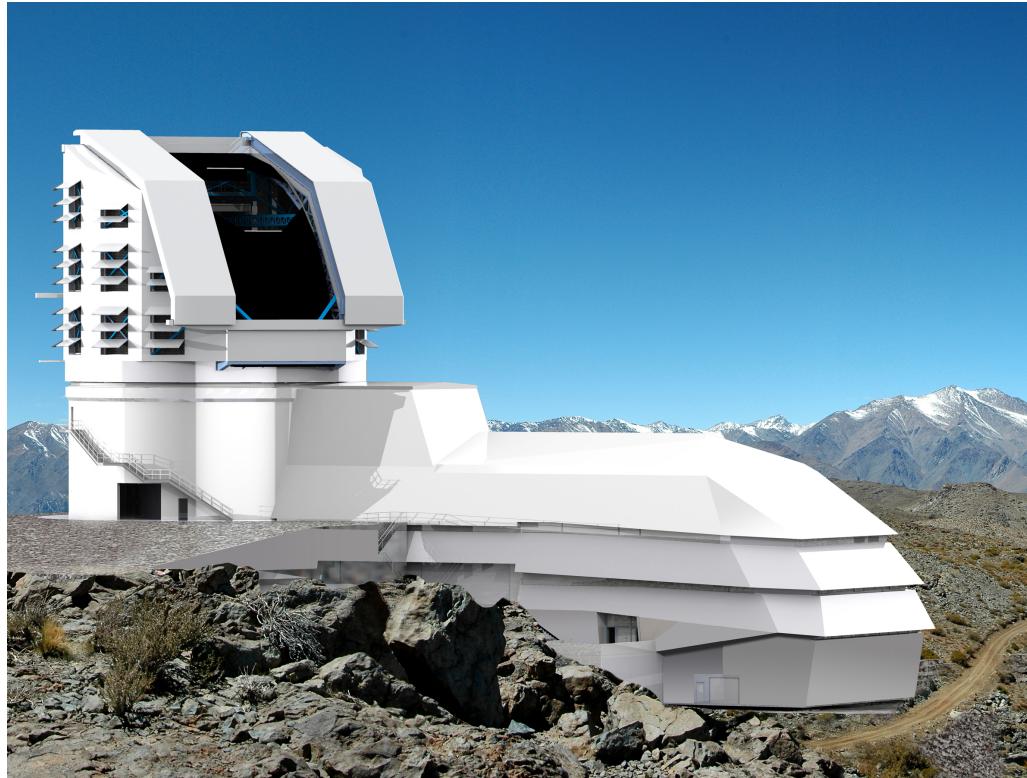


Astronomy in Latin America: Present and Future



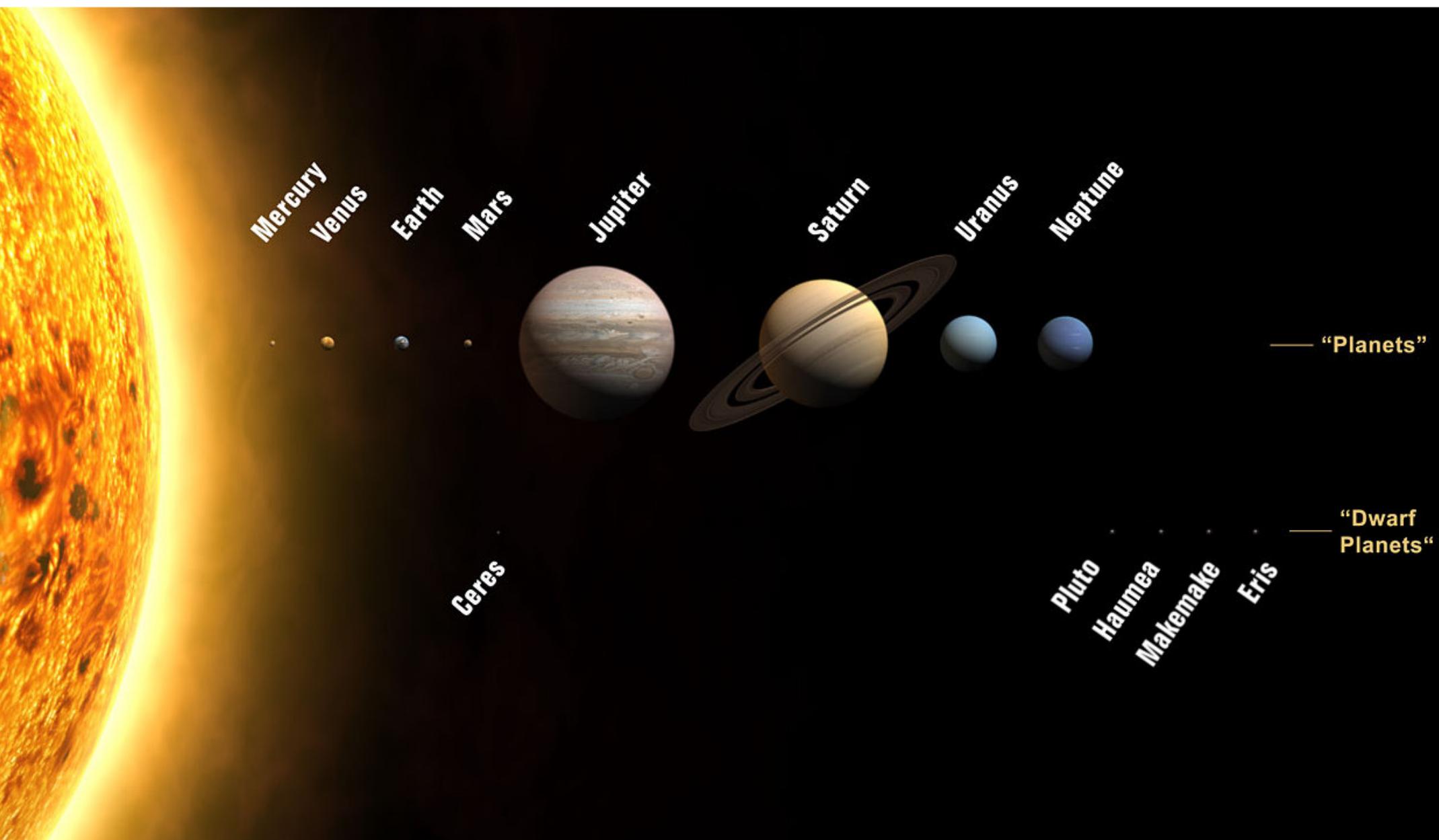
Kevin Huffenberger
Department of Physics
University of Miami



What's out there to look at?

