

Telescope Names

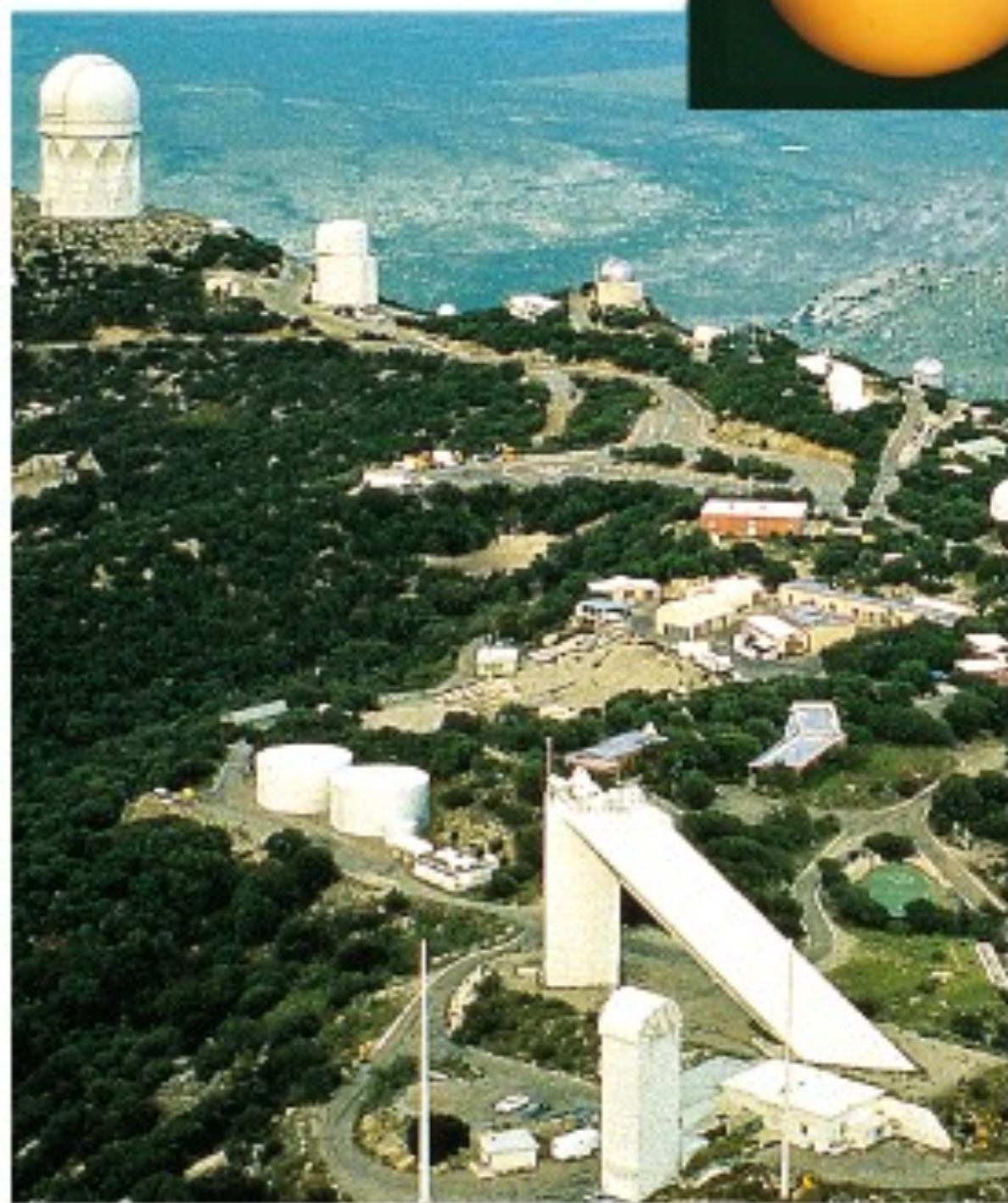
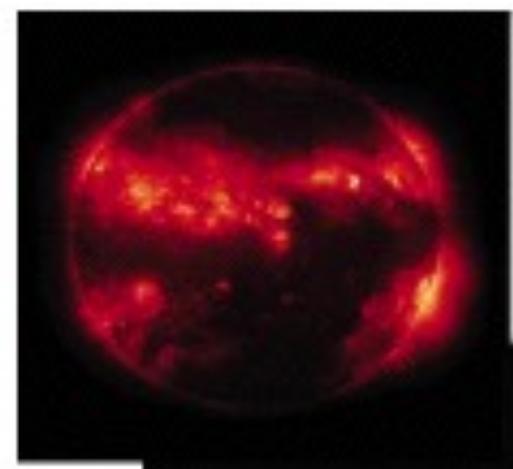
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|-------------------------------------|--|
| THE VERY LARGE TELESCOPE | <input checked="" type="checkbox"/> |
| THE EXTREMELY LARGE TELESCOPE | <input checked="" type="checkbox"/> |
| THE OVERWHELMINGLY LARGE TELESCOPE | <input checked="" type="checkbox"/> (CANCELED) |
| THE OPPRESSIVELY COLOSSAL TELESCOPE | <input type="checkbox"/> |
| THE MIND-NUMBINGLY VAST TELESCOPE | <input type="checkbox"/> |
| THE DESPAIR TELESCOPE | <input type="checkbox"/> |
| THE CATACLYSMIC TELESCOPE | <input type="checkbox"/> |
| THE TELESCOPE OF DEVASTATION | <input type="checkbox"/> |
| THE NIGHTMARE SCOPE | <input type="checkbox"/> |
| THE INFINITE TELESCOPE | <input type="checkbox"/> |
| THE FINAL TELESCOPE | <input type="checkbox"/> |

The Thirty Meter Telescope will be renamed The Flesh-Searing Eye on the Volcano.

Light and Telescopes



A Telescopes is a tool used to gather light from objects in the universe



Three main functions of a telescope

Most important!!

- **Gather More Light** - (bigger is better) *making objects appear brighter*

followed by

- to see fine detail
(called resolution)

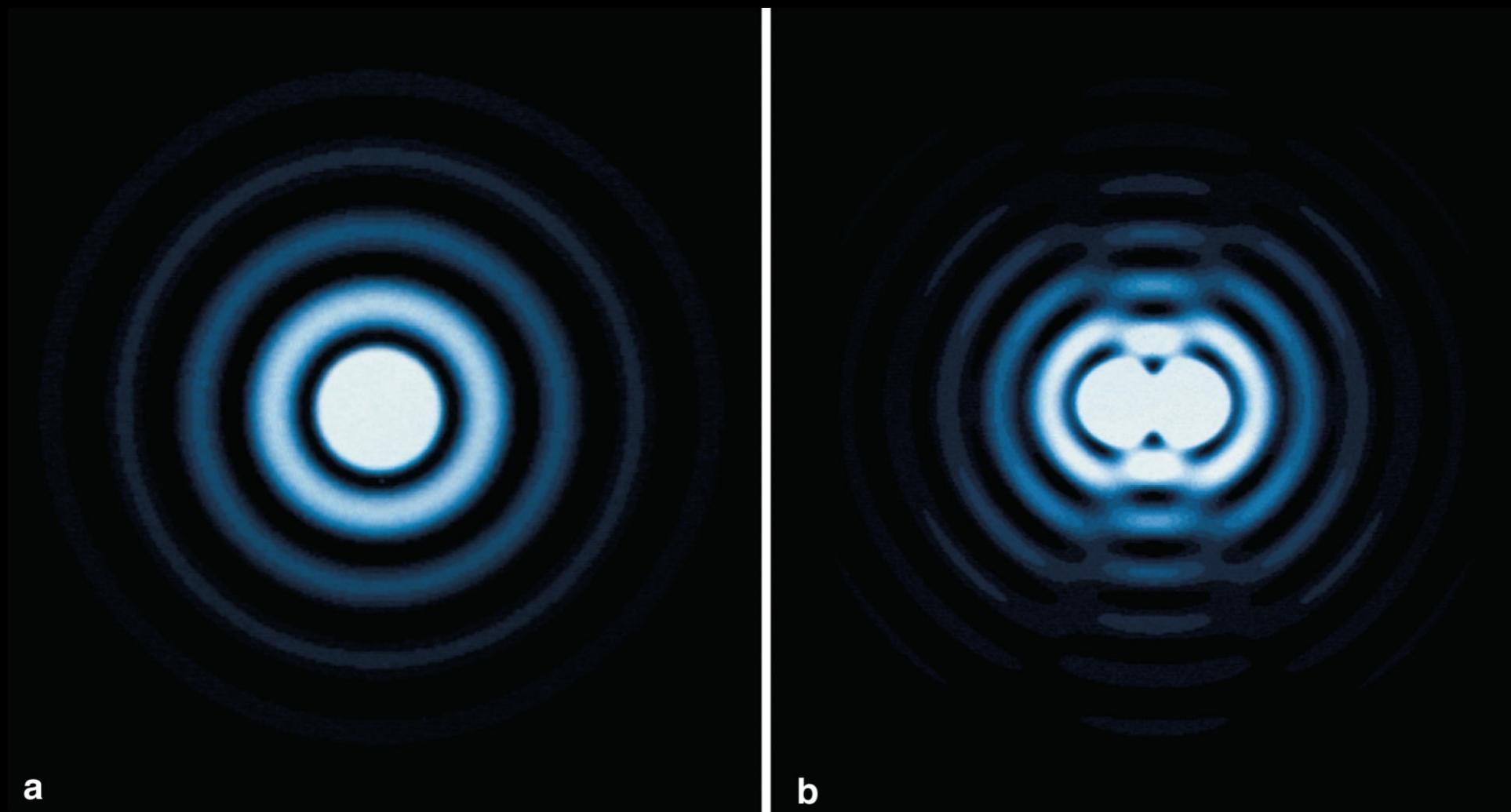
and least important,

- magnify

magnification = (objective lens focal length / eyepiece lens focal length)

Resolving power refers to the ability of the telescope to reveal fine detail.

- One consequence of the wavelike nature of light is that there is an inevitable small blurring called a **diffraction pattern**



The **bigger** the telescope, the **greater** its
resolving power at a given wavelength



Better
than



Pismis 24 in NGC 6357



Rolf Olsen 2012
10" Newtonian f/5

10 inch

ESO La Silla Observatory 2010
Danish 1.5m telescope

1.5 m

Hubble Space Telescope 2002

2.4 m



The resolving power of a telescope also depends on the wavelength of light being collected - the longer the wavelength, the worse the resolution for a given telescope size.

