Dynamite Diameters

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Presented by Hal McAlister

Goals

- To measure the angular diameter (θ) of a large sample of A, F, and G main sequence stars with the CHARA Array to better than 4% accuracy
  - Establish effective temperatures to better than 2%
  - Absolute luminosity → HR diagram
  - Test stellar evolution models
    - Metallicity and age
    - Duplicity
  - Rotation effects

Target Selection

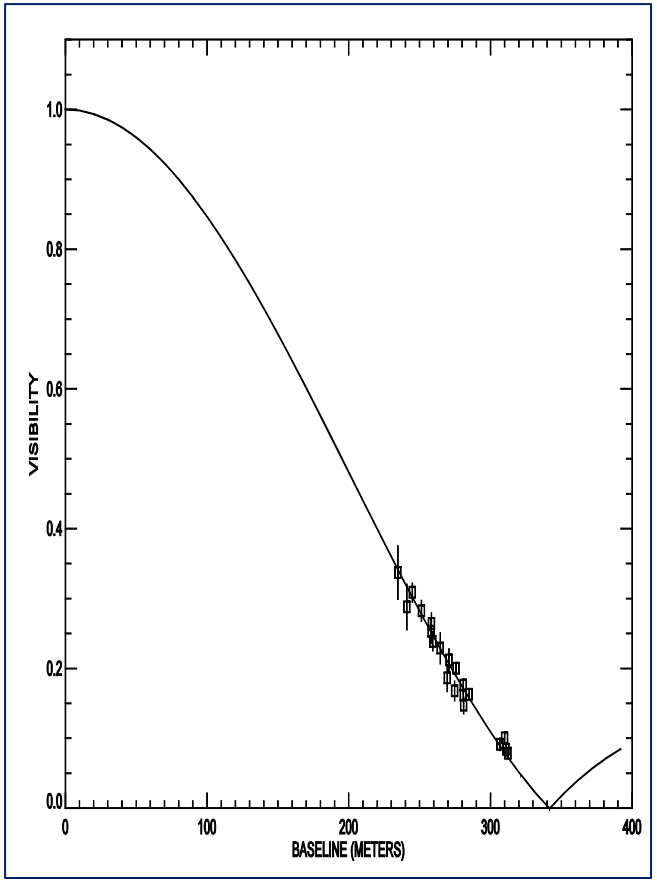
- *HIPPARCOS* Catalogue Query
  - **Spectral type**: defined by B-V colors
  - **Distance limit**: Estimated radii from spectral types gives maximum distance (i.e. angular size) for each spectral type.
    - The error on diameter is directly related to how far down the visibility curve that you can sample. For 4% accuracy, limits are $\theta > 0.65$ mas in K-band and $\theta > 0.50$ mas in H band
  - Folding in CHARA declination and magnitude observing limits and and filtering out the abnormal stars, there are ~90 stars, all with $\theta < 1.7$ mas, 25 with $\theta > 1.0$ mas

