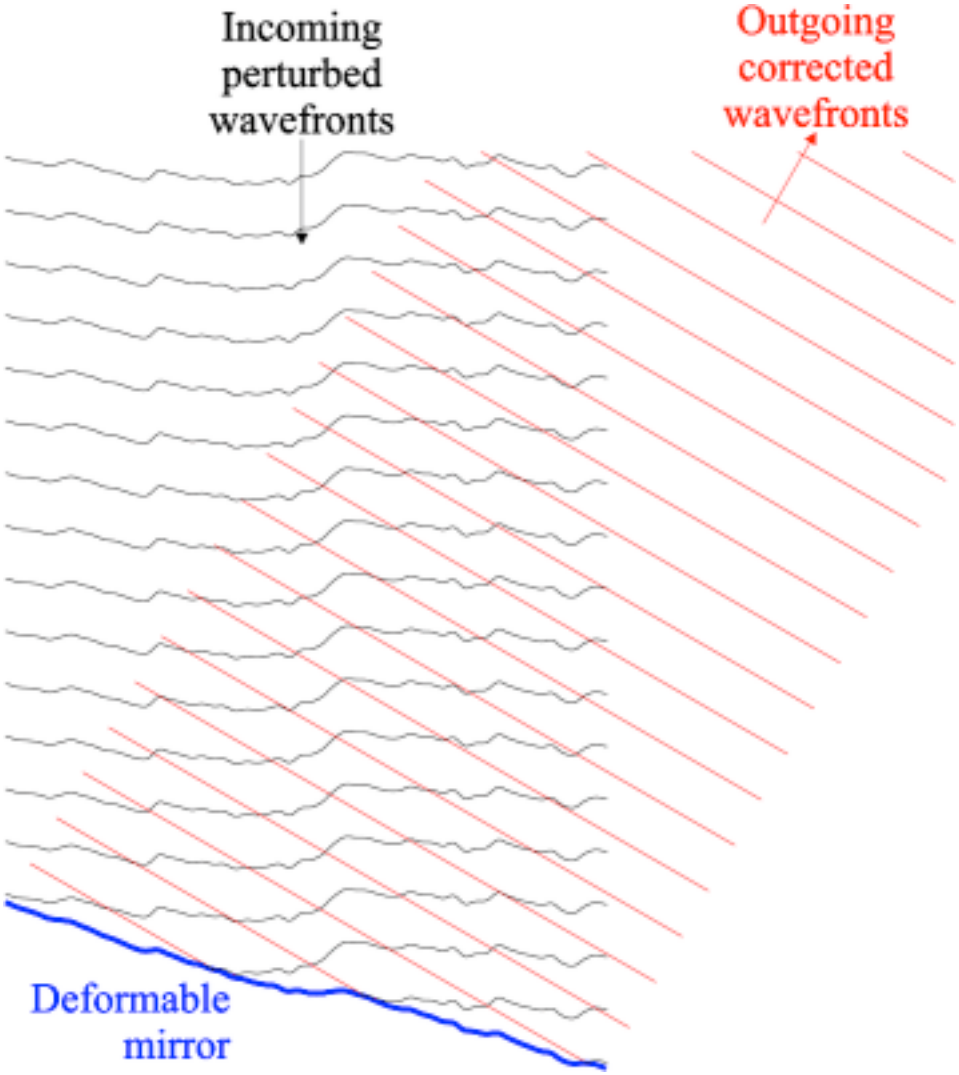
PHY385-H1F Introductory Optics

Class 13 – Outline: Sub-section 5.7.7, Sections 5.8, 5.9

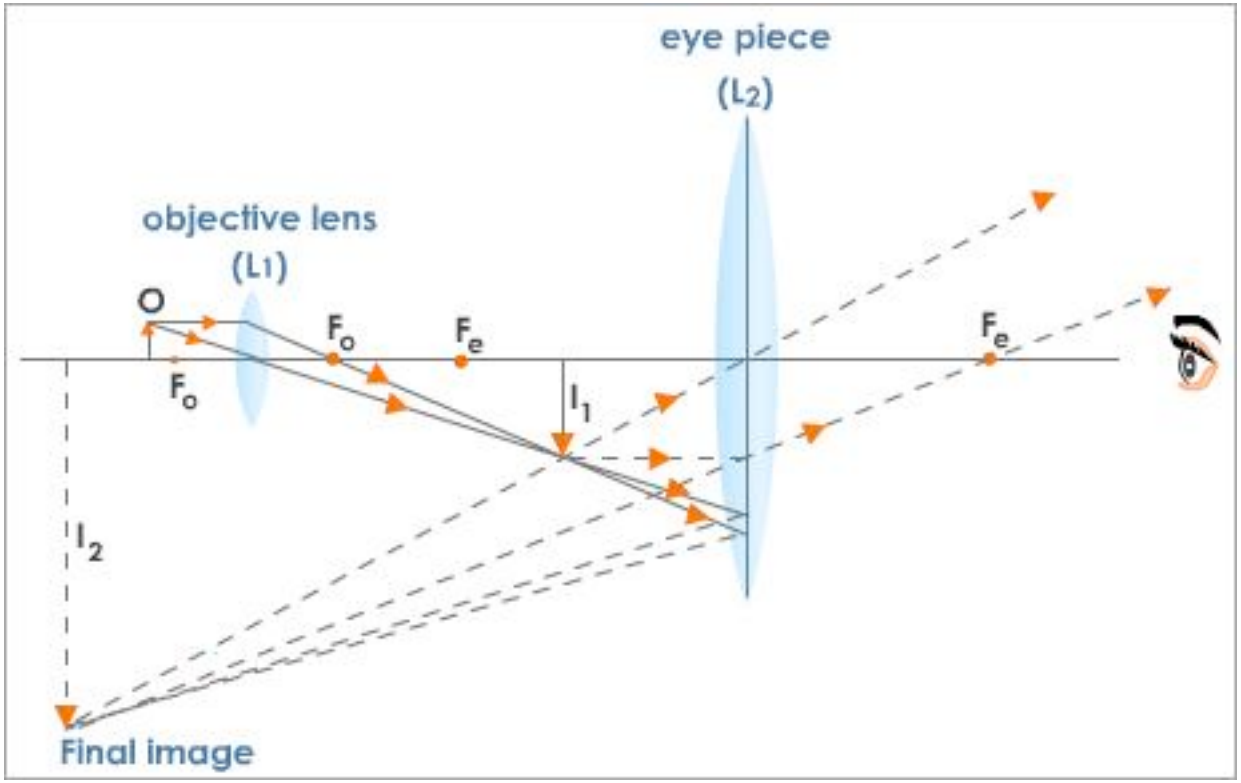
- Microscope
- Refracting and Reflecting Telescopes
- Wavefront shaping
- Gravitational Lensing



Compound Microscope

- Invented by Zacharias Jansen of Holland (1590), or Galileo of Italy (1610).
- Objective lens at the bottom forms a real, inverted image in the tube.
