

Irradiation effects in HW Vir-type binaries

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The Extreme Horizontal Branch

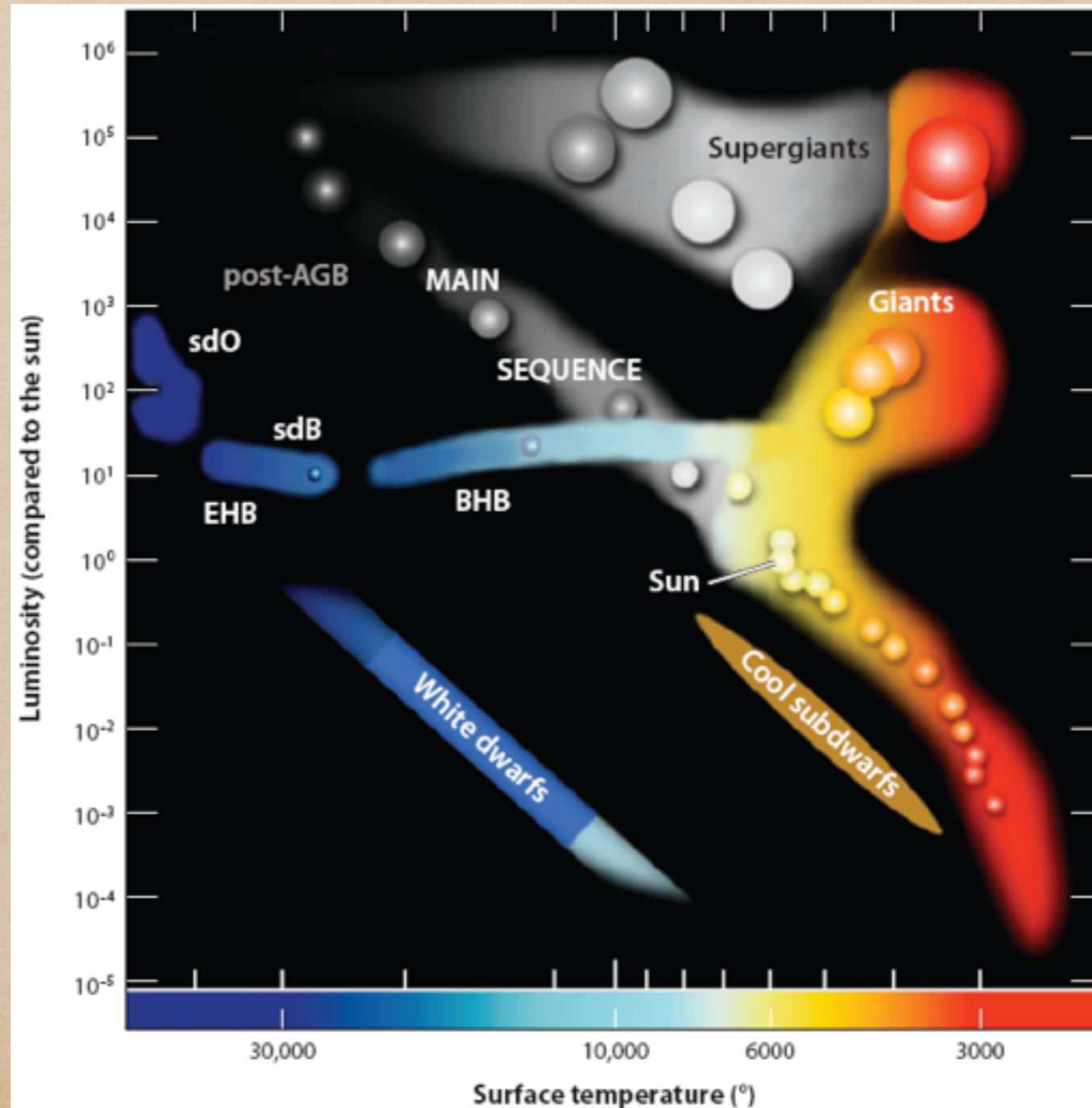
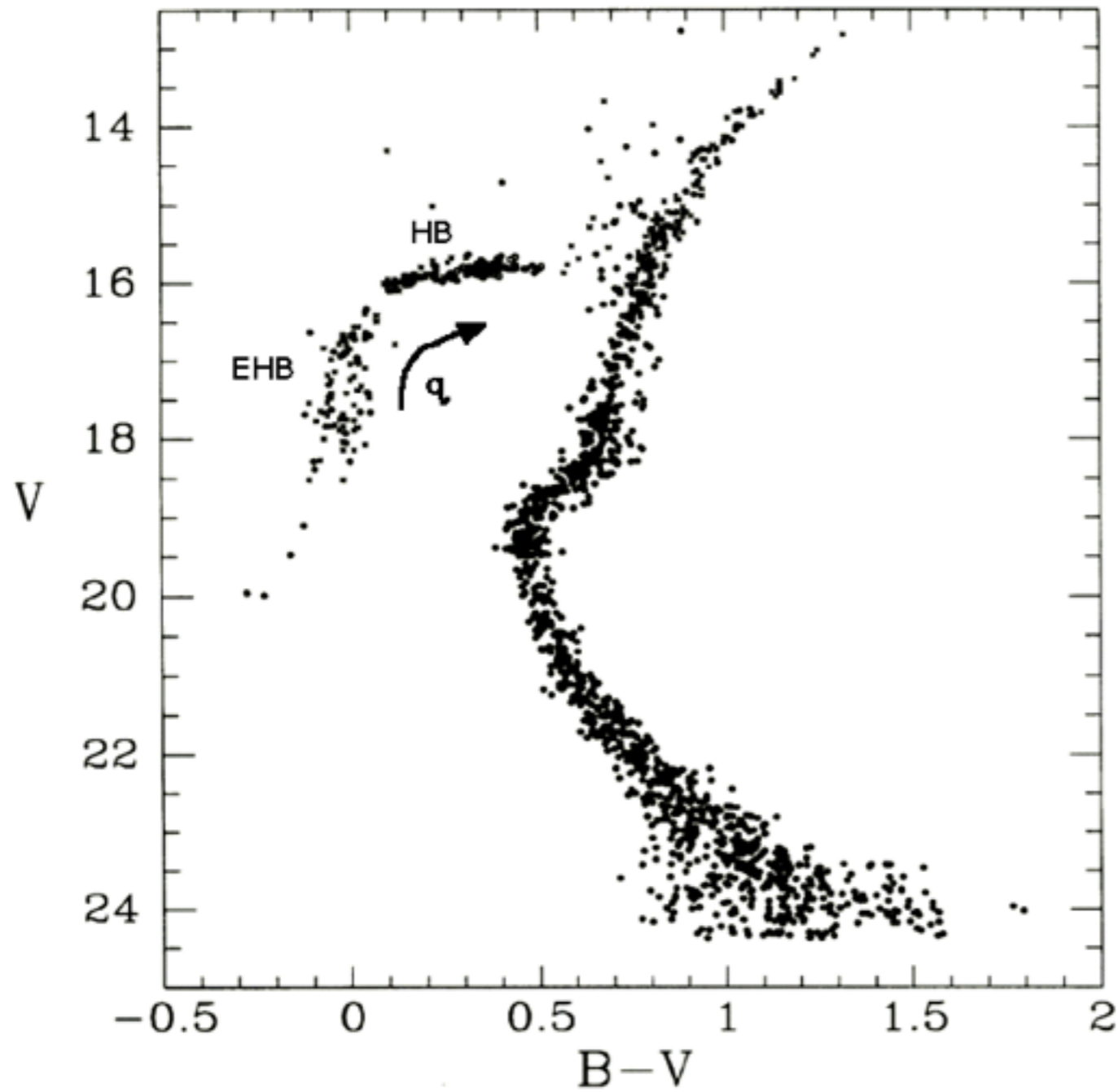
