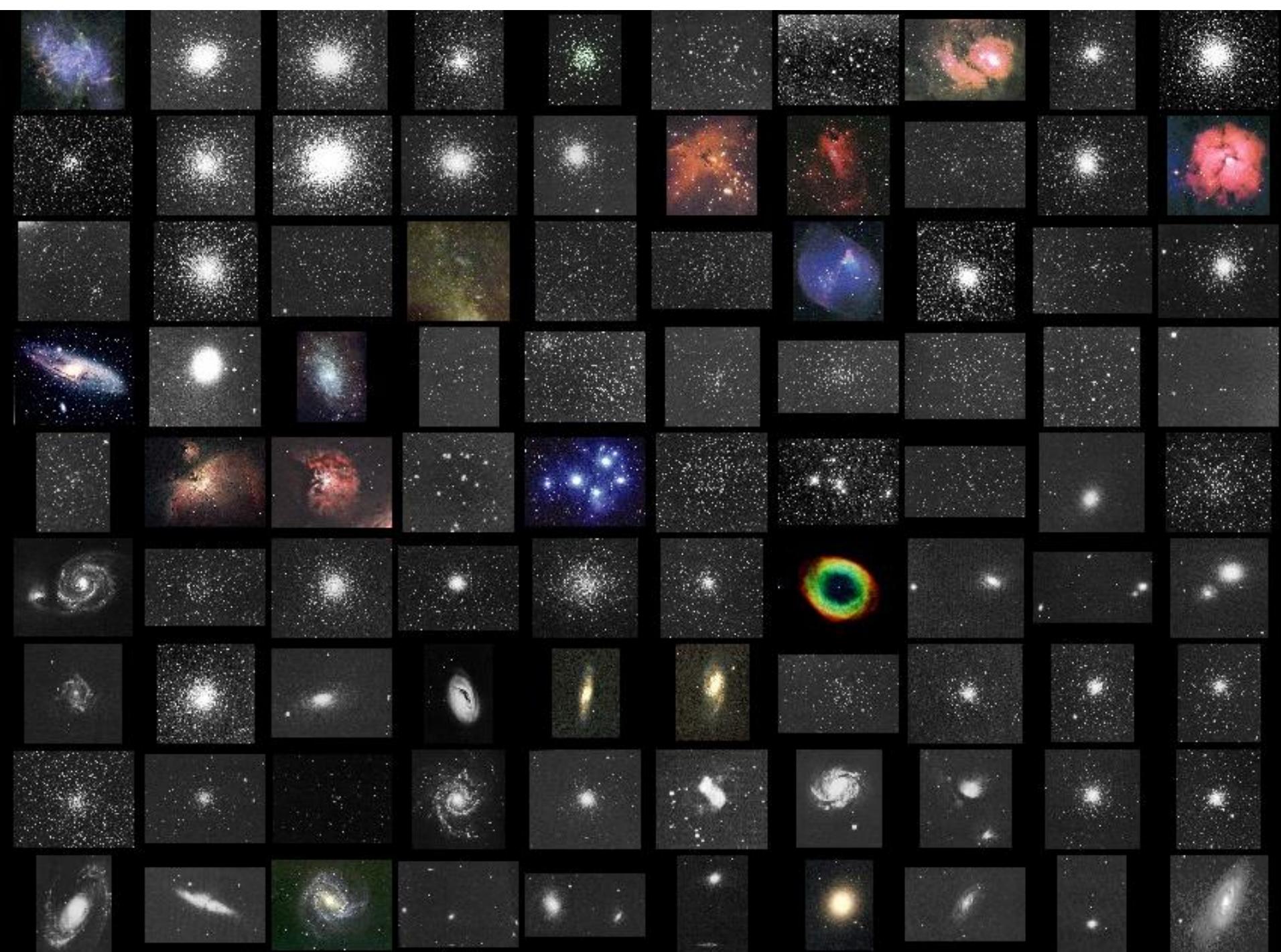


**An Introduction to Astronomy
Presentation I
Fall 2018
Physics Department –SUT
Shant Baghram**

Claude Monet, Impression soleil levant, 1872

How Big is The Universe?



کروه محی

1 pc ~ 3.2 lyr

- NGC 3190
- Antila Dwarf

• Leo A

• Leo I

• Leo II

• Canes Dwarf

• Ursa Major I

Sextans Dwarf

Boötes Dwarf

Ursa Major II

Ursa Minor Dwarf

Draco Dwarf

Large Magellanic Cloud

Small Magellanic Cloud

Carina Dwarf

Milky Way Galaxy

Sagittarius Dwarf

Sculptor Dwarf

Fornax Dwarf

800 Kpc

IC 10

NGC 185

NGC 147

M110

Andromeda Galaxy (M31)

M32

Andromeda II

Andromeda III

NGC 6822

Triangulum Galaxy (M33)

Pisces Dwarf

Aquarius Dwarf

SagDIG

Pegasus Dwarf

Phoenix Dwarf

Tucana Dwarf

IC 1613

Cetus Dwarf

WLM

ابرخوشه سنبله (Virgo) (Virgo)

16.5 Mpc

NGC 7582

NGC 6744

Local Galactic Group

NGC 5128

M101

Sculptor Maffei M81

NGC 5933

NGC 4697

Canes Groups

Virgo Cluster

NGC 1023

Leo I

Ursa Major Groups

NGC 2997

Dorado

Fornax Cluster

Eridanus Cluster

Leo II Groups

ارضه محلی

Corona-Borealis
Supercluster

Capricornus
Supercluster

Ophiuchus
Supercluster

Capricornus Void

Hercules
Superclusters

Corona Borealis
Void

Boötes
Superclusters

Pavo-Indus
Supercluster

Microscopium
Void

Hydra-Centaurus
Supercluster

Centaurus
Supercluster

Shapley
Supercluster

Sculptor Void

Sculptor
Superclusters

Pisces-Cetus
Superclusters

Virgo Supercluster

Coma
Supercluster

Boötes Void

Ursa Major
Supercluster

Fornax
Void

Phoenix
Supercluster

100 Mpc
 $Z \sim 0.02$

Leo
Superclusters

Canes-Major
Void

Columbia
Void

Sextans
Supercluster

Horologium
Supercluster

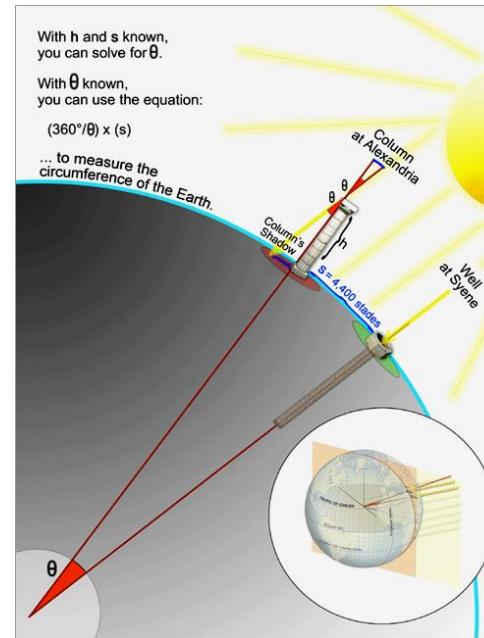
Columbia
Supercluster

اندازه‌گیری کیهان : از جغرافیا تا کیهان‌شناسی

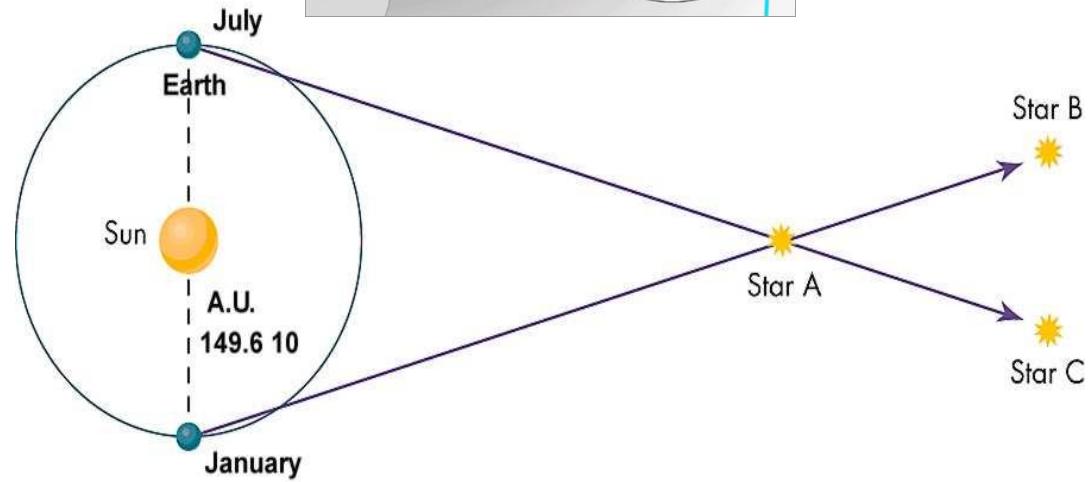


اراتوستنس

۲۷۶-۱۹۰ ق.م.



فريديريك بسل
1846-1784 م



کاپیوٹر ہائی ہاروارد: ہنریتا سوان لویت



Pickering and his Computers standing in front of Building C at the Harvard College Observatory, 13 May 1913 The Harvard Observatory, under the direction of Edward Charles Pickering (1877 to 1919) had a number of women working as skilled workers to process astronomical data. © Wiki

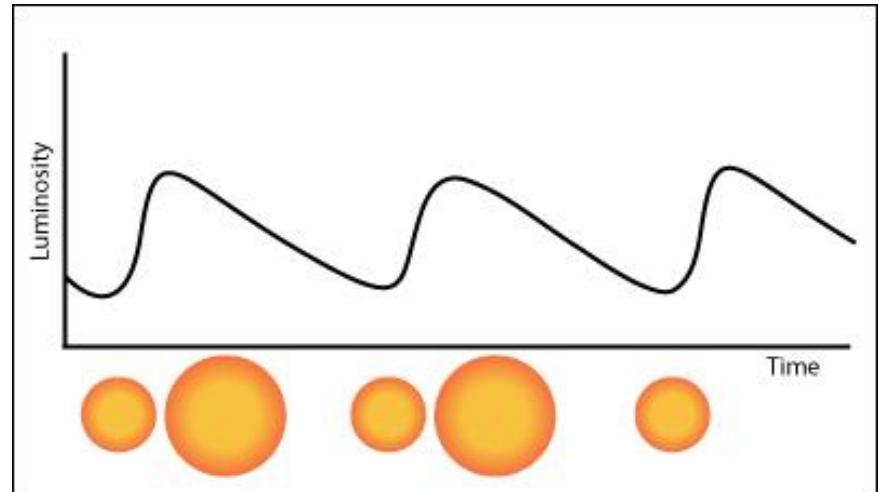
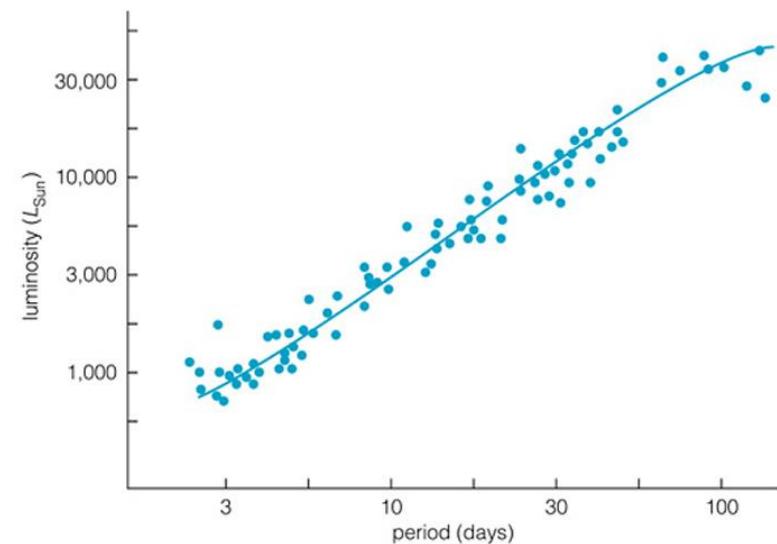
ستاره های متغیر: پایانی بر جدل ابتدای قرن



