The Evolutionary State of HR 7955

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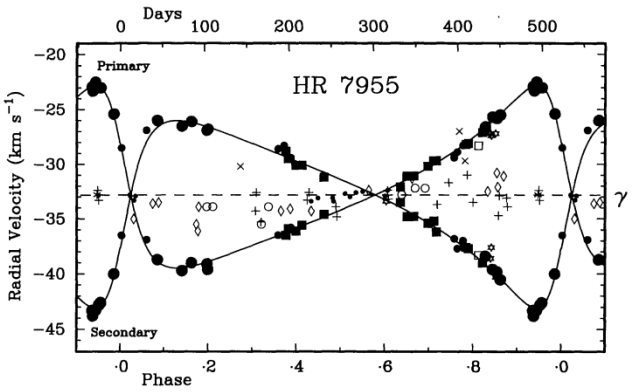
HR 7955: Coravel, CHARA, NPOI

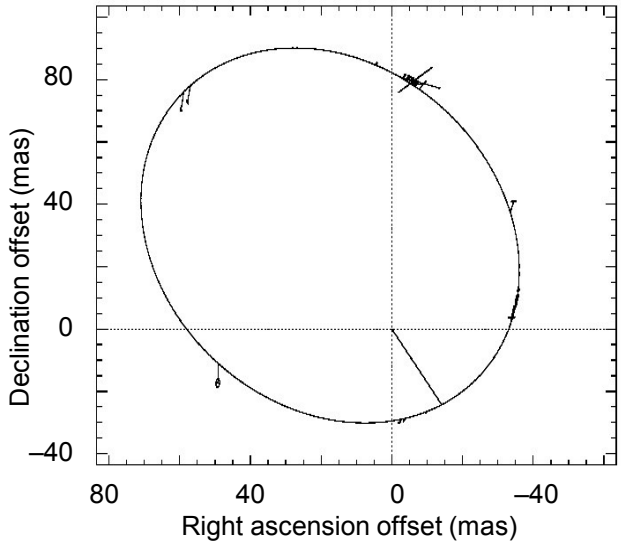
Spectroscopic orbit from Griffin (1999):

(V_A, V_B) for 38 epochs
Inclination i = 23° inferred from assuming masses ~ 1.3 M_{sol} from spectral type (F8 V).
Mass ratio $q = M_A/M_B = 1.025$, – but $\Delta m_V \approx 0.4$.



Interferometric orbit from Farrington et al. (2010):

60 SFP observations
$i = 24.5^0 \pm 3.1^0$ yields $M_A, M_B = 1.07, 1.04\ M_{sol}$.
($\sigma_{\sin i}$ / sin i = 0.12, so $\sigma_M \sim 0.4$ for both.)



NPOI data

28 nights with two to six baselines
$i = 23^0 \pm 3^0$ yields $M_A, M_B = 1.30, 1.26\ M_{sol}$,
both ± 0.5 M_{sol}.

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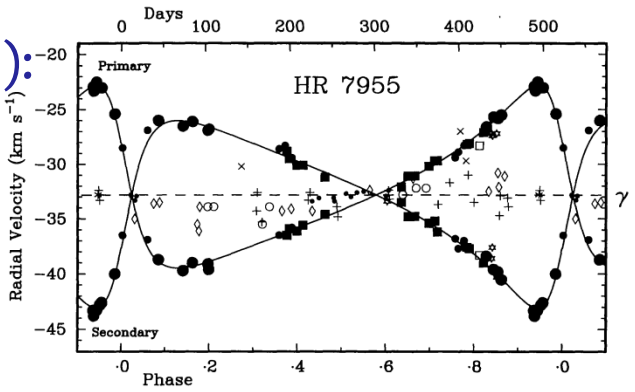
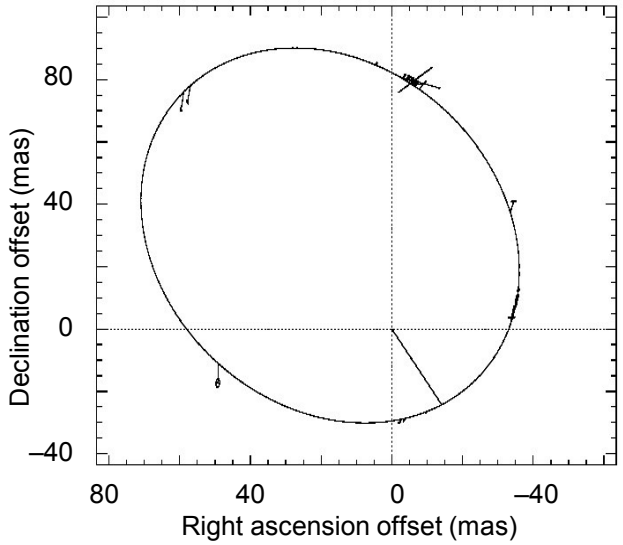


NPOI data

$i = 23^0 \pm 3^0$ yields $M_A, M_B = 1.30, 1.26\ M_{sol}$,
both $\pm$ 0.5 M_{sol}:

Parameter	Value
P	523.35 days (Griffin)
a	63.7 ± 0.4 mas
e	0.547 (Griffin)
i	23 ± 3 deg
M_{star}	1.3 ± 0.3 $M_\odot$ for both
Mass ratio	1.025 ± 0.015 (Griffin)



HR 7955: Colors & magnitudes

NPOI magnitude differences:

Data in 16 channels, 0.55 – 0.85 μm

$\Delta M_V = 0.85$, $\Delta M_I = 0.34$

Primary: $M_{V,A} = 2.72$, $(R - I)_A = 0.25$

Secondary: $M_{V,B} = 3.65$, $(R - I)_B = 0.32$

The combination of mass ratio and brightness ratio barely fits with evolutionary models — and then only with $q = M_A/M_B \approx 1.3$.

