(Astro)Physics 343 Lecture # 9: telescopes; interferometry
This week's schedule

Monday – Wednesday: ad hoc office hours for lab # 4
   (Baker for sections A, C; Sharon for sections B, D, and E)
I will try to have Lab # 3 ready to return by your section.

Monday + Thursday: regular office hours

Note: I will be out of town and in sporadic email contact from Wednesday night through Friday night.

Lab # 4 due next Monday.
## 15 people + 4 cars to Green Bank

Preliminary plan for NJ → WV (can reshuffle for return):

<table>
<thead>
<tr>
<th>Departs</th>
<th>Driver</th>
<th>Passengers</th>
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<tbody>
<tr>
<td>1:00pm</td>
<td>Baker</td>
<td>Demarest, Shah, Tarabichi</td>
</tr>
<tr>
<td>3:00pm</td>
<td>Heiblim</td>
<td>Law, Patel, Rodriguez</td>
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<tr>
<td>4:00pm</td>
<td>Sharon</td>
<td>Llamas, Salmon</td>
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<tr>
<td>5:00pm</td>
<td>Fadely</td>
<td>Galkin, Patterson, Spassova</td>
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Why do we need telescopes?

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

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)

tapered!
Telescope designs: mount?

**Equatorial:** one axis to track sources

**Alt-Az:** both axes to track sources

*Horseshoe, German, Fork, English, Piers*
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 $\Delta v$

... integration time is $\Delta t$

then the sensitivity (1σ noise) will be

$$\Delta T = \frac{T_{sys}}{\sqrt{\Delta v \Delta t}}$$

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