Minor Members of the Solar System
Light
Astronomical Tools

click for 9/page to print

Minor Members of Solar System

- Asteroids
- Meteoroids
- Comets
- Kuiper Belt Objects
- Dwarf Planets

“Planet”

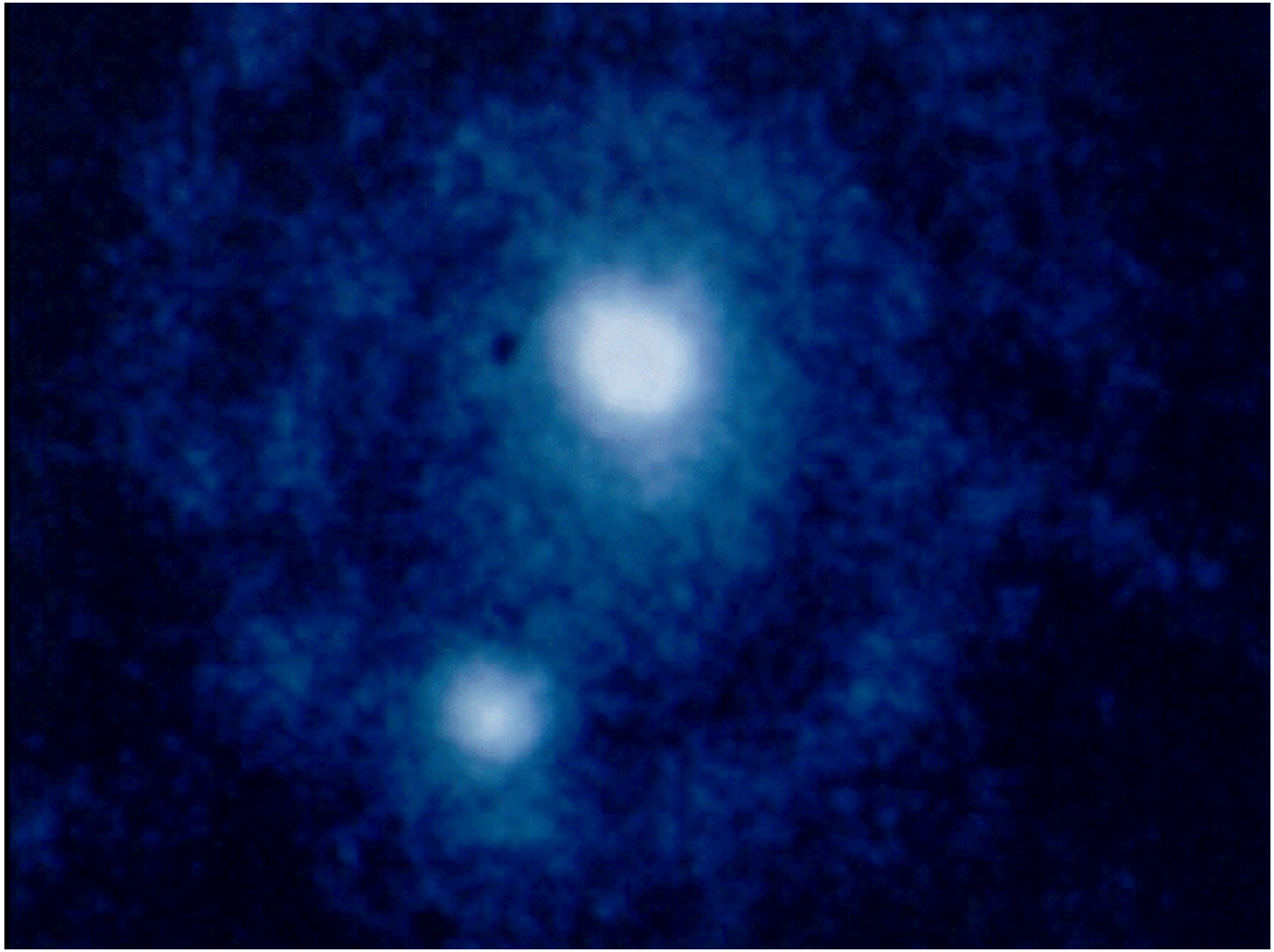
- Orbits Sun
- Not a satellite
- Dominates its orbital path

“Dwarf Planet”

- is in orbit around Sun
- has sufficient mass for its self-gravity to pull itself into near-spherical shape
- has not cleared the neighbourhood around its orbit
- is not a satellite

Pluto and Charon

HST image



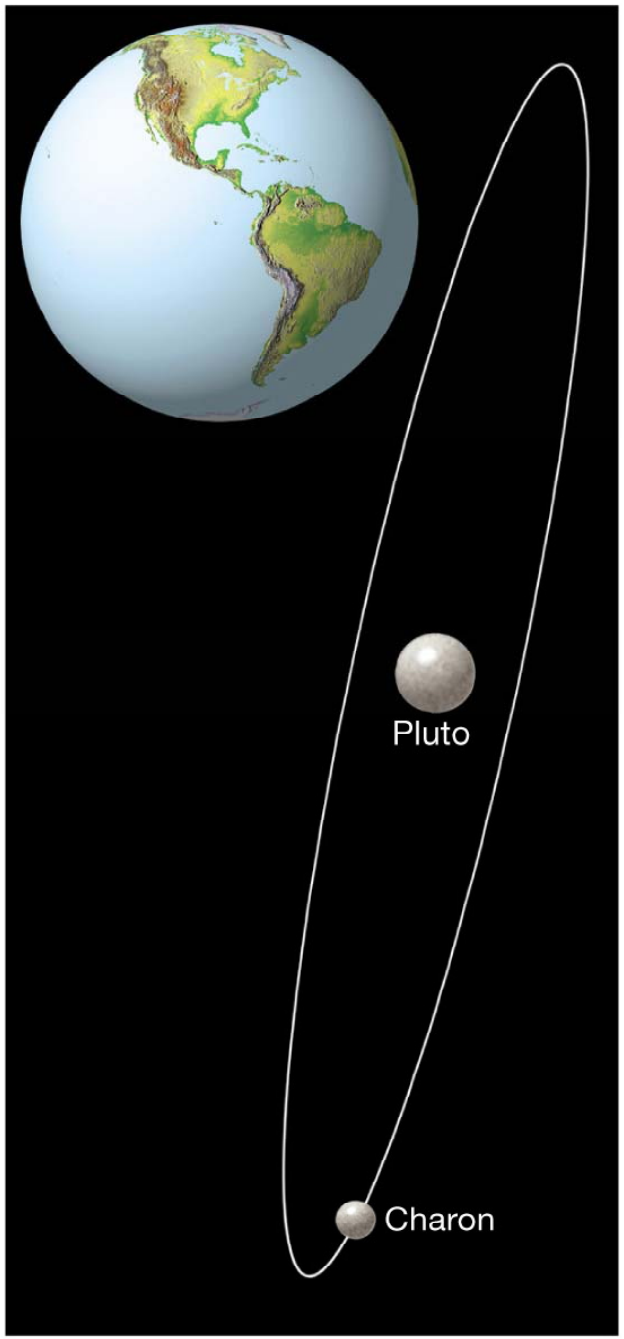
- http://www.solarviews.com/cap/pluto/pluto3.htm

Kuiper Belt

- Donut shaped area containing numerous icy bodies of various sizes
- Eris is the largest discovered
- Pluto and Charon are some
- Triton, moon of Saturn, is likely one that was captured by Saturn’s gravity
- Origin of numerous comets that orbit Sun in periods less than 200 years

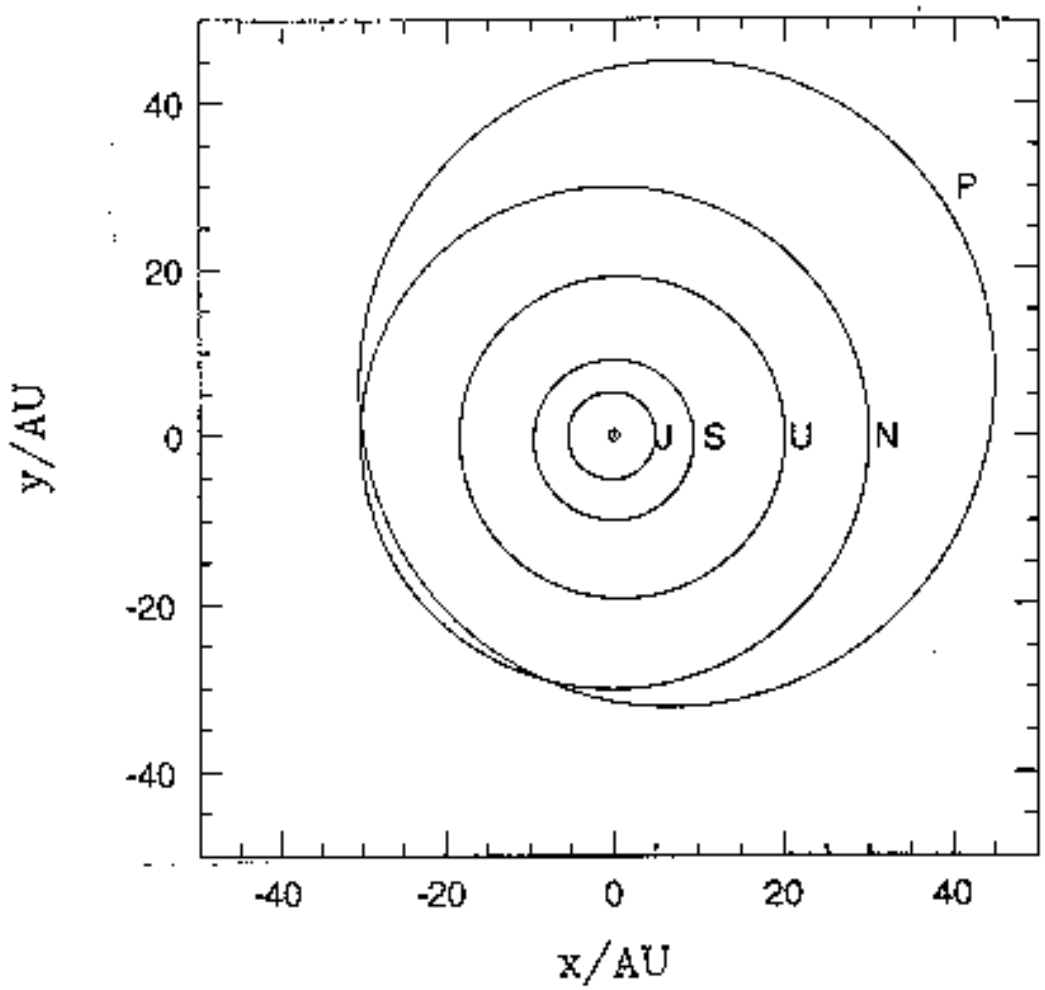
Pluto and Charon

- Pluto has Charon as a satellite, or they are twin dwarf planets
- Does not dominate its orbit
- Largest Kuiper Belt Object
  - “Plutonian objects” of which it is the original example



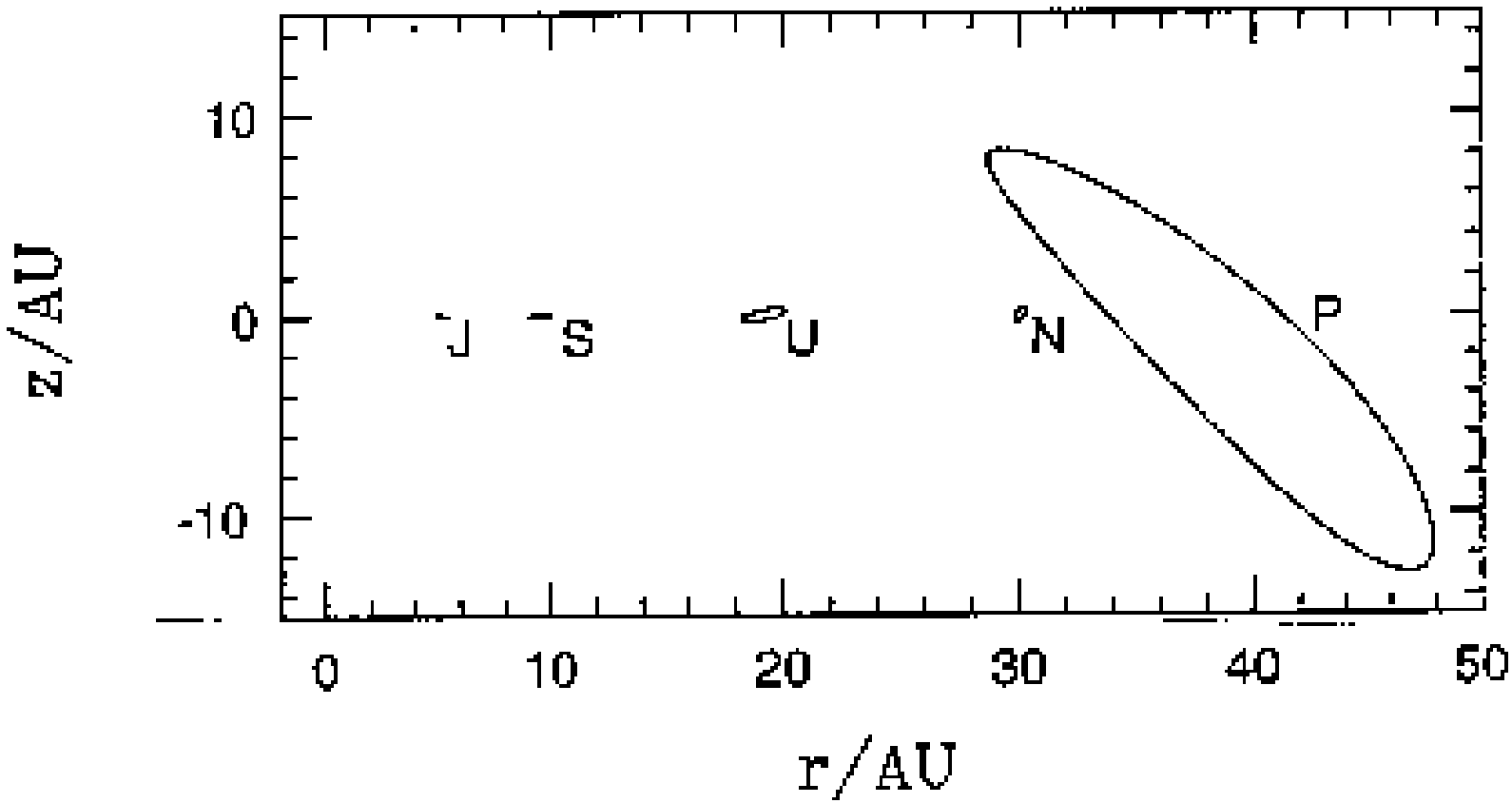
Orbits of outer planets

- Notice Pluto is sometimes closer to Sun than Neptune



- http://www.nineplanets.org/plutodyn.html

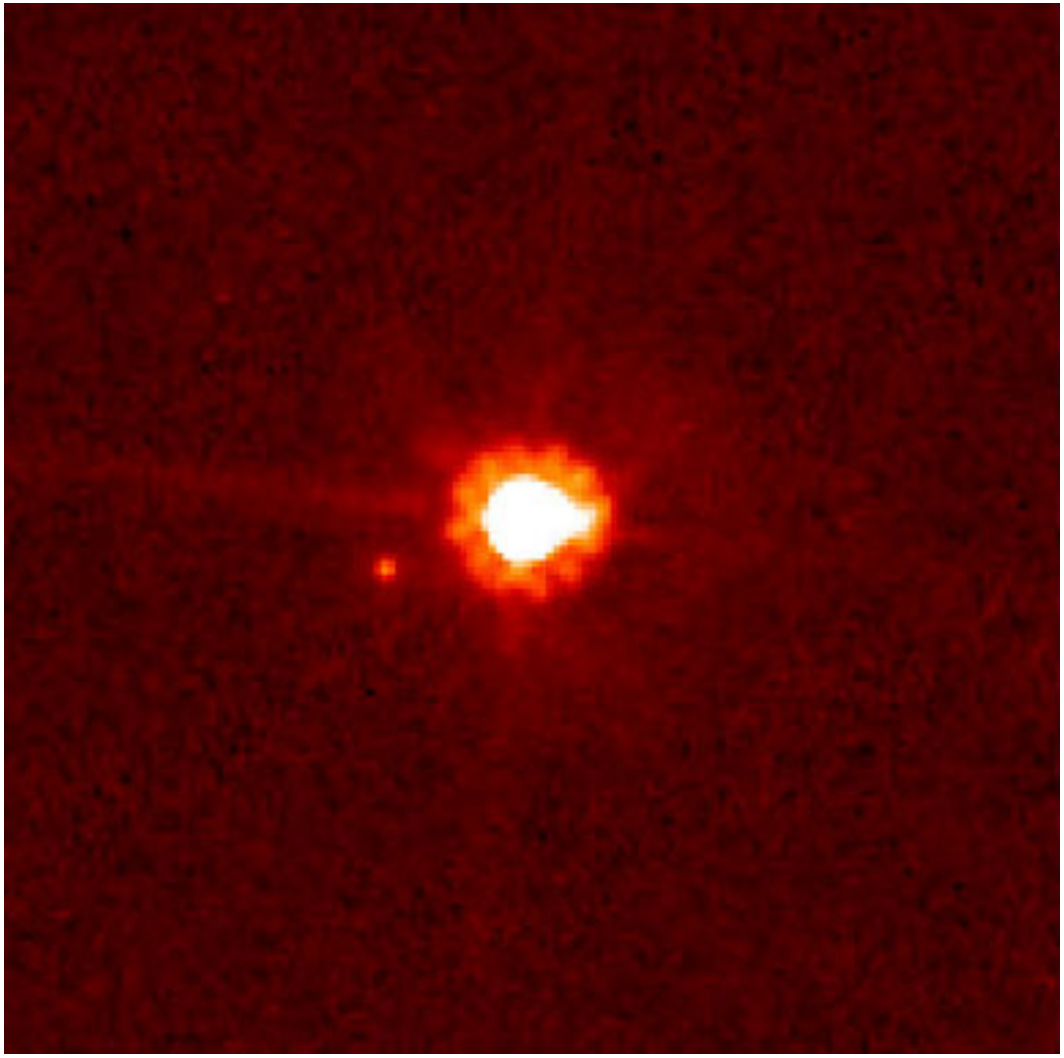
Inclination of Pluto's orbit



- http://www.nineplanets.org/plutodyn.html

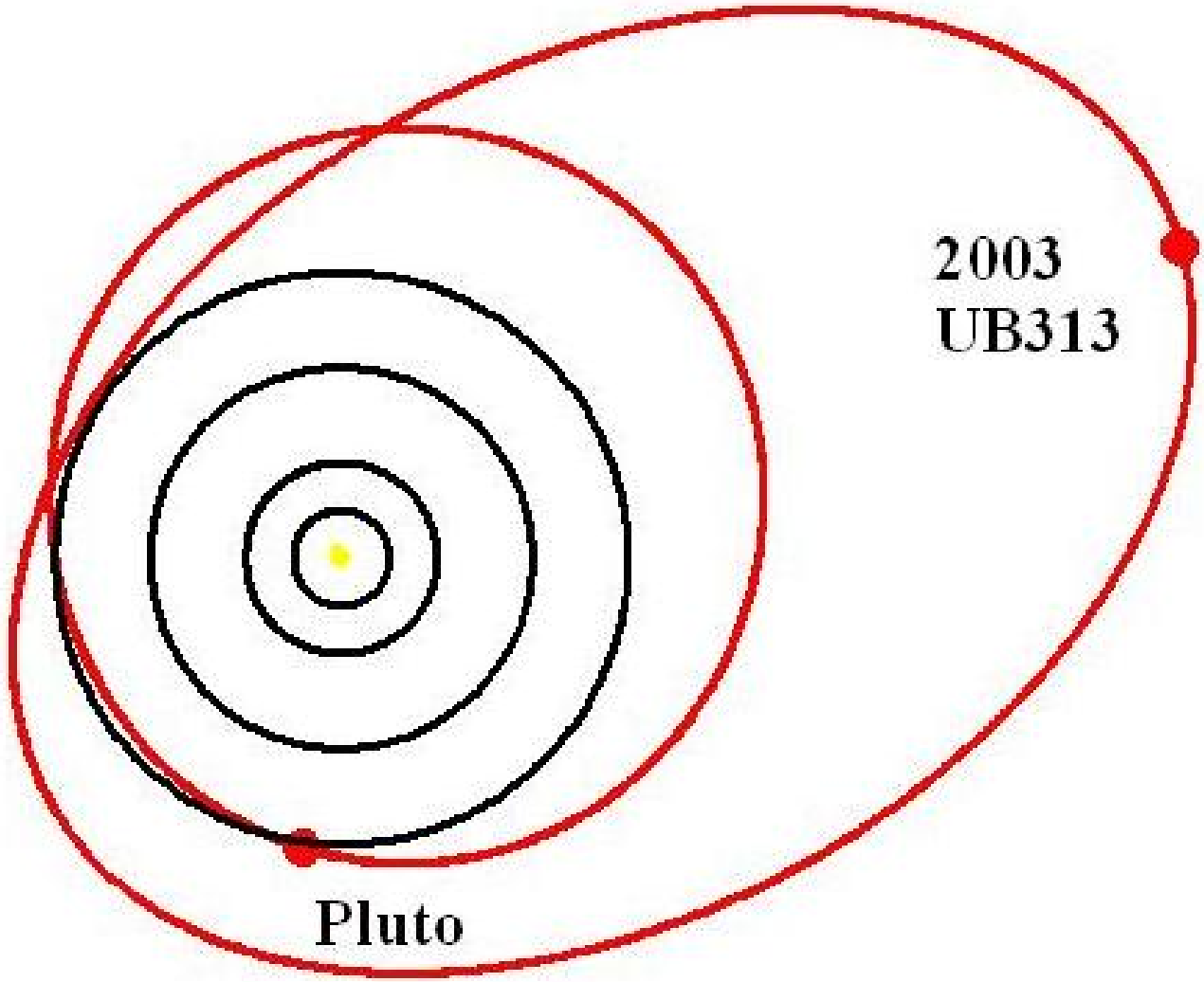
Eris

- Kuiper Belt Object
- Larger than Pluto
- Discovered in 2003



http://en.wikipedia.org/wiki/Eris_(dwarf_planet)