Ex: Radio telescopes need to be larger than optical telescopes.

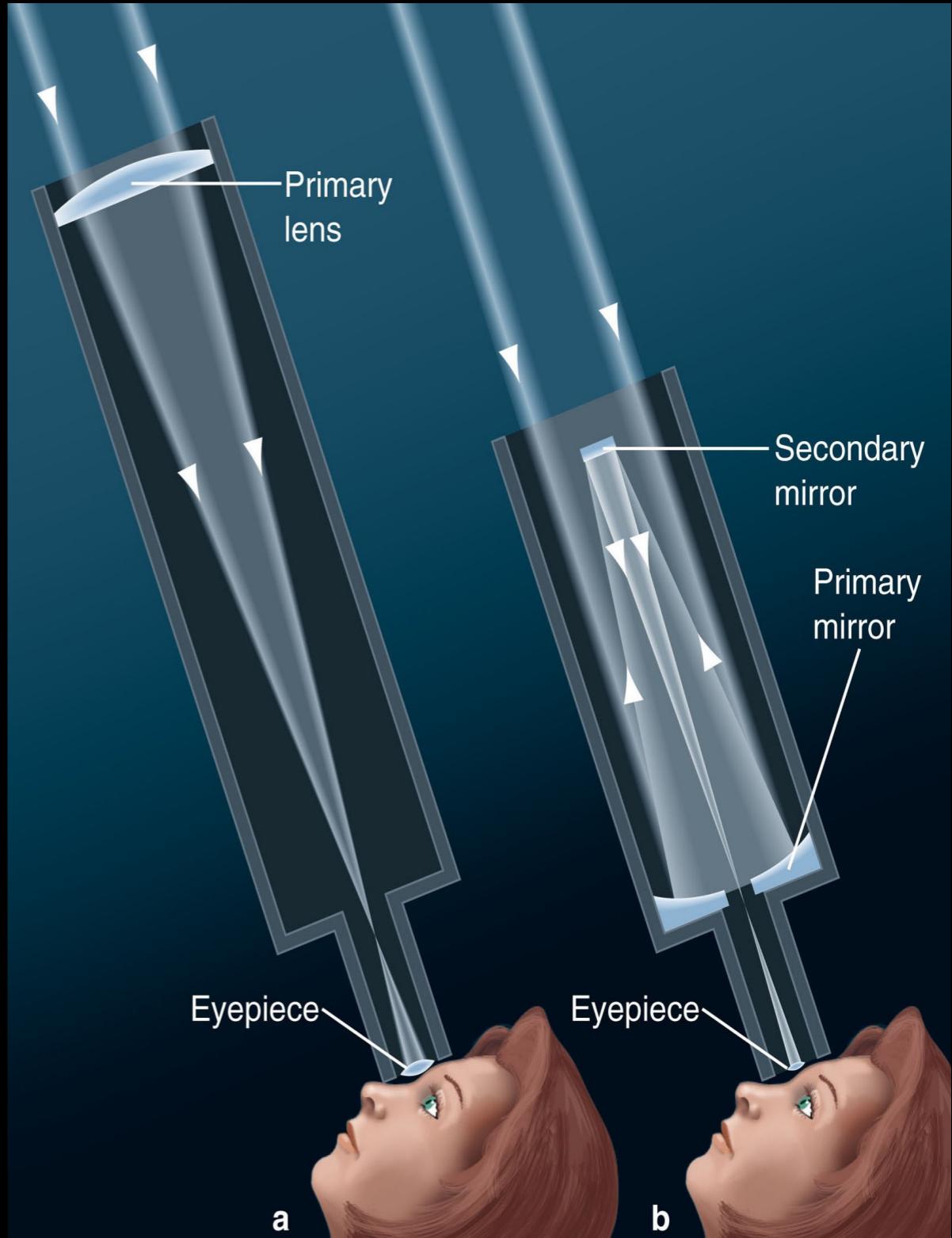


Which telescope has the best resolving power?

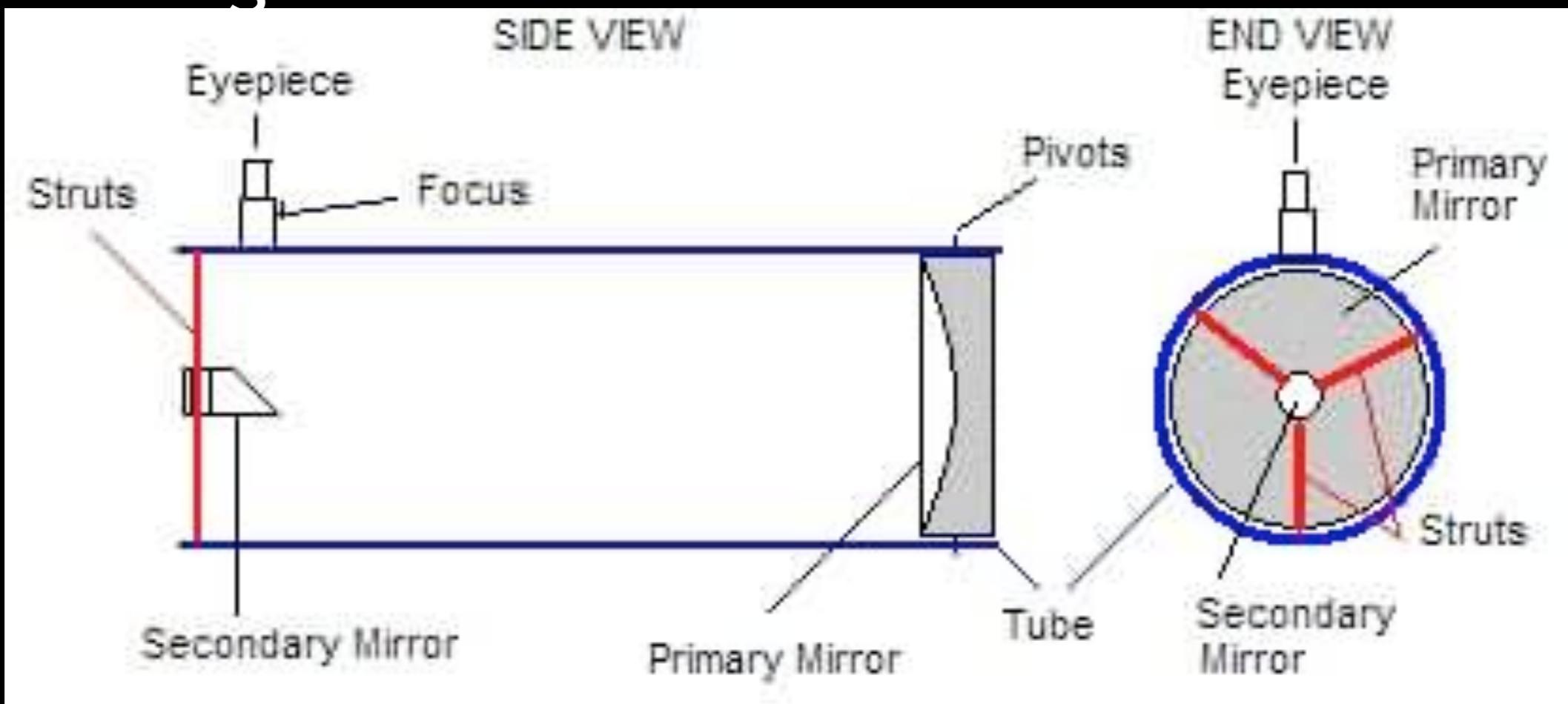
- A) A 10 meter infrared telescope
- B) A 10 meter optical telescope
- C) A 20 meter infrared telescope
- D) A 20 meter optical telescope

There are two types of astronomical telescopes.

- **Refracting telescopes** use a lens to gather and focus the light.
- **Reflecting telescopes** use a mirror.



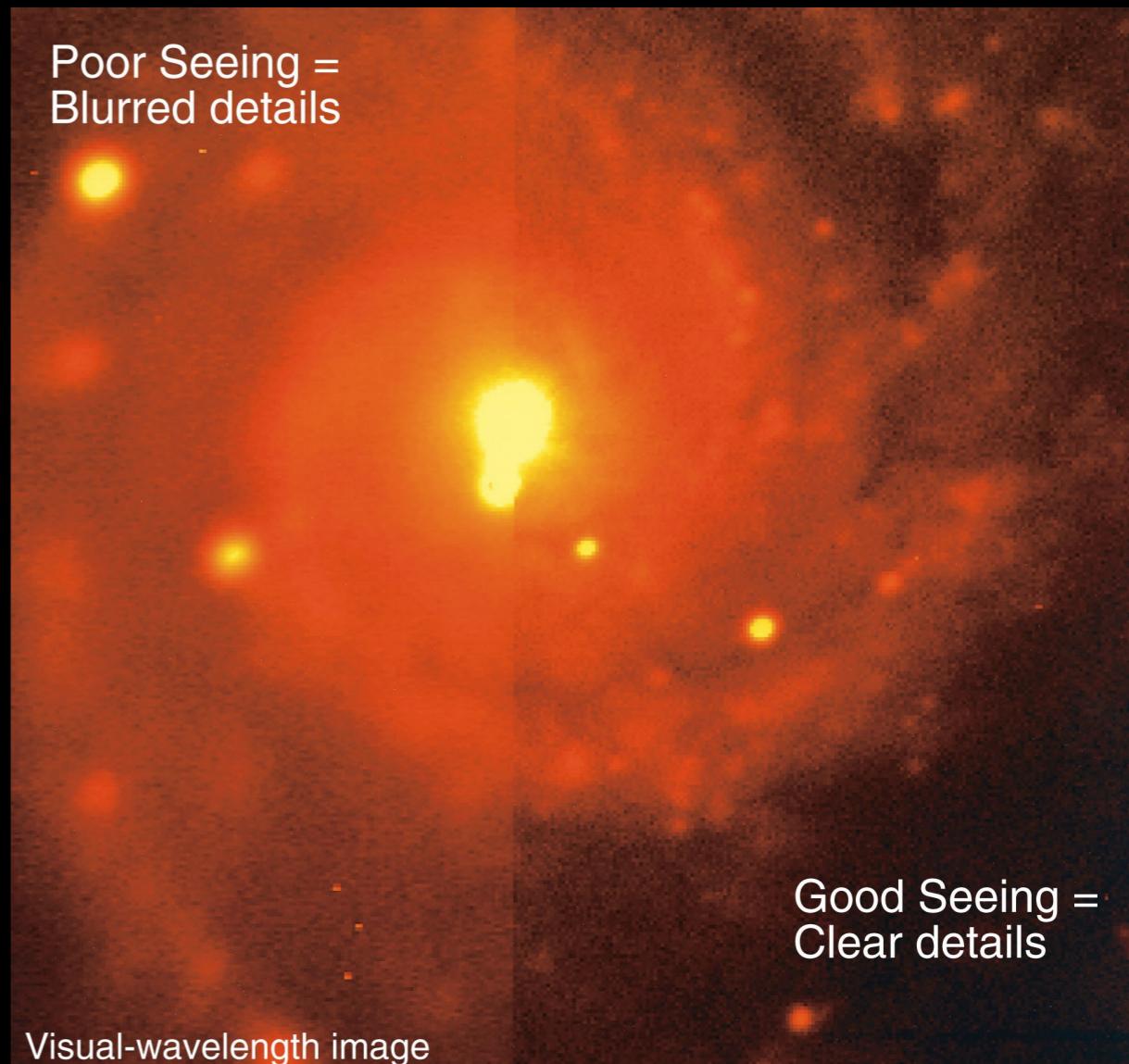
- The main lens in a refracting telescope is called the **primary lens**.
- The main mirror in a reflecting telescope is called the **primary mirror**.
- The **eyepiece** is used to magnify the image



