ASTRONOMY IN CHILE

Mónica Rubio
Departamento de Astronomía
Universidad de Chile

Sociedad Chilena de Astronomía SOCHIAS

LASS, December 9, 2005

Institutions in Chile

Departamento de Astronomía
Universidad de Chile

DOCENCIA Programas

Licenciatura
Magister
Doctorado en Astronomia

www.das.uchile.cl

Sociedad Chilena de Astronomia SOCHIAS

Institutions in Chile

Departamento de Astronomía y Astrofísica
Pontificia Universidad Católica

DOCENCIA Programas

Licenciatura
Doctorado en Astronomia

www.astro.puc.cl

Sociedad Chilena de Astronomia SOCHIAS

Institutions in Chile

Grupo de Astronomía
Facultad de Ciencias Fisicas y Matematicas
Universidad de Concepcion

DOCENCIA Programas

Licenciatura Astronomia
Doctorado en Fisica (Astrofisica)

http://cluster.cfm.udec.cl/

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Institutions in Chile

Grupo de Astronomía, Departamento de Física
Universidad de la Serena

Universidad Católica de Antofagasta

Universidad Católica de Valparaiso

Universidad de Tarapacá

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Development of the Chilean Astronomical Community

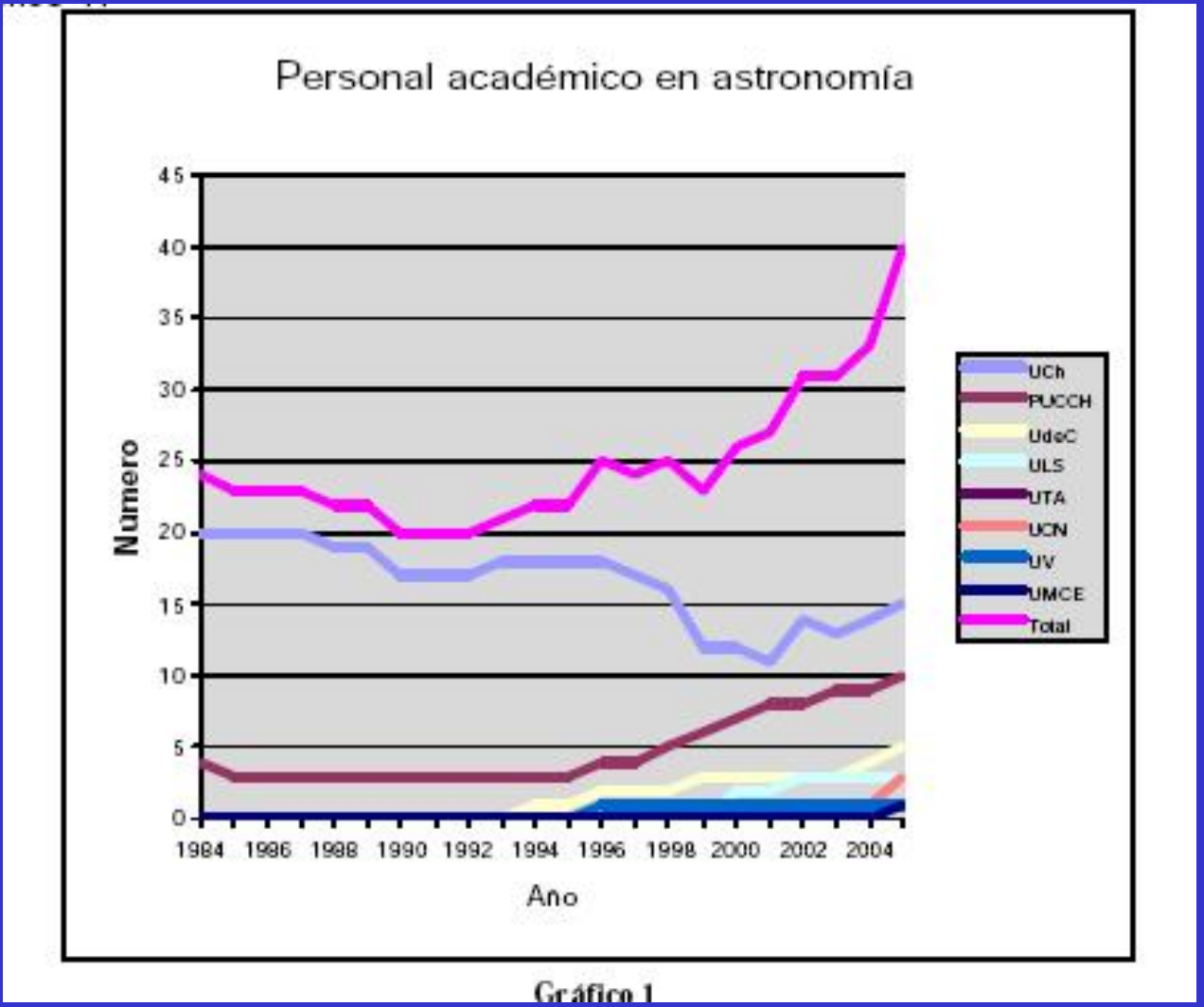

Gráfico 1

S.Lopez et al 2005, Academia de Ciencias

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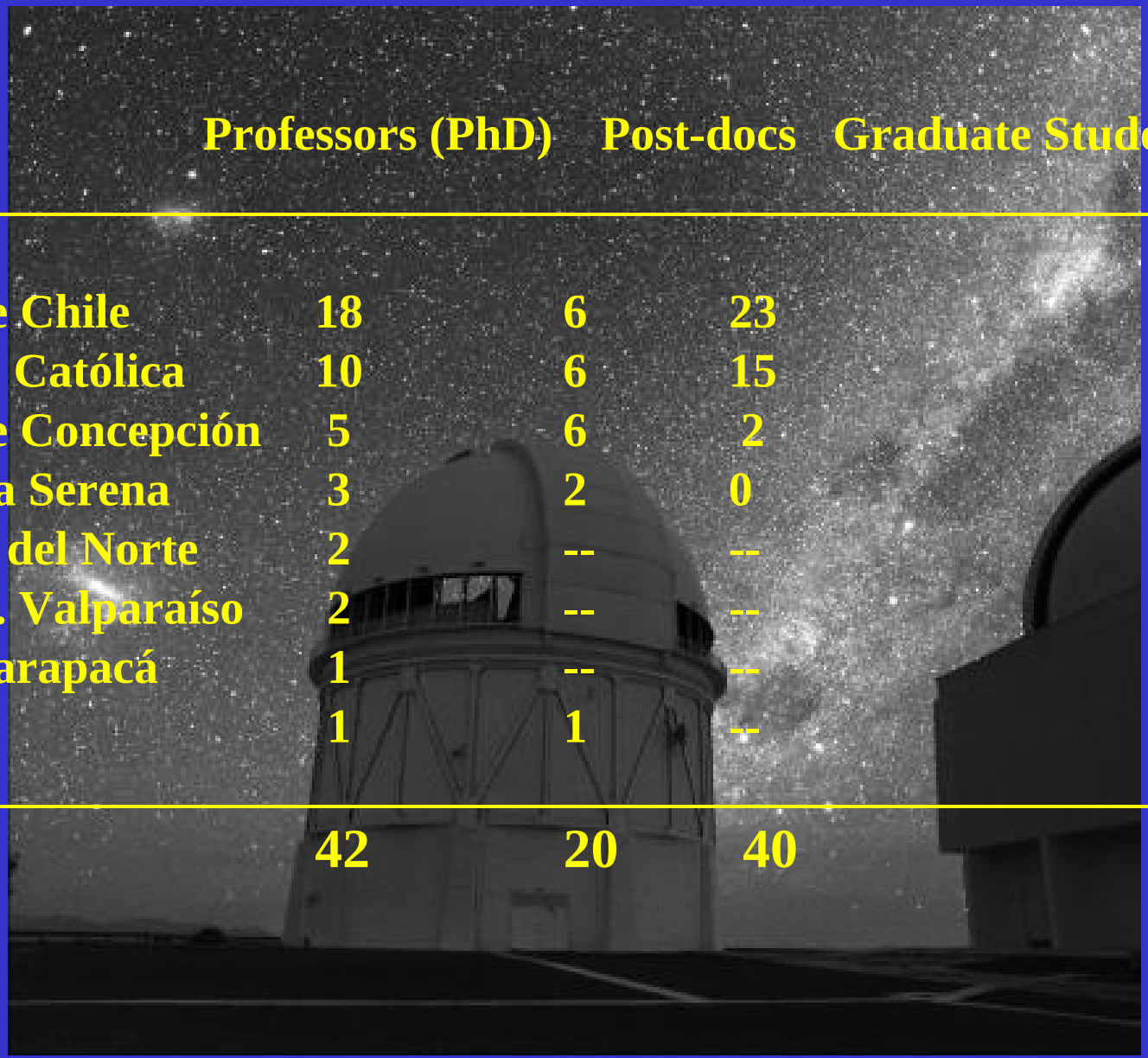
Astronomers in Chilean Institutions