Eris (2003 UB 313)

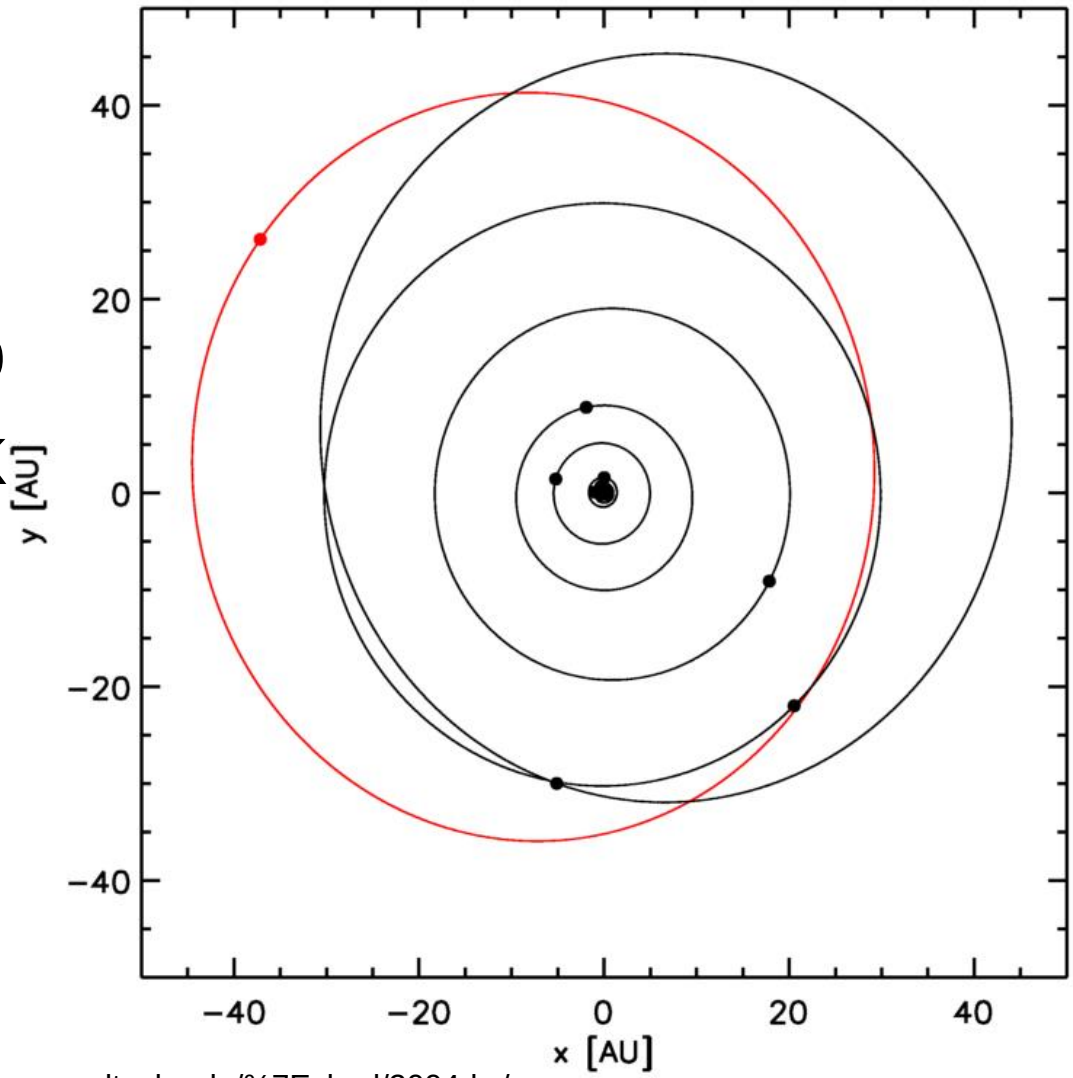


http://www.gps.caltech.edu/~mbrown/planetlila/#size

Orbit of 2004 DW Kuiper Belt Object

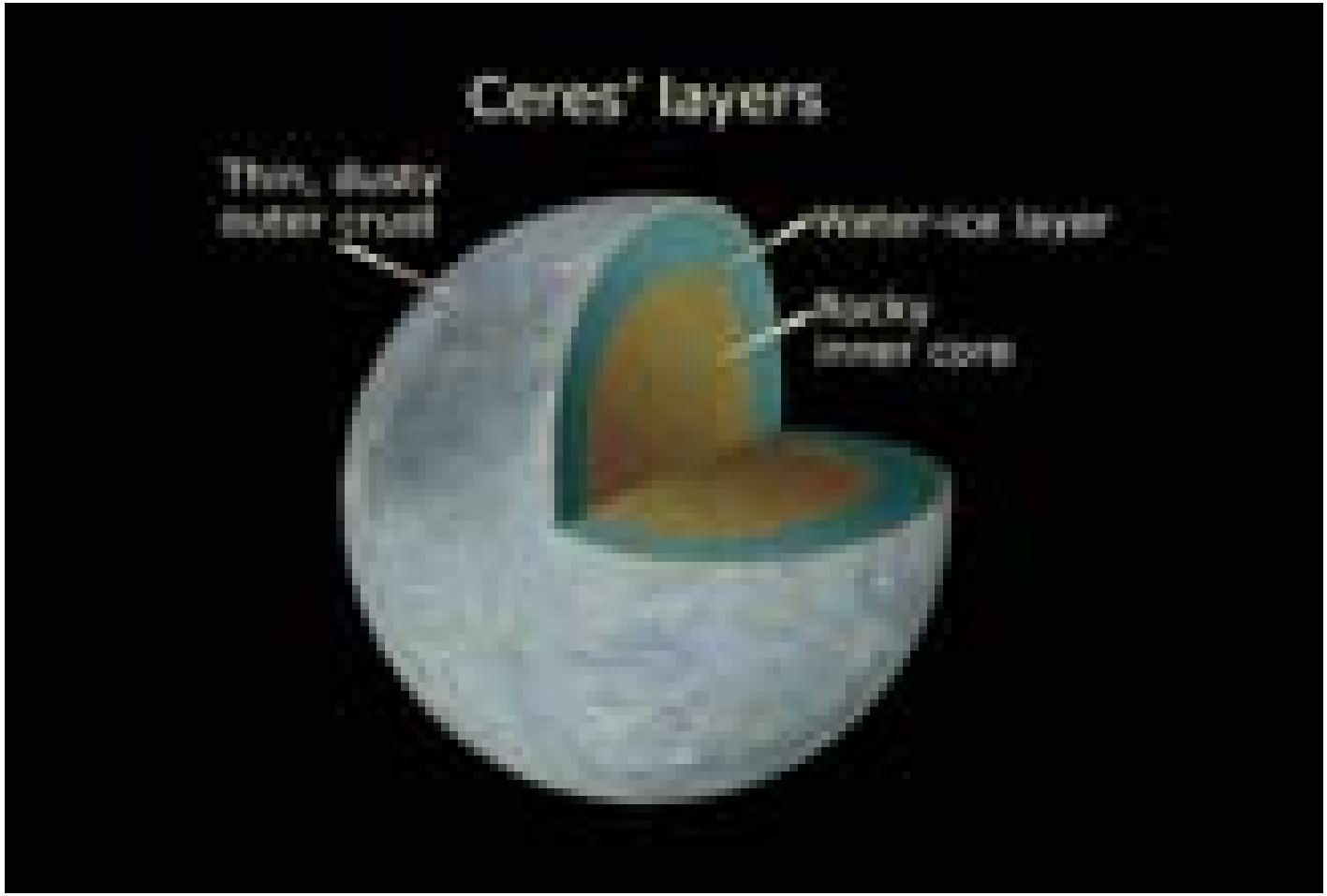
In red

Compare
to Pluto
in black



- http://www.gps.caltech.edu/%7Echad/2004dw/

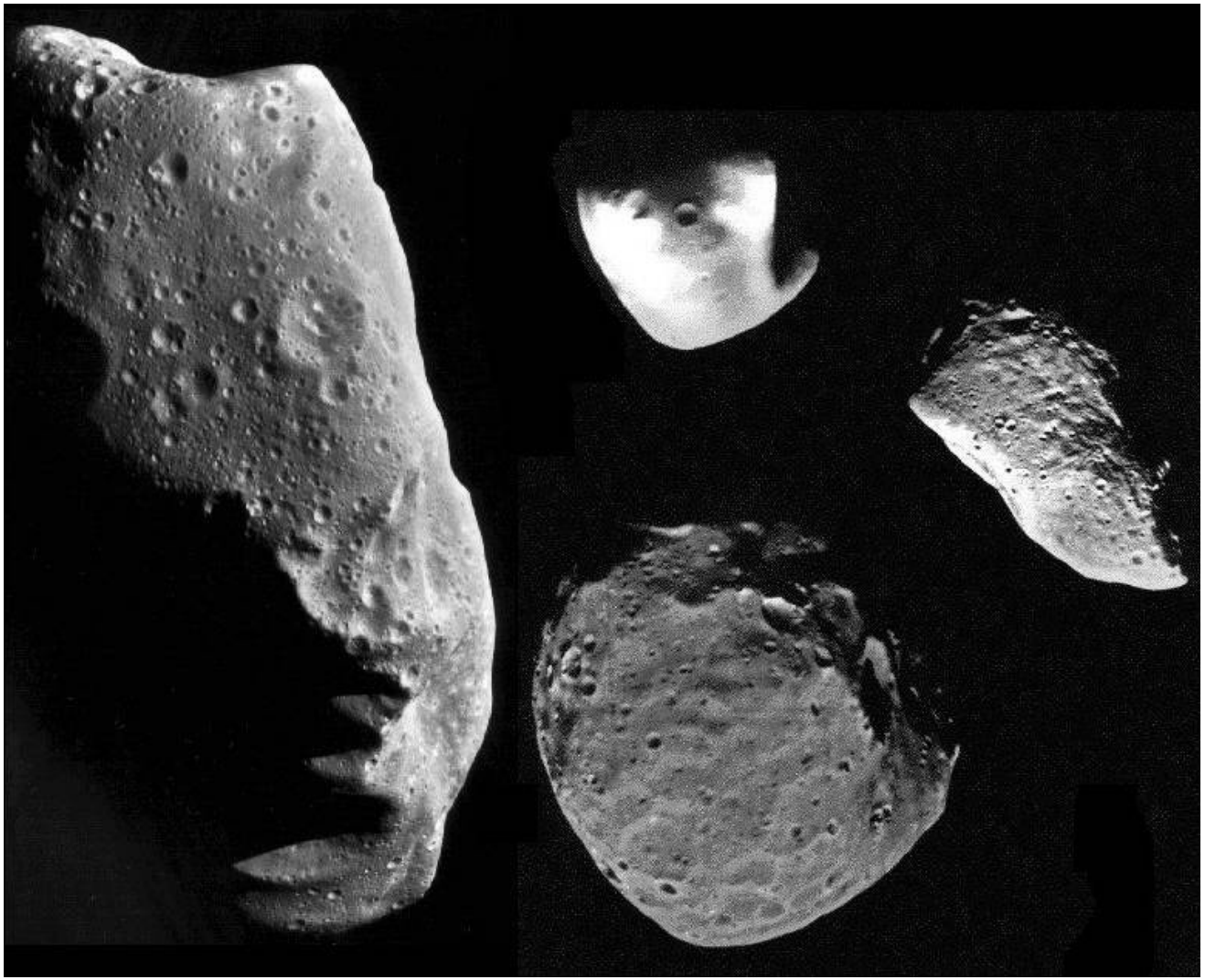
Ceres composition



- http://www.space.com/scienceastronomy/050907_ceres_planet.html

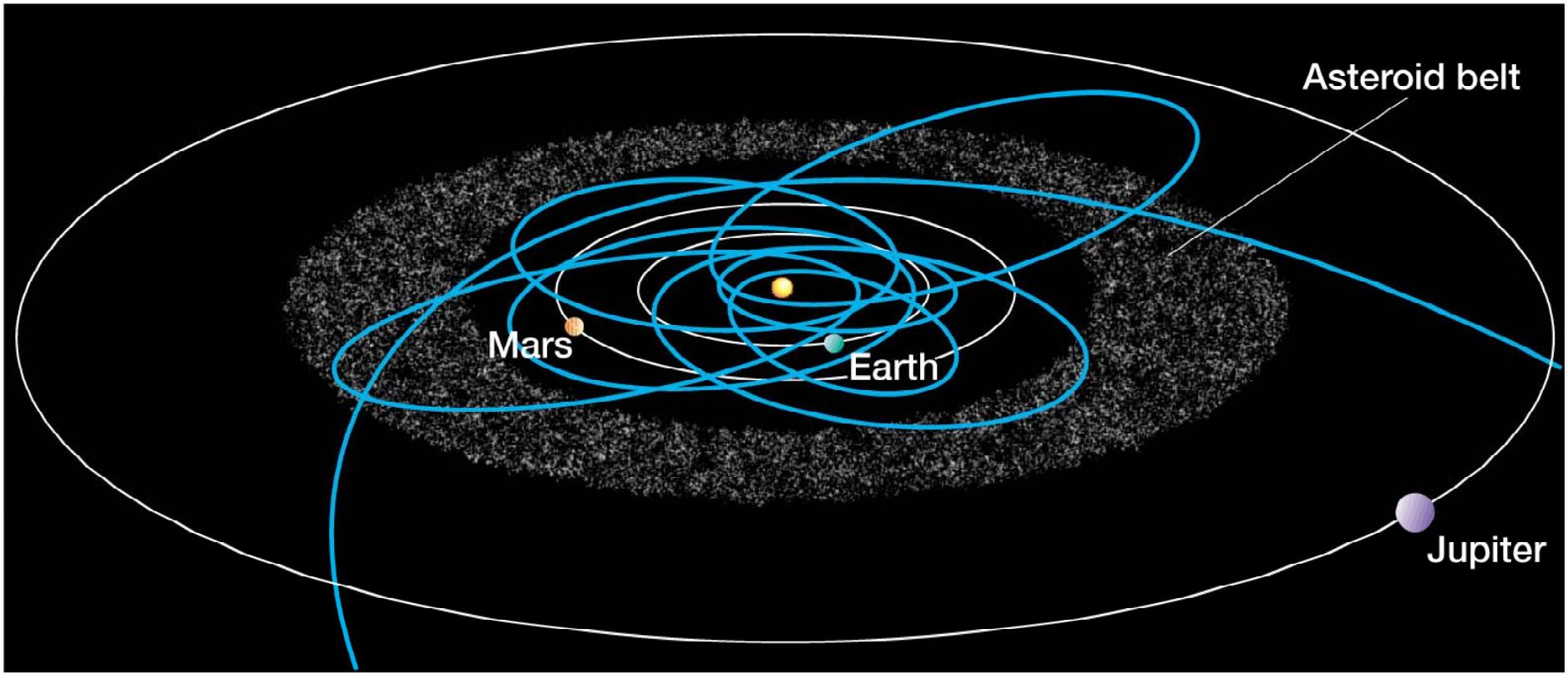
Asteroids

Ida,
Gaspra,
Deimos,
Phobos



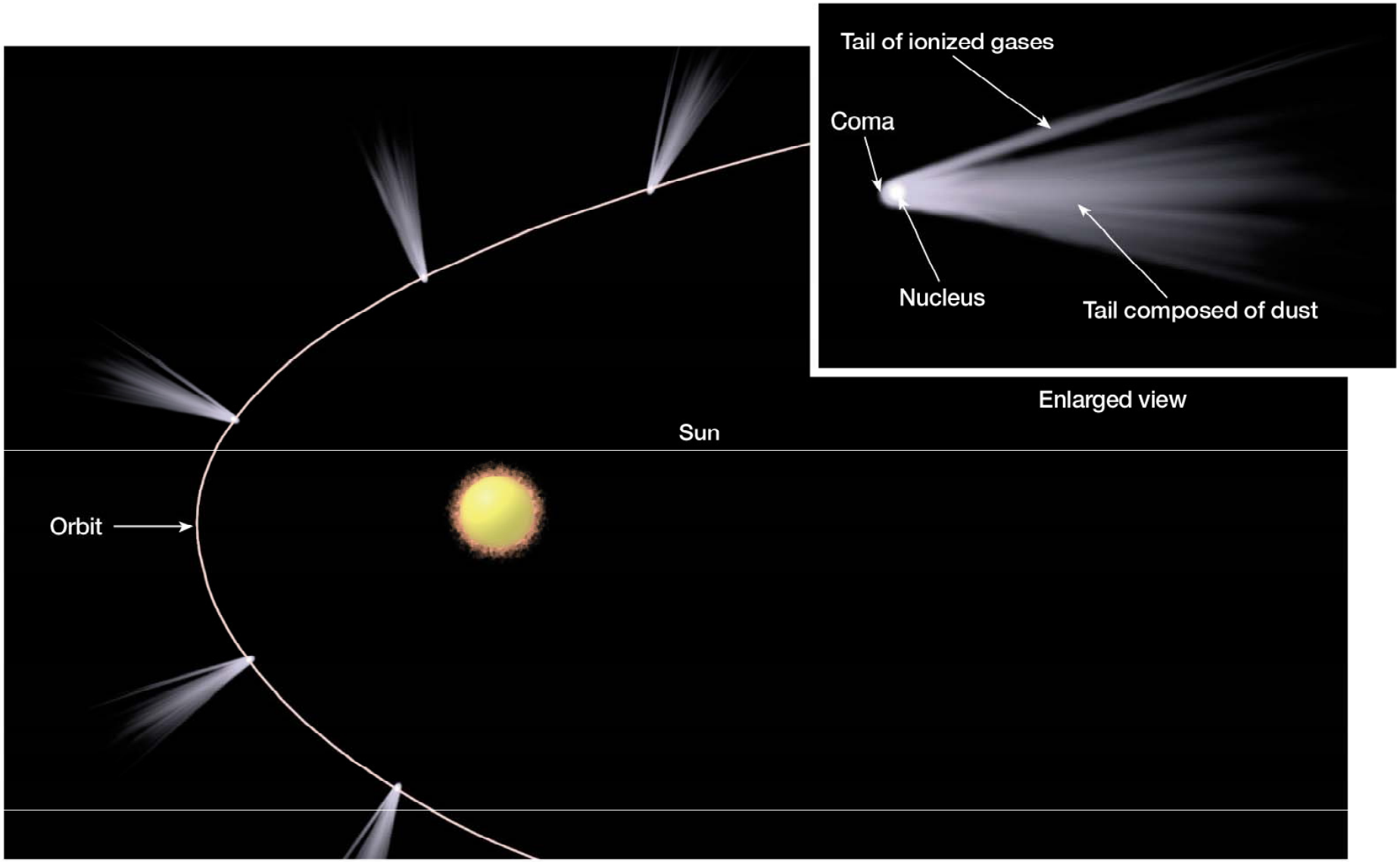
- http://www.nineplanets.org/asteroids.html