Two other factors limit resolving power

- Optical quality
- Atmospheric conditions

When we look through a telescope, we look through turbulence in Earth's atmosphere, which makes images dance and blur—a condition we call **seeing**.

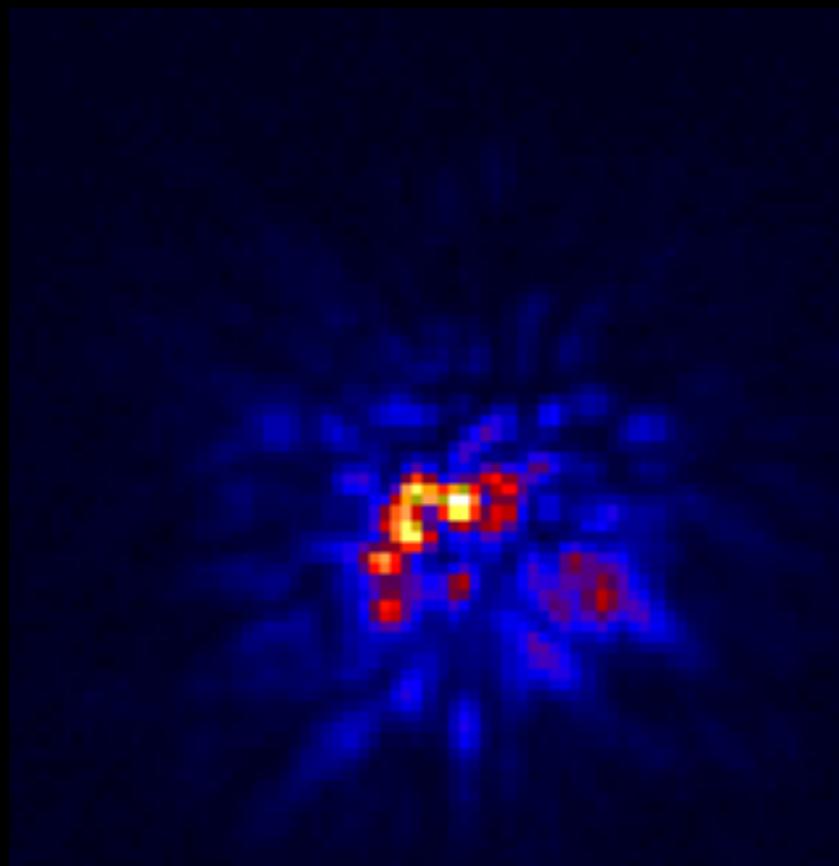


Example: Heat waves on the road ...



Earth's atmosphere makes stars twinkle

- A star near the horizon—where you look through more air—will twinkle more than a star overhead.
- A telescope performs best on a high mountaintop—where the air is thin and steady.

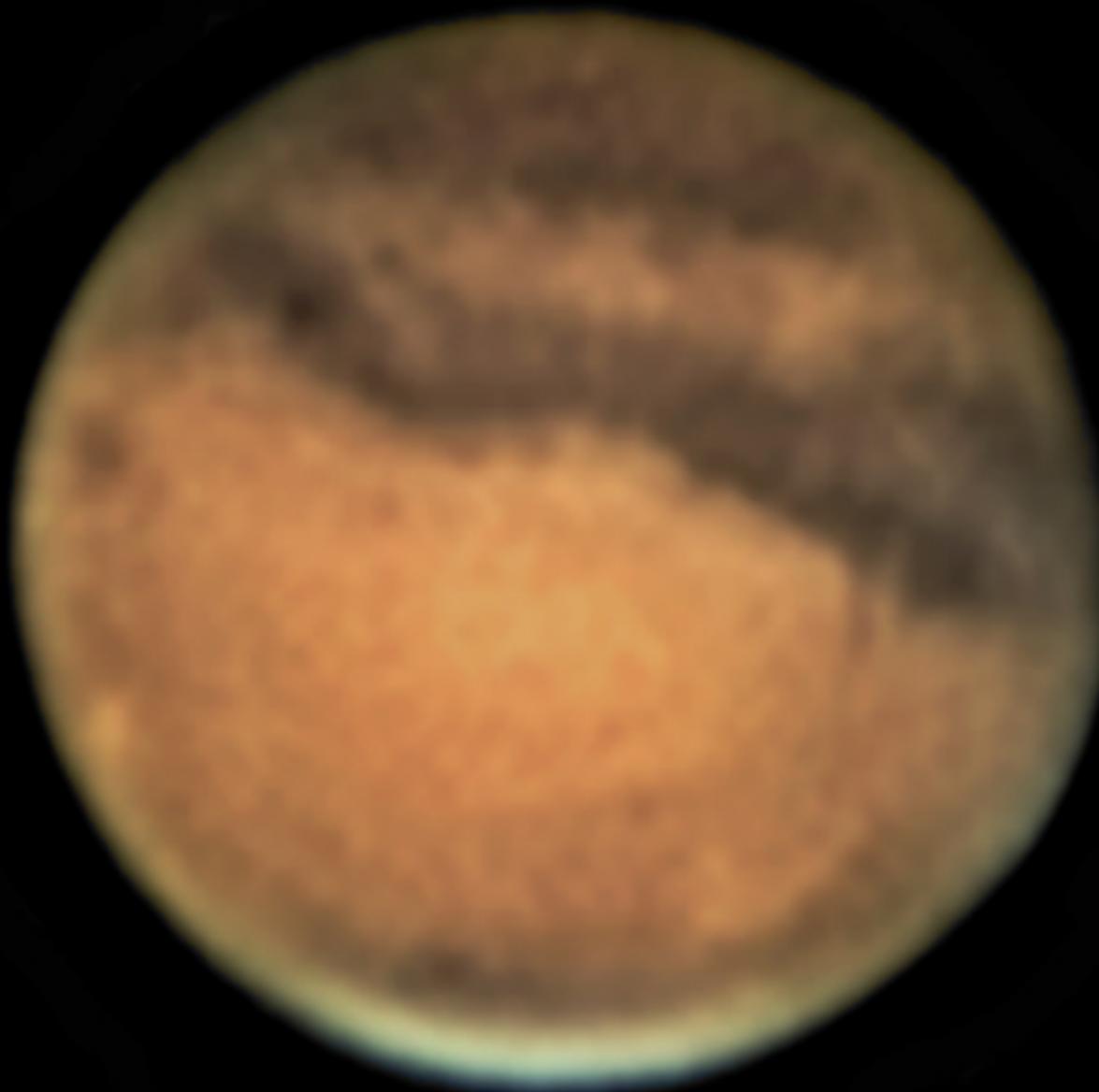


HOME

MARS

NOVEMBER 7, 2005

HUBBLE



MEADE LX200GPS 10in., CGE MOUNT, TOUCAM 840 PRO

SETTINGS: BRIGHT.=40%, GAMA=0%, SATUR.=30%, SHUTTER=1/25fps

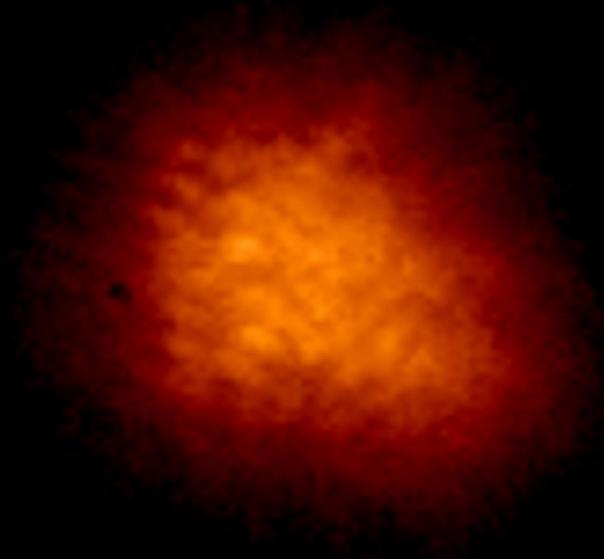
FRAMES=10fps, BAARDER IR-UV FILTER, MEADE #8 YELLOW FILTER

