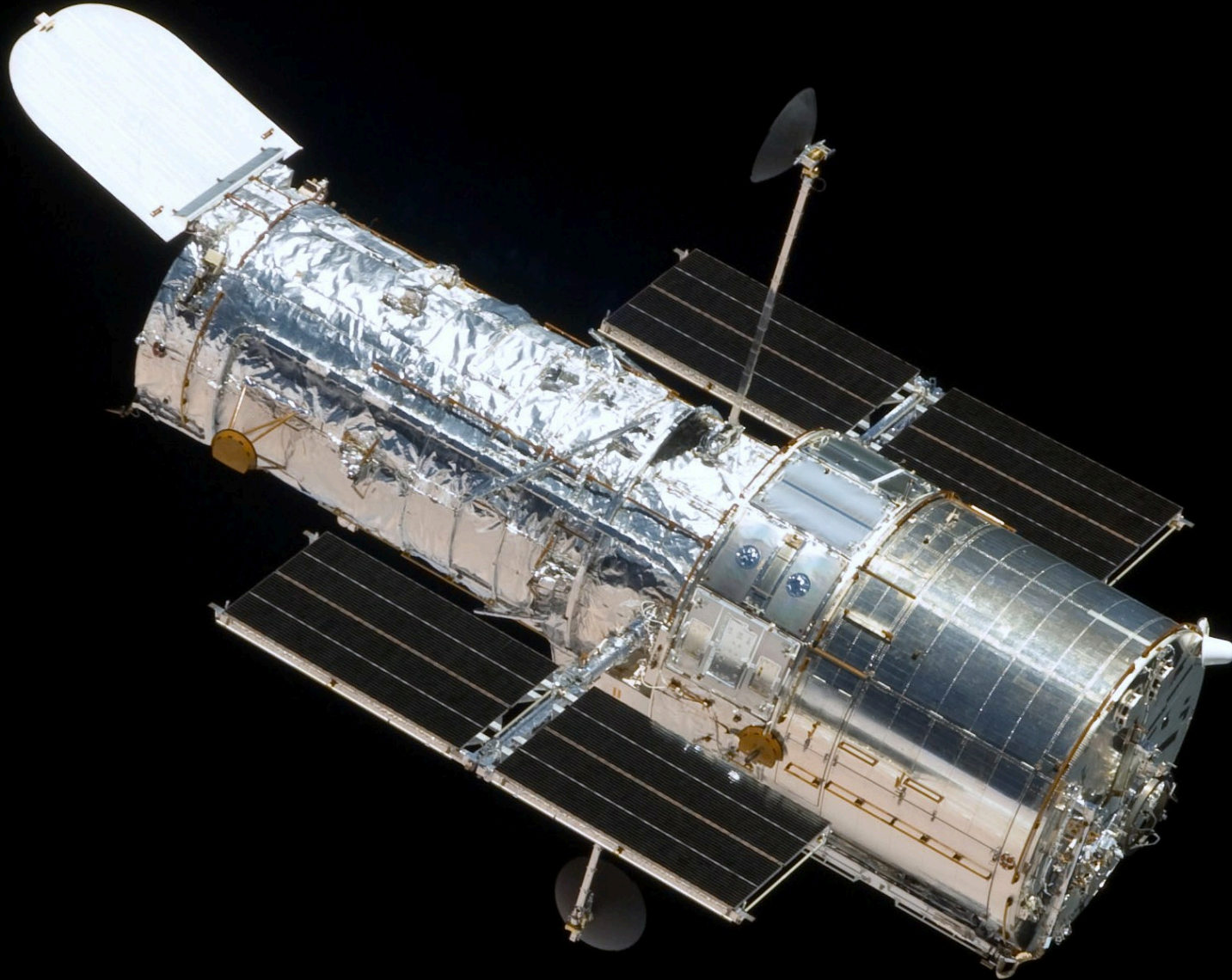