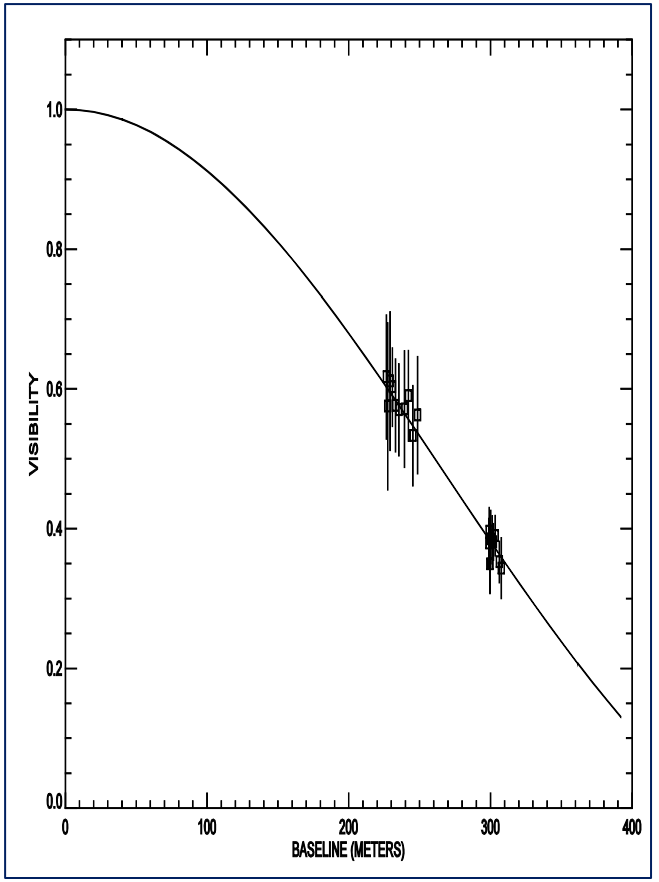
Observing Dynamite Diameters

- 50 stars observed over the past 2 years
  - 20 G stars, 22 F stars and 8 A stars
- Observed on ***more*** than one
  - Date
  - Baseline
  - Calibrator

  to obtain highly reliable (and precise) angular diameters for the program stars
- H-band data acquisition not successful