1000 FRAME AVIS. LOCATION: LAT.+18.41, LONG.-67.14, AGUADILLA, PUERTO RICO

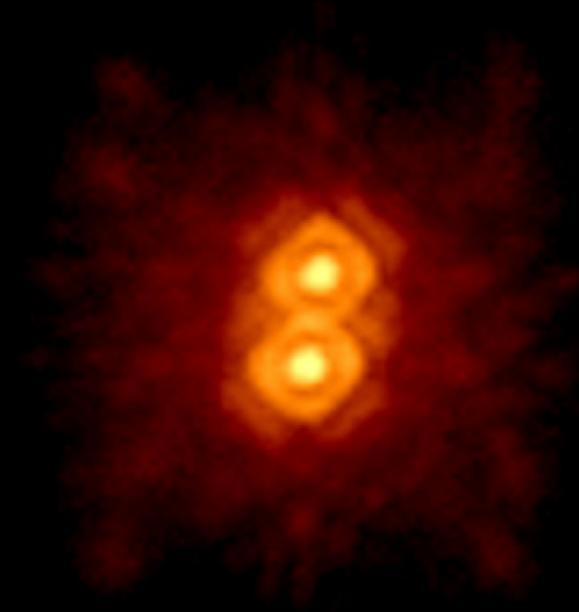
Taken By: EFRAIN MORALES {jaicoa@choicecable.net}

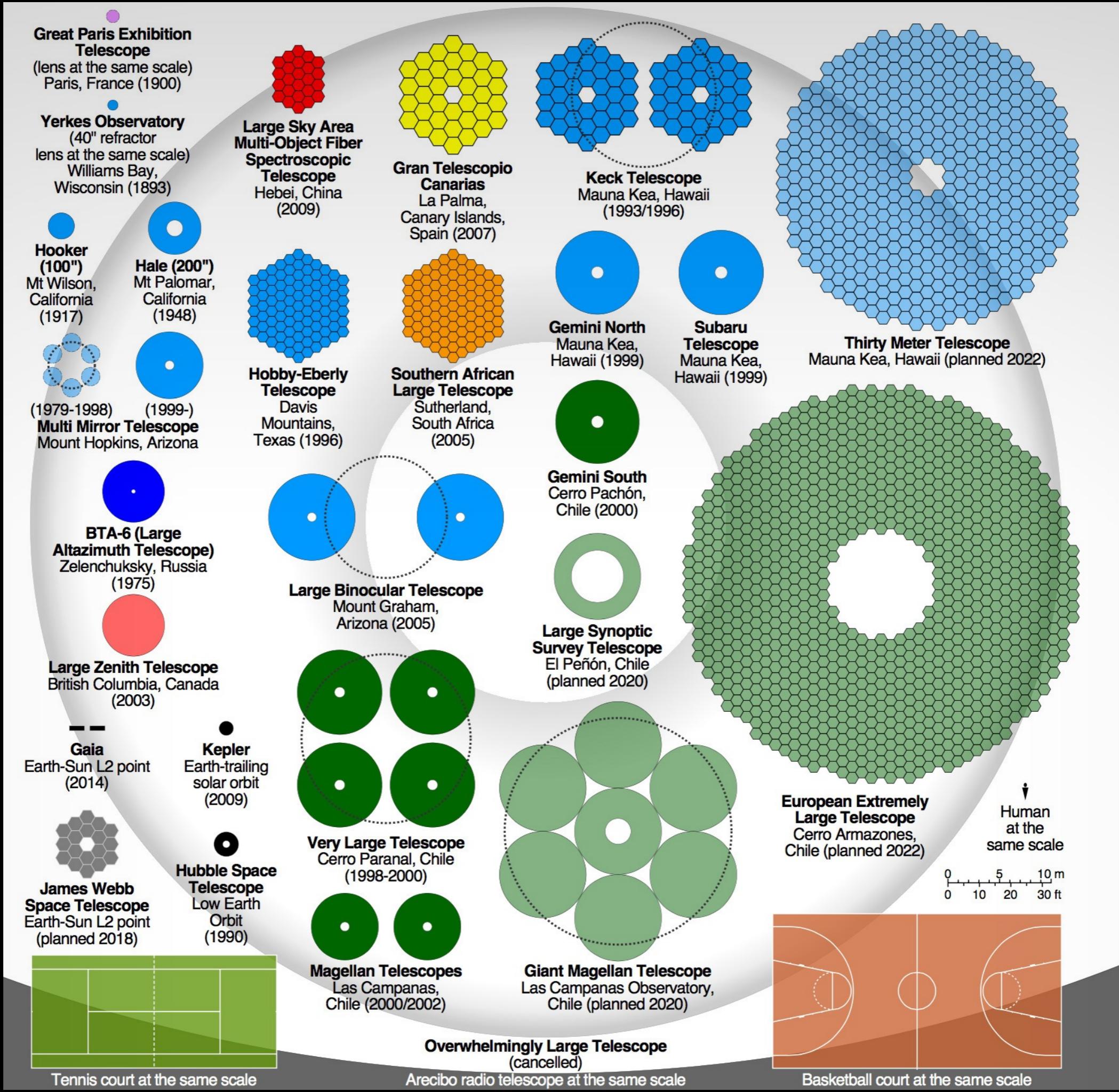
- The effect of atmospheric seeing can be removed by a technique called **adaptive optics**.
 - Rapid computer calculations adjust the telescope optics and partly compensate for seeing distortions.