Earth



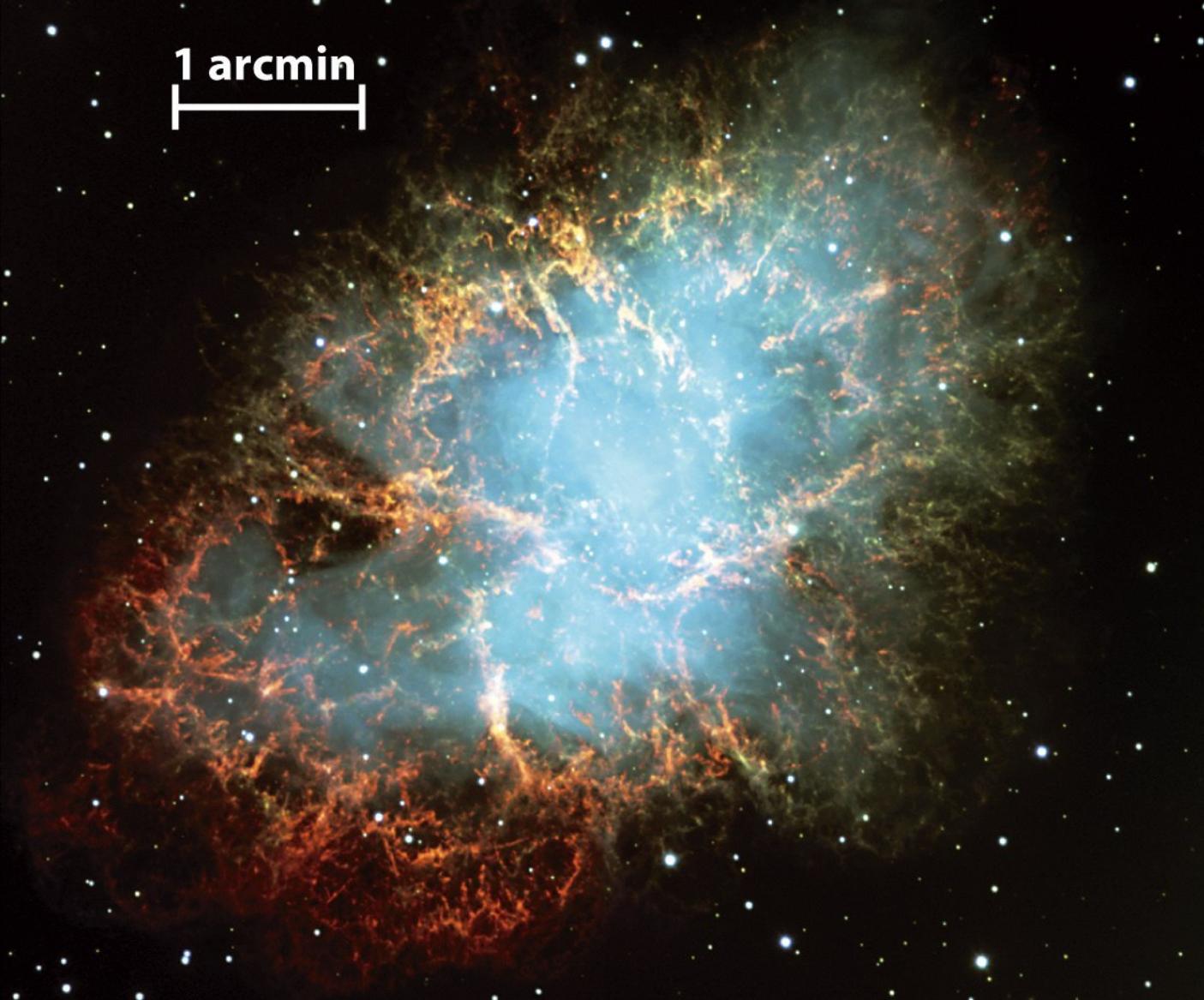


Stars





Figure 21-1
Universe, Eighth Edition
© 2008 W.H. Freeman and Company



1 arcmin

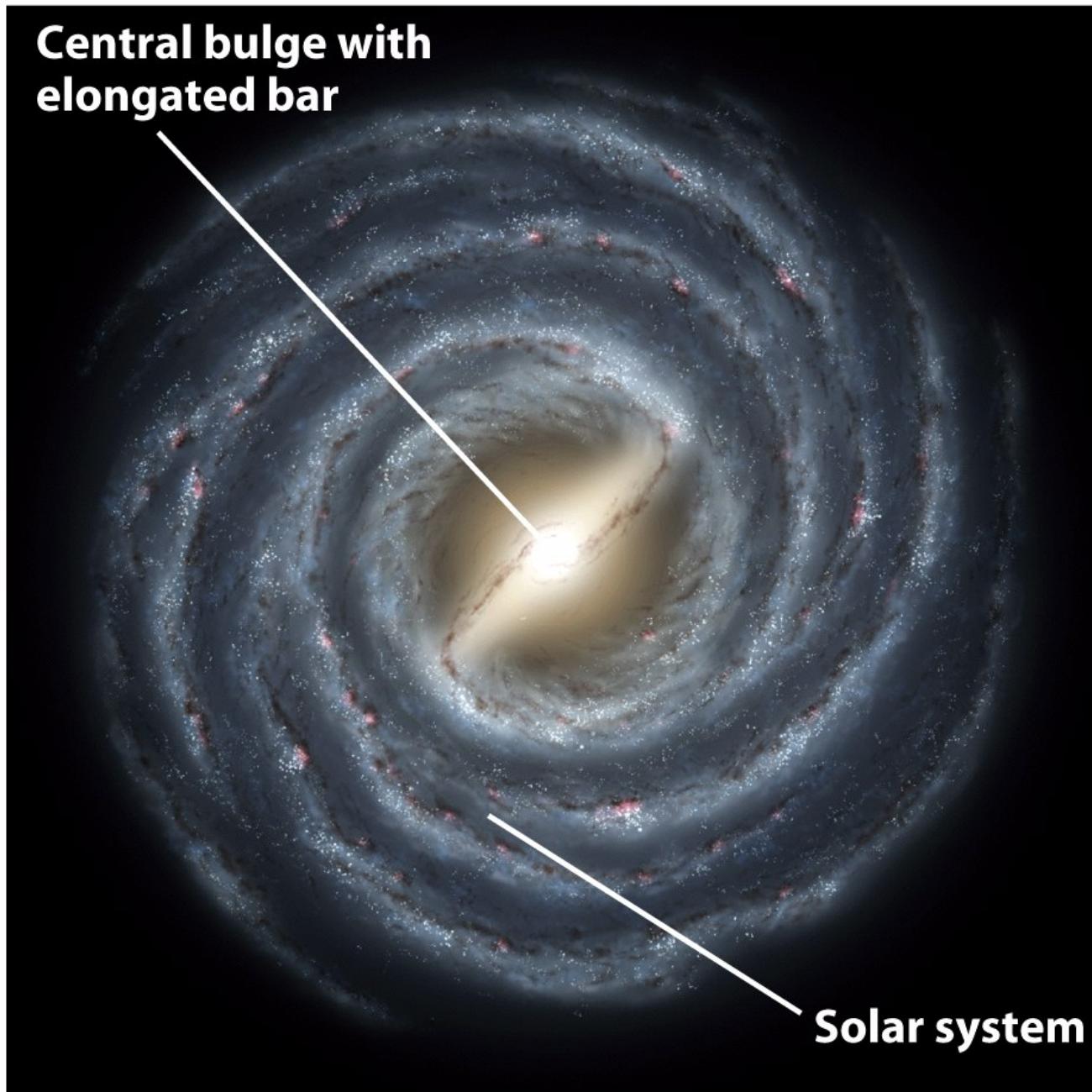
The Crab Nebula

Figure 21-4 part 1

Universe, Eighth Edition

© 2008 W.H. Freeman and Company

Disk's spiral structure



The structure of the Milky Way's disk

Figure 23-16a

Size and shape of Milky Way

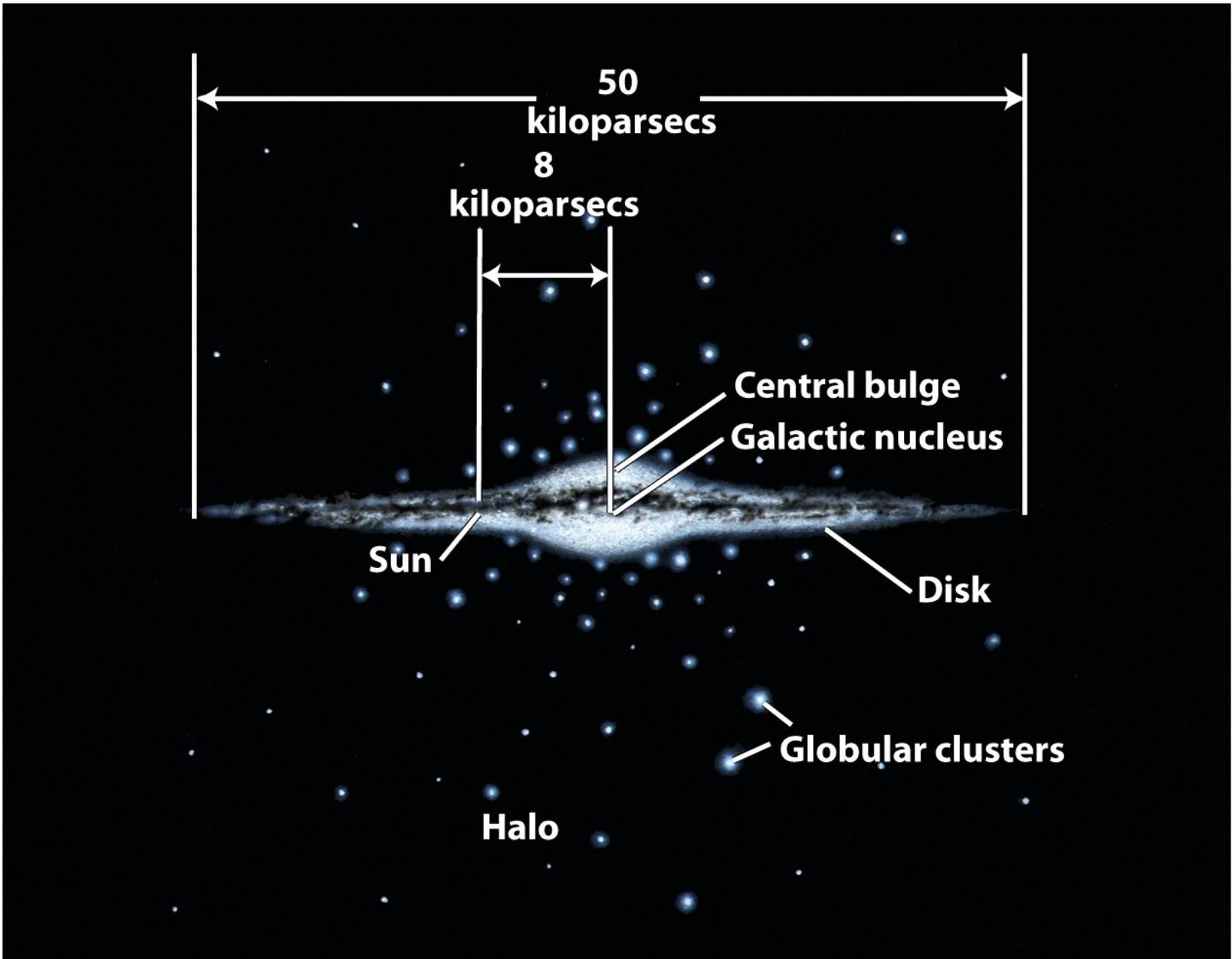


Figure 23-7

Universe, Eighth Edition

© 2008 W.H. Freeman and Company

Andromeda galaxy

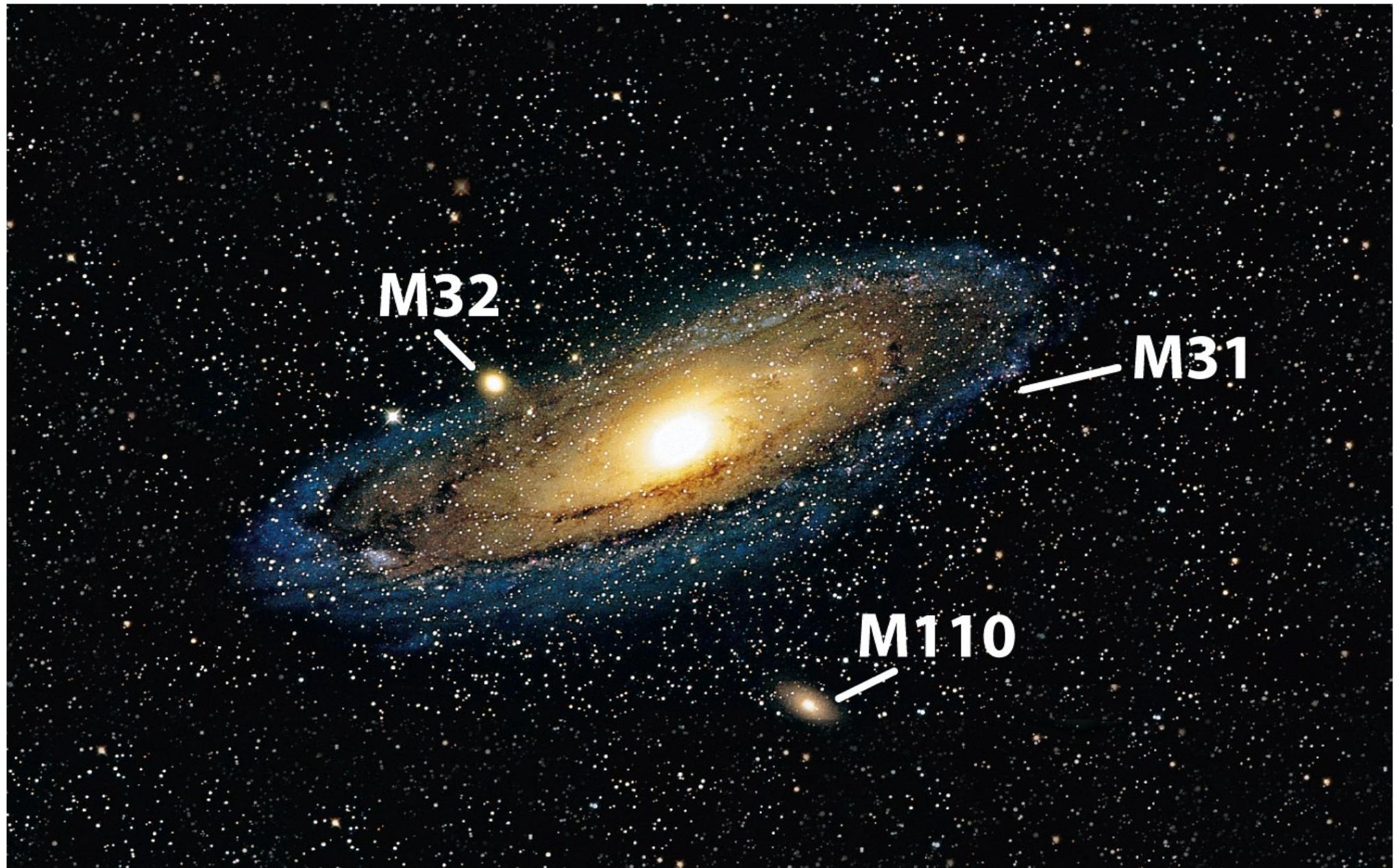


Figure 24-3

Universe, Eighth Edition

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$\sim 700 \text{ kpc} = 2 \text{ Mly}$ away

Hubble Ultra Deep Field

HST • ACS



NASA, ESA, S. Beckwith (STScI) and The HUDF Team

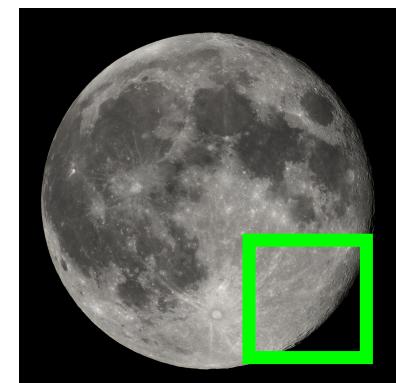
STScI-PRC04-07a



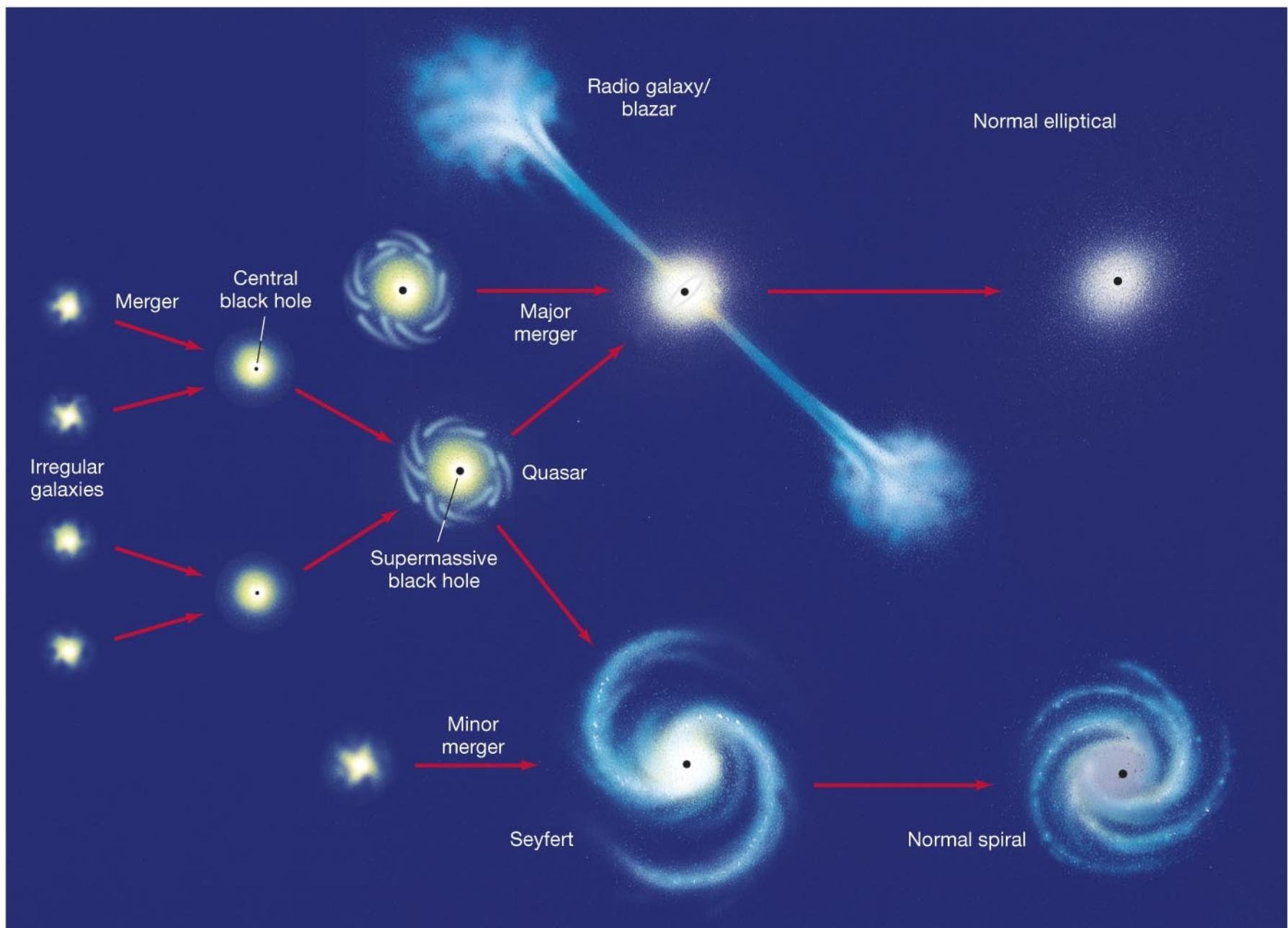
In Fornax,
11.0 arcmin²

1 mm² @ 1 m

13 million such
patches to cover
sky.

