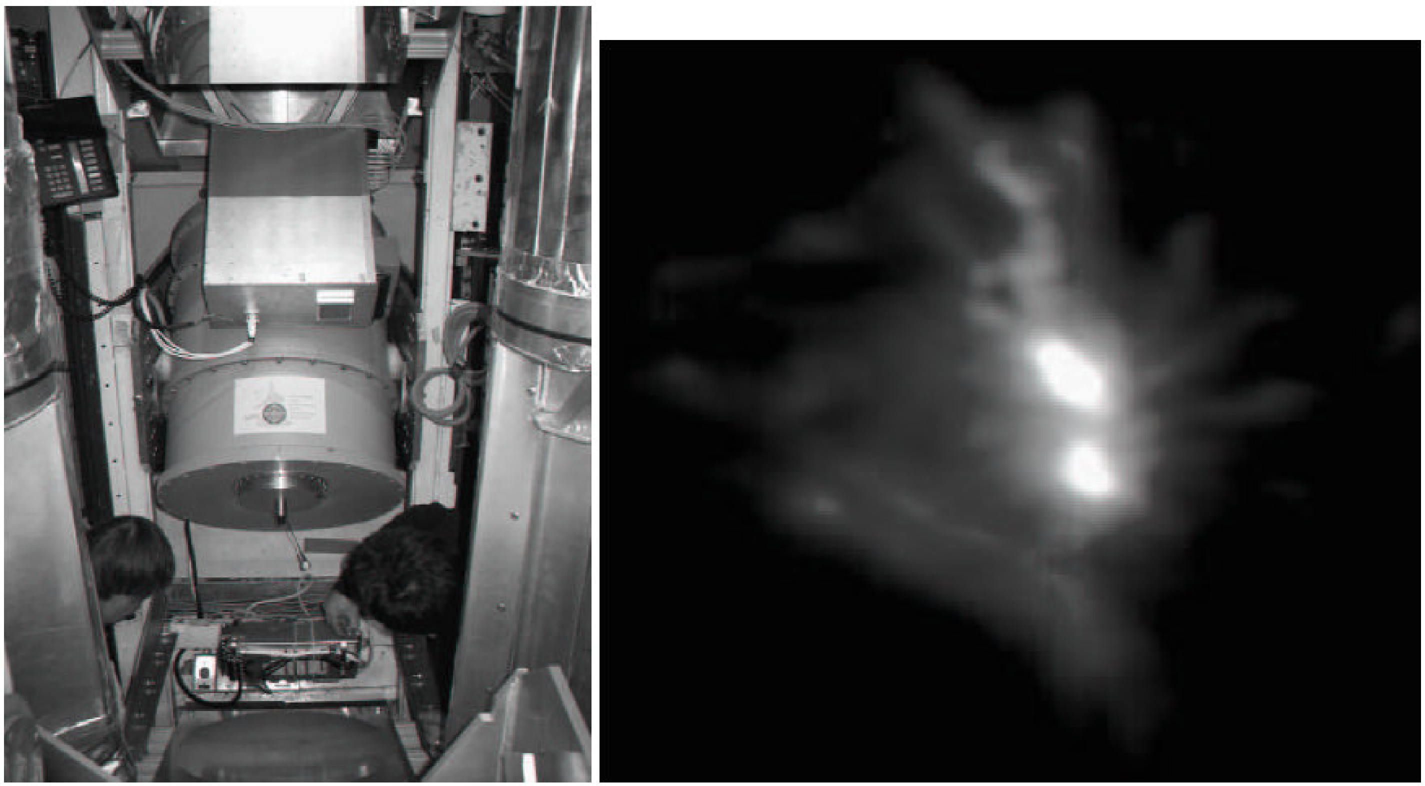
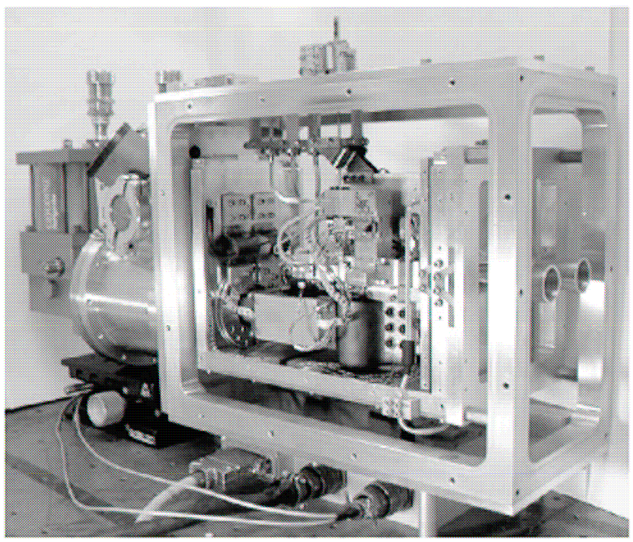


