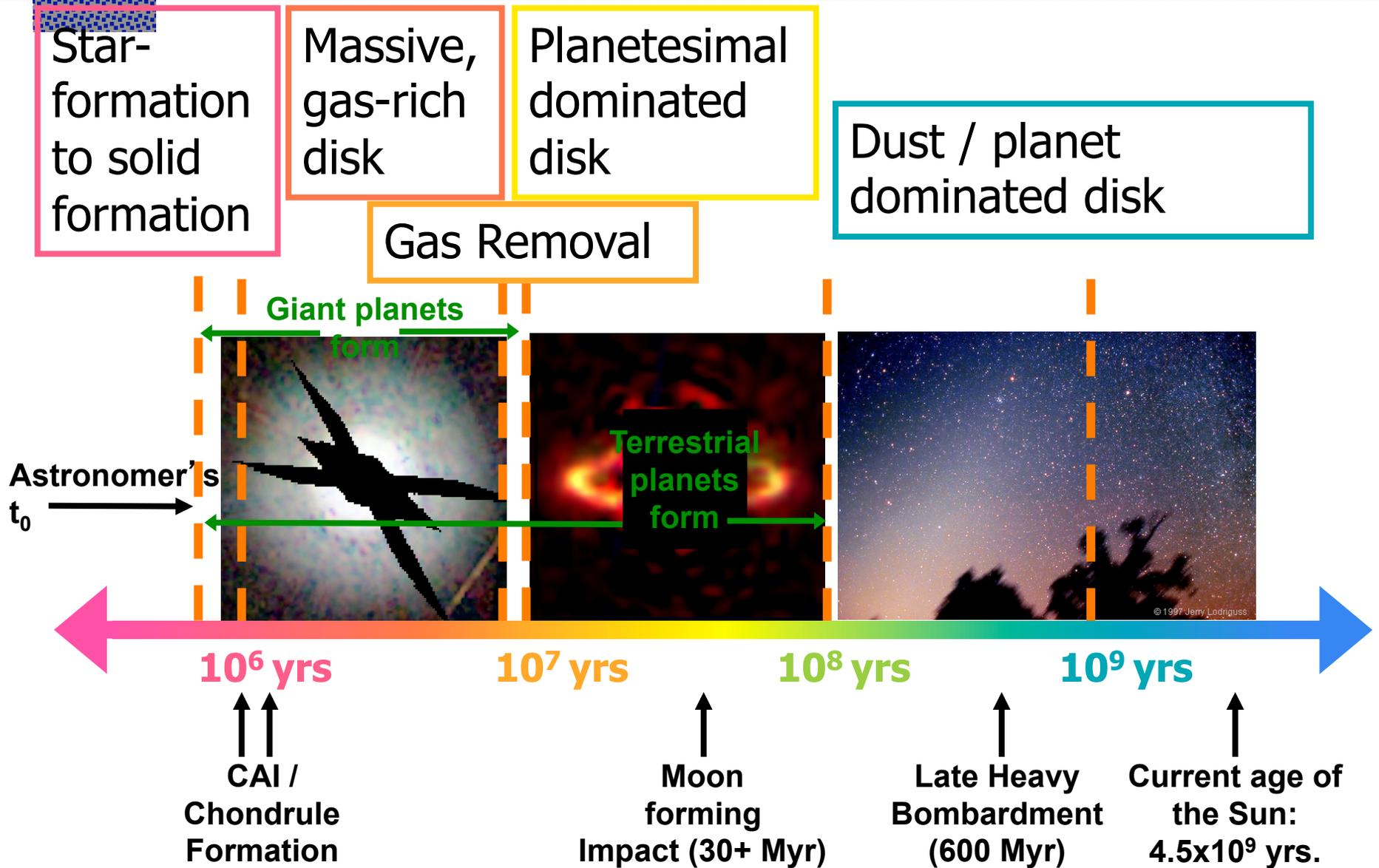
A photograph of an astronomical observatory at night. The observatory is a multi-story building with a prominent telescope enclosure. The sky is dark and filled with stars, with the Milky Way galaxy visible as a bright, hazy band of light. The observatory is silhouetted against the starry sky.

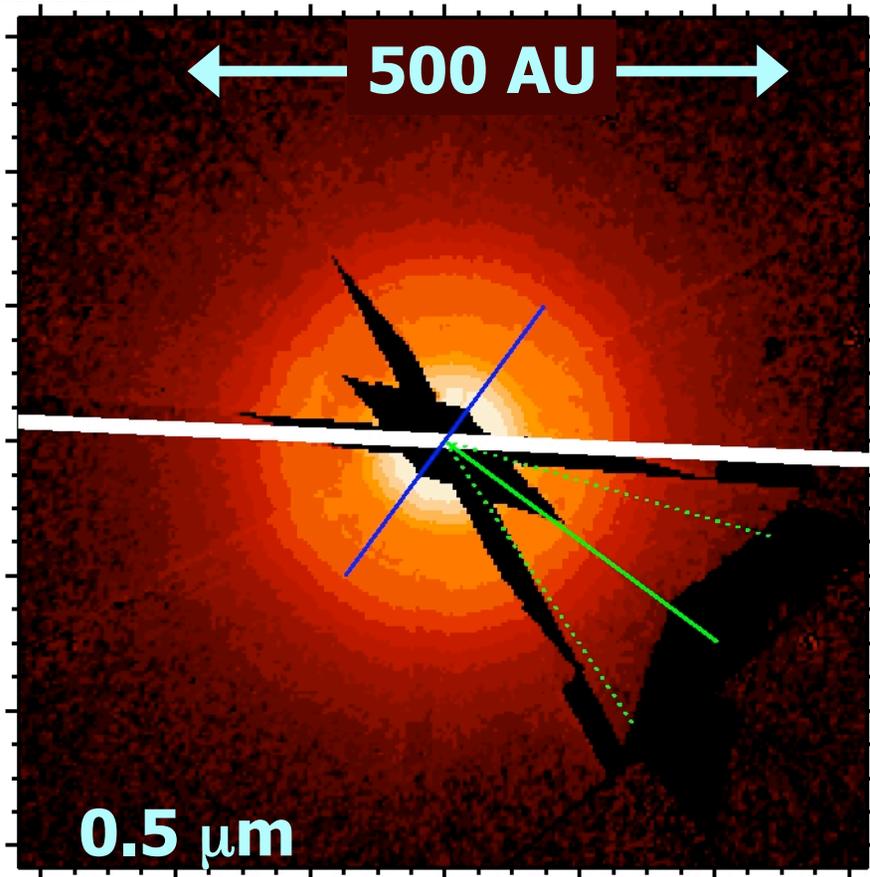
Parallactic Distances to Nearby Young Association Stars

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Planetary Formation Timescales



TW Hya With HST 0.5 - 2 μm



Roberge et al. 2005



Debes et al. submitted

TW Hya is a classical T Tauri star with lots of gas and dust. What is its age?