	Professors (PhD)	Post-docs	Graduate Students
U. de Chile	18	6	23
P. U. Católica	10	6	15
U. de Concepción	5	6	2
U. La Serena	3	2	0
U.C. del Norte	2	--	--
U. C. Valparaíso	2	--	--
U. Tarapacá	1	--	--
IIN	1	1	--
	42	20	40

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Productivity

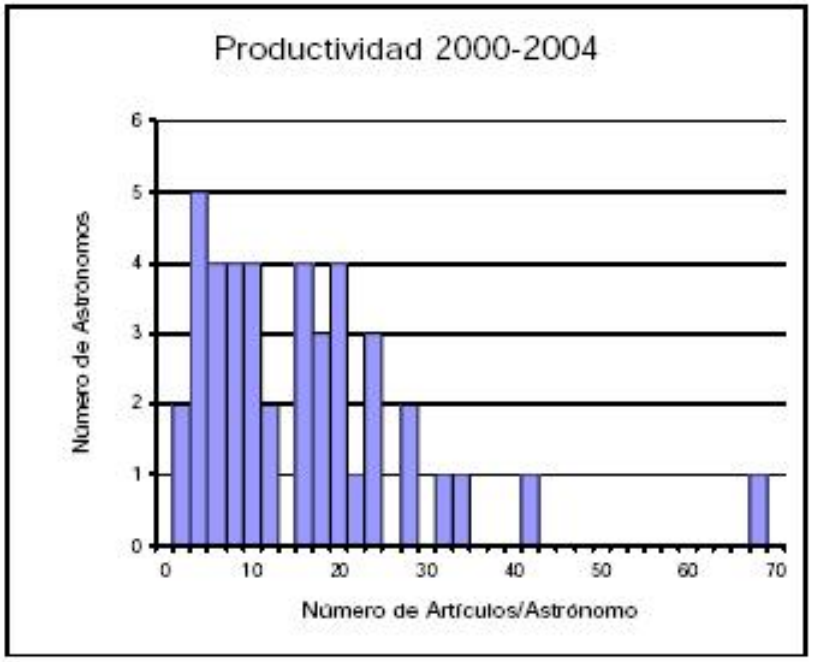

Gráfico 3

Tabla 1 Productividad en Astronomía 2000-2004

Institución (o país)	Artículos/Astrónomo (2000-2004)
Princeton	50.8
Harvard	28.4
Oxford	25.2
Chile	15.5
UNAM	13.2
UNLP	11.6
IAG	10.2

S.Lopez et al 2005, Academia de Ciencias

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Scientific Impact

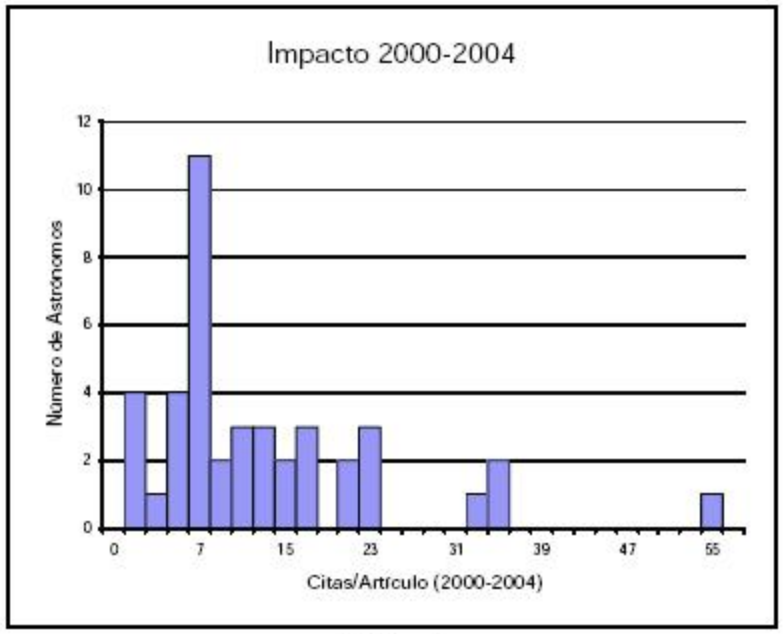

Gráfico 4

Tabla 1 Productividad en Astronomía 2000-2004

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Princeton	50.8
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Chile	15.5
UNAM	13.2
UNLP	11.6
IAG	10.2

S.Lopez et al 2005, Academia de Ciencias

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Areas in Astronomy

Data and Physical Processes	7
Astronomical Instrumentation	0
Data Bases	0
Astrometry an Celestial Mechanics	3
The Sun	1
Solar System	2
Stars	20
ISM	8
The Galaxy	11
Galaxies	19
Cosmology	10
Source wavelengths	4

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CHILE

- **Excellent and unique conditions for ground based astronomical research.**
- **10% of observation time allocated to astronomers working on chilean institutions.**
- **Small but strong astronomical community**
  - **Over 100 publications each year in peer review international journals.**
  - **The highest rate of international publications and impact in basic science of the country.**

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Developments 1995-2000

Optical and Infrared Telescopes

- 8m Gemini at Cerro Pachón Observatory
  SOAR
- 6.5 m Magellans at Las Campanas Observatory
- 8m VLT at Paranal Observatory

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VST, Vista, VLTI in Paranal

The Very Large Telescope Interferometer (VLTI) consists in the ccoherent combination of the four VLT Unit Telescopes and of the four moveable 1.8m Auxiliary Telescopes. Once fully operational, the VLTI will provide both a high sensitivity as well as milli-arcsec angular resolution provided by baselines up to 200m lenght.

The VLT Array on the Paranal Mountain

ESO PR Photo 14a/00 (24 May 2000) ©European Southern Observatory

Developments in Chajnantor Plateau

ESO PR Photo 24c/99 (8 June 1999)

Radio and IR telescopes: 2000➔

- **CBI , Caltech, USA**
- **Apex, Germany & ESO**
- **ASTE, Japan**

- **ACT, Princeton**
- **IR telescope, Cornell**
- **others**

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Cosmic Background Imager CBI

LASS, December 9, 2005

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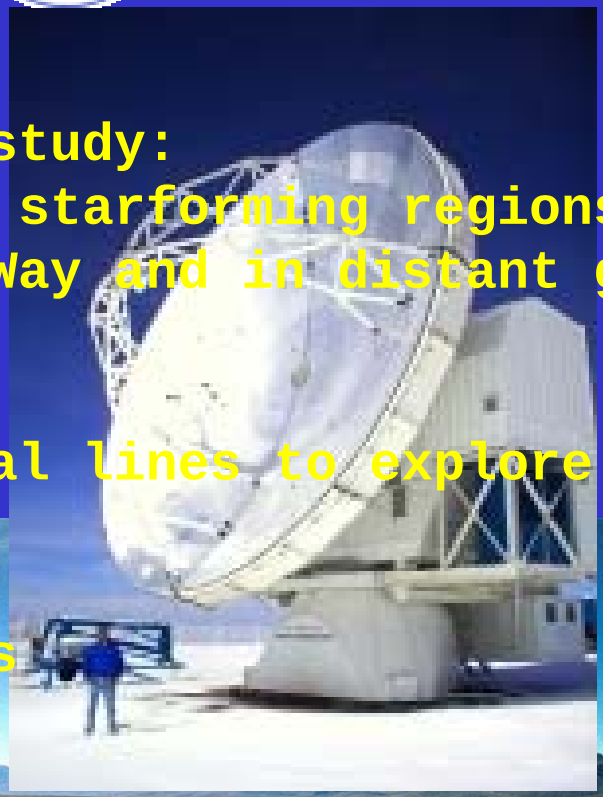
Atacama Pathfinder Experiment APEX

Max-Planck-Institut für Radioastronomie

ESO

Onsala Rymdobservatorium, Chalmers Tekniska Högskola



APEX will allow us to study:
-warm and cold dust in starforming regions both in our own Milky Way and in distant galaxies in the young universe.

-High frequency spectral lines to explore the structure and chemistry of

- planetary atmospheres
- dying stars
- molecular clouds
- inner regions of starburst galaxies.

- Will address issues from the vast scales of the structure of the Universe down to the physics and chemistry of comets.

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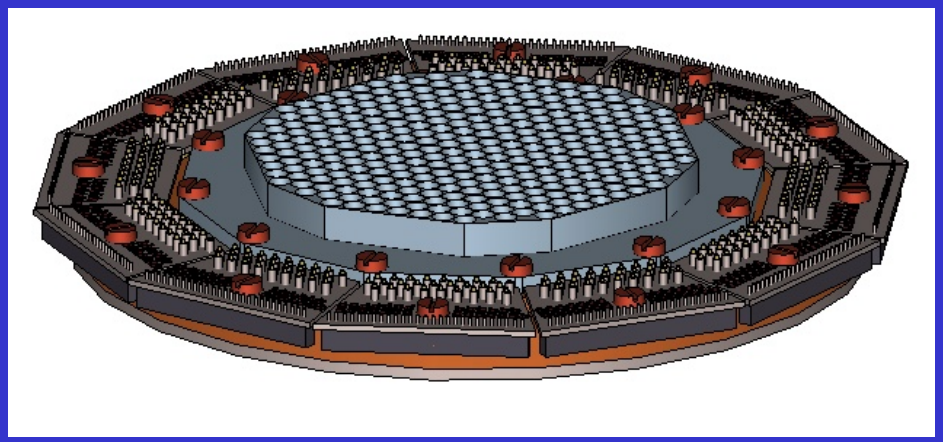
Diameter	12m
Mass	125 000 kg
Mounting	Alt-Az
f/D	8
Surface Accuracy (r.m.s.)	18 micron
Pointing Accuracy	2″ (abs)
Receiver cabins	2 Nasmyth + 1 Cassegrain
Instrumentation	Heterodyne receivers + Bolometers
ters	2048 channel correlator
overage	300 - 1500 microns (230 -1200 GHz)
rer	Vertex Antennentechnik

Two bolometer arrays will be provided at APEX.