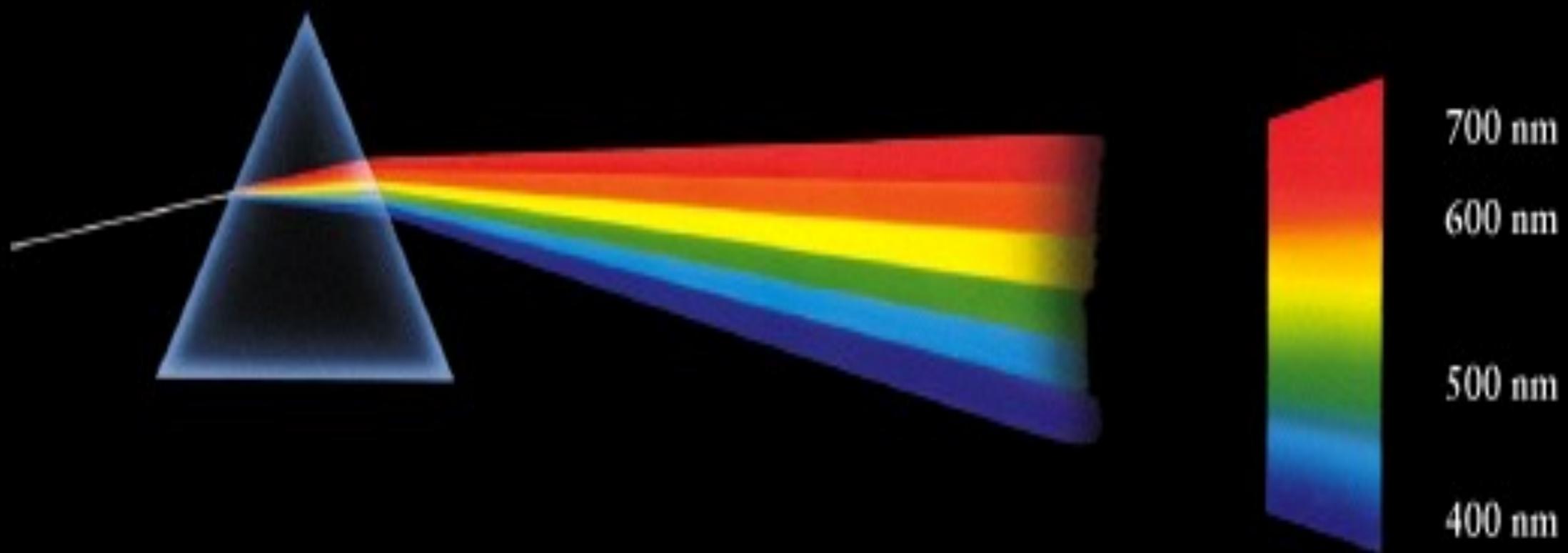
Before

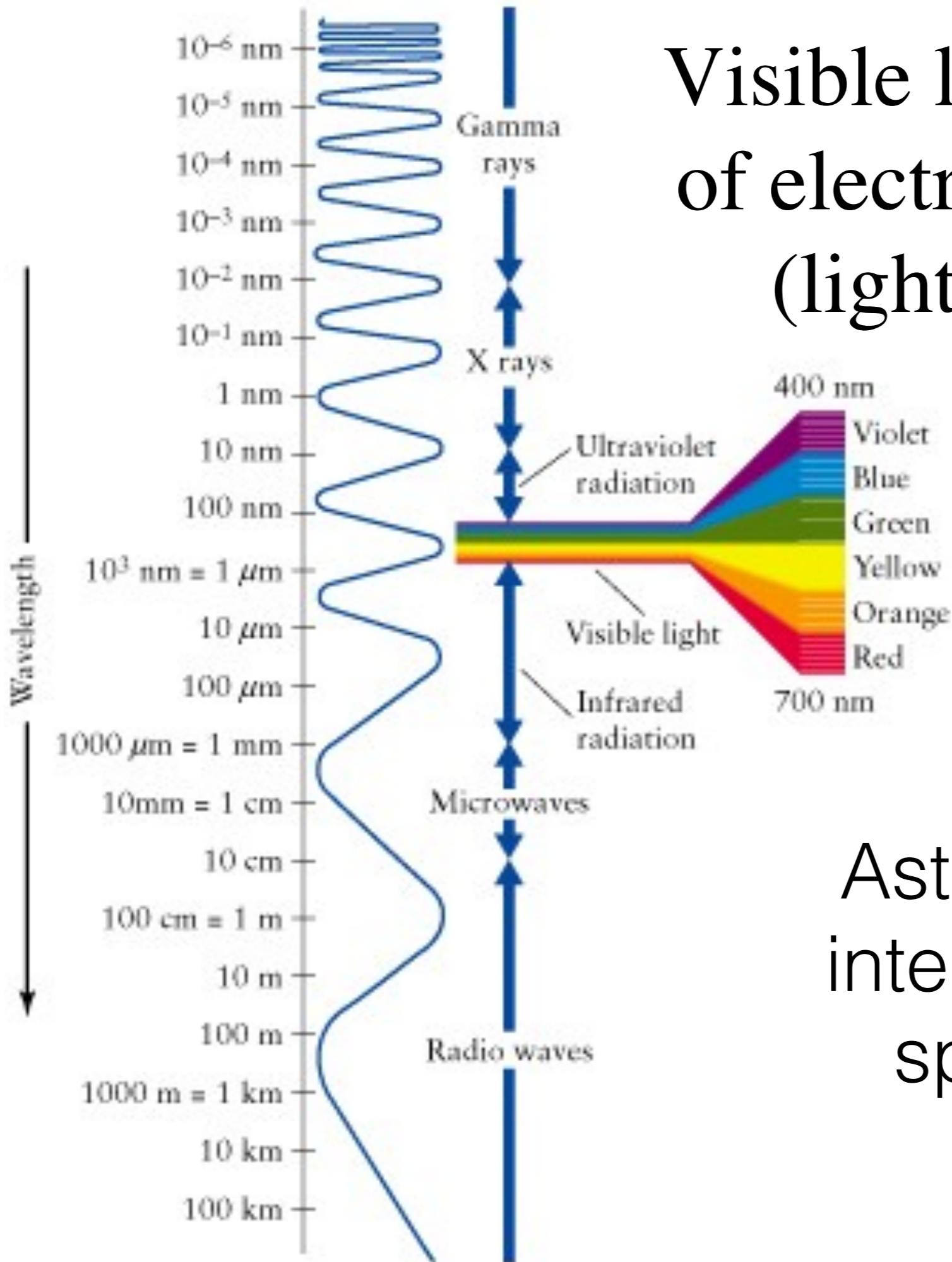


After





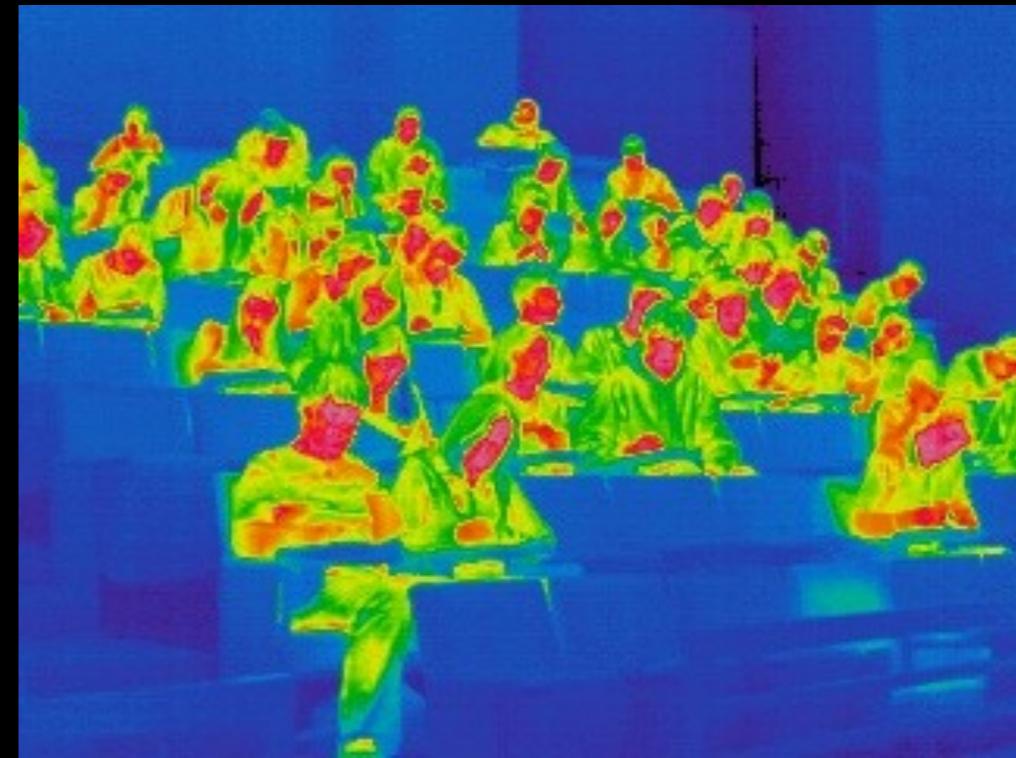
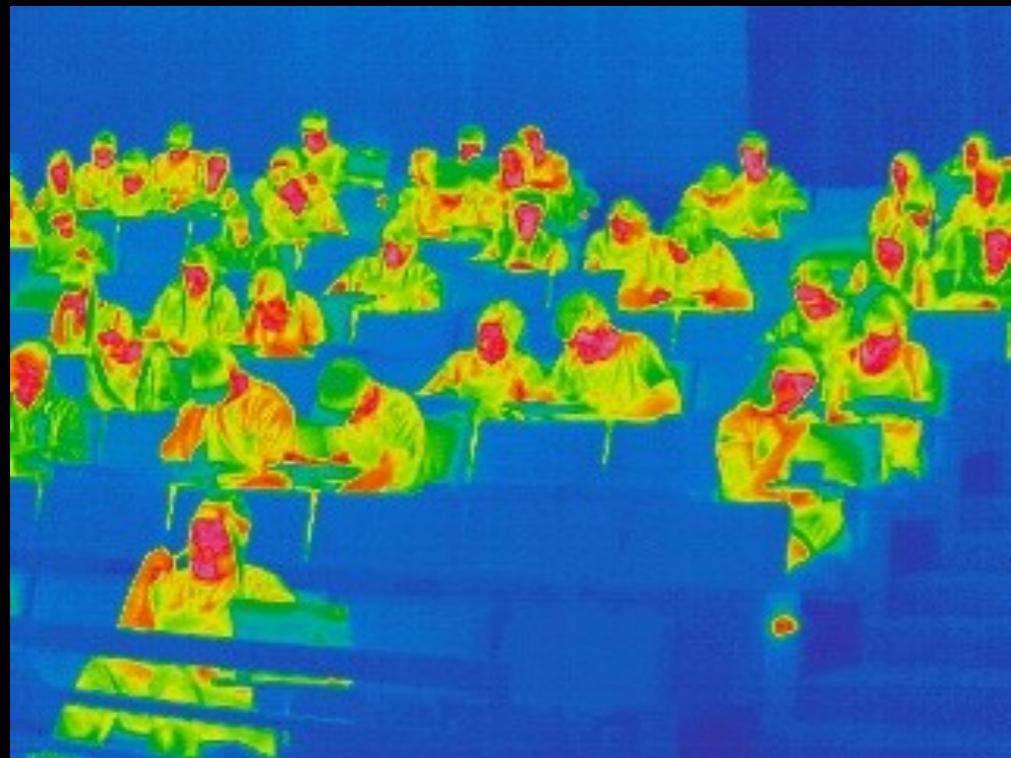




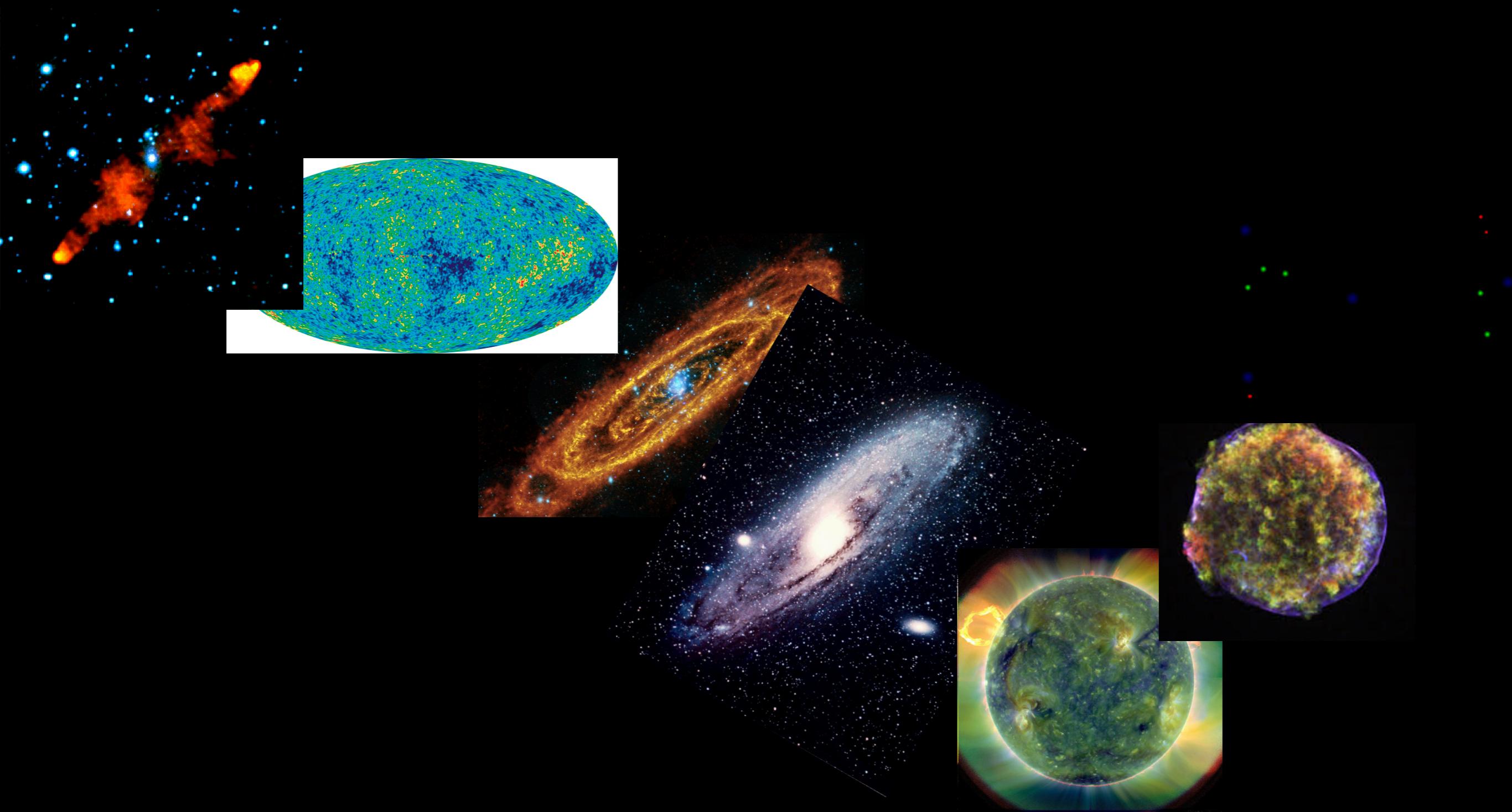
Visible light is only one type
of electromagnetic radiation
(light) emitted by stars

Astronomers are truly
interested in the entire
spectrum of Light!