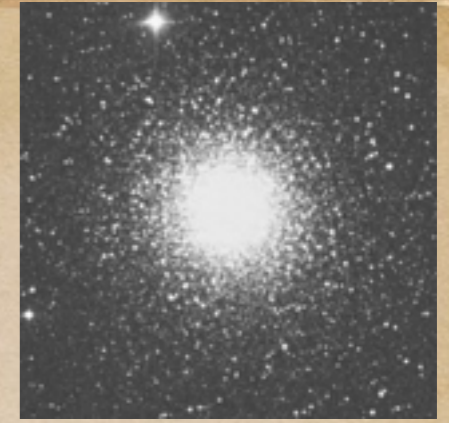
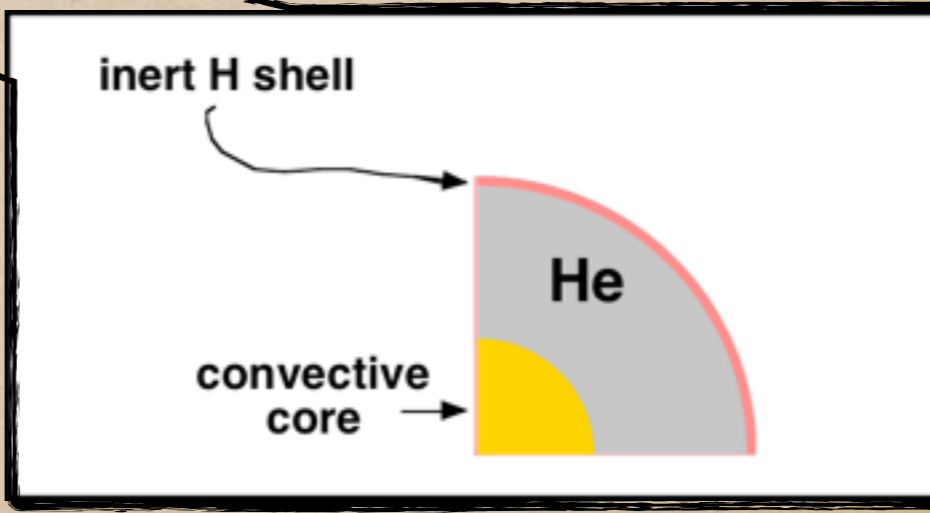
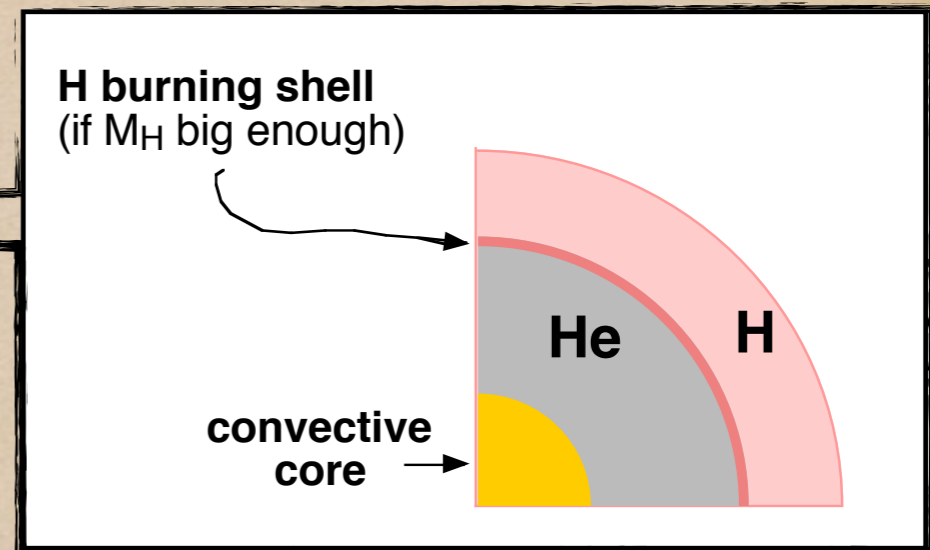
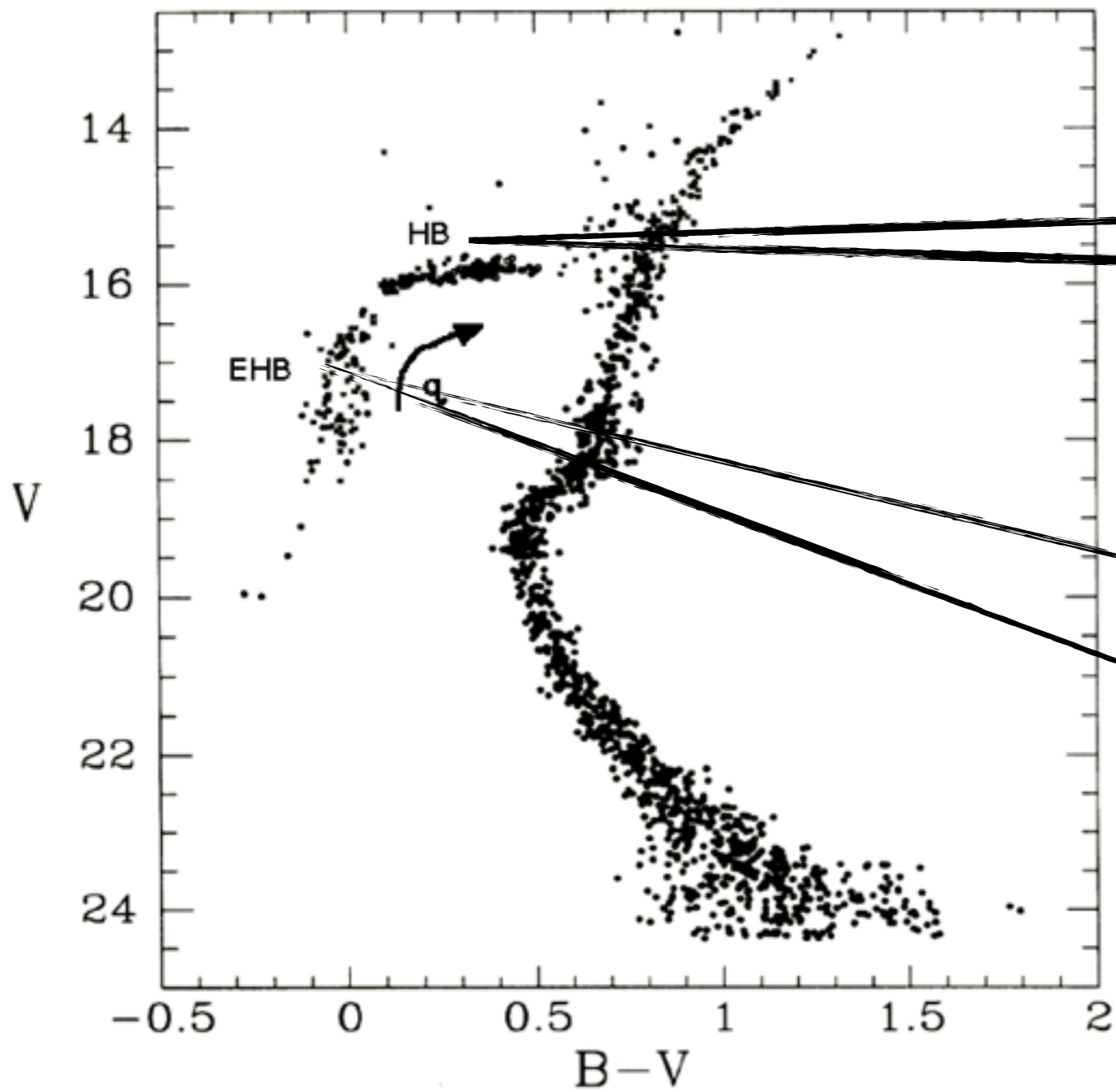
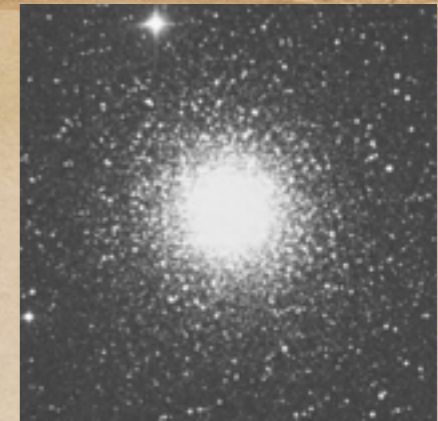