Examples


VISIBILITY
1.0
0.8
0.6
0.4
0.2
0.0
0
100
200
300
400
BASELINE (METERS)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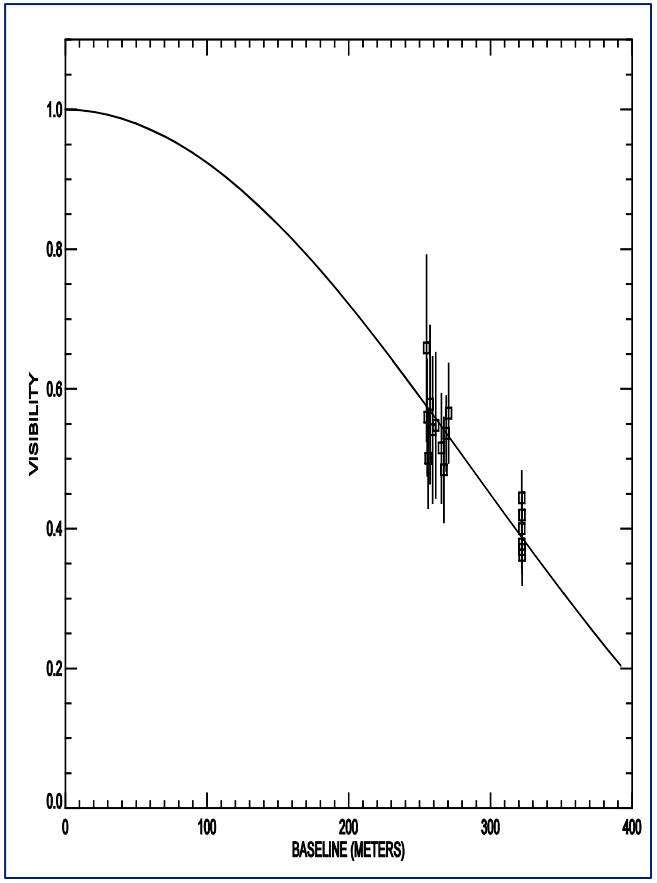