Figure 9. *(left) AzTEC in receiver cabin of the JCMT during commissioning in 2005; (right) AzTEC map of OMC1 source at 1.1 mm wavelength.*



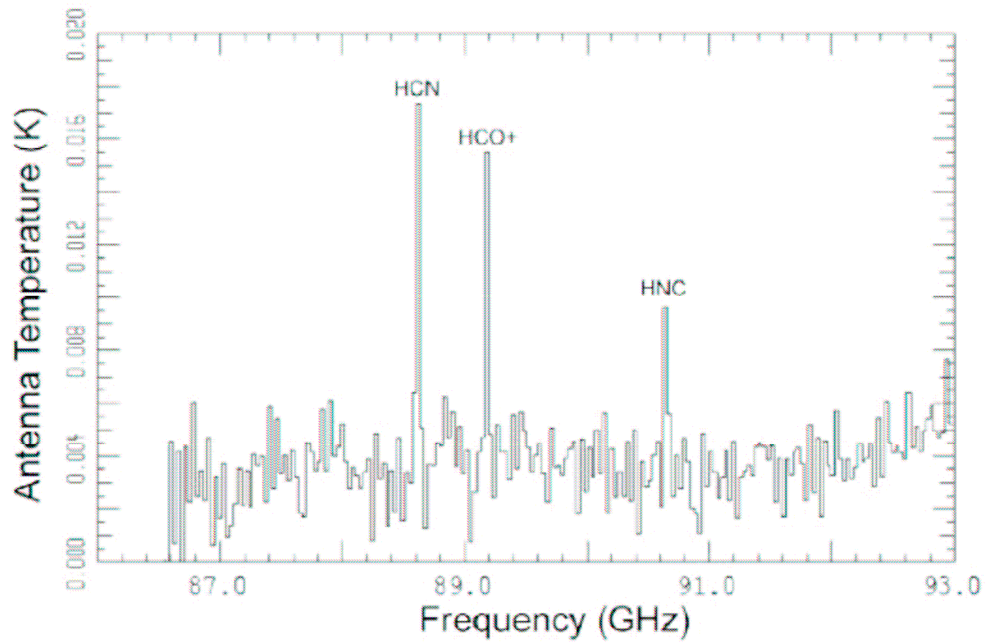
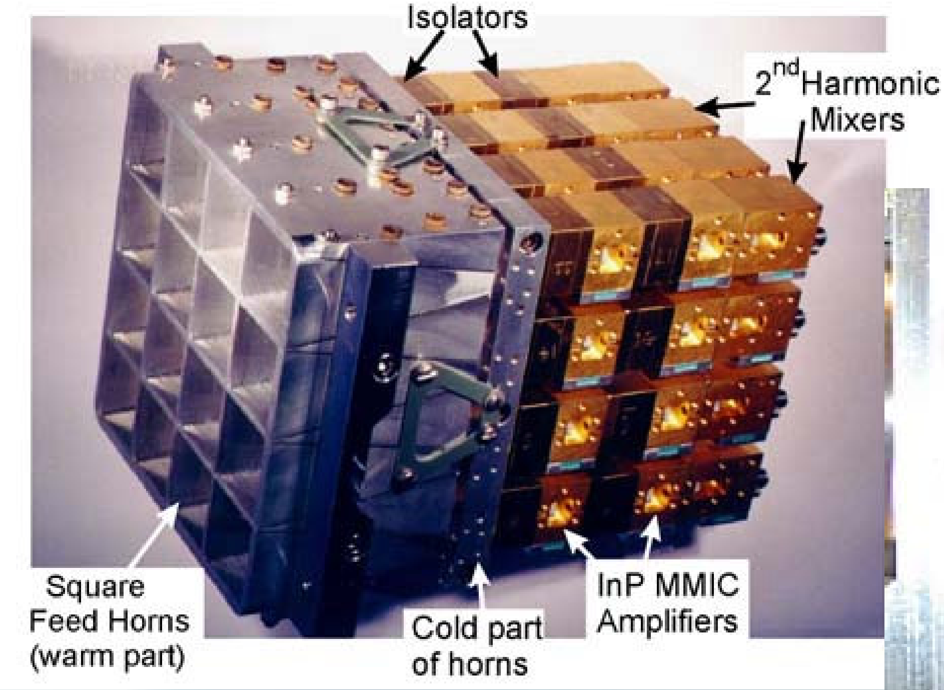
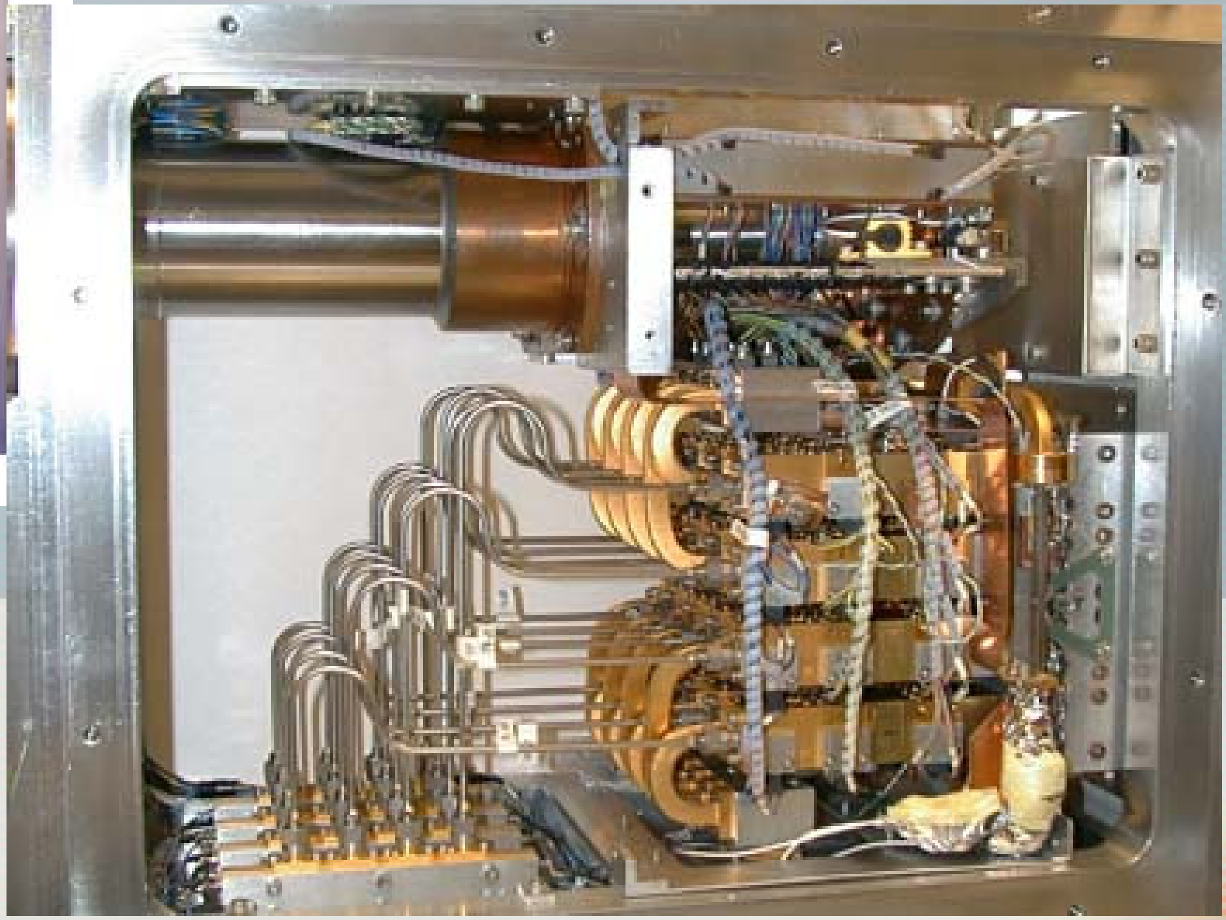