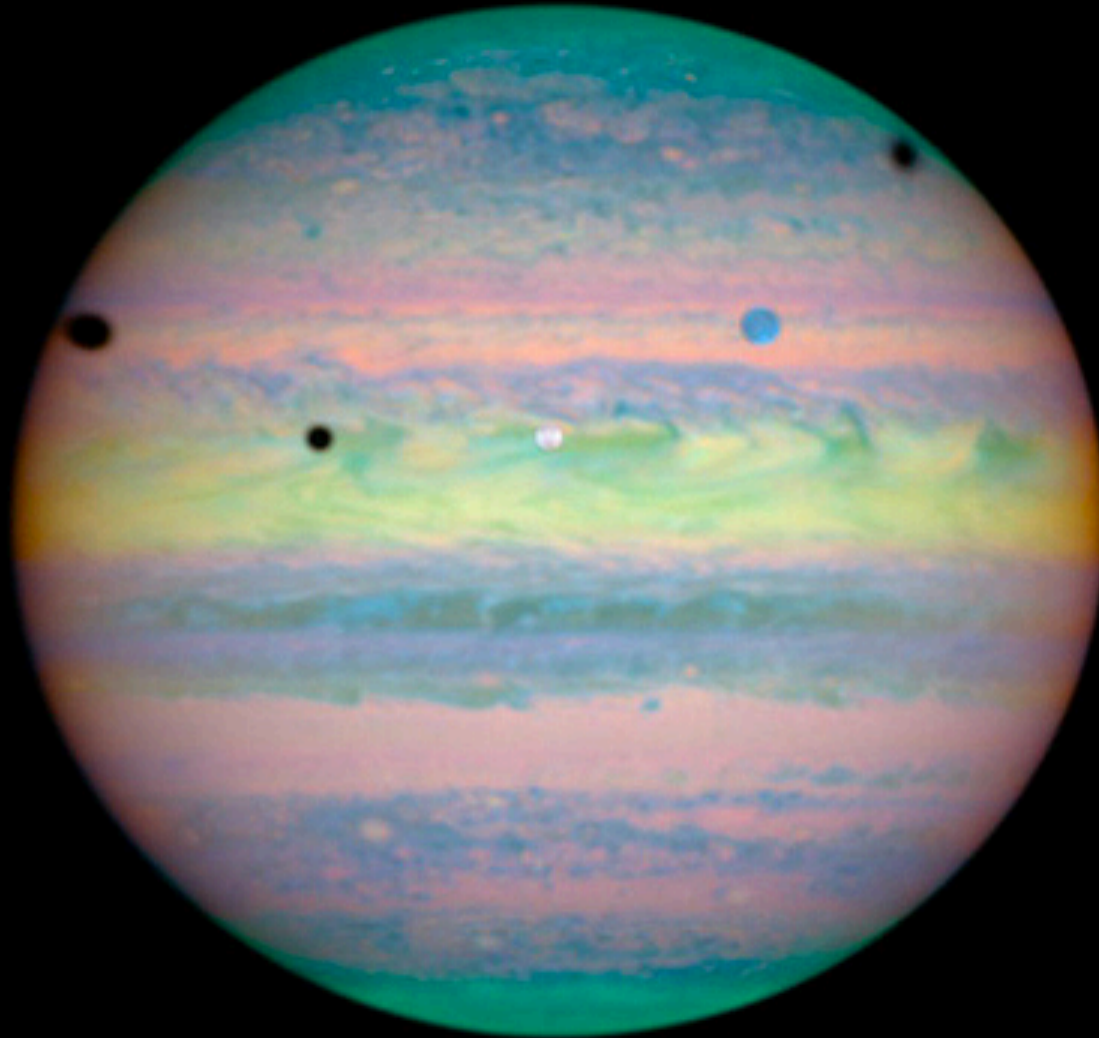