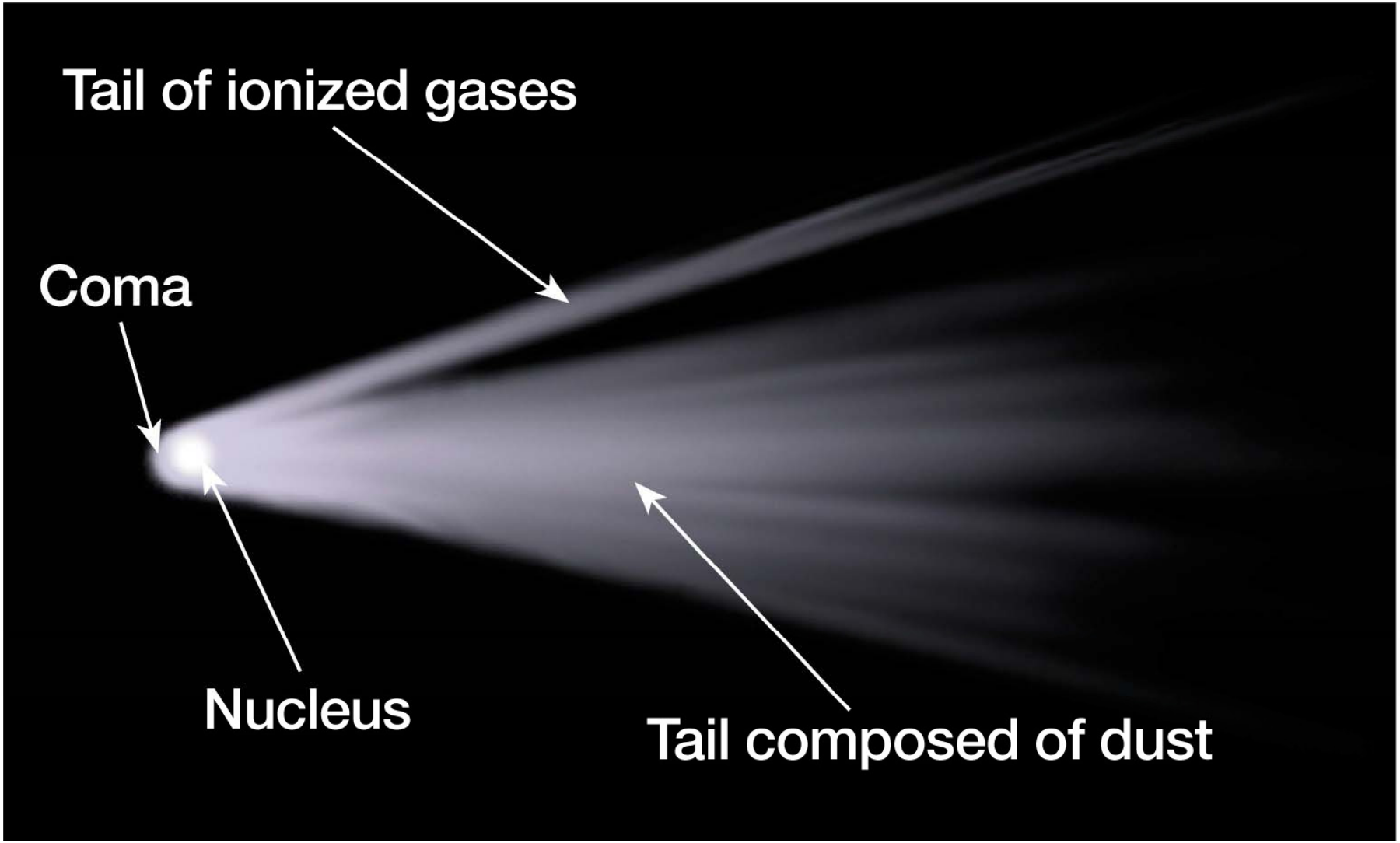
Asteroids

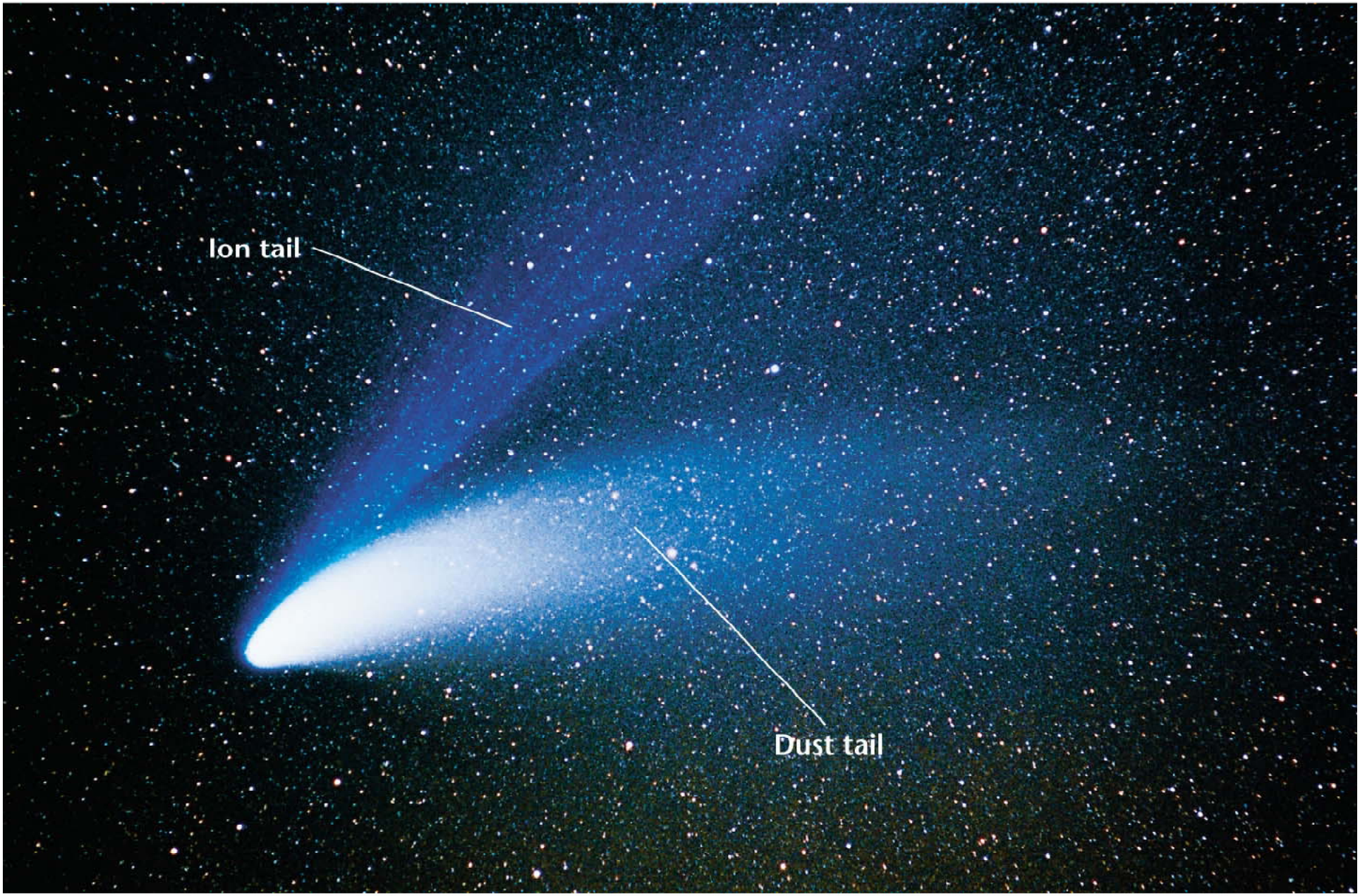


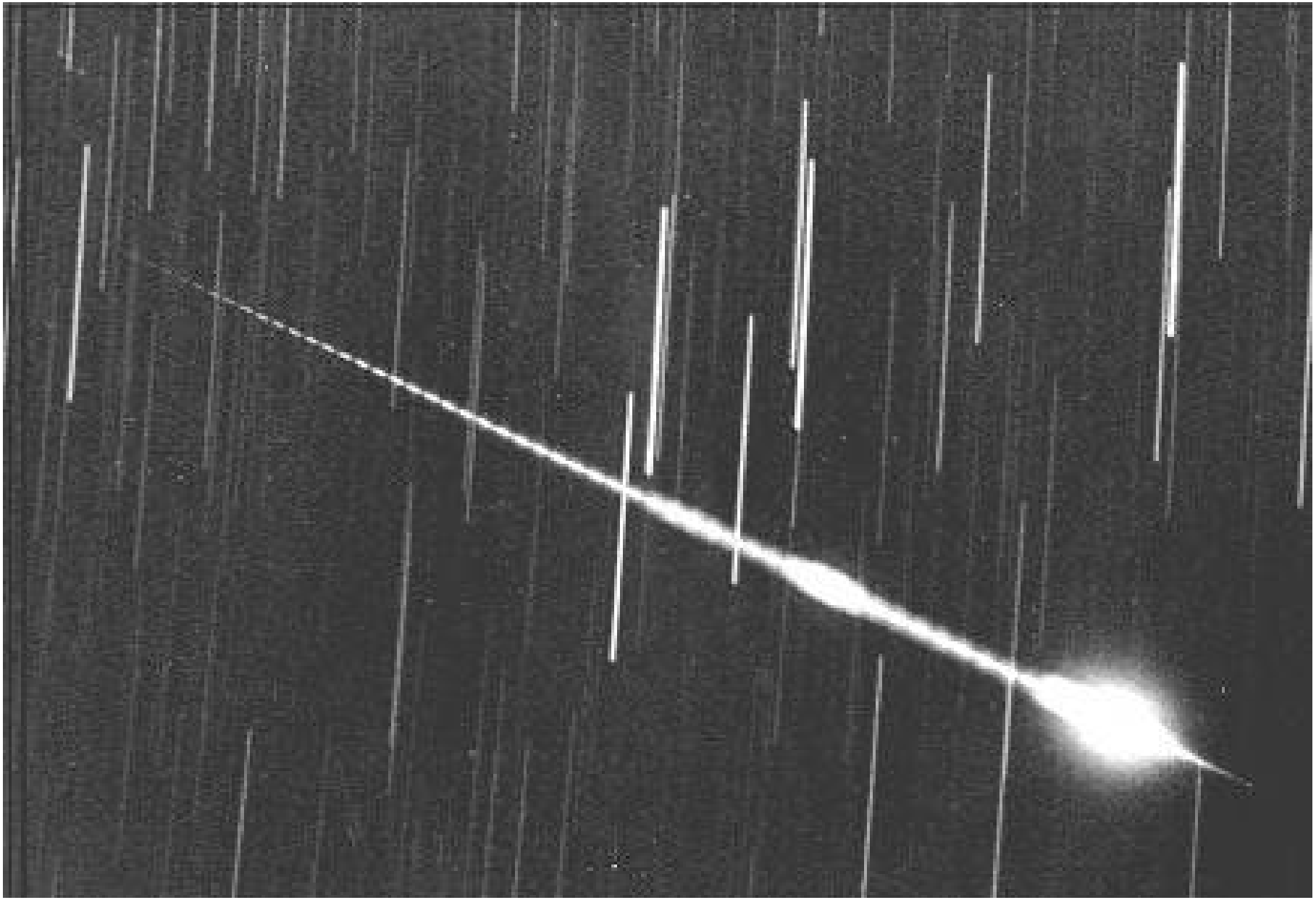
Gaspra

Comet


Tail of ionized gases
Coma
Nucleus
Tail composed of dust
Enlarged view
Sun
Orbit

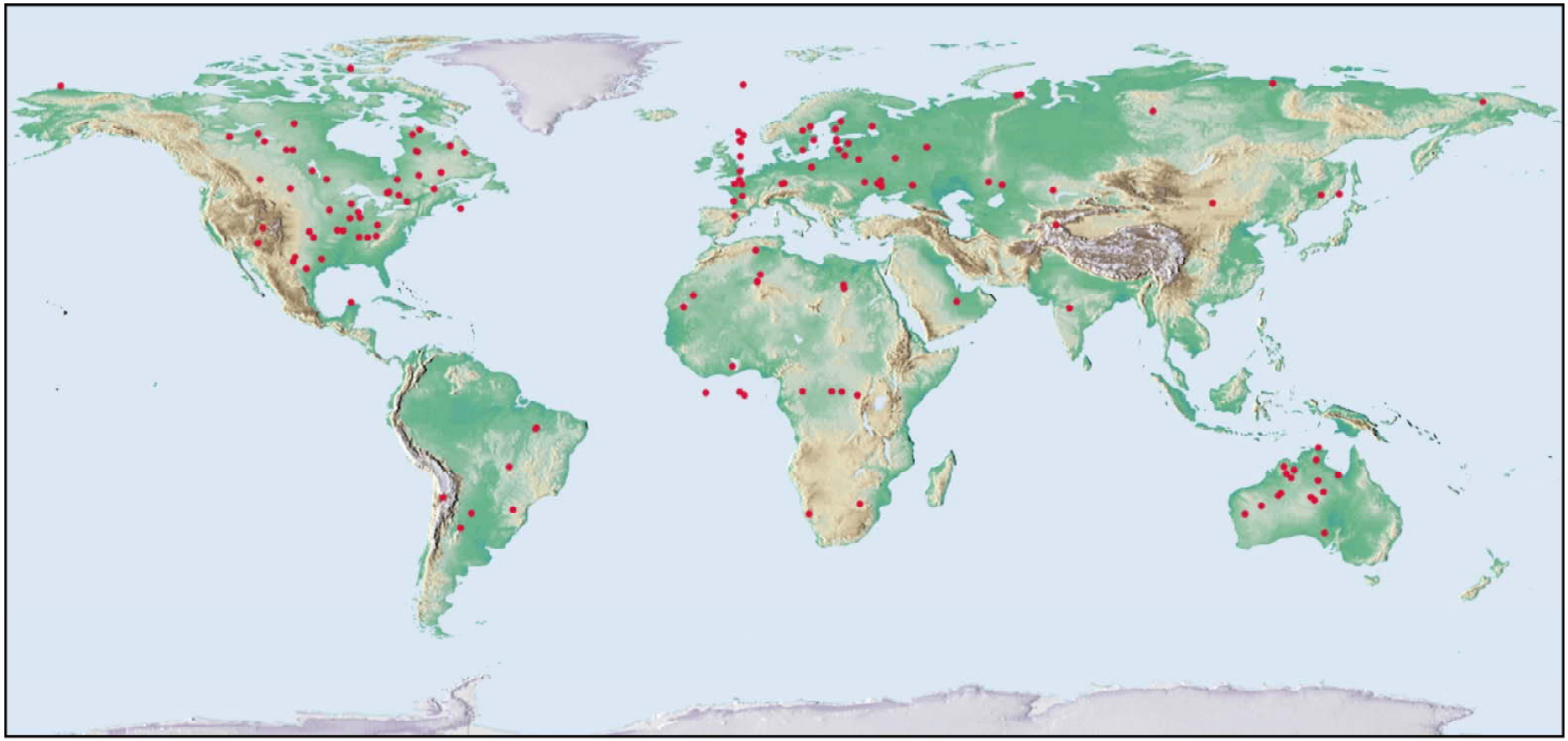

Tail of ionized gases
Coma
Nucleus
Tail composed of dust


Ion tail
Dust tail



- http://www.dmsweb.org/

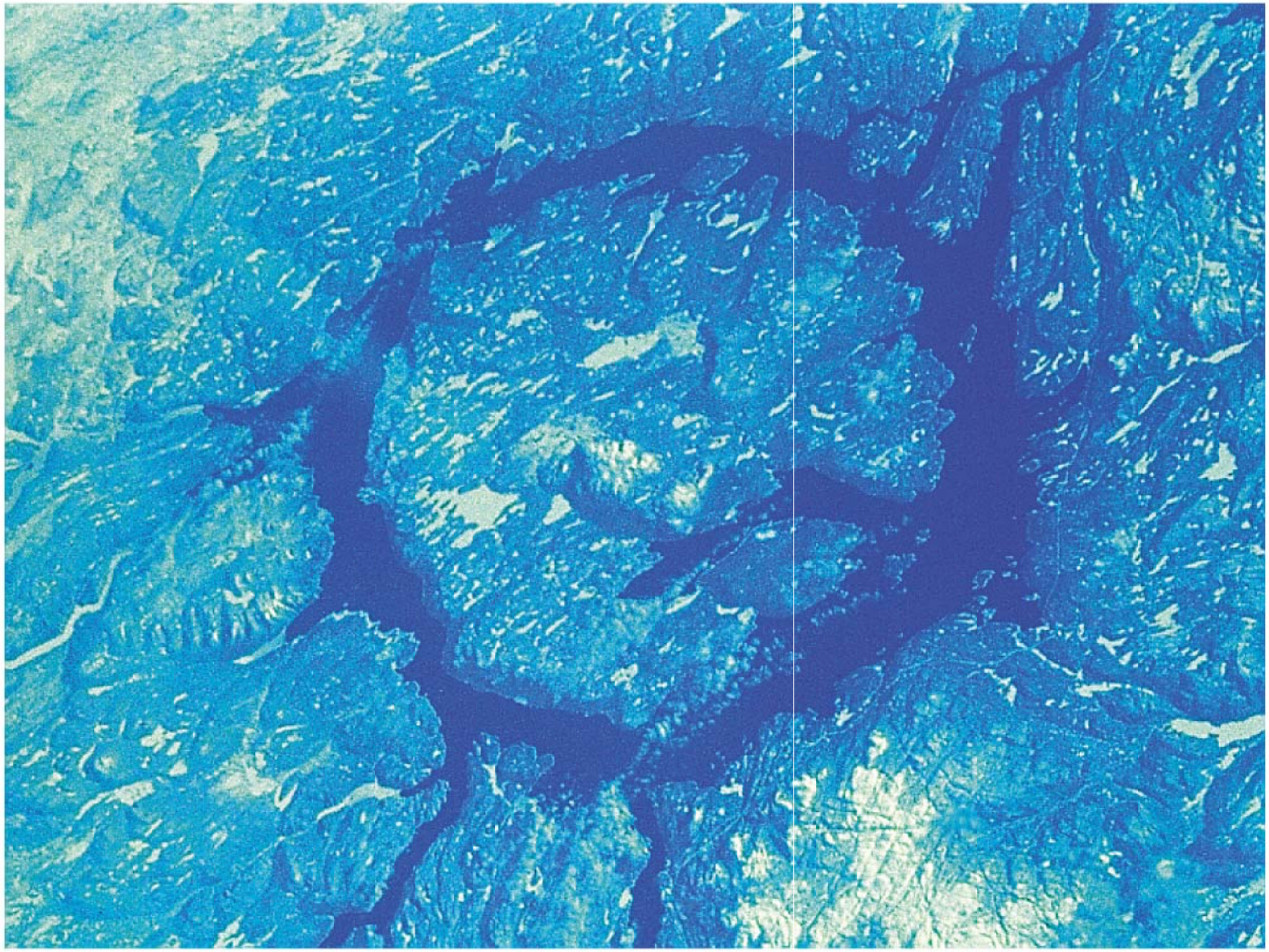
Major Impact Structures



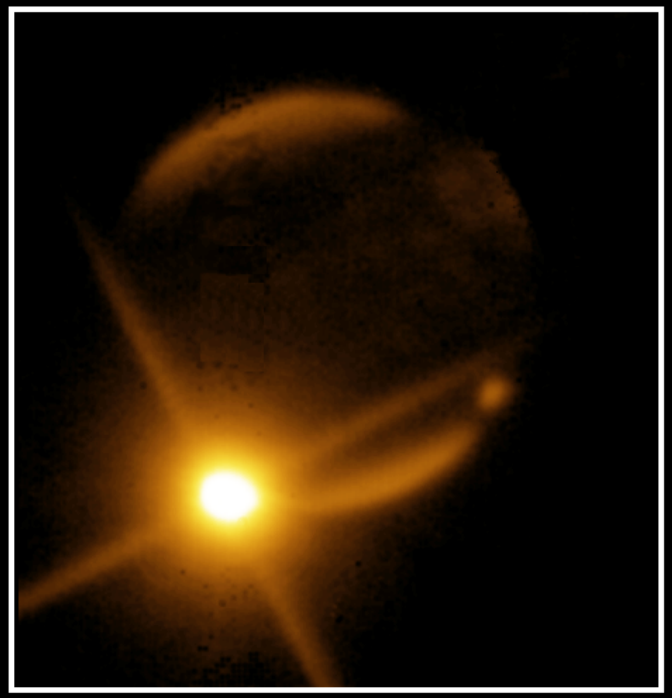
Meteor Crater, Arizona

- http://www.xtec.es/recursos/astronom/craters/METEOR.jpg

Manicouagan, Quebec



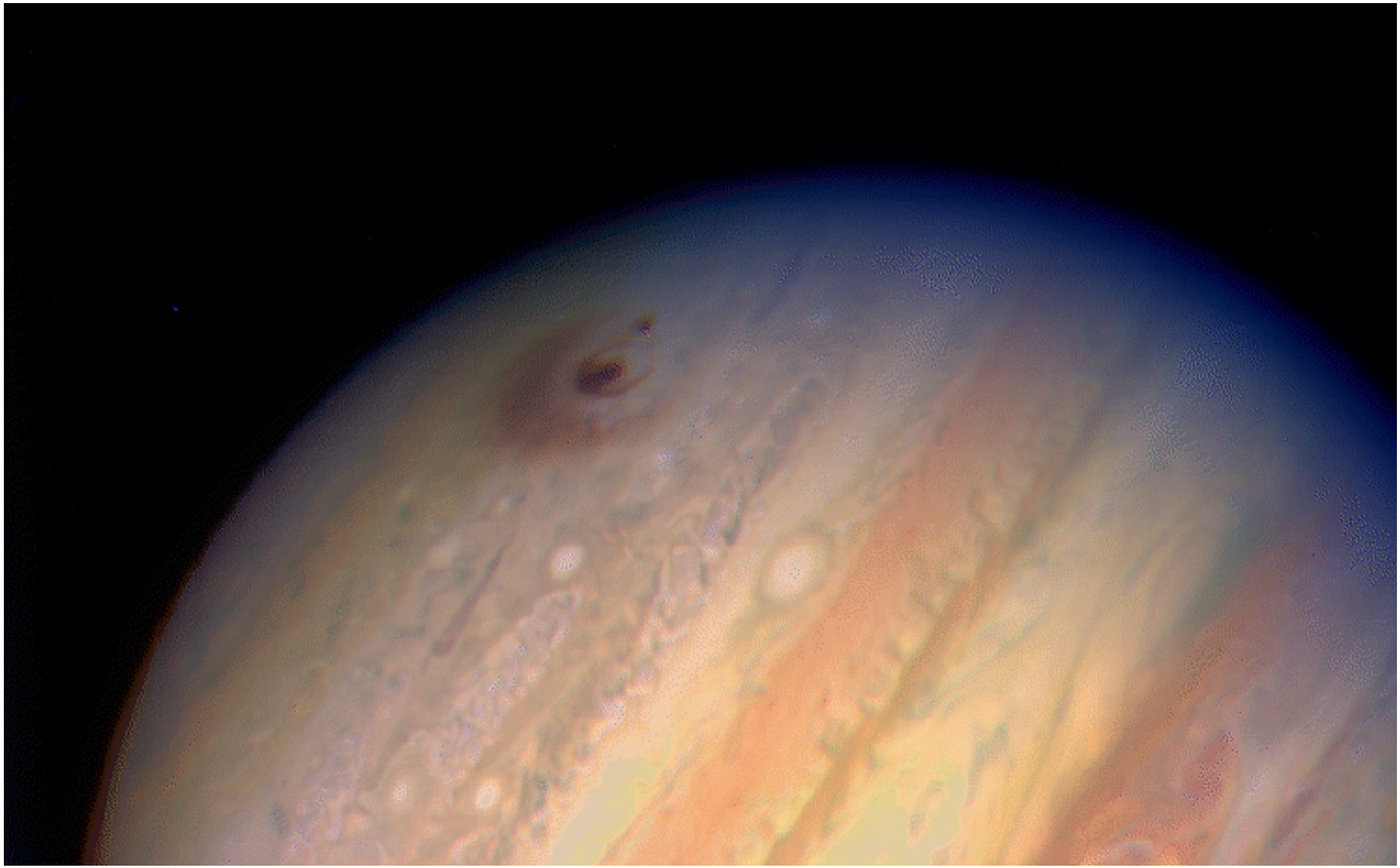
Shoemaker-Levy 9



Impact of Fragment G of Comet Shoemaker-Levy on Jupiter
The fireball is seen 12 minutes after impact at 2.34 microns.
The impact A site is seen on the opposite limb of the planet.