- هابل با استفاده از ستاره های قیفاووسی،
فاصله ما از آندرومدا را به دست آورد.
- (وستو سلیفر -هابل در پالومار...)

$$L_{obs} \propto L_{int} / r^2$$

$$r \sim 80,000 \text{lyr} \rightarrow 2.8 \text{Mlyr} \sim 1 \text{Mpc}$$



قانون هابل

$$Z \sim \frac{v}{c}$$

❖ سرعت دور شدن کهکشان ها متناسب است با فاصله آن ها

زمانی که نسبت
آفتابی نمایش
گردید

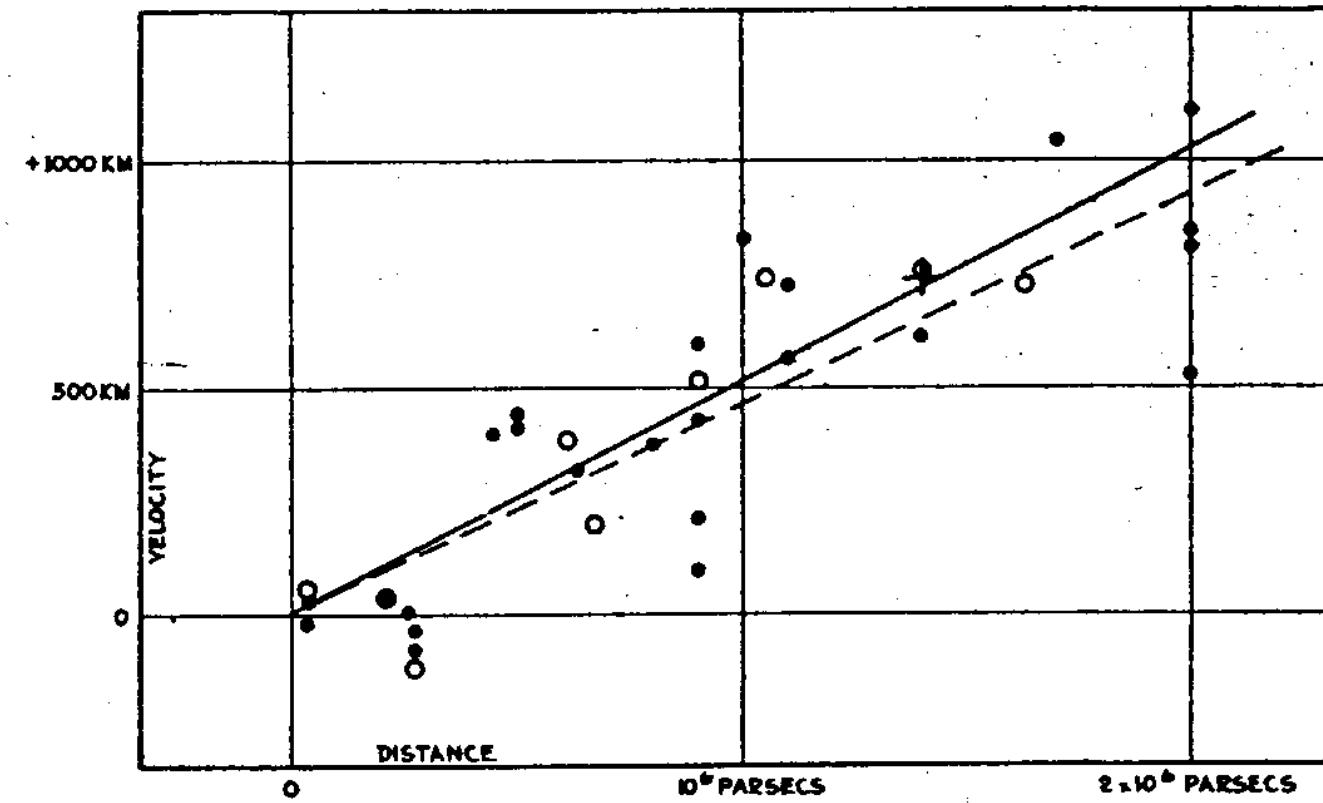


FIGURE 1

فاصله

قانون هابل

$$v = H_0 d$$

$$H_0 = 70.2 \pm 1.4 \text{ km/s/Mpc}$$

❖ سرعت دور شدن کهکشان ها متناسب است با فاصله آن ها

فرموده شده
آنفال

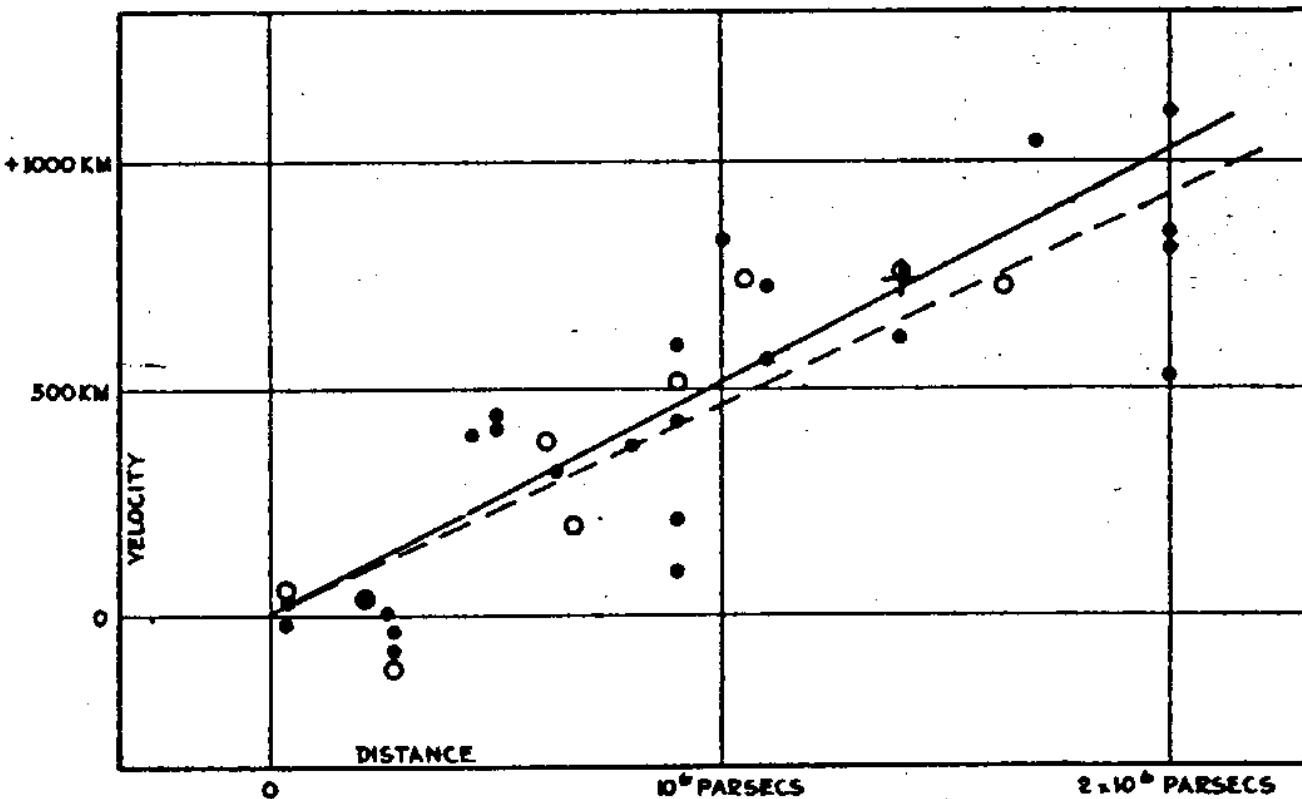


FIGURE 1

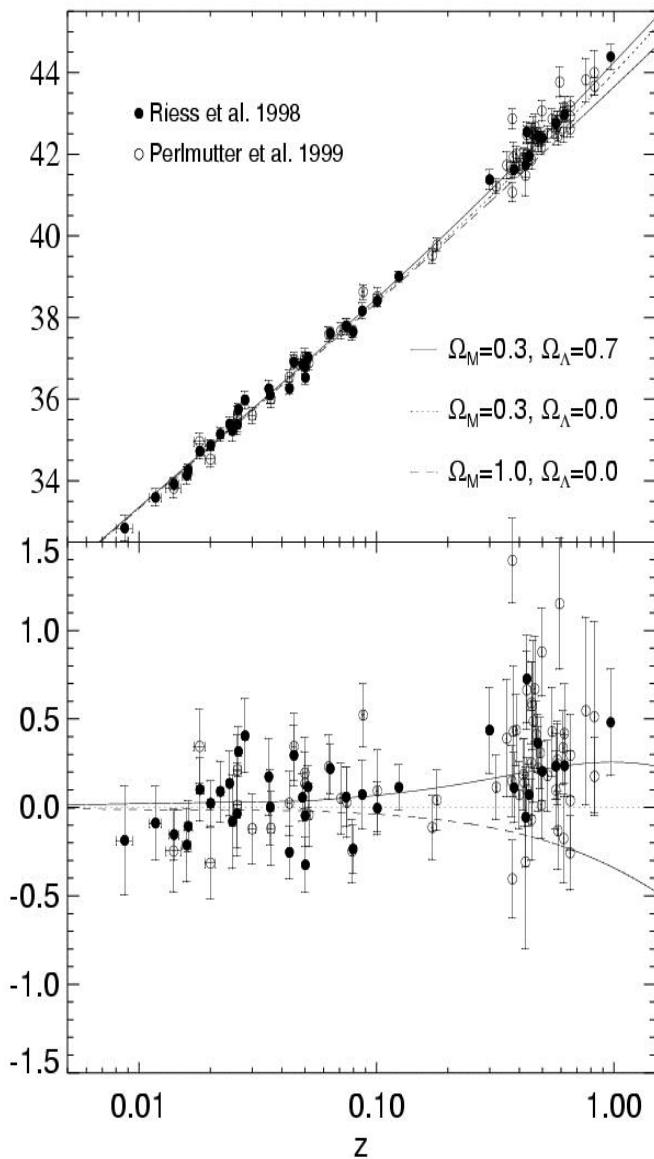
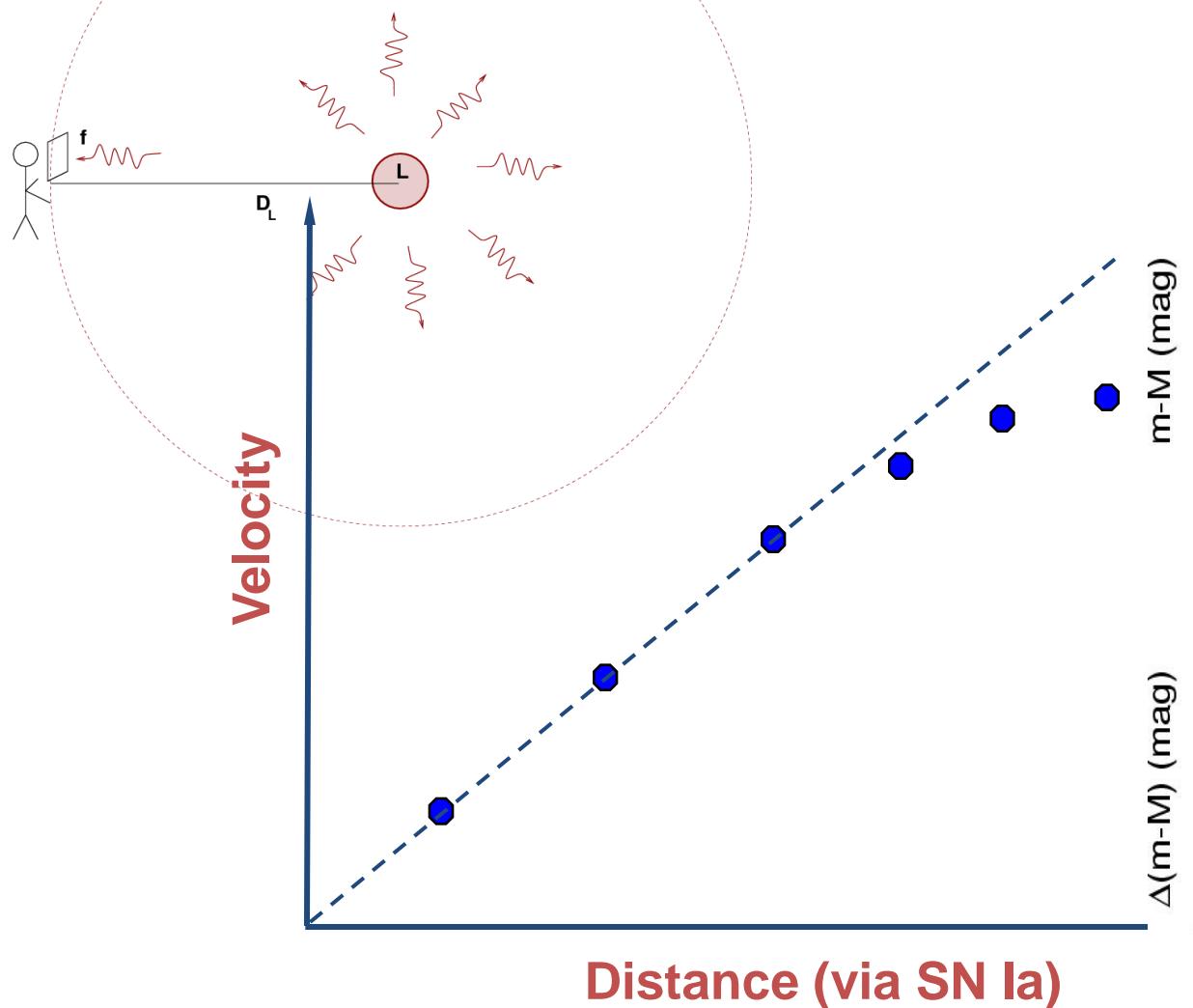
فاصله



