

Extending Our Vision — Telescopes

Lecture Outline -- 1

Reading: chapter 8 in *Astronomy Notes*

Vocabulary terms used:

telescope—device used to gather and focus electromagnetic radiation. A telescope extends the power of human vision by making objects brighter, sharper, and larger, as well as, imaging objects in wavelengths that are not detectable by the human eye.

objective—the primary optical element of a telescope, it gathers the electromagnetic radiation and does the initial focussing.

refractor telescope—telescope that uses a large glass lens at the front end of the telescope as the objective. The objective has a maximum size limit and suffers to some degree from chromatic aberration.

chromatic aberration—a defect seen in the images from refractor telescopes that is caused by different colors of light focussing to different points behind the objective. A rainbow of colors is produced around the image.

reflector telescope—telescope that uses a large mirror at the back of the telescope as the objective. The objective has no size limit and is the type preferred for large research telescopes.

spherical aberration—a defect seen in images that is caused by the objective not being exactly shaped (e.g., an objective mirror not being exactly parabolic) so that not all of the light is focussed to the same point.

light-gathering power—the ability of a telescope to collect more light than the human eye in a given amount of time. Depends on the *area* of the telescope's objective, such that the larger the collecting area of the objective, the brighter the image will be.

resolving power—the ability of a telescope to detect very small details and produce sharp images. Depends on the *diameter* of the telescope's objective **AND** the wavelength of light used to observe, such that the more wavelengths that can be fit across the objective, the sharper the image will be.

interferometer—an array of telescopes connected electronically to act as one large telescope with much improved resolution. The resolution of the interferometer is equal to a single telescope having a diameter equal to the length of the interferometer.

magnifying power—the ability of telescope to enlarge images. Can be increased by using an eyepiece with a shorter focal length.

seeing—a measure of the amount of turbulence in the air. When the seeing is “good”, the amount of turbulence is small and the images are steady (less twinkling). “Poor” seeing occurs when the atmosphere is turbulent so the images shimmer and dance around (more twinkling).

adaptive optics—a technique that compensates for atmospheric turbulence by quickly adjusting the light path in the optics. This removes seeing effects and enables the telescope to achieve much better resolution, closer to its theoretical resolving power.

Extending Our Vision — Telescopes
Lecture Outline -- 2

Outline

Two basic types of telescopes

Type of objective for refractor telescope _____ and where at _____

Disadvantages of refractor telescope

 Cause of chromatic aberration _____

 Why refractor objectives have a maximum possible size _____

Type of objective for reflector telescope _____ and where at _____

Advantages of reflector telescope _____

 Why they have no maximum limit on size _____

Hubble Space Telescope

 Type of telescope _____

 Problem with HST's objective _____; result on images _____

 How the problem is corrected _____

The need for big telescopes

How to increase the brightness of images (see faint, far-away objects) _____

 How many times brighter a star will be in a 51-cm telescope than 3-cm binoculars

How light spreads out with distance _____

1-meter diameter telescope sees object at 1 AU, 2-meter telescopes see object at _____

3-meter telescope sees it at _____

How to increase the sharpness of images _____ and/or _____

What an interferometer is _____ and why used _____

 Resolution of interferometer = _____

Views with radio eyes (if time permits)

Why magnification is not important _____

Atmosphere distorts our view

How atmosphere causes twinkling of stars _____

What you see under high magnification _____

Effect on images _____

Why telescopes are built on tall mountains _____

Why telescopes are put into orbit around the Earth _____ and _____