Fig: Heber (2009)

The Extreme Horizontal Branch



The Extreme Horizontal Branch



Common envelope ejection

Common-Envelope Channels

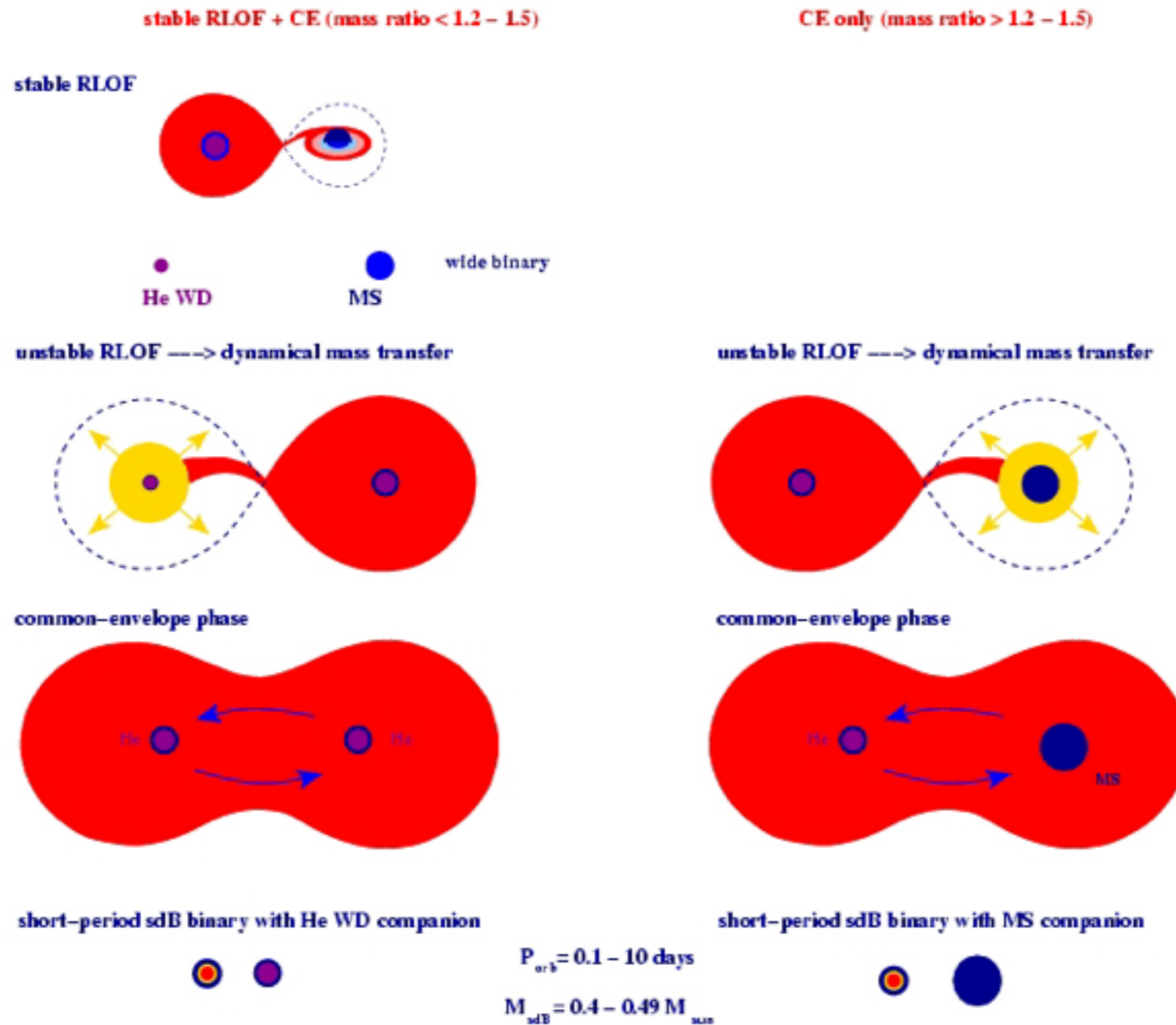
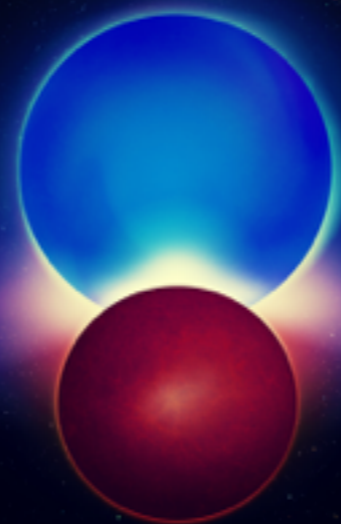


Fig: Podsiadlowski(2008)

HW Vir - type system



HW Vir-type systems

Star	P (d)	i (deg)	a(R_{\odot})
HW Vir	0.117	82.3	0.9
NY Vir	0.101	81	0.8
AA Dor	0.261	89	1.2
HS 0705+6700	0.096	84.4	0.8
HS 2231+2441	0.111	79.6	?
J 2020+0437	0.11	82	?
BUL SC16-335	0.125	74.6	?
2M 1533+3759	0.162	86.6	1
ASAS 102322-3737	0.139	65.7	1
J 08205+0008	0.096	85.9	0.7

HW Vir-type systems

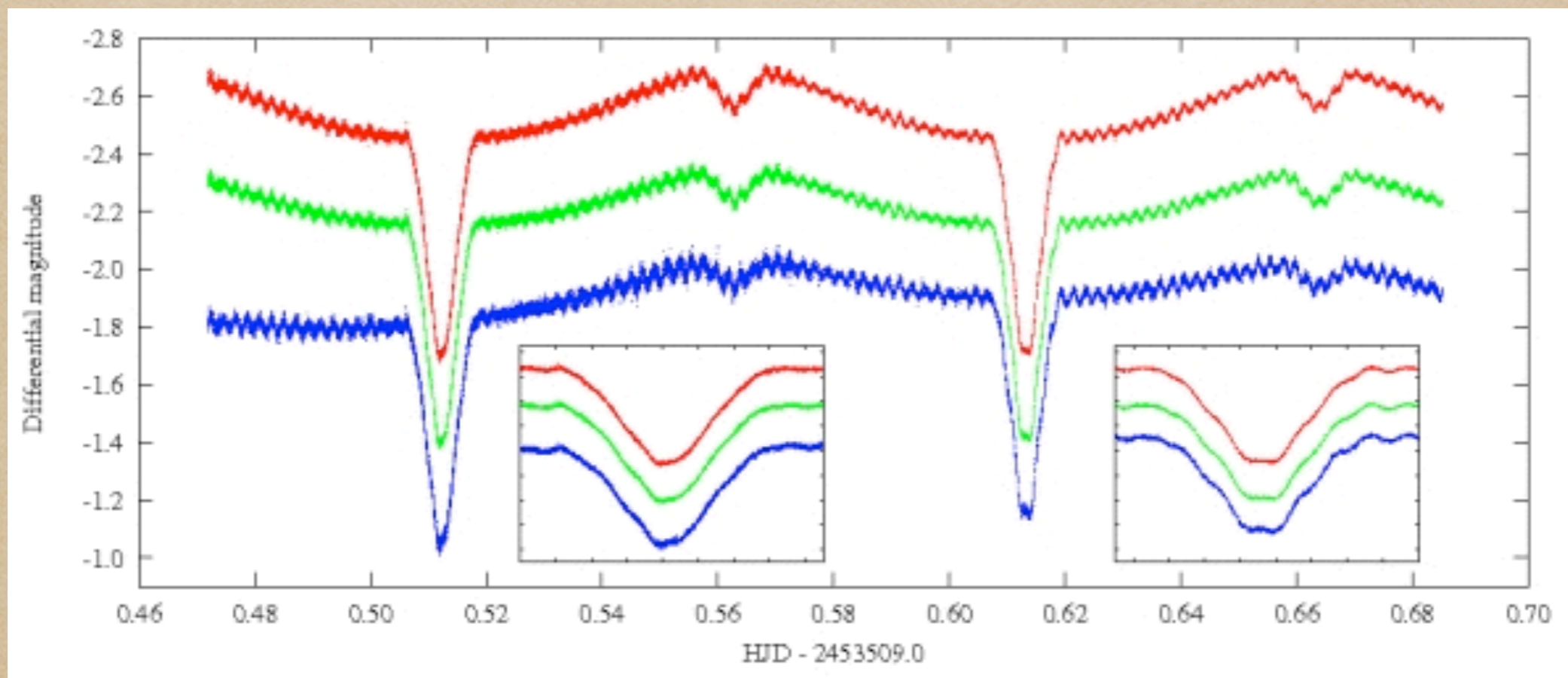
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> 50 systems by now!

