

6.3 Telescopes and the Atmosphere

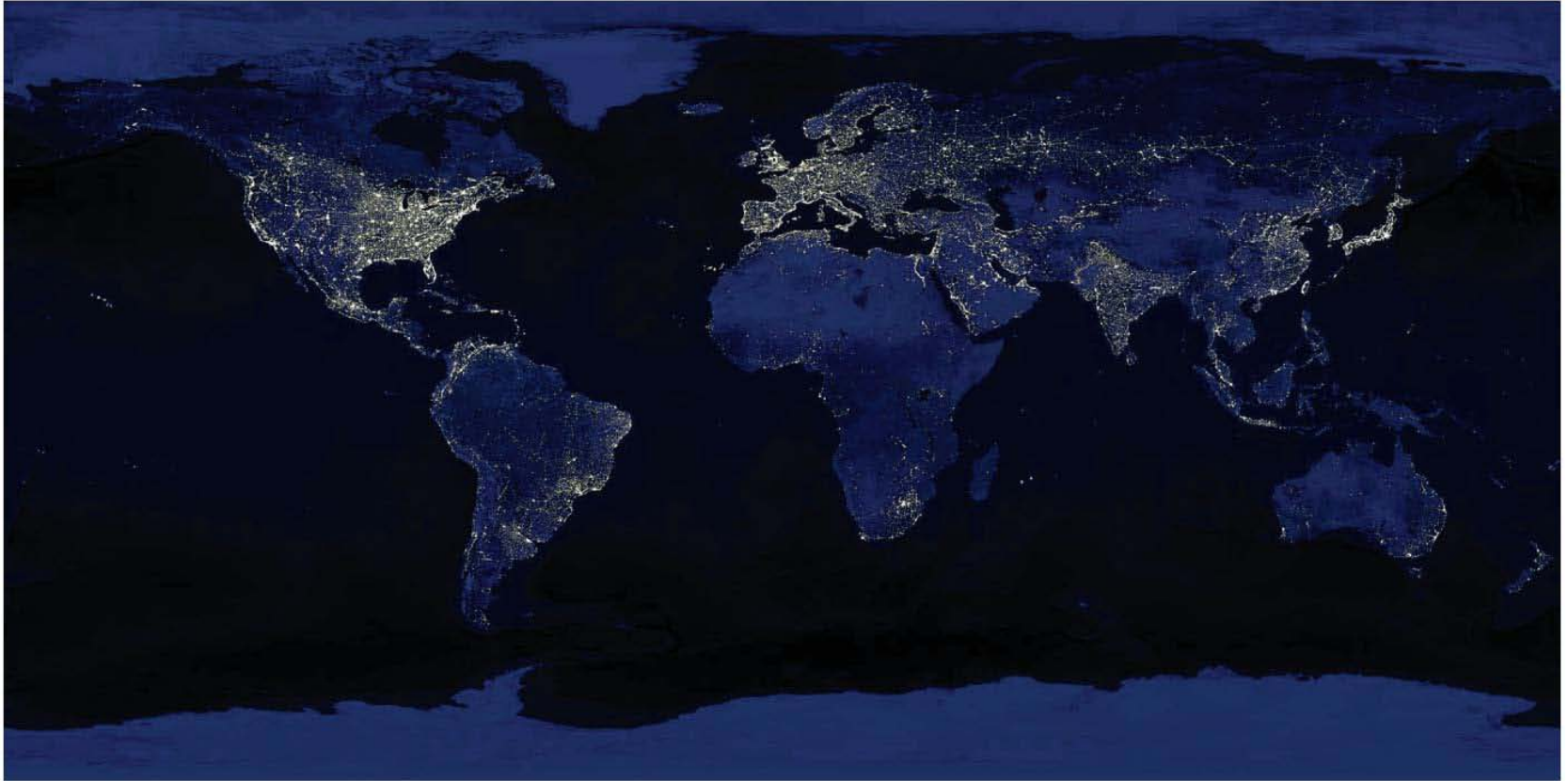
Our goals for learning:

- How does Earth's atmosphere affect ground-based observations?
- Why do we put telescopes into space?