- Eyepiece at the top is used as a magnifier to view this image.

Compound Microscope



$$MP = \left(-\frac{16\,\text{cm}}{f_o} \right) \left(\frac{25\,\text{cm}}{f_e} \right)$$

Telescope

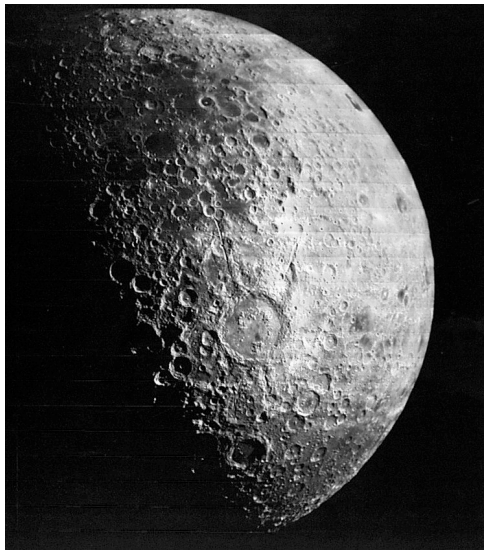
- Invented by somebody in Holland (1608), or Galileo of Italy (1610).
- Objective forms a real, inverted image in the tube.
- Eyepiece is used as a magnifier to view this image.