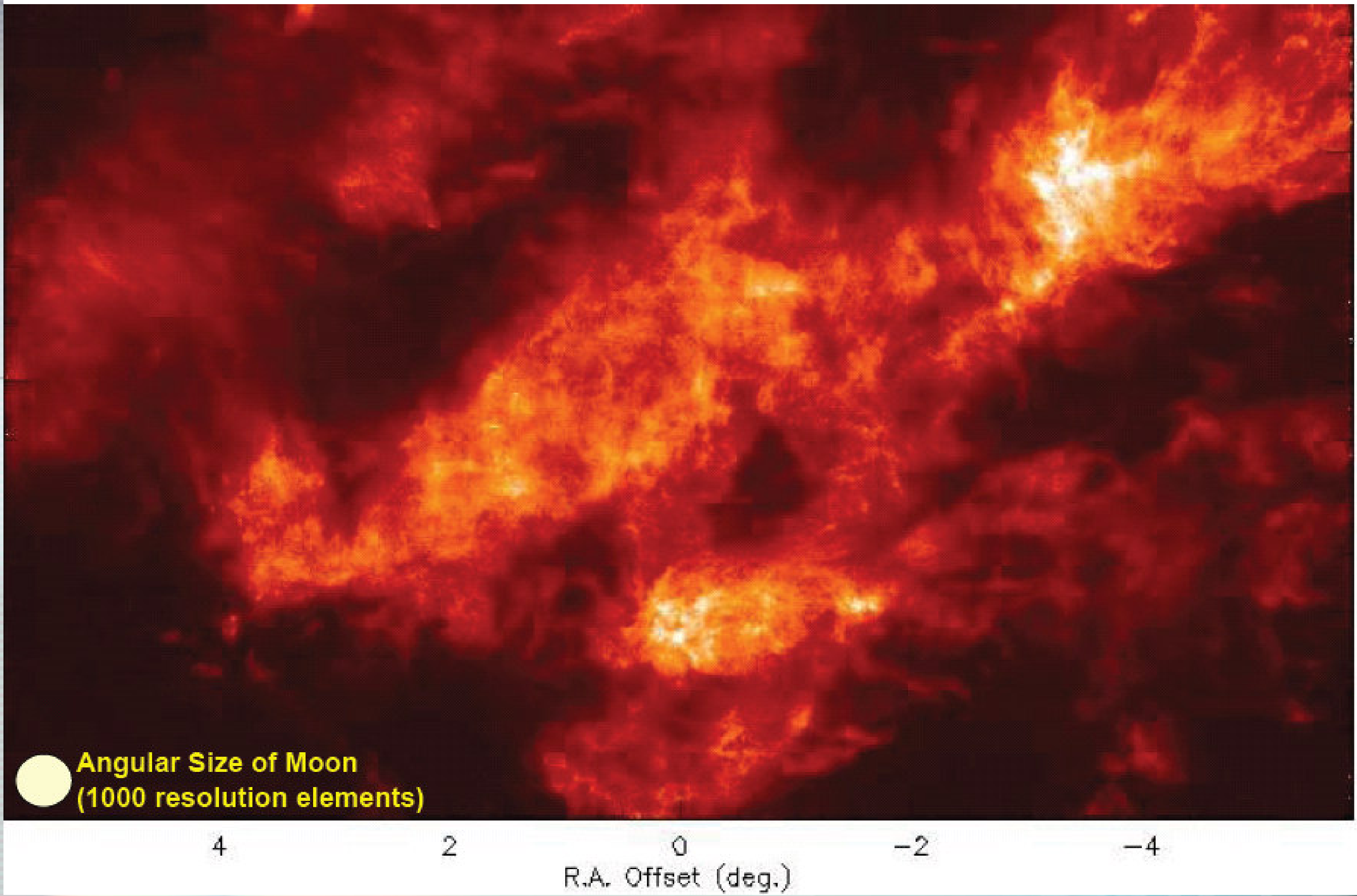
Figure 10. *(left) Photograph of Redshift Search Receiver dewer interior; (right) Test observation of 6 GHz portion of the spectrum of IC342, showing millimeter-wave spectral lines of HCN, HCO^+, and HNC.*