Hubble – The Little Telescope That Could



Hubble is Awesome



Triple eclipse on Jupiter!

Hubble is Awesome



The Orion Nebula, an active star forming region near us

Hubble is Awesome



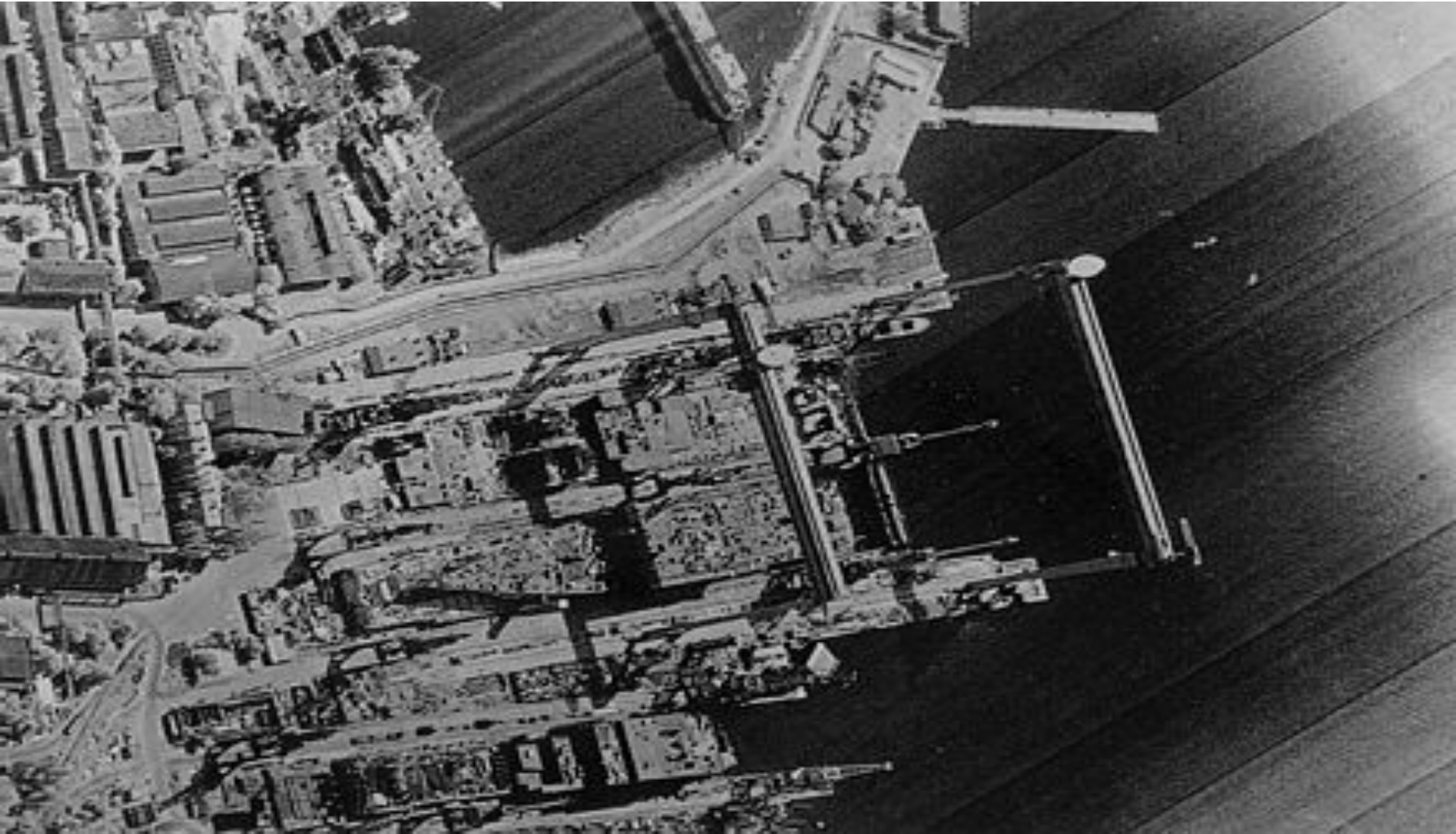
M82 is a 'starburst' region

Hubble is Awesome



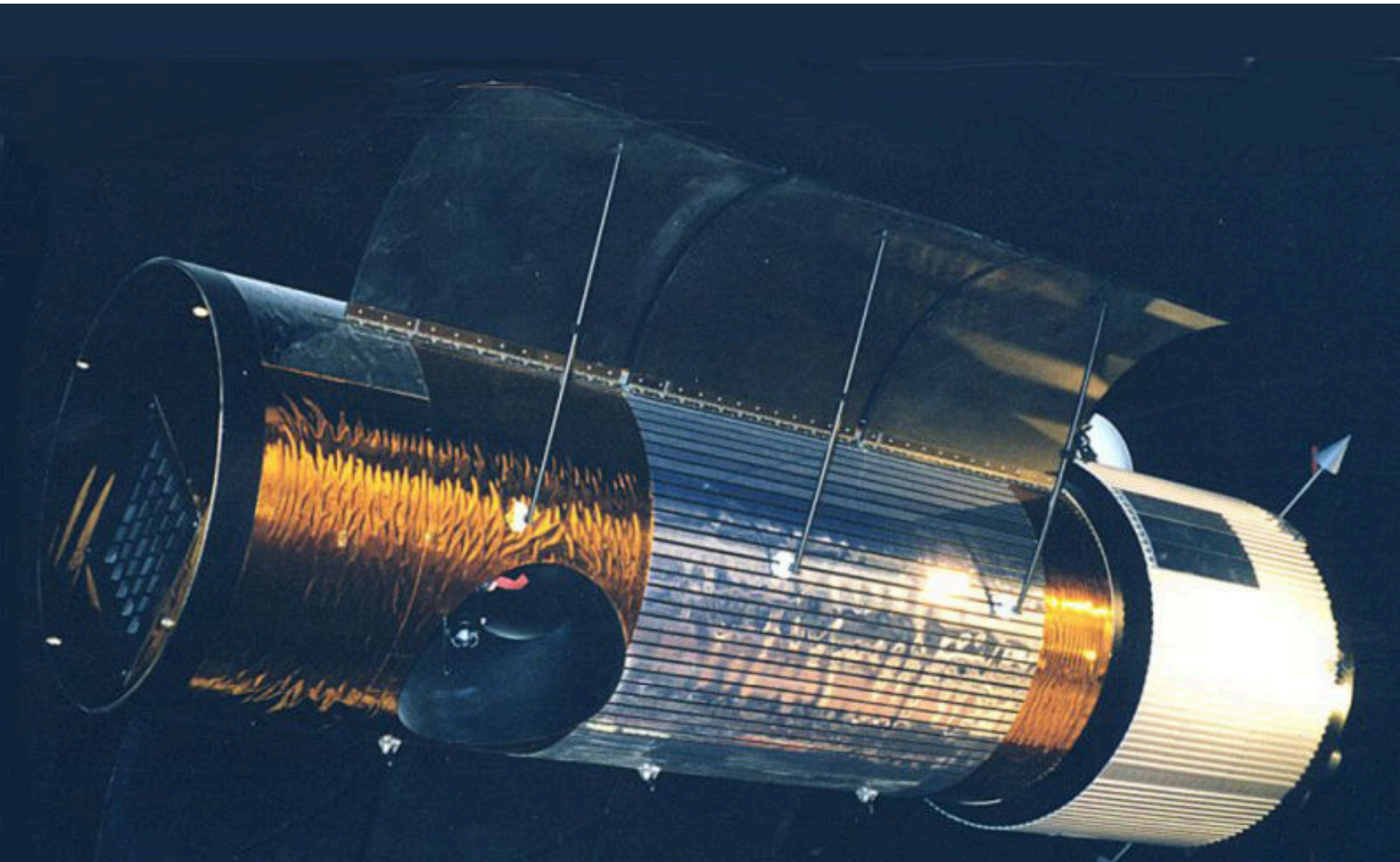
J1038+4849 is a cluster of galaxies acting as a gravitational lens

Hubble is Aw...



Construction of an aircraft carrier in Kiev, Ukraine

Hubble is an Up-cycled Spy Satellite KH-11



Action Plan

- How reflecting telescopes work
- How to launch a satellite
- How huge, ambitious projects involve a lot of mishaps! An inspiration to persist when the going gets hard on your great idea.
- Build a paper Hubble