PG1336+018

NY Vir

$$P = 0.101d$$

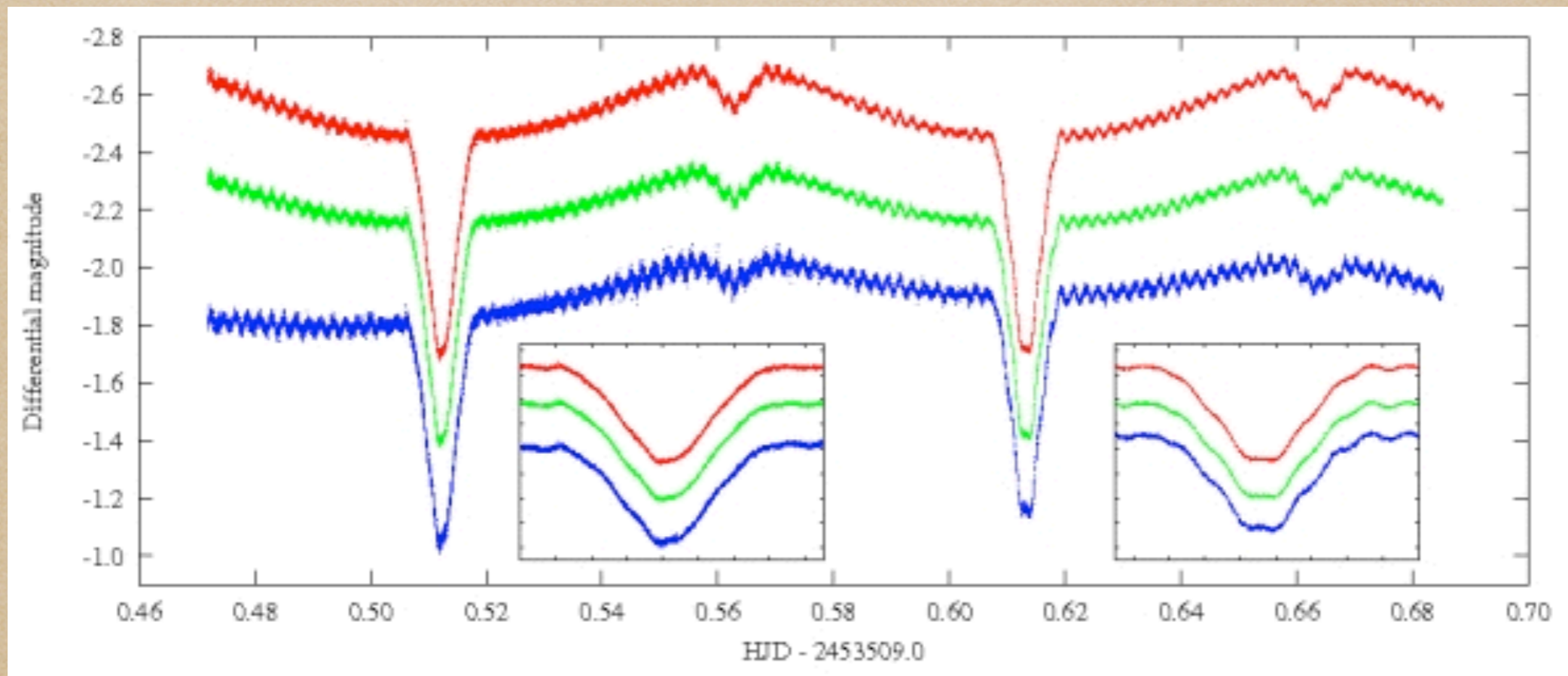


Vučković et al. 2007

PG1336+018

NY Vir

$$P = 0.101d$$



$M = 0.466 (0.006) M_{\odot}$ Vučković et al. 2007

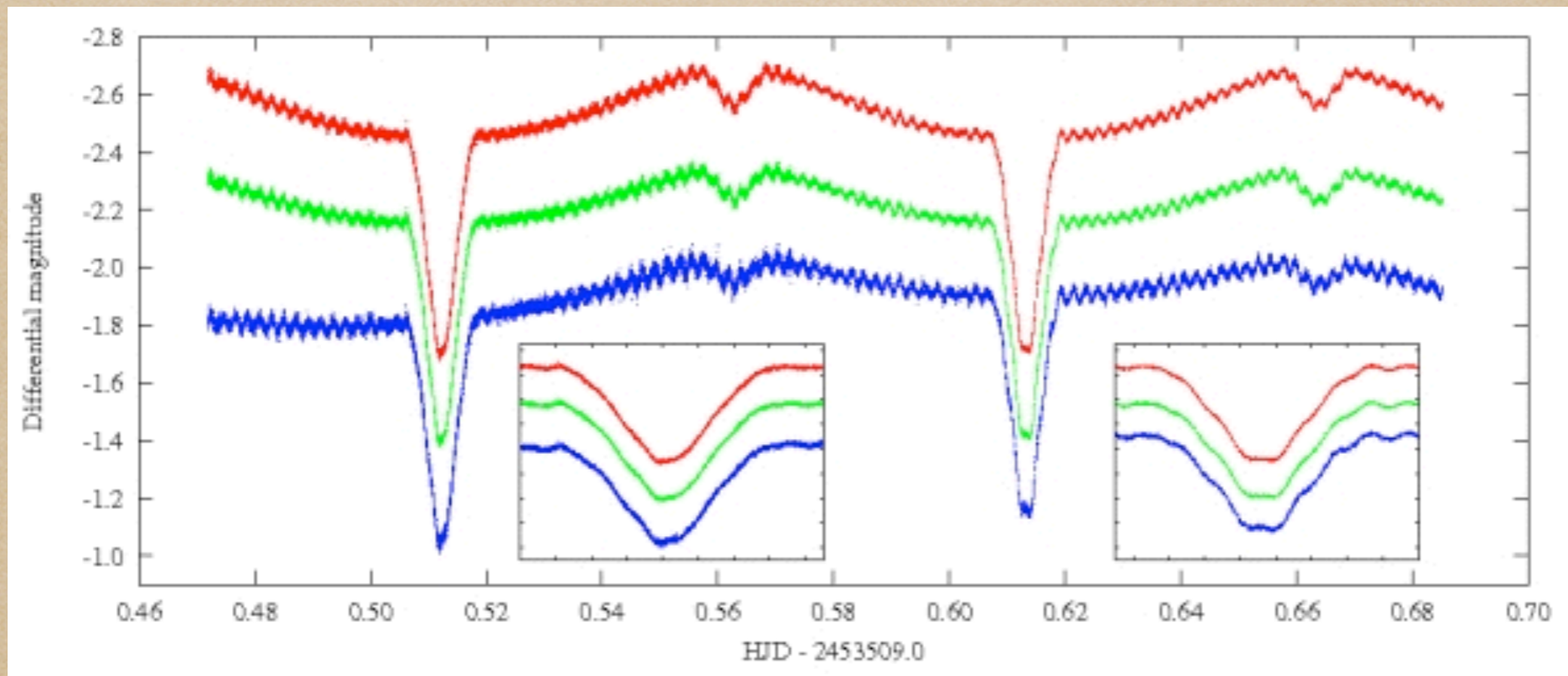
$R = 0.15 (0.01) R_{\odot}$

Vučković et al. 2009

PG1336+018

NY Vir

$P = 0.101d$



$M = 0.466 (0.006) M_{\odot}$

Vučković et al. 2007

$M = 0.459 (0.005) M_{\odot}$

$R = 0.15 (0.01) R_{\odot}$

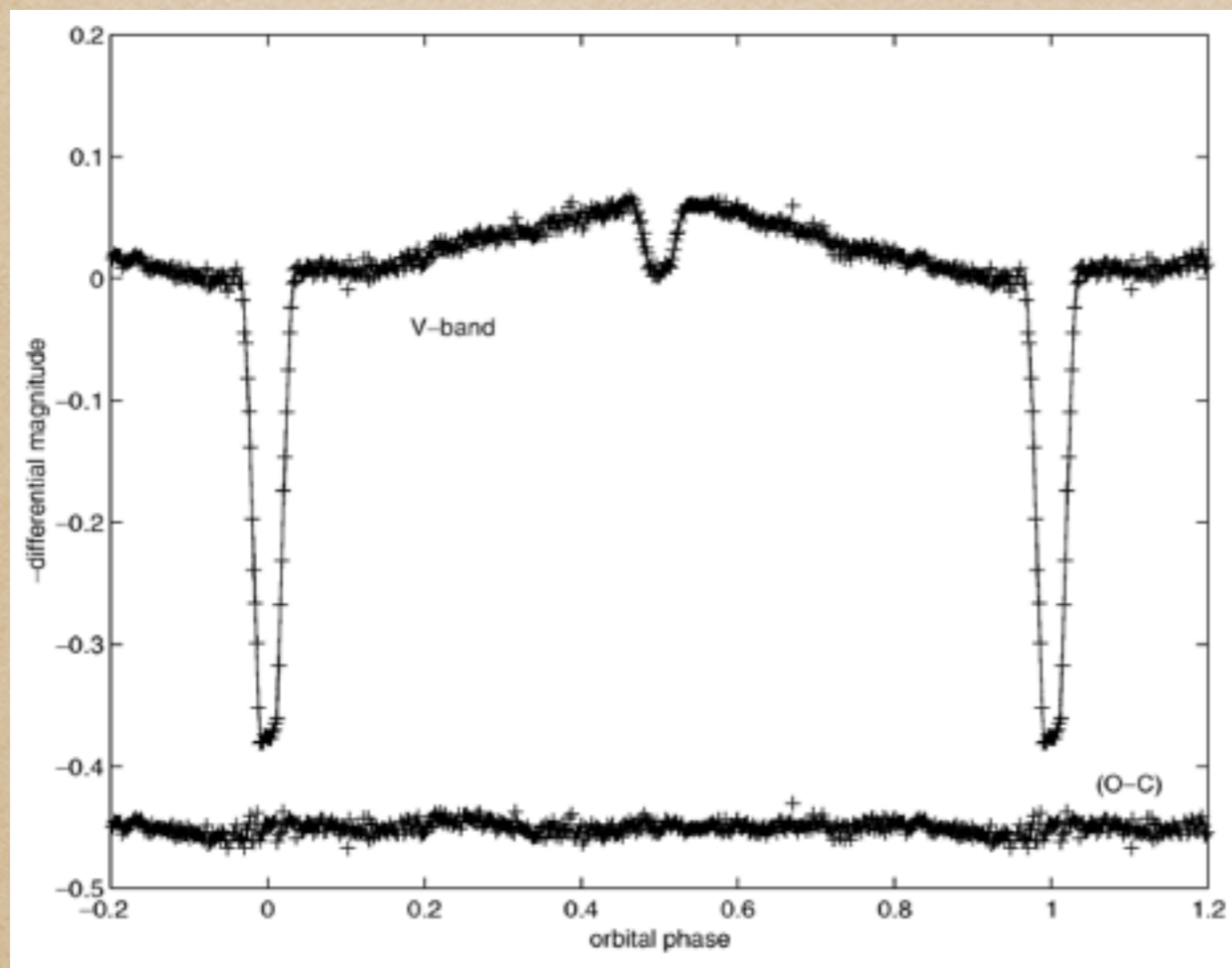
$R = 0.151 (0.001) R_{\odot}$

Vučković et al. 2009

Charpinet et al. 2010

AA Dor

$$P = 0.26d$$



Hilditch et al. (2003)