Image at 2.34 microns with CASPIR by Peter McGregor
ANU 2.3m telescope at Siding Spring

- http://www.nineplanets.org/sl9.html



- http://nssdc.gsfc.nasa.gov/planetary/sl9/image/sl9g_hst5.gif

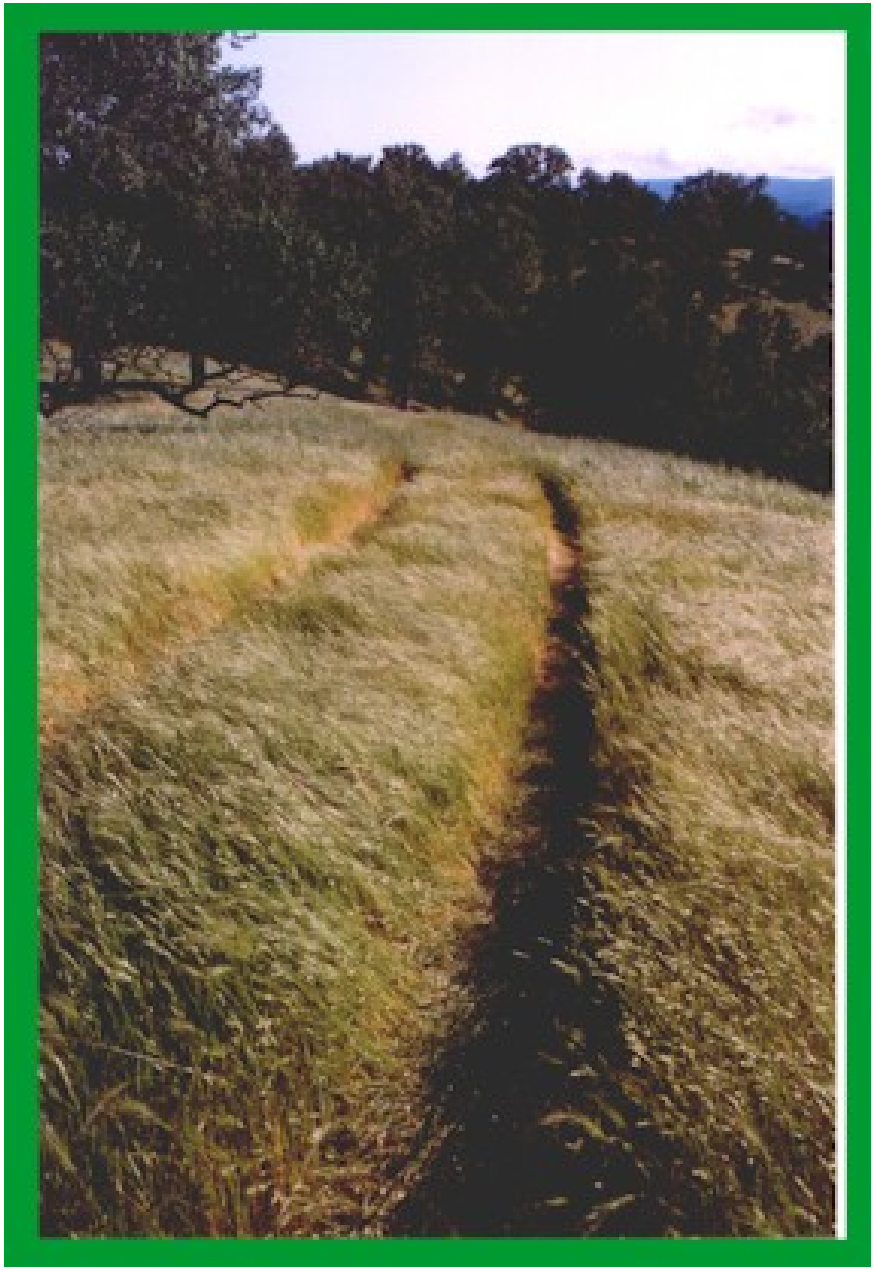
The Nature of Light

- Light is made of photons
- Photons act as particles
- Photons act as waves

Waves

- Movement of energy, not of matter

Overlapping ripples



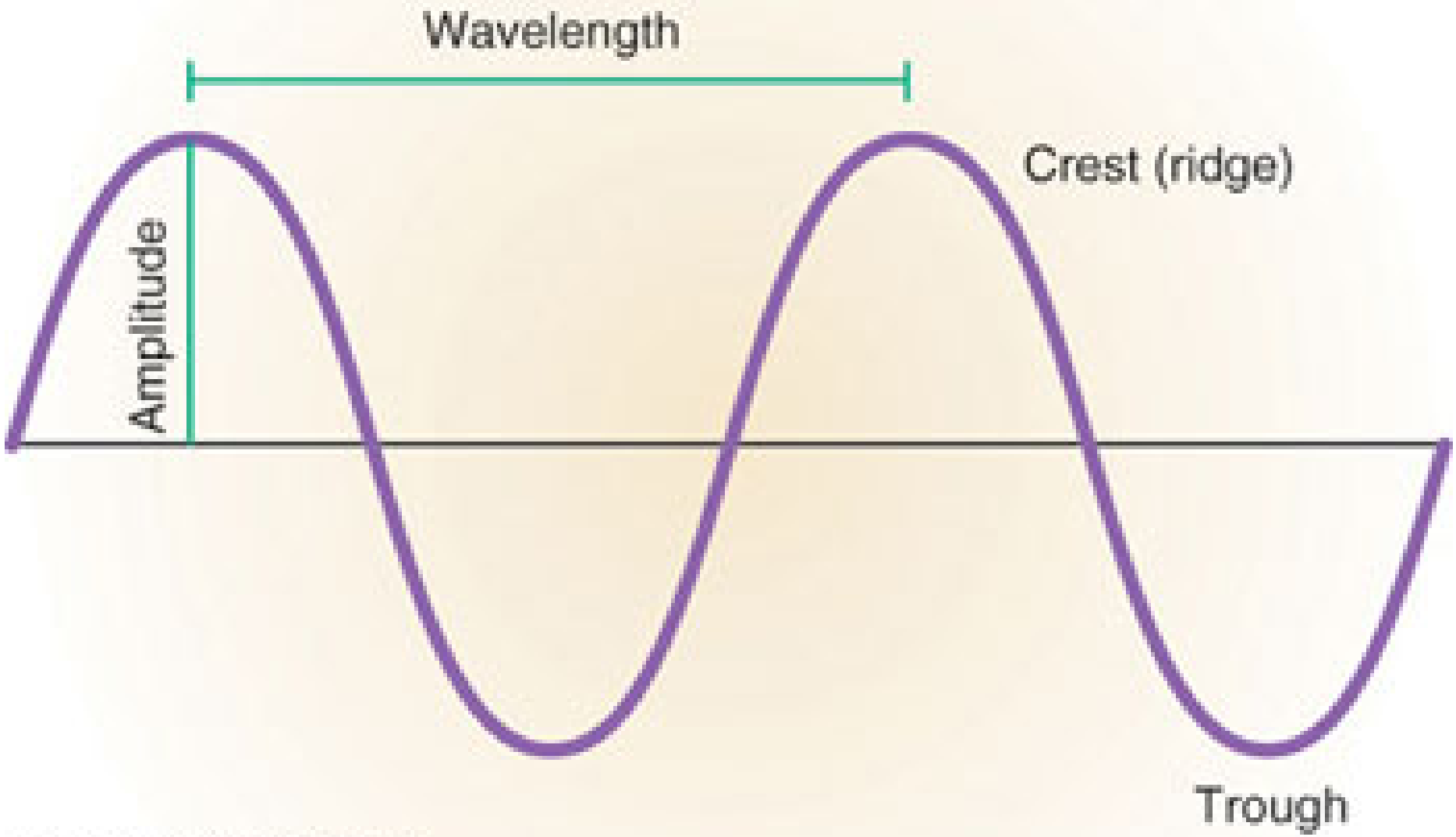
http://www.4oliveus.com/land_4_sale/images/L_Wave_of_Grass.jpg

Waves are movement of energy

- The matter pretty much stays put

- Video link below, clip #142-69

http://creative.gettyimages.com/source/frontdoor/DefaultFilm.aspx



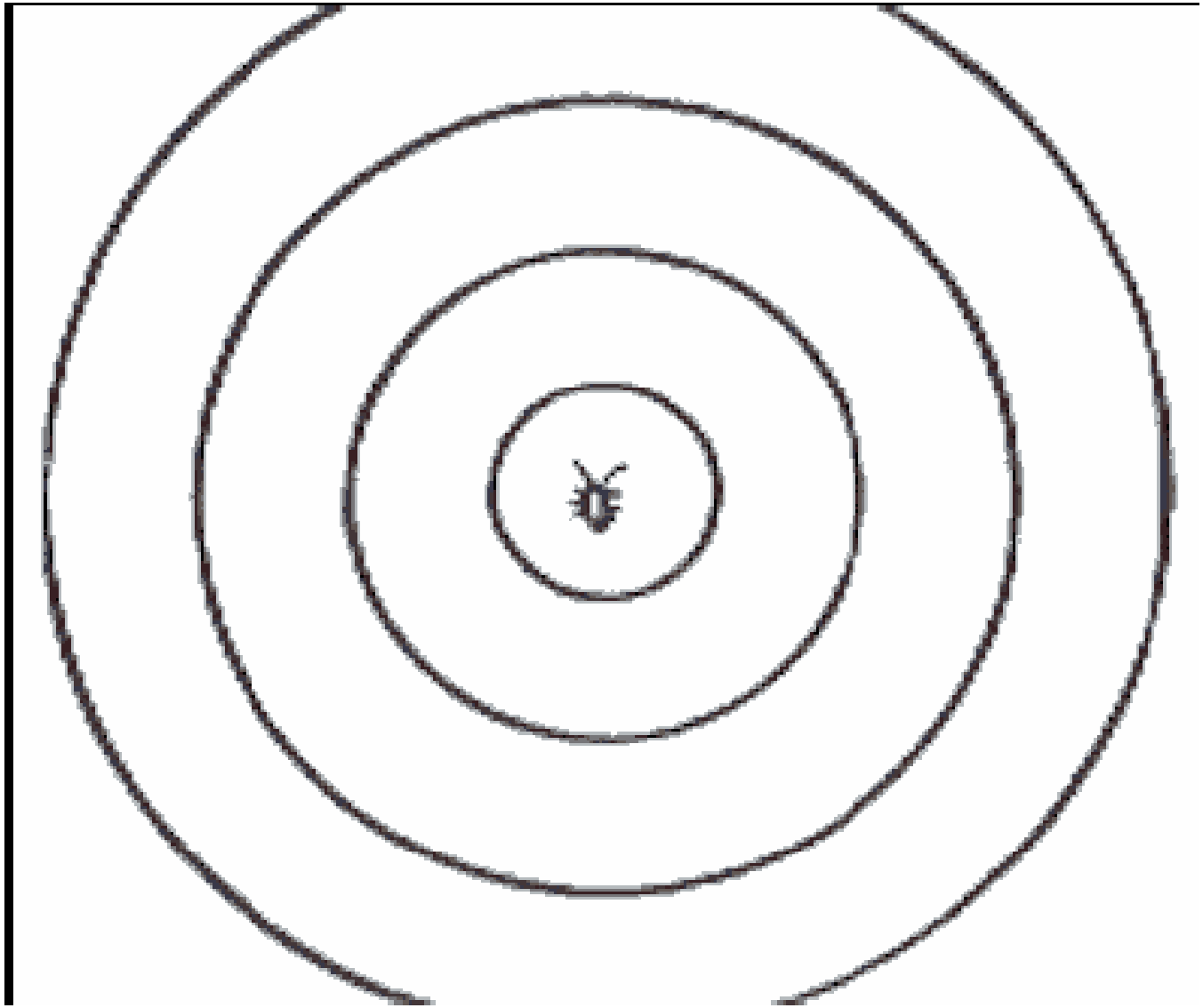
http://cimss.ssec.wisc.edu/satmet/modules/spectrum/wavelength.html