LABOCA (LArge BOlometer CAmera)

Bolometer array 870 micron (345 GHz).
l295 channels arranged in a hexagonal layout consisting of a center channel and 9 concentric hexagonals .

beam size at this wavelength is 18"
total field of view for LABOCA is 11.4'.



350 micron array

APEX will also have a 37-channel bolometer array operating at 350 micron (850 GHz). It will have a typical hexagonal bolometer design.

I e APEX will equipped with SIS receivers covering the bands at 275 - 3 5 - 500 GHz as well as the submillimetre and THz bands.

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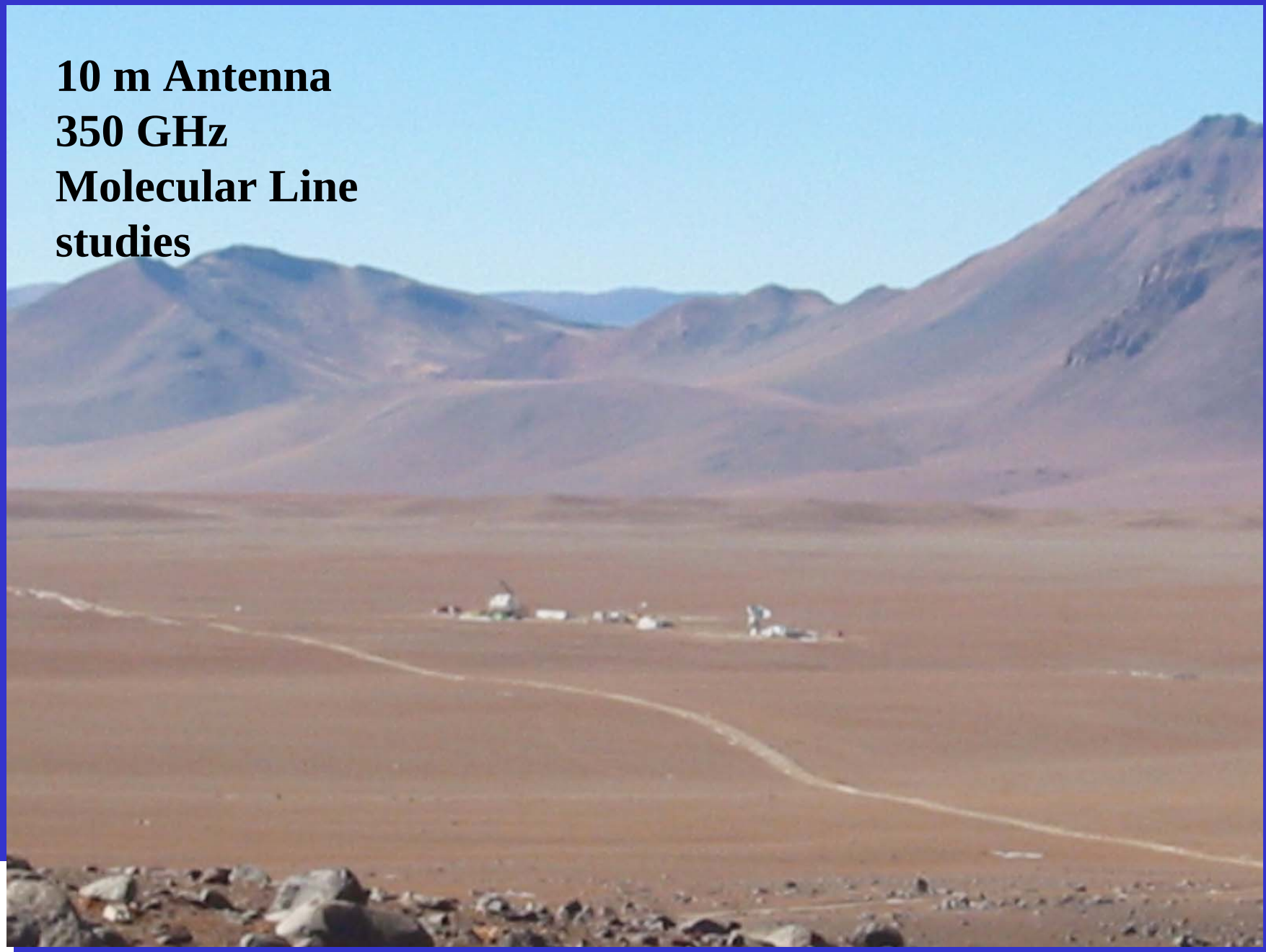
Atacama Submillimeter Telescope ASTE



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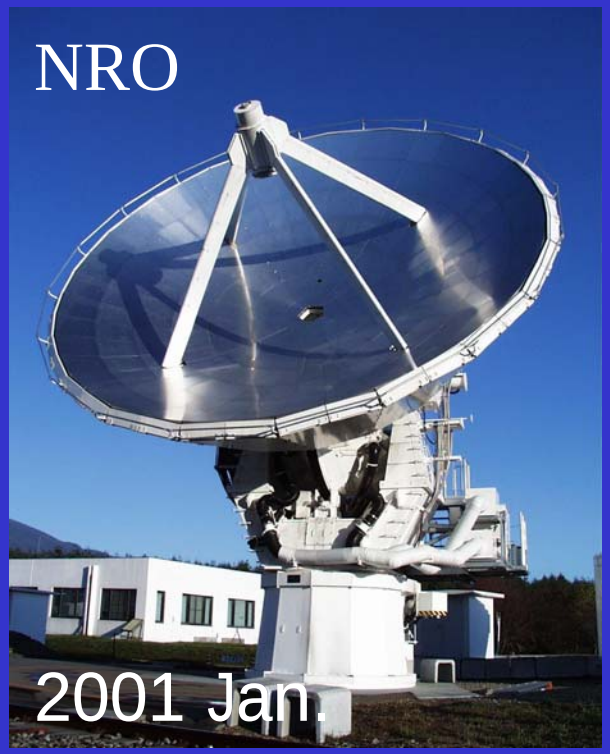
From Nobeyama to Chile

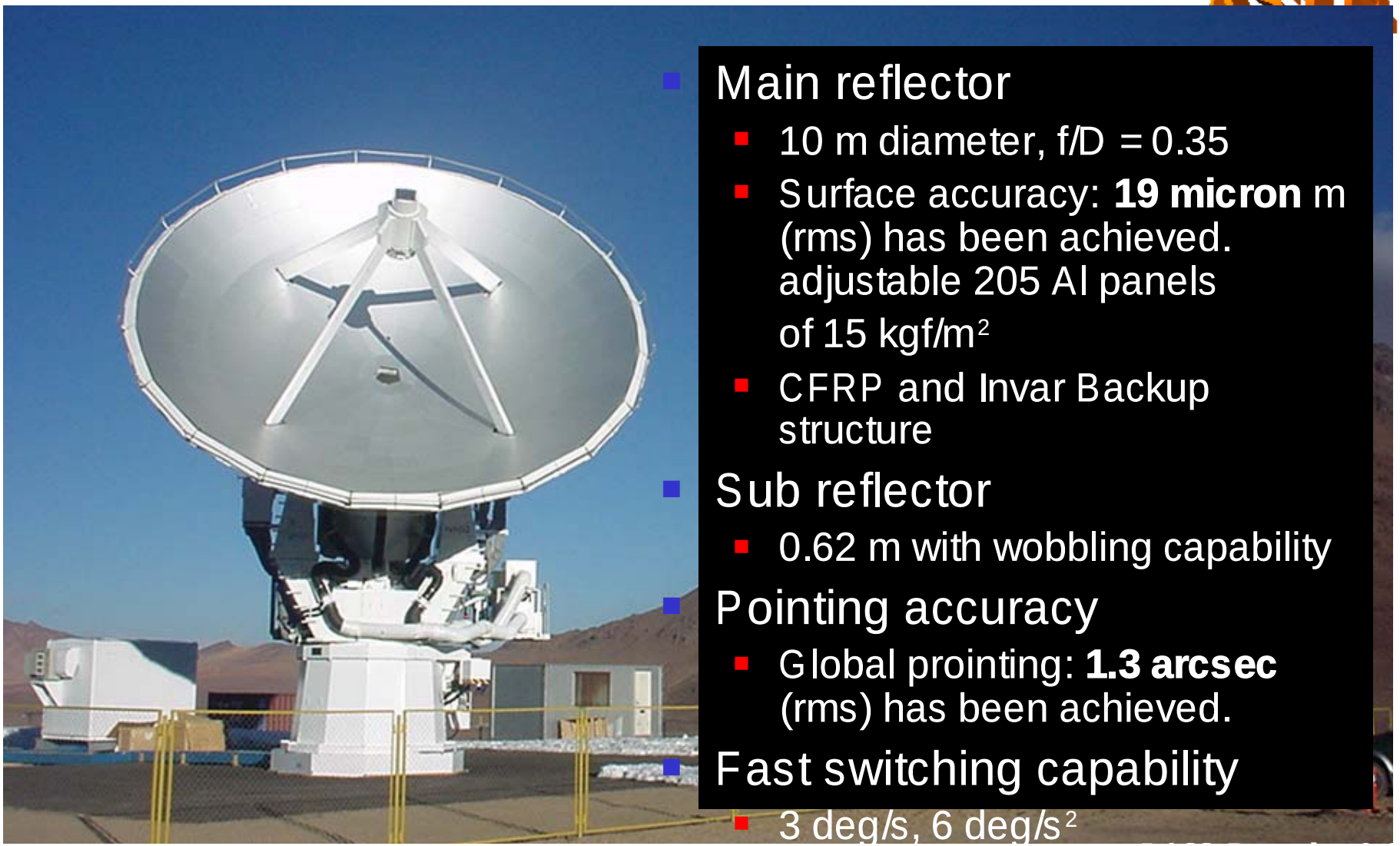
- **2000/02 — 2001/05 : Evaluation at NRO**
- **2001/05 — 2002/03 : Relocation to Chile**
- **2002/03 — : Start evaluation in Chile**