Other Disks in TWA?

4 accreting, optically thick disks

TW Hya – disk, accreting (IRAS)

Hen 3-600 – disk, accreting (IRAS)

TWA 30 – disk, accreting

2M1207 – BD disk, accreting

7 transitional / debris disks

HD 98800 – disk, not accreting (IRAS)

HR 4796A – debris, not accreting (IRAS)

TWA 7 – debris, not accreting

2M1139 – BD disk, not accreting

SSPM1102 – BD disk, not accreting

TWA 31 – disk, not accreting

TWA 32 – disk, not accreting

~14 stars with no detected disks

Bi-modal distribution of dust?

(e.g. Weinberger et al., AJ, 2004; Low et al. 2005; Riaz et al. 2008; Plavchan et al. 2009, Schneider et al. 2012)

TW Hya is a Puzzle

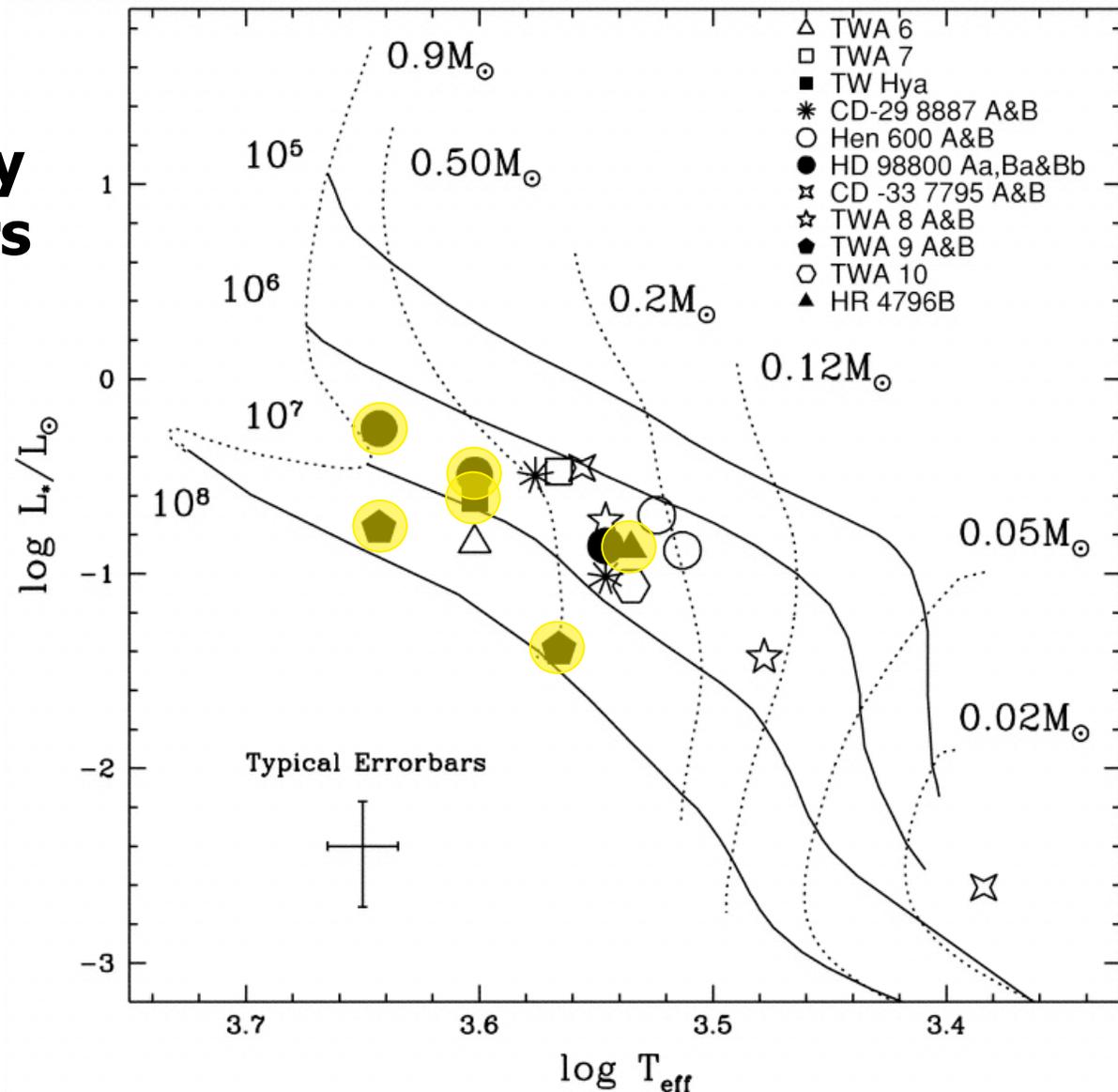
- At a fairly old age, TW Hya still has a massive disk
- Something is making a partial “gap” in the disk at 80AU
- Very small grains are coexisting with very large grains throughout the disk

A planet can account for all of these, except perhaps the first!

What is the age of TW Hya anyway?