Cape Town Daily Photo®



Luminosity Distance



٢٠١١ نوبل



Nobelpriset 2011

Nobelpriset i fysik 2011



Med ena hälften till
With one half to



SAUL PERLMUTTER

The Supernova Cosmology Project

Lawrence Berkeley National Laboratory
and University of California,
Berkeley, CA, USA

och med den andra hälften gemensamt till
and with the other half jointly to



BRIAN P. SCHMIDT

The High-z Supernova Search Team

Australian National University,
Weston Creek, Australia



ADAM G. RIESS

The High-z Supernova Search Team

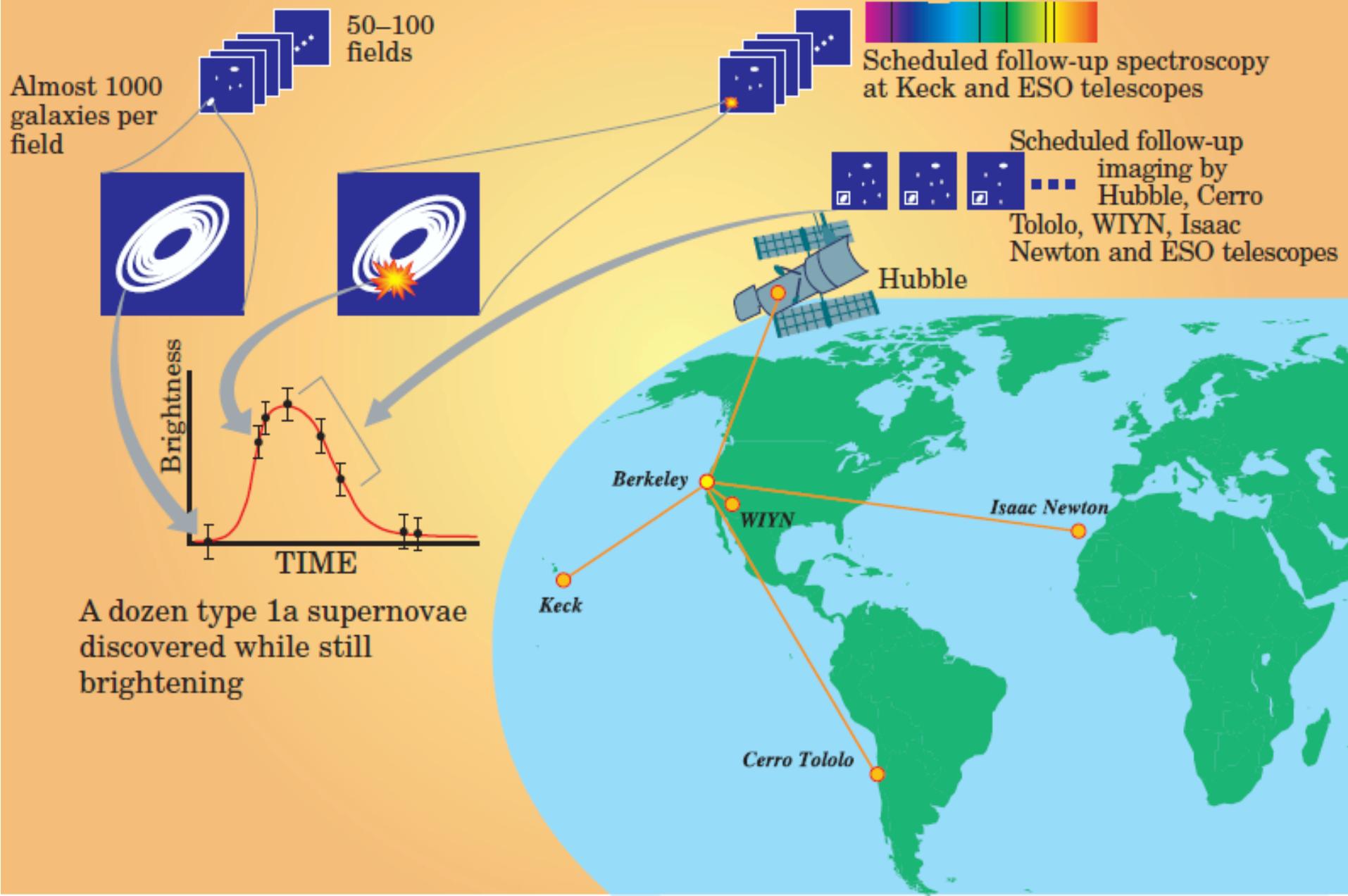
Johns Hopkins University and
Space Telescope Science Institute,
Baltimore, MD, USA

"För upptäckten av universums accelererande expansion genom observationer av avlägsna supernovor"

"for the discovery of the accelerating expansion of the Universe through observations of distant supernovae"