Galileo Galilei

$$MP = \frac{\alpha_a}{\alpha_u}$$

Galileo's discoveries with his telescope

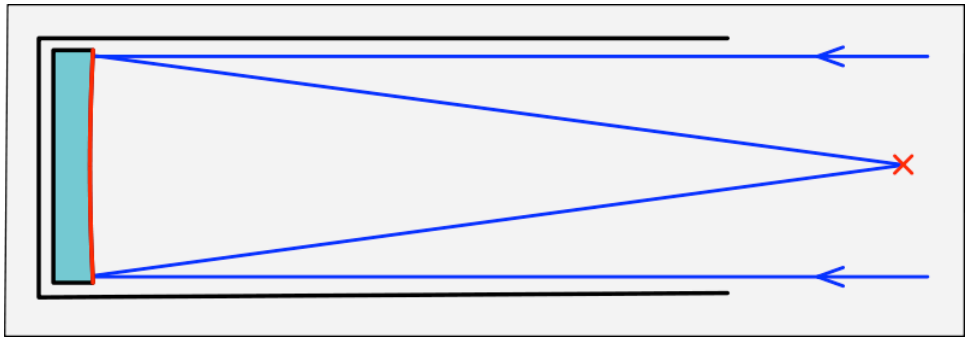
Craters on the moon.



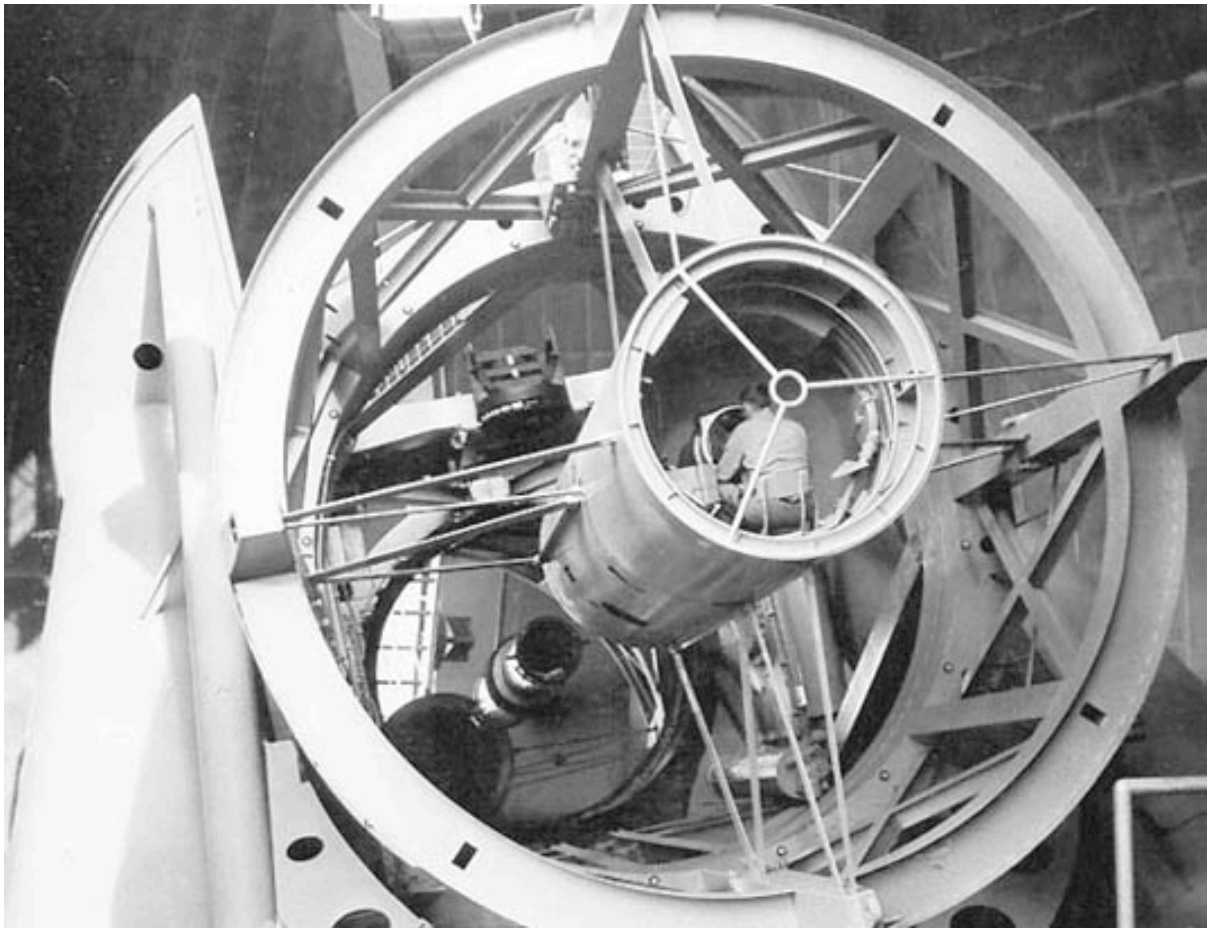
Jupiter has moons that orbit around it.