$$P = 6.3h$$

$$a \approx 1.2 R_{\odot}$$

$$i = 90$$

$$r_1 = 0.138a ; r_2 = 0.079a$$

$$T_1 = 42\,000\text{ K} ; T_2 \approx 2\,000\text{ K}$$

$$\log g_1 \approx 5.2-5.4 ? ; \log g_2 \approx 5.2$$

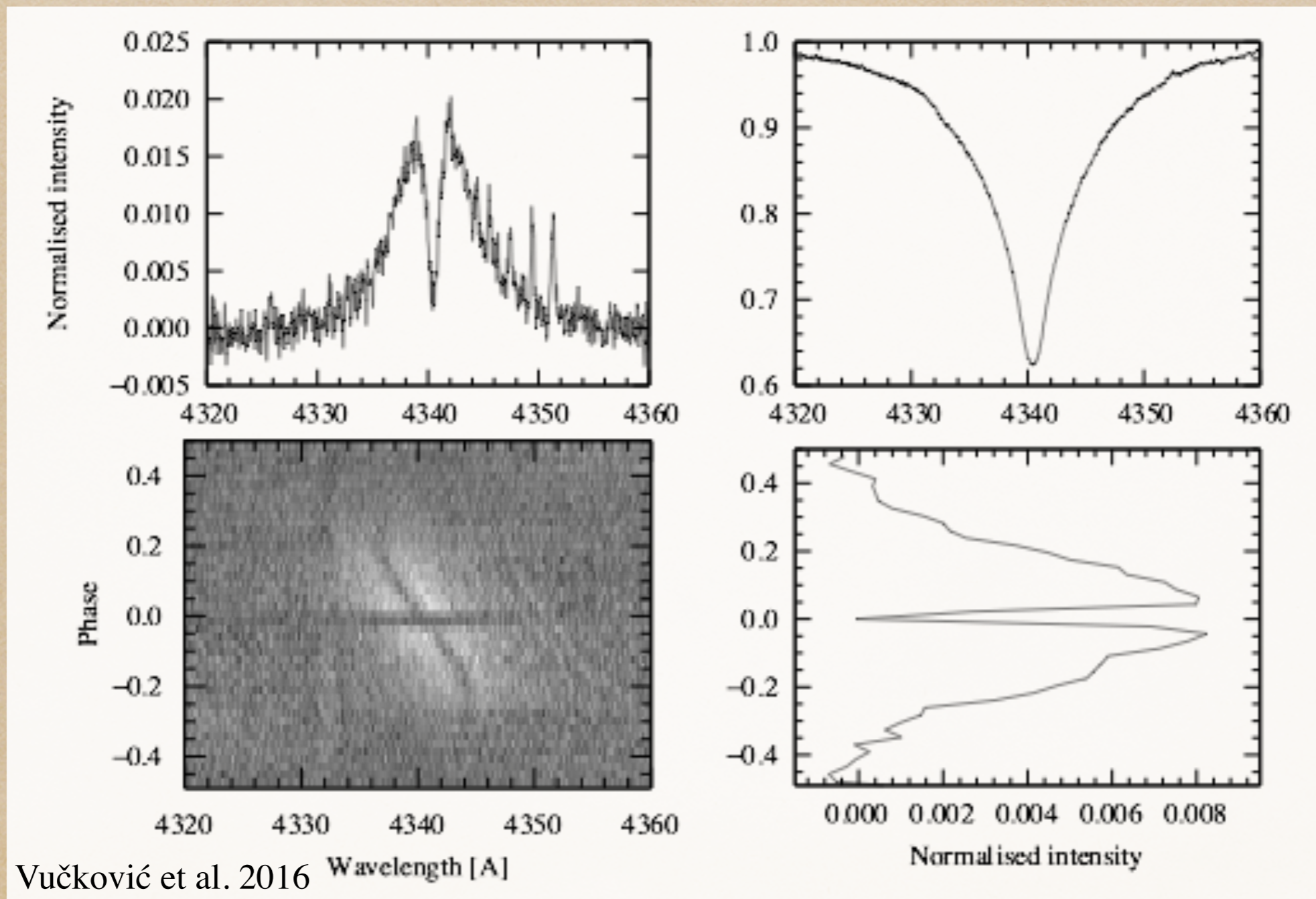
$$V_{\text{rot}} = 34 - 47\text{ km/s}$$

$$M_1 \approx 0.33 M_{\odot}$$

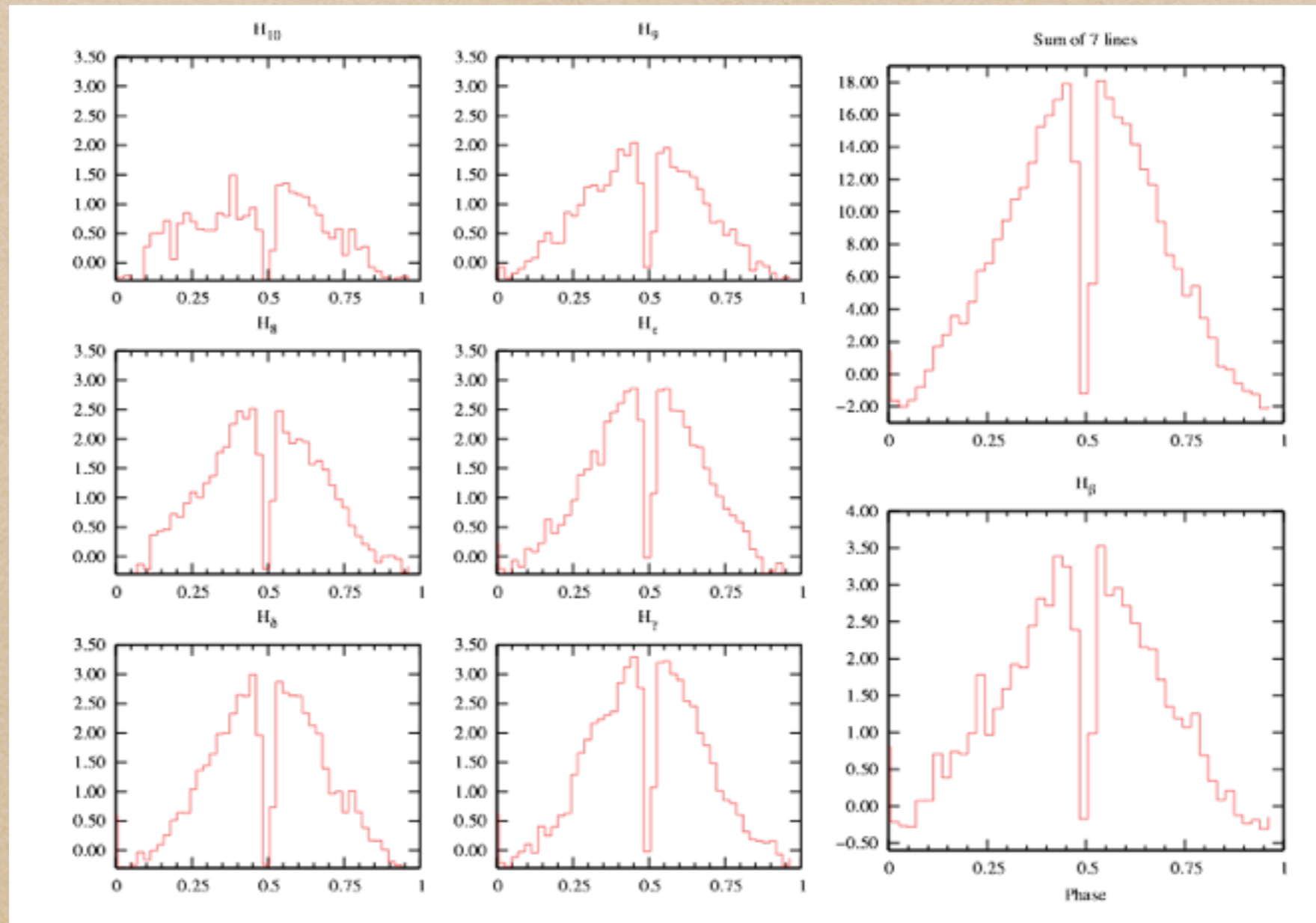
$$M_2 \approx 0.066 M_{\odot}$$

Rauch & Werner (2003)