How does Earth's atmosphere affect ground-based observations?

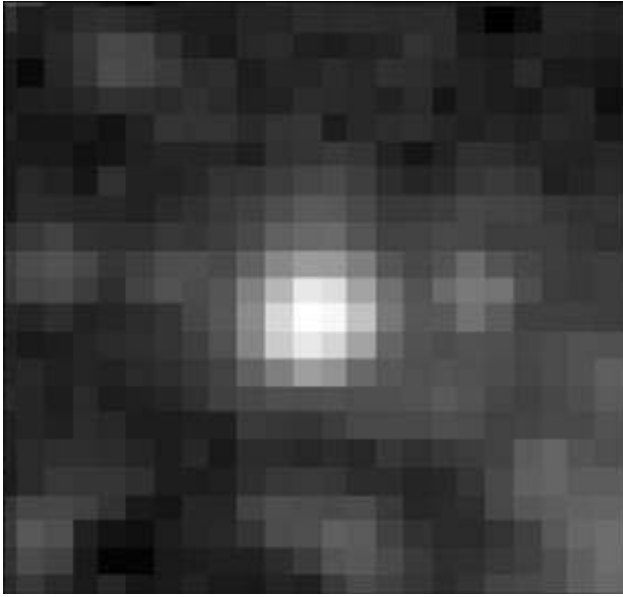
- The best ground-based sites for astronomical observing are
 - Calm (not too windy)
 - High (less atmosphere to see through)
 - Dark (far from city lights)
 - Dry (few cloudy nights)

Light Pollution

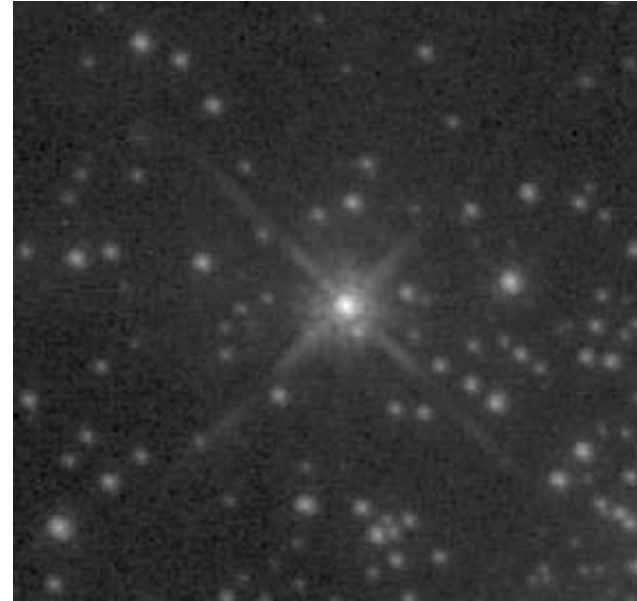


- Scattering of human-made light in the atmosphere is a growing problem for astronomy

Twinkling and Turbulence



Star viewed with ground-based telescope



Same star viewed with Hubble Space Telescope

Turbulent air flow in Earth's atmosphere distorts our view, causing stars to appear to twinkle