SEQUOIA


Isolators
2nd Harmonic Mixers
Square Feed Horns (warm part)
Cold part of horns
InP MMIC Amplifiers



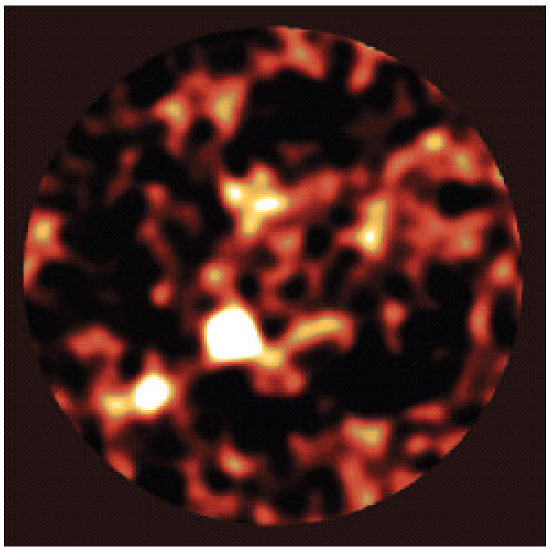
Taurus Molecular Clouds observed with UMass 14m Antenna and SEQUOIA



LA CUBIERTA PROTECTORA FUE TERMINADA EN NOVIEMBRE 2006

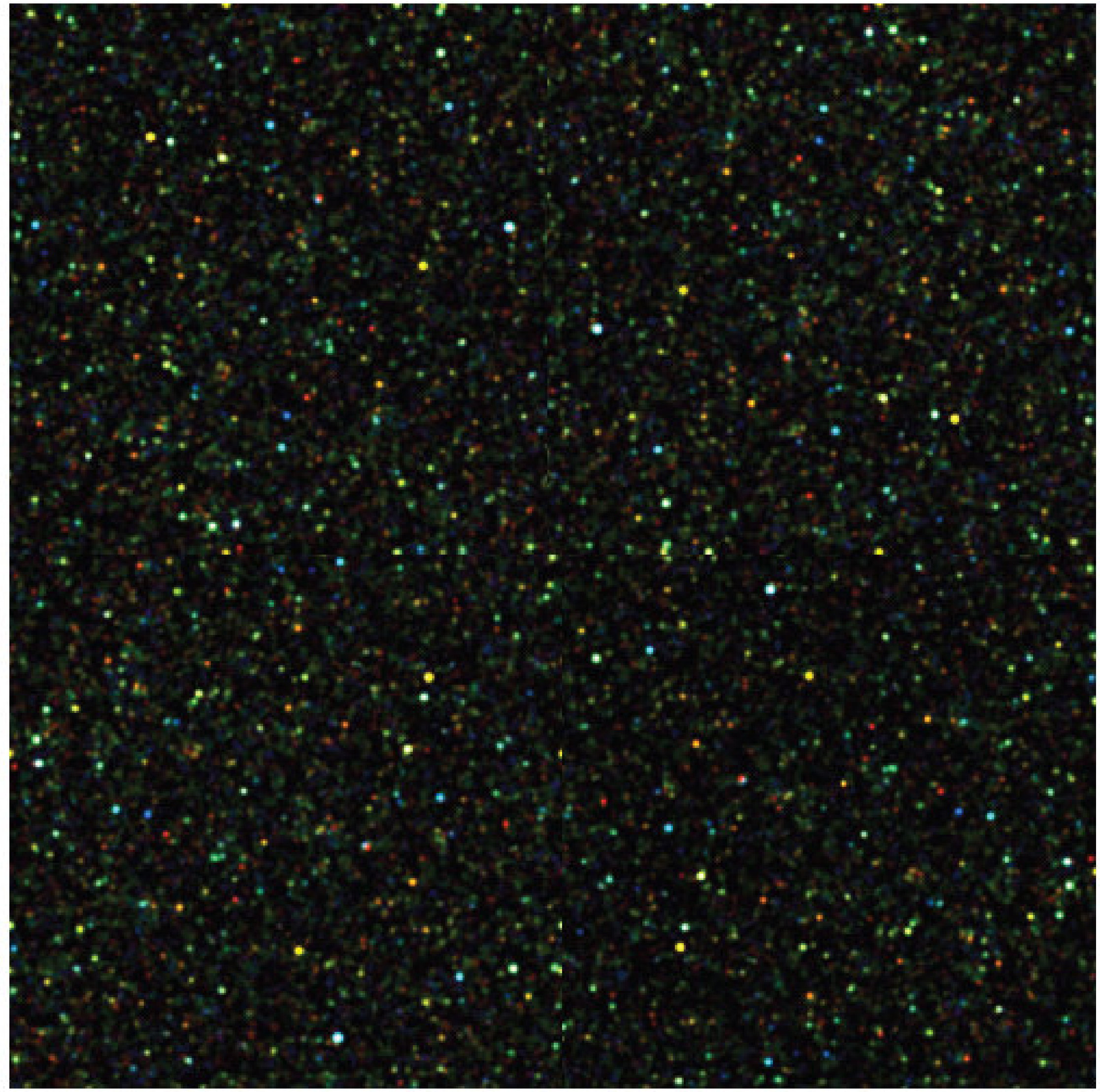
Current State of the Art

…es Clerk Maxwell Telescope
6 square arcmin
50 hours
1-sigma = 0.6 mJy



Ref: D. Hughes *et al*
Nature 1998
~5 sources detected
~500 citations to paper

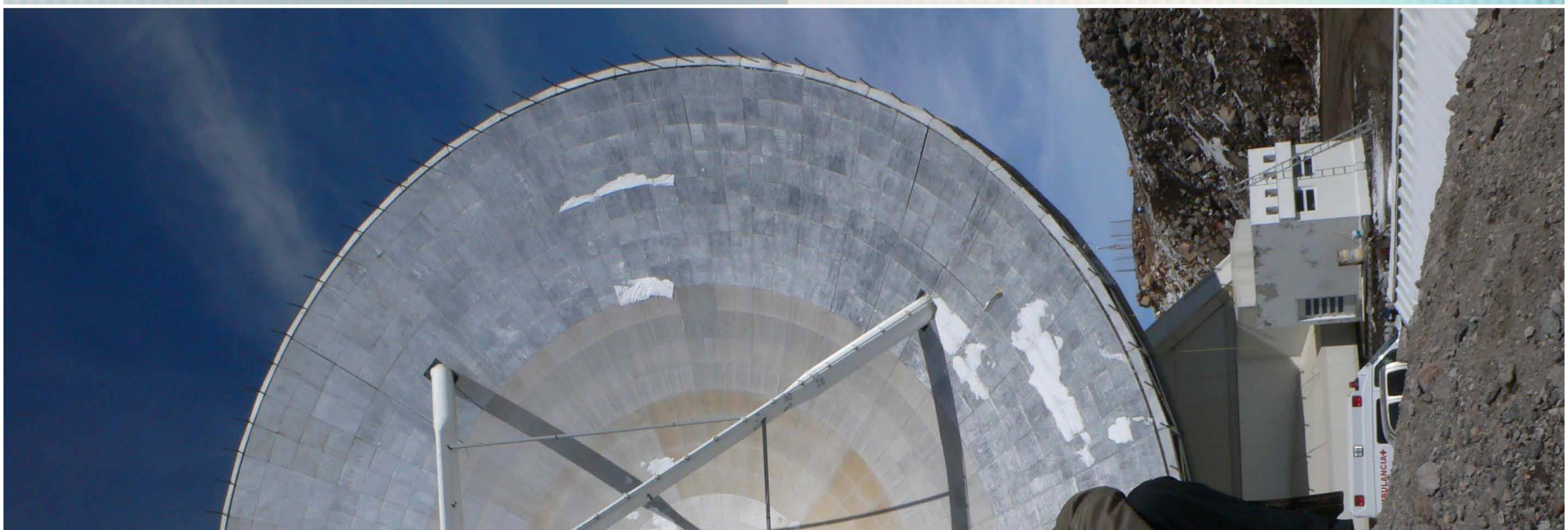
LMT SURVEY OF 25 Square Arcmi…



50 Hours with 1-sigma=0.02 mJy
LMT Detects > 600 sources

Time for ALMA to complete the same field ...

- **To same flux sensitivity: 100 hours**
- **To same brightness sensitivity: 10000 hours**



Quantitative Comparisons of Other MM-wave Telescopes relative to LMT

Red indicates that LMT is better

	GBT	CARMA	LMT	ALMA	ALMA
Telescope Type	***Single***	***Array***	***Single***	***Array***	***Array***
Year of Operation	2006	2006	2007	2008	2012