Consider a Class as Seen in Different Wavelengths of Light!



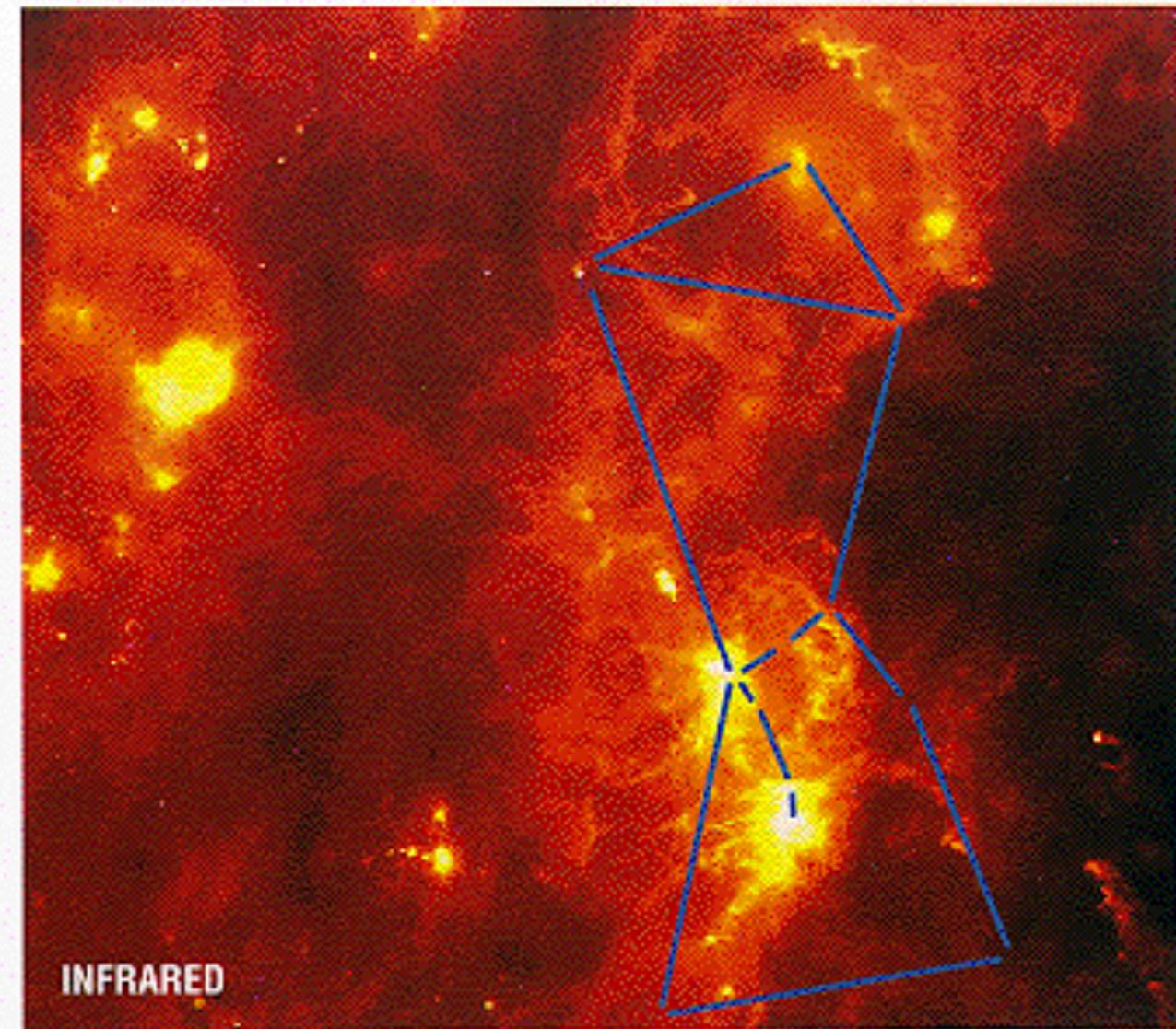
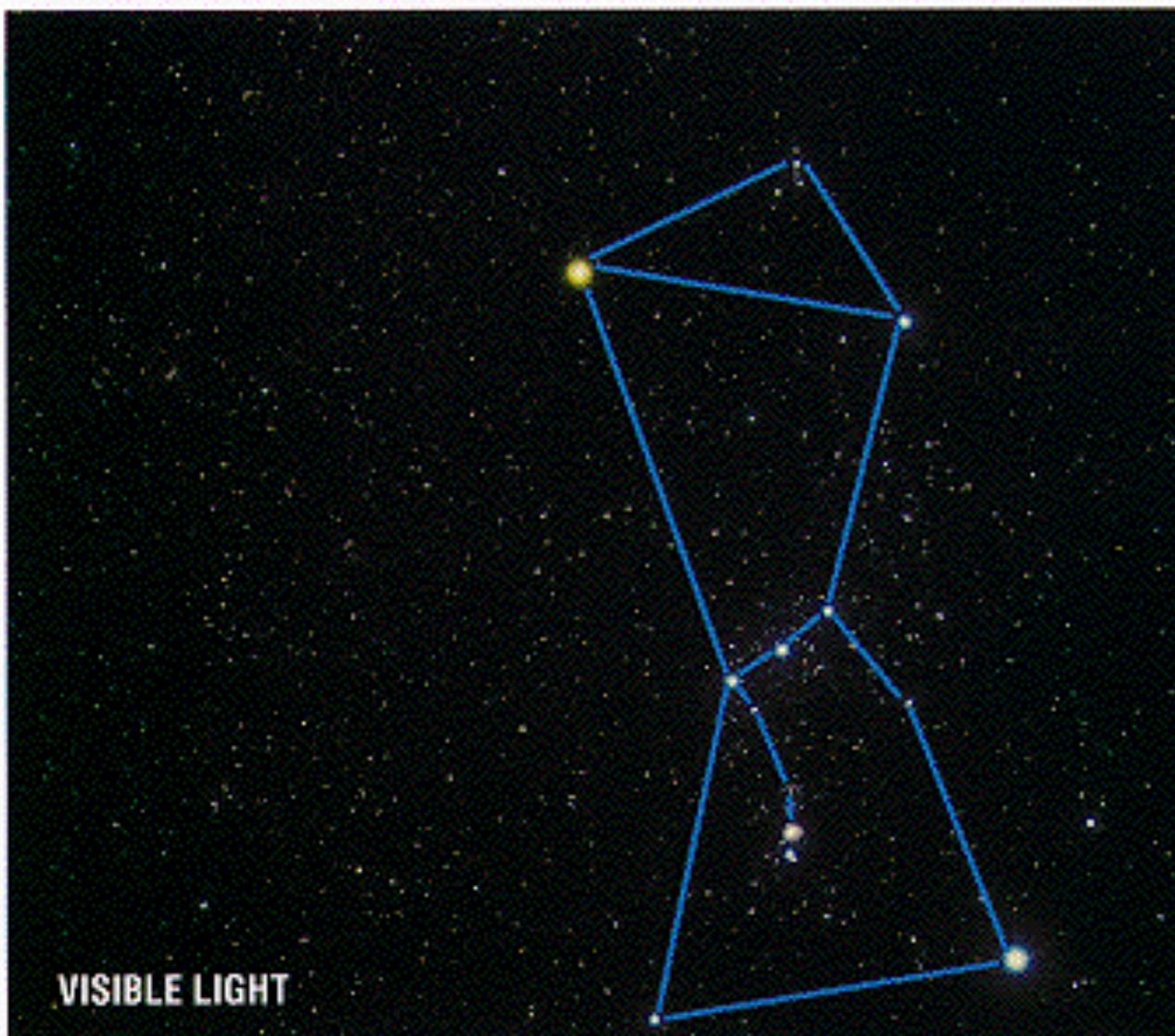
Telescopes collect electromagnetic radiation over the entire spectrum! Radio -> Gamma Rays!





National Aeronautics and
Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Infrared Astronomy: More than Our Eyes Can See