Wave Description

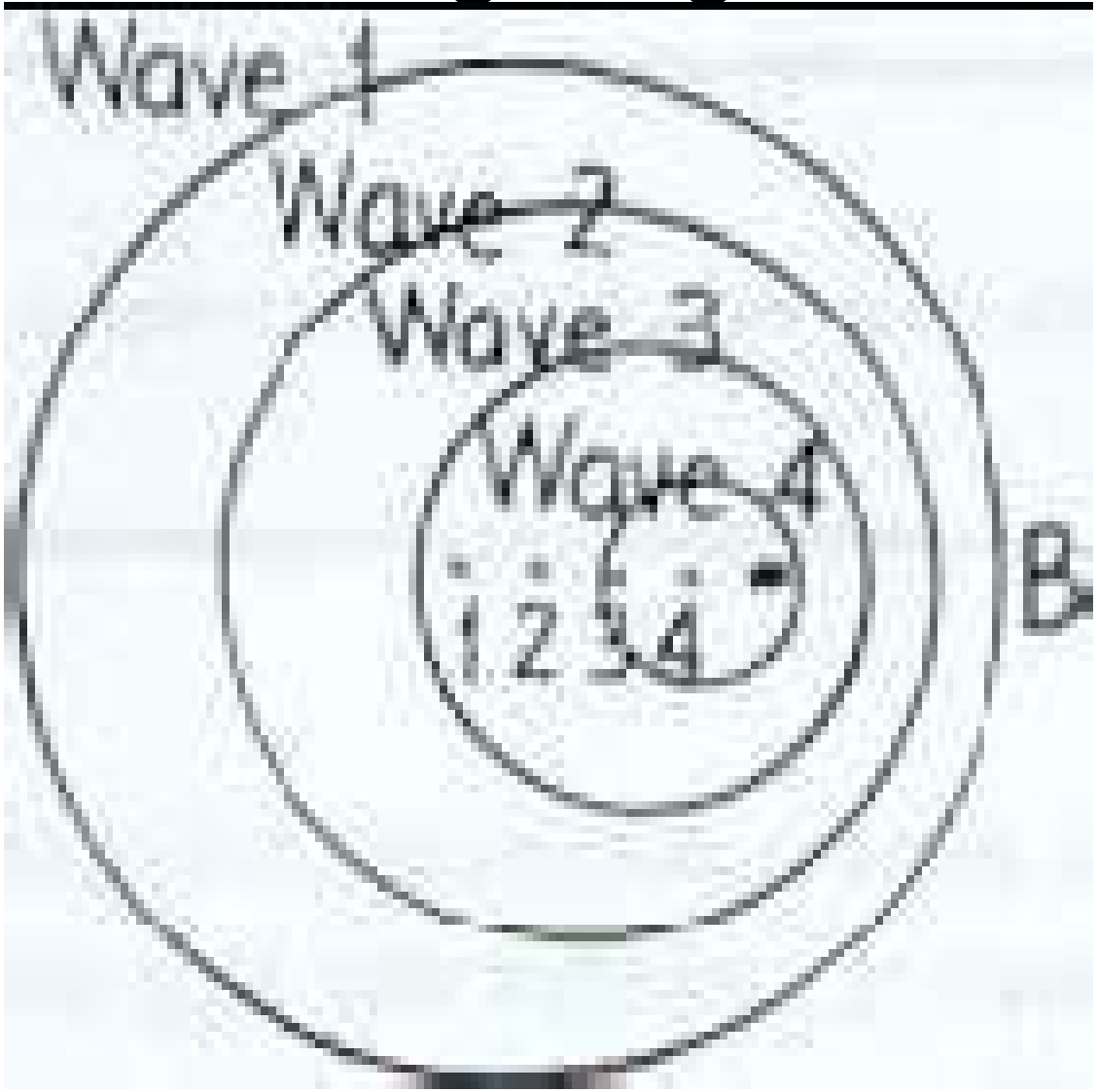
- Wavelength—distance from one part of the wave to the same part of the next wave
- Crest—top
- Trough—bottom
- Amplitude—distance from midway between crest and trough, to the crest or trough
- Period—time for one complete wave to pass
- Frequency—how often the wave passes

http://www.yenra.com/banner-ad-effectiveness/

Stationary Bug



Moving Bug



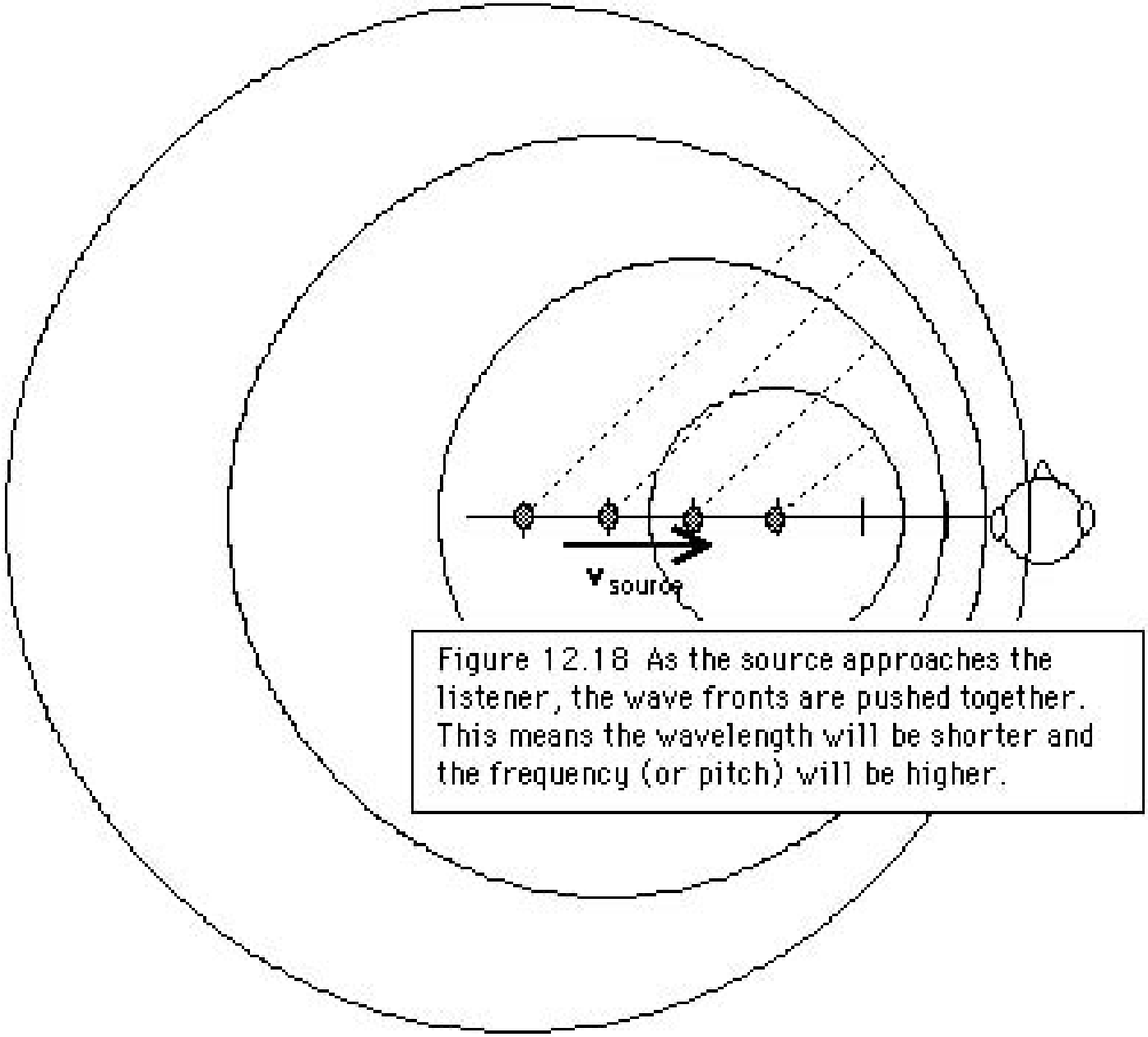
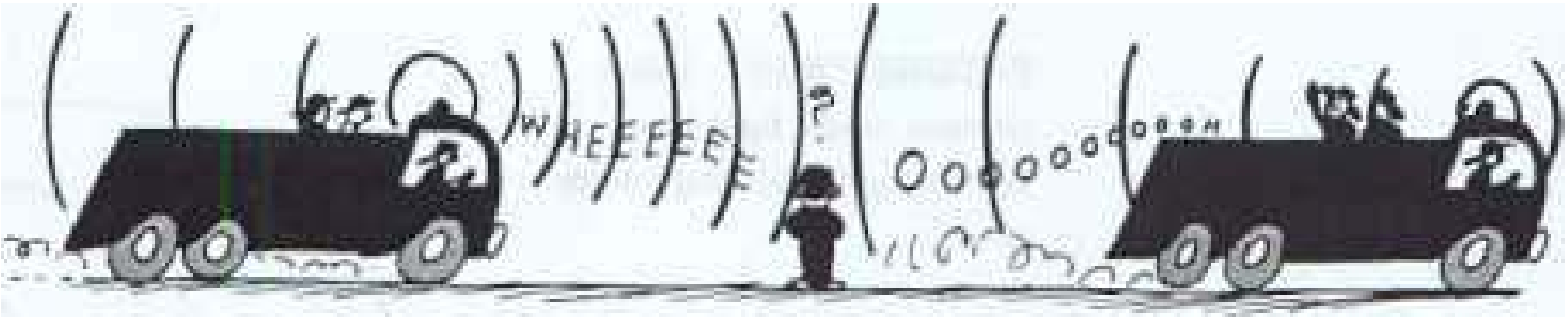


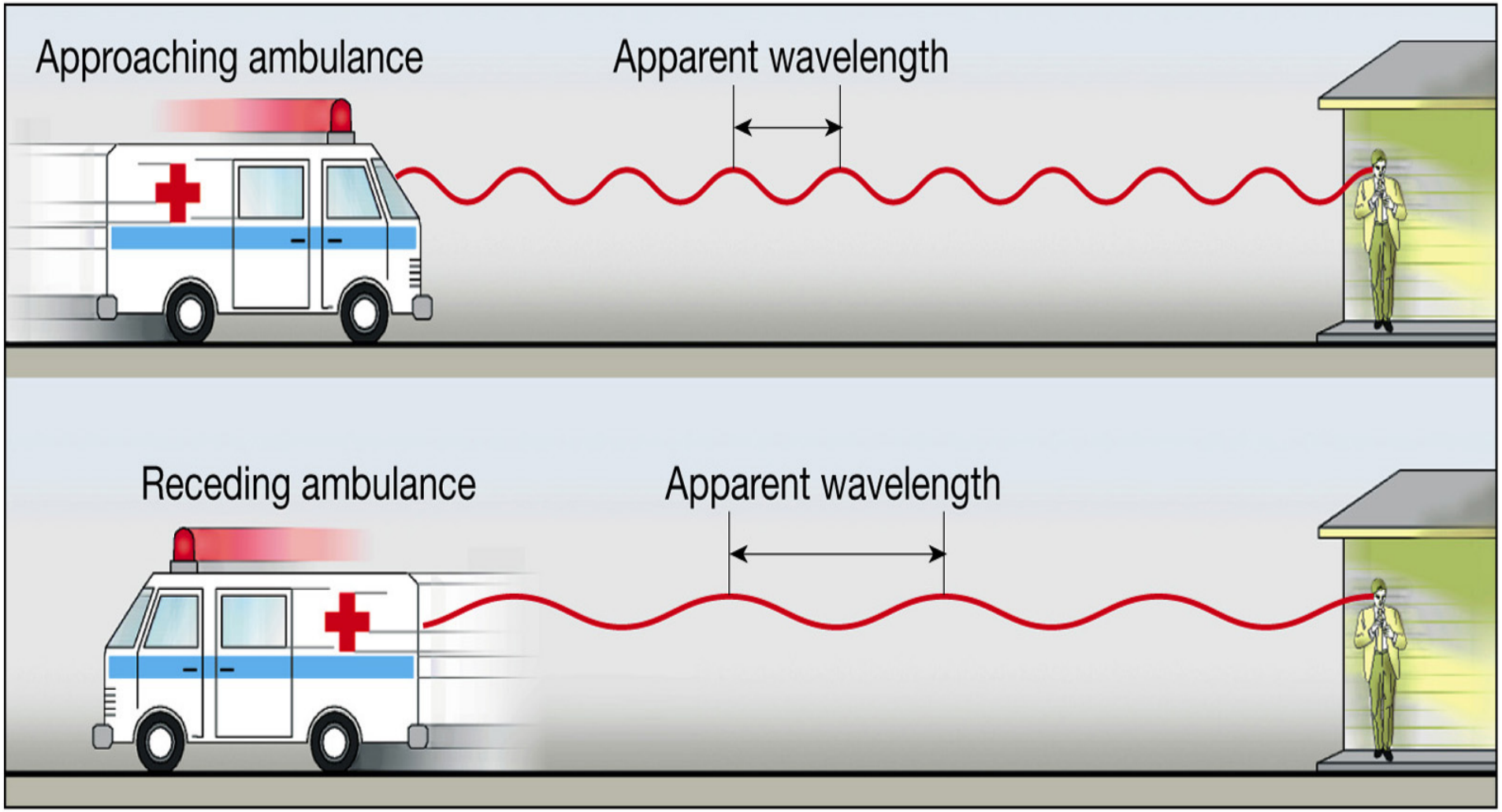
Figure 12.18 As the source approaches the listener, the wave fronts are pushed together. This means the wavelength will be shorter and the frequency (or pitch) will be higher.

http://www.eiu.edu/~mediasrv/davis/chapter_12/ch12_6.htm

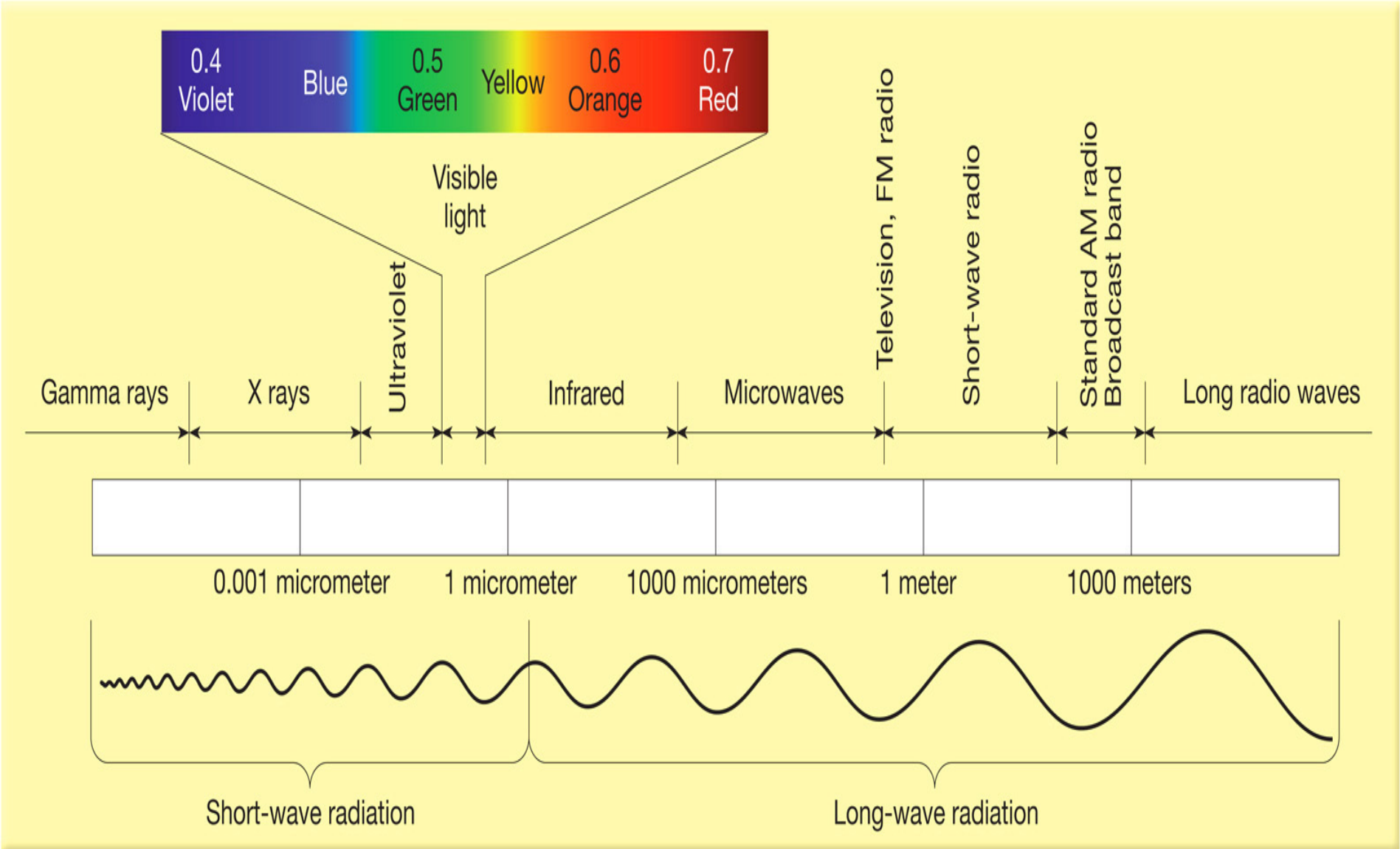
Doppler Effect of Siren



Doppler effect of movement on the reception of wave forms



Electromagnetic Spectrum



Spectrum

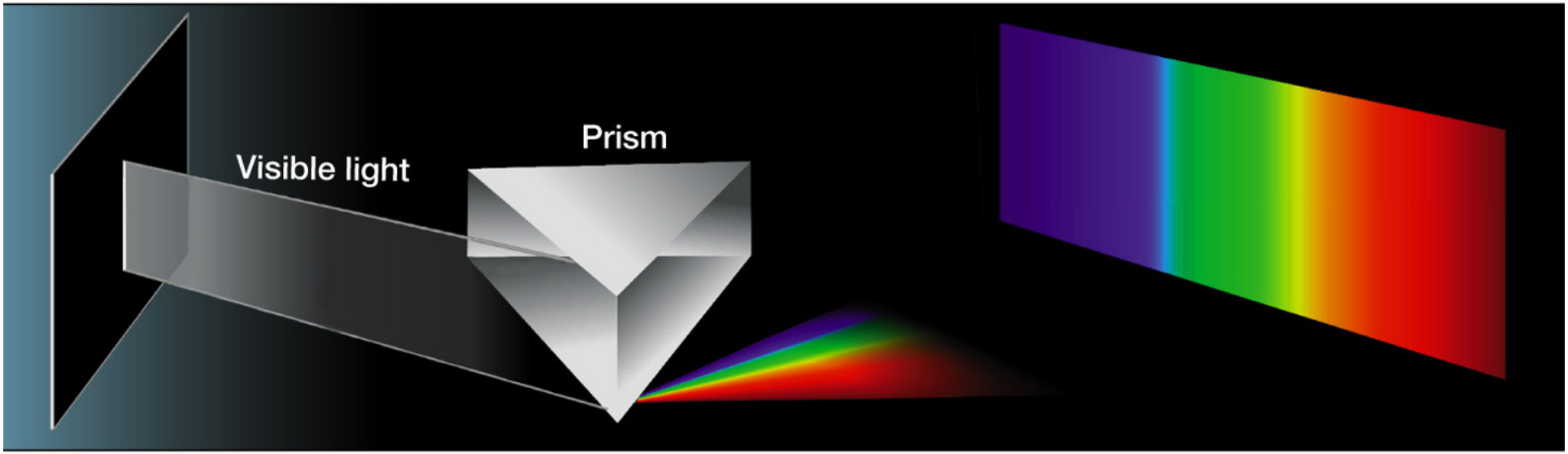
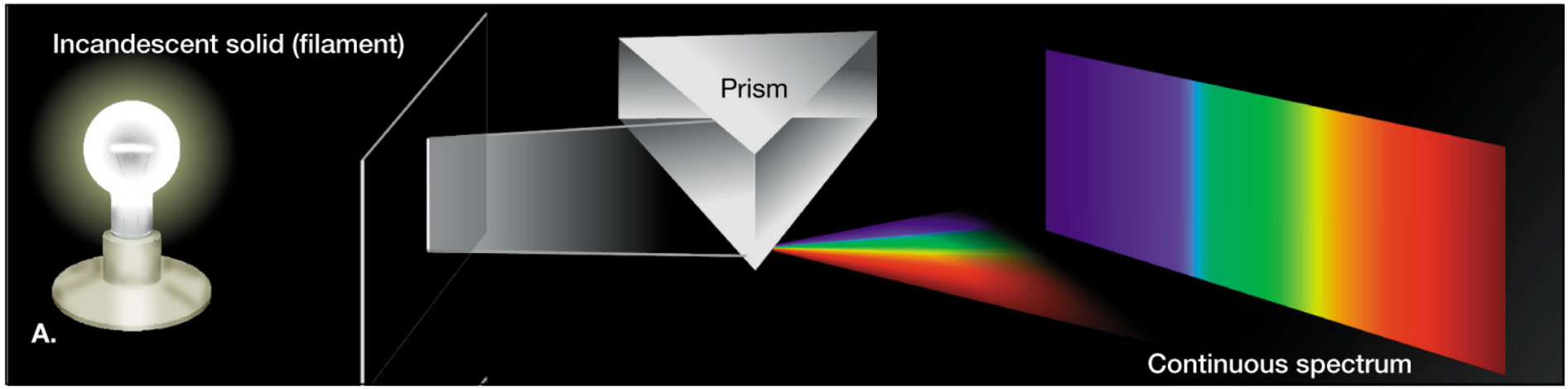


TABLE 23.1 Colors and corresponding wavelengths.