Venus goes through phases as it orbits the Sun.

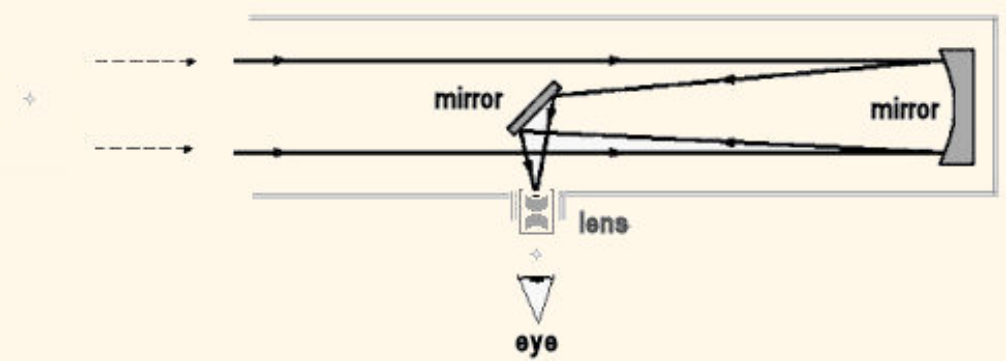
Reflecting Telescope arrangements



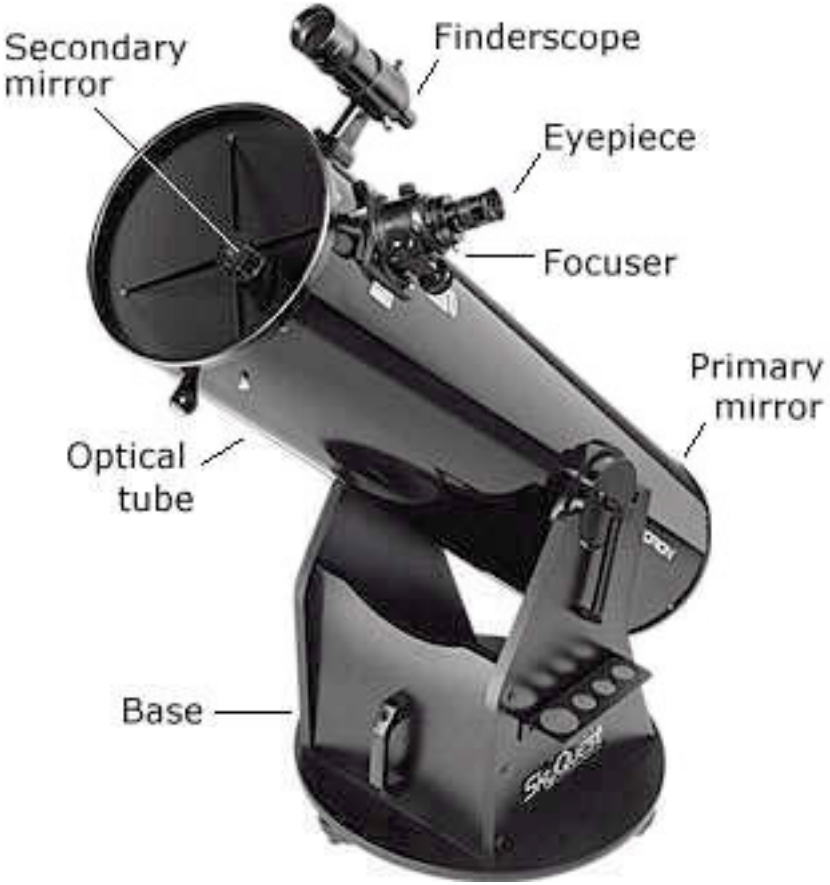
- Prime focus



Reflecting Telescope arrangements

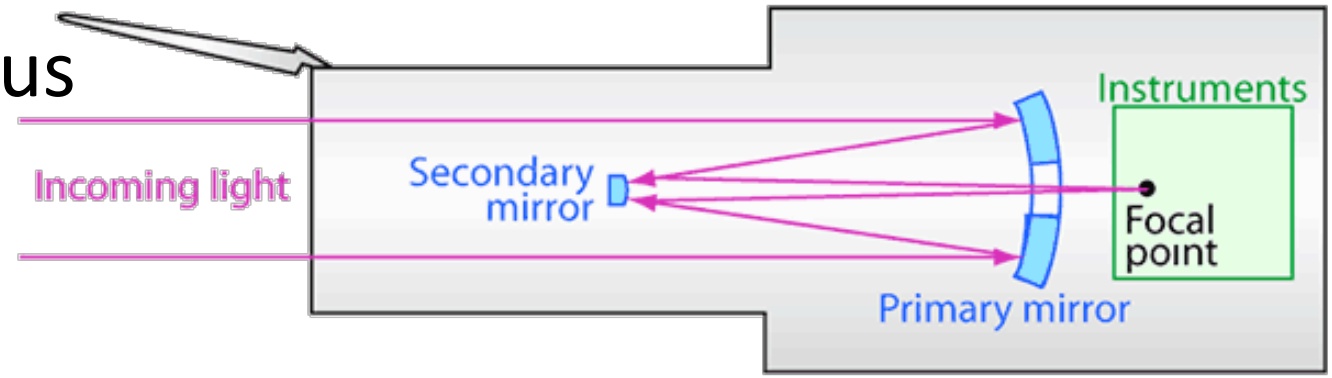


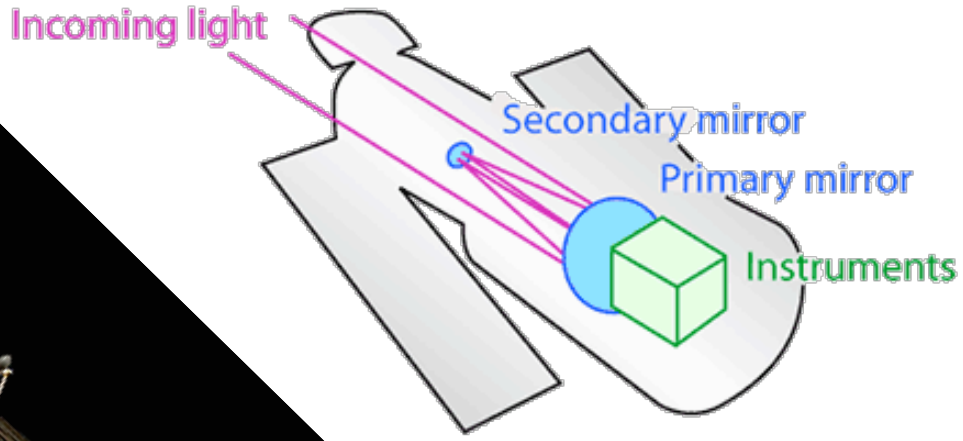
- Newtonian focus



Reflecting Telescope arrangements

- Cassegrain focus

