

**Physics 343 Lecture # 9:
telescopes; interferometry**

This week's schedule

Monday – Wednesday: on call office hours for lab # 4
(Baker for sections A, C, F, G; Rivera for B, D, E, H)

Thursday + Friday: regular office hours

Lab # 4 due next Monday. If you have questions, please ask in office hours or by email!

Still waiting for responses from two people re trip.

Why do we need telescopes?

If a simple dipole antenna can detect radio waves...



long-wavelength
development array
at VLA site (test
bed for larger array
with $\lambda=0.3-30\text{m}$)

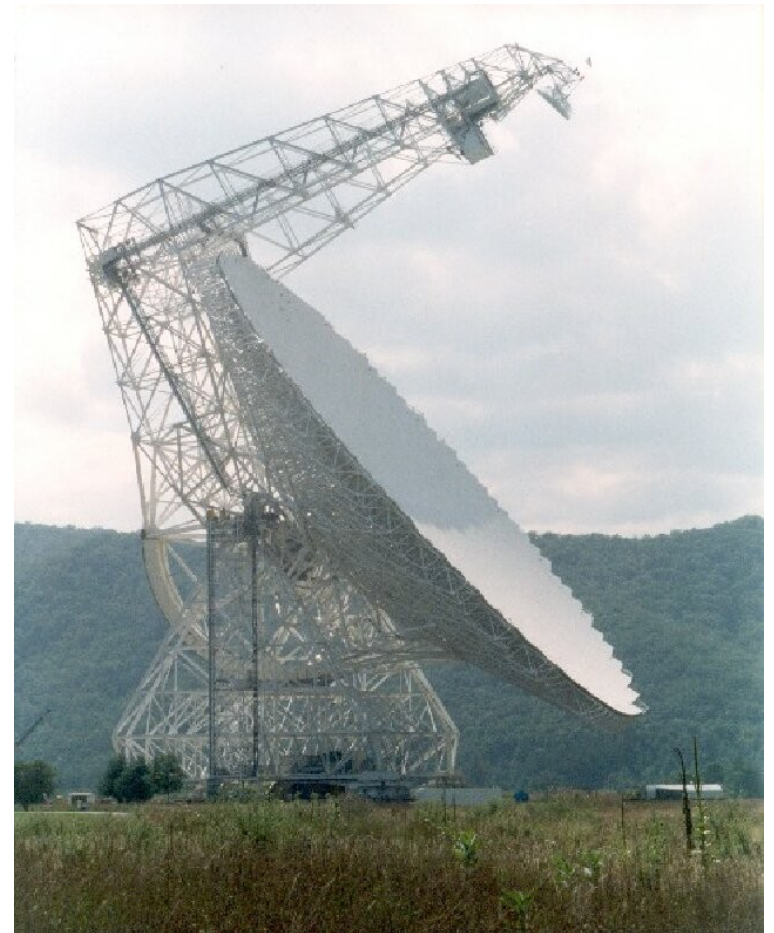
**Answer: collecting area (for short-wavelength observations).
Telescopes collect and focus power onto a smaller (e.g.,
feed horn or dipole) antenna.**