Color	Wavelength (nanometers*)
Violet	380–440
Blue	440–500
Green	500–560
Yellow	560–590
Orange	590–640
Red	640–750

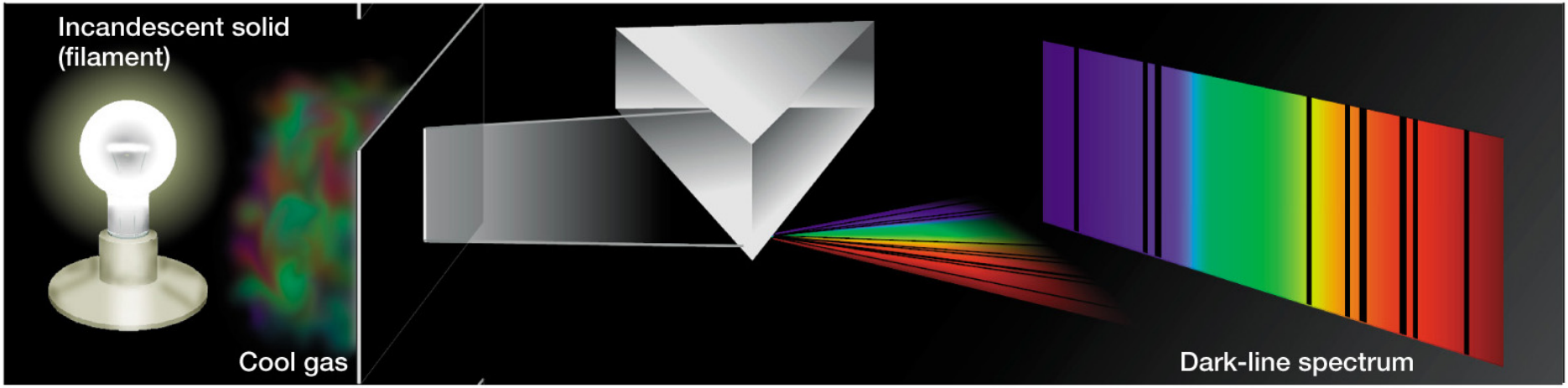
*One nanometer is 10^{-9} meter.

Continuous Spectrum



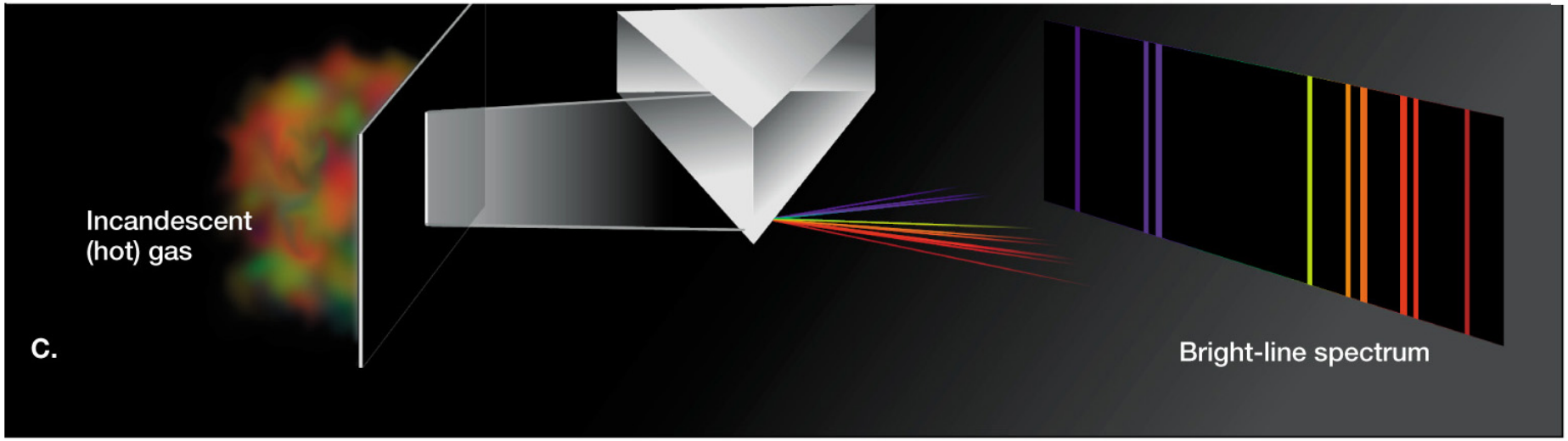
- From glowing gas under pressure
- Like the interior of Sun

Dark Line Spectrum

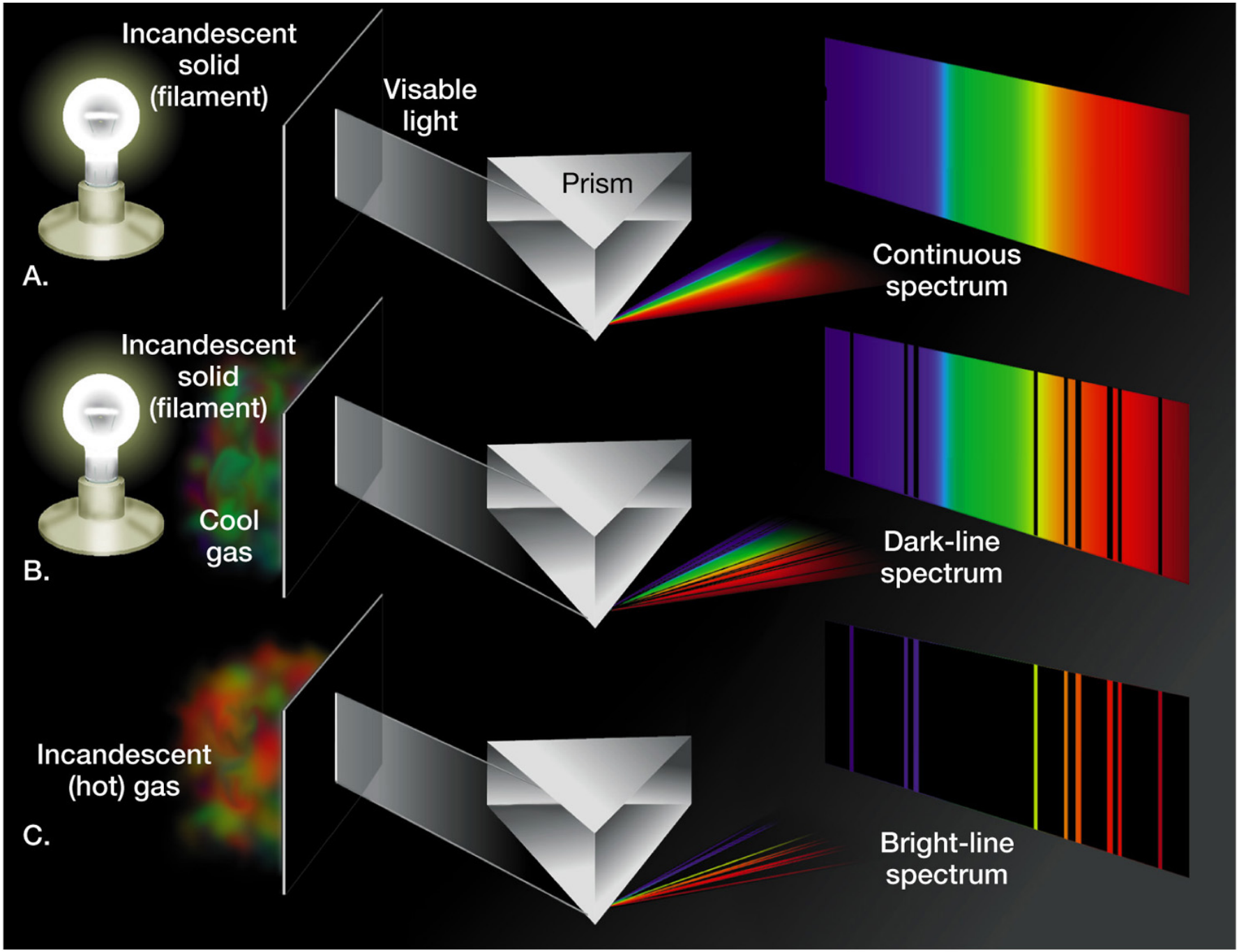


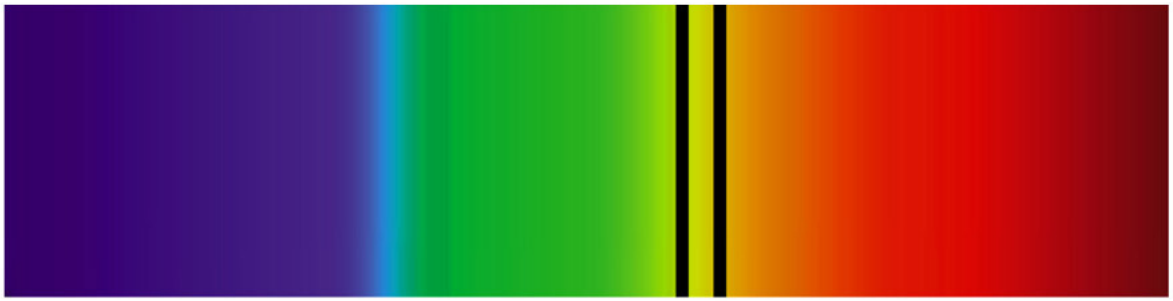
- White light passing through cold, low pressure gas
- Gas absorbs its elemental wavelength signature