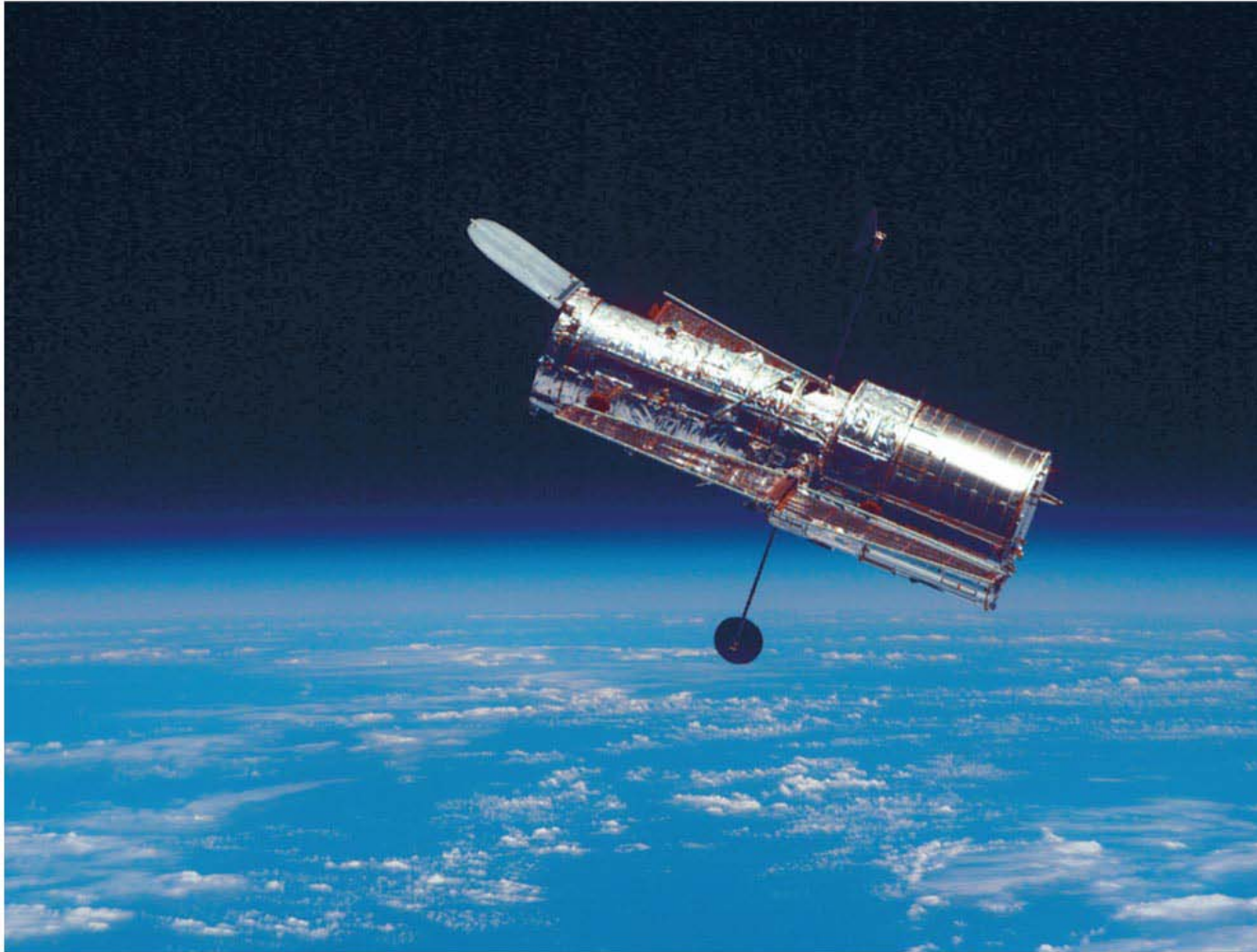
Calm, High, Dark, Dry

- The best observing sites are atop remote mountains

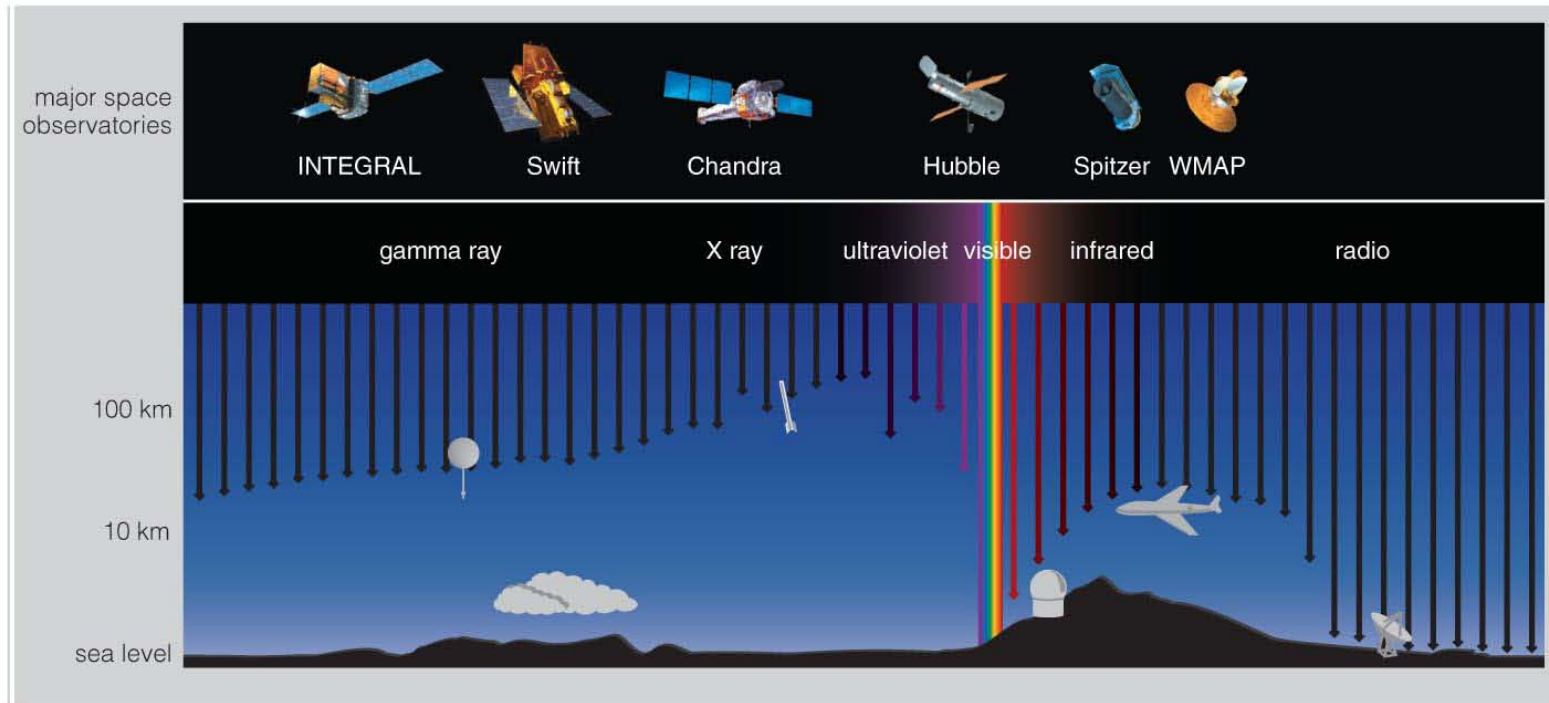


Summit of Mauna Kea, Hawaii

Why do we put telescopes into space?



Transmission in Atmosphere



[Interactive Figure](#)

- Only radio and visible light pass easily through Earth's atmosphere
- We need telescopes in space to observe other forms

What have learned?

- How does Earth's atmosphere affect ground-based observations?
 - Telescope sites are chosen to minimize the problems of light pollution, atmospheric turbulence, and bad weather.
- Why do we put telescopes into space?
 - Forms of light other than radio and visible do not pass through Earth's atmosphere.
 - Also, much sharper images are possible because there is no turbulence.

6.4 Eyes and Cameras: Everyday Light Sensors

Our goals for learning:

- How can we observe nonvisible light?
- How can multiple telescopes work together?

How can we observe nonvisible light?