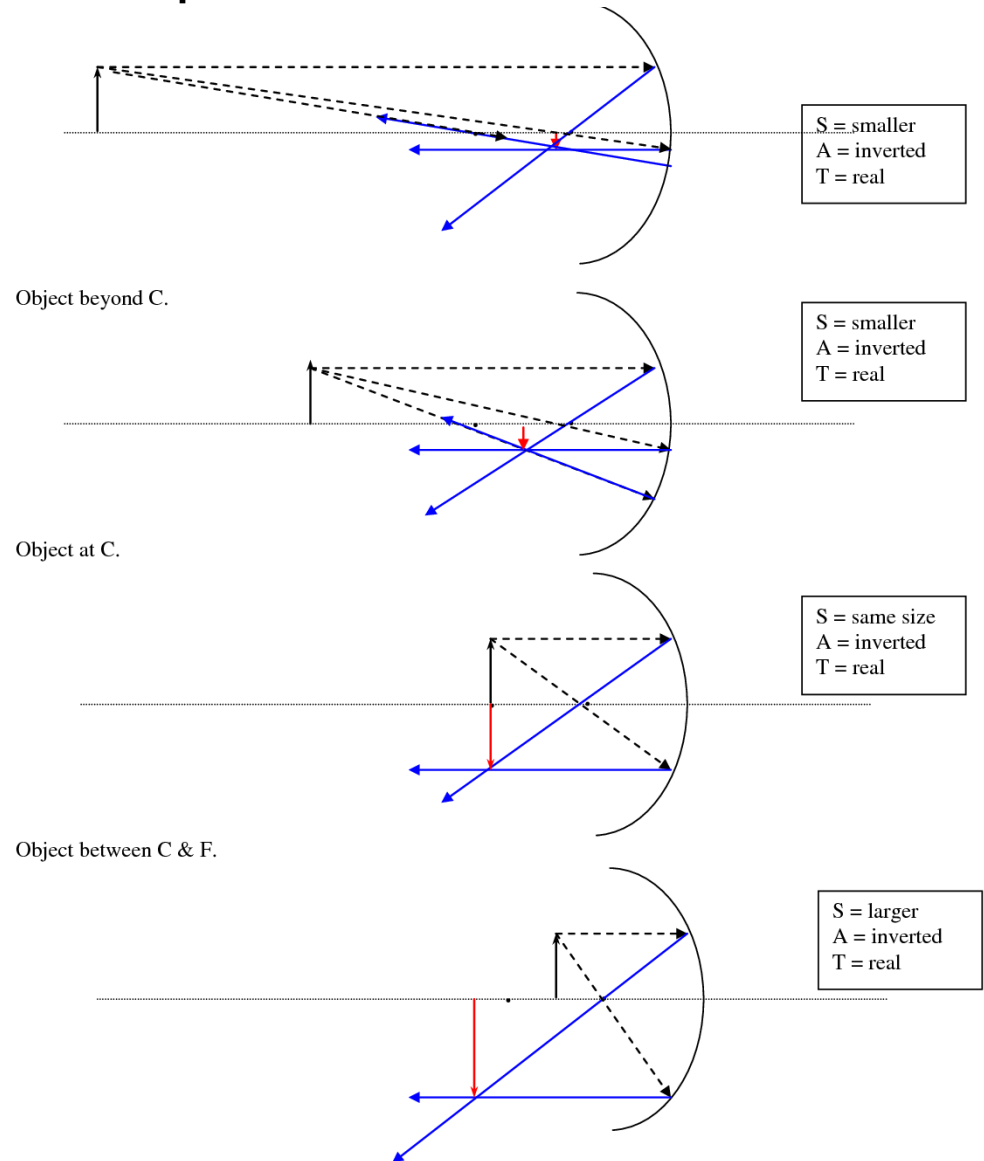
How Does a Reflecting Telescope Work?

At the heart of it is a concave mirror

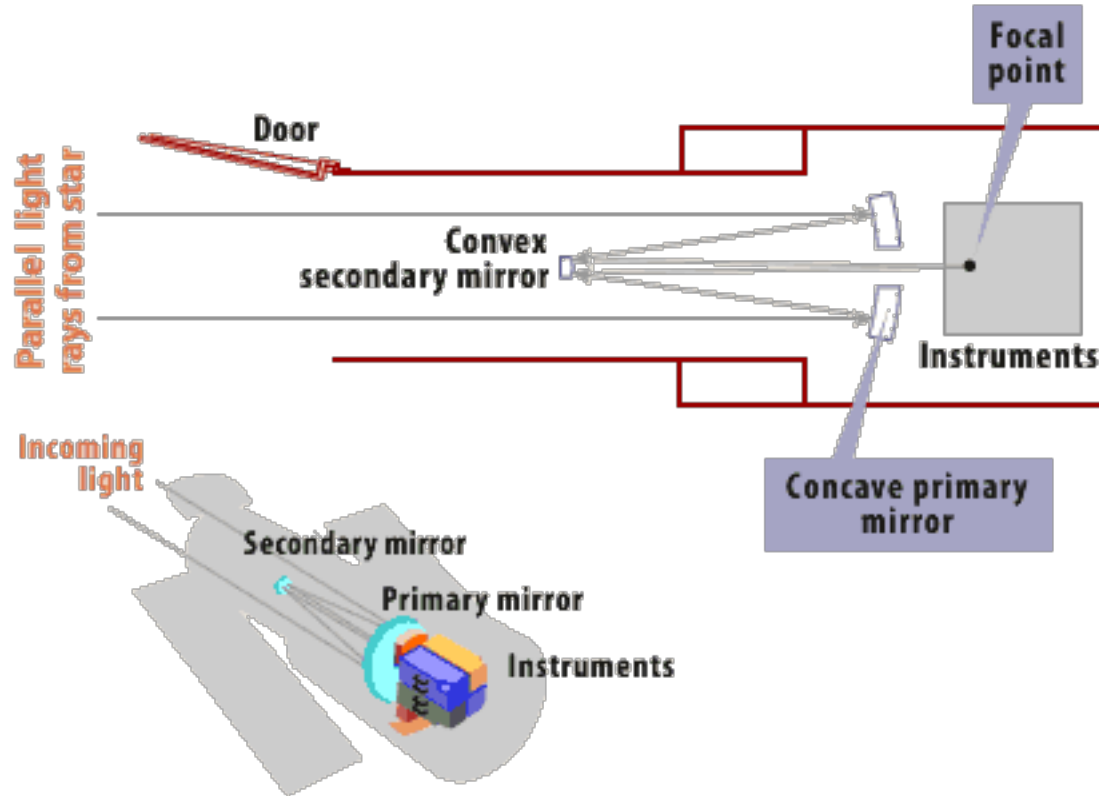
Incoming parallel rays (from infinity) are concentrated at the focus