Telescope designs: feed horn vs. paraboloid

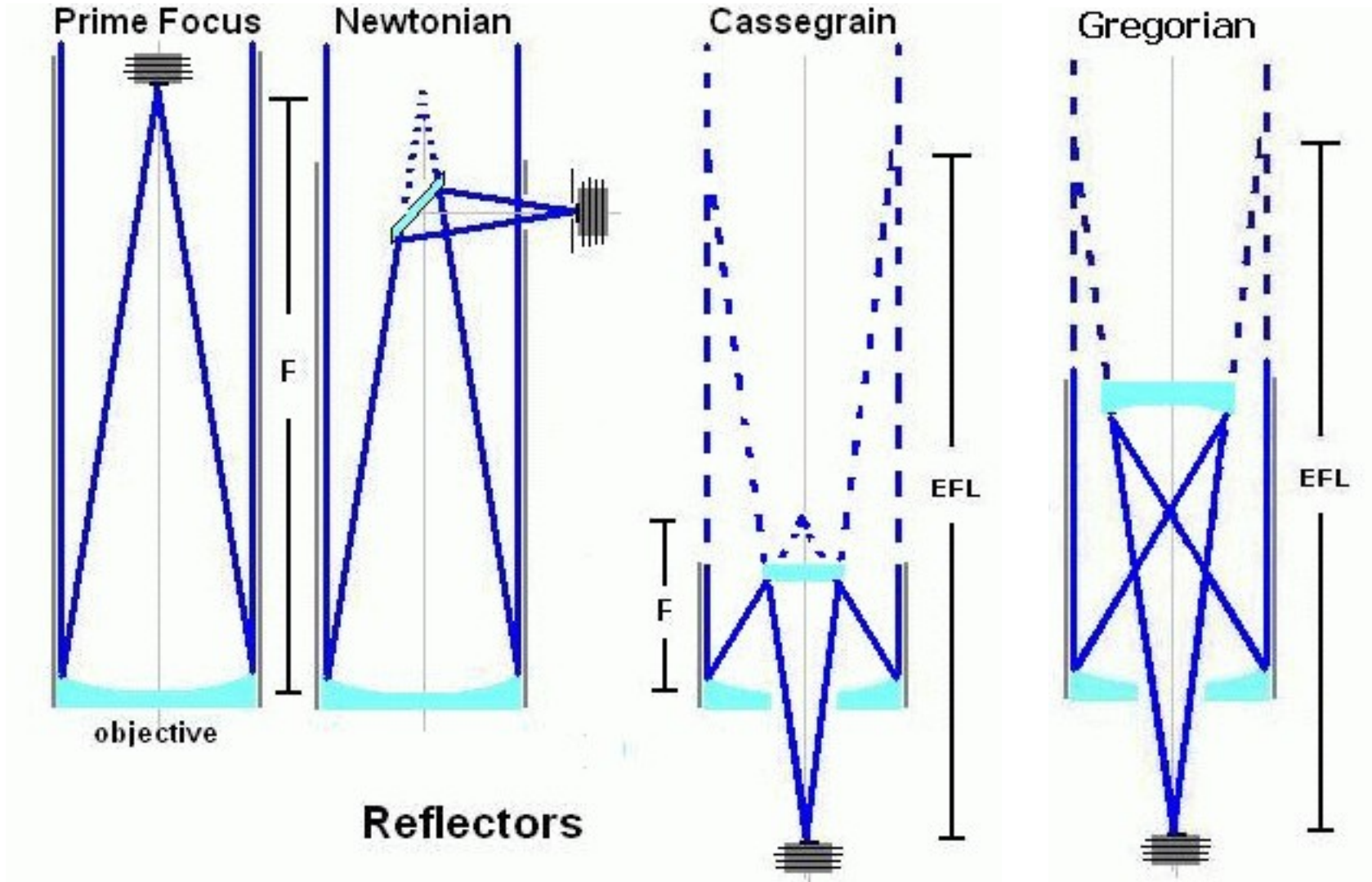


feed horns: response can be calculated a priori! but size limited...

paraboloid antennas: good for collecting area, calibration tricky



Telescope designs: location of foci



Borrowed from J. Oliver.

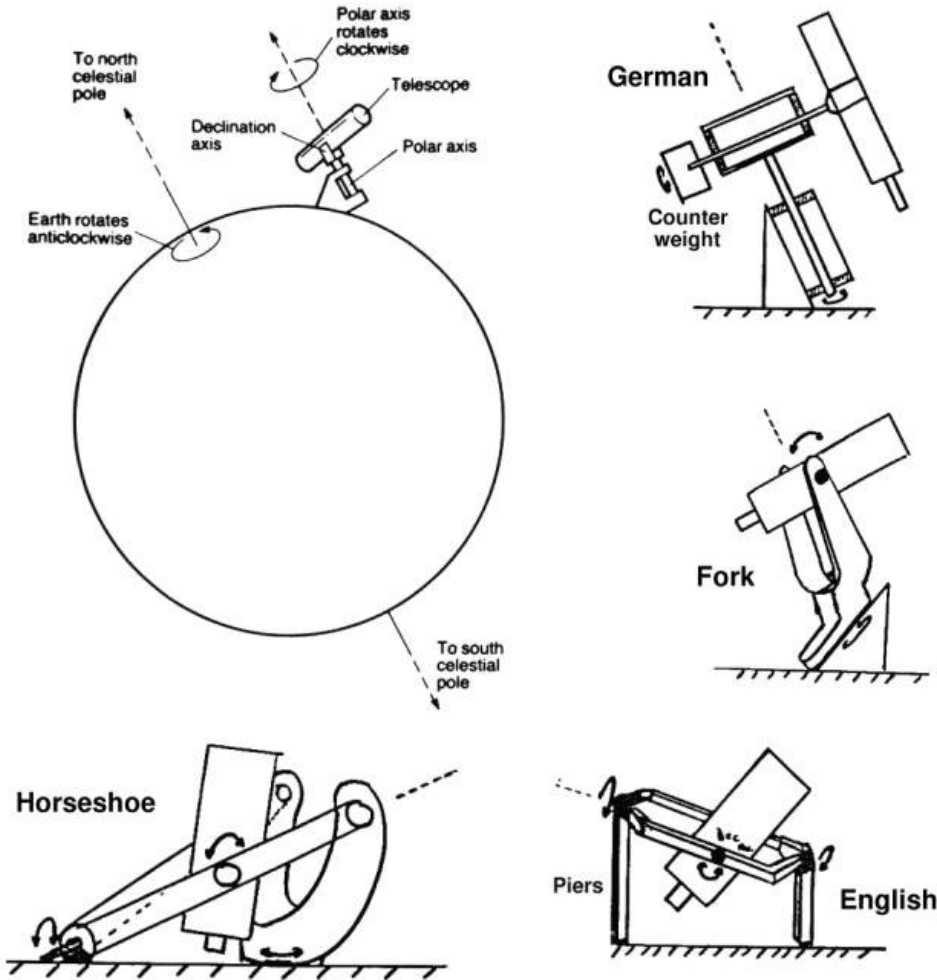
Telescope designs: on or off axis?