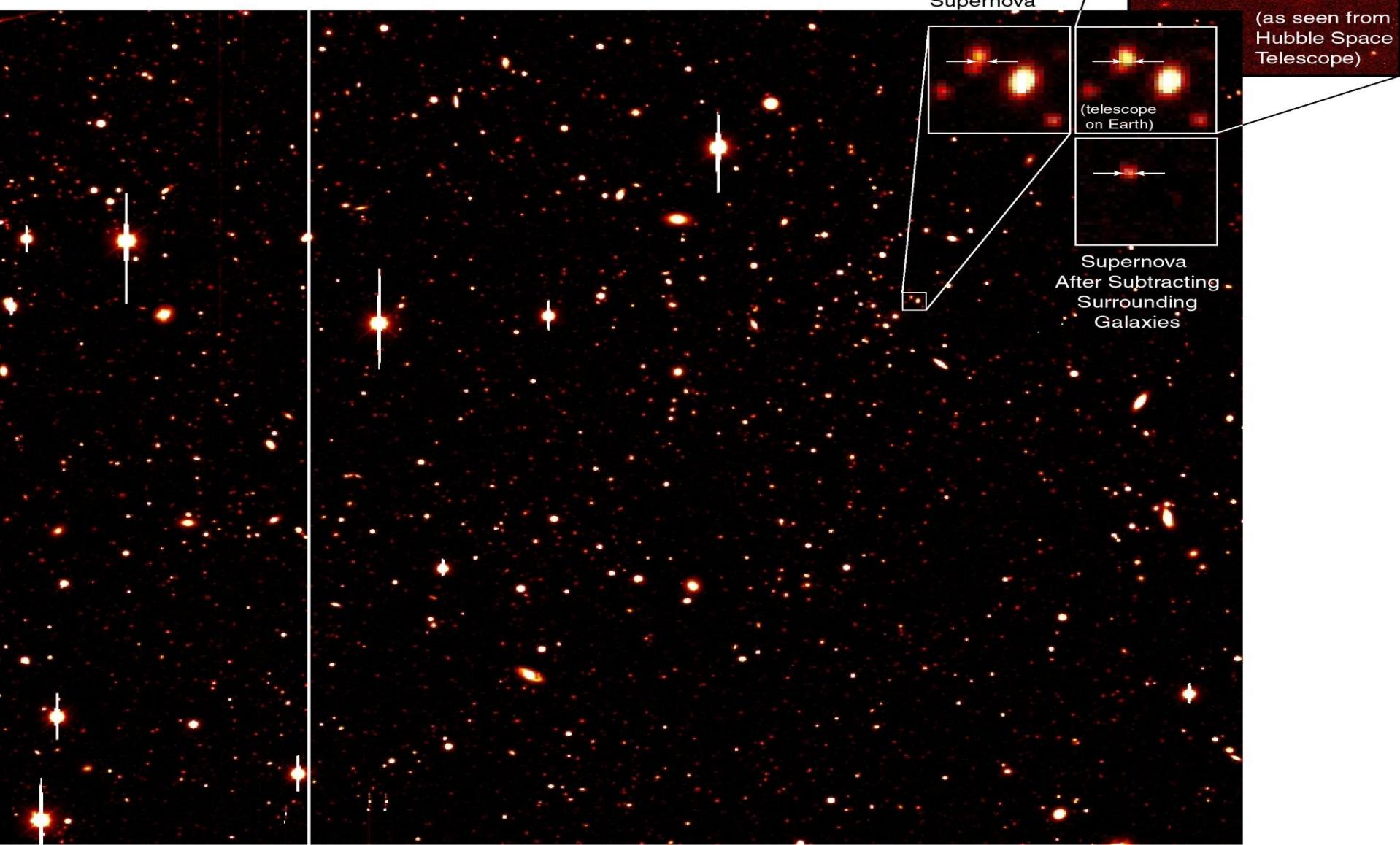


Nobelprize.org
© Kungl. Vetenskapsakademien

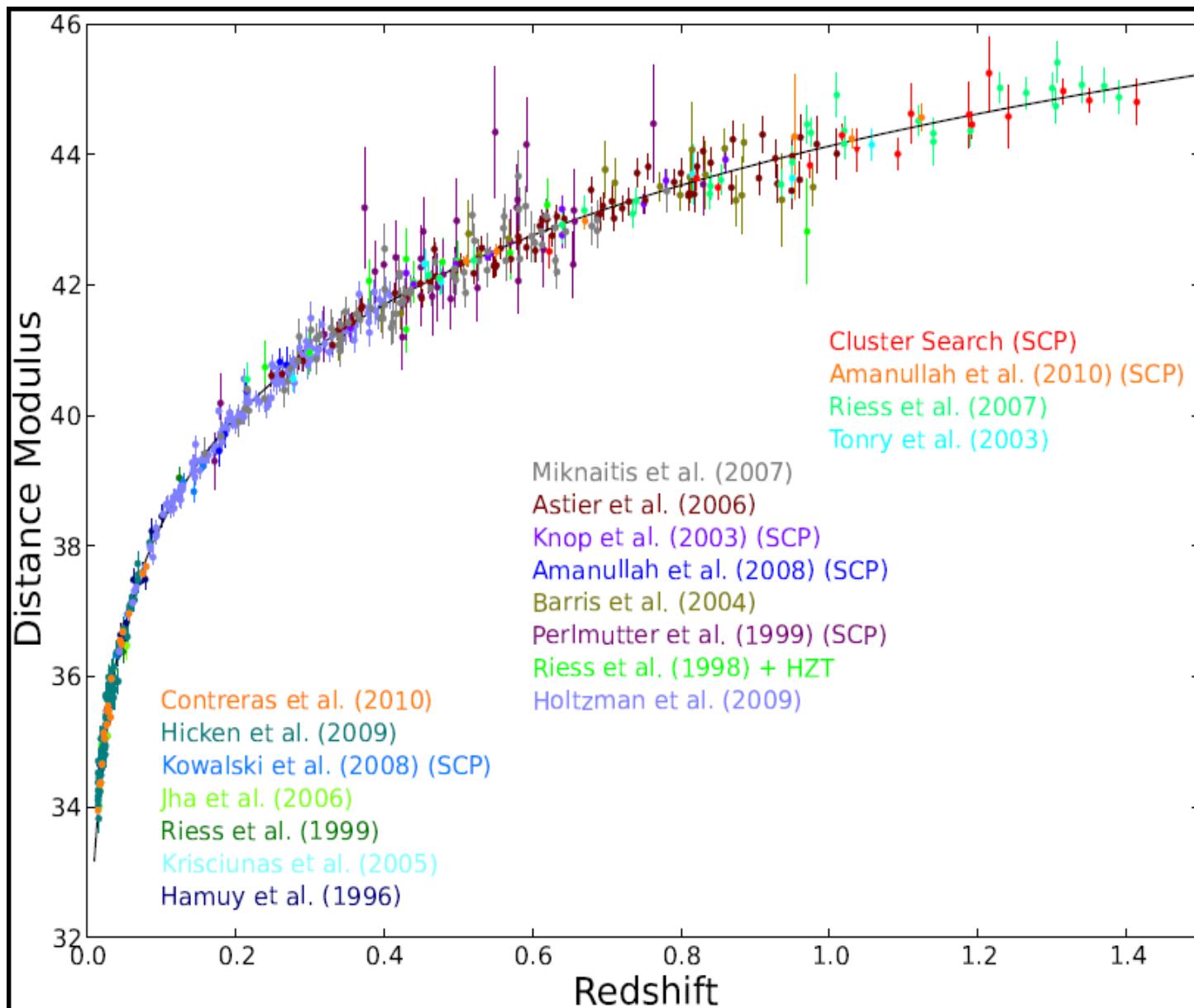




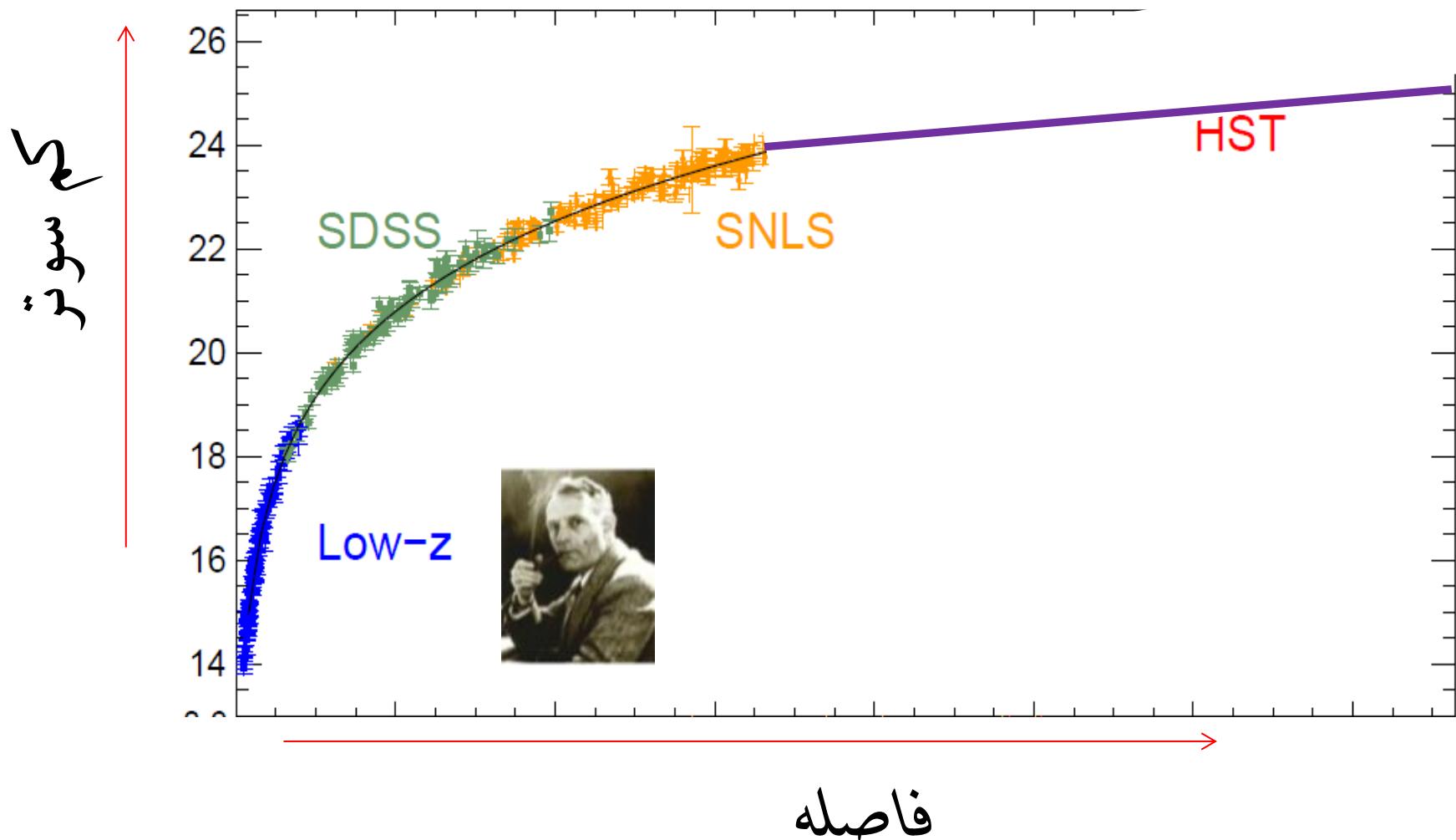
سوزن در کاهدان



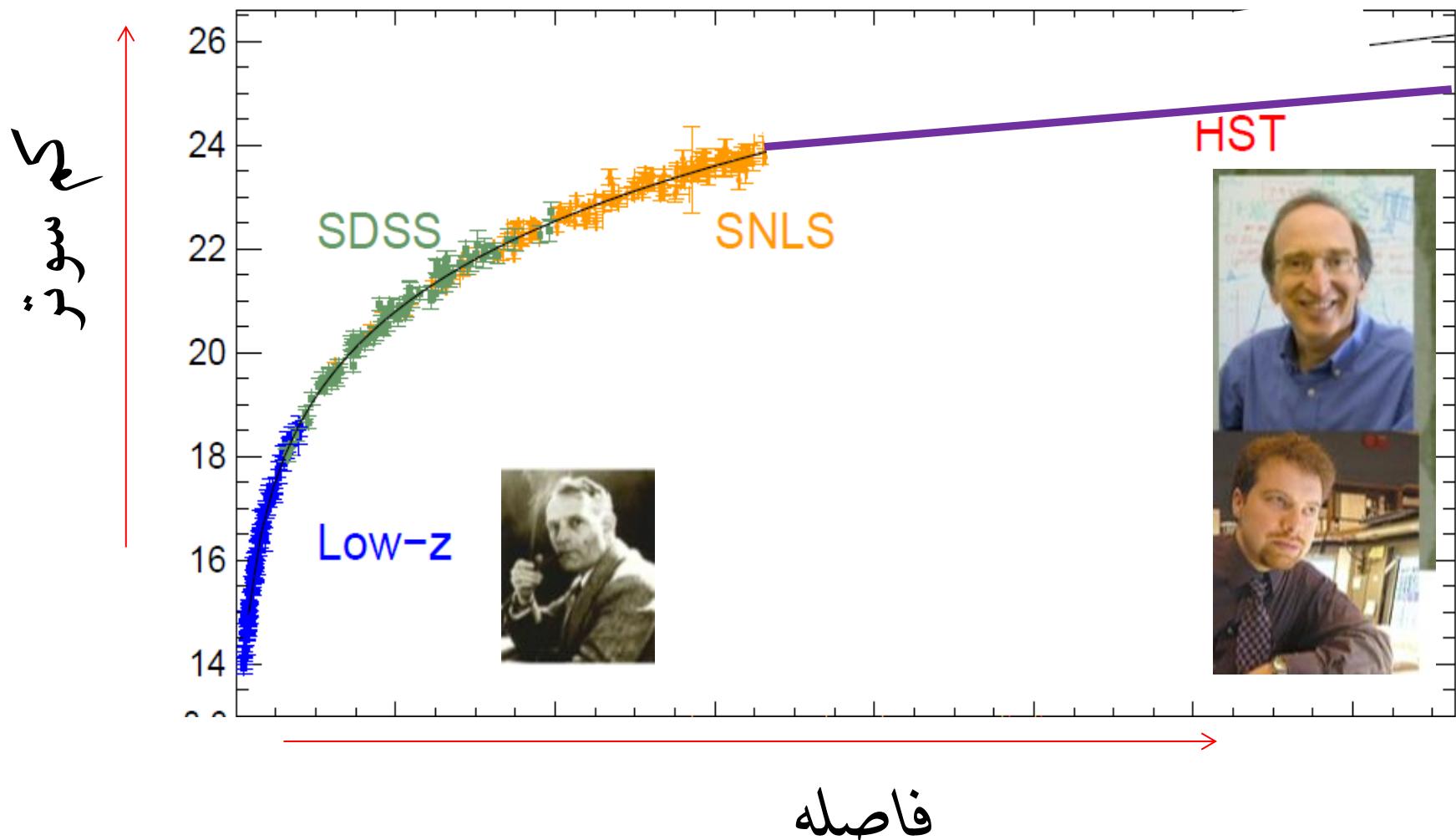
داده‌های ابرنواختری Union2



اندازه گیری و ...



اندازه گیری و ... غافلگیری



Observation and Instruments

- a) Multi wavelength Astronomy
- b) Telescopes

Radio

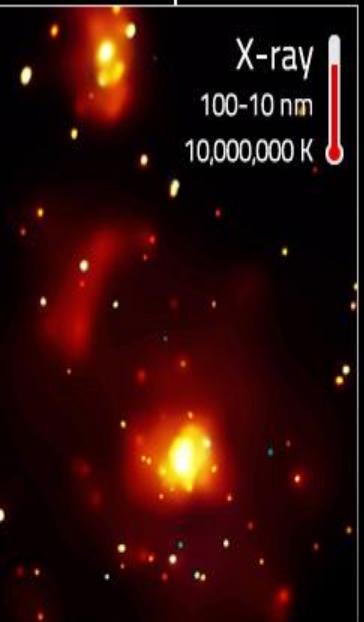
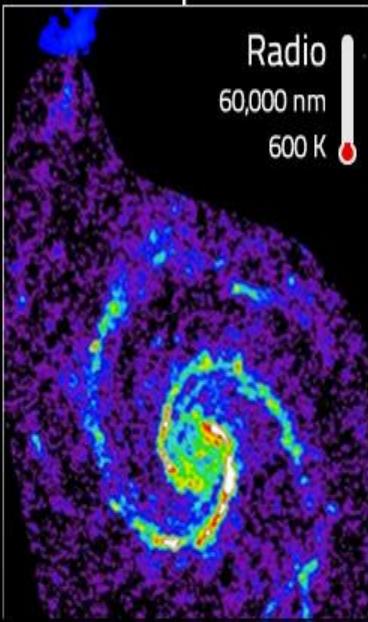
Microwave

Infrared

UV

X-Ray

Gamma Ray



Multiwavelength Whirlpool Galaxy

COLD GAS: Radio waves reveal regions of gas cool enough for CO₂ molecules to exist.