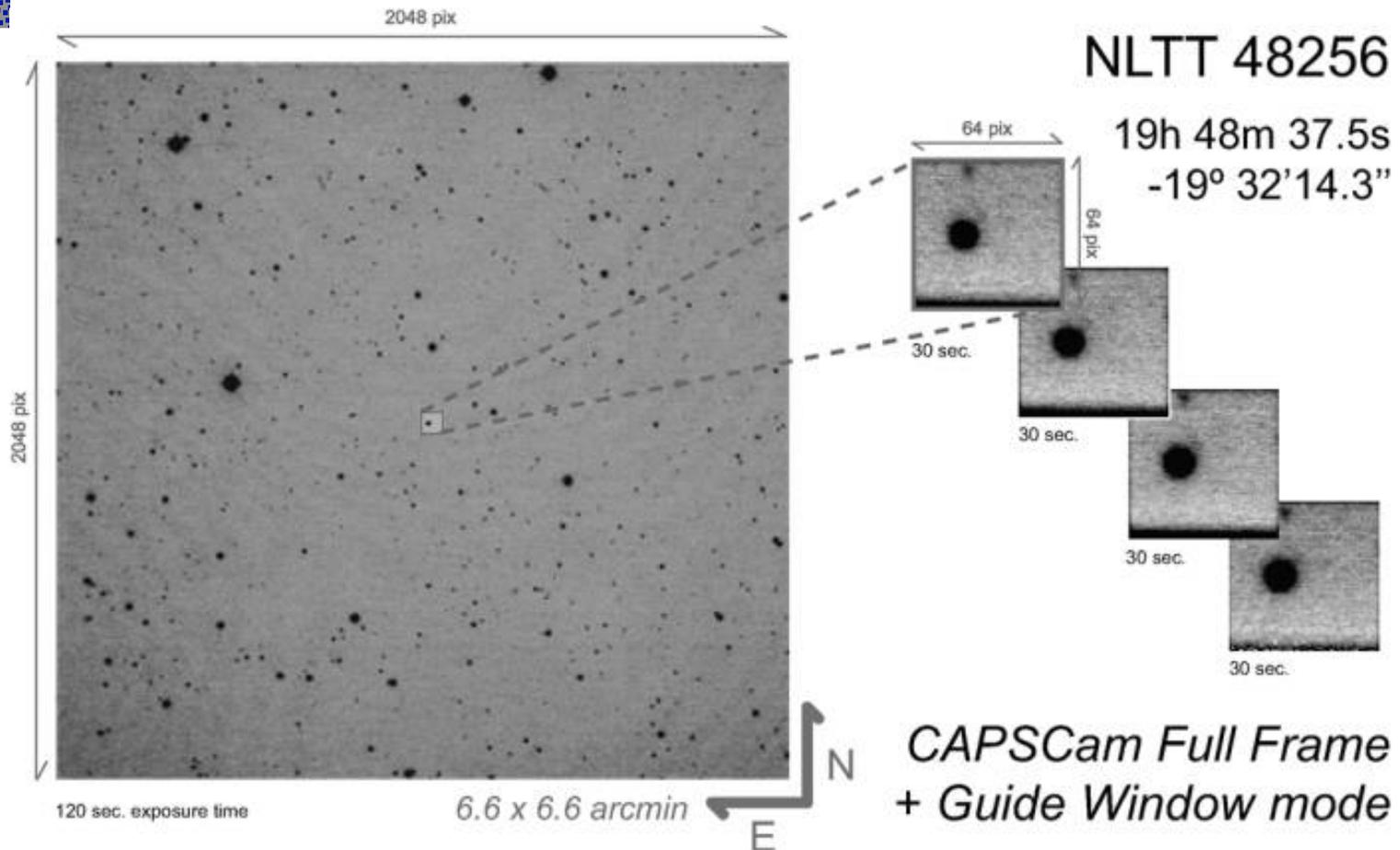
TWA Age Canonically ~10 Myr

TW Hya (and only 3 other TWA stars marked by ●) have Hipparcos parallactic distances



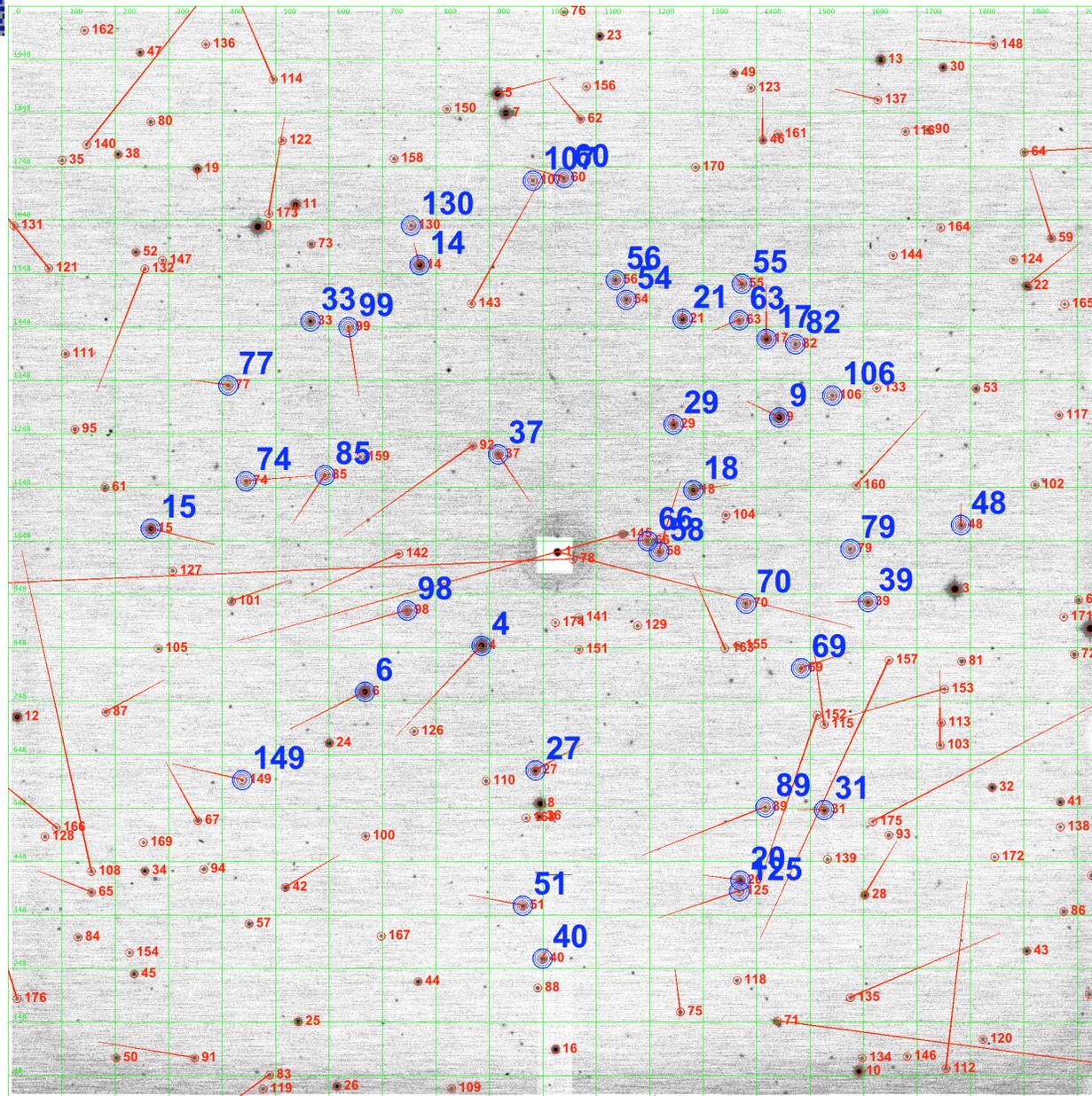
(Adapted from Webb et al. 1999, ApJL)