Emission from irradiated secondary

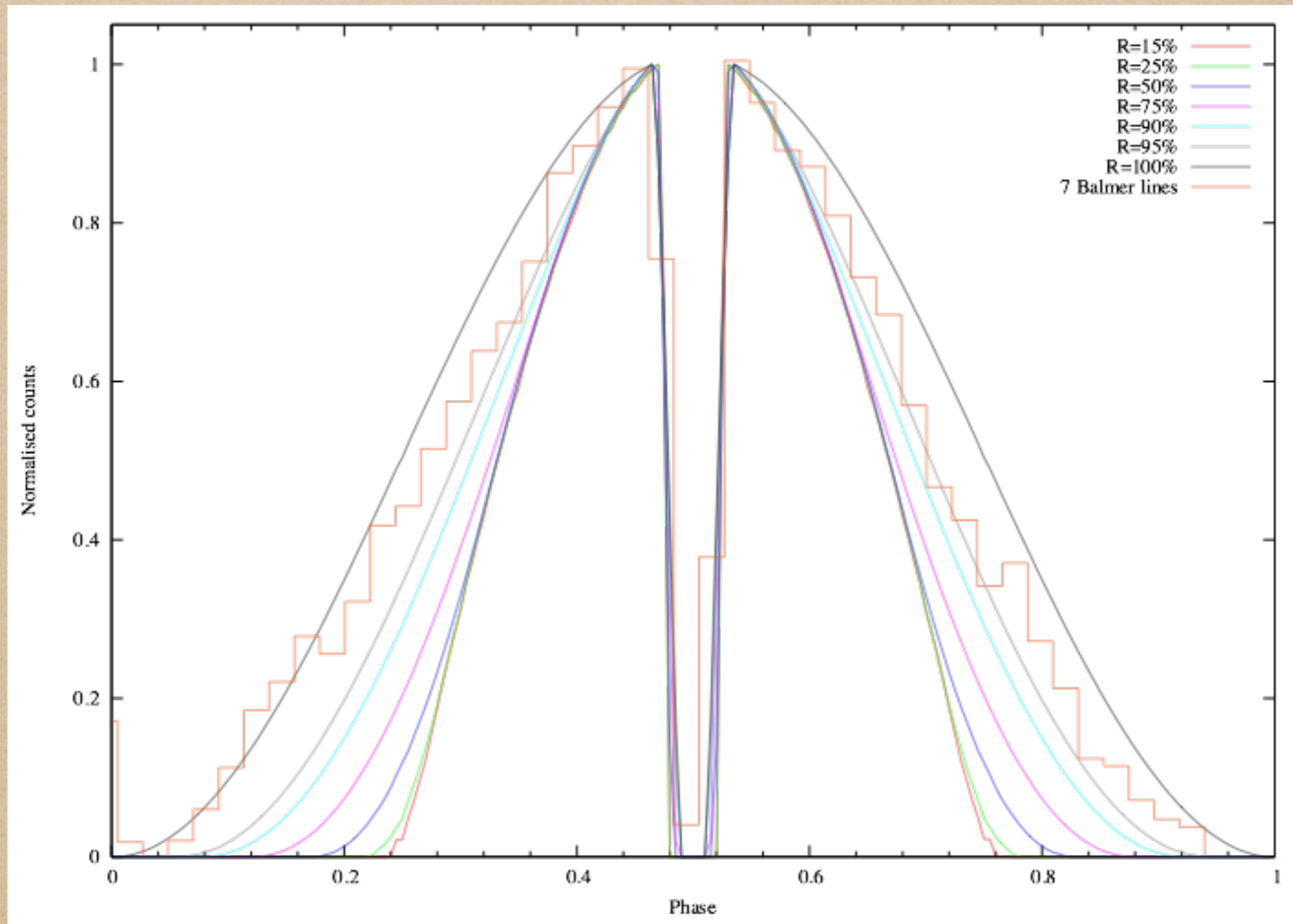


Phase profiles of Balmer lines

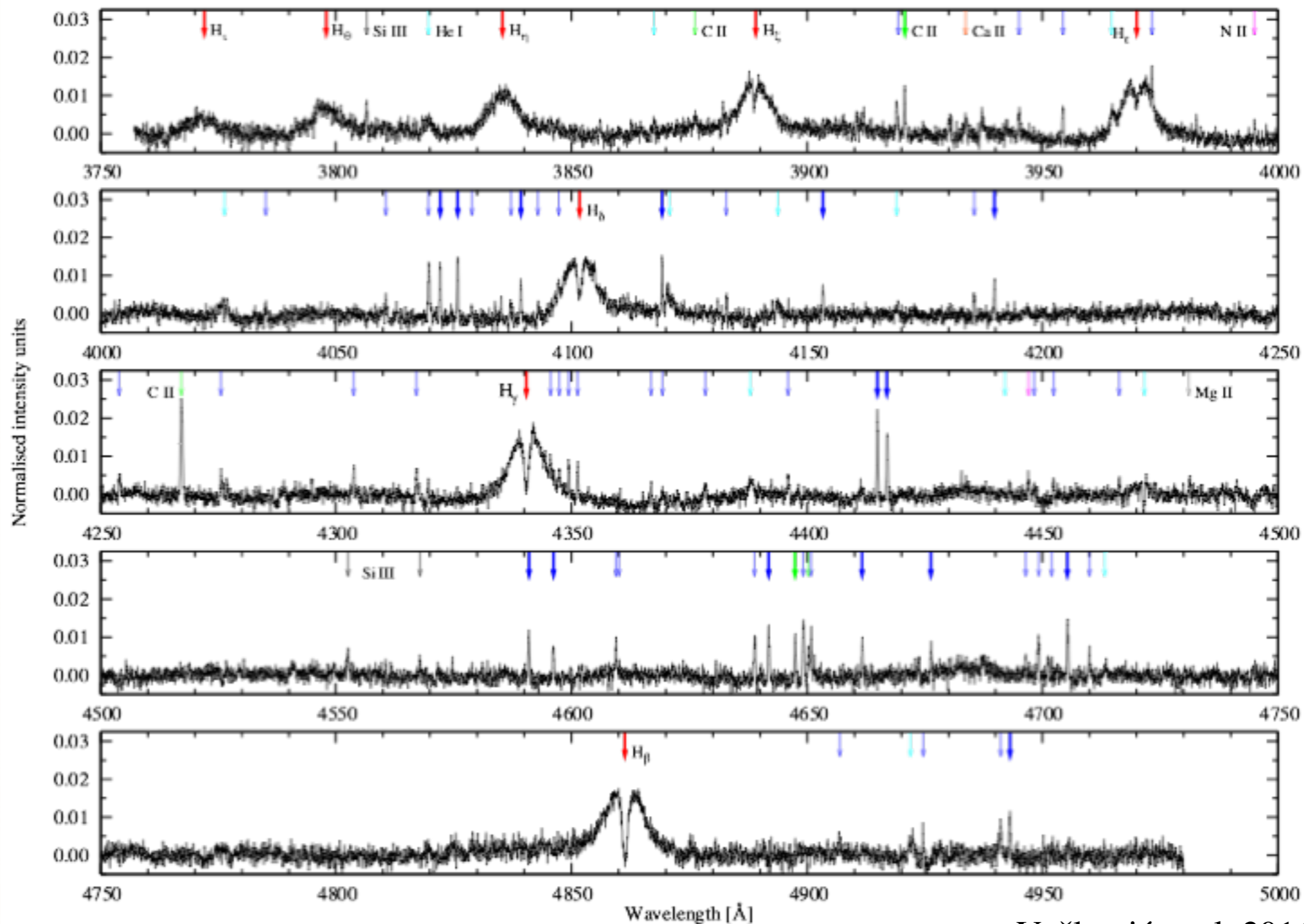


Vučković et al. 2016

Phase profiles vs models

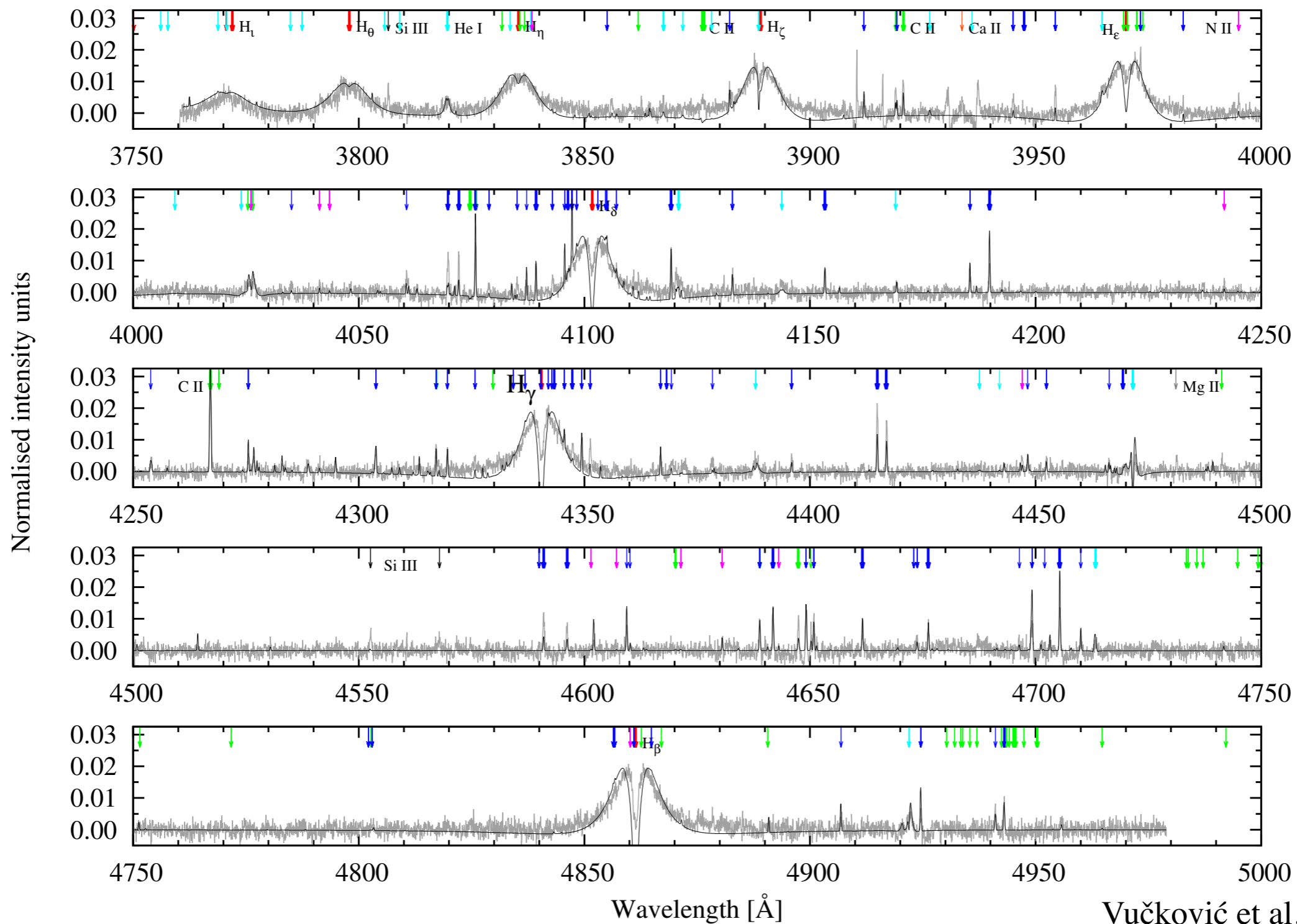


Emission line spectrum of irradiated dM



Vučković et al. 2016

UVES data overplotted with TLUSTY model for the irradiated brown dwarf