Relocate



SOCHIAS

ASTE 10 m Antenna



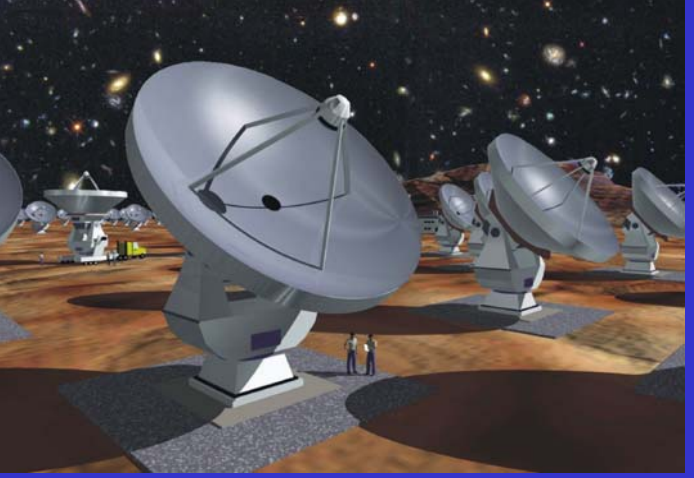
- Main reflector
  - 10 m diameter, f/D = 0.35
  - Surface accuracy: **19 micron** m (rms) has been achieved. adjustable 205 Al panels of 15 kgf/m^2
  - CFRP and Invar Backup structure
- Sub reflector
  - 0.62 m with wobbling capability
- Pointing accuracy
  - Global pointing: **1.3 arcsec** (rms) has been achieved.
- Fast switching capability
  - 3 deg/s, 6 deg/s^2

NANTEN telescope

NANTEN = Southern Sky

- Diameter: 4m

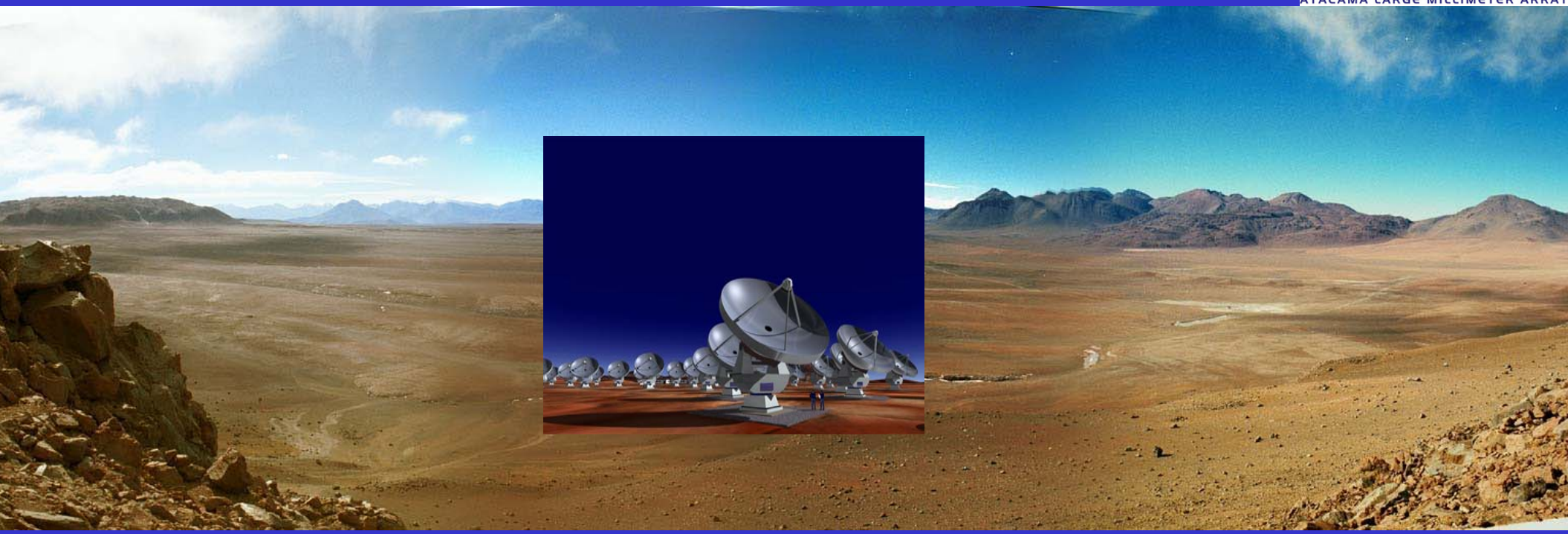
  CFRP + conductive paint
- SIS receiver + AOS backend
- 85-115GHz, mainly CO(J=1-0)
- Beam size 2.6 arcmin (@115GHz)
- Velo. Res. 0.1 or 0.6 km/s
- Band Width 100 or 500 km/s



