(Mostly)
Science Topic: Stellar Diameters

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Motivation

– EMPIRICAL stellar astrophysical parameters.
– Exoplanet characterization via characterization of host stars.
– Stellar physics, particular late-type stars.
– Calibration / constraints for stellar models
– Predictive, semi-empirical relations.
Approach

– IR / optical interferometry and limb darkening corrections: angular stellar diameter.
– Observing: minimize unknown systematics.
– Trigonometric parallax: physical stellar diameter.
– SED fit / spectrophotometry: stellar $F_{\text{BOL}}$.
– From angular diameter and $F_{\text{BOL}}$: $T_{\text{EFF}}$ and $L$. 
Status

Empirical HRD (~ 290 stars)

size of data point = log $R_{\text{star}}$

- Status Nov 2016
- $\delta \theta < 5\%$
- $d < 150$ pc
- $R < 100$ $R_{\text{solar}}$
- no fast rotators
- no pulsators

von Braun & Boyajian (2017)
Why Interferometry for Diameters?

– SB Law: \( T_{\text{eff}} \sim (L R^{-2})^{0.25} \sim (F_{\text{BOL}} \theta^{-2})^{0.25} \)

– Alternative approaches:
  
  • Full-on stellar models
  
  • Semi-empirical: determine \( T_{\text{eff}} \) spectroscopically, SED fitting for \( F_{\text{BOL}} \), get \( \theta \) and \( R_{\text{star}} \).
  
  • Interferometric results calibrate models & relations.

– But:
  
  • Stellar models tend to underestimate stellar radii (5-10%) and overestimate \( T_{\text{eff}} \) (3-5%), especially for late types.
  
  • For semi-empirical models, \( \sigma T_{\text{eff}} \) of 3-5% result in \( \sigma R_{\text{star}} \sim 6-10\% \).
  
  • Accuracy, eccentric objects, …
However...

Interferometry prone to difficulties / systematics.
– Atmospheric conditions; time scales.
– (Un)known calibrator sizes; choice of calibrators.
– Uncertainties very hard to characterize.
– Inherently complicated and challenging method.
  • Delay space
  • Proper motion of targets
  • Telescopes experience different weather
  • Vacuum or lack thereof
  • Piston
  • etc
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\[ \theta \]

\[ \text{Baseline } B \text{ sin } \theta \]

light from star

delay lines

interference fringe