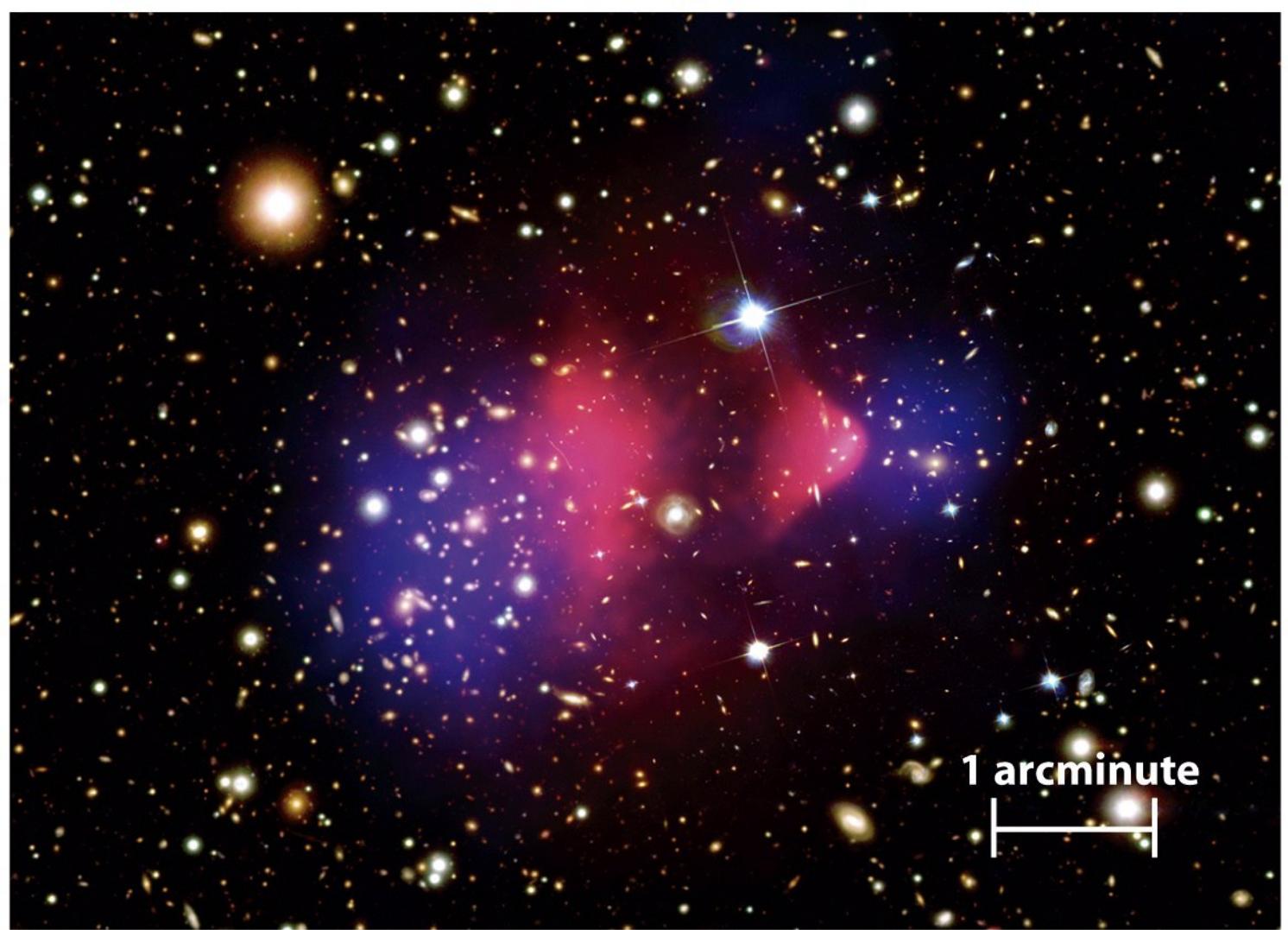






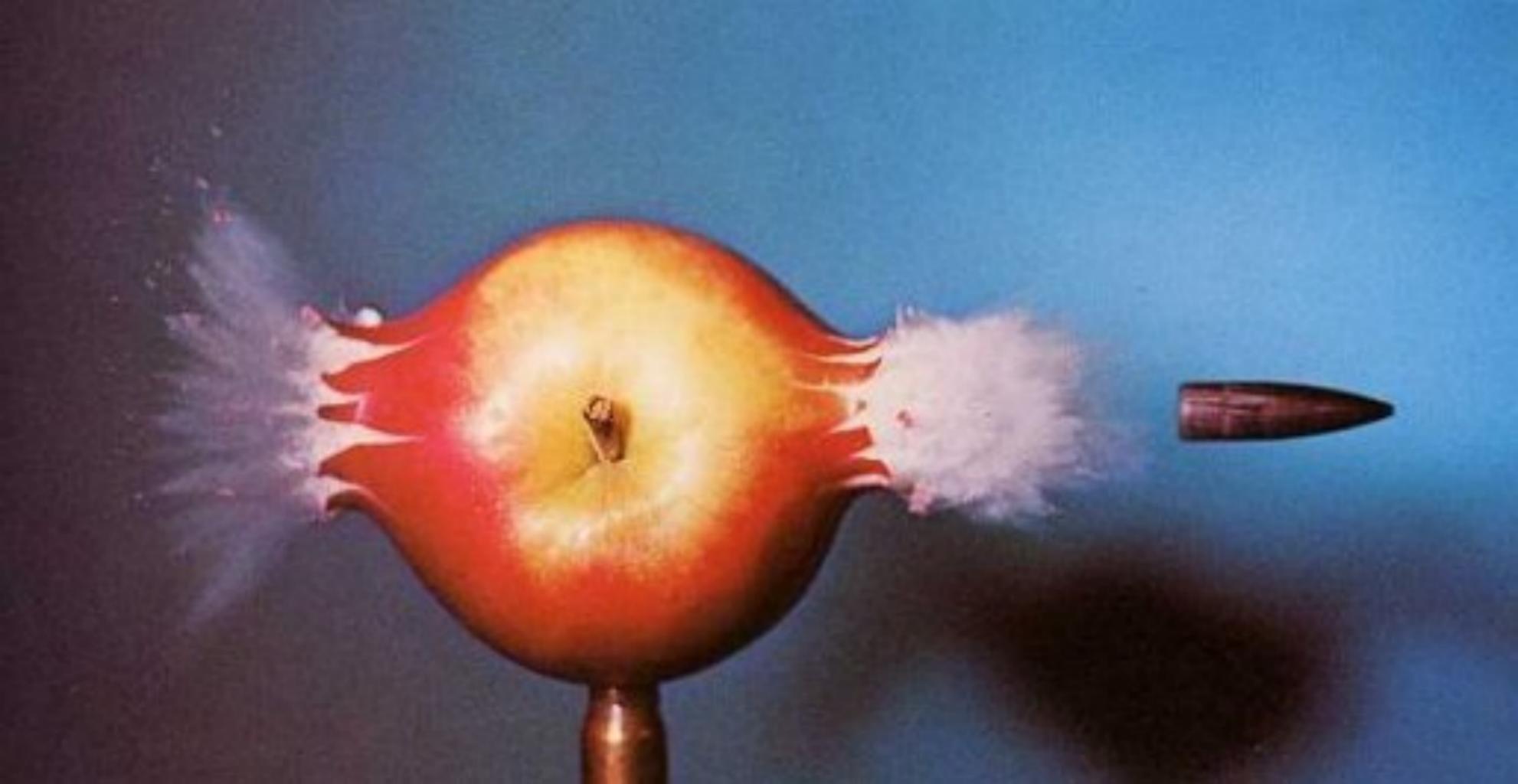
Coma cluster

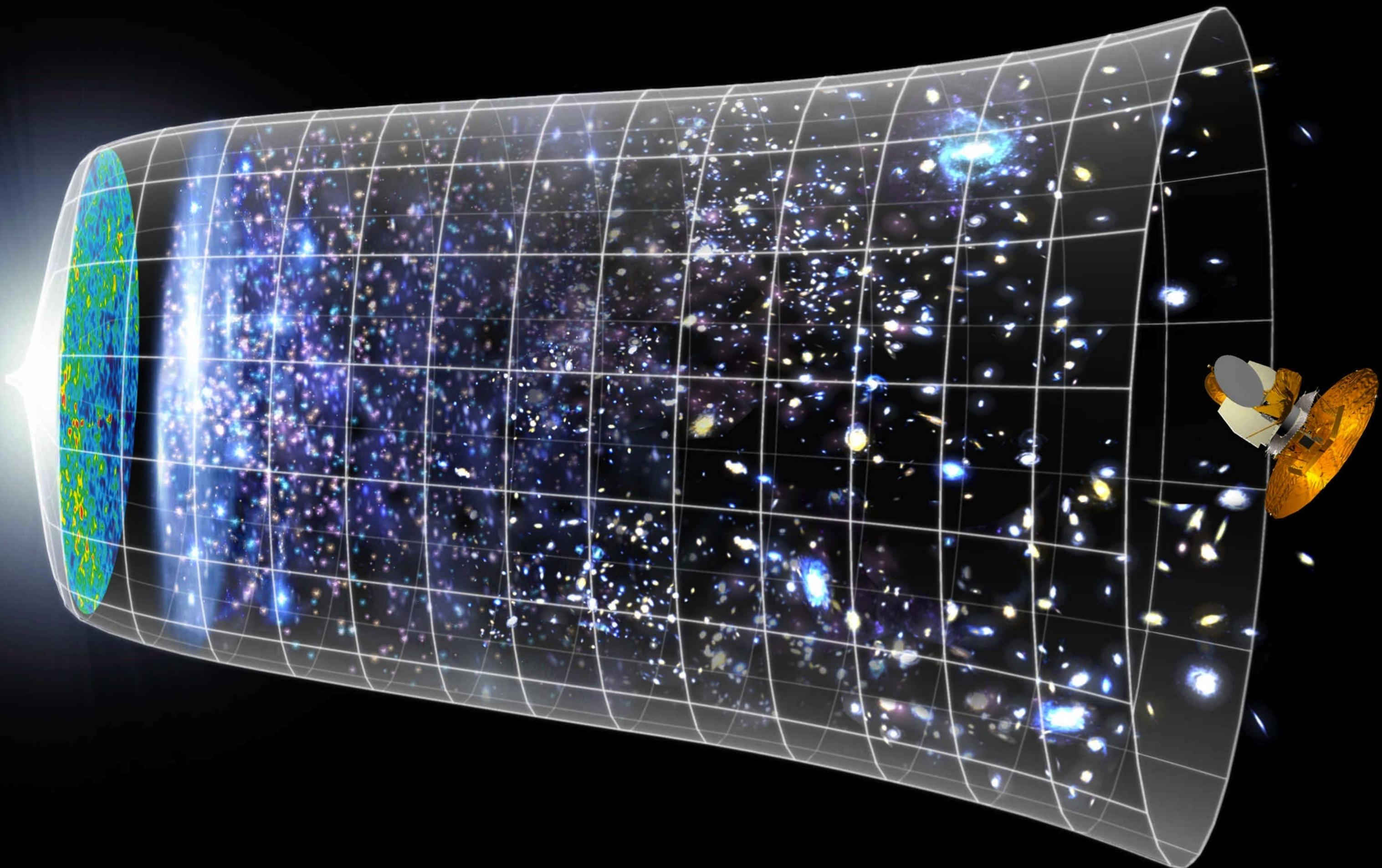




**Composite image of galaxy cluster 1E0657-56
showing visible galaxies, X-ray-emitting gas
(red) and dark matter (blue)**

R I V U X G



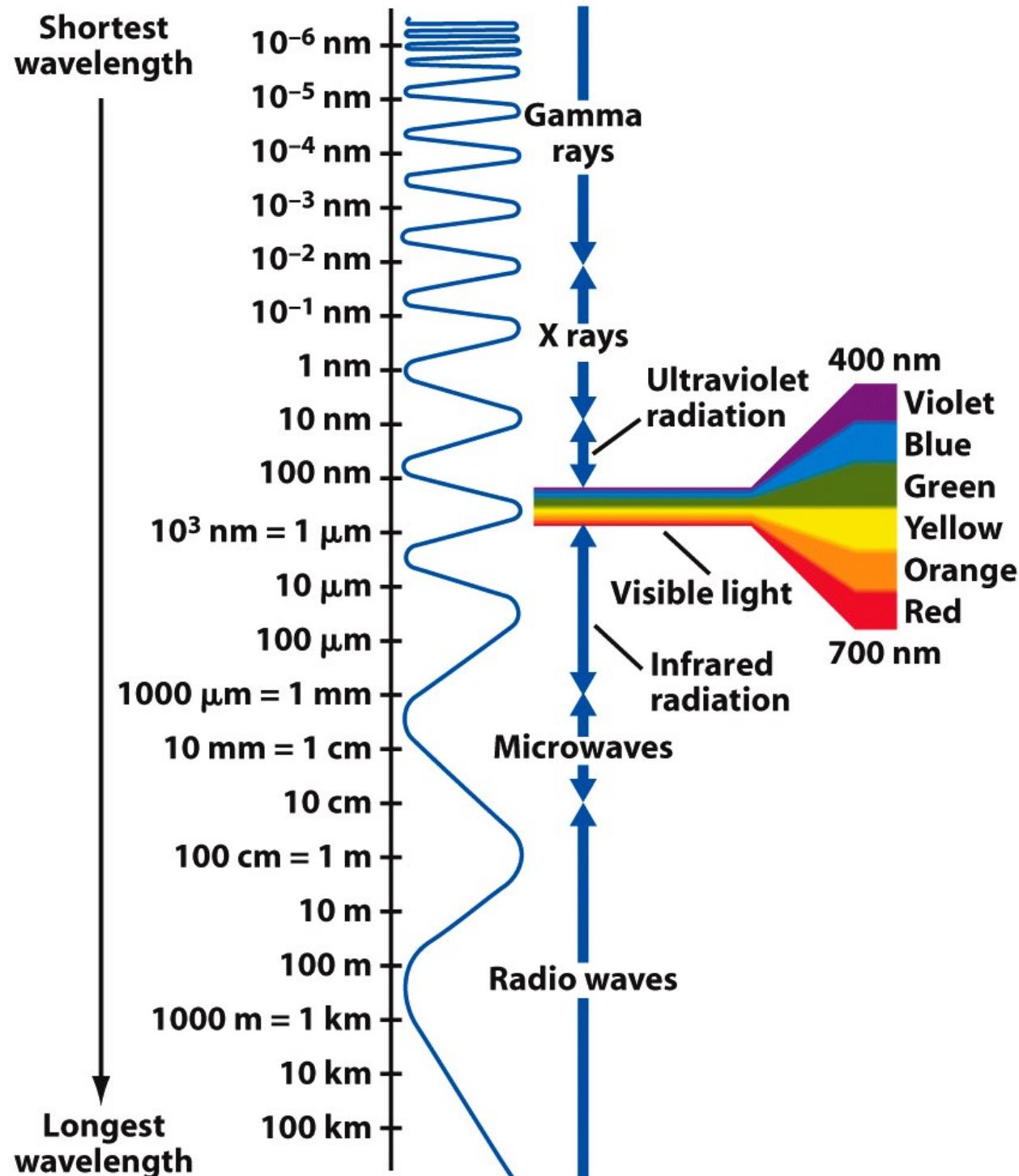


How do we find it?