COOL STARS: Infrared shows smaller cool red stars that make up most of the galaxy.

SOLAR STARS: Optical light comes from stars around the size of the Sun.

HOT STARS: Ultraviolet shows the larger hot blue stars that are less frequent in galaxies.

HOT GAS: X-rays are emitted from the hottest regions of gas where atoms are ionized.

← COOL LOW ENERGY RADIATION

VISIBLE LIGHT

HOT HIGH ENERGY RADIATION →

Radio vs Optical

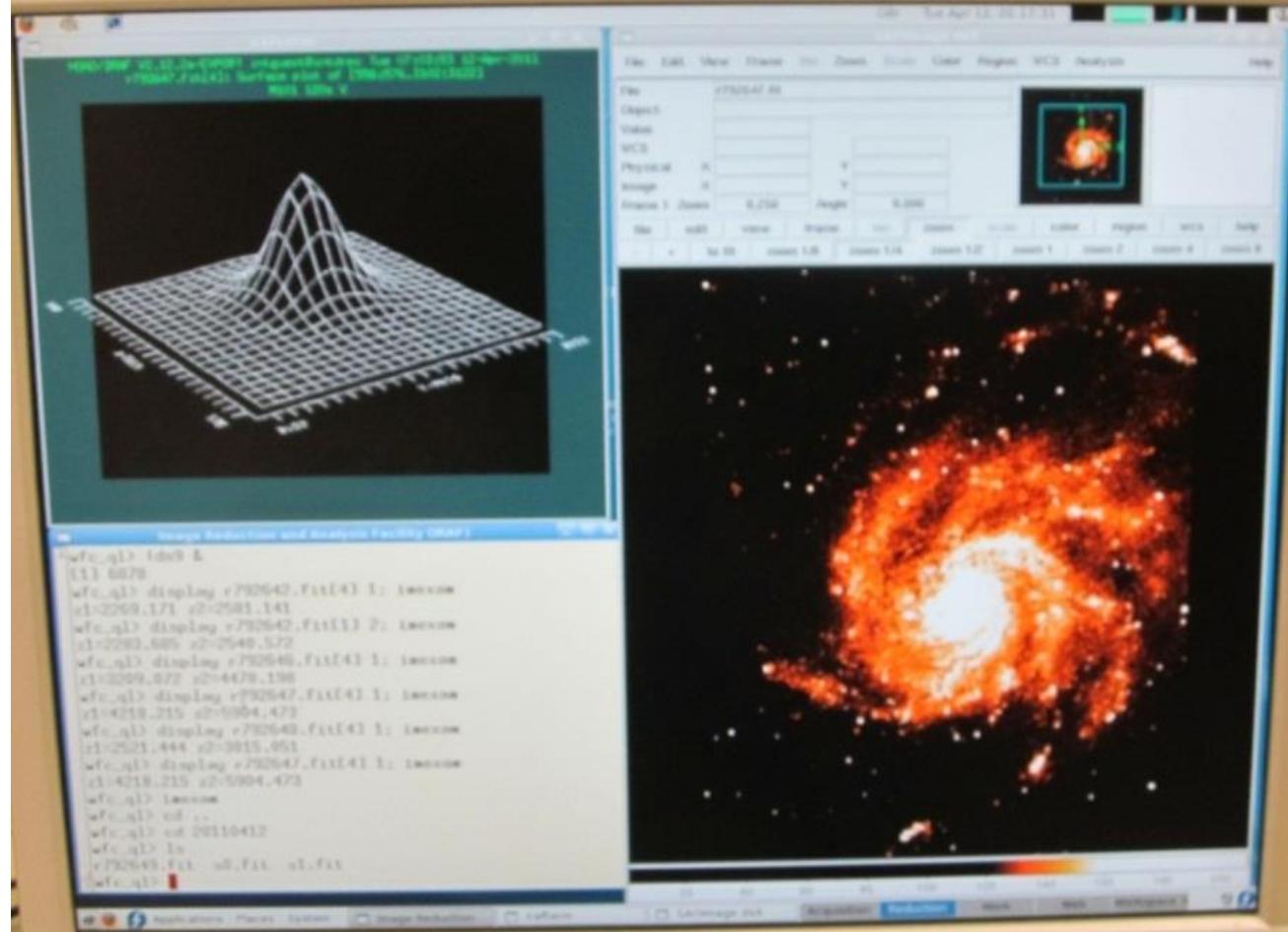
NGC 6964: same scale

Optical (stars)

radio 21cm (hydrogen gas)

NTDRPC

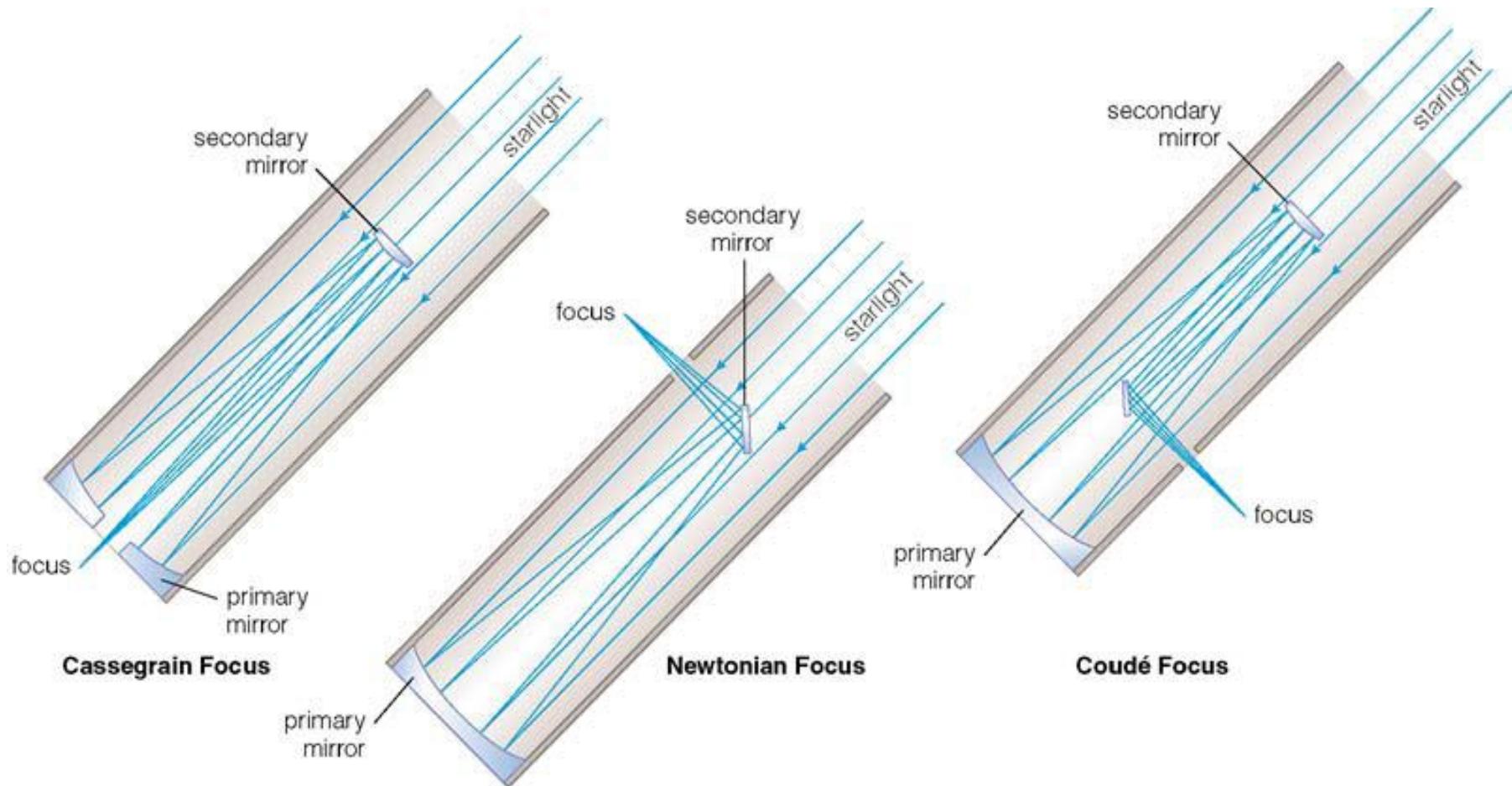
User: intguest Password: int_guest



Don't switch this PC off. Thanks.

DELL

Telescopes



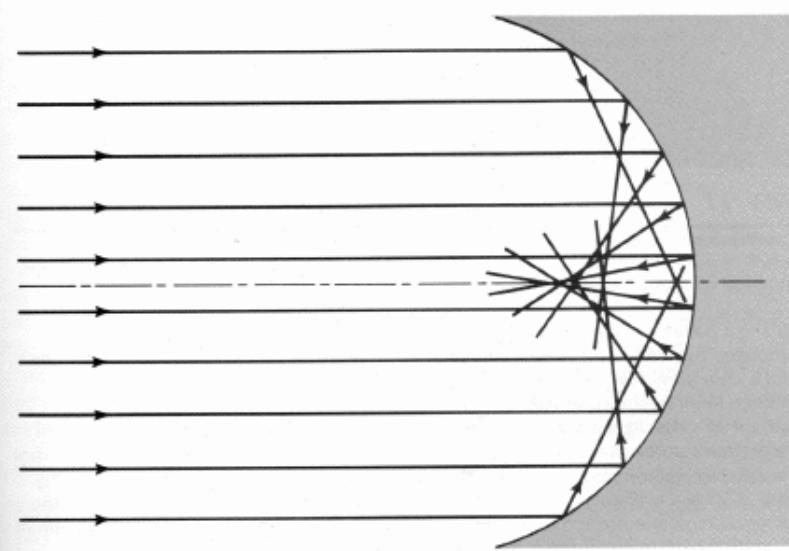
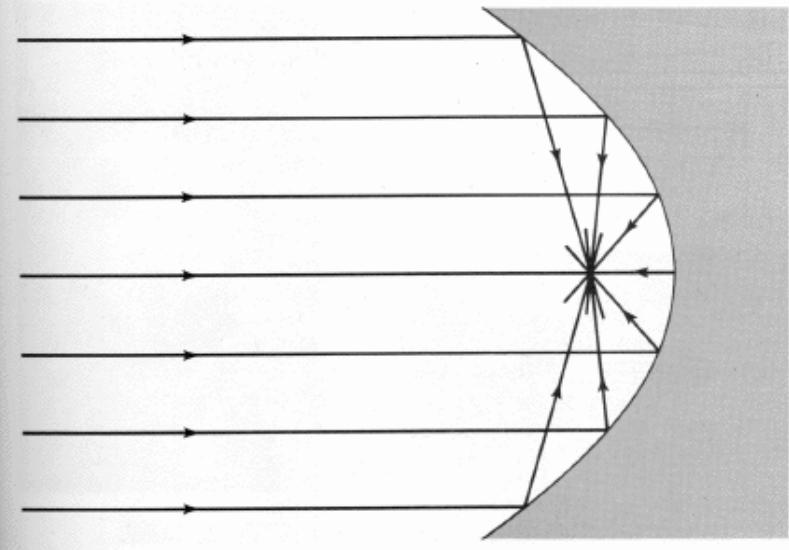