Rays in a Concave Mirror:

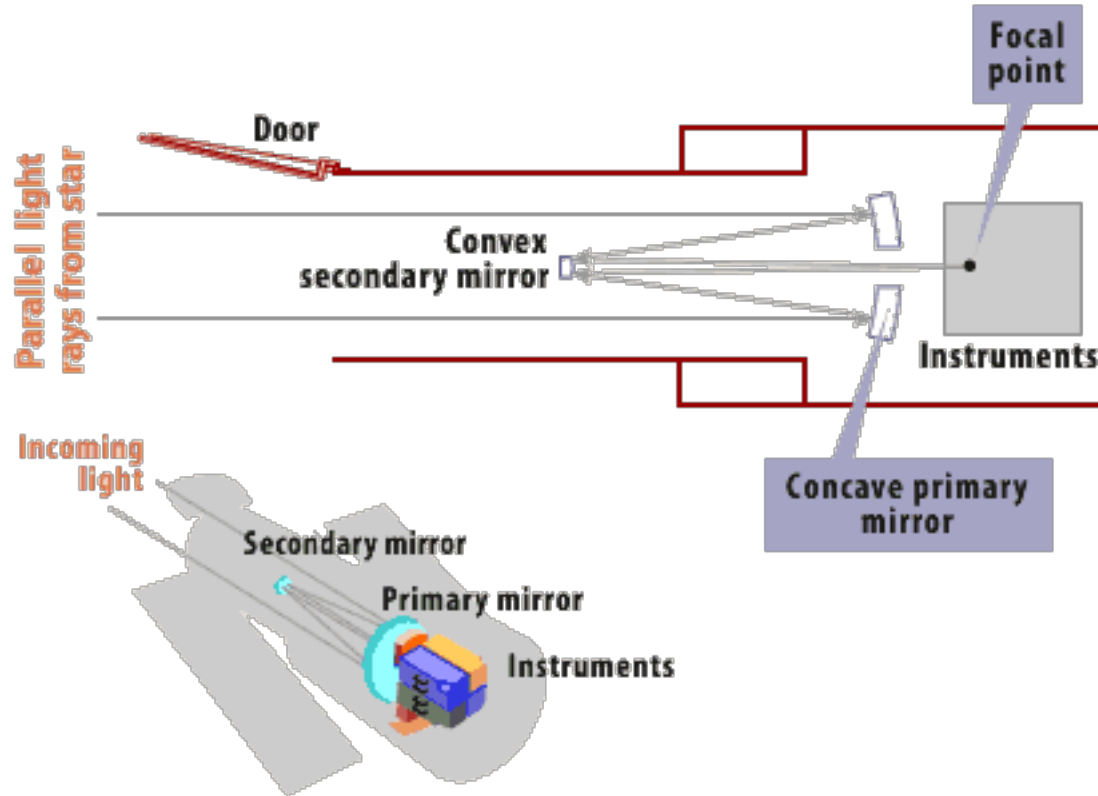
- Parallel rays meet at focus
- Rays passing through focus reflected parallel
- Rays through $C = 2F$ go back the way they came



How Does a Reflecting Telescope Work?



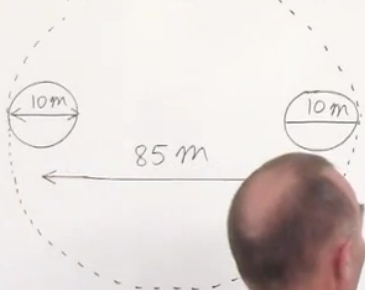
Wait – but we said parallel rays from infinity are converged into a point!