Earth



EM radiation characterized by wavelength



Practical uses of EM radiation



(a) Mobile phone:
radio waves



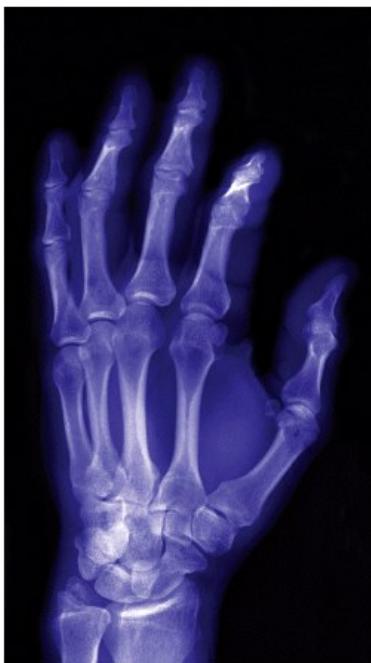
(b) Microwave oven:
microwaves



(c) TV remote:
infrared light



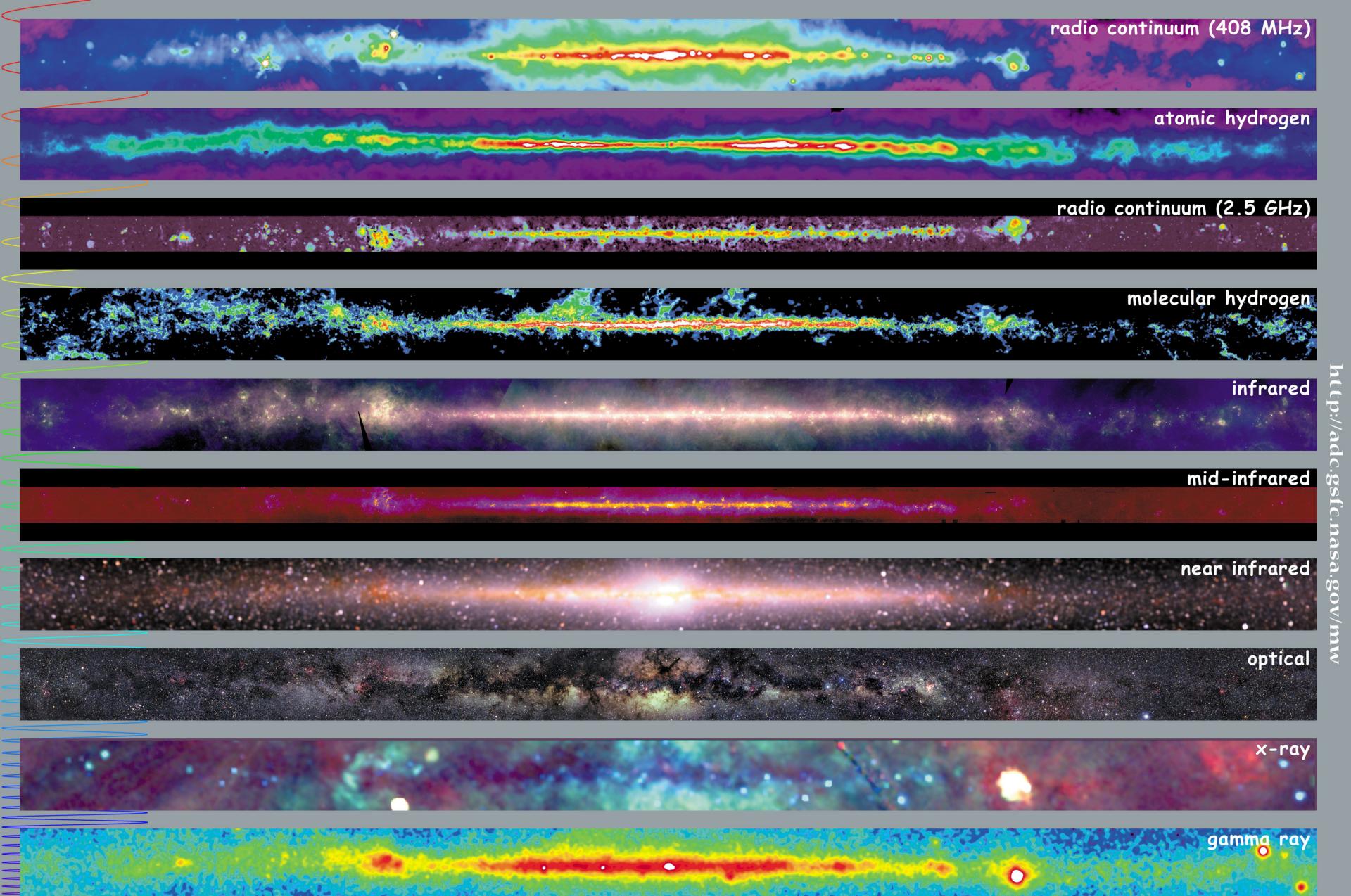
(d) Tanning booth:
ultraviolet light



(e) Medical imaging:
X rays.



(f) Cancer
radiotherapy:
gamma rays



radio continuum (408 MHz)

atomic hydrogen

radio continuum (2.5 GHz)