Observations at other wavelengths are revealing previously invisible sights

UV



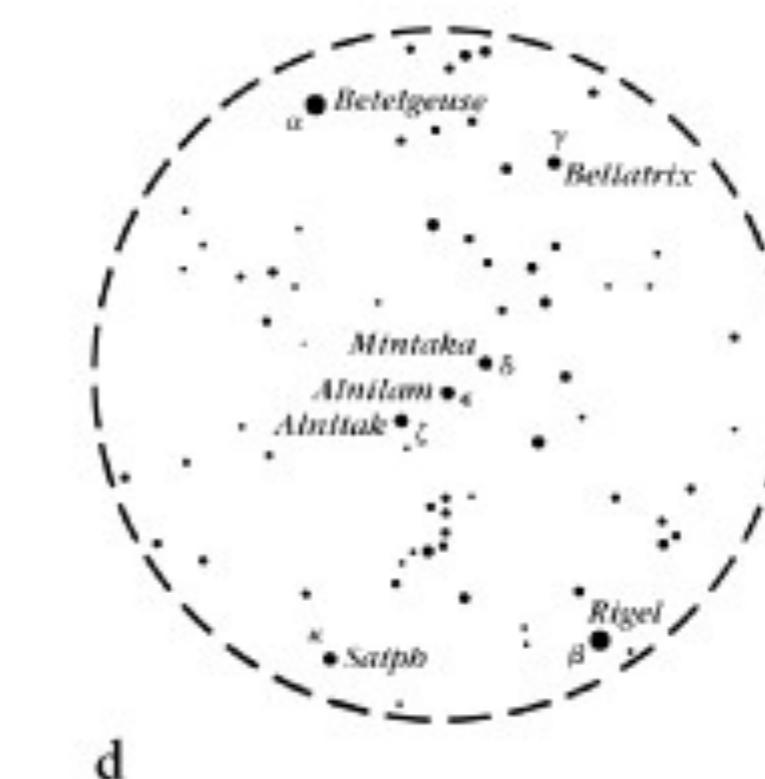
a

b

Ordinary
visible



c

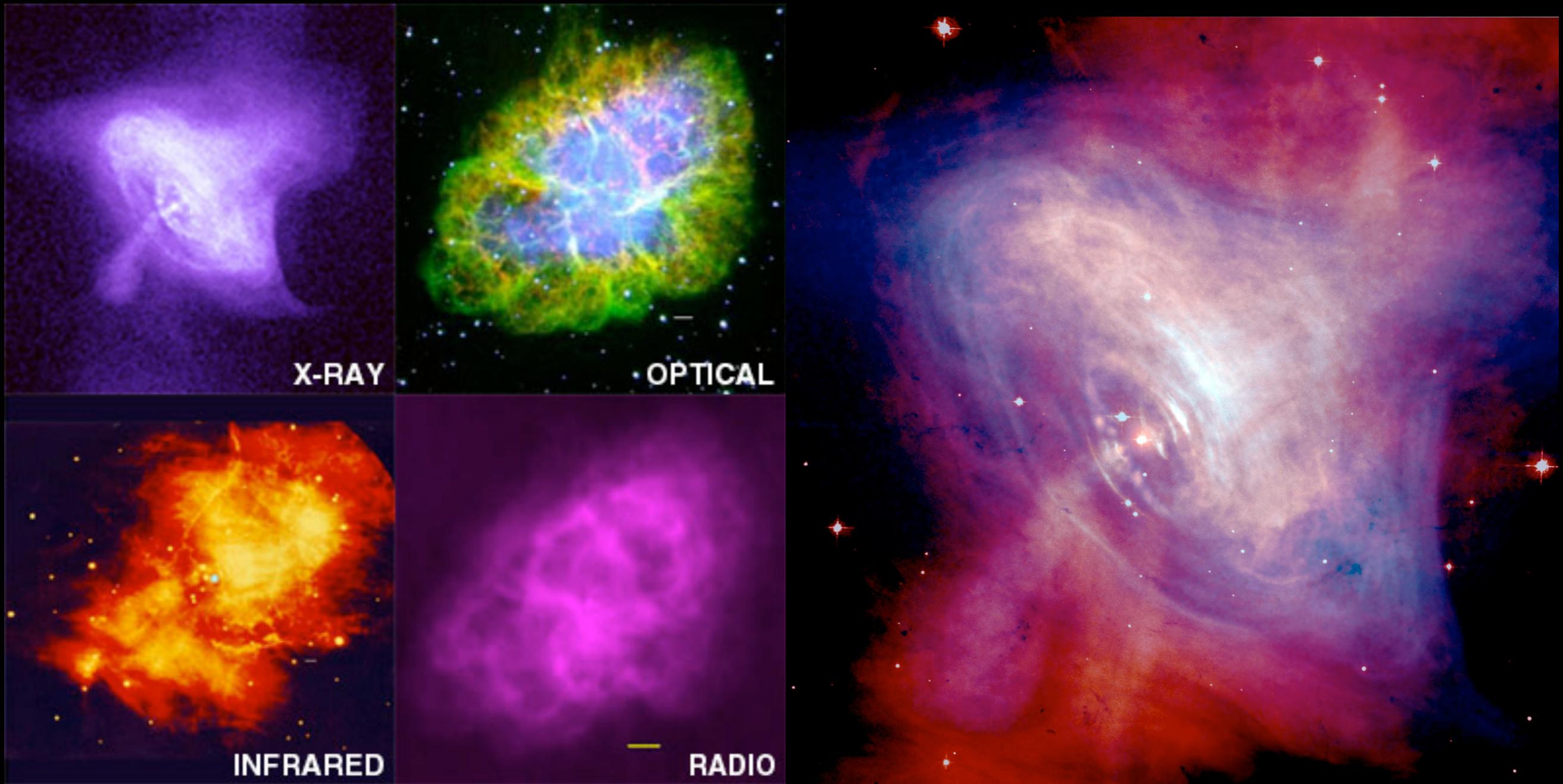


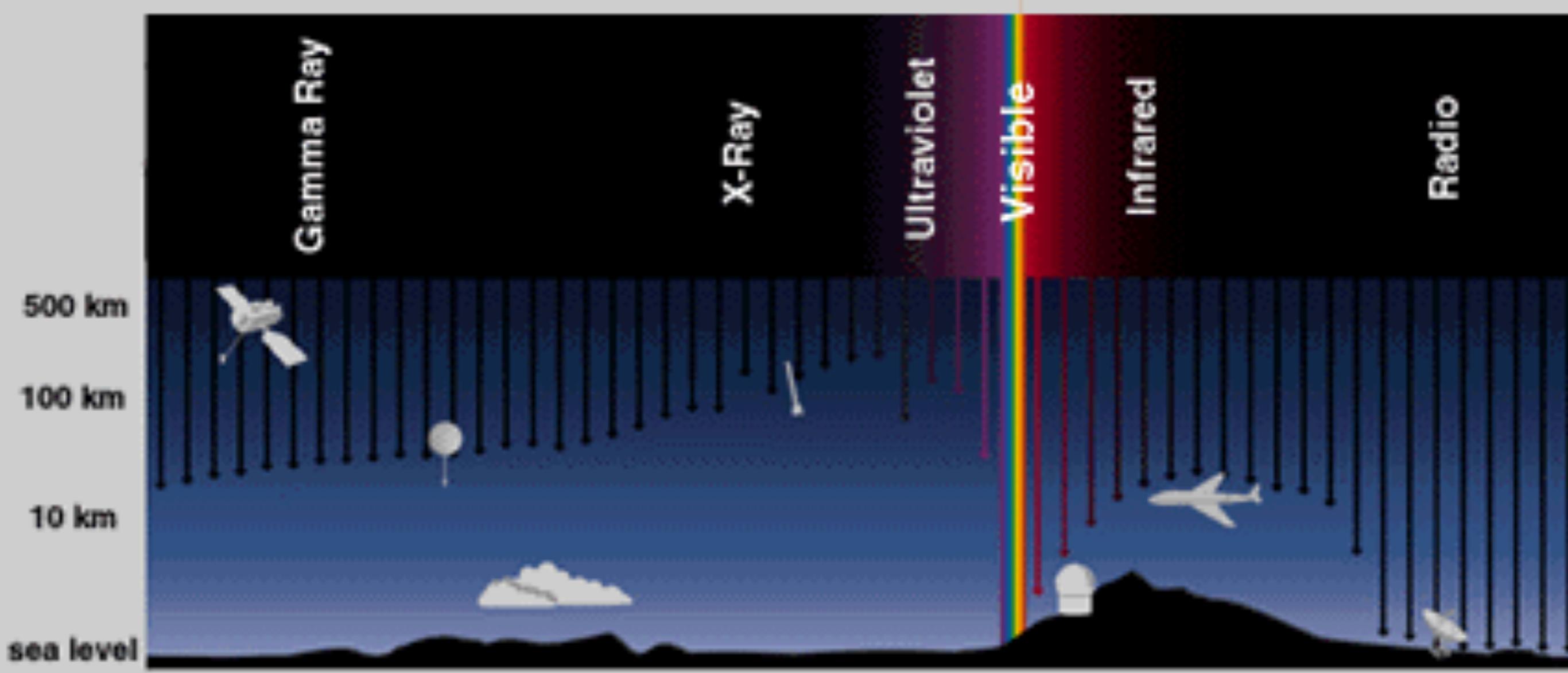
d

infrared

Map of
Orion
region

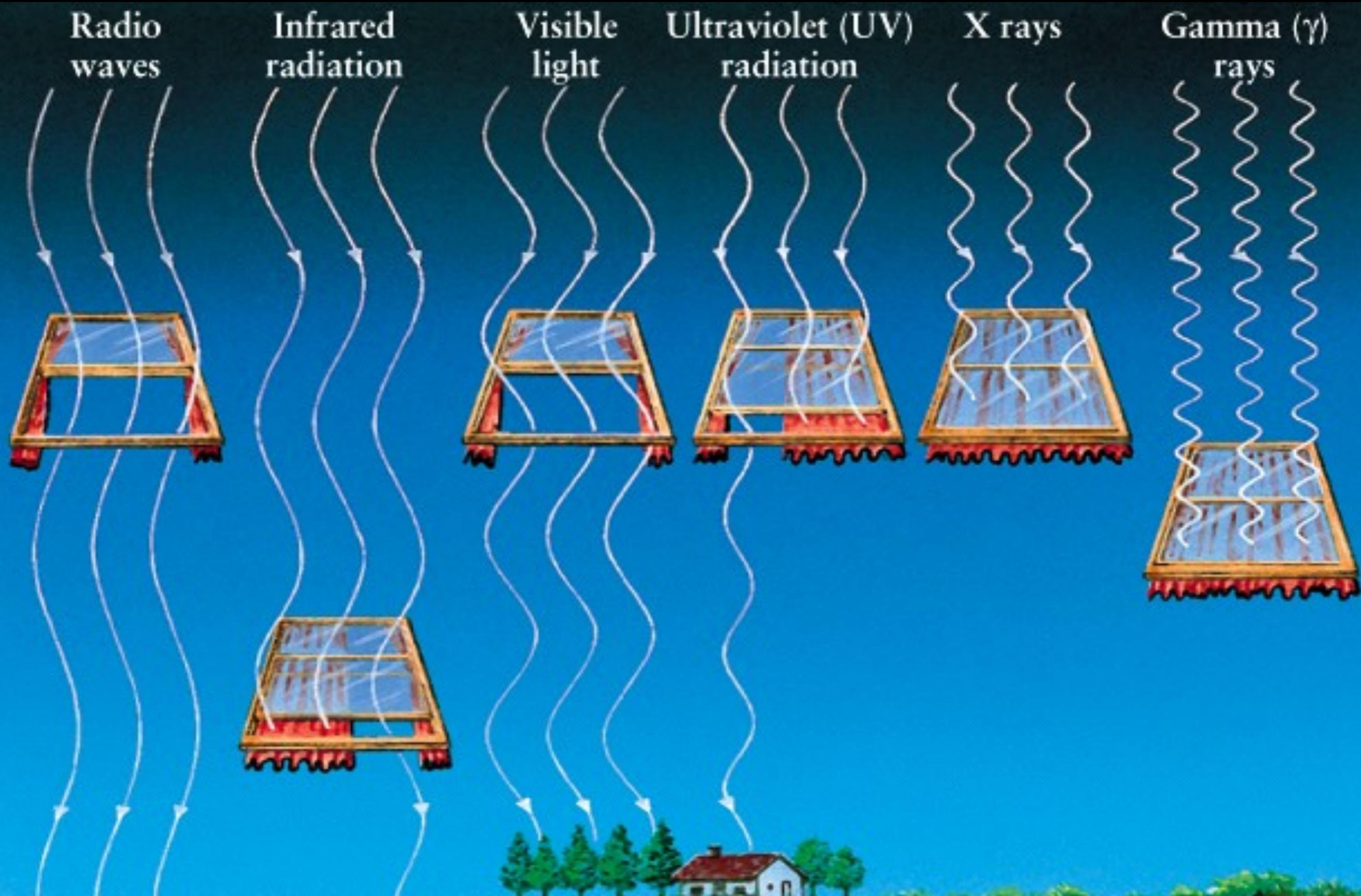
We can combine images from different telescopes





