**Epsilon Aurigae** – the brightest member of a new class of “disk-eclipsed” binary stars –

*Gibson & Stencel, papers 315.01 & 315.02*

- Mass transfer stream, rich in rare-earth elements
- F0Ia supergiant star, Irregular variable, Interferometrically resolved.
- Opaque accretion disk, hidden companion star, Enhanced 13Carbon, 18 times solar

*Orbital period 27.1 years*

**THE DEBATE**, since 1929:

- 15 + 12 Msun –VERSUS-- 1 + 6 Msun
- NEW! GAIA DR2 parallax → distance
- 2.4 +/- 0.5 mas → 500 +/- 100 pc (about 1500 light years)
- → ANSWER: 1+6 Msun (pre-AGB + B star)
Backup slides
Epsilon Aurigae: The System

- Type F01a supergiant primary in 27.1 year orbit with an unseen companion
- Most recent eclipse: 2009 - 2011
  - Numerous spectroscopic and photometric data sets generated
- Disk was imaged using interferometry
- New distance from GAIA: 500 +/- 100 pc
- Outstanding question:
  - What is the mass and evolutionary state of the hidden companion star?

Kloppenborg, Stencel, Monnier, et al. 2010
Evidence of a Mass Transfer Stream

- Different velocity features associated with different components of the system
- New type of velocity feature: High velocities seen only near third-contact
  - Interpreted to be a stream of matter accreting onto secondary star from primary star
Modeling with MESA code

• MESA is a stellar evolution code used to constrain the evolutionary state of epsilon Aurigae

• Constraints to be met:
  • Close match to current primary star temperature and luminosity
  • Period close to observed value, 27.1 years
  • Mass function close to the determined value of 3.0
  • Require Roche lobe overflow & mass transfer
  • Carbon isotopic ratio, $C^{12}/C^{13} = 5$
  • Match the interferometrically determined angular diameter

• Results: Constraints closely matched at an age of 20 Myr, when the donor star is a pre-AGB star and the accreting star is a B-type main-sequence star (typical Algol during mass transfer phases)
Next Steps

• This benchmark MESA model can provide a basis for further exploration of this interacting binary, and other disk-eclipsed binary stars.
• NEW GAIA parallax measurement of 500 +/- 100 pc will greatly help in constraining the luminosity of the primary star in future models
• Confirmation of the mass-transfer stream can lead to more targeted observations during the next eclipse in 2037.
• Monitor quadrature circa 2020 for infrared heating expected on disk third-contact quadrant