molecular hydrogen

infrared

mid-infrared

near infrared

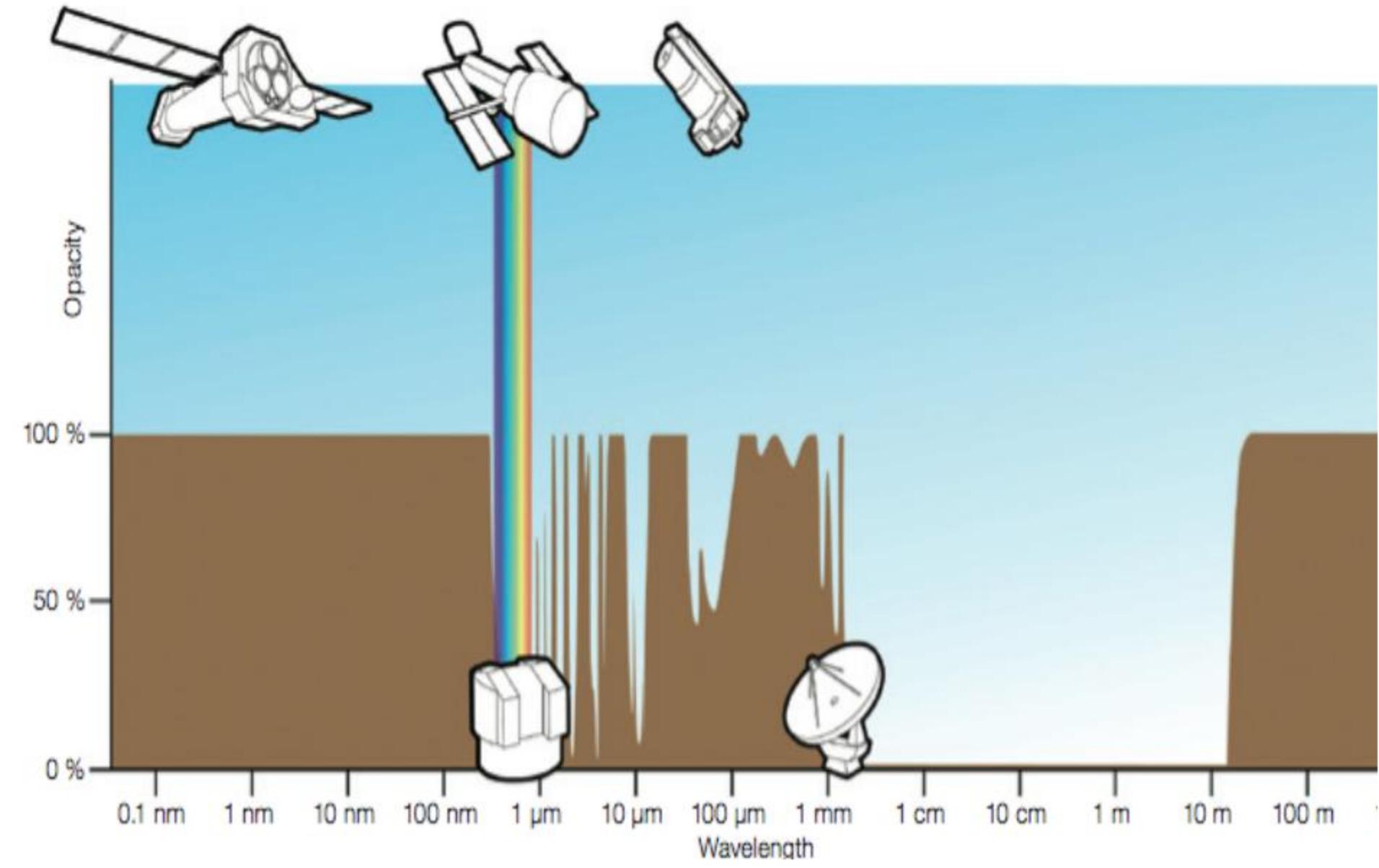
optical

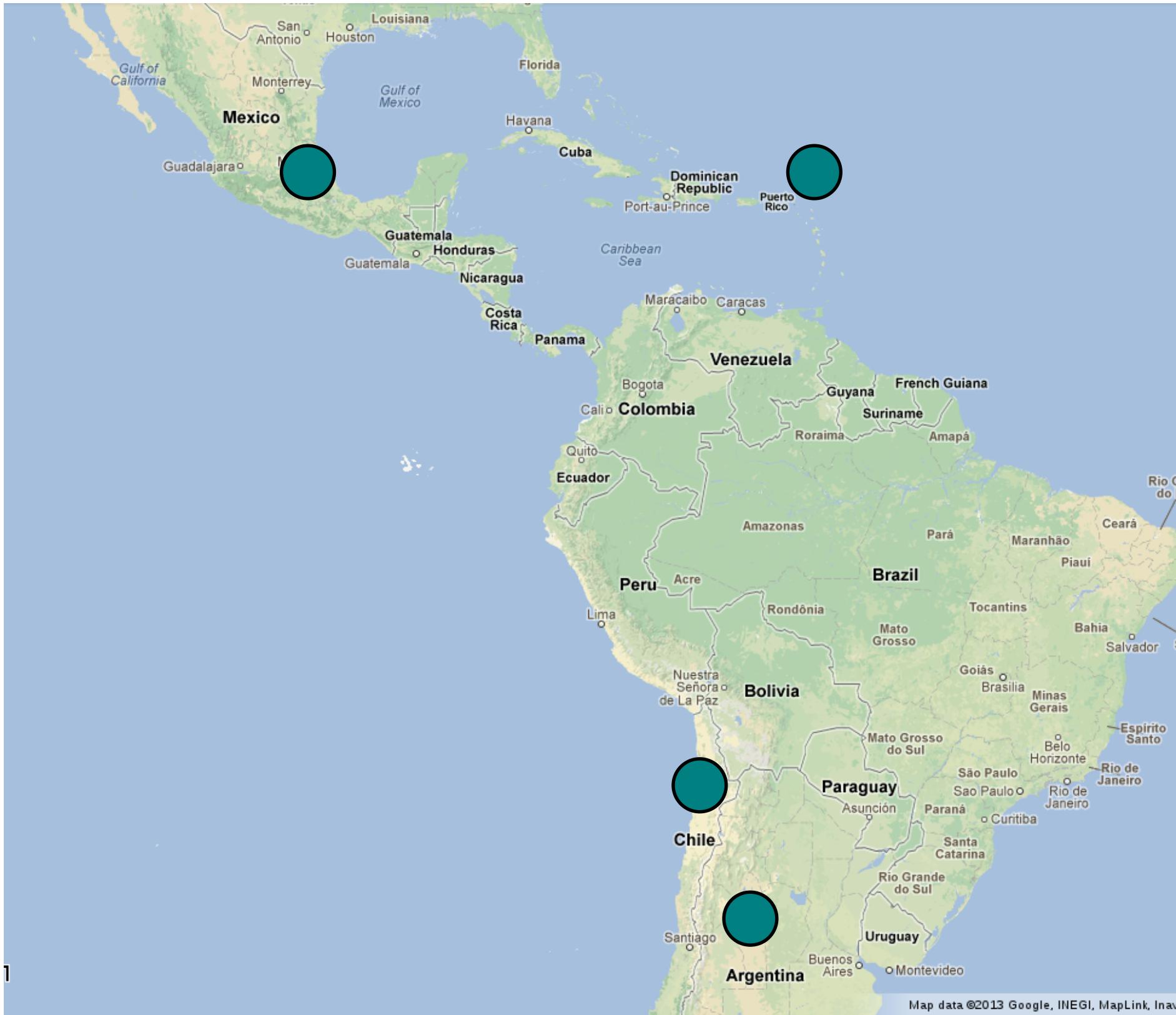
x-ray

gamma ray



Multiwavelength Milky Way







Inter-American Astrophysics Seminar Series

EL **INCOMPARABLE CIELO CHILENO**

L. Infante · Pontificia Universidad Católica de Chile



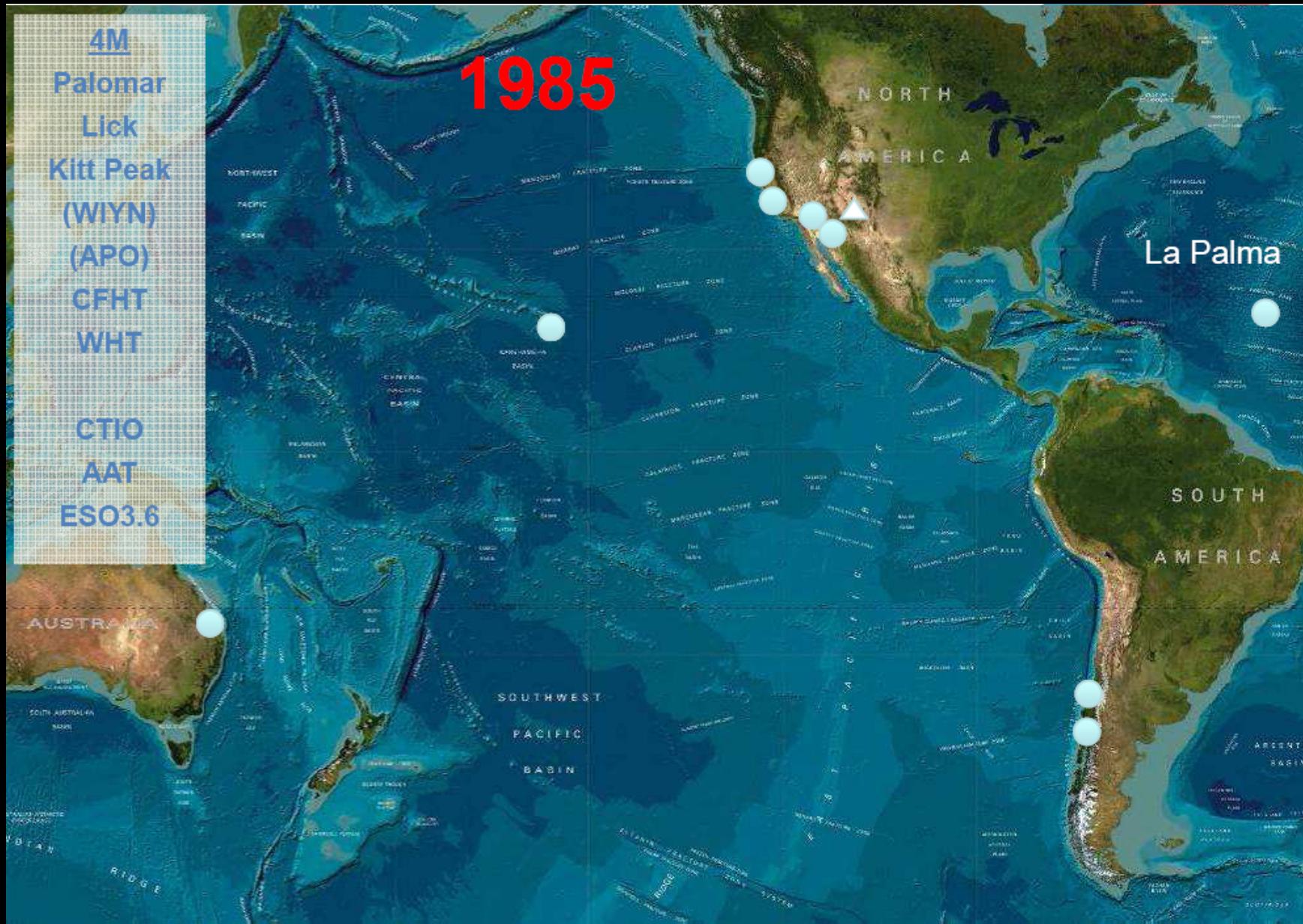


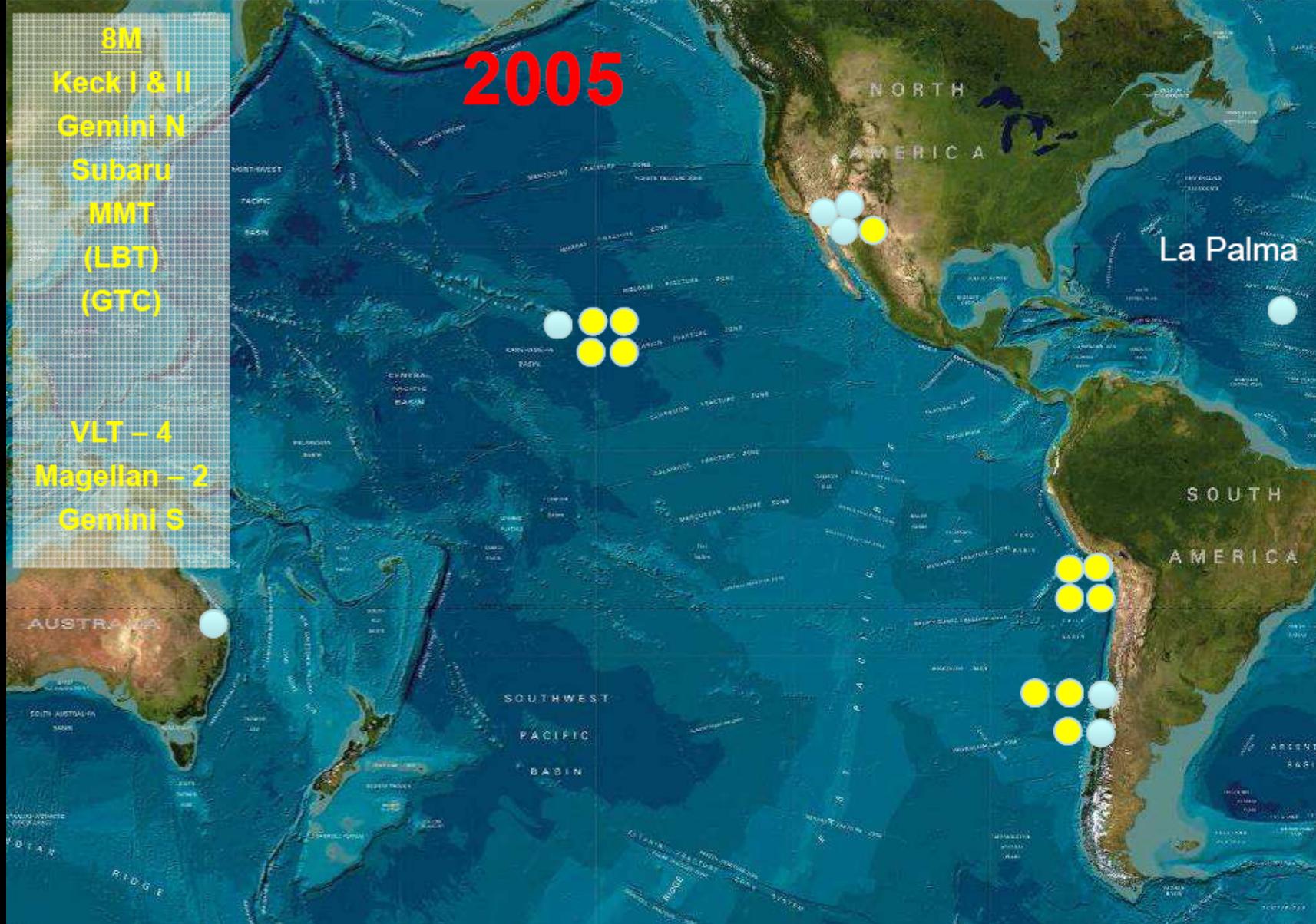


4M
Palomar
Lick
Kitt Peak
(WIYN)
(APO)
CFHT
WHT

CTIO
AAT
ESO3.6

1985



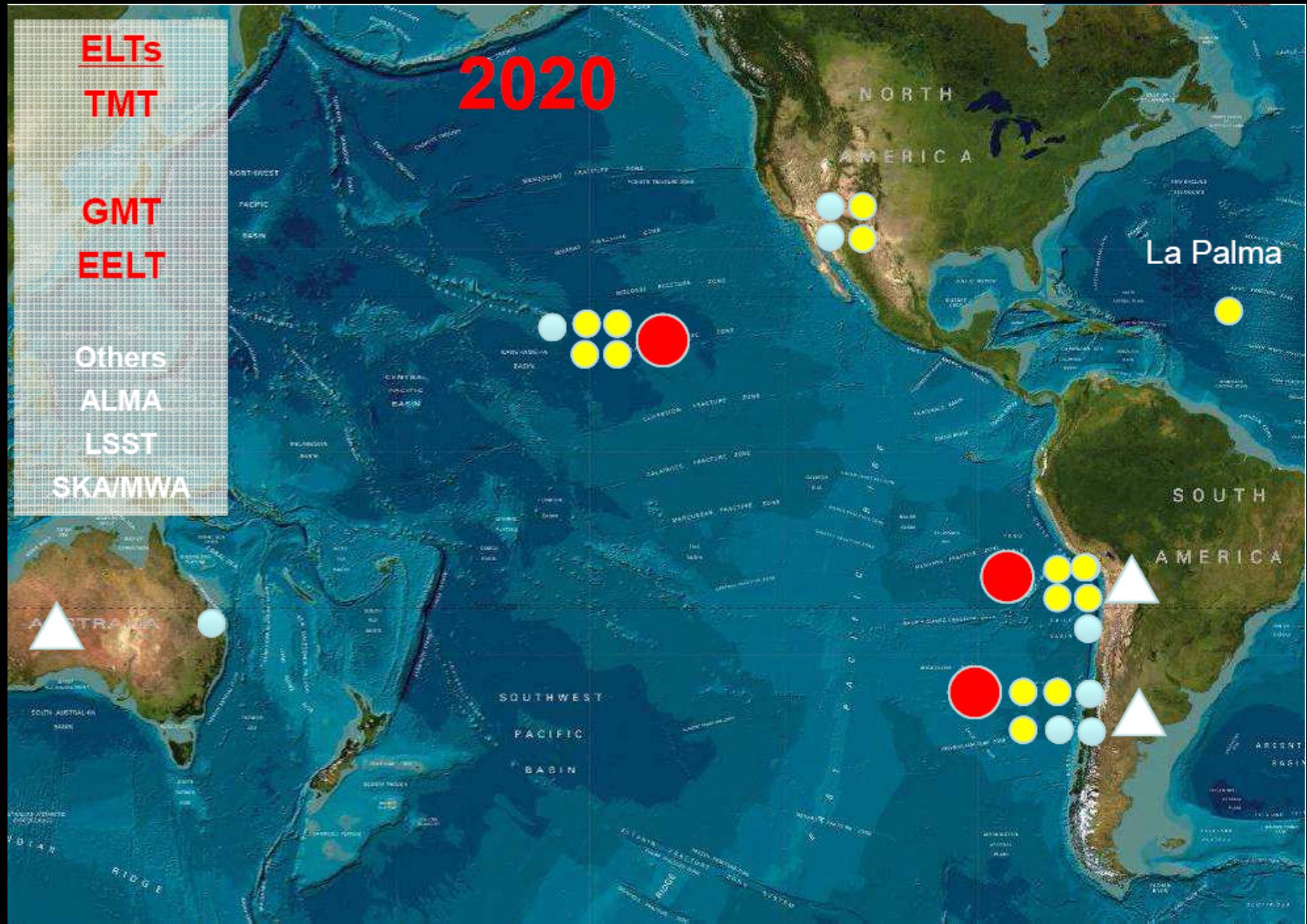


ELTs
TMT

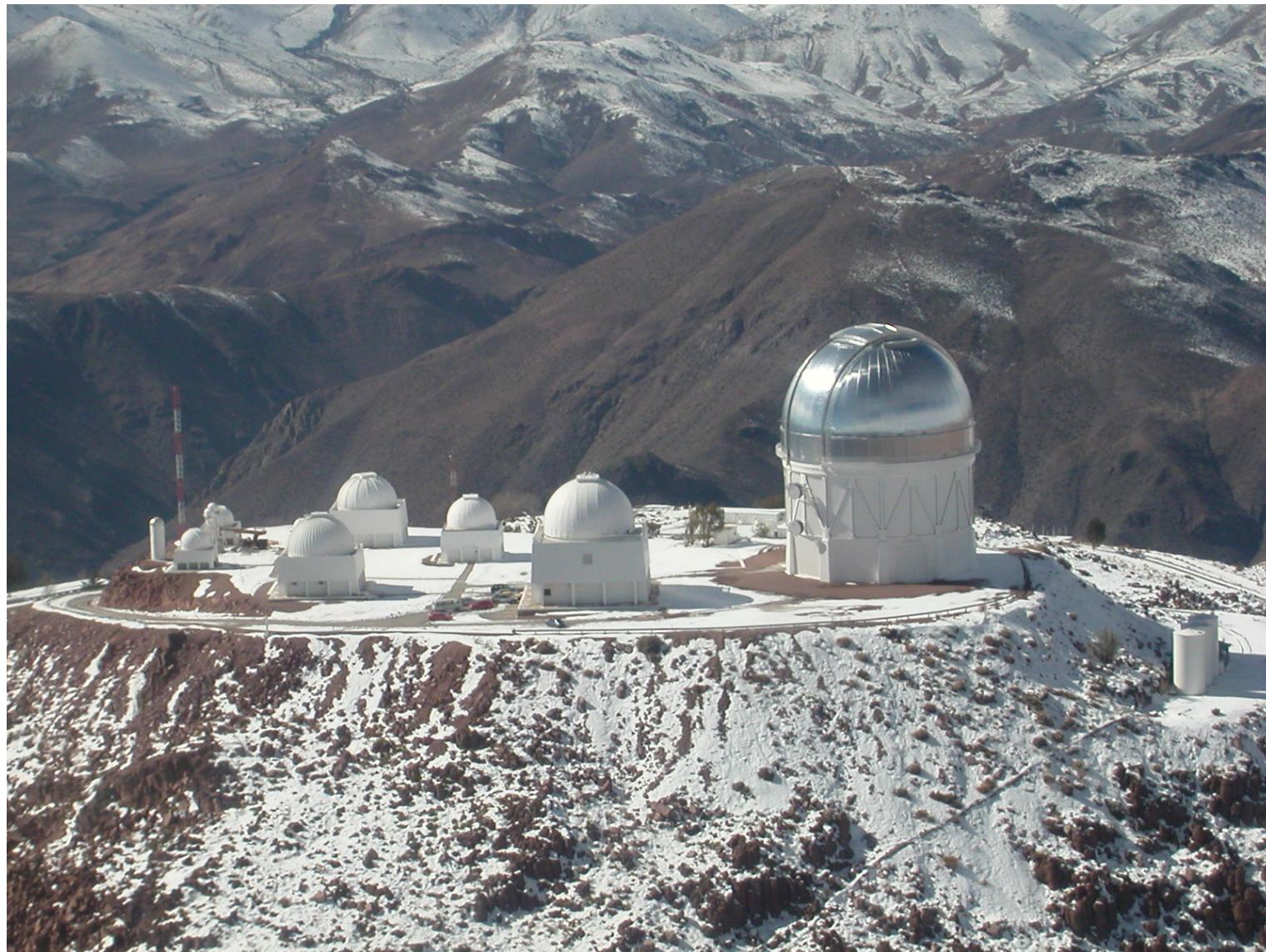
GMT
EELT

Others
ALMA
LSST
SKA/MWA

2020



Tololo, IV Region





NOAO/AURA/NSF

Las gran nube de Magallanes vistas por el telescopio Víctor Blanco, arriba se ve también la conocida nebulosa Tarántula



**Las nebulosa
Laguna vista
a través del
telescopio
Blanco en
cerro Tololo**

Bernstein,
Universidad de
Michigan

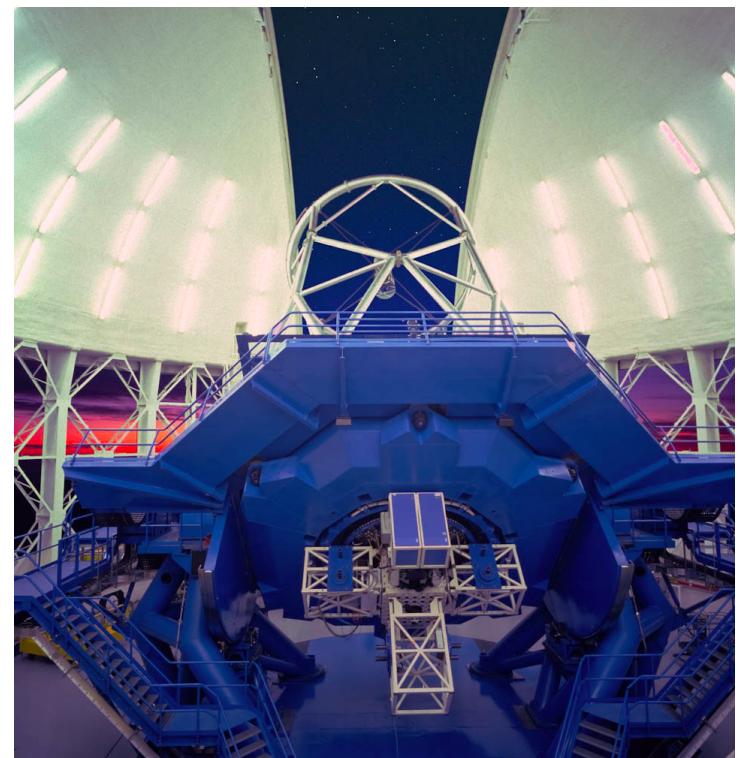
Pachon, IV Region

SOAR Telescope

U.S. National Optical Astronomy Observatory (NOAO), the Ministério da Ciencia e Tecnologia of the Federal Republic of Brazil (MCT), the University of North Carolina at Chapel Hill (UNC), and Michigan State University (MSU).