FIGURE 3.35

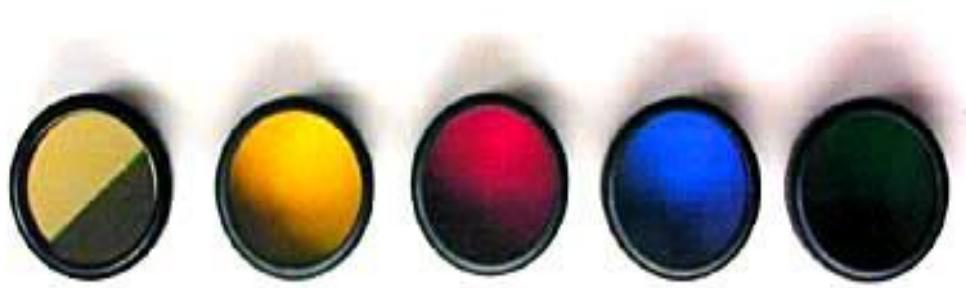
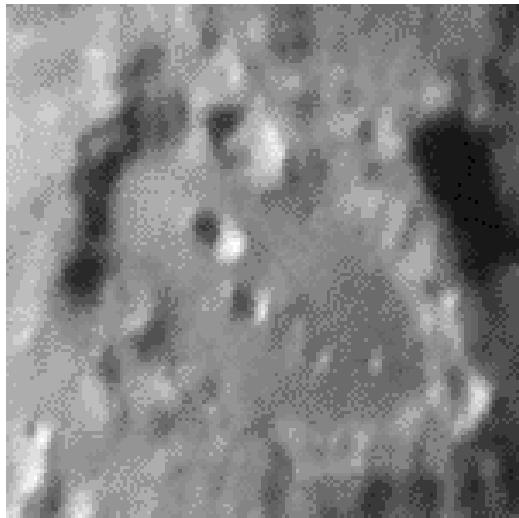
Spherical aberration in a concave mirror.



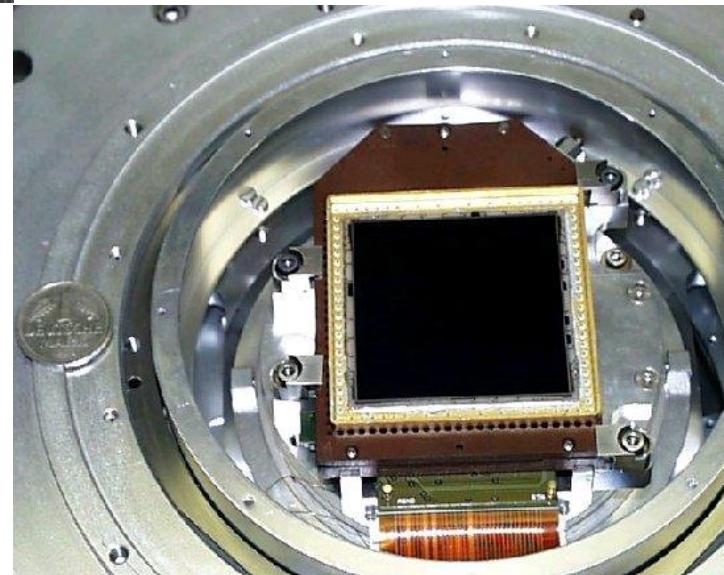
Aberrations

- Spherical •
- Coma •
- Chromatic •
- Field Curvature •
- Astigmatism •

Seeing, filters and ...



© 2000 How Stuff Works



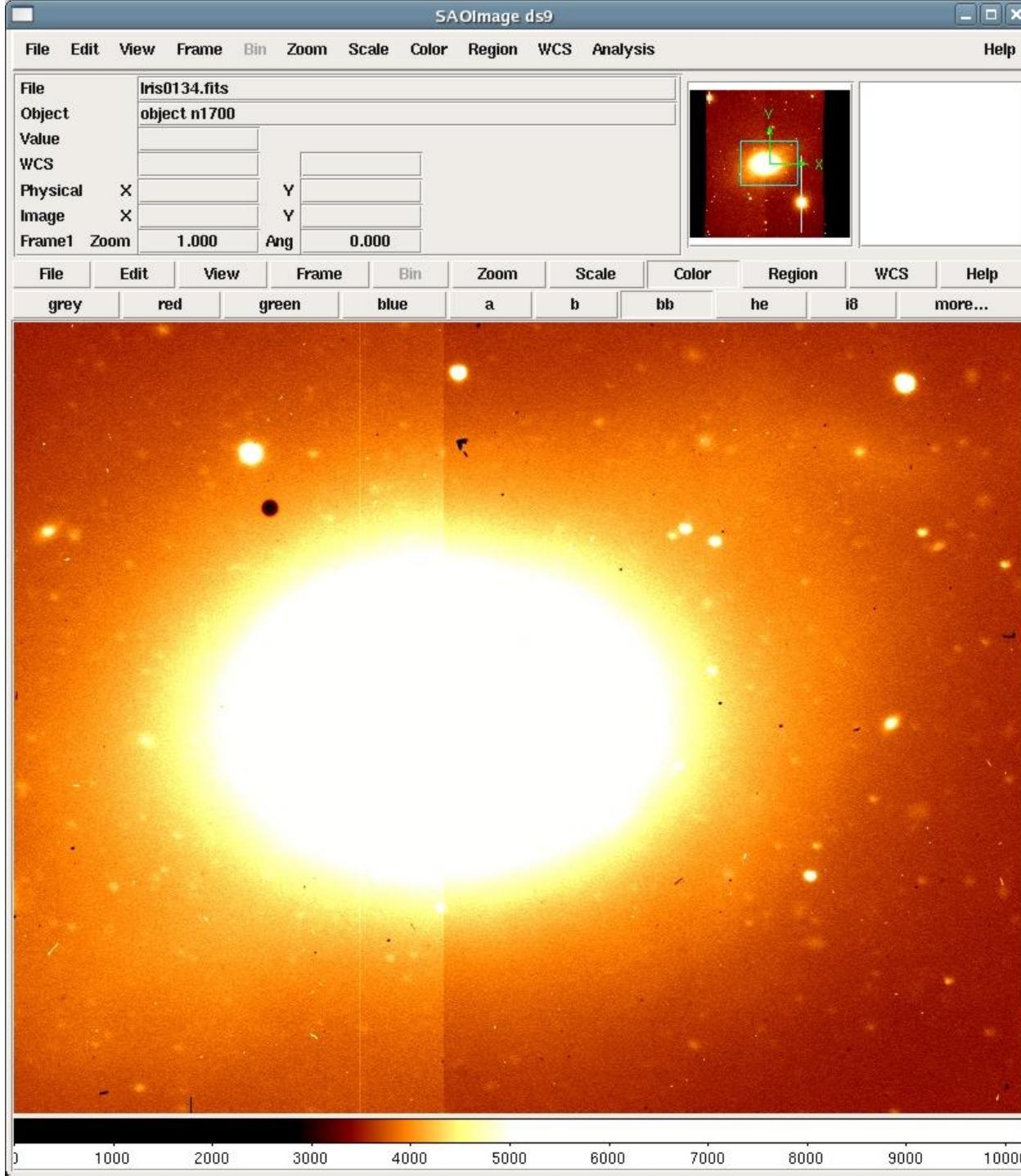
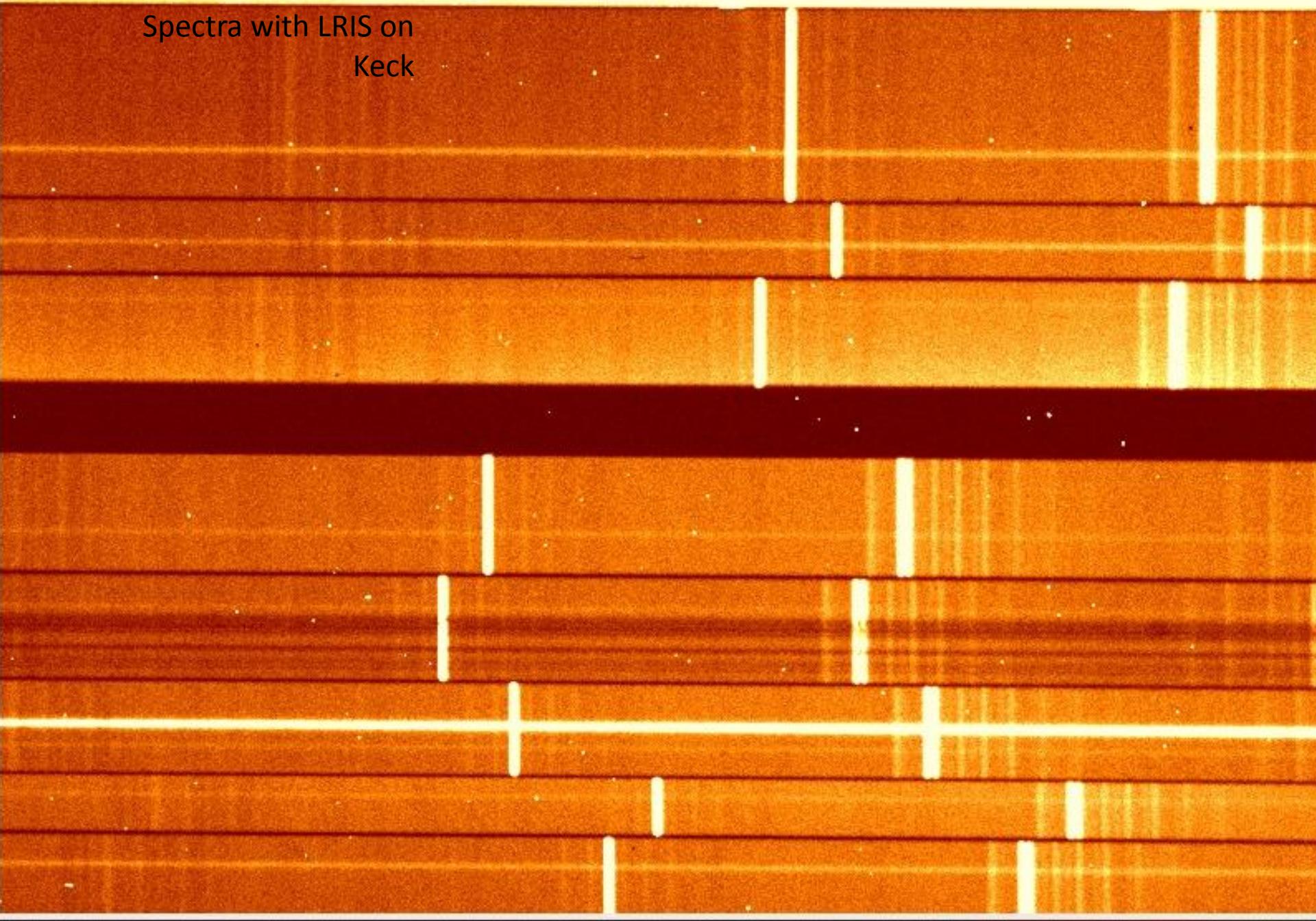