Bright Line Spectrum

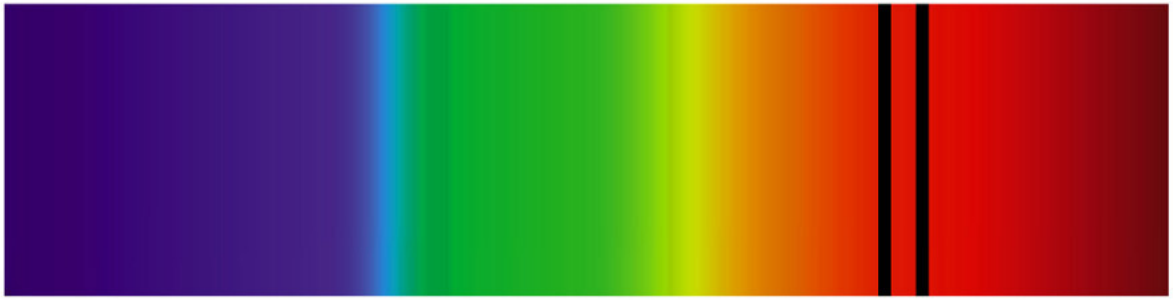


- Incandescent hot gas emits its elemental wavelength signature

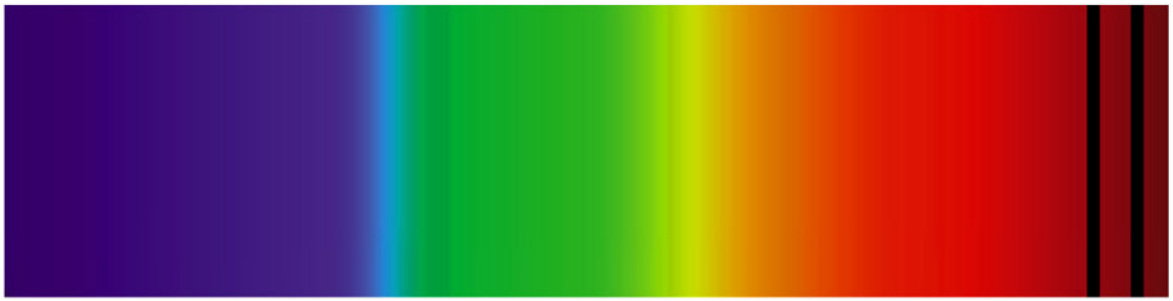




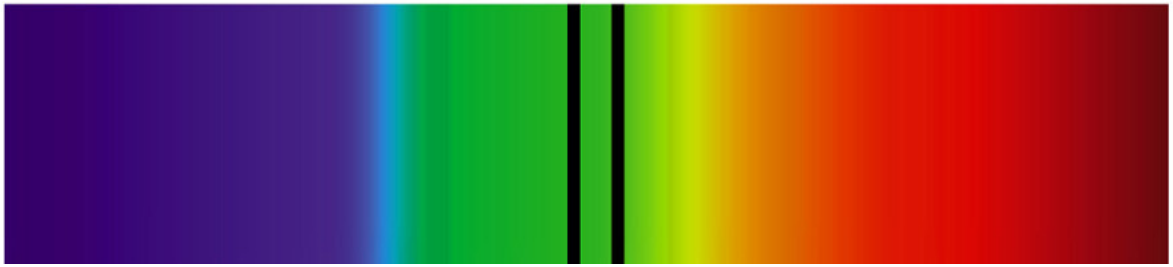
A. Standard sodium lines



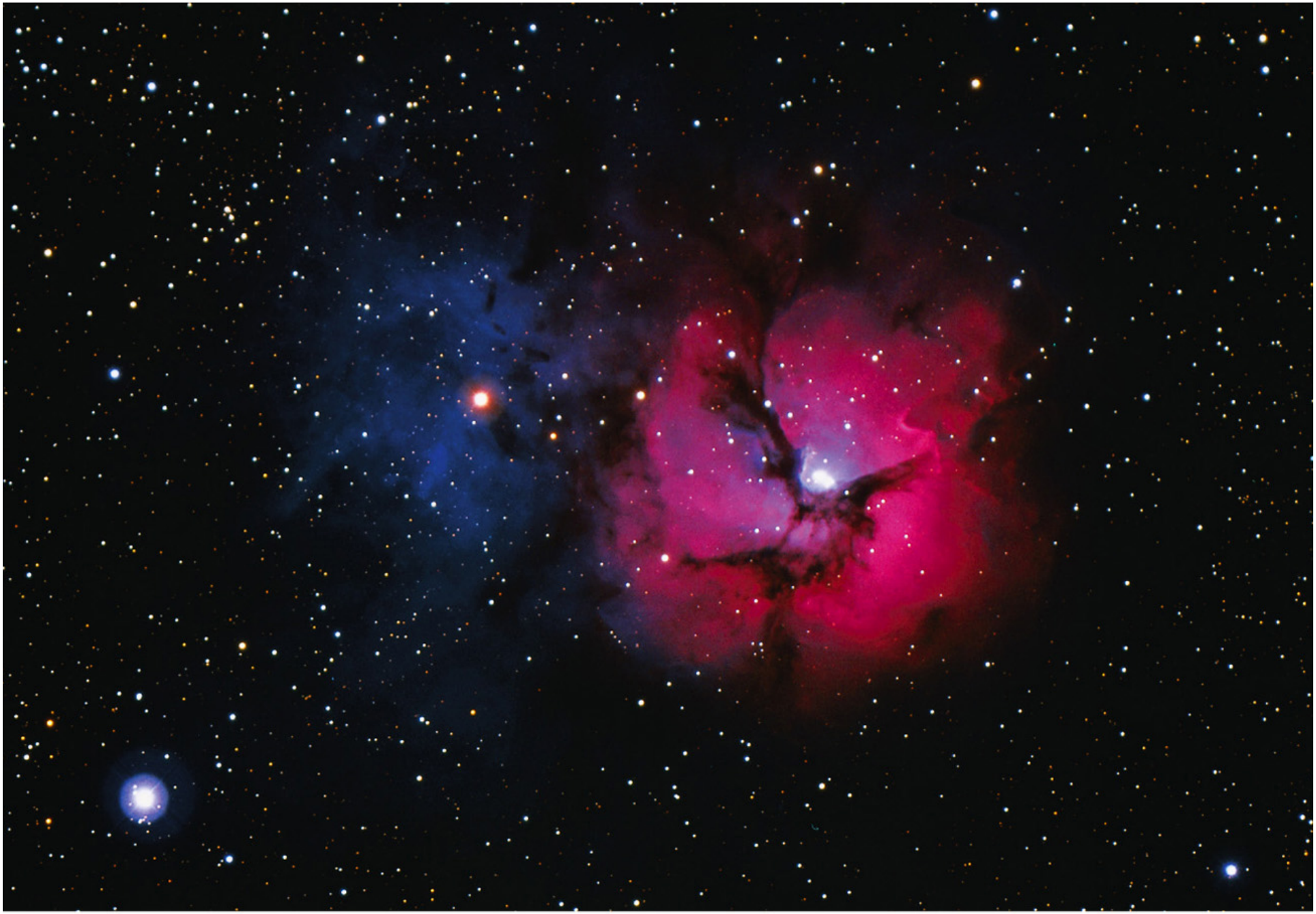
B. Red-shifted sodium lines



C. Large red-shifted sodium lines



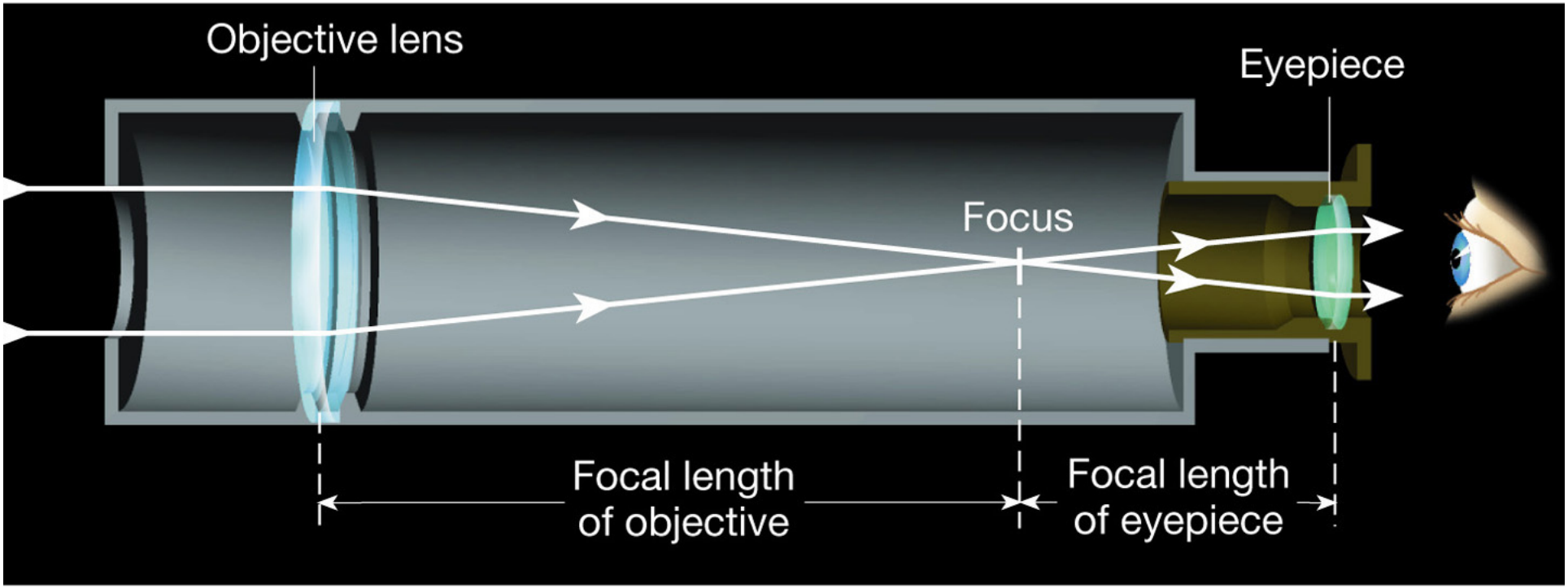
D. Blue-shifted sodium lines



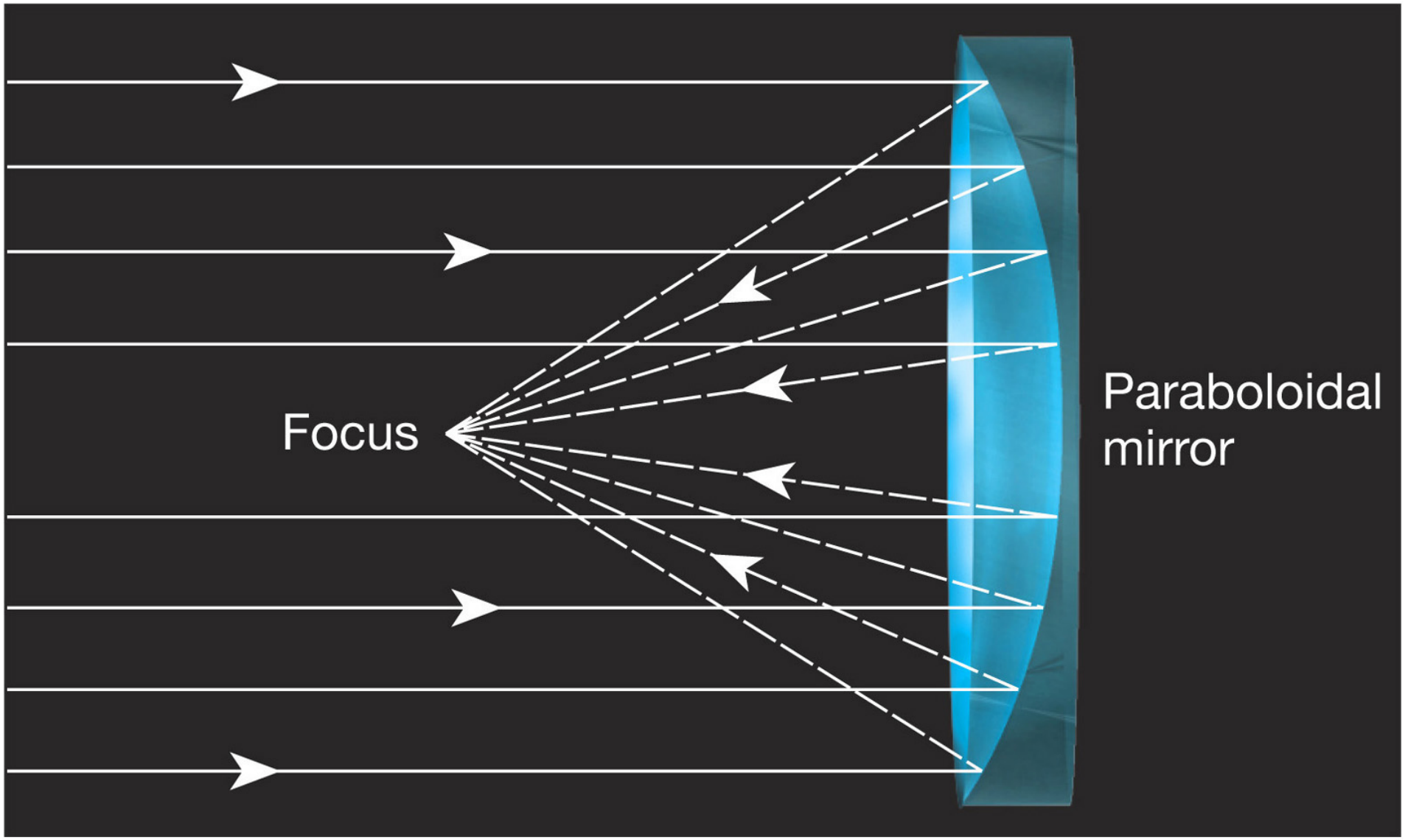
Astronomical Tools

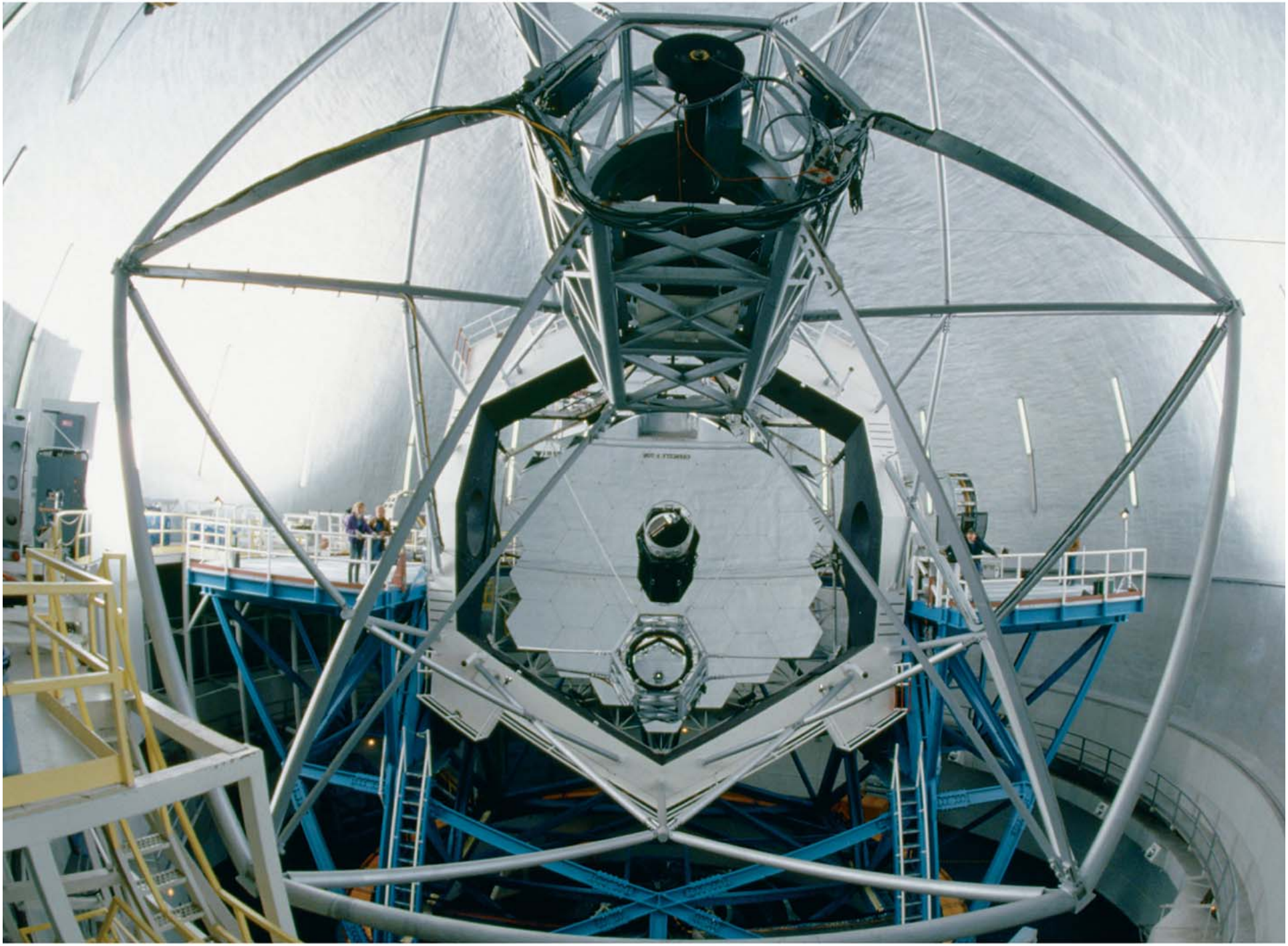
- Optical Telescopes
  - Refracting telescope
  - Reflecting telescope
  - Space telescopes
- Other telescopes
  - Radio telescopes
  - Infra-red sensing
  - X-ray, gamma ray emissions

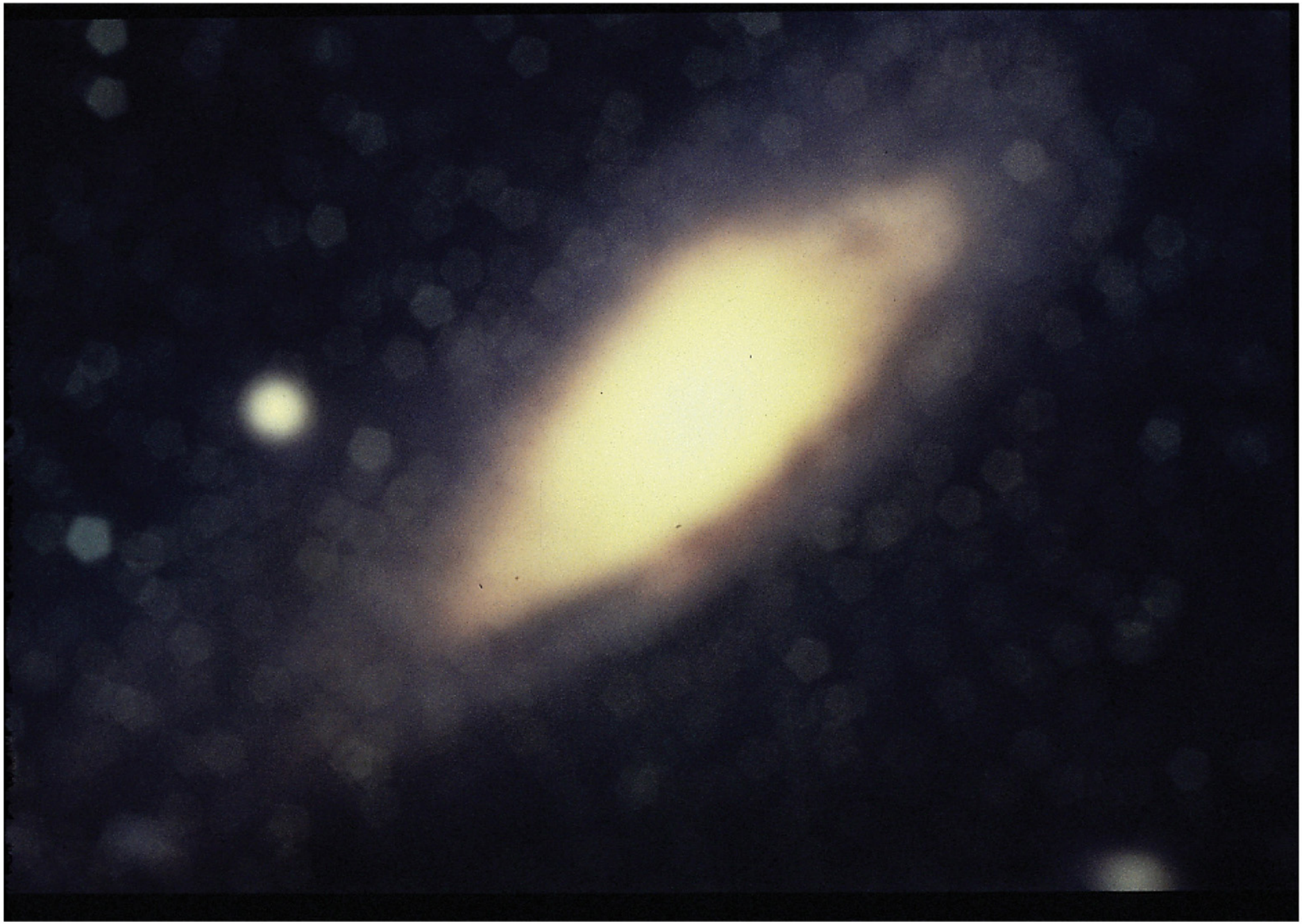
Refracting Telescope



Reflector Telescope



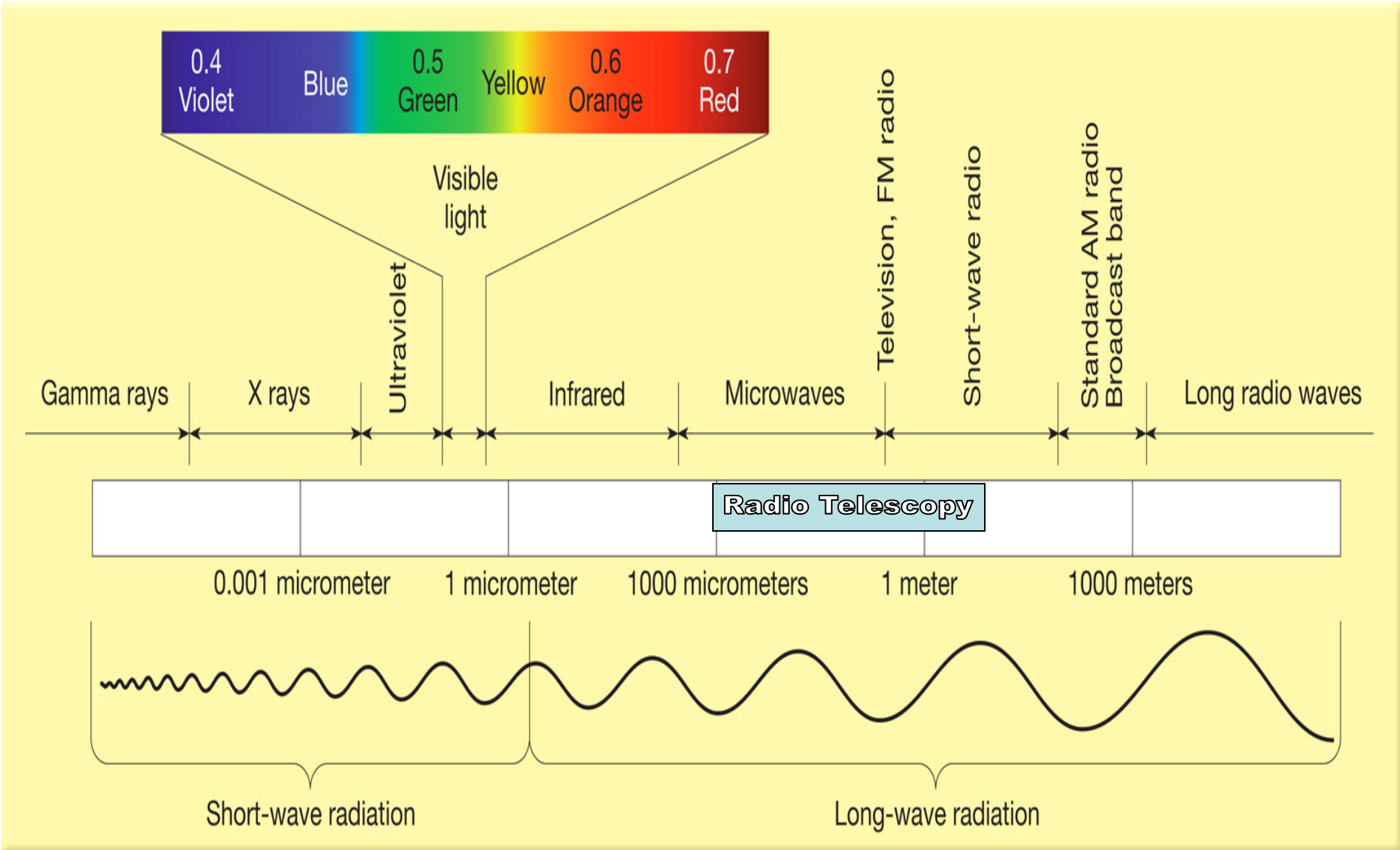




A.

Hubble Space Telescope

Electromagnetic Spectrum



James Maxwell

Unified electricity and magnetism into aspects of the same force

1860-1870

http://www.nrao.edu/whatisra/hist_prehist.shtml

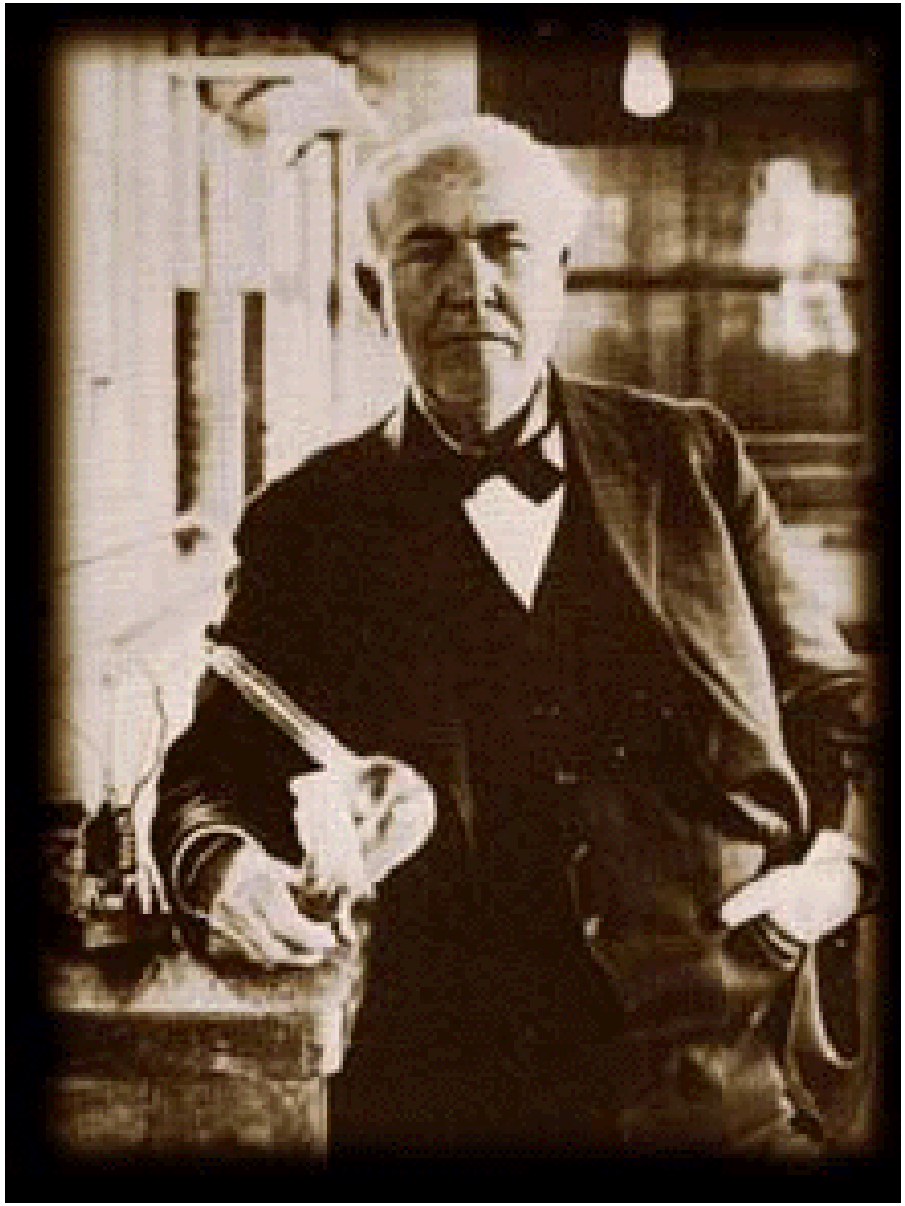
Heinrich Hertz

Built device to transmit
- 5 m long electromagnetic waves

1888

http://www.nrao.edu/whatisra/hist_prehist.shtml

Thomas Edison



Proposed experiment to measure electromagnetic radiation from Sun

1890

Never conducted the experiment

http://www.nrao.edu/whatisra/hist_prehist.shtml

Guglielmo Marconi

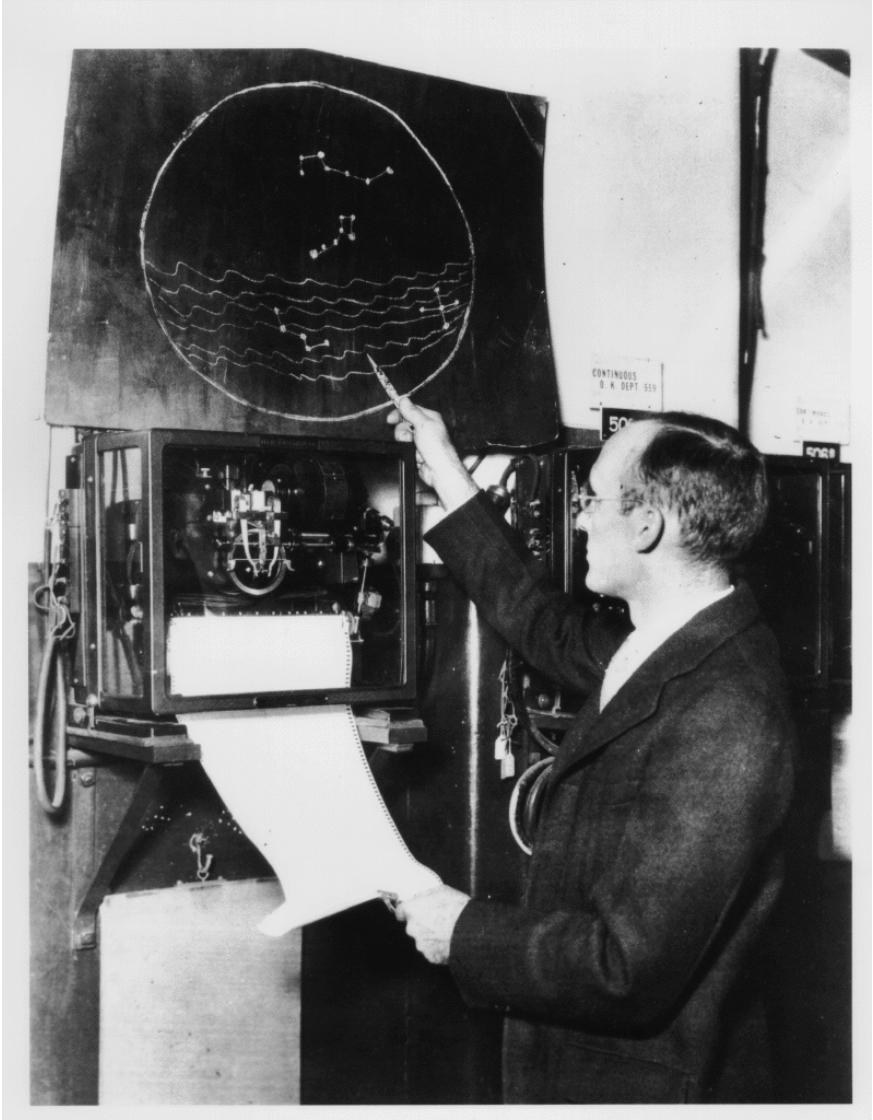
Sensitive radio receiver allowed communication