- A standard satellite dish is essentially a telescope for observing radio waves

Radio Telescopes

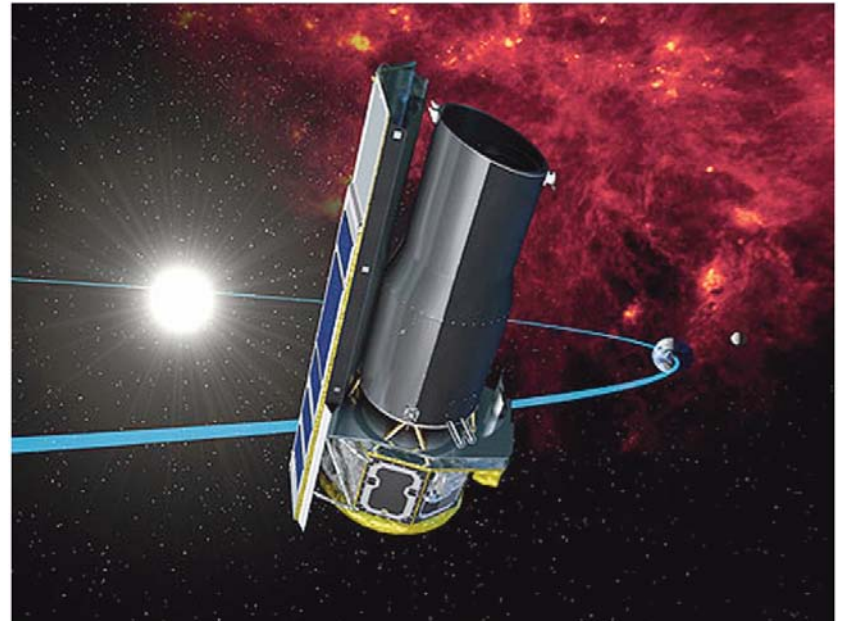


- A radio telescope is like a giant mirror that reflects radio waves to a focus

IR & UV Telescopes



SOFIA



Spitzer

- Infrared and ultraviolet-light telescopes operate like visible-light telescopes but need to be above atmosphere to see all IR and UV wavelengths