Enter CAPSCam



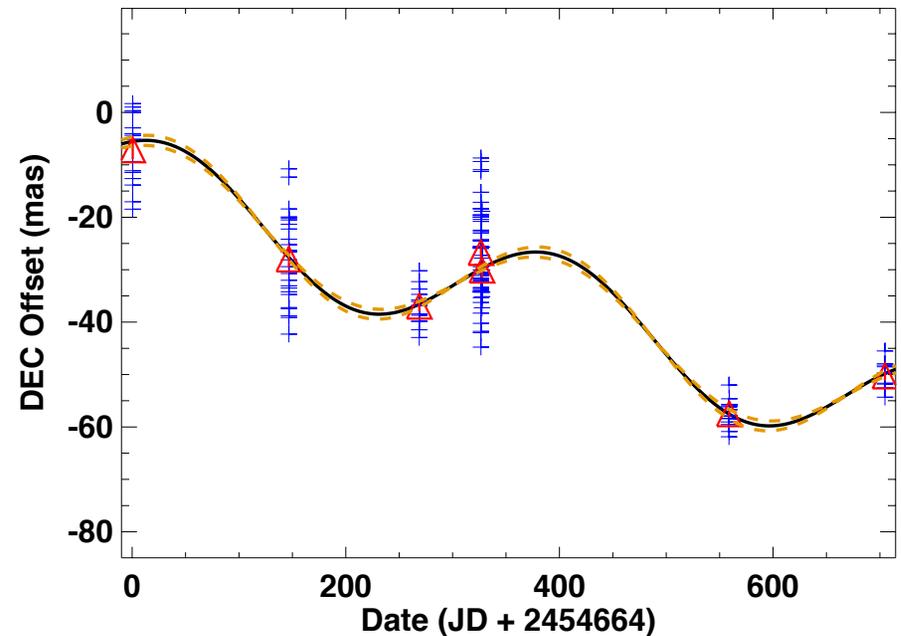
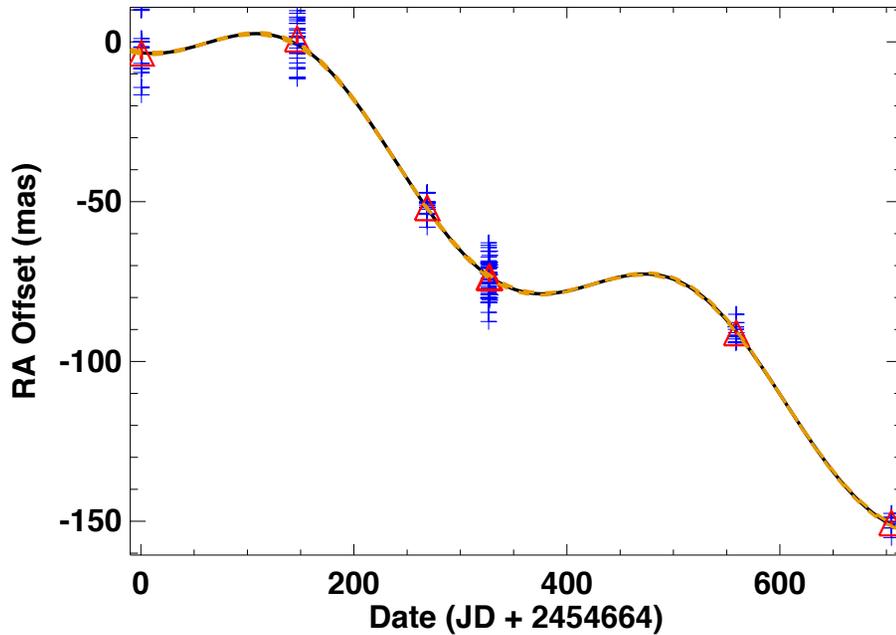
See description of CAPSCam in Boss et al. 2009