Masses:

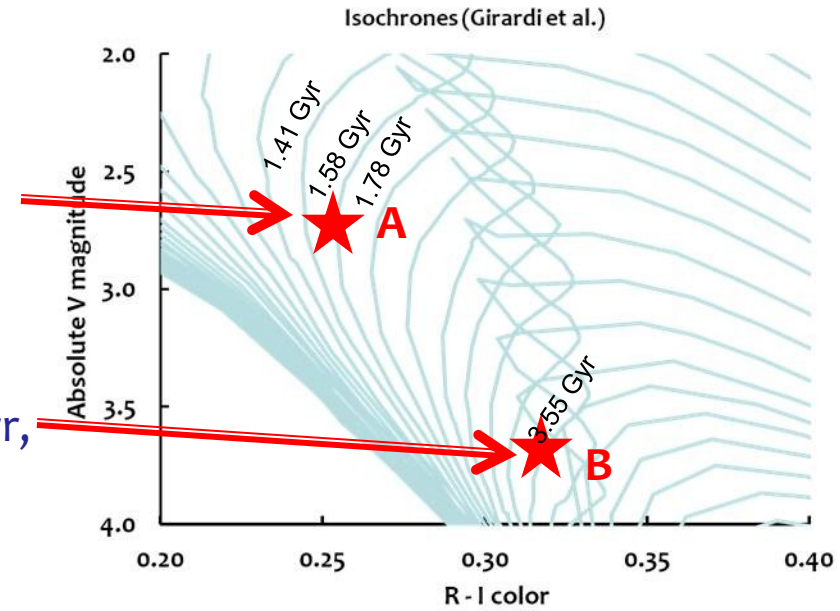
$M_{V,A}$, $(R - I)_A$ => $M_A \approx 1.53\ M_\odot$ @ ≈ 1.6 Gyr

but

$M_{V,B}$, $(R - I)_B$ => $M_B \approx 0.60\ M_\odot$ @ ≈ 3.6 Gyr,

way undermassive and too old!

Note that $q = 1.025 \pm 0.015$ => $M_B = 1.49 \pm 0.02\ M_\odot$



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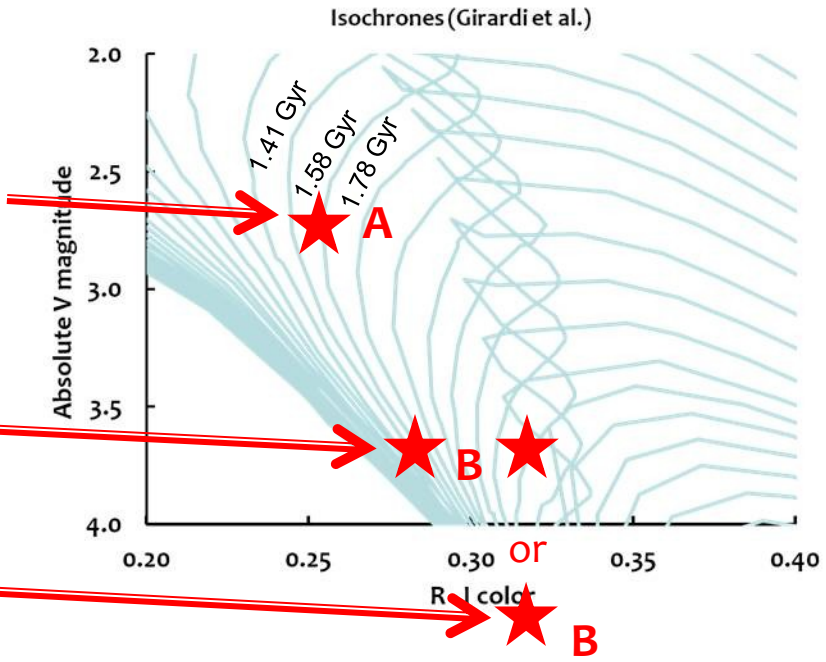
If we move B to the 1.6 Gyr isochrone:

$(R-I)_B \rightarrow 0.28$ => $M_B = 1.30\ M_\odot$
(color is okay, mass is too small)

— or —

$M_{V,B} \rightarrow 4.41$ => $M_B = 1.14\ M_\odot$
(much too faint, mass is even smaller)



HR 7955: A third body?

The secondary could be multiple, but the parameter space is constrained:

Stability: $P_{inner} < 100$ days

Radial velocities: Griffin (O – C) ≈ 0.2 km/s
$M_{Bb}/M_{Ba} < 0.1$ (component Bb can't be too big) — or $i \sim 0^o$

Magnitudes: $\Delta m_V \approx 0.85 \Rightarrow M_A/M_{Ba} < 1.3$ (component Ba can't be too small)

Astrometric perturbations ? Revisit when the orbit is improved.