Sensitivity to Point Sources					
Line (3mm)	0.6	2.5	1.0	1.1	0.3
Continuum (1mm)	-	19	1.0	2.9	0.7
Sensitivity to Extended Emission					
Line (3mm)	2.3	3.3	1.0	3.3	2.5
Continuum (1mm)	-	25	1.0	8.8	6.6
Mapping Speed (Point Sources)					
Line (3mm)	15	4.5	1.0	1.1	0.1
Continuum (1mm)	-	1108	1.0	34	2.2
Mapping Speed (Extended Emission)					
Line (3mm)	348	7.7	1.0	10	5.8
Continuum (1mm)	-	1908	1.0	324	182

LMT compares favorably with ALMA and will compete with ALMA as the best place for certain experiments

- The impact on Earth of an asteroid with a diameter of 140 meters would be equivalent to the explosion of a 500 megaton bomb. This is enough power to destroy a large city or create a 100m tsunami. By 2019, a NASA programme will find around 500,000 previously unknown asteroids, of which a few thousand will have “uncomfortable” levels of probabilities of impacting the Earth in the next 50 years.

To determine whether one of those asteroids will impact Earth, and when, will require accurate knowledge about its composition, shape and orbital characteristics. Radar telescopes are the best tools for this purpose.

Mexico is one of a few countries of the world, which are capable of detecting, tracking and characterizing near-Earth asteroids that constitute an impact danger on our planet.

Mexico's Large Millimeter Telescope (LMT), a 50-meter diameter single dish telescope, can be converted into the largest radar in the world and used to characterize dangerous asteroids and enable international mitigation actions.

- Possible to track asteroids having a probability of impact with Earth above a threshold established by the international scientific community, in order to determine their orbital parameters and other characteristics.

With this knowledge, it is possible to determine if the asteroid indeed represents a risk to Earth and to decide if mitigation strategies need to be pursued. To date, there are not enough radars on a global level to track the number of asteroids, which are anticipated to be discovered.

ESTADO ACTUAL DEL RADIOTELESCOPIO