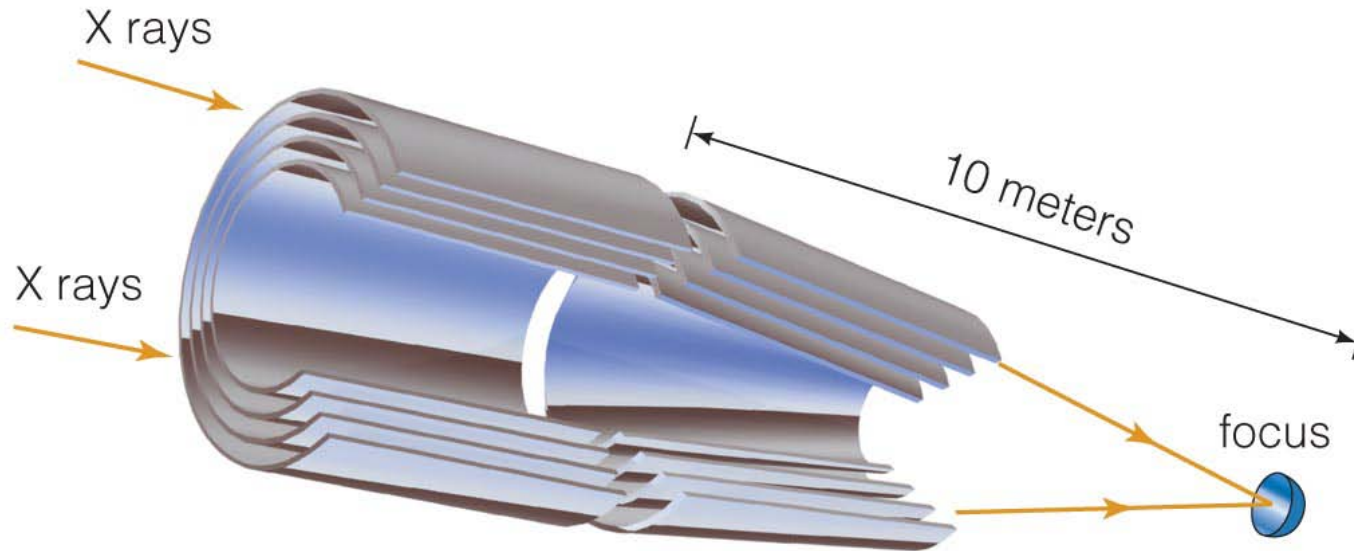
X-Ray Telescopes



Chandra

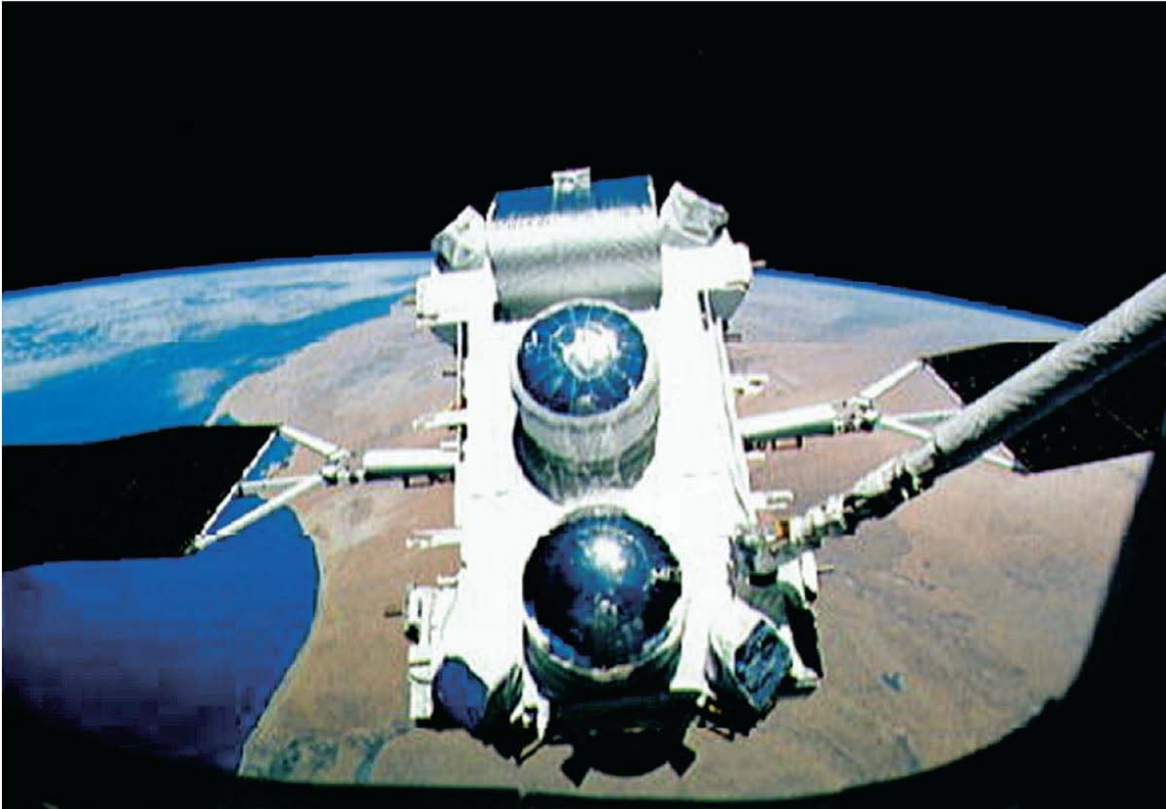
- X-ray telescopes also need to be above the atmosphere

X-Ray Telescopes



- Focusing of X-rays requires special mirrors
- Mirrors are arranged to focus X-ray photons through grazing bounces off the surface

Gamma Ray Telescopes



Compton Observatory

- Gamma ray telescopes also need to be in space
- Focusing gamma rays is extremely difficult

Future of Astronomy in Space?



- The Moon would be an ideal observing site