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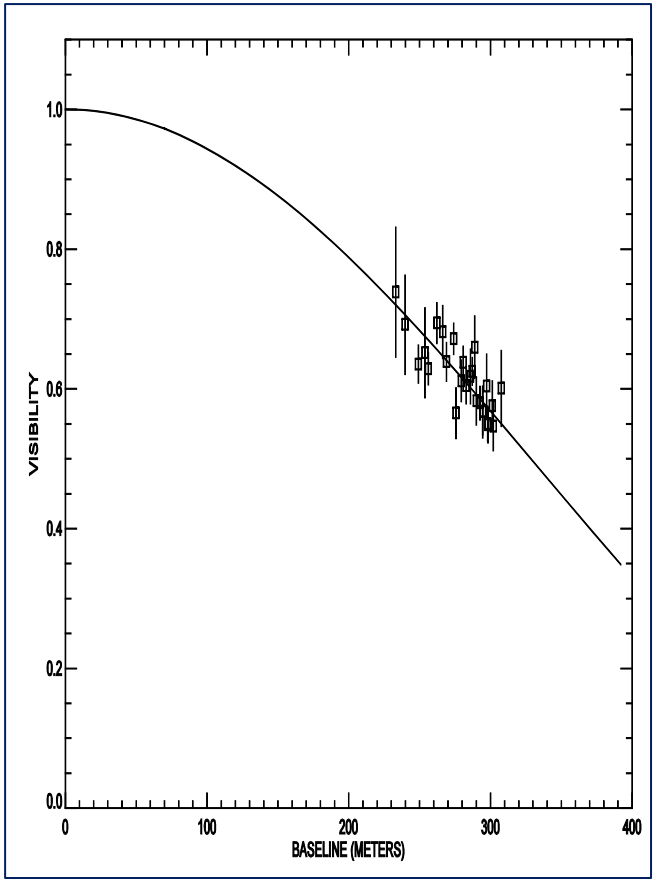
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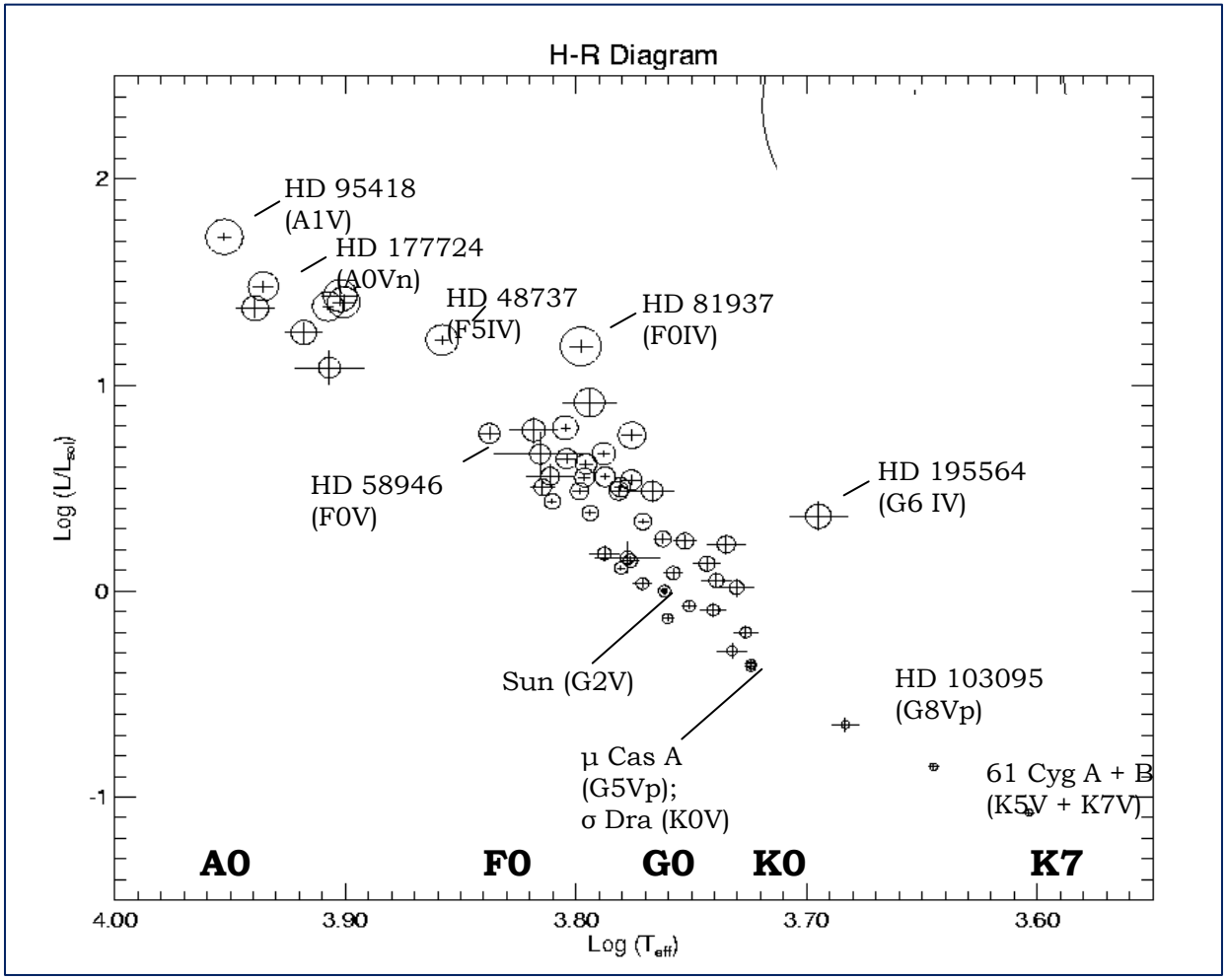
Empirical HR Diagram