http://www.nrao.edu/whatisra/hist_prehist.shtml#marconi

Karl Jansky's radio discovery

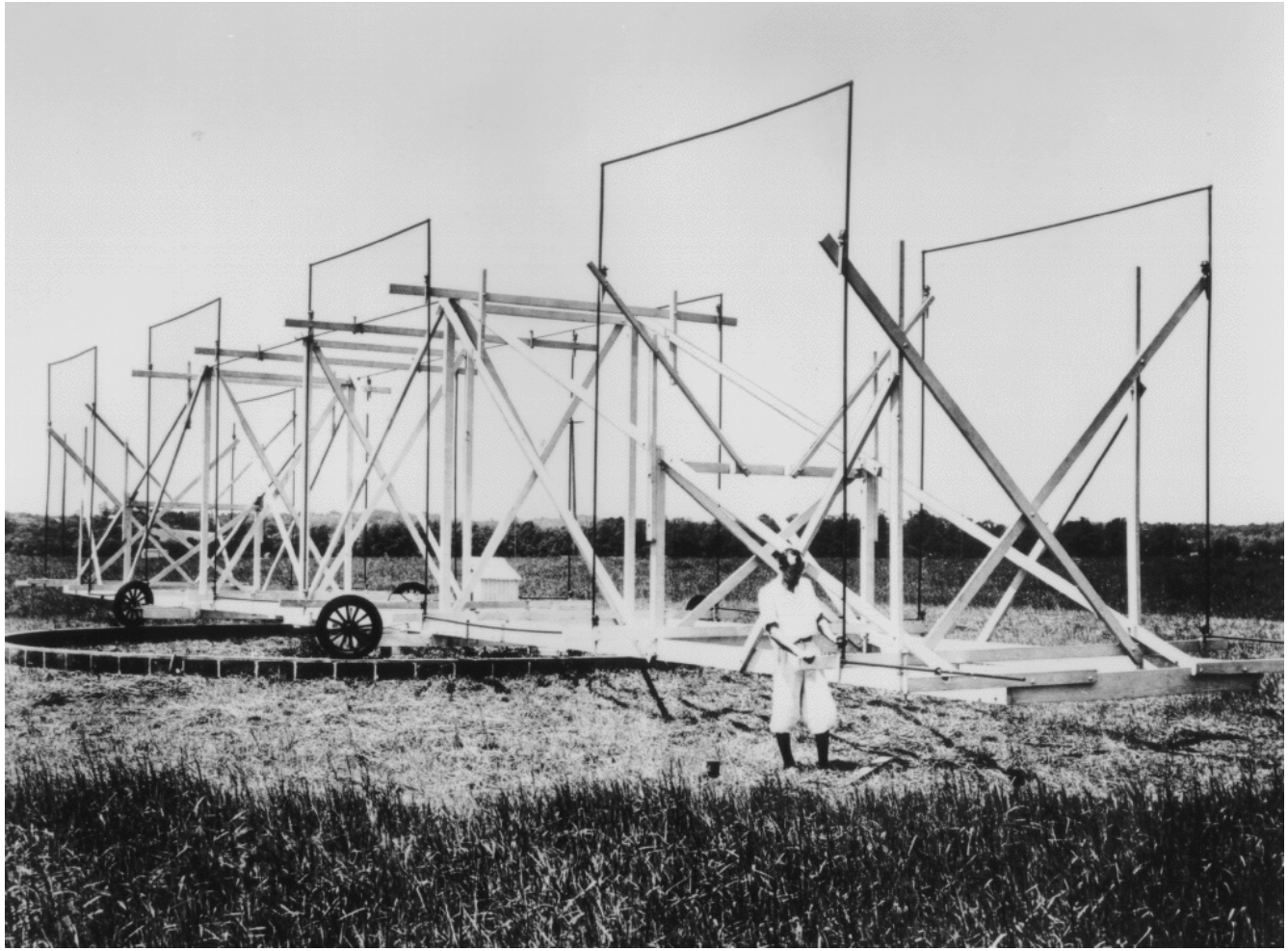
Found radio emission from Milky Way

1933



http://www.nrao.edu/whatisra/hist_jansky.shtml

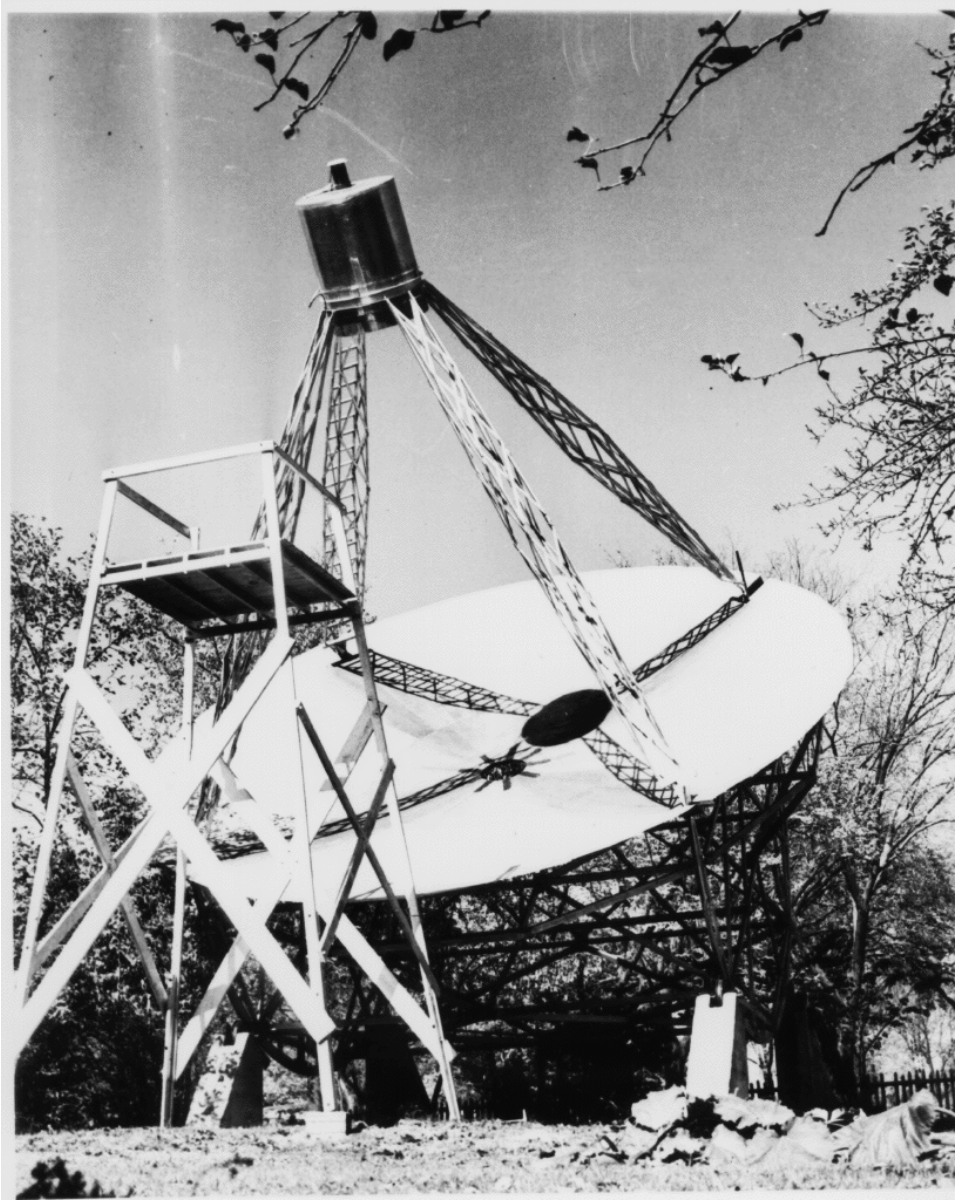
Jansky’s radio antenna



http://www.nrao.edu/whatisra/hist_jansky.shtml

Grote Reber

http://www.nrao.edu/whatisra/hist_reber.shtml



Reber’s dish antenna

http://www.nrao.edu/whatisra/hist_reber.shtml

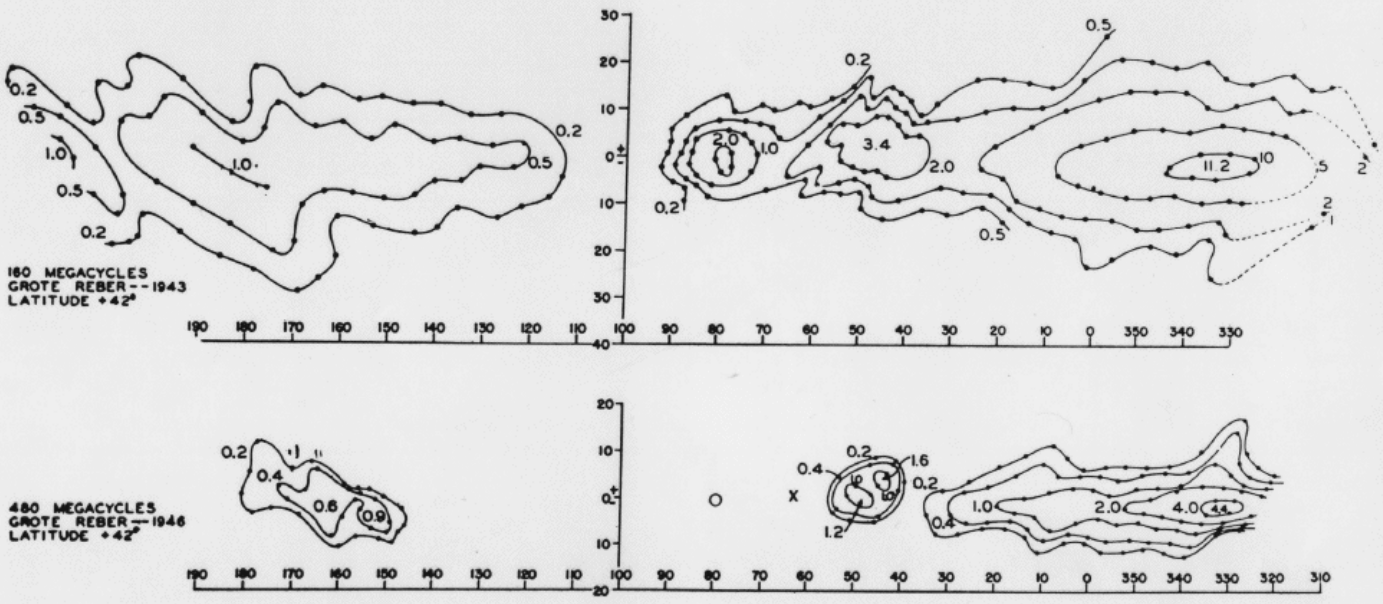
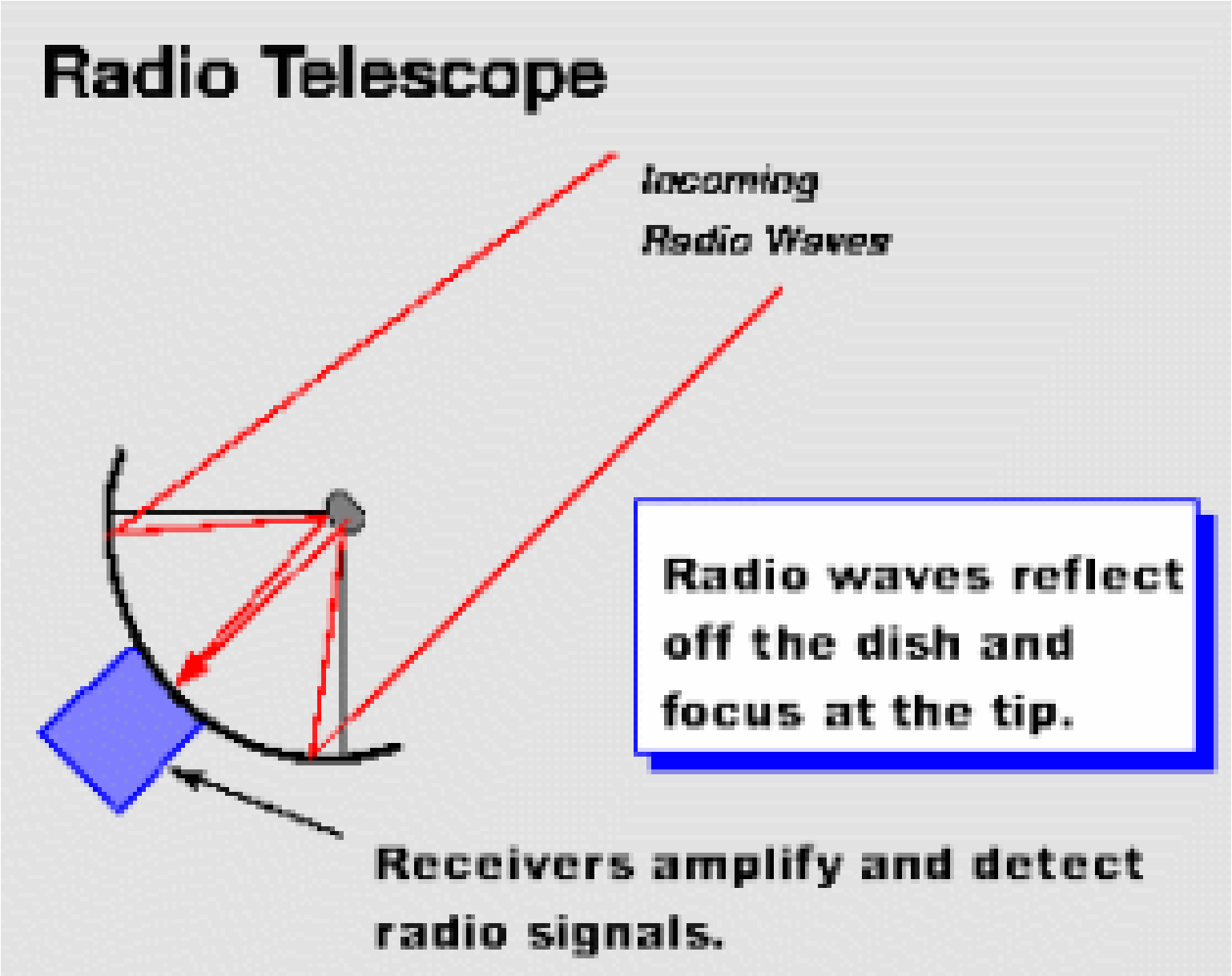


FIG. 7—Contours of constant intensity at 160 MHz and 480 MHz, taken at Wheaton, Illinois.

Reber's galactic map of radio emissions

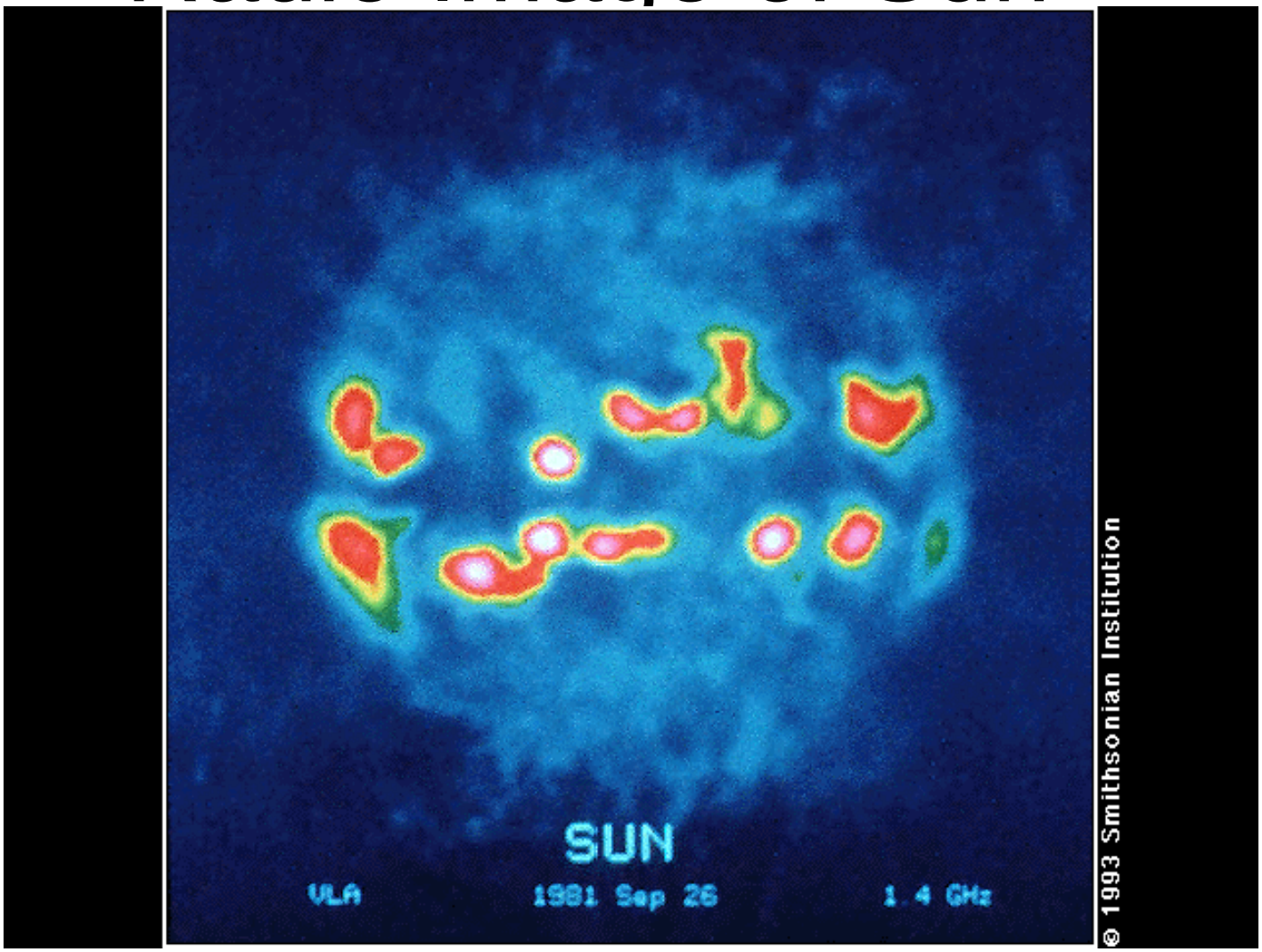


http://www.nrao.edu/whatisra/radiotel.shtml

National Radio Astronomy Observatory

Plains of San Agustin, New Mexico, USA
Very Large Array in golden glow at dusk
Photo by Kelly D. Gatlin

Radio Image of Sun



http://seds.lpl.arizona.edu/nineplanets/nineplanets/pxsol.html