Resolution

ASTRONOMY – CHAPTER 6: TELESCOPES (14) INTERFEROMETRY

TWIN KECK TELESCOPES

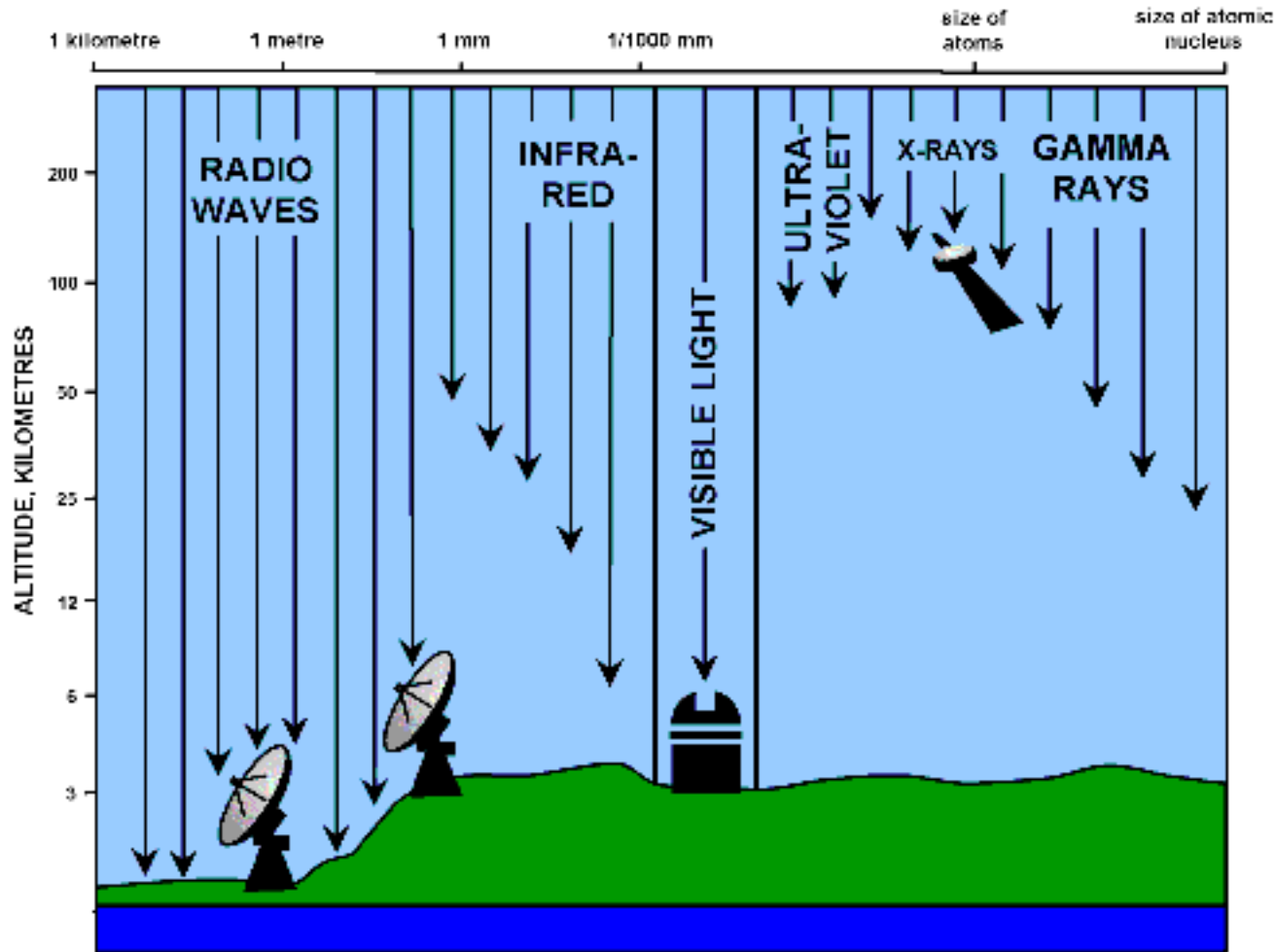


MAUNA KEA
ELEVATION 4100m

<http://ilectureonline.com> Next video explains how CCDs, charged coupled devices, revolutionized astronomy.

The diagram shows two circular telescopes, each with a diameter of 10m, separated by a distance of 85m. A dashed line connects the centers of the two telescopes, and a horizontal arrow below it is labeled '85 m'. The telescopes are situated on a mountain peak, with the text 'MAUNA KEA ELEVATION 4100m' written to the right. A man in a white shirt is standing in front of the whiteboard, writing.

What if it weren't diffraction limited?