**Gemini
South**
US, Canada,
UK, Brazil,
Argentina

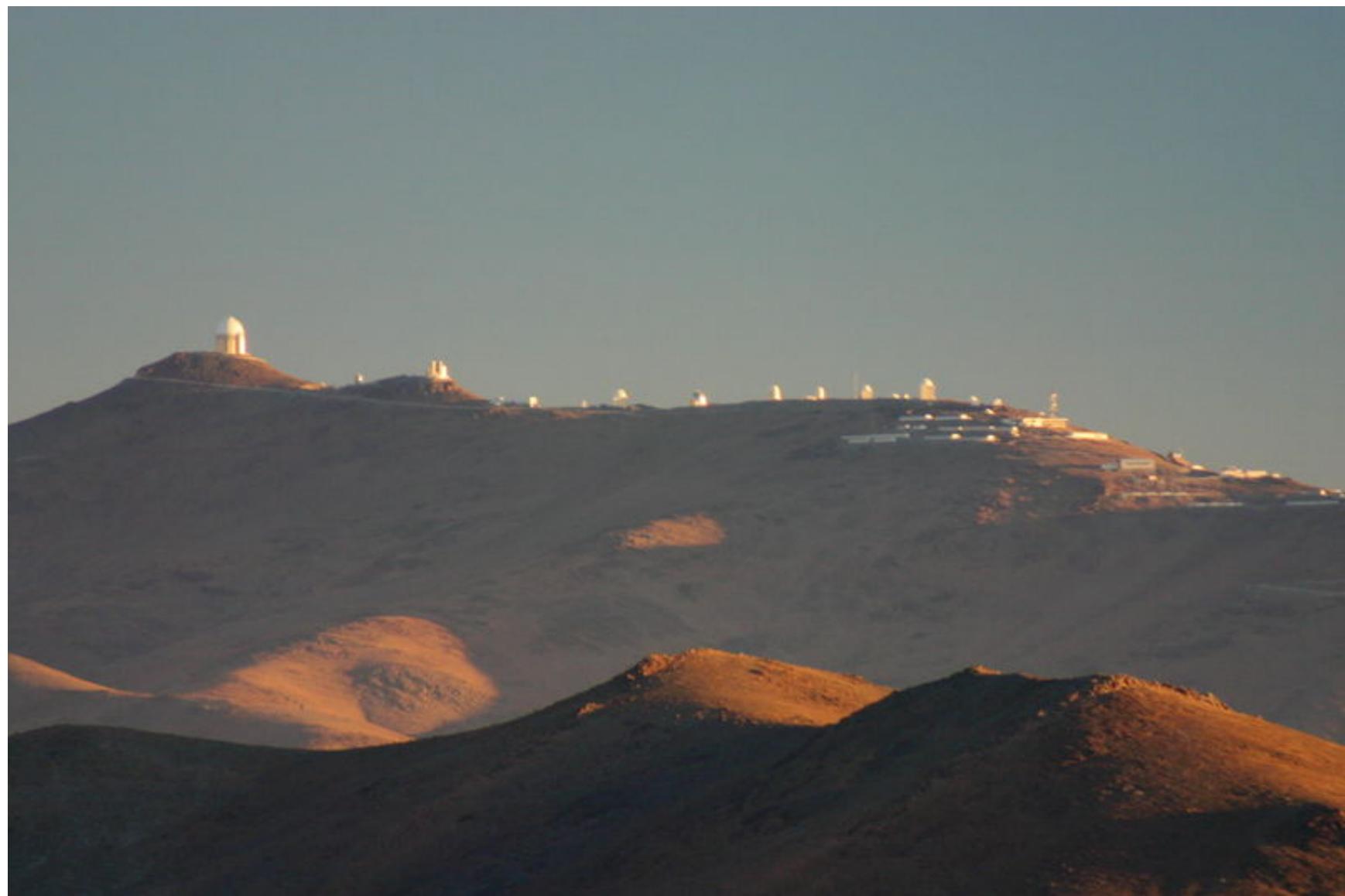




Gemini Observatory/AURA/Sydney Girls High School Astronomy Club/
T. Rector/A. R. Lopez-Sanchez (AAO)/Australian Gemini Office

Gemini Observatory Legacy Image

La Silla, IV Region



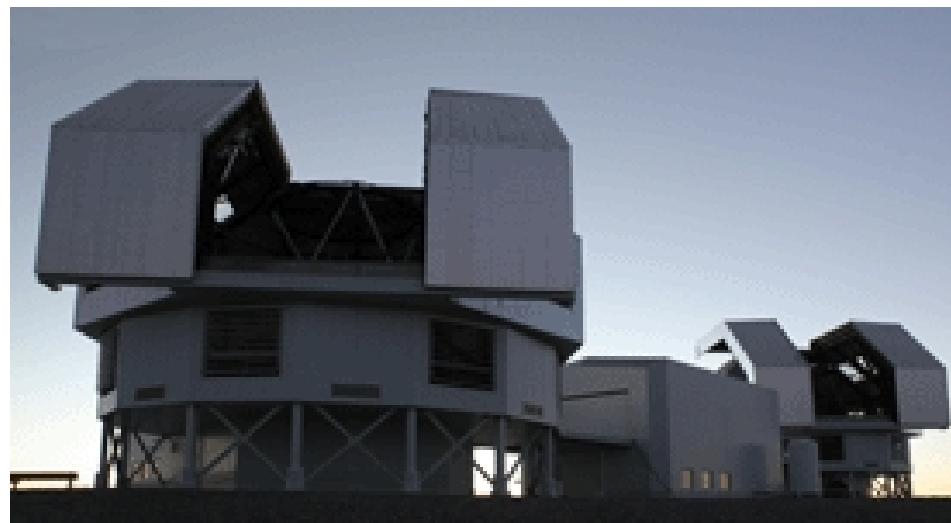
**A la izquierda, imagen de la galaxia M83.
Abajo la galaxia Centauro A.
Tomadas con el telescopio de 2.2m en La Silla con la cámara de amplio campo (WFI)**



Cúmulo de
estrellas en la
gran nube de
Magallanes.
Telescopio
NTT en la
Silla

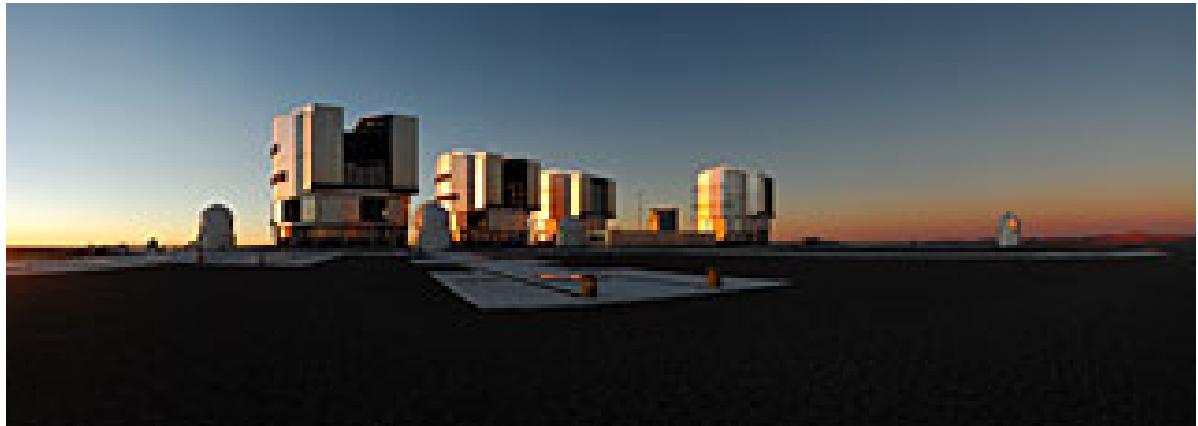


Las Campanas, III Region

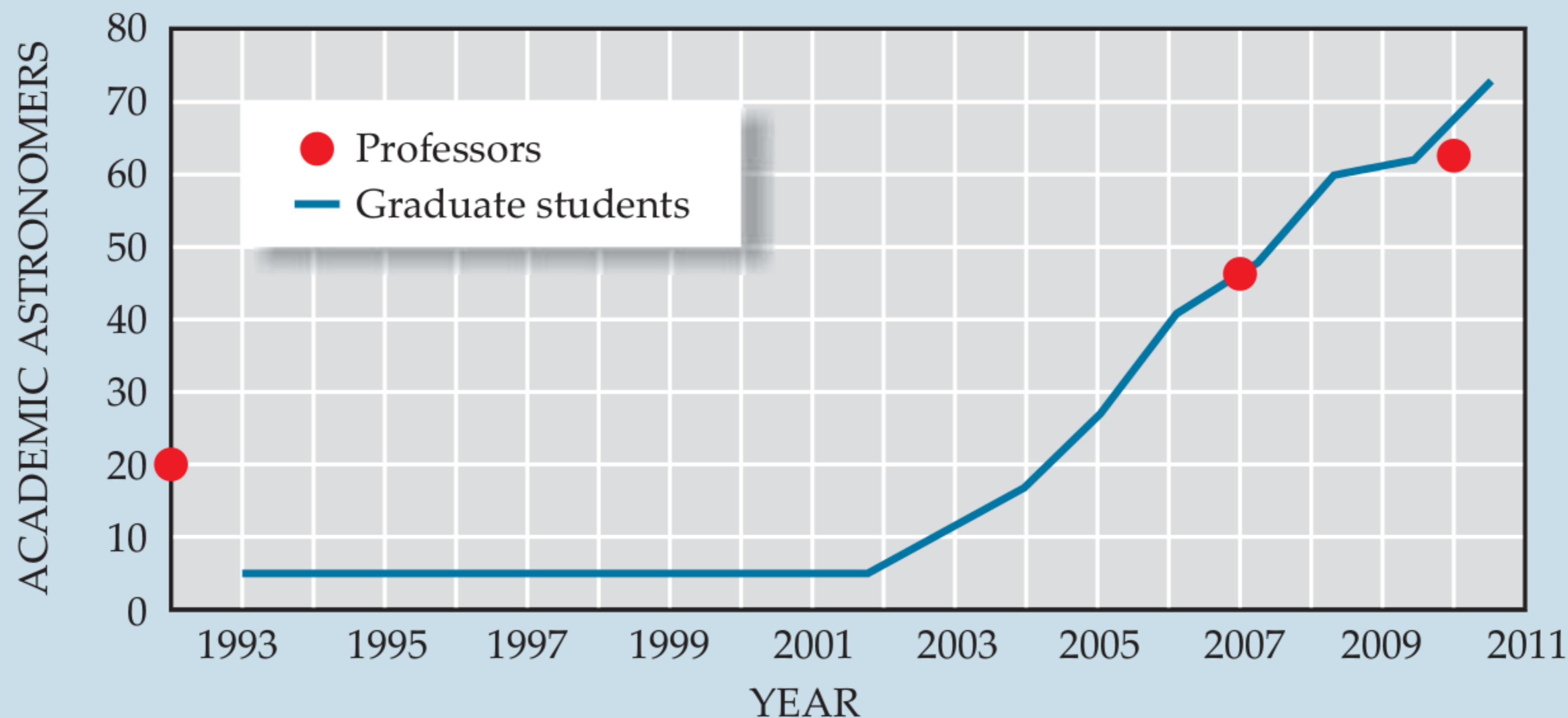


Paranal, II Region

ESO VLT
4 x 8.2 mt



DATA SUPPLIED BY CONICYT



Astronomy is growing fast in Chilean universities, due in large part to money from observatories and to efforts by the Chilean government to take advantage of their presence.