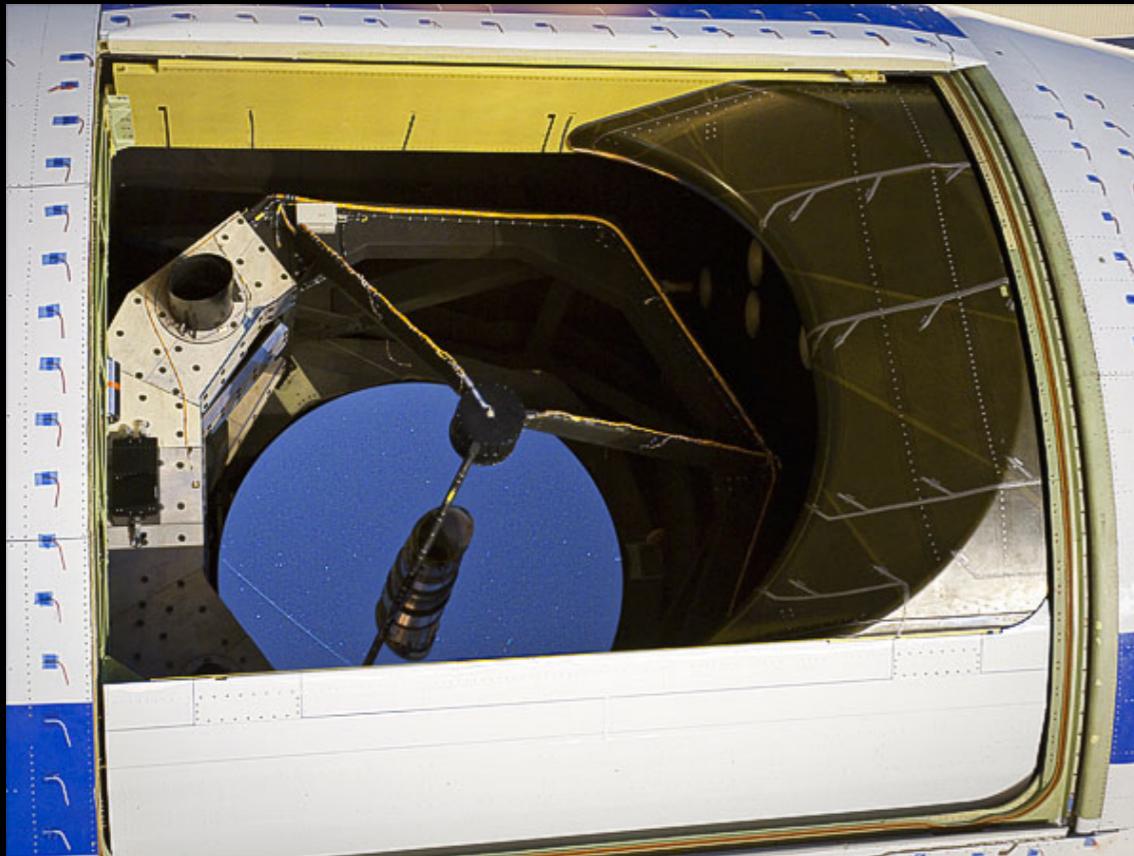
Astronomers use different instruments to look at light of different wavelengths - sometimes, we even have to go above Earth's atmosphere.

Not all electromagnetic radiation can penetrate Earth's atmosphere.



The Stratospheric Observatory for Infrared Astronomy (SOFIA)

- This is a Boeing 747-P aircraft that carries a 2.5-m (100-in.) telescope to the fringes of the atmosphere.



THREE reasons to go to space

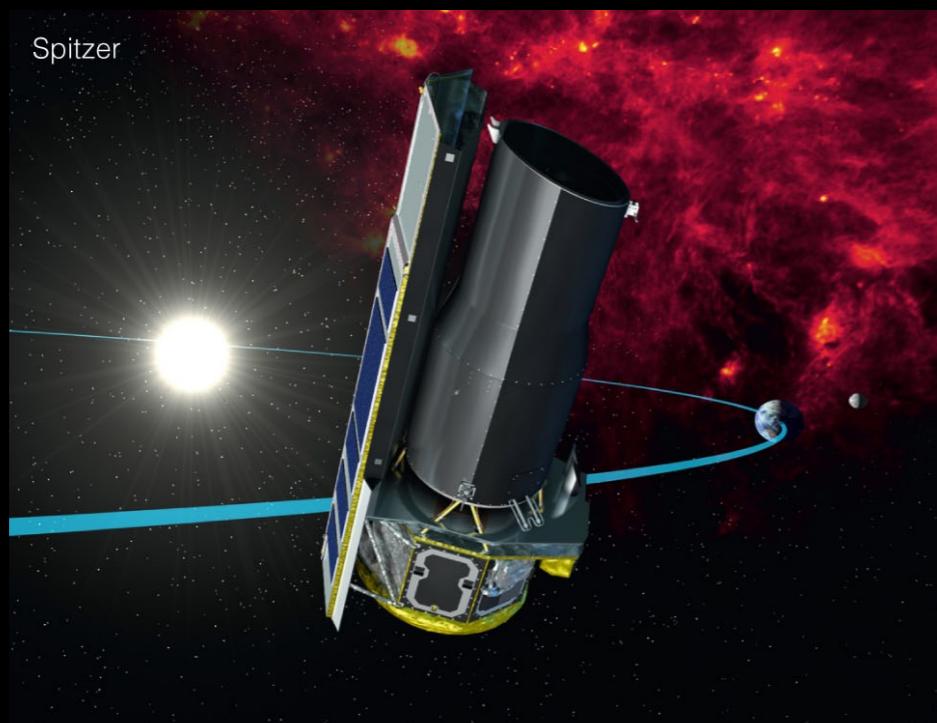
- 1) Can observe stars in Northern and Southern hemisphere
- 2) Can escape the Earth's atmosphere
- 3) Wavelengths in the far-ultraviolet, X-ray, and gamma-ray ranges—are completely absorbed by the ozone layer extending from 20 km to about 40 km above Earth's surface.



Spitzer telescope

Infrared

- The most sophisticated of the infrared telescopes put in orbit
- It still needs to be cooled to -269°C (-452°F).

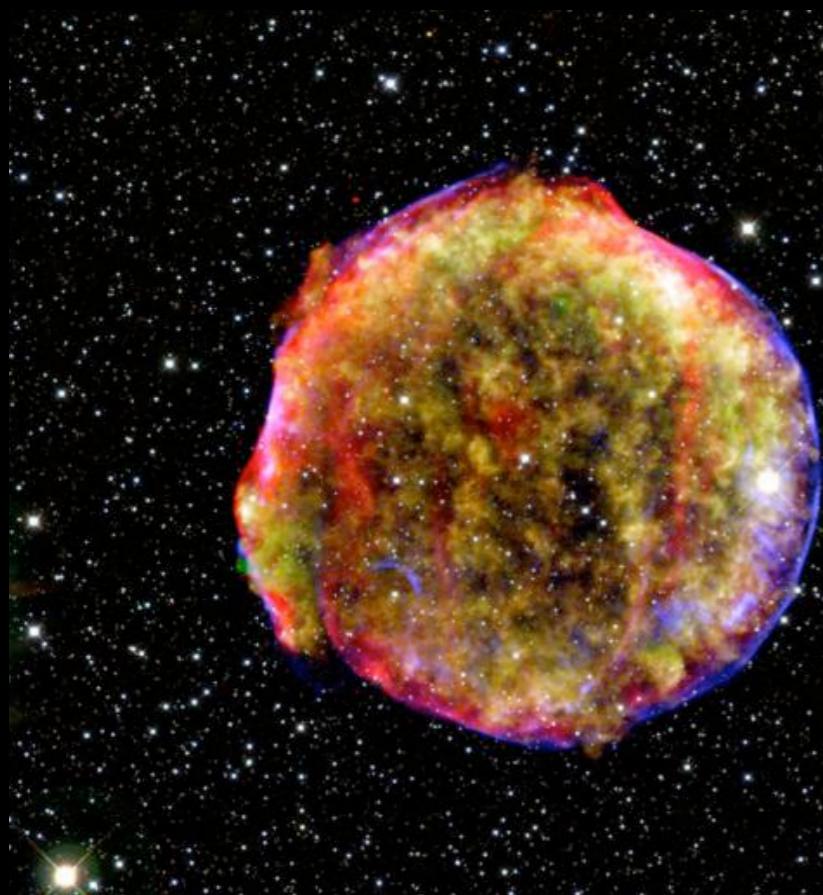


Chandra telescope

Xrays



- The largest X-ray telescope to date, it was launched in 1999 and orbits a third of the way to the moon.
- Focusing X rays is difficult because they penetrate into most mirrors



The future means bigger telescopes in space and on the ground ...

See fainter
See further

See more
See what we have never seen before

Thirty Meter Telescope



James Webb Space Telescope





Telescope review

- 1) The bigger the better for both collecting photons (seeing faint) and resolution (seeing detail)
- 2) The atmosphere blurs the light from objects AND blocks UV, gamma ray and Xray light requiring telescopes in space or on mountain tops
- 3) Ground based telescopes can use adaptive optics to un-blur the light
- 4) The longer the wavelength of the light, the bigger the telescope needs to be to recover its ability to see detail - radio telescopes are huge!
- 5) Interferometers (multiple telescopes) can combine their light to mimic large telescopes
- 6) Different parts of the EM spectrum reveal different physical processes from the astronomical object