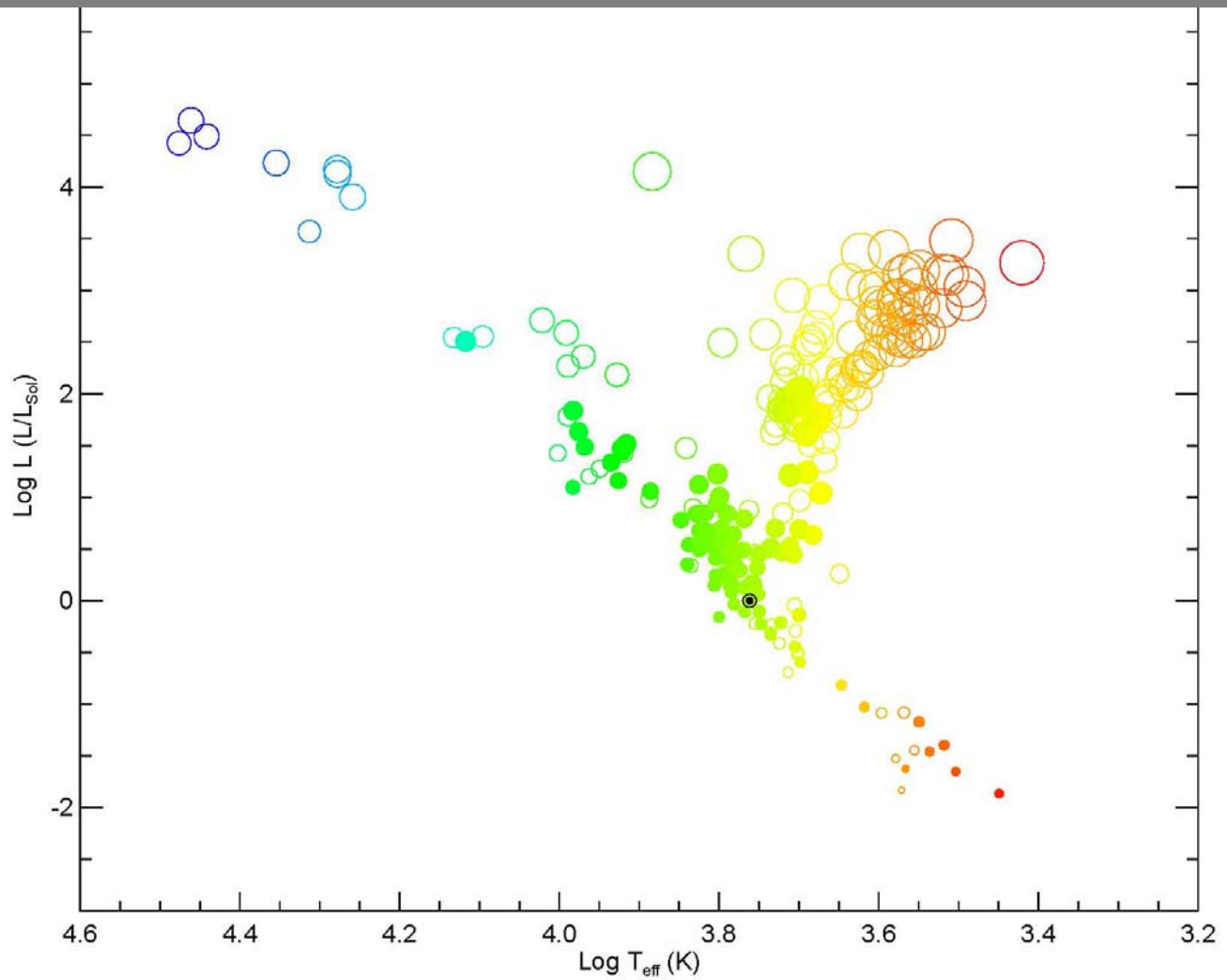
- Linear radii
  - The measured angular diameter combined with the parallax gives the linear radius of the star
- Effective temperatures
  - The measured angular diameter combined with the bolometric flux gives the effective temperature of the star

