# Physics 343 Lecture # 9: telescopes; interferometry

# This week's schedule

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

**Thursday + Friday: regular office hours**

**Lab # 4 due next Monday.**

**Still waiting for responses from two people re trip.**

**Section B: conflicts with an astro thesis defense, so**
**Amruta will likely be available starting at 11:00 only.**

# Why do we need telescopes?

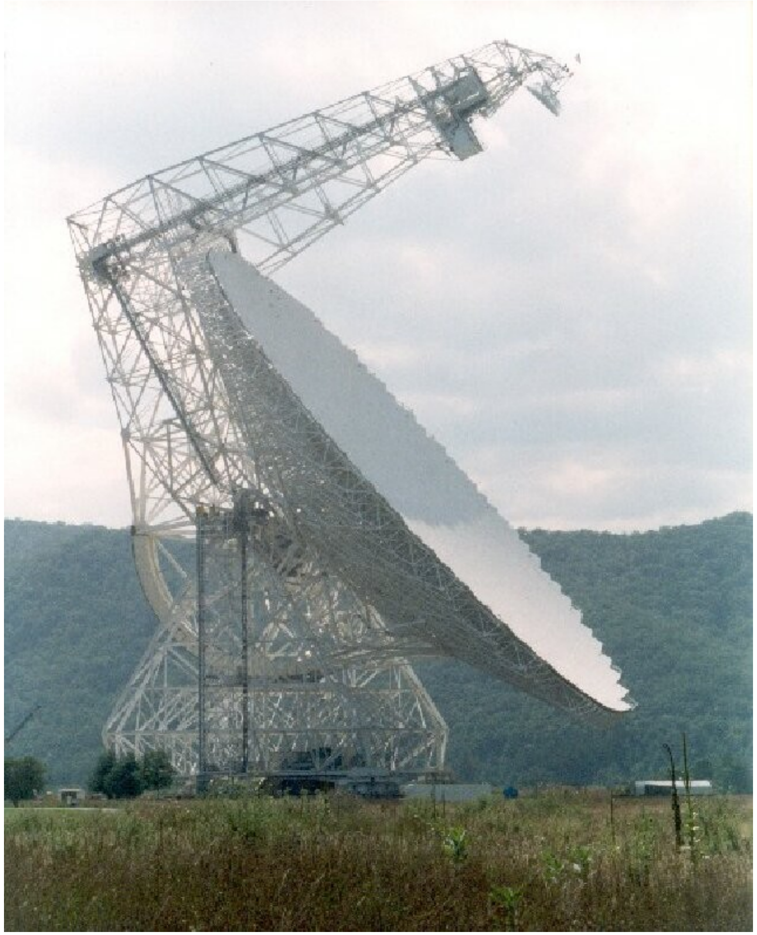
**If a simple dipole antenna can detect radio waves...**


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

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

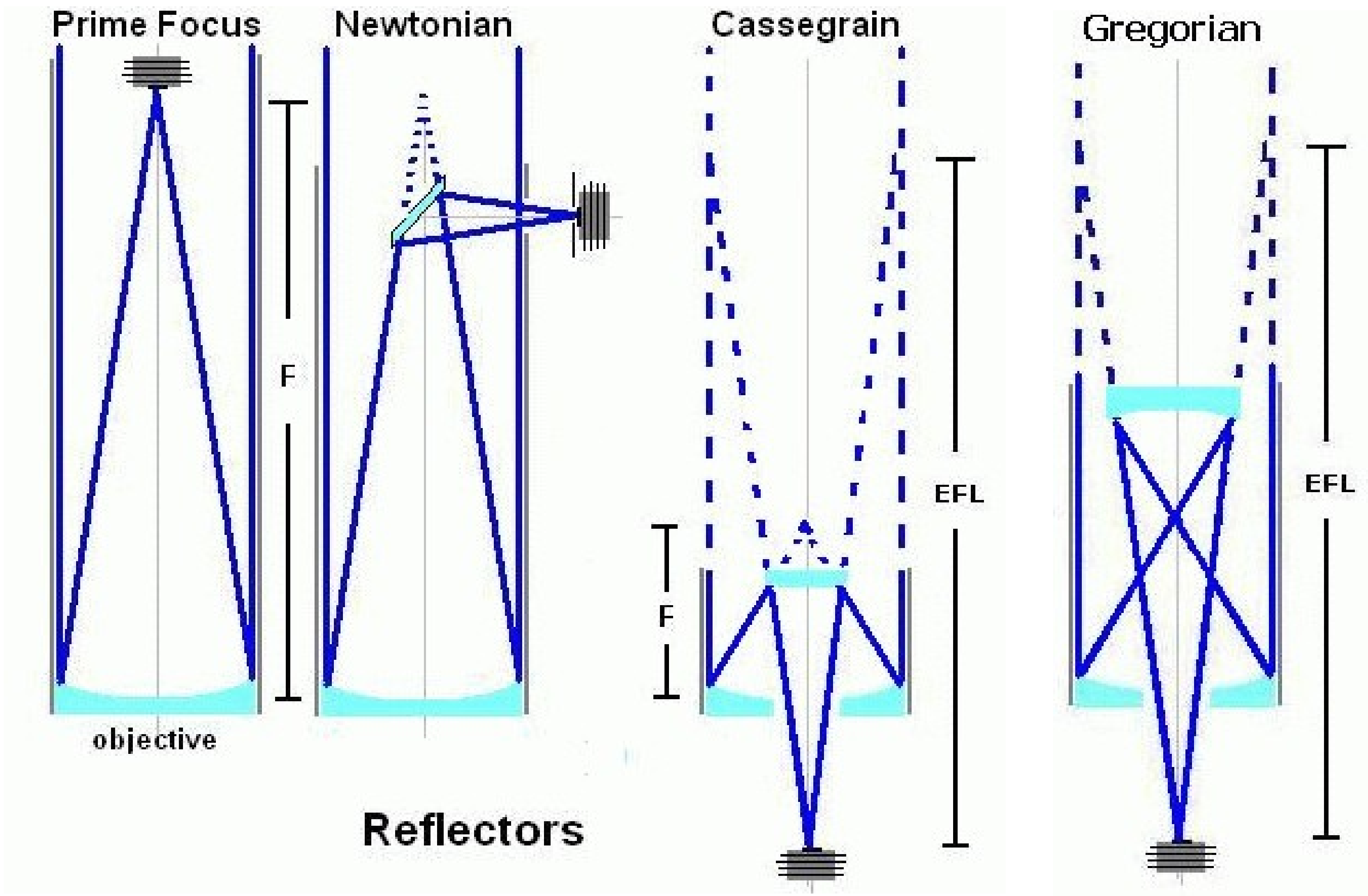
# Telescope designs: feed horn vs. paraboloid