140 м

120 м

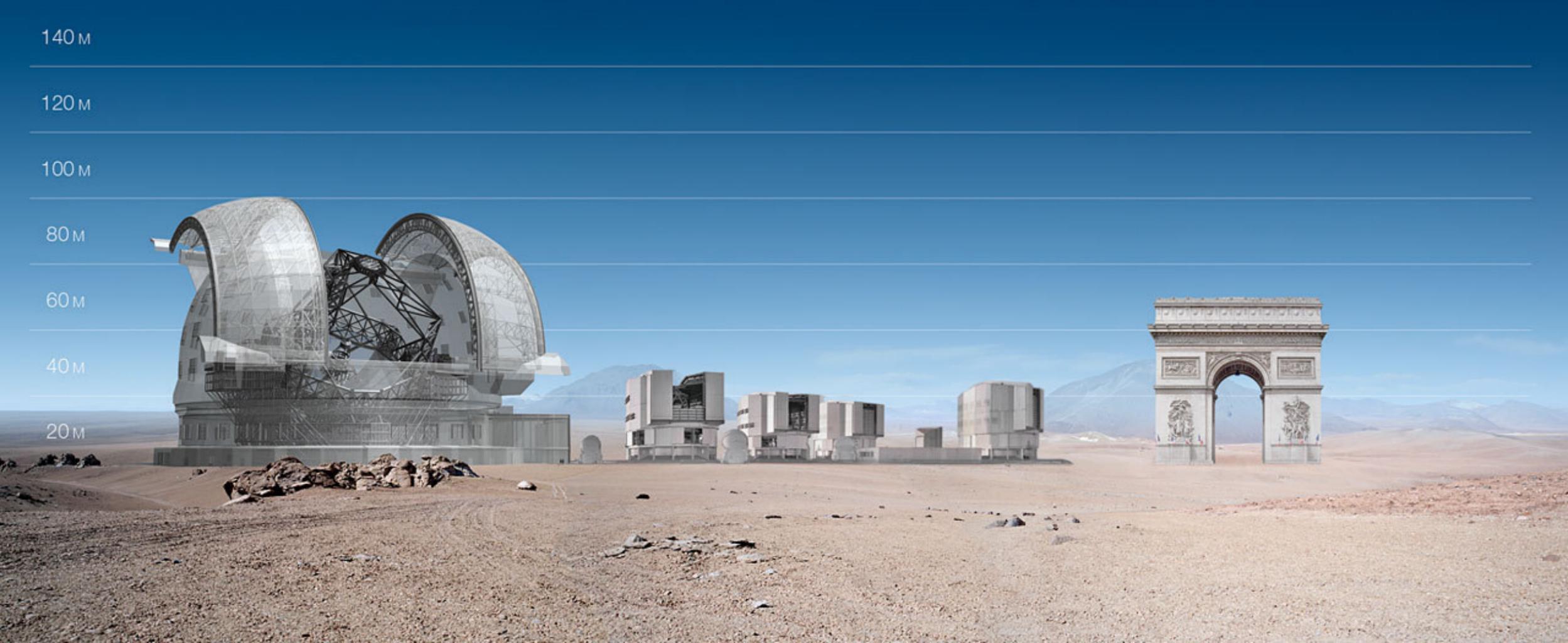
100 м

80 м

60 м

40 м

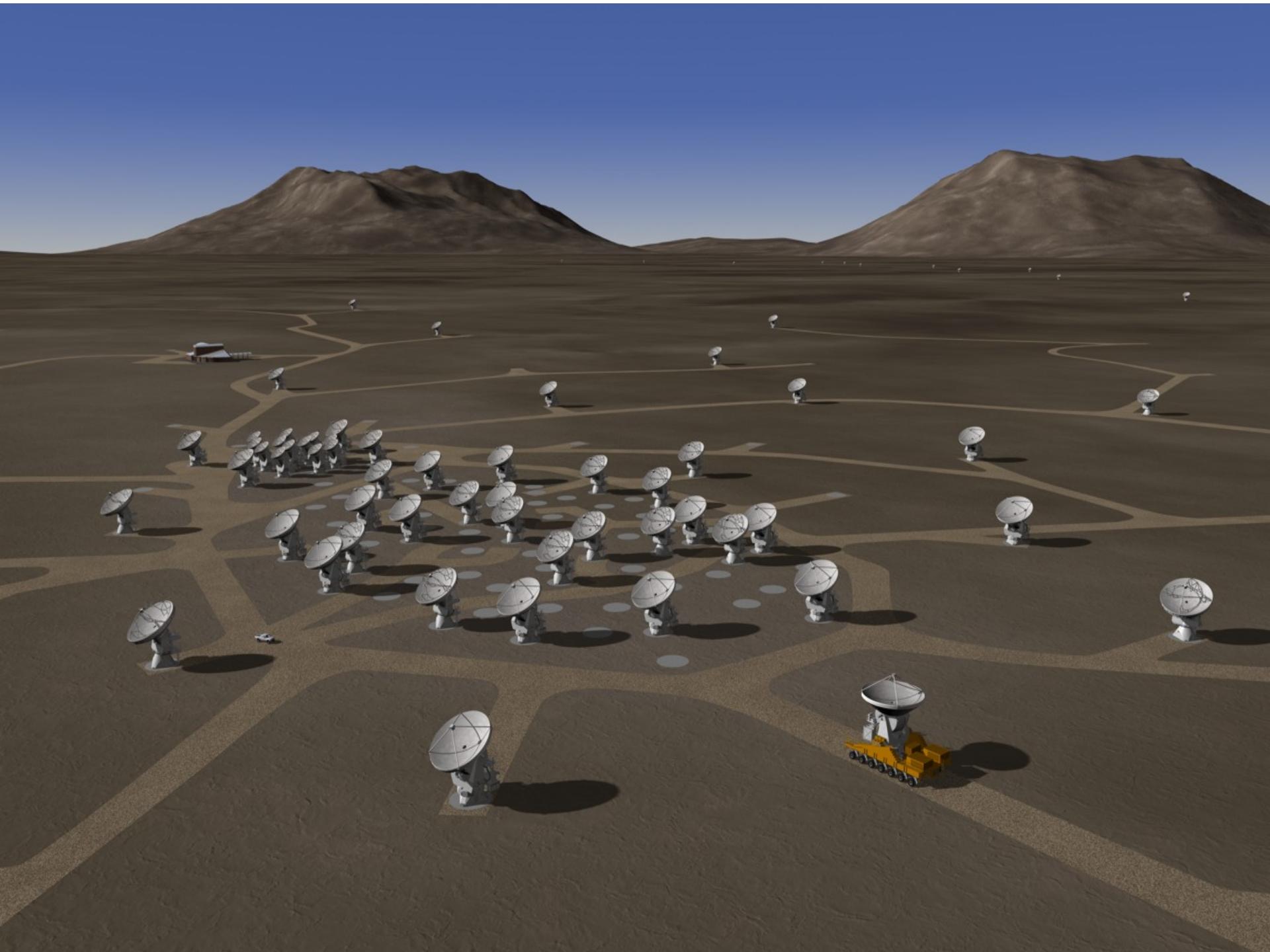
20 м



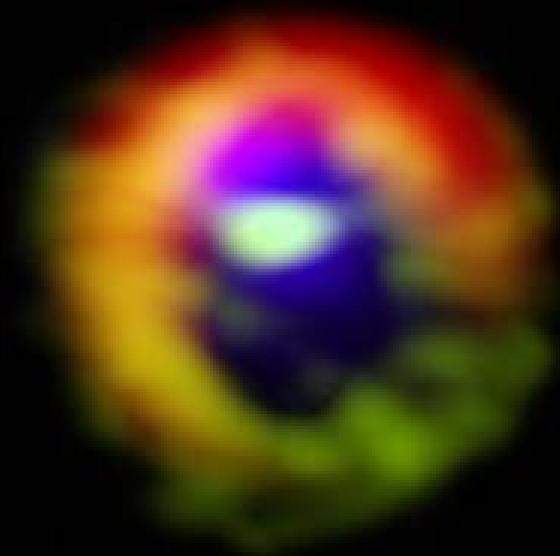


A wide-angle photograph of the Atacama Large Millimeter Array (ALMA) observatory at night. The sky is filled with numerous stars of varying brightness. In the foreground, several large white satellite dishes are visible, mounted on tall metal towers. The dishes are arranged in a grid-like pattern across the landscape. A prominent dish is centered in the middle ground. The ground is a dry, light-colored dirt or gravel surface. The overall atmosphere is dark and clear, providing a perfect view of the celestial bodies above.

ALMA



ALMA; giant planets



Casassus... & Jordan et al.



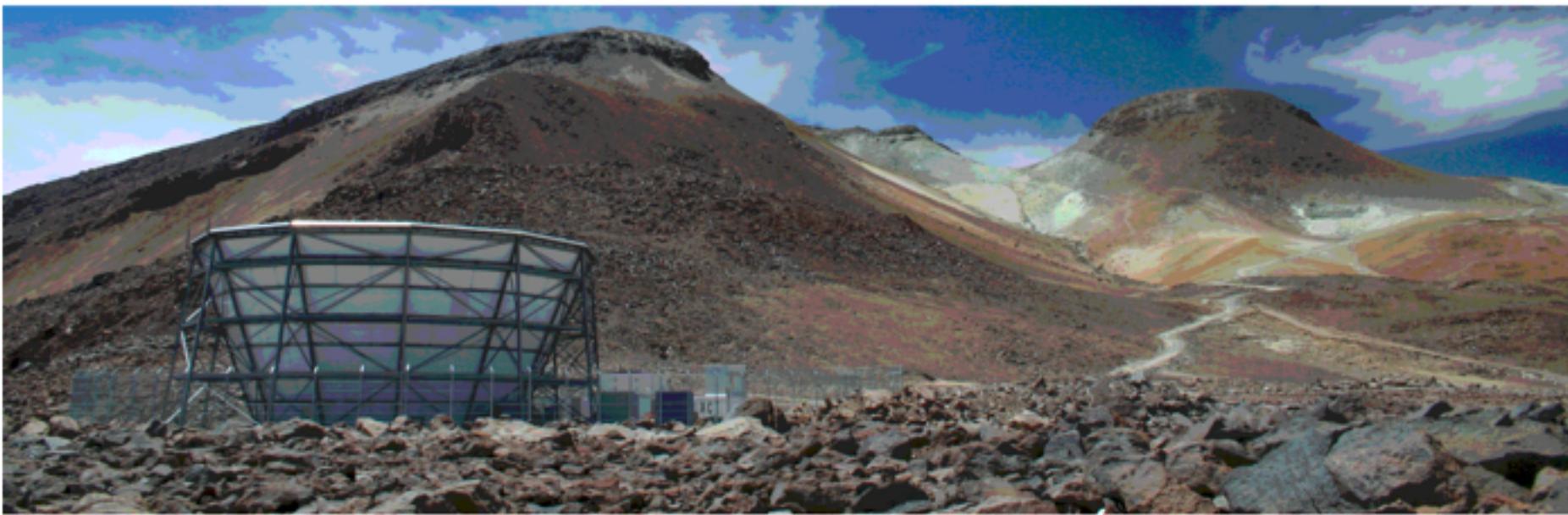


Large Millimeter Telescope
Gran Telescopio Milimétrico

Large Millimeter Telescope / Gran Telescopio Milimétrico




solar-system planetesimals & planets
extra-solar protoplanetary-disks
individual Galactic star-forming regions
the Galactic nucleus
local galaxies
active galactic nuclei
high-redshift dusty starburst galaxies
clusters of galaxies and their large-scale distribution 50 m



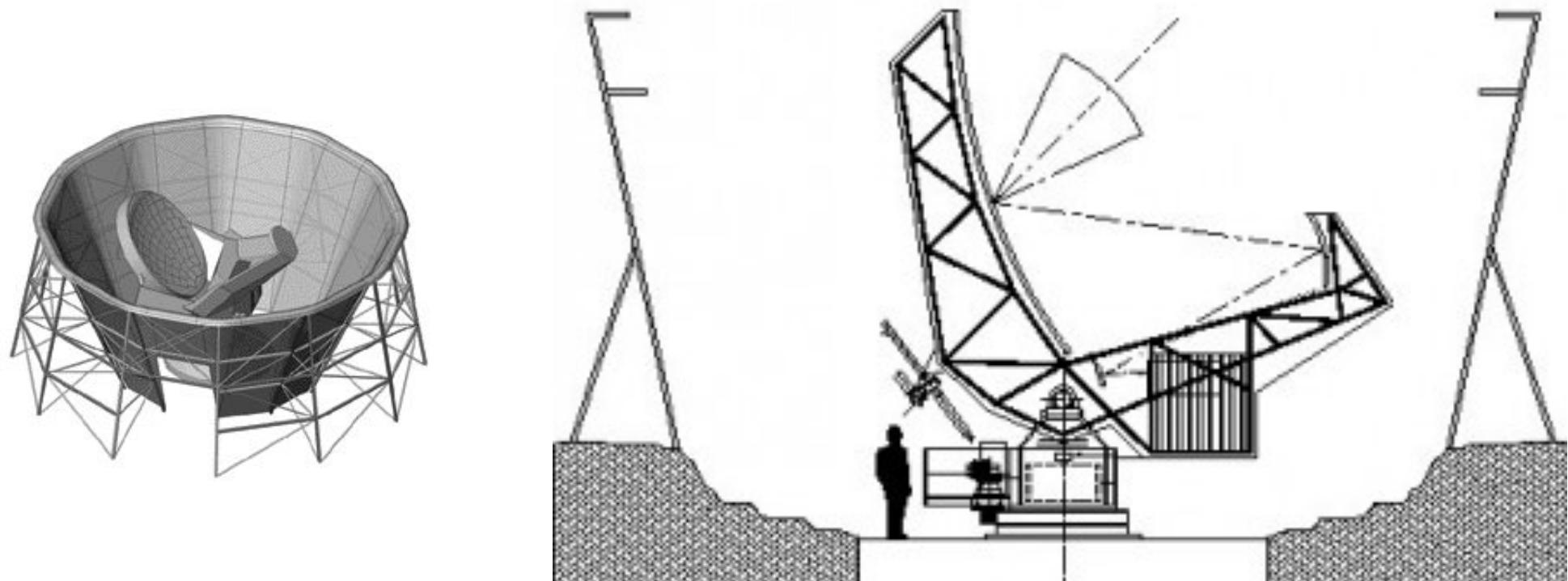
ATACAMA COSMOLOGY TELESCOPE



The Atacama Cosmology Telescope (ACT) is a six-metre telescope on Cerro Toco in the Atacama Desert in the north of Chile, near the Llano de Chajnantor Observatory. It is designed to make high-resolution, microwave-wavelength surveys of the sky in order to study the cosmic microwave background radiation (CMB). At an altitude of 5190 metres (17,030 feet), it is one of the highest permanent, ground-based telescopes in the world.