Vučković et al. 2016

Modelling the metal lines

$$K_{dM} = 231.3 (7) \text{ km/s}$$

$$M_{sdOB} = 0.46 (1) M_{\odot}$$

$$q = K_{dM}/K_{sdOB} = 0.171 (1)$$

$$M_{dM} = 0.079 (2) M_{\odot}$$

M. Vučković et al.: Looking at the bright side of AA Dor

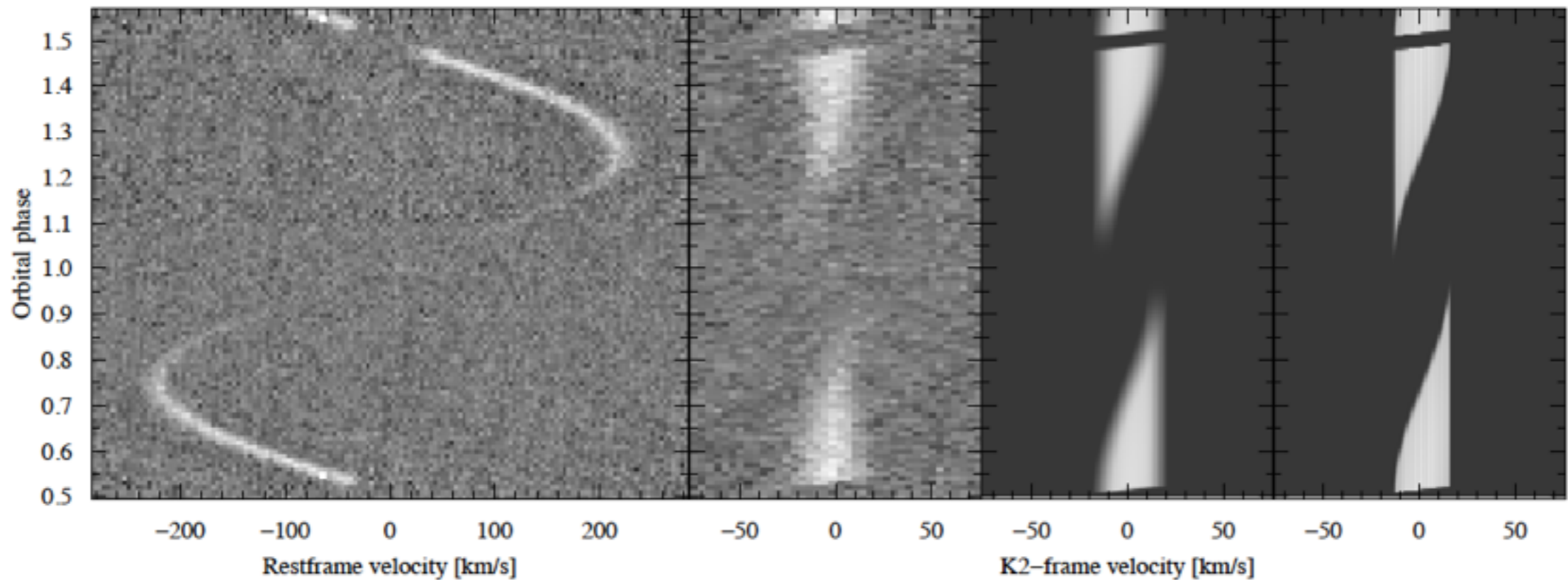
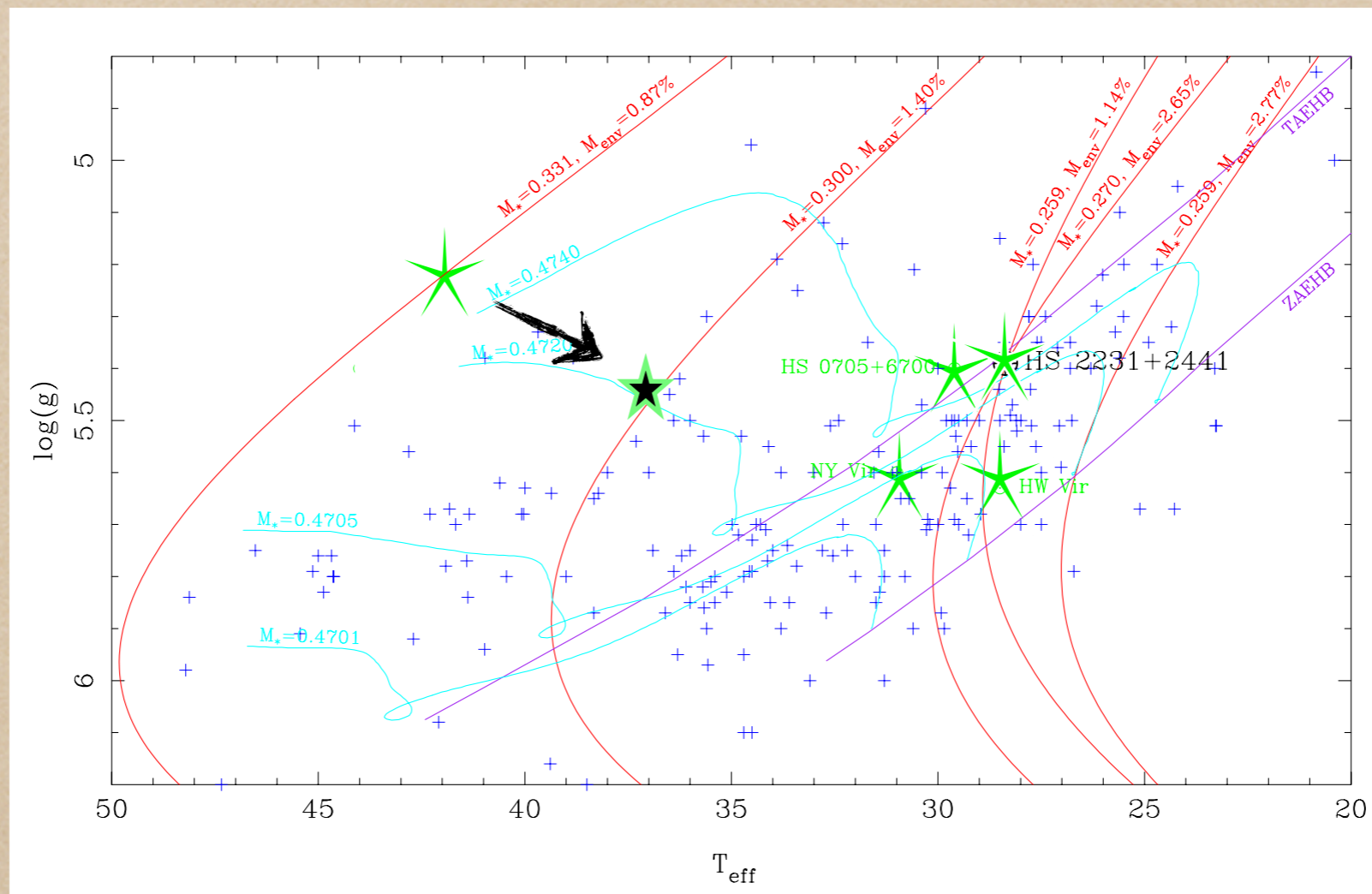


Fig. 5. Grayscale plot of the sum of all the metal lines in the rest frame of the system (left) and shifted to the rest frame of the secondary (middle). The last two panels show a geometrical model line profile for comparison, with the first having been subjected to a Gaussian broadening.

AA Dor

$P = 0.26d$



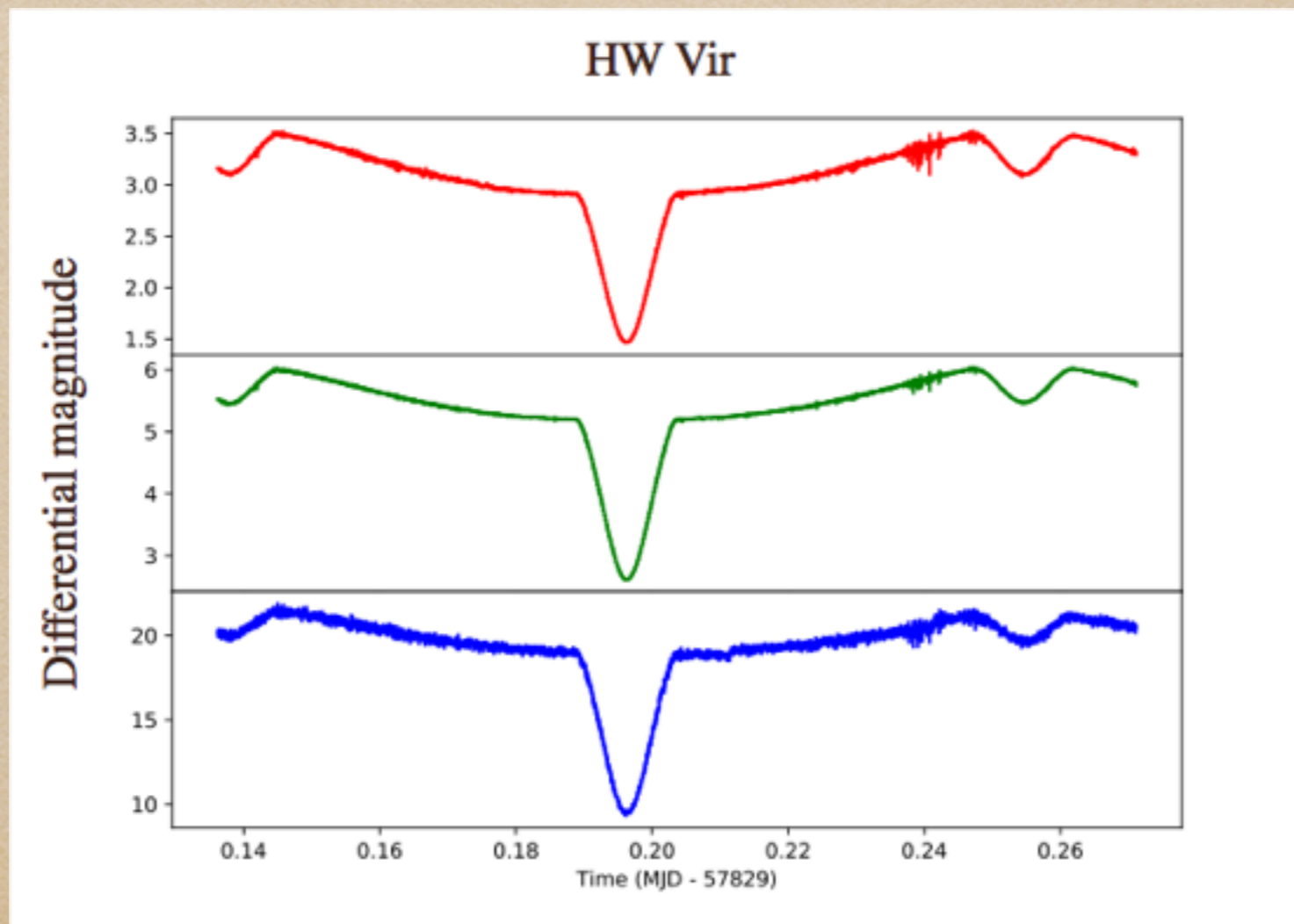
Vučković et al. 2016

$$M_{\text{sdOB}} = 0.46 (1) M_{\odot}$$

$$M_{\text{dM}} \approx 0.079 (2) M_{\odot}$$

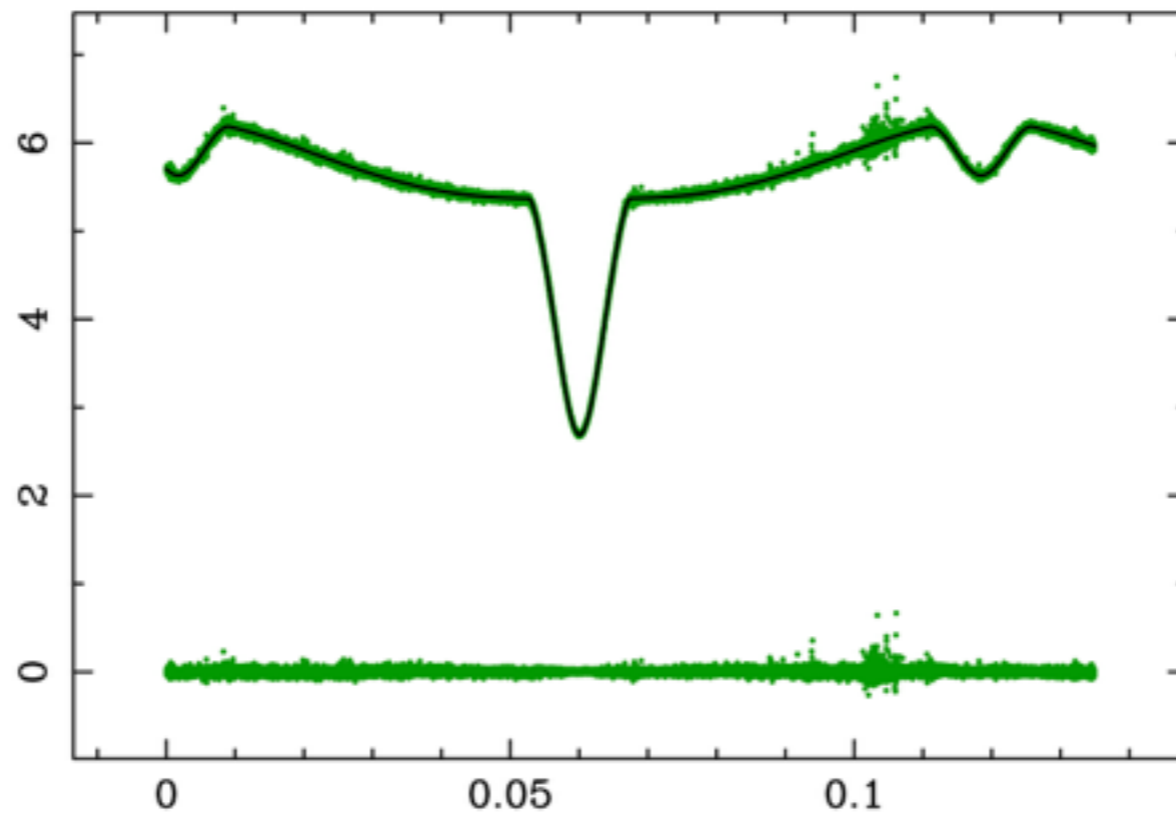
HW Vir

$$P = 0.117d$$



HW Vir

$$P = 0.117d$$



T - 57829.136130016