Image
Display
Software

SAODS9

Format .fits

Spectra with LRIS on
Keck



Kitt Peak National Observatory

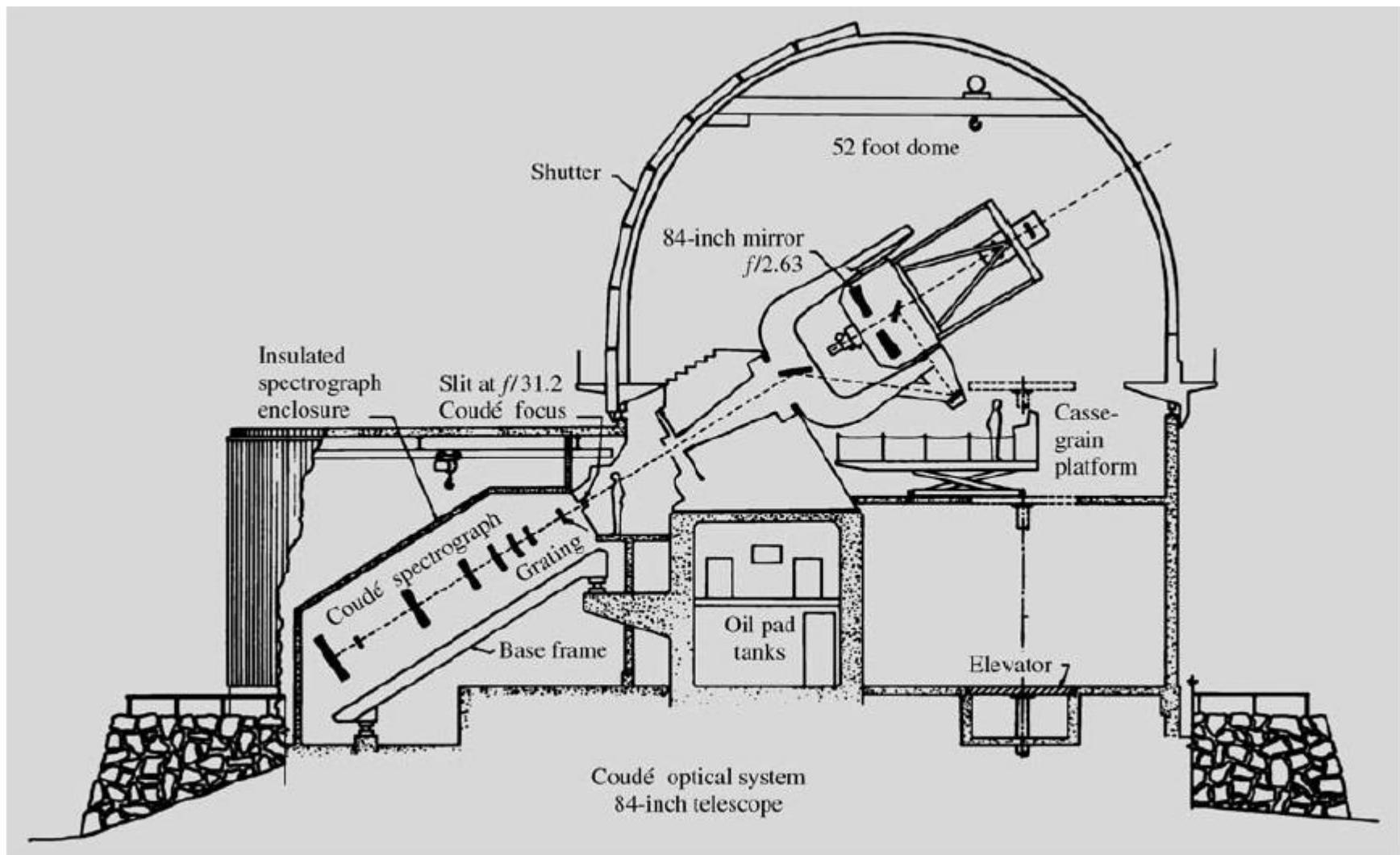
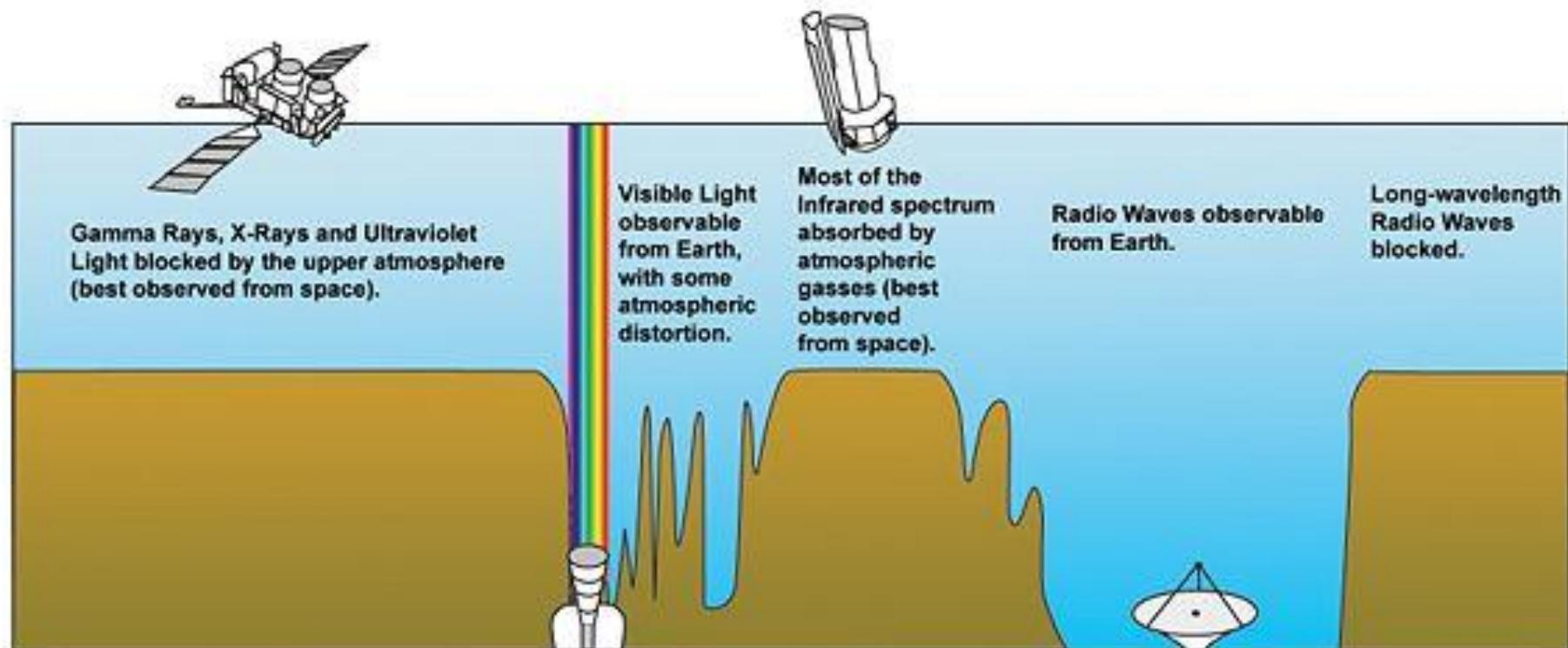
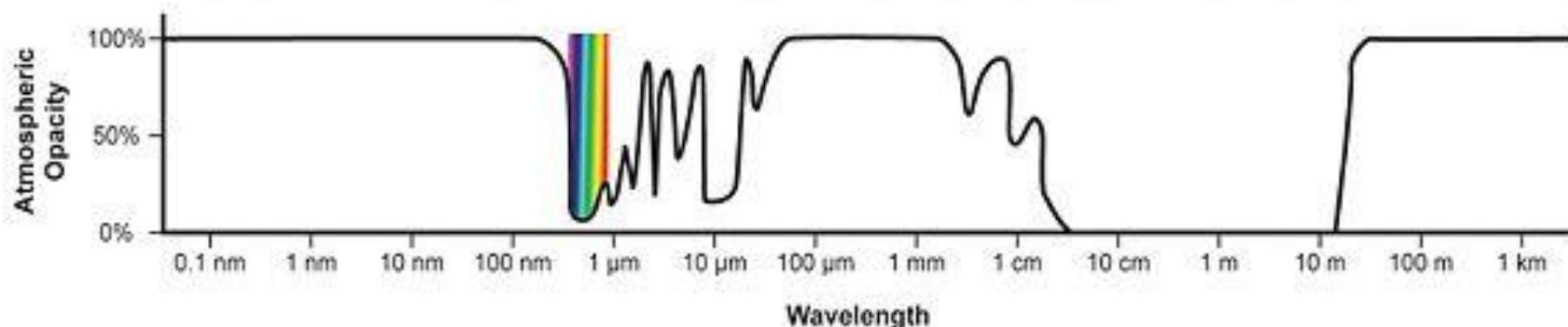


Fig. 3.13. The coudé system of the Kitt Peak 2.1 m reflector. (Drawing National Optical Astronomy Observatories, Kitt Peak National Observatory)

Atmospheric transparency



History with Telescopes

Yerkes 40-inch (about 1 m).
Largest refractor.

Edwin Hubble, the astronomer who discovered the expansion of the universe, looking though the Palomar 200 inch telescope in 1929



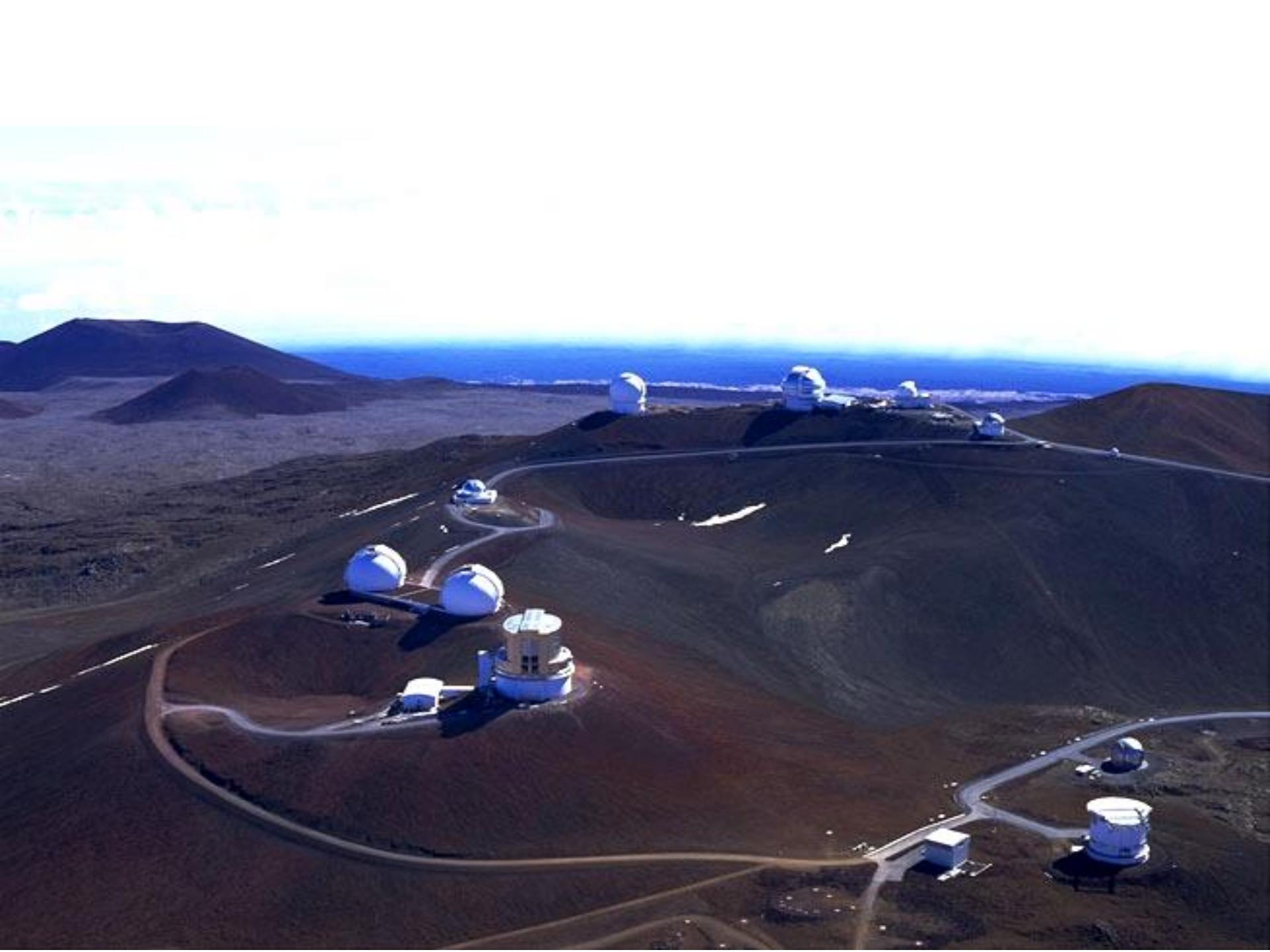
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Philosophy & Phenomenology
of Science Institute of Technology