The world project

ALMA : NRAO & ESO

ALMA
ATACAMA LARGE MILLIMETER ARRAY



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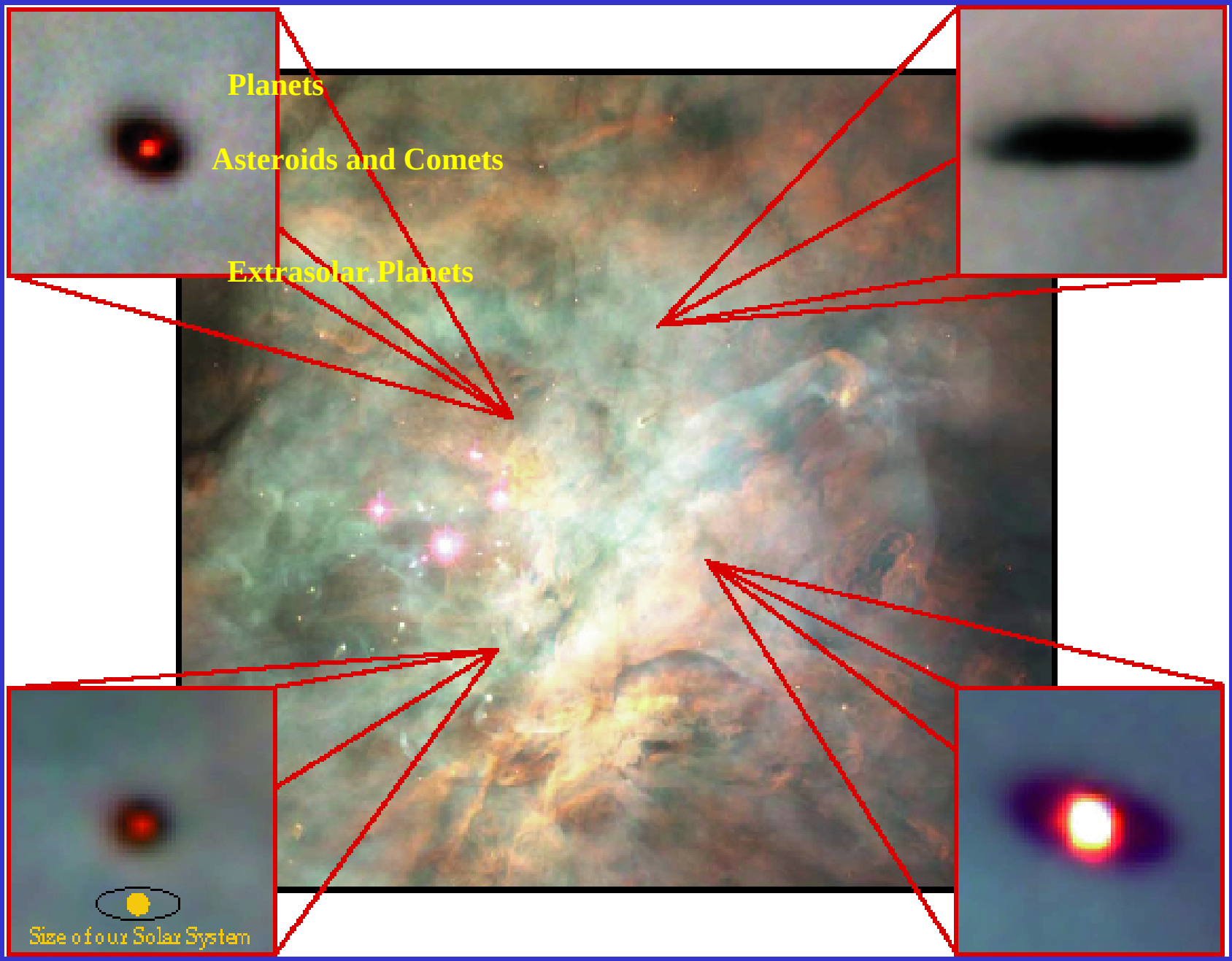
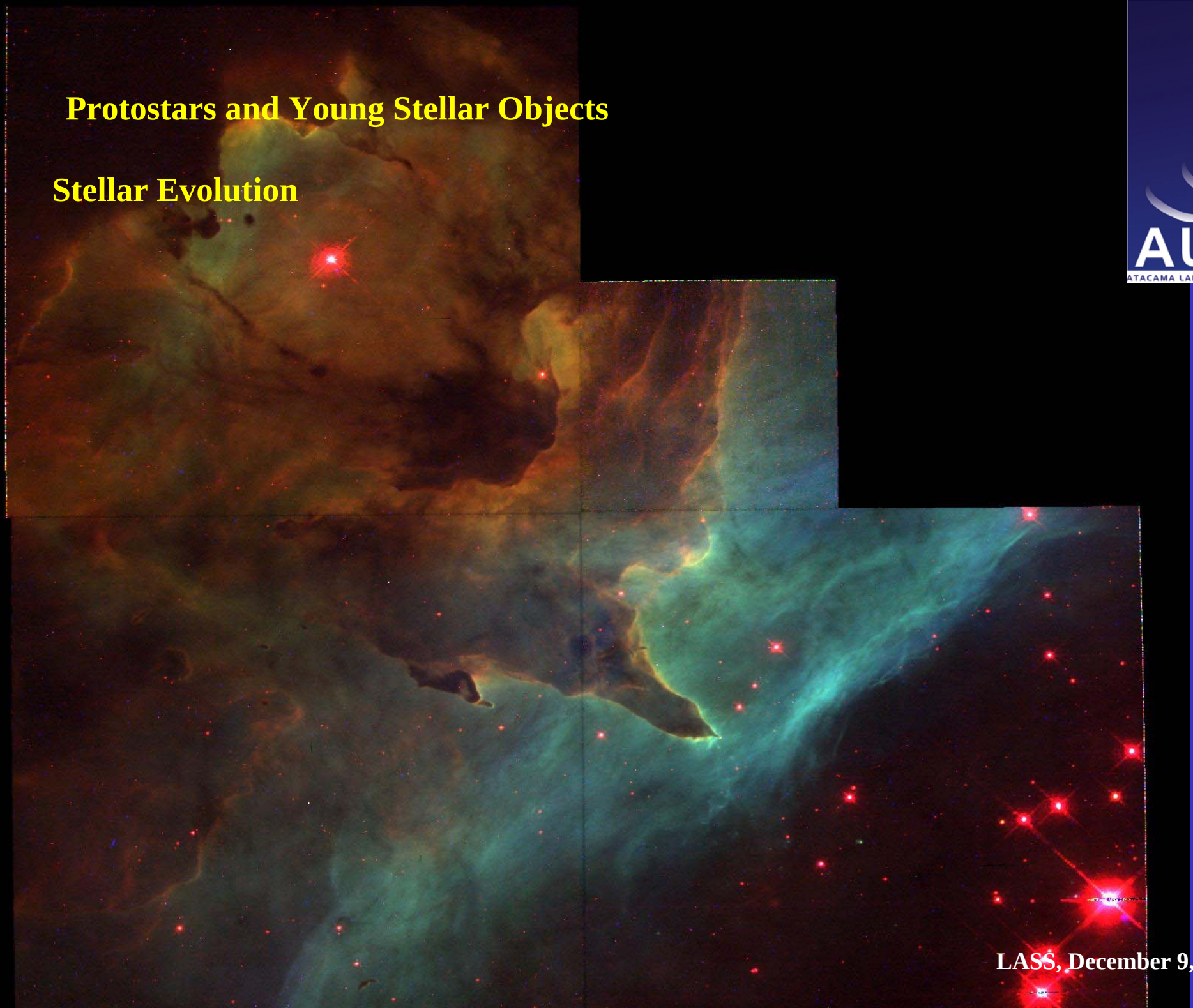