Fundamentally determined plot from the observations to-date. The size of circle represents the linear size of the star. The 1-σ errors are indicated.



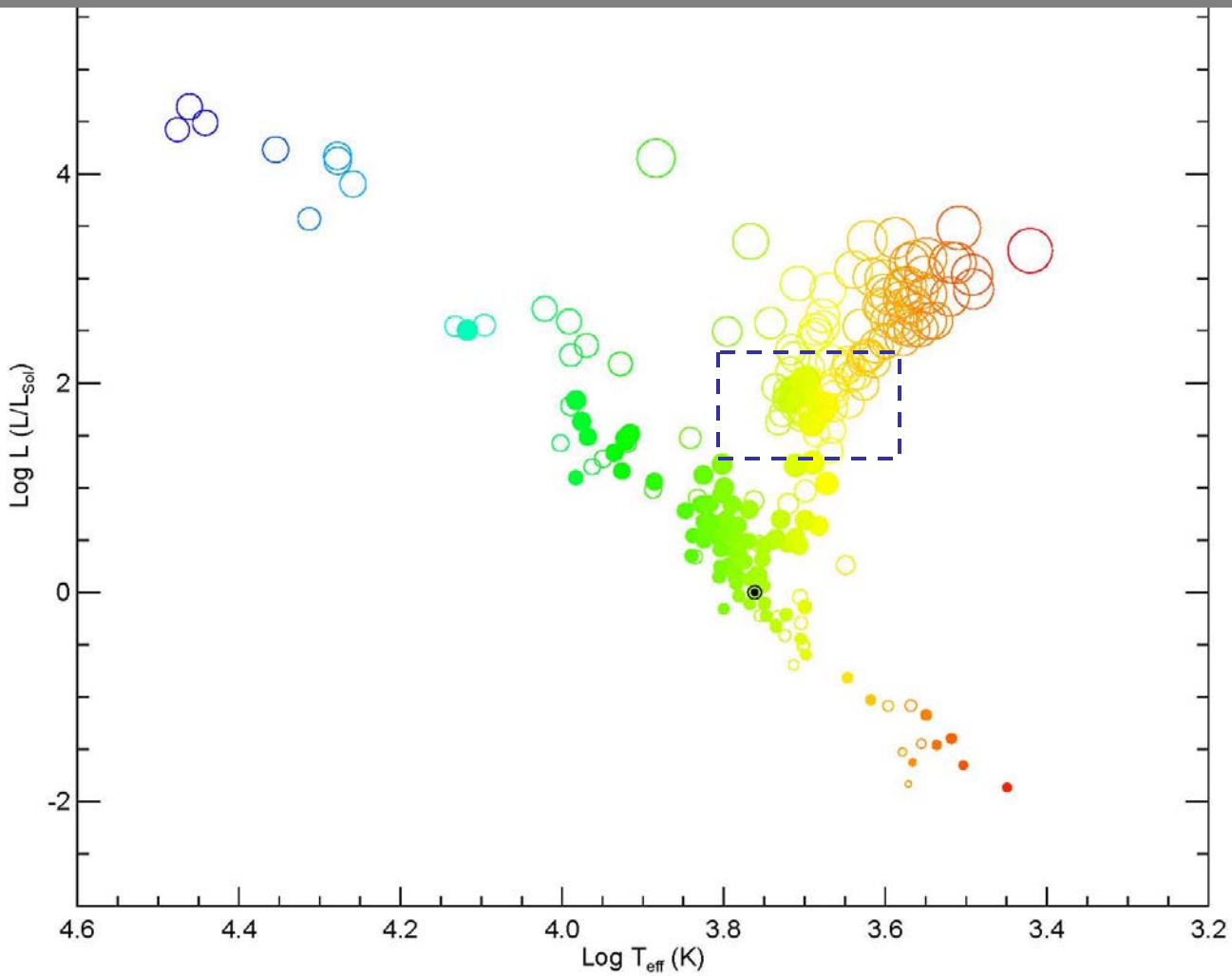
An Interferometric HR Diagram