**paraboloid antennas: good for collecting area, calibration tricky**



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

# Telescope designs: location of foci



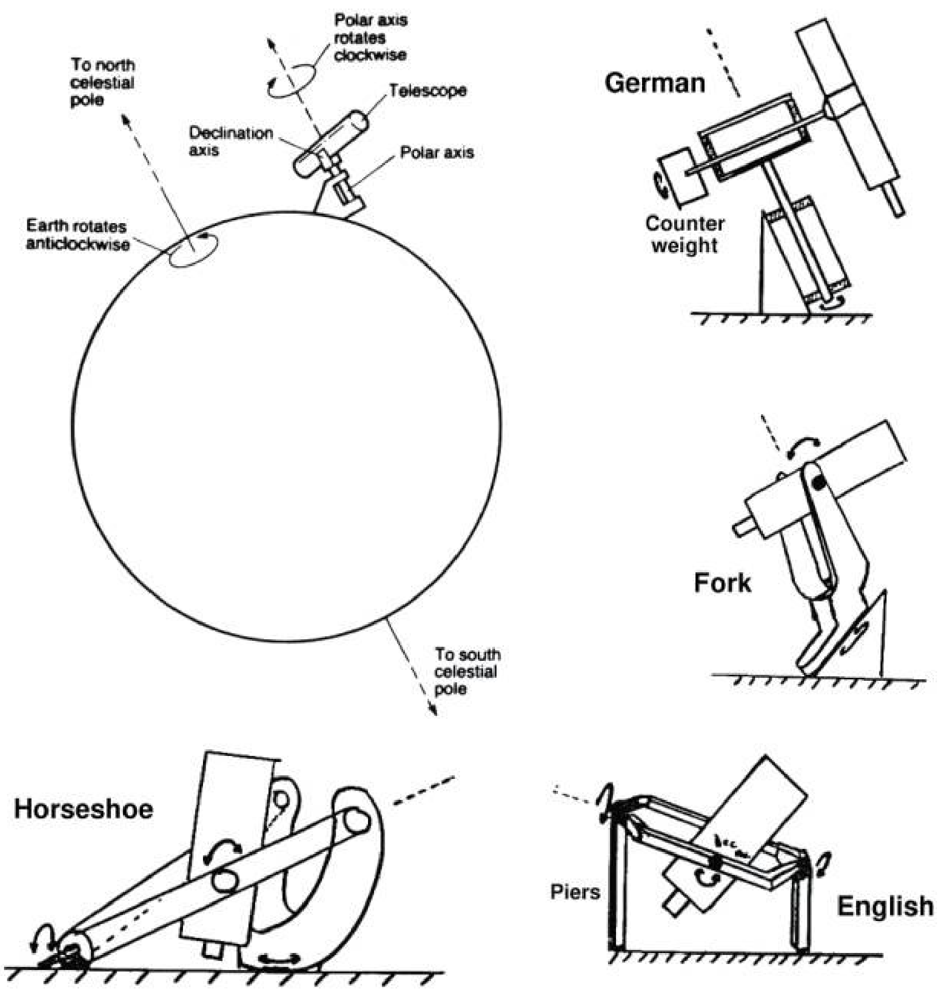

**Borrowed from J. Oliver.**

# 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**

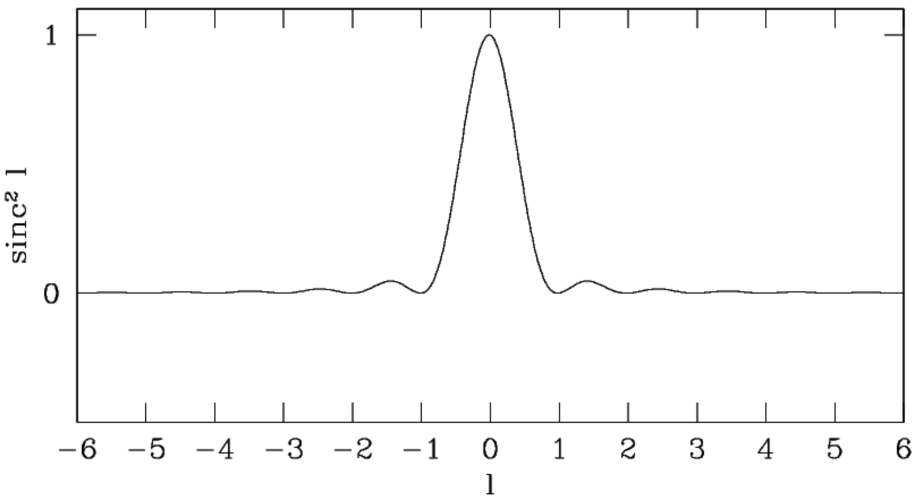
# The last big scope with an equatorial mount

**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 $\lambda/D$.