The Angular Diameter of λ Boötis

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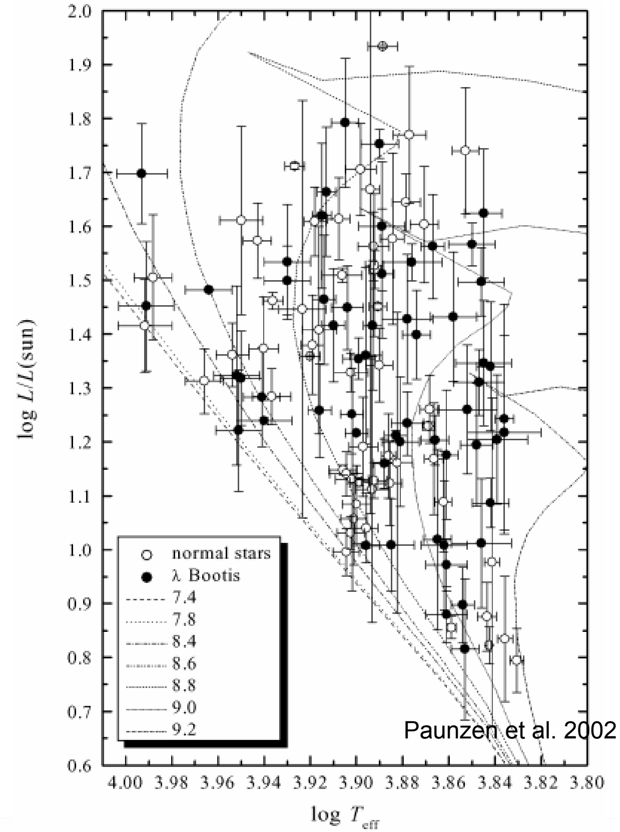
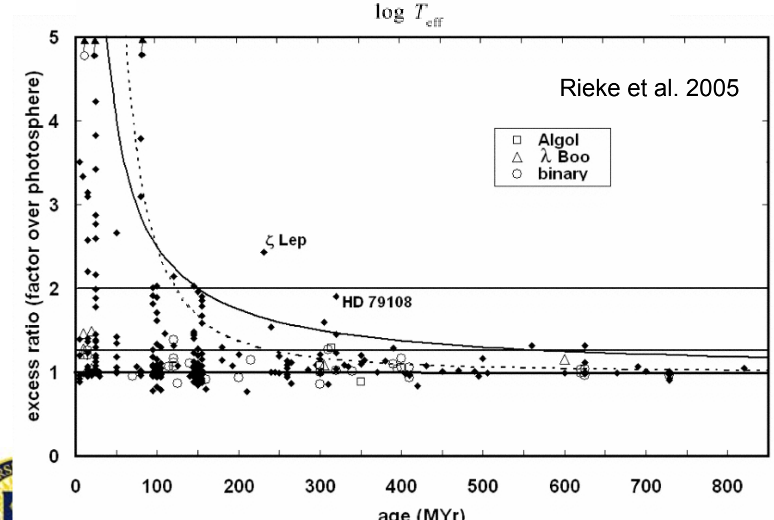
The λ Boo Class

- λ Boo (A3V) is the prototype
  - About 50 stars (2% of all known A-stars)
- Chemically peculiar A/F V stars
  - C, N, O, S – solar abundances
  - Mg, Ca, Fe – highly depleted ([M/H]~ –2)
- Depletion may be related to gas/dust separations in disks
  - Strong infrared excess
    - Vega-like Phenomenon - Young (MYr)
    - Evolved stars with mass loss - Old (GYr)
  - Ages determined from HRD
    - Solar Metallcity tracks only
      - No consideration of other metallicties
    - Ages: 10 – 1000 Myr
- Alternative hypothesis
  - Binary stars of similar spectral types
  - Blended spectra
- Been a general acceptance of the stars being young and related to the Vega-likes