Compliments of Tabetha Boyajian



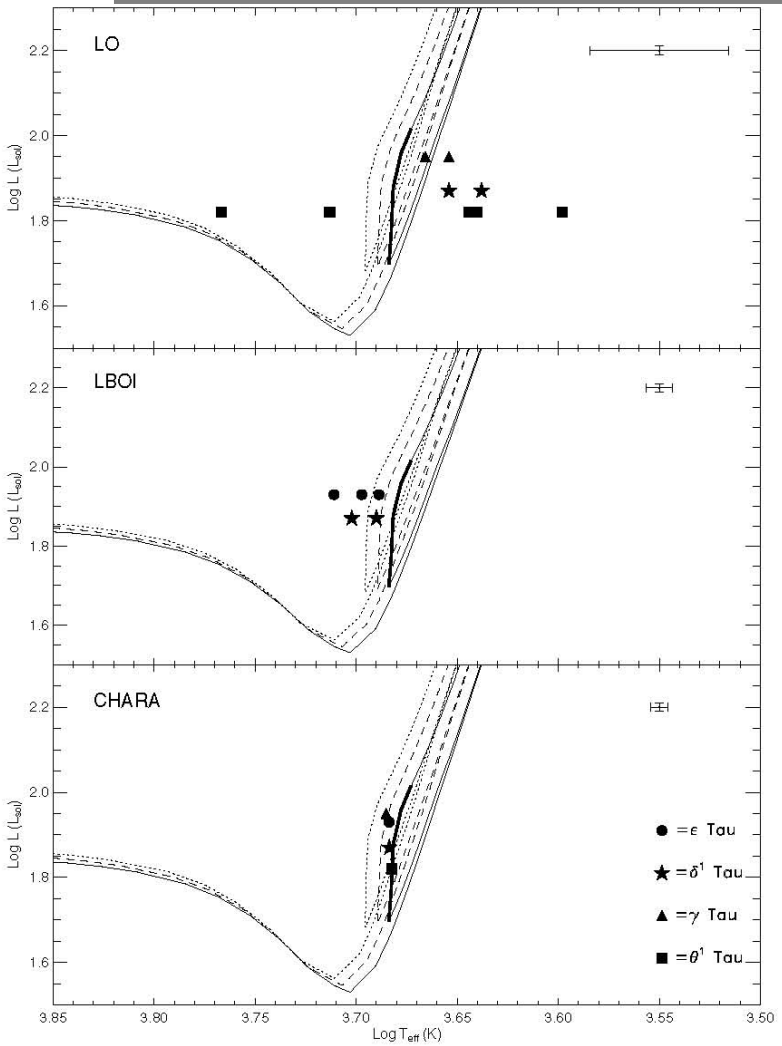
Red Giants in the Hyades

Known Cluster Age is an Asset in Modeling



Red Giants in the Hyades

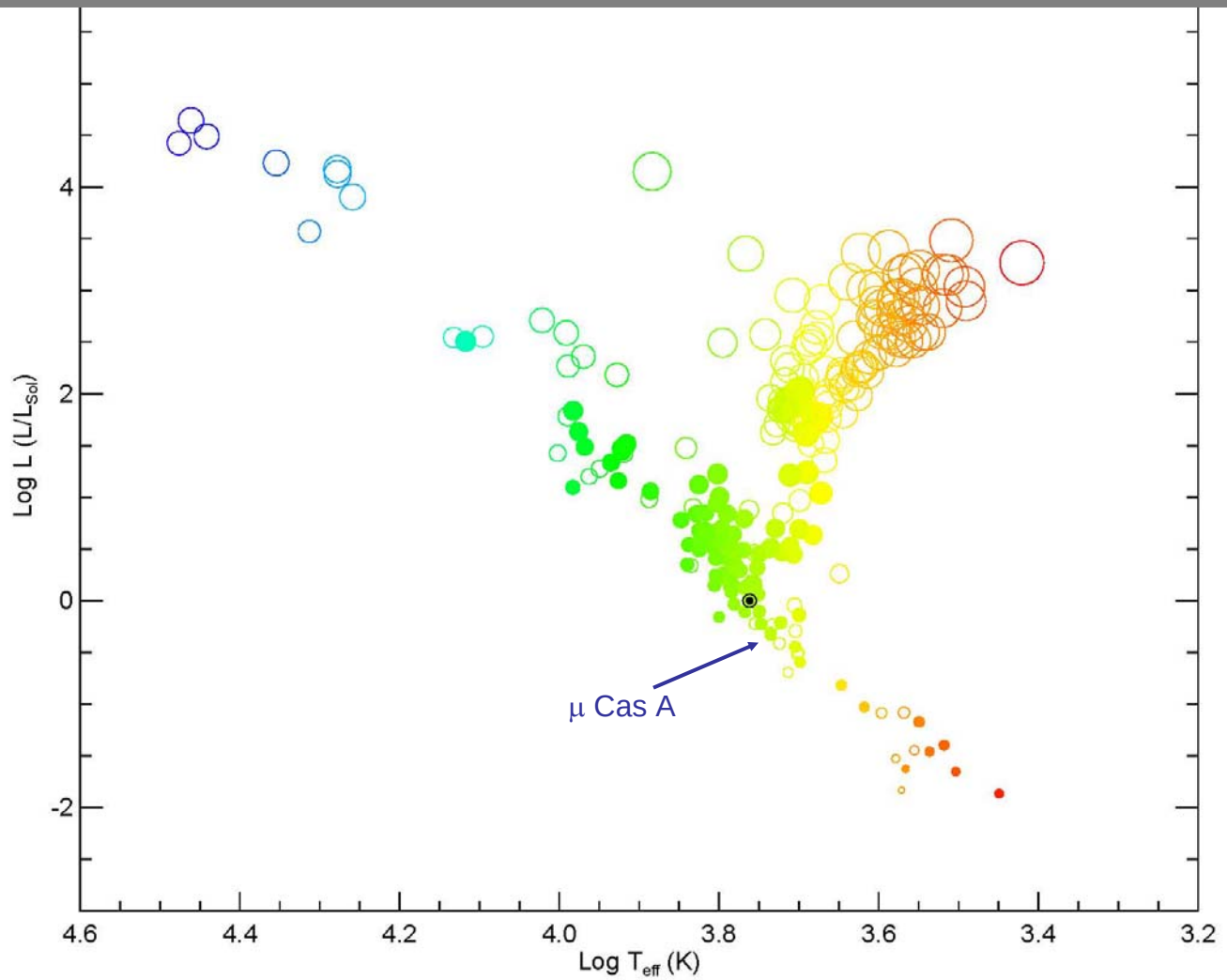
Boyajian et al. ApJ 2009.



625 Myr (Padova) isochrones with slightly varying heavy element abundances for existing and new results for Hyades giants.

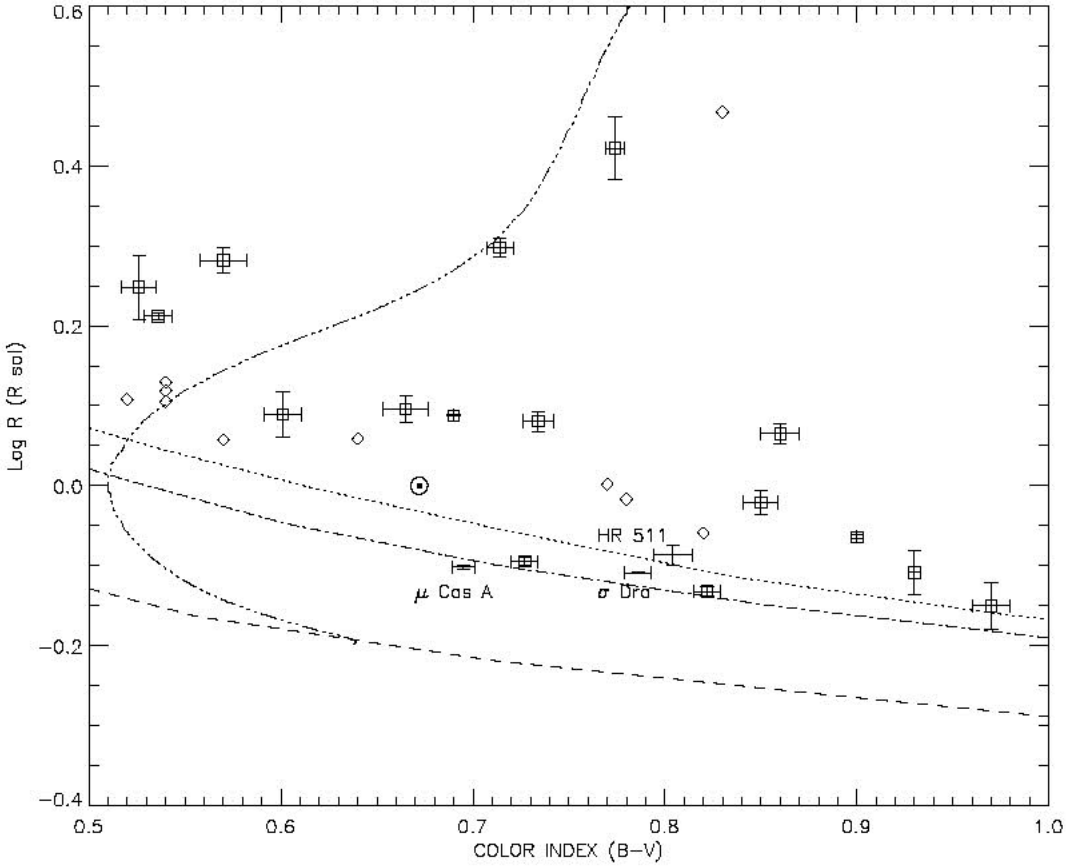
CHARA values show the stars sitting pretty on the Red Giant Clump.

First Diameter for a Population II Star



Diameter of Low-Metallicity Star μ Cas A

Boyajian et al. ApJ 2008.



For μ Cas A:

$\Theta_{LD} = 0.973 \pm 0.009$ mas

Figure shows radii for EBs and LBOI targets for G to mid-K along with ZAMS for 3 target stars and the evolutionary track for μ Cas A. Models (Y^2 and V-R) for such metal-poor stars obviously need improvement.