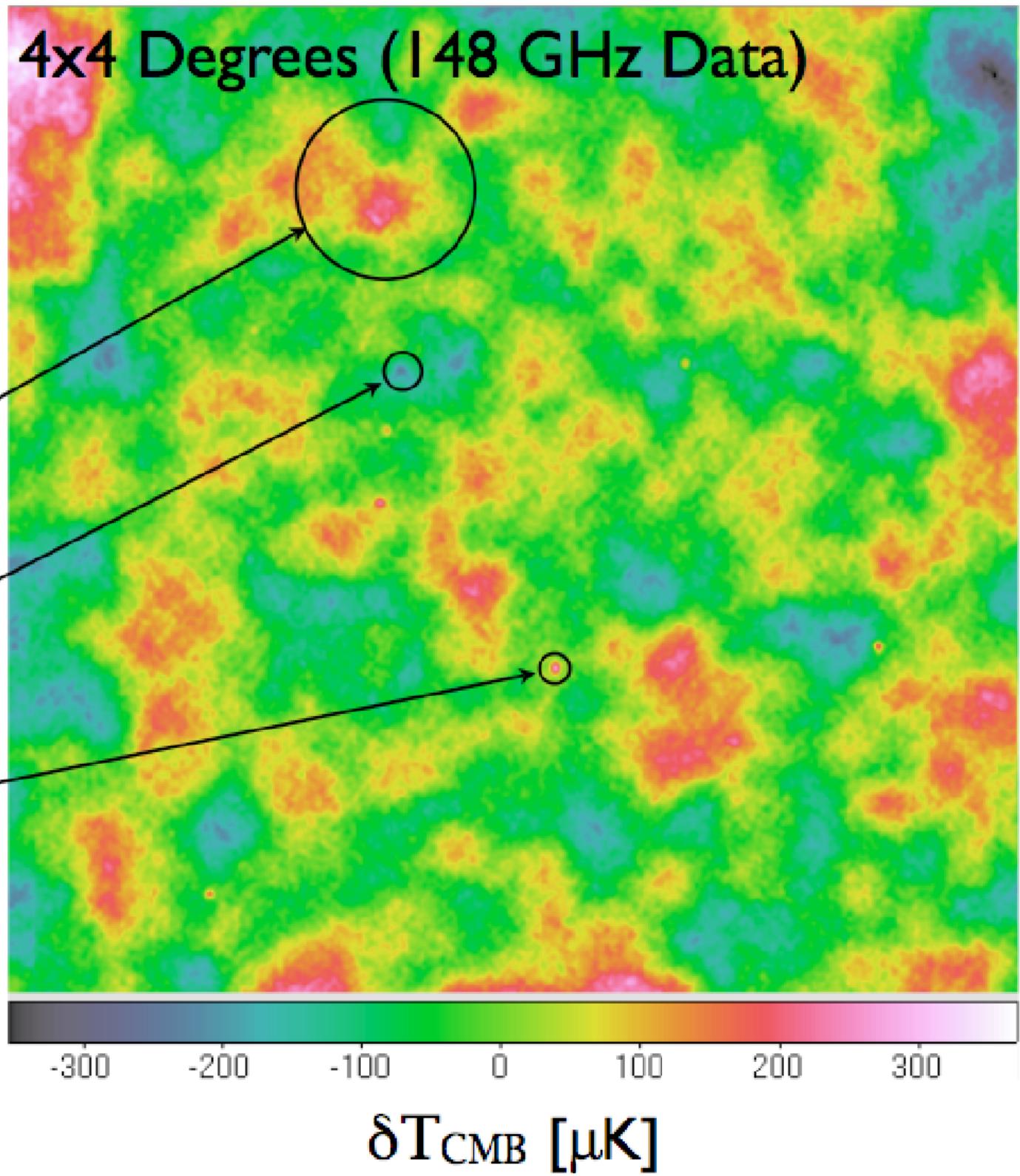


Atacama Cosmology Telescope



ACT Map

CMB fluctuation
Cluster
Active Galactic Nucleus



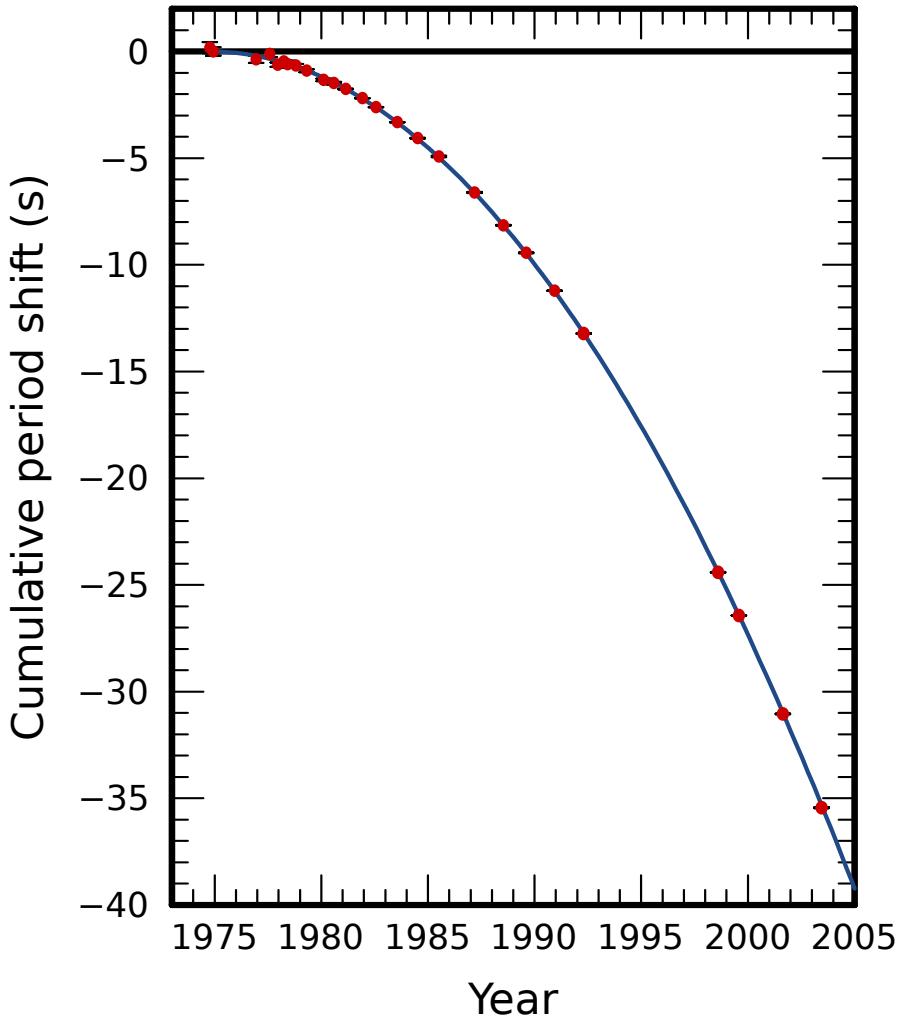
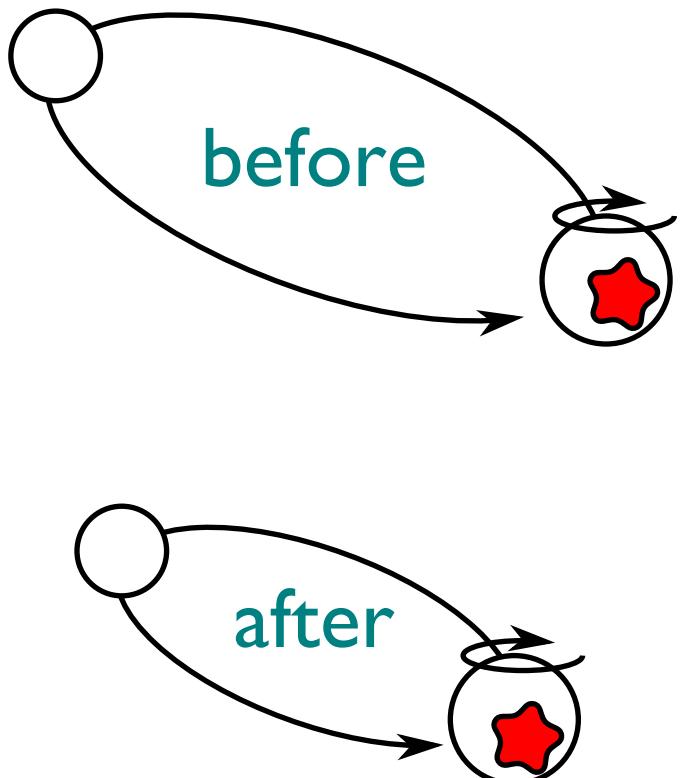
National Astronomy and Ionosphere Center



Arecibo, Puerto Rico



Binary Pulsars



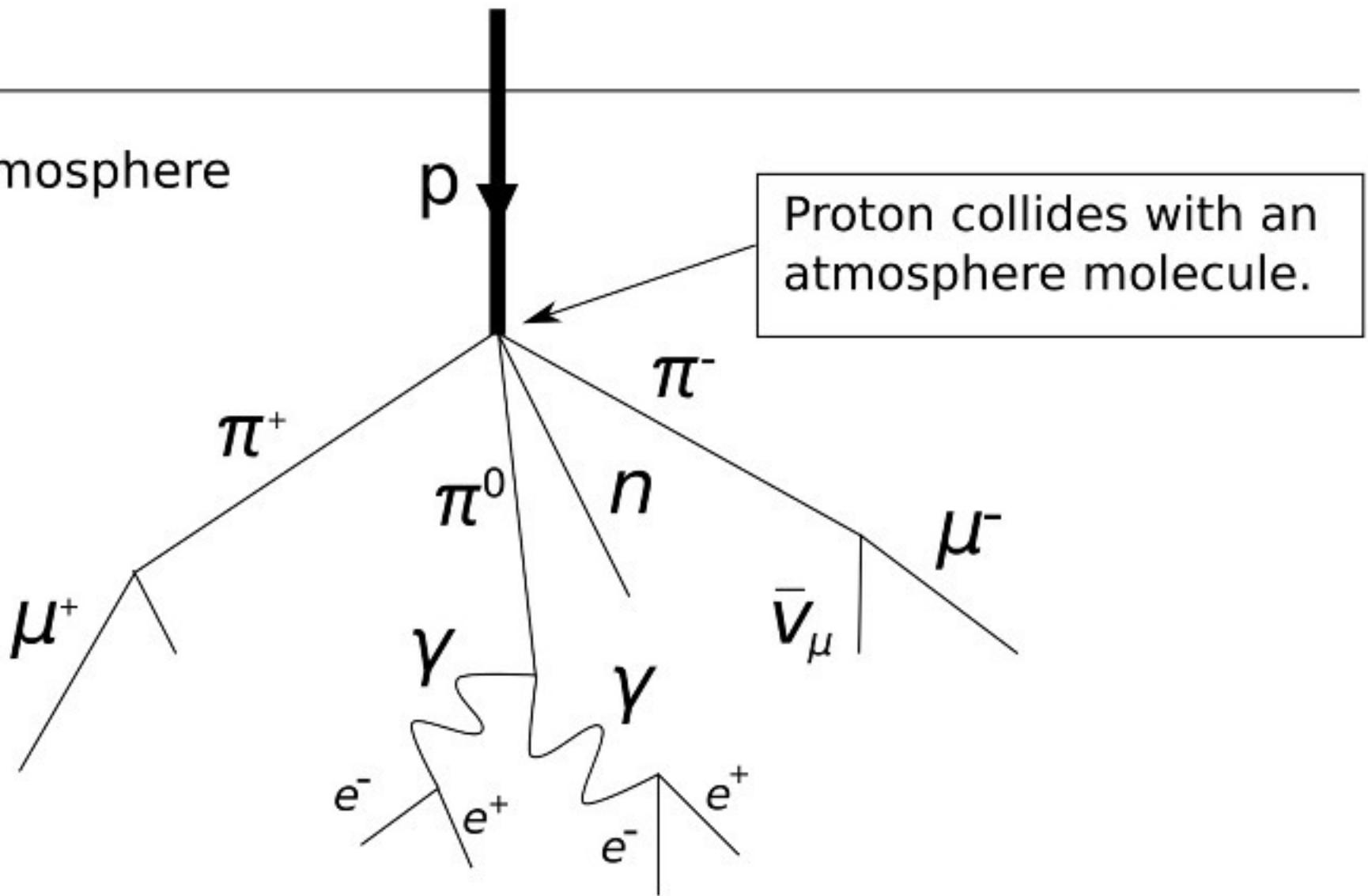


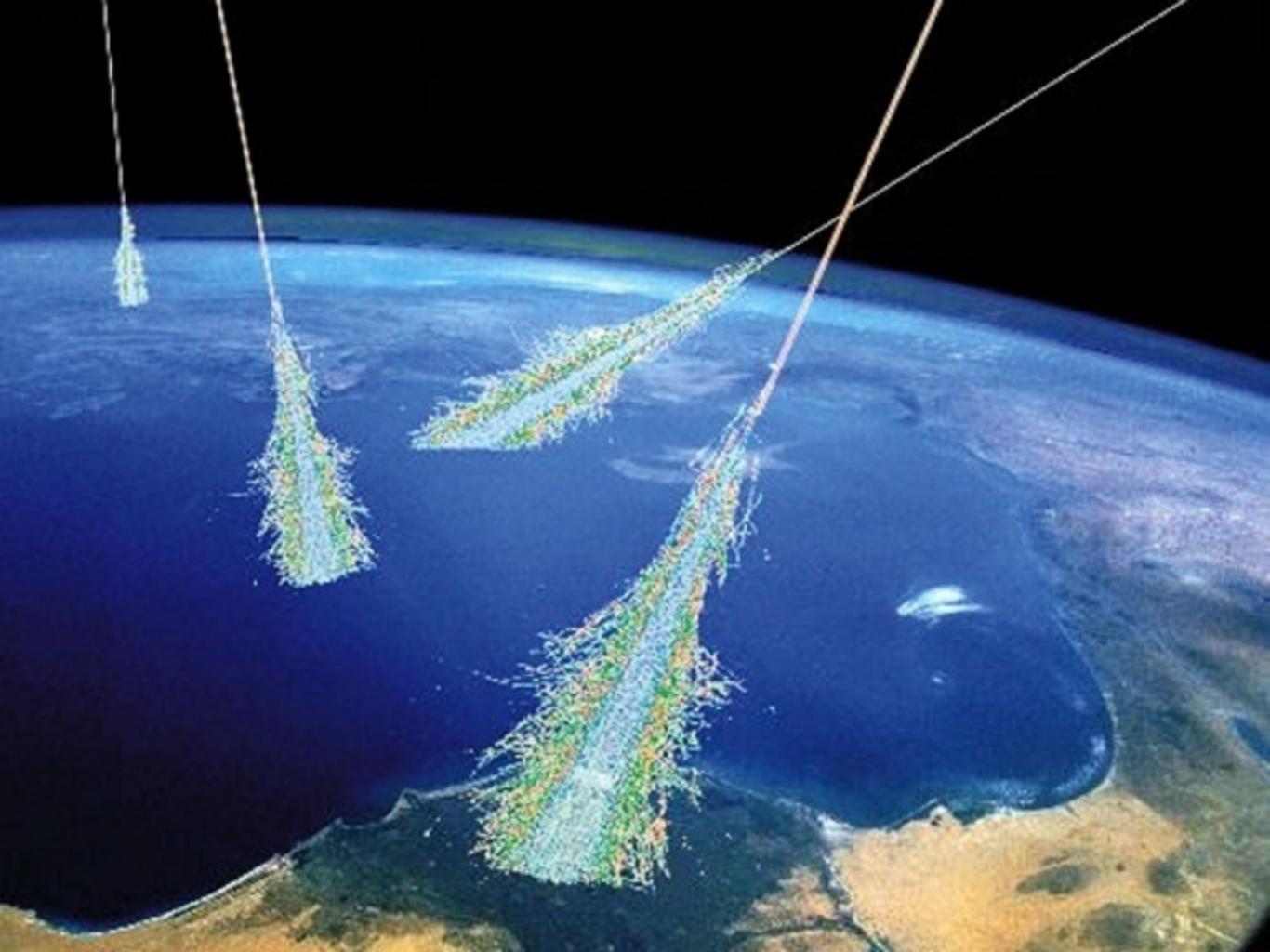
Pierre Auger Observatory



ALAIDE

Top of the atmosphere







It's an amazing universe out there!

**Latin American observatories and
astronomers are playing a great role
(and the best is yet to come)!**