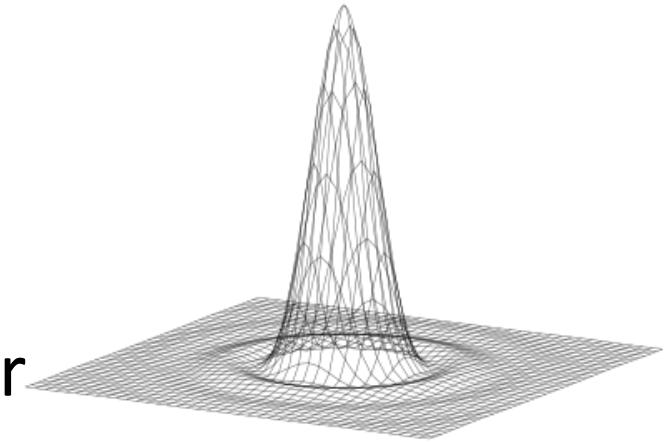




The Hubble Space Telescope

Doing Astronomy from the ground

- Diffraction limit is set for a circular aperture by the Airy disk pattern
- "Seeing" on Earth is about 1 arc-second
- Meaning that on Earth, once your telescope is larger than about 14 cm diameter, the images are as crisp as they can get!
- Adaptive optics can help one approach the diffraction limit