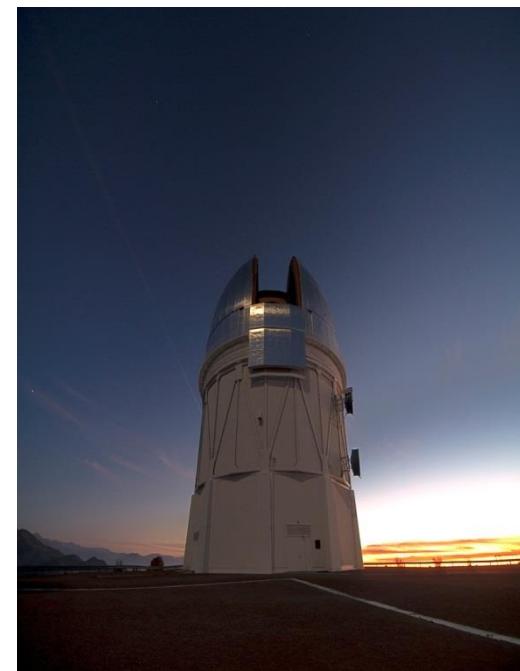
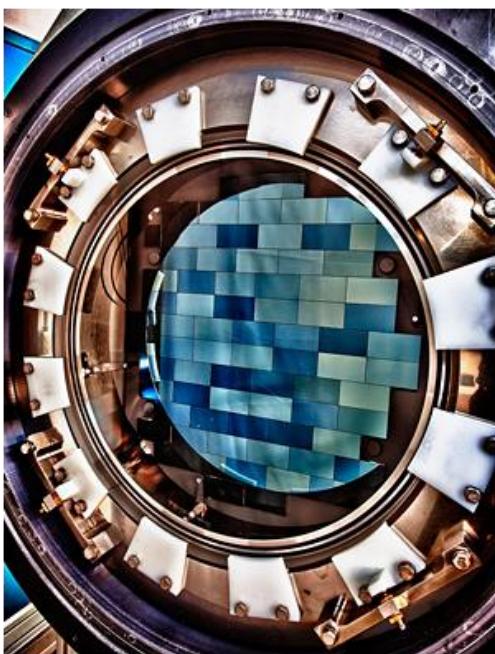
Hale 200" Telescope

Image courtesy by Dr. Thomas Furtach, IPMC/University









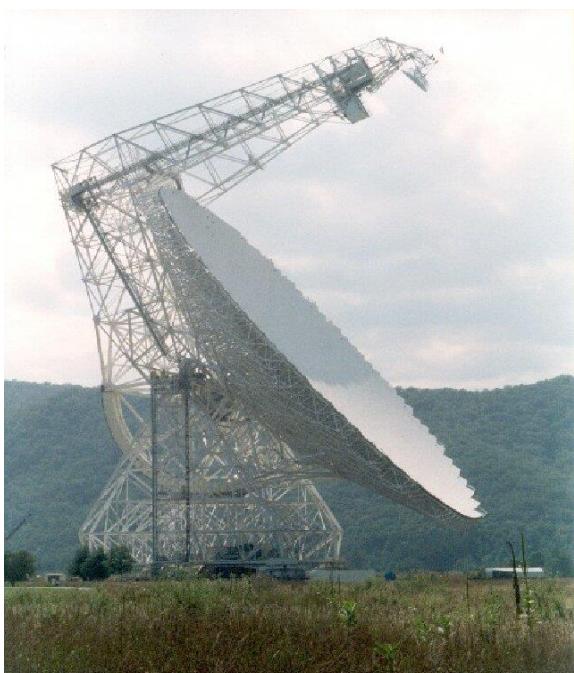
VLA



Parkes 64-m (Australia)



Effelsberg 100-m (Germany)

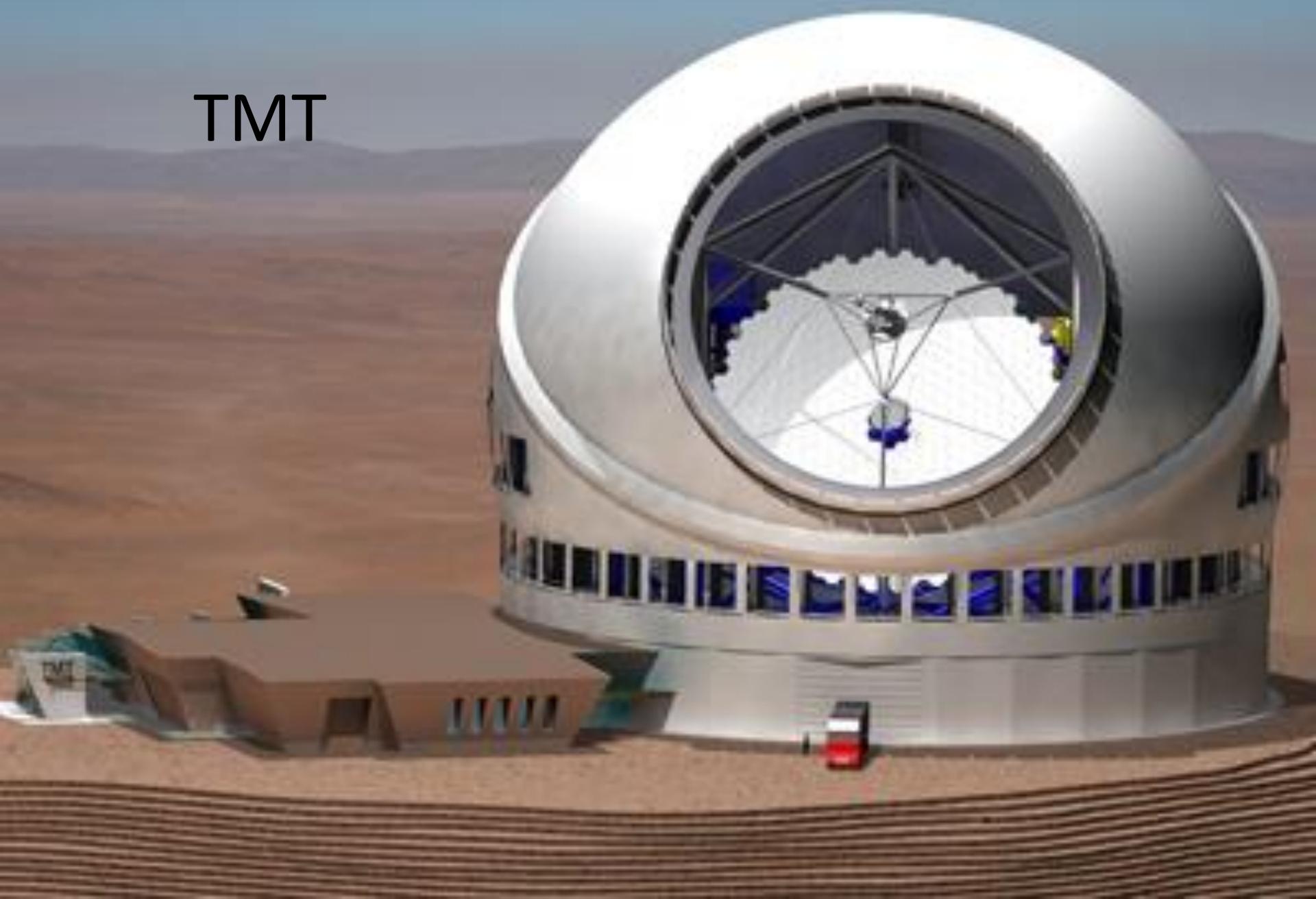


Green Bank 105-m telescope (WV)

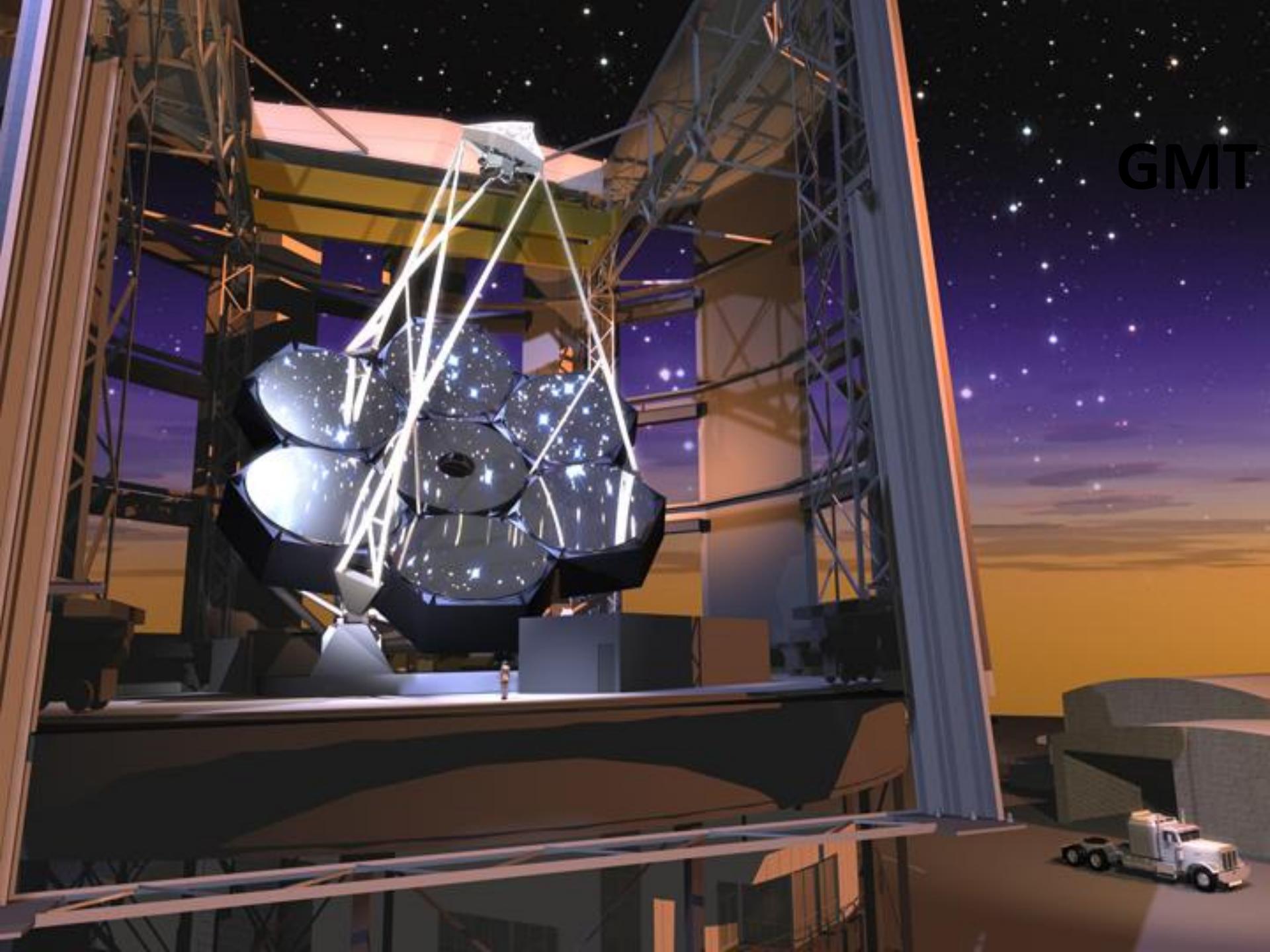


Arecibo 300-m telescope (Puerto Rico)

TMT



GMT



LSST