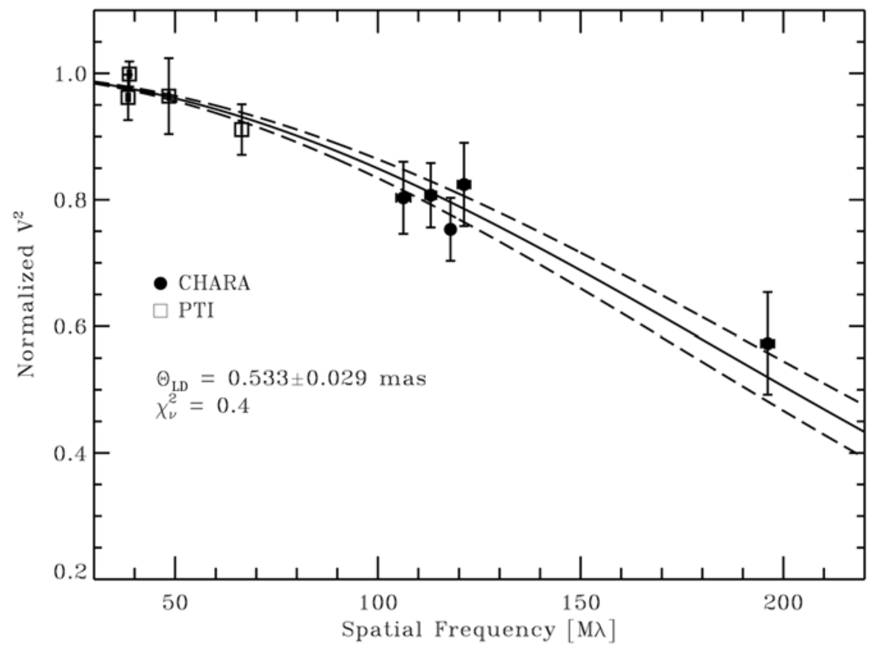


CHARA Array Observations

- Predicted angular size: ~0.5 mas
  - Very small
  - Used the long baselines available at CHARA: 250 – 300 m
  - Wavelengths of observation: H and K
  - Added in archival PTI data (H and K @ 85 and 100 m)
- Data span 6 years
  - PTI (2000, 2003, 2004)
  - CHARA (2004 & 2006)

Angular Diameter and Stellar Parameters

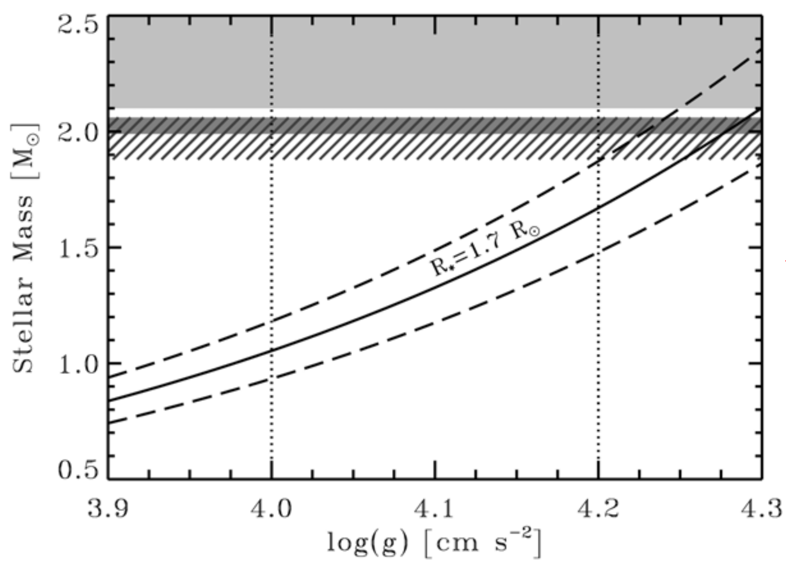
- Limb Darkened Model
  - $\Theta_{LD} = 0.533 \pm 0.029$ mas
- Linear Radius
  - Using D = 29.8 ± 0.5 pc
  - $R = 1.70 \pm 0.10\ R_{Sun}$
- Temperature
  - Using L = 16.3±0.6 Lsun (determined from SED fit)
  - $T_{eff} = 8887 \pm 242$ K
- Mass
  - Surface gravity log(g) = 4.0 – 4.2
  - $M = 1.1 – 1.7\ M_{Sun}$



- Mass range mostly a result of the uncertainty in the log(g)
- Radius uncertainty contributes only ~0.1 M_{Sun} in mass uncertainty

In Comparison to other A-Stars …

Star	Spectral Type	Radius $[R_{Sun}]$	Gravity $[cm\ s^2]$	Mass $[M_{Sun}]$
Vega	A0V	2.78 ± 0.02 (eq) 2.26 ± 0.07 (pole)	3.98	2.3 ± 0.2
Sirius	A1V	1.71 ± 0.01	4.31	2.01 ± 0.05
β Leo	A3V	1.72 ± 0.04	4.26	1.97 ± 0.09
λ boo	A3V kB9.5mB9.5	1.70 ± 0.10	4.0 – 4.1	1.1 – 1.7



HR Diagram and the Age of λ Boo

- Solar-Metallicity Tracks Predict
  - $M \sim 2.0\ M_{Sun}$
  - pre-MS Age: 8 – 30 MYr
  - post-MS Age: 80 – 300 MYr
  - Derived mass does *not* agree with solar-metallicity mass
- Metal-Poor Tracks Predict
  - pre-MS: $M \sim 1.6\ M_{Sun}$, Age: 3 – 4 MYr
  - post-MS: $M \sim 1.2\ M_{Sun}$, Age: 1 – 2 GYr (!)
  - Likely *not* pre-MS – no evidence for HAeBe-like phenomenon
- This is only one λ Boo star
  - Where do the rest fall ?
  - Can the λ Boo phenomenon occur during both ms and post-ms lifetimes?
  - Are metal-poor tracks appropriate for all λ Boo stars?