Observe 14 TWA stars



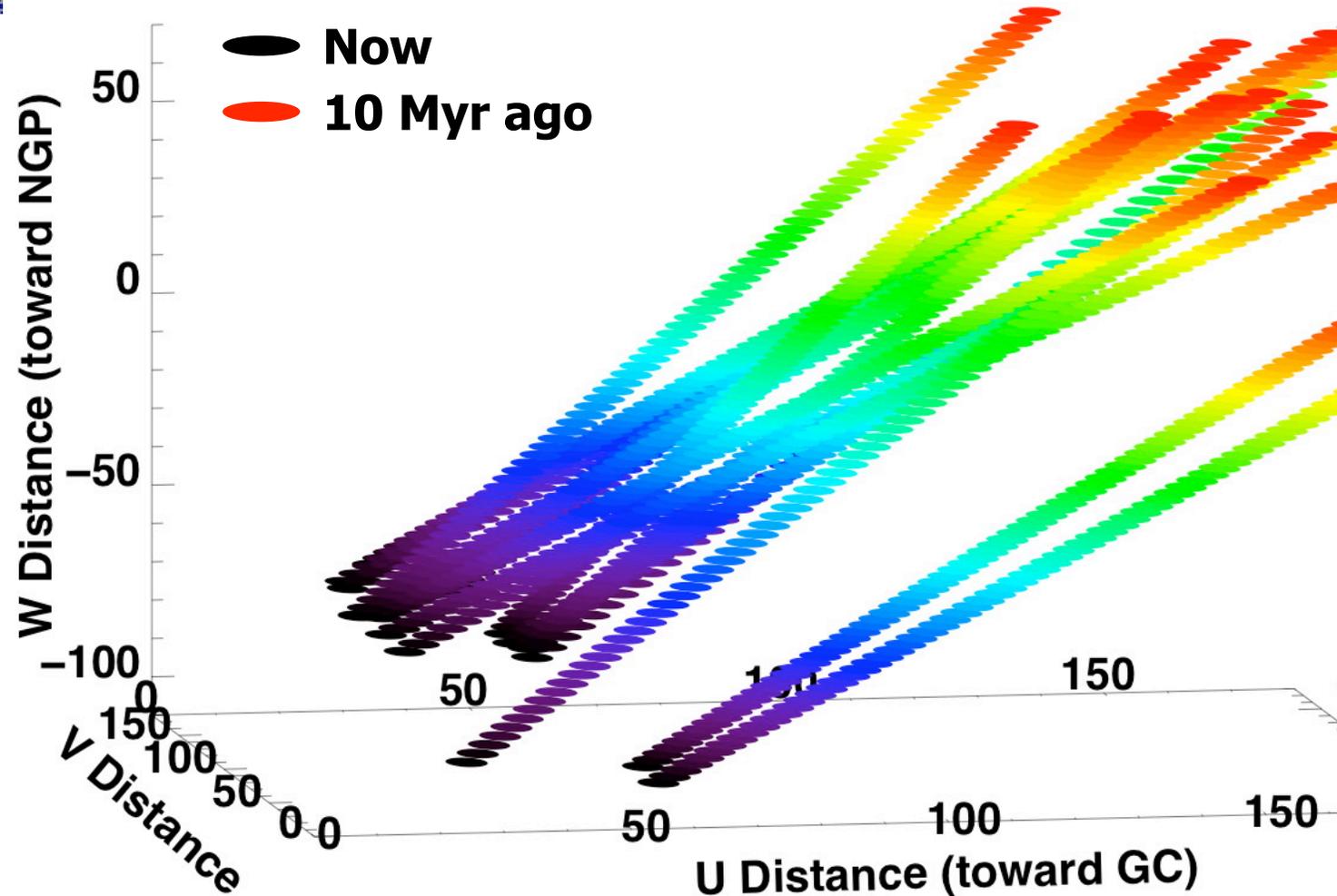
e.g. TWA 12

Fit Parallax and Proper Motion



We did this for 14 primary TWA members plus 2 visual binary companions

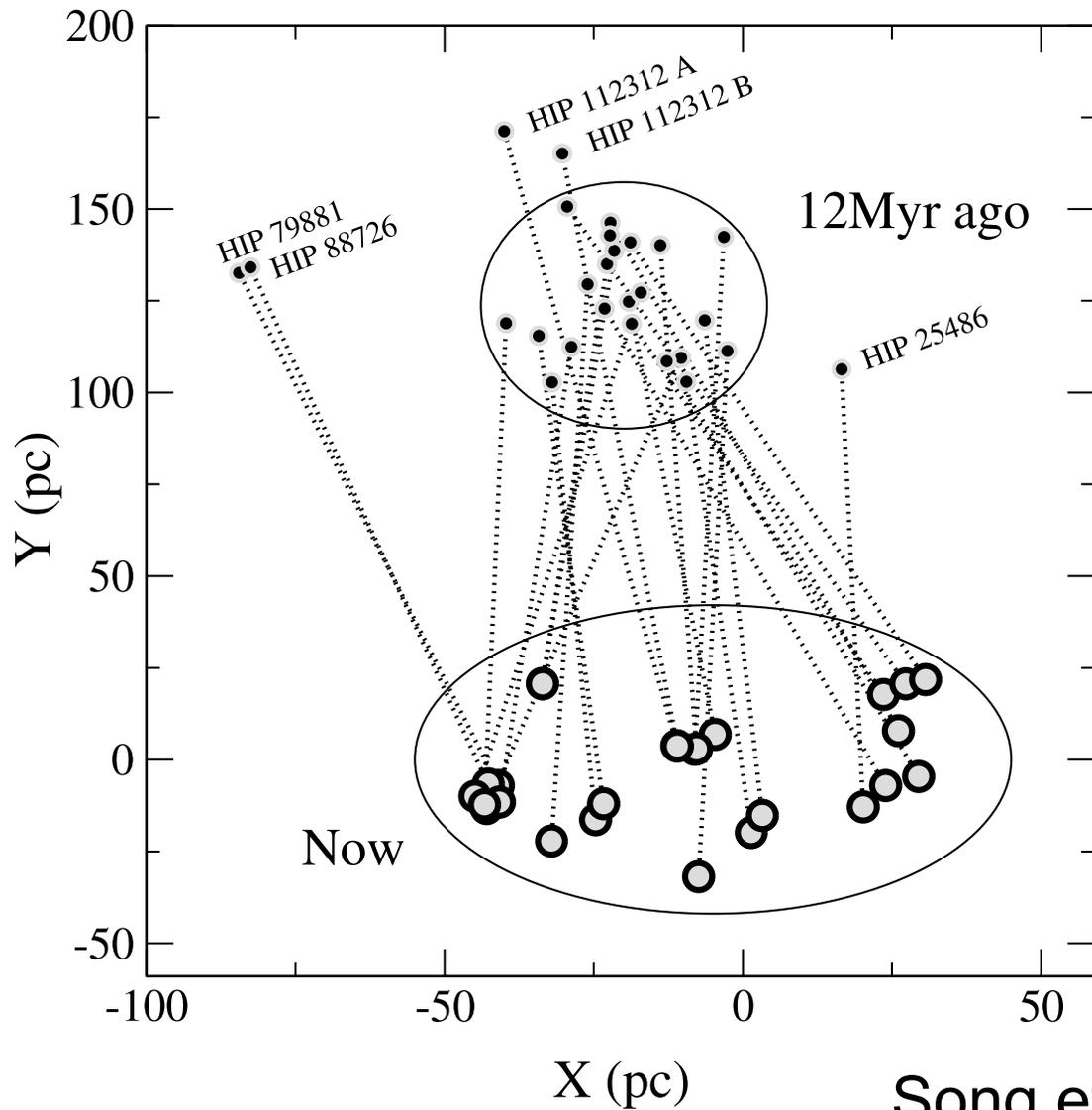
Age from Kinematics?



No convergence = no single age?

Weinberger et al. 2012 (submitted)