100m Effelsberg telescope (Germany) + Green Bank Telescope (WV)

Telescope designs: mount?

alt-az: both axes to track sources



equatorial: one axis to track sources

The last big scope with an equatorial mount



140 ft telescope at Green Bank:

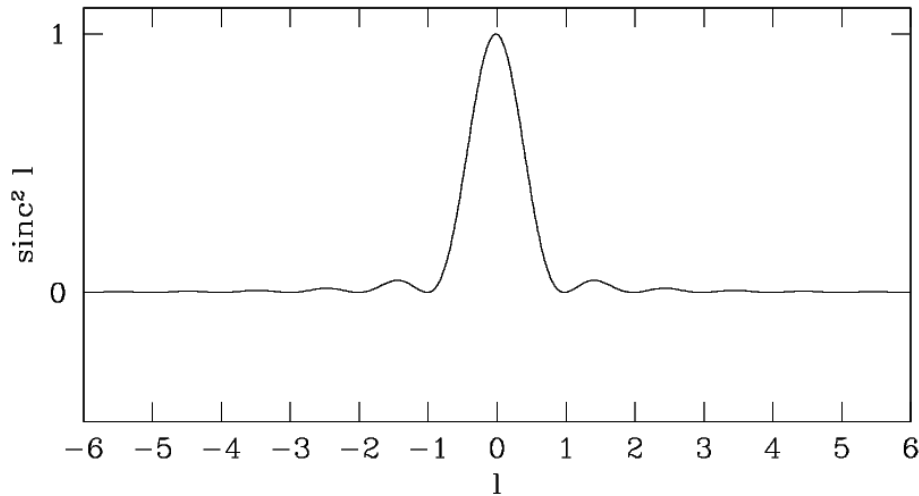
**(1) world's largest telescope
with an equatorial mount**

**(2) contains world's largest
ball bearing!**

The (angular) resolution of a telescope

We know that the FWHM of the telescope's beam is proportional to λ/D .

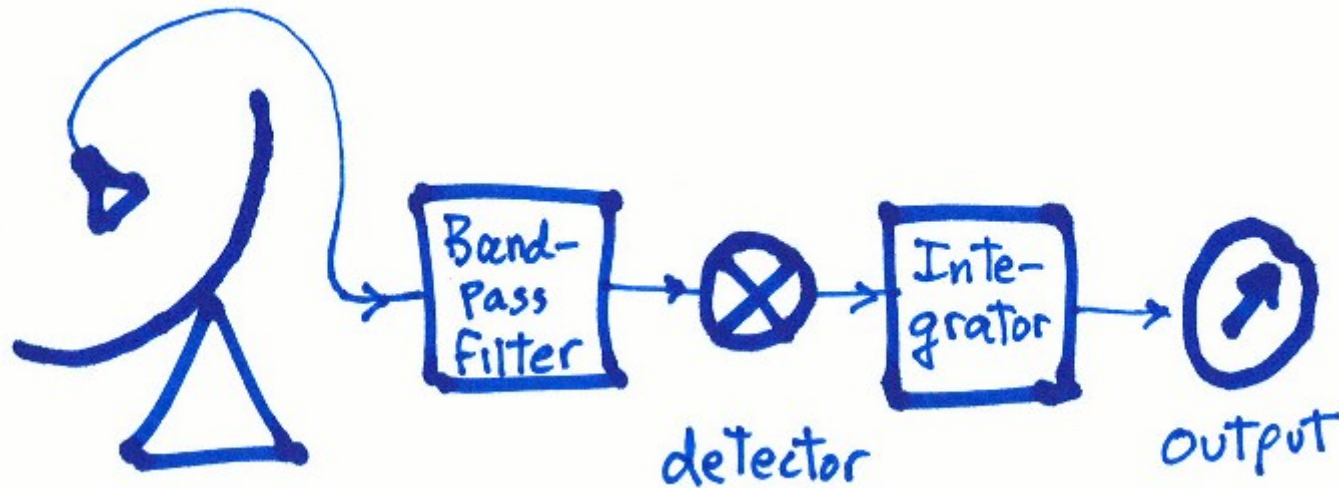
By the **Rayleigh criterion**, this is also its **resolving power**: two point sources separated by the FWHM will sit on peak + first dip of response.



Radiometers

Steps in detection of radio emission with a **radiometer**:

- (1) select a frequency bandpass
- (2) multiply signal by itself
- (3) integrate over some time interval
- (4) record output signal proportional to input power



Borrowed from Condon & Ransom, ERA.

Sensitivity of an ideal radiometer

If system temperature is T_{sys}

... bandwidth is $\Delta\nu$

... integration time is Δt

then the sensitivity (1σ noise) will be

$$\Delta T = T_{\text{sys}} / \text{sqrt}(\Delta\nu \Delta t)$$

i.e., goes down as $\text{sqrt}(\text{number of samples})!$

Quiz