ALMA
ATACAMA LARGE MILLIMETER ARRAY

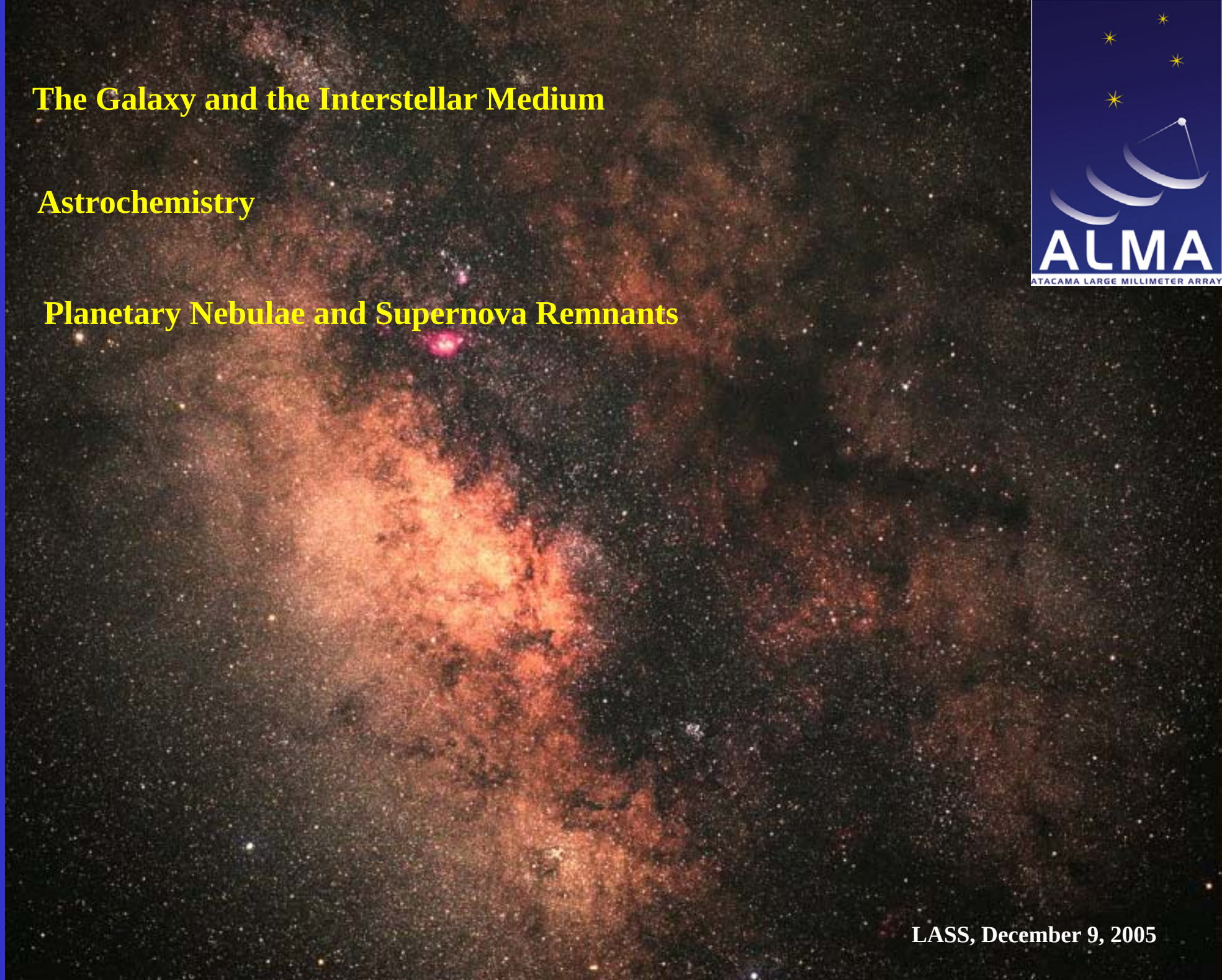
Protostars and Young Stellar Objects

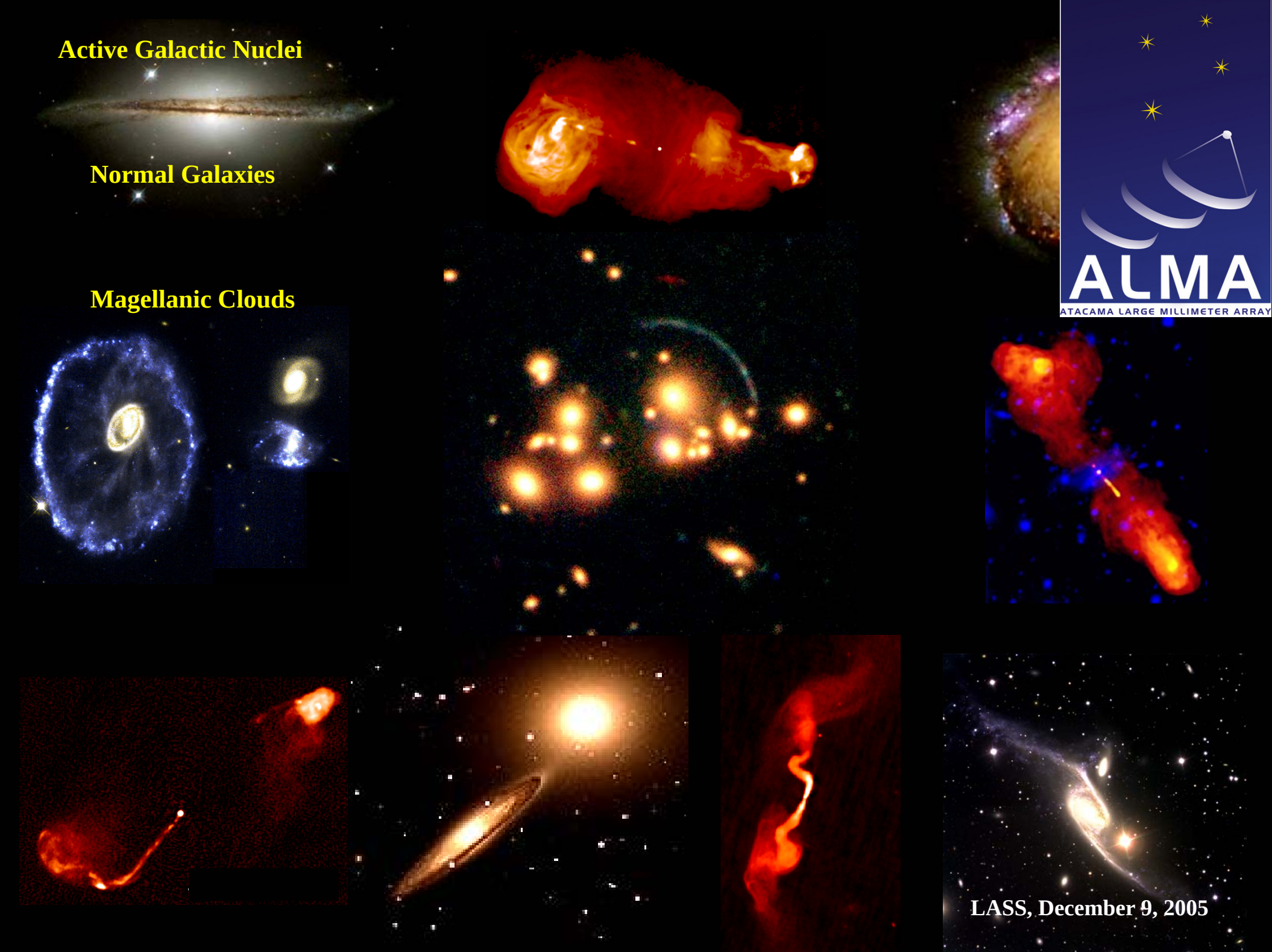
Stellar Evolution



ALMA
ATACAMA LARGE MILLIMETER ARRAY

LASS, December 9, 2005


The Galaxy and the Interstellar Medium
Astrochemistry
Planetary Nebulae and Supernova Remnants
ALMA
ATACAMA LARGE MILLIMETER ARRAY
LASS, December 9, 2005


Active Galactic Nuclei
Normal Galaxies
Magellanic Clouds
ALMA
ATACAMA LARGE MILLIMETER ARRAY
LASS, December 9, 2005

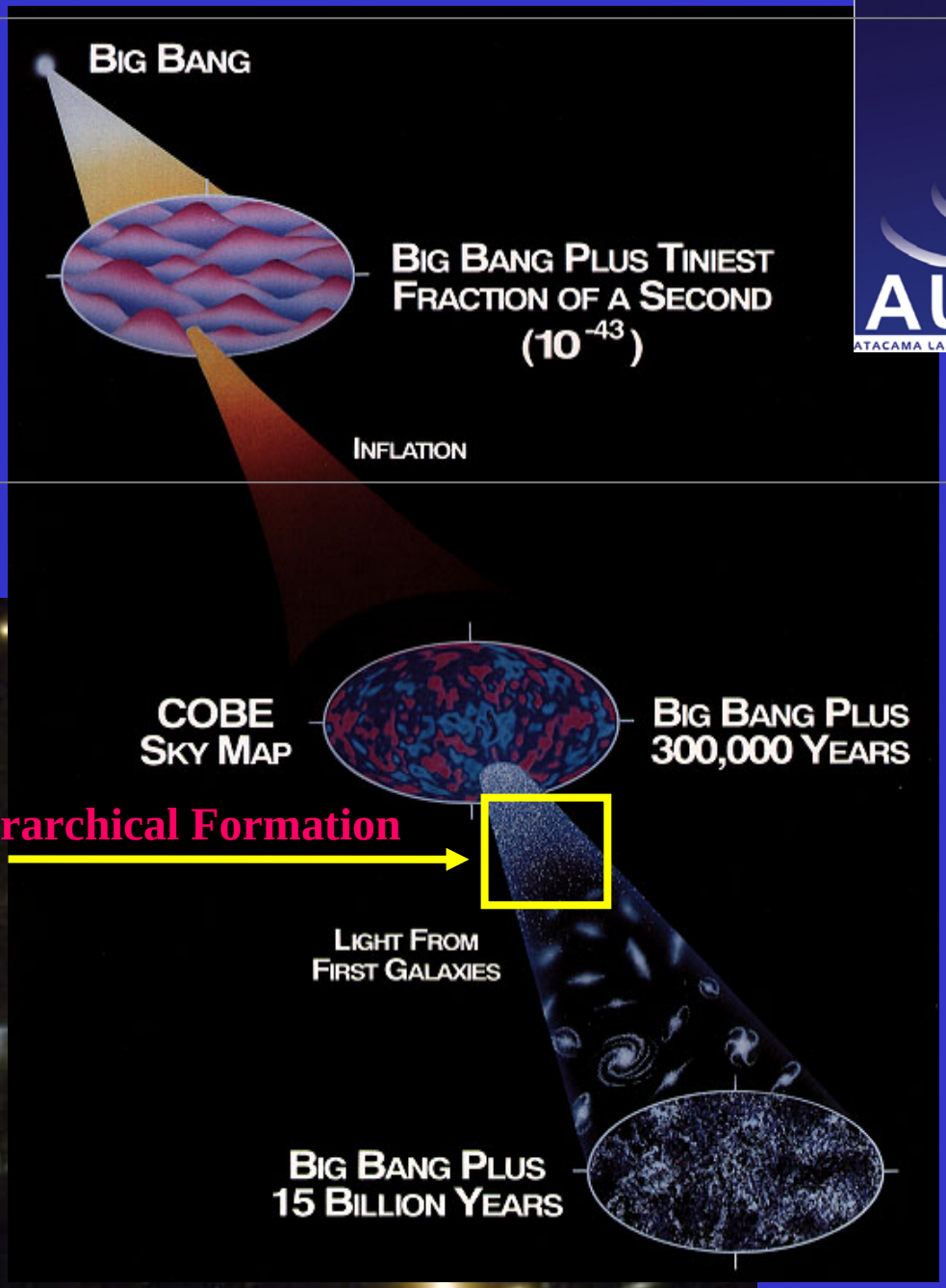
The Early Universe

Gravitational Lenses

Quasar Absorption Lines

Age of the Universe

Redshift

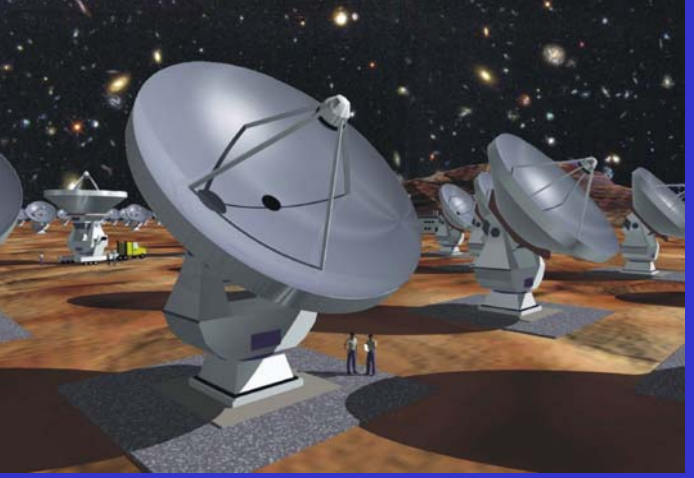


Z=1000

Z = 10

Today

ALMA
ATACAMA LARGE MILLIMETER ARRAY



The world project

ALMA : NRAO & ESO

+

ALMA-J : Japan

ALMA
ATACAMA LARGE MILLIMETER ARRAY

ALMA at Chajnantor
(Courtesy NAOJ)