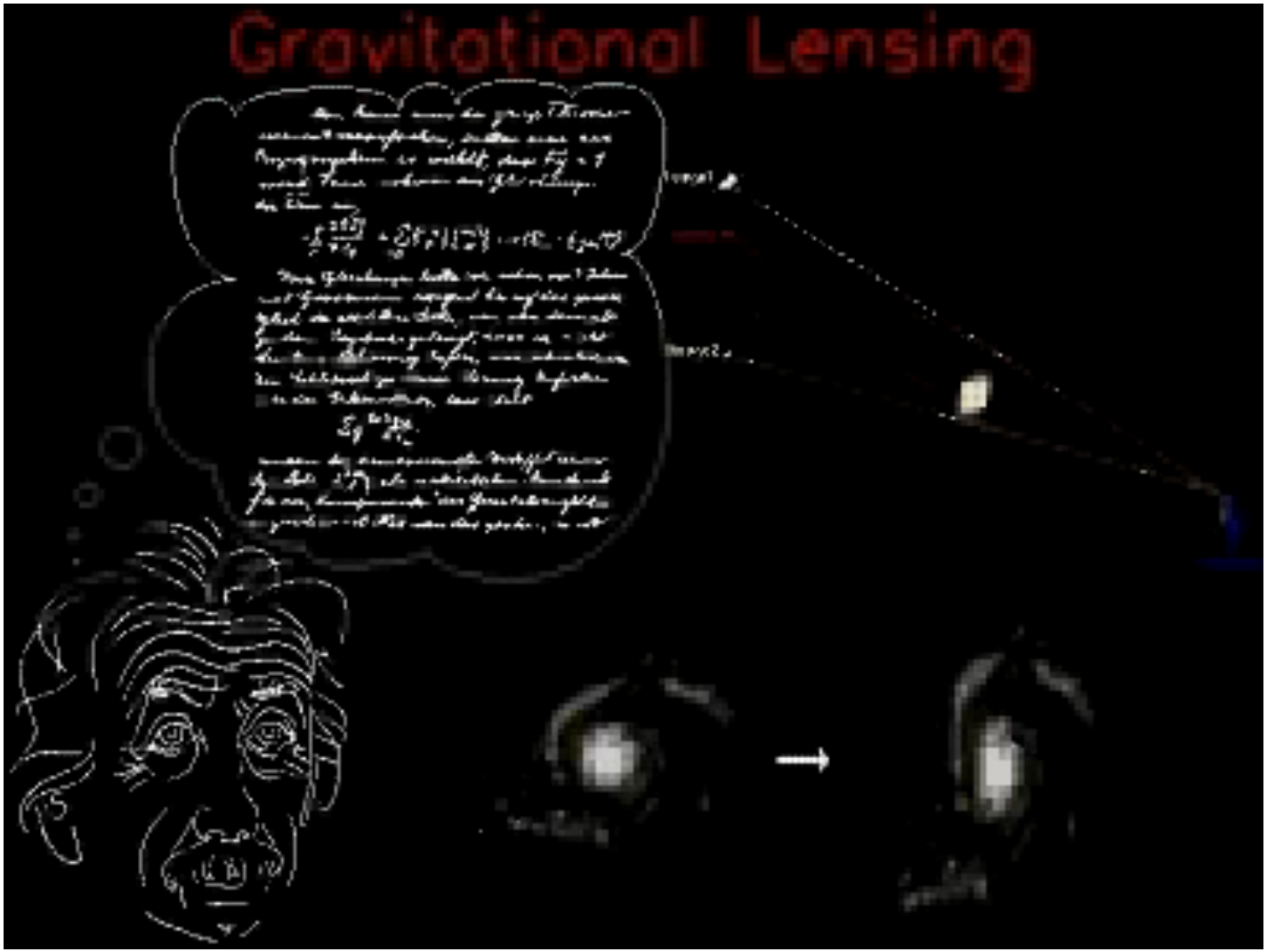


Airy Disk Pattern

Adaptive optics at European Southern Observatory

http://www.youtube.com/watch?v=67jF2Ui0AdU

Gravitational Lensing



http://www.youtube.com/watch?v=yamVbK-J69M

Gravitational Lensing

- Abell 2218