**Ch. 3 TELESCOPES**

INTRO: In astronomy, \_\_\_\_\_\_\_\_\_\_\_\_ usually precedes \_\_\_\_\_\_\_\_\_\_\_\_.

Ex/ New solar systems;

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ universe

Telescopes have grown in \_\_\_\_\_\_ and complexity and now cover the entire \_\_\_\_ spectrum.

I. Optical Telescopes (Sec 3.1)

A. Telescope: A “\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_”

used to capture incoming photons

& concentrate them into a focused

beam for analysis.

B. Types of Telescopes

1. \_\_\_\_\_\_\_\_\_\_\_\_\_: A glass \_\_\_\_\_\_\_ bends

(refracts) incoming light rays to a

focus. Eyepiece

magnifies. Ex/ \_\_\_\_\_\_\_\_ Observatory

2. \_\_\_\_\_\_\_\_\_\_\_: A curved \_\_\_\_\_\_\_\_\_\_\_\_

(primary mirror) reflects incoming

rays to a focus. Eyepiece magnifies.

C. Reflector Design

1.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: Secondary mirror

reflects light to an eyepiece on the

\_\_\_\_\_\_\_\_ of the telescope.

Subcategory: Dobsonian

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: Secondary mirror

reflects light back through a hole

in the primary mirror.

II. Telescope Size (Sec 3.2)

A. Light-gathering power:

Larger collecting area = \_\_\_\_\_\_\_\_ image.

1. Brightness ~ \_\_\_\_\_\_\_\_\_\_\_\_\_\_2

Ex/ 10” aperture is \_\_\_\_ x brighter than a 2” (*or* 25 x\_\_\_\_\_\_\_\_\_\_ exposure)

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Example Problem: How long would it take a telescope with a 9” aperture to produce the same image that a 3” scope can make in 45 min.?

2. Largest: \_\_\_\_\_ in Chile (16.4 m)

\_\_\_\_\_\_ I & II in Hawaii (13.7 m)

GMT (2016); TMT (2018); ELT (?)

B. **Resolving Power**: Ability to make

\_\_\_\_\_\_\_\_ images of faint objects or

to distinguish between 2 adjacent

objects in the sky.\*\*

aka **Angular \_\_\_\_\_\_\_\_\_\_\_\_\_\_**

III. High Resolution Astronomy

(Sec 3.3)

A. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Blurring

1. Hinders \_\_\_\_\_\_\_\_\_\_\_-based scopes

Ex/ “twinkling” stars

2. Best locations- \_\_\_\_\_\_, \_\_\_\_\_\_, & \_\_\_\_\_

Ex/ Chile, Hawaii, Arizona

3. Another solution - \_\_\_\_\_\_\_\_\_.

Ex/Hubble (1993) - \_\_\_ x better

B. \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_: Mirror

changes \_\_\_\_\_\_\_\_ to compensate for

the blurriness of the \_\_\_\_\_\_\_\_\_\_\_\_\_.

a. \_\_\_\_\_\_\_\_\_ pierce atmosphere,

create “artificial star”

b. Some now sharper than Hubble!

Ex/ Keck, VLT

IV. Radio Astronomy (Sec 3.4)

A. Radio telescopes

1. Only since the 1950’s

2. Pioneers- Karl \_\_\_\_\_\_\_, Grote Reber

3. Curved metal dish focuses radio

waves to a \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_.

4. Instruments located at \_\_\_\_\_\_ \_\_\_\_\_.

B. Large Size Necessary

1. Signals are \_\_\_\_\_\_\_\_\_ from space.

2. Long wavelength radio \_\_\_\_\_\_\_\_\_

greatly – poor resolution

a. Surface doesn’t have to be \_\_\_\_\_\_\_\_

b. It’s \_\_\_\_\_\_\_ to make them large!

Ex/ Largest: \_\_\_\_\_\_\_\_\_\_\_ – 1000 ft.

wide! (305 m)

C. Value of Radio Astronomy

1. Can be done during the \_\_\_\_\_\_\_\_\_\_\_.

2. Pierces clouds, rain, snow.

3. Objects *visibly* \_\_\_\_ may be

strong *radio* sources. Ex/

\*4. Radio penetrates \_\_\_\_\_\_\_\_\_ in space

Ex/ Center of \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_

V. INTERFEROMETRY (Sec 3.5)

A. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: Data from 2 or

more scopes combined. Ex/ \_\_\_\_\_\_

in N. Mex (27 dishes); ATA- 42

(2007) \_\_\_\_\_\_\_ – 66 (2012); Square

Kilometer Array- 150 (2020)

B. Behaves like a single dish whose diameter is the \_\_\_\_\_\_\_ between dishes.

Largest Telescopes 201\_\_

Refractor: \_\_\_\_\_\_\_\_\_\_\_\_\_ - \_\_ m

Single mirror: \_\_\_\_\_\_\_\_\_\_\_\_\_ -10.4 m

Optical interferometer: \_\_\_\_\_\_-16.4 m

Single Radio Dish: \_\_\_\_\_\_\_\_\_\_ -305 m

Radio Array: \_\_\_\_\_\_\_\_ -66 dishes

ATA – 42 dishes; \_\_\_\_\_ -27 dishes

VI. SPACE-BASED TELESCOPES

(Sec 3.6)

A. Microwave satellites

1. COBE (1990’s) - Measured the

\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ - proof

of the \_\_\_\_ \_\_\_\_\_\_!

2. \_\_\_\_\_\_\_\_\_ (2009)

B. INFRARED Astronomy

1. Long wavelength IR penetrates

\_\_\_\_\_\_\_\_ in space.

2. Good for \_\_\_\_\_ or \_\_\_\_\_\_\_-forming

clouds of warm dust & gas.

3. Mountaintops may be used. Ex/

4. Airplanes may be used. Ex/

5. Or Space-based telescopes. Ex/

\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ Space Tel. (201?)

~ 6.5 m- “Successor to the \_\_\_\_\_\_\_\_\_\_”

C. VISIBLE light

1. The \_\_\_\_\_\_\_\_\_ Space Telescope

2.\_\_\_\_\_\_\_\_\_\_ aberration corrected-‘93.

3. Final repair mission in 2009.

D. ULTRAVIOLET Astronomy

1. Used for \_\_\_\_\_\_\_ stars.

2. Can be done by high-altitude

\_\_\_\_\_\_\_\_\_\_\_\_.

3. Or by satellites. Ex/ Galex, Hubble

E. X-RAY Astronomy

1. No \_\_\_\_\_\_\_\_\_observations - only

satellites

2. Emitted from \_\_\_\_\_\_\_\_\_\_ events.

Ex/

3. Special design (difficult to focus)

Ex/ \_\_\_\_\_\_\_\_\_\_\_ (1990’s)

F. GAMMA RAY Astronomy

1. Can’t be \_\_\_\_\_\_\_\_\_.

2. Counted by special detectors

3. \_\_\_\_\_\_\_\_\_\_\_ (~ 1 detection per day)

4. Occasional “bursts”, or \_\_\_\_\_\_\_’s.

a. \_\_\_\_\_\_\_\_\_\_\_\_ – *really* massive star

explodes, forming a \_\_\_\_\_\_\_ \_\_\_\_\_\_\_!

b. Colliding binary \_\_\_\_\_\_\_\_\_ stars

5. Compton Gamma Ray Obs (2000)

6. Swift (2004)

7. \_\_\_\_\_\_ Gamma Ray Observatory-07