Telescopes
* Essentially a bucket that gathers light
* Optical telescopes gather visible light
* Optical Telescopes
* 
• ______________ used this type for astronomy
• ______________ is the most important piece
  – Light converges to a point called the “________”
  – Object is inverted in eyepiece
• Objective focal length - distance from the objective lens to the focus
• Eyepiece focal length - distance from the eyepiece to the focus
• Eyepiece is required to magnify the image
• Objective lens creates a small bright light source, the eyepiece magnifies the light source
• Refracting telescopes have a focusing problem called “________”
  – Problem occurs with telescope when light is bent
  – All wavelengths of light are not brought to the same point focus, so it typically leaves a blue halo around bright objects.
• Image is always inverted unless you use a correcting lens
* Reflecting telescopes
• ______________ couldn’t stand the chromatic aberration problem, so he built a reflecting telescope
• Uses a concave mirror to reflect light to the focus
• Image will be inverted as well
• Light is focused in front of the mirror, therefore some incoming light gets blocked
• Typically less expensive than refractors, because mirrors are cheaper than lenses
• Most large optical telescopes are reflectors
  – Great Canary Telescope (10.4 m)
  – Twin Keck (10 m)
  – Yerkes Observatory (1.02 m)
* Reflecting Telescope Design (4 types)
• Prime focus
  – 
• Newtonian focus
  – Designed by Isaac Newton
  – Uses a mirror to reflect light to the side of the tube
  – Smaller and less expensive telescopes
• Schmidt-Cassegrain focus
– Popular easy viewing scope with high quality views
  • Coude focus
    – The largest optical reflectors

* Telescope Properties

• Faint light needs to be amplified
• Larger / Wider telescopes gather more light
• Example of how size changes your image
• Larger telescope increase light gathering power proportional to the area
  – 5-meter mirror gathers 25X more light than a 1-meter mirror

• Resolution -
  • Larger telescopes have finer angular resolutions
  • ____________ - tendency to bend light causes the fuzziness in a telescope
  • Increasing resolution decreases diffraction
  • Even small telescopes can resolve more than a human’s eye

• Computed by dividing objective focal length by the eyepiece focal length
• Can simply change magnification by changing the eyepiece
• Increased magnification doesn’t necessarily mean clearer images
• Magnification tends to spread out light, so the objects becomes less bright in the eyepiece

High Resolution Astronomy

* Atmospheric Blurring
  • Earth’s atmosphere decreases the resolution
  • Steady shine is good viewing
  • Same reason a roadway will shimmer on a hot summer day
  • Less atmosphere, dust, moisture, ________________
  • Telescopes are often placed in deserts
  • The ______________ is placed above the atmosphere

* New Telescope Designs
  • Computers accomplish most of the observing with large telescopes today
  • CCD’s (________________________) send information directly to a computer
    • More efficient at gathering light than film
    • Can be sent directly to a computer (digital)
  • Active Optics
    • Controls the environmental and mechanical fluctuations in the telescope
    • Adjusts the mirror shape to correct for atmospheric distortion

Radio Astronomy

* Essentials

  * Atmosphere does not distort radio waves
* Can view only narrow wavelength bands, so we must change frequencies constantly
* Radio sources from space are weak so big dishes are needed
* Value of Radio Astronomy
  * Largest radio telescopes in the world
    * Arecibo telescope (305 meters)
    * Interferometry – using several radio telescopes to view the same object at the same time
      - VLA (Socorro, NM)
      - VLBA – uses radio telescopes around the world to essentially produce a radio telescope half the size of the Earth
* Less affected by the
* Many objects in space cannot be seen optically, but can be seen in radio
* Can view through interstellar dust
* Center of the Milky Way can’t be seen optically, but it can be seen with radio
* Other Astronomies
  * Infrared
    * Longer wavelengths
    * Most have to be placed above atmosphere, but some are ground based
    * Optical vs. Infrared example
  * Ultraviolet
    * Must be placed above atmosphere on satellites atmosphere is opaque to shortwave energy
* High Energy Astronomy
  * These are high energy sources
  * Searches out to farthest reaches of the universe
  * Full Spectrum Coverage

End of Chapter 3