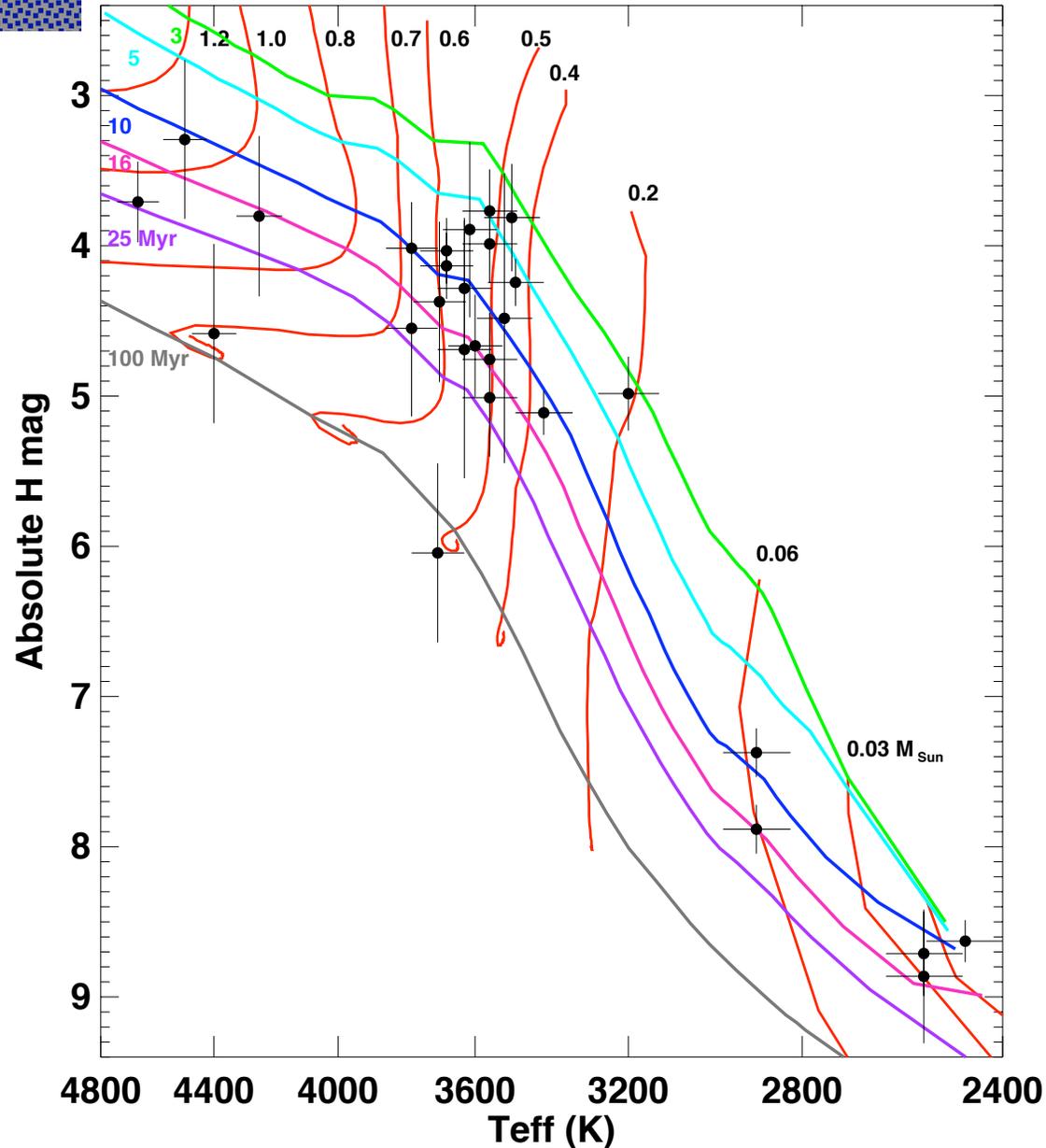
Contrast to β Pic Association



**Smallest volume
about 12 Myr
ago**

Song et al. 2003

Ages from Isochrones



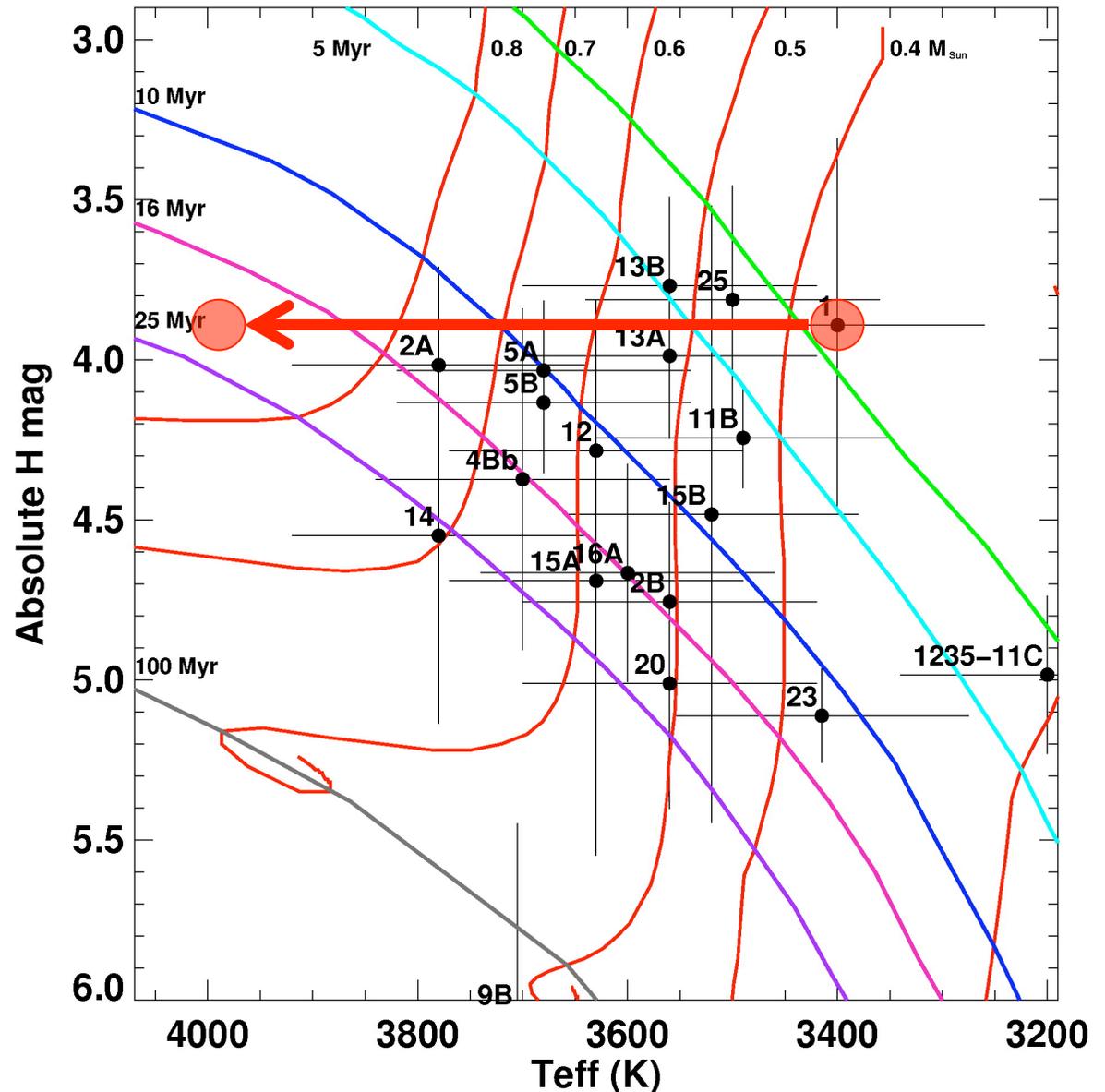
Plot all TWA stars with parallaxes on Baraffe et al. 1998 tracks; hybrid mixing length/He abundance

(Weinberger et al. 2012)

Ages from Isochrones, cont.