O PR Photo 14/01 (6 April 2001)

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Atacama Compact Array (ACA)

(18 stations)
stations)

New Receiver Bands

Frontend cartridges (80 sets + spares)

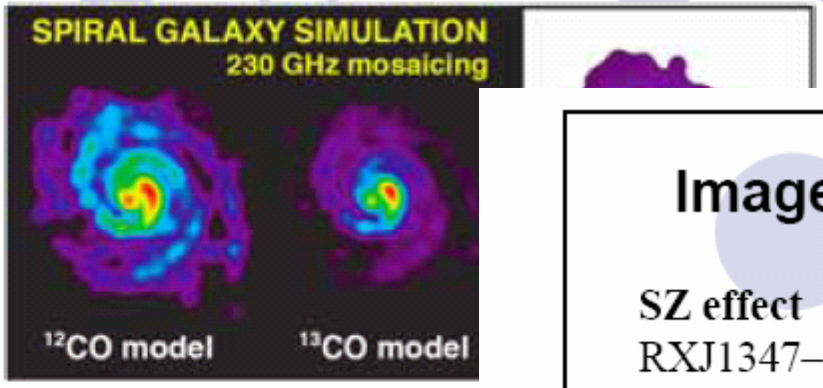
Band	Mixer	IF	Frequency range
Band 4	SIS (2SB)	4 - 8 GHz x 4	RF = 125 - 163* GHz LO = 133 - 155* GHz
Band 8	SIS (2SB)	4 - 8 GHz x 4	RF = 385 - 500 GHz LO = 393 - 492 GHz
Band 10	SIS (DSB) NbTiN or NbN	4 - 12 GHz x 2	RF = 787 - 950 GHz LO = 799 - 938 GHz

* Informal request to expand to 168.8 GHz received. Feasibility yet to be checked.

Atacama Compact Array (ACA)

Image Fidelity Improved by ACA (1)

Simulation (Tatematsu, Tsutsumi et al.)



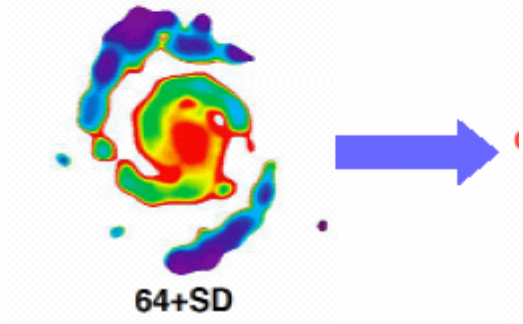
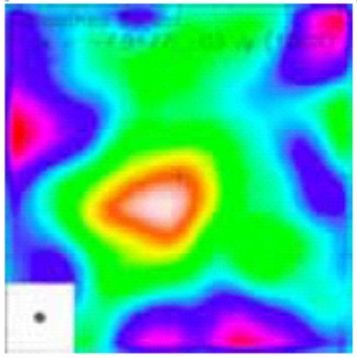


Image Fidelity Improved by ACA (2)

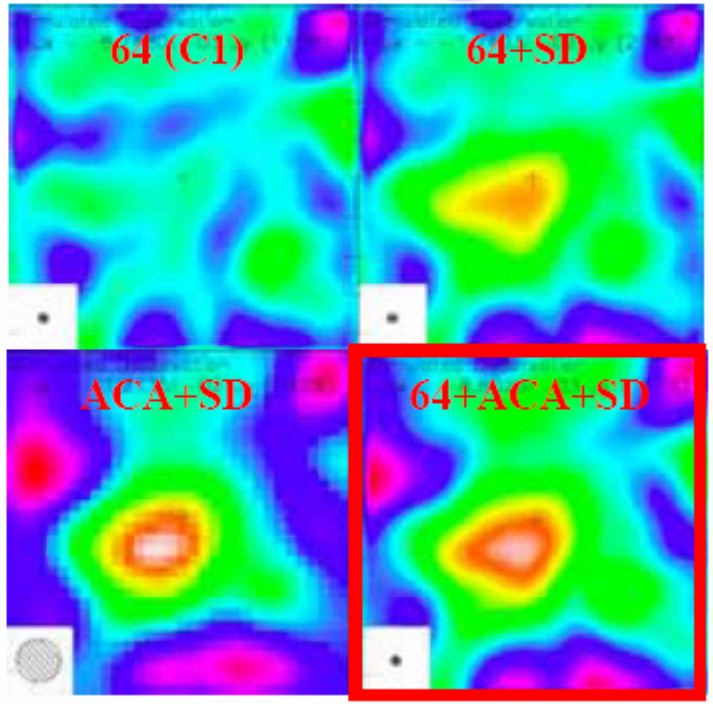
SZ effect
RXJ1347–1145
NRO 150GHz data
(Komatsu et al. 2001)



90 arcsec

–0.22 mJy/beam

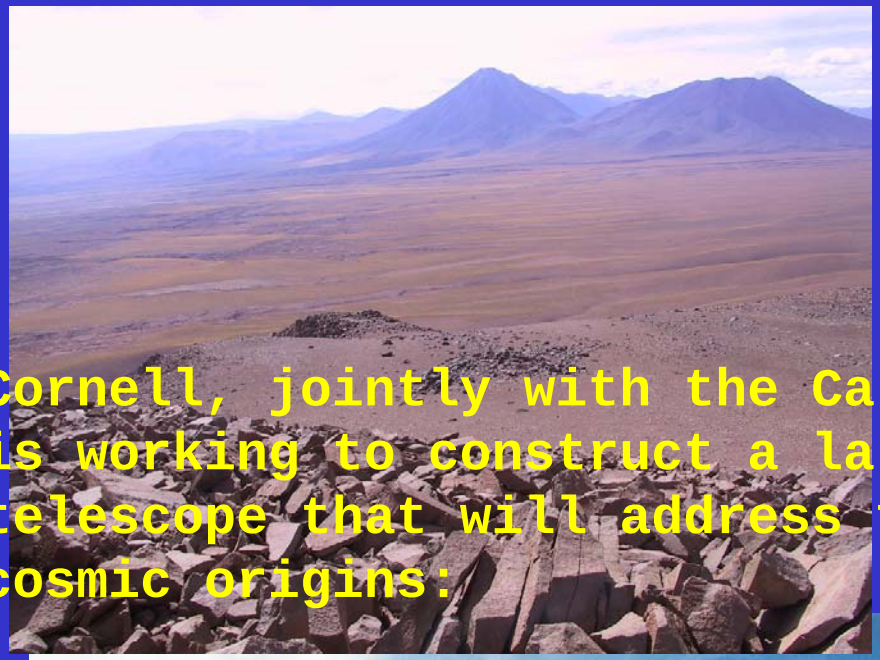
Simulation (Kitayama, Tsutsumi et al.)



13-field mosaic, 18 min (64), 72 min (ACA)

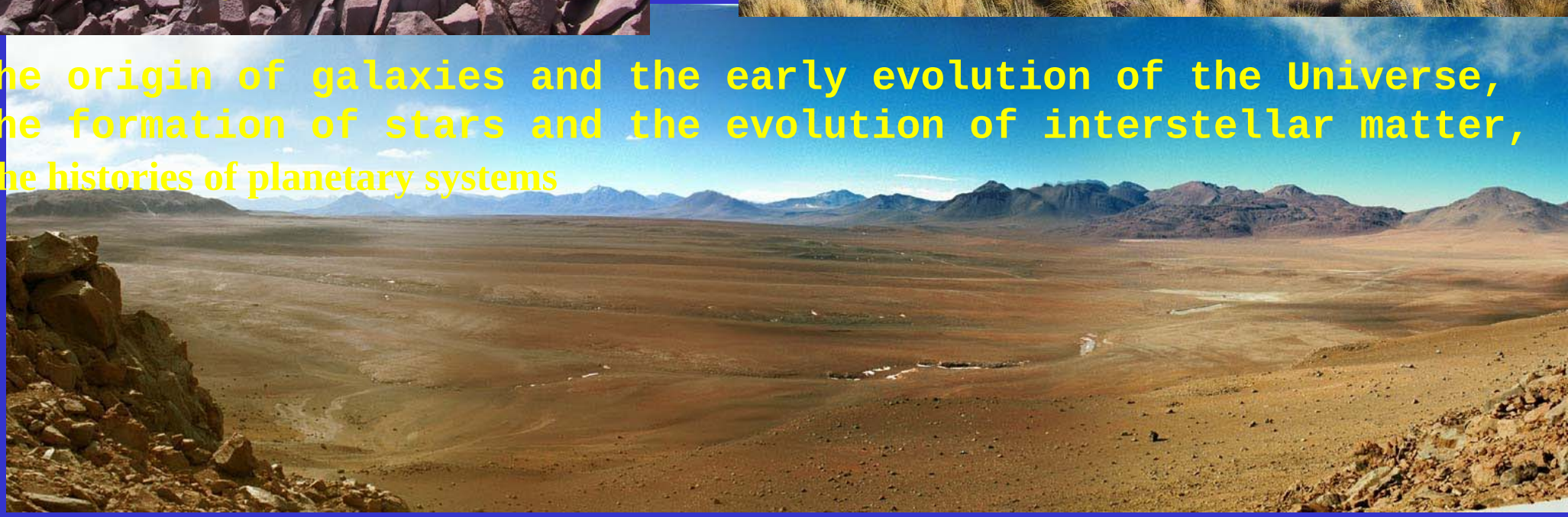
The Atacama Telescope Project

Home Goals Science Site info Site Surveys Oct. '03 Workshop



Cornell, jointly with the California Institute of Technology, is working to construct a large far infrared/sub-millimeter telescope that will address fundamental questions regarding cosmic origins:

The origin of galaxies and the early evolution of the Universe,
The formation of stars and the evolution of interstellar matter,
The histories of planetary systems



Atacama Cosmic Telescope ACT

A large collecting area and small beam:
6 m diameter reflector with 1.7' pixels

145Ghz

Installation: 2006 Cerro Toco

Map the CMB temperature anisotropy over 100 square degrees beyond the resolution limits of the WMAP (operating) and Planck (launch 2007) satellites, with an error of 2 microK/pixel for 1.7'x1.7' pixels.

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Future Astronomical projects

- **Giant Magellan Telescope GMT) 25m Telescope , Carnegie**

The Giant Magellan Telescope can open a window to fundamental discoveries about the birth of stars and planetary systems, the mysteries of black holes and the genesis of galaxies.

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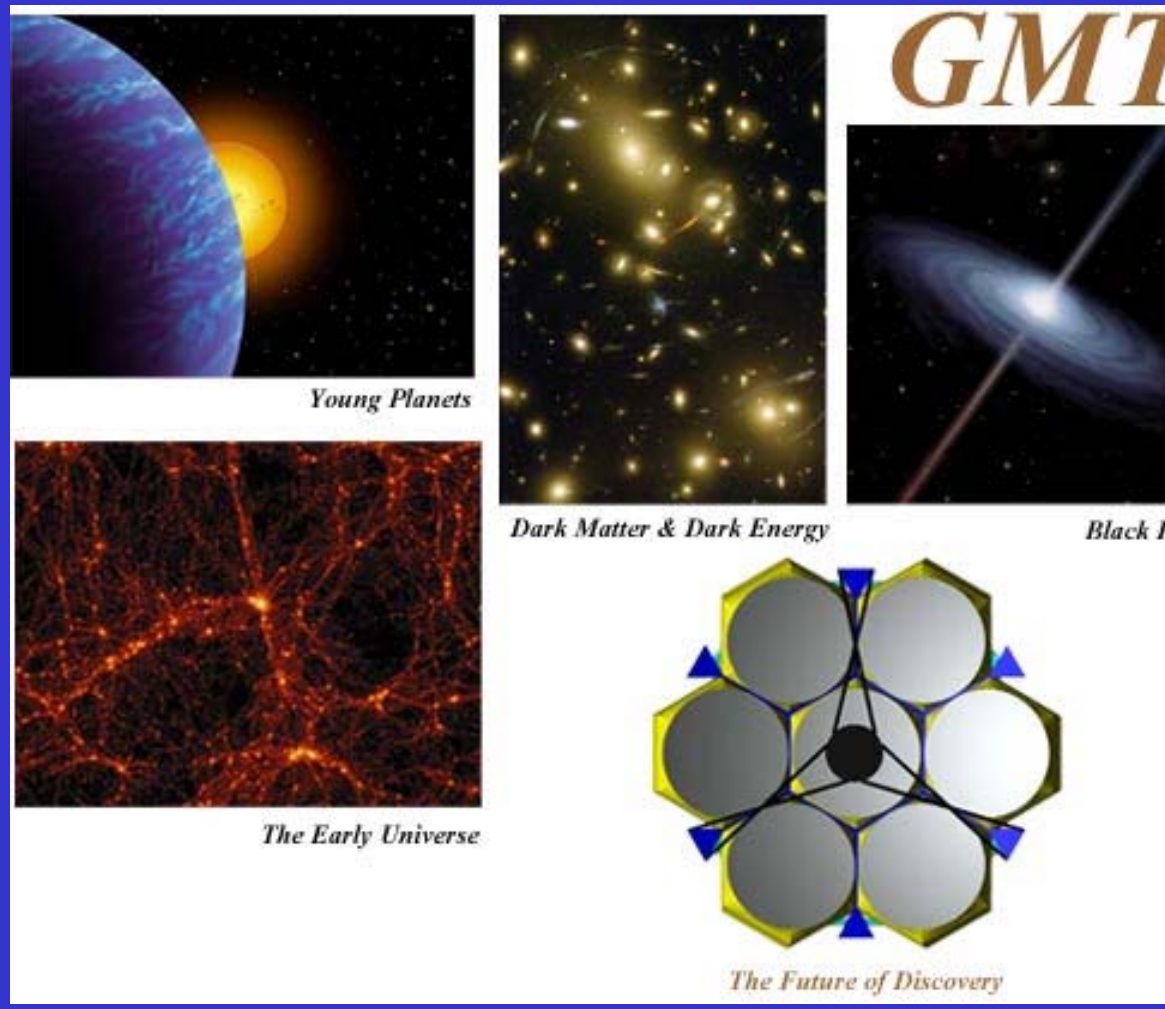
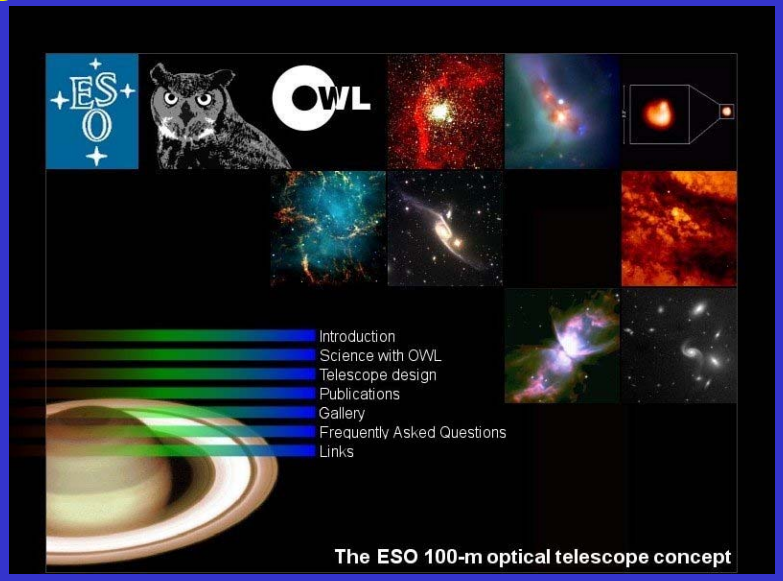


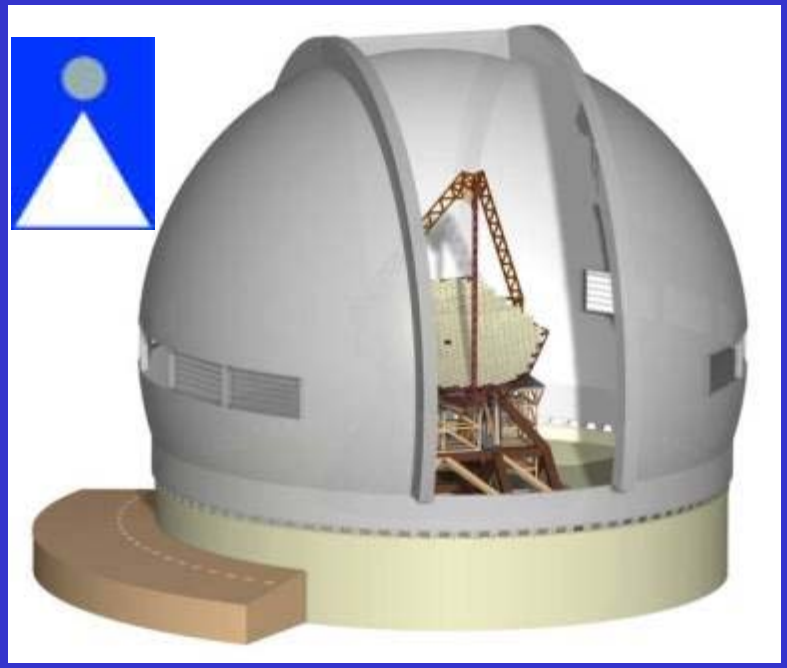
Future Astronomical projects

- **Overwhelming Large Telescope (OWL)**
  100m Telescope , ESO

- **Tokyo Atacama Observatory (TAO)**
  6.5 m IR telescope

- **Giant Segmented Mirror Telescope GSMT,**
  30m Telescope, USA





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ASTRONOMY IN CHILE

An excellent opportunity to promote and develop new international collaborations with chilean institutions.

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