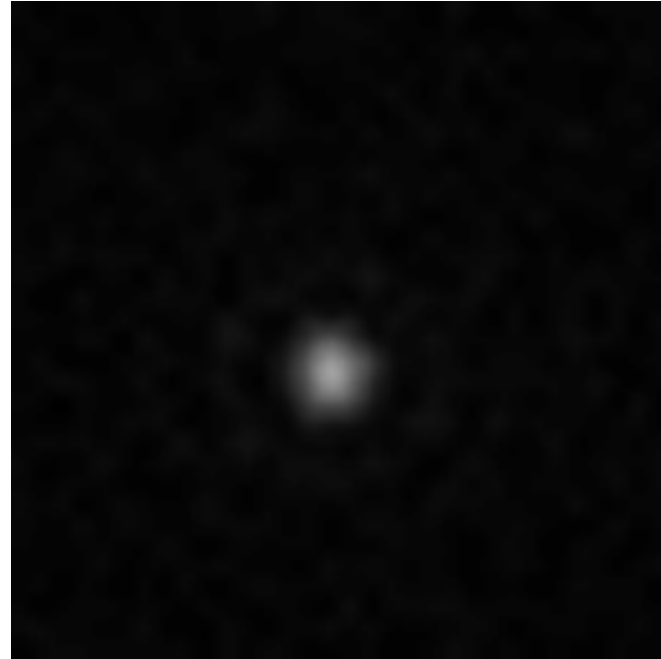
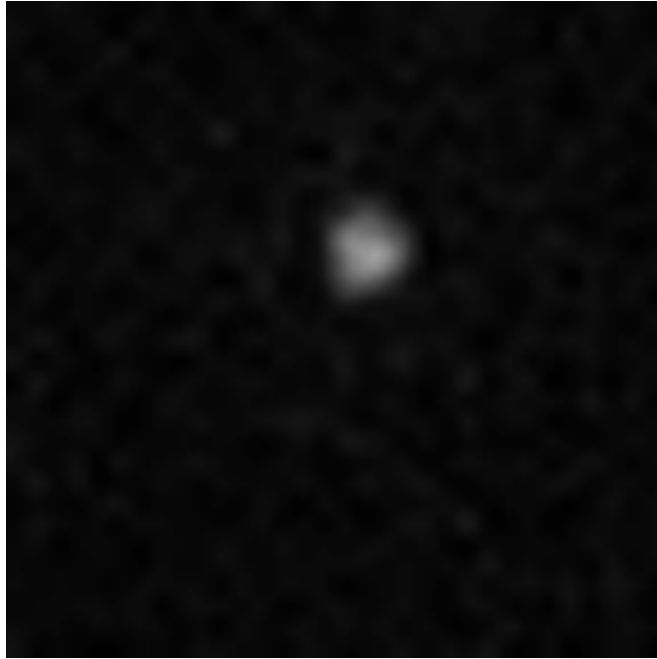
Absorption

What if it weren't diffraction limited?



Scattering

What if it weren't diffraction limited?



Atmospheric seeing

Basically, the atmosphere kinda blows.

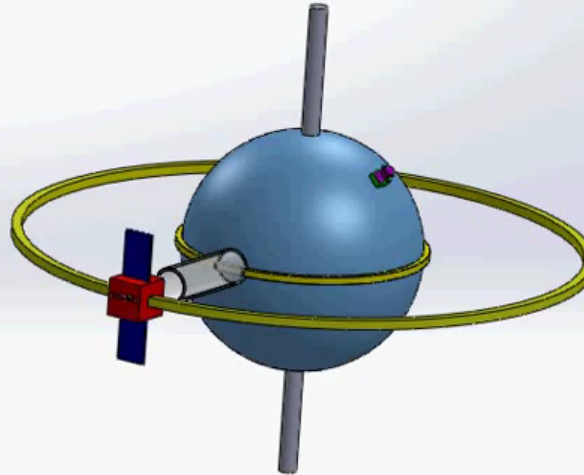




- ~600-800 km above Earth
- Orbital period 96-100 min
- Great for relatively shallow coverage of large areas

Just how much can we see from space?

2. Geo-synchronous satellites



Orbital period equals that of earth

$$F_{centripetal} = F_{gravity}$$

$$\frac{v^2}{r} = \frac{GM_{\oplus}m_{sat}}{r^2}$$

$$P = \frac{2\pi r}{v} = P_{\oplus}$$

$$\left(\frac{2\pi r}{P_{\oplus}}\right)^2 = \frac{GM_{\oplus}}{r} \Rightarrow r = \sqrt[3]{\frac{GM_{\oplus}P_{\oplus}^2}{4\pi^2}}$$

$$r = 42160\text{km}$$

$$\text{Altitude} = r - \text{radius of Earth}$$

$$= 35,800\text{km}$$

So let's build the thing!

Ideas!



Questions?