**

**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

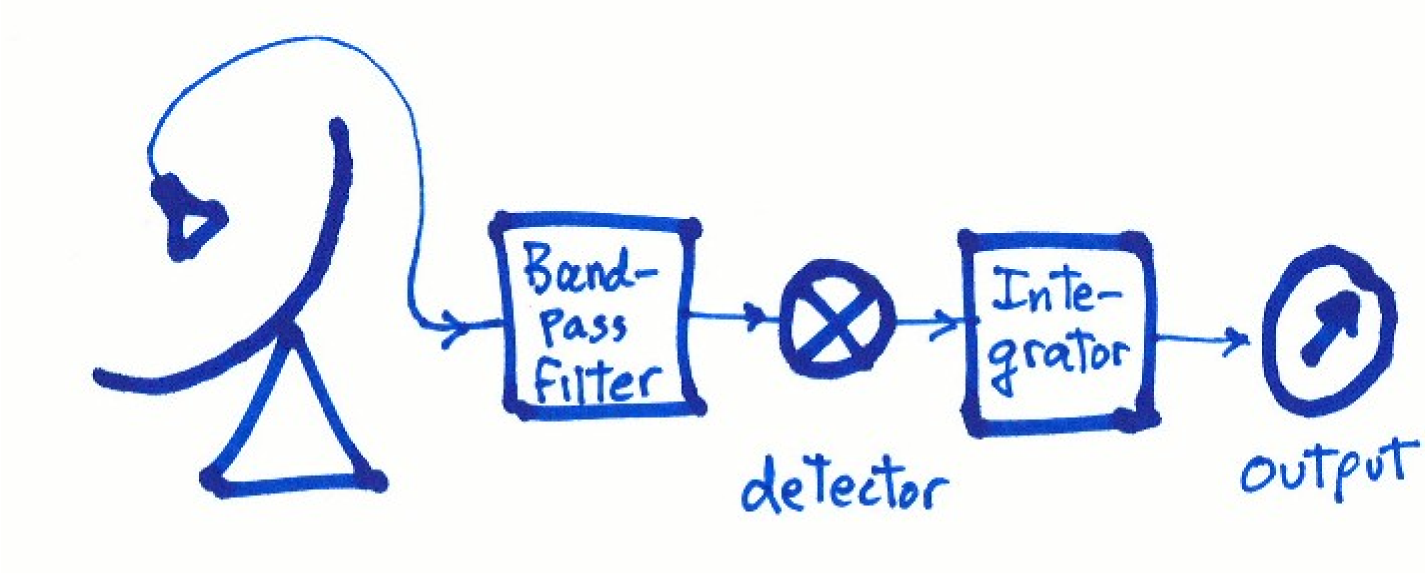
**Steps in detection of radio emission with a radiometer:**

**(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 $\Delta t$**

**then the sensitivity (1$\sigma$ noise) will be**

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

**i.e., goes down as sqrt(number of samples)!**

# Quiz