Bessel, Henderson, & Struve—3 Oct

- You are a young astronomer in 1814. What problem do you want to study?
  - In 1814, Madison evacuated Washington, DC before the British attack.
  - Napoleonic Wars

Bessel, Henderson, & Struve Measure Distances of Nearest Stars

- Parallactic angle
  angle = baseline / distance
- For the great distances of the stars, the angles are small and difficult to measure

1. You are a young astronomer in 1825. What baseline should you choose?
Bessel, Henderson, & Struve Measure Distances of Nearest Stars

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1. You are a young astronomer in 1825. What baseline should you choose?
   A. London to South Africa
   B. Paris to Cayenne
   C. Earth and Earth 6 months later

Definitions

- Angles are measured in arcseconds (arcsec)
  - An arcminute is 1/60 degree
  - An arcsecond is 1/60 arcminute
- Distances to stars are measured in parsec
  - 1 pc = 200,000AU
  - Nearest stars are about 1 pc away.
- With a baseline of 1 AU
  \[ a = \frac{1}{D} \]
  if angle \( a \) is in arcsec and distance \( D \) is in parsec.
2. You are a young astronomer in 1825. Measuring the distance to one star requires years of work. What type of star should you choose to likely get a close one?

3. You are a young astronomer in 1825. Measuring the distance to one star requires years of work. What type of star should you choose to likely get a close one? Bright/faint? Fast/slow?

A. Bright or fast
B. Bright or slow
C. Faint or fast
D. Faint or slow
First distances of stars 1837

- Thomas Henderson in South Africa
- Wilhelm Struve in Dorpat, now in Estonia
- Frederich Bessel in Königsberg, now in Russia

1. Which is the most distant star?
   A. 61 Cygni
   B. Vega
   C. α Centauri

<table>
<thead>
<tr>
<th>Star</th>
<th>Parallactic angle [arcsec]</th>
<th>Dist [pc]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bessel</td>
<td>0.29</td>
<td>3.4</td>
</tr>
<tr>
<td>Struve</td>
<td>0.12</td>
<td>8.3</td>
</tr>
<tr>
<td>Henderson</td>
<td>0.75</td>
<td>1.3</td>
</tr>
</tbody>
</table>

F G Wilhelm Struve

- Born in Altona (Denmark, now Germany)
- Educated at U Dorpat (Russia, now Estonia)
- Petition to Prince Lieven, Chancellor of University of Dorpat
  - “The opportunity to acquire this instrument, the possession of which would raise our observatory to one of the first in Europe, perhaps will never return.”
- The Great Refractor built by Fraunhofer arrived in 22 crates in 1824, and the city of Dorpat celebrated.
- Czar Alexander I sent diamond rings to Struve & Fraunhofer.
Friedrich Bessel

• 61 Cyg was difficult because there is no nearby reference star.
• Fraunhofer built a telescope with a split lens to show two separate images.
  – By moving the two lens pieces, Bessel could offset the two images and bring 61 Cyg close to reference star.

Summarizing Question

• What was known about the universe in 1850 that was not known in 1814?
Friedrich Bessel

- 61 Cyg was difficult because there is no close reference star.
- Fraunhofer built a telescope with a split lens to show two separate images.