Age is 5-10 Myr,
consistent with
Li depletion age

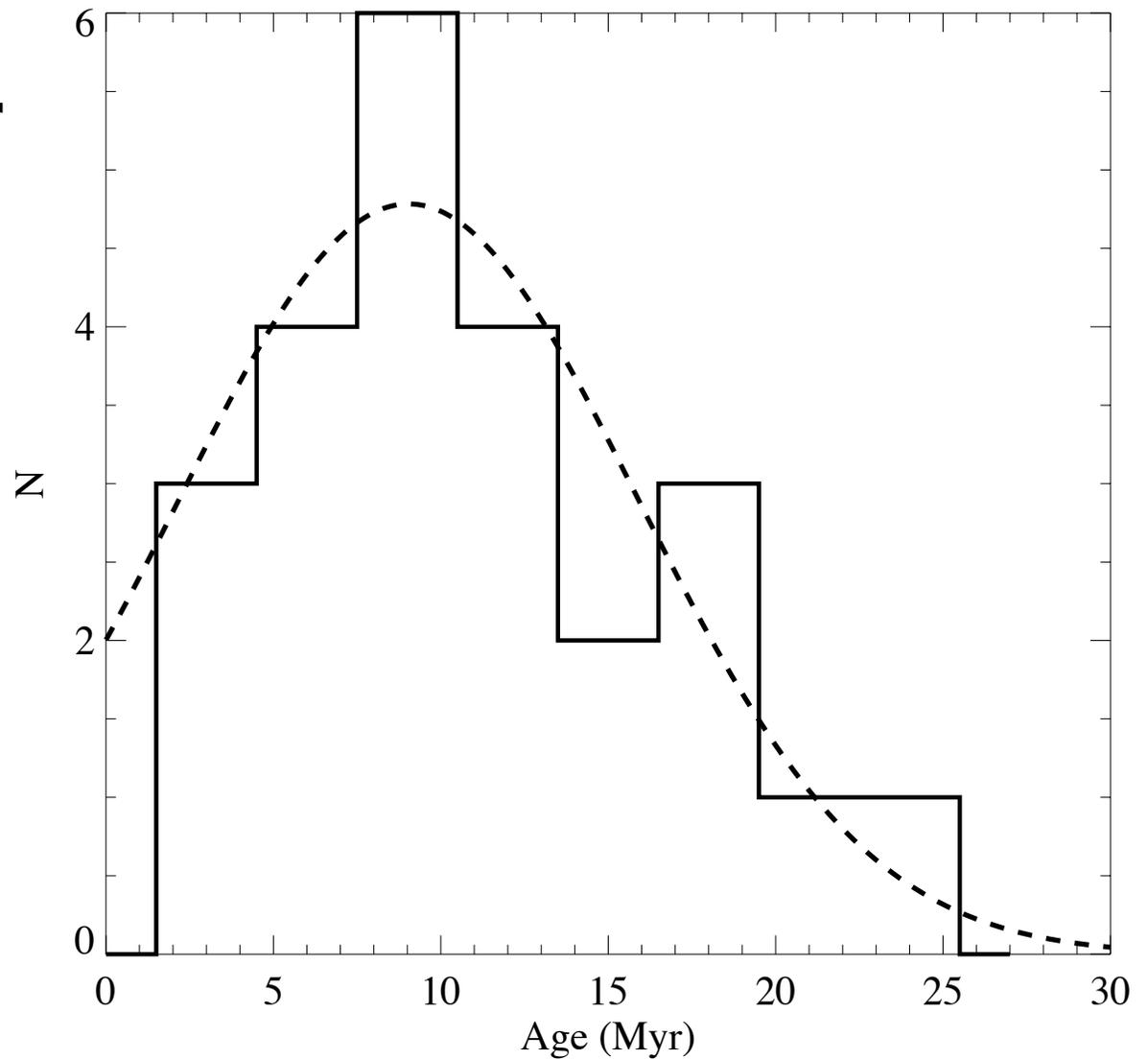
**Spectral Type
of TW Hya very
uncertain and
has large
impact on
inferred age**



(Weinberger et al. 2012)

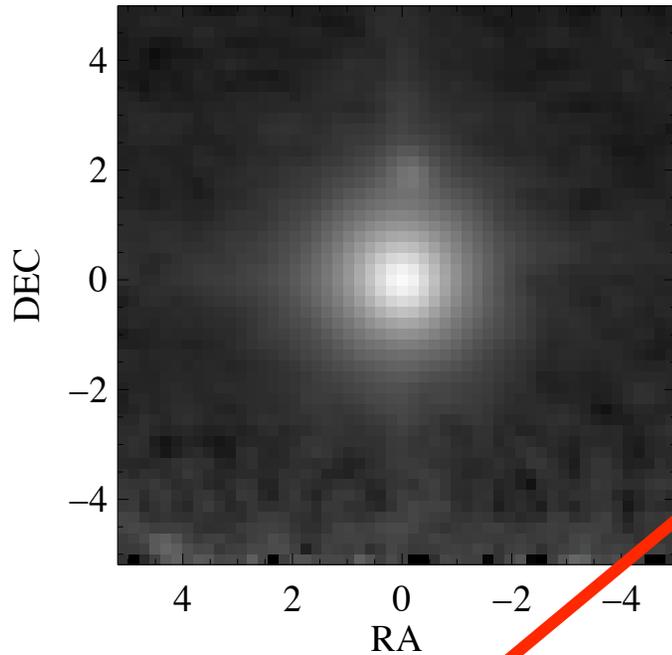
Age Histogram

- **Mean age 10.5 Myr**
- **No ages < 3 Myr**
- **Age spread 7 Myr**



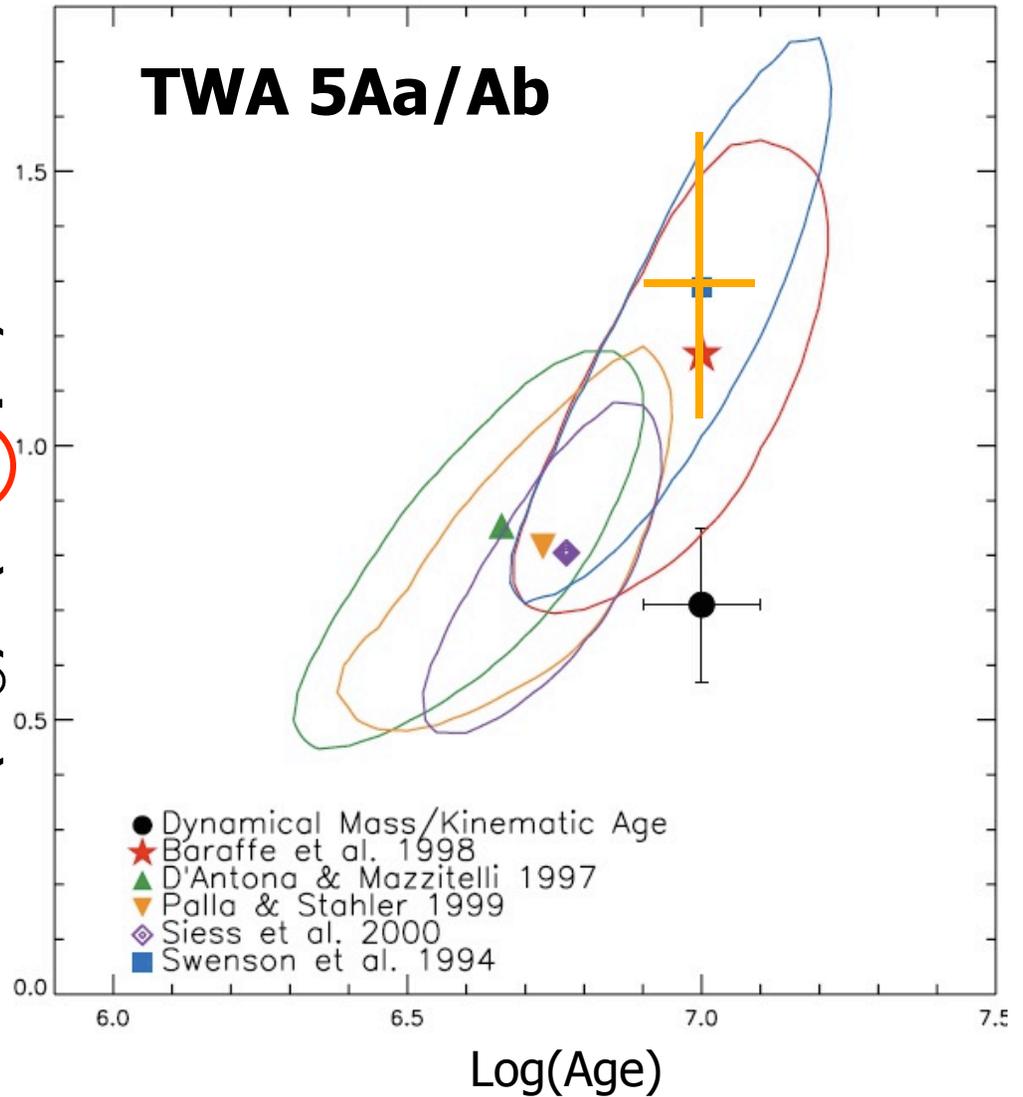
(Weinberger et al. 2012)

Age/Mass of TWA 5



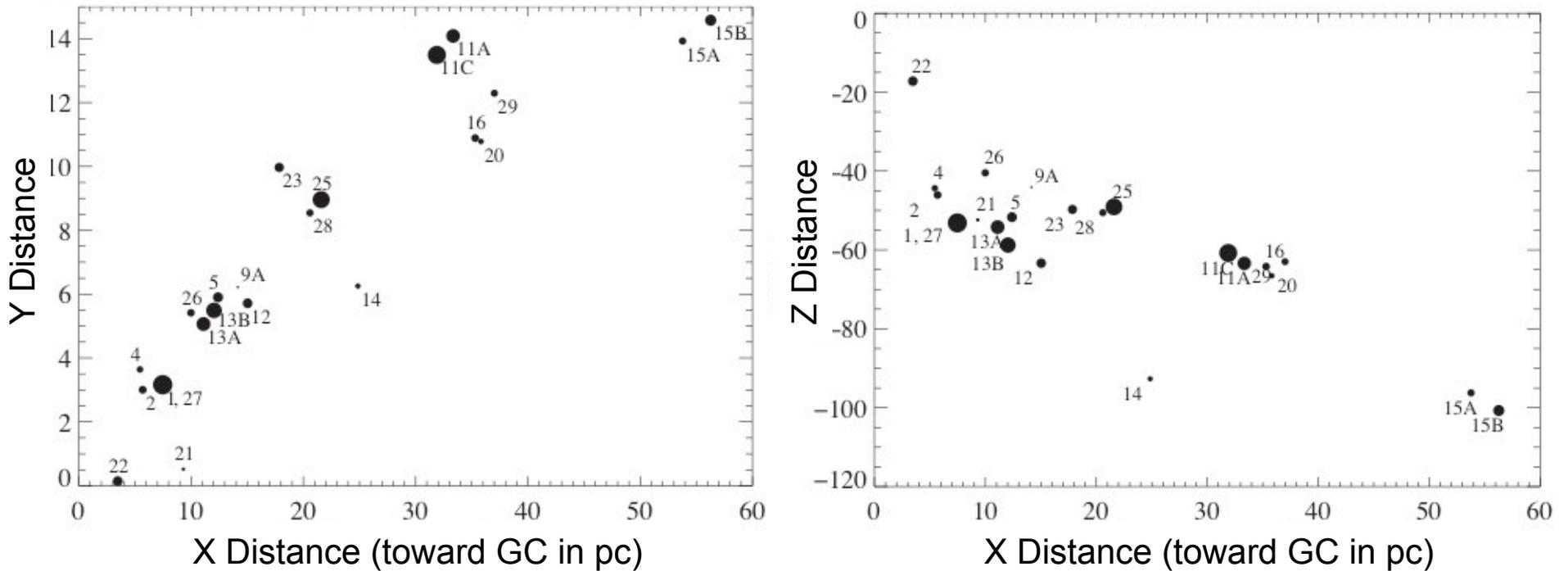
$$M (M_{\odot}) / (D/44 \text{ pc})^3$$

New distance $53.5 \pm 2.4 \text{ pc}$
brings mass into perfect
agreement with Baraffe et al.
1998 tracks



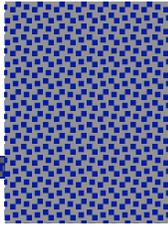
Update to Konopacky et al. 2007

Dispersed Star Formation



TWA stars formed along a filamentary structure, but not as an obvious function of time

(Weinberger et al. 2012)



TWA Conclusions

- TW Hya looks like a young star just forming planets
 - Maybe a $10 M_{\oplus}$ planet at 80 AU!
- TW Hya sits in a filamentary association of stars of age ~ 10 Myr
 - These may not be precisely co-eval
- The age spread in a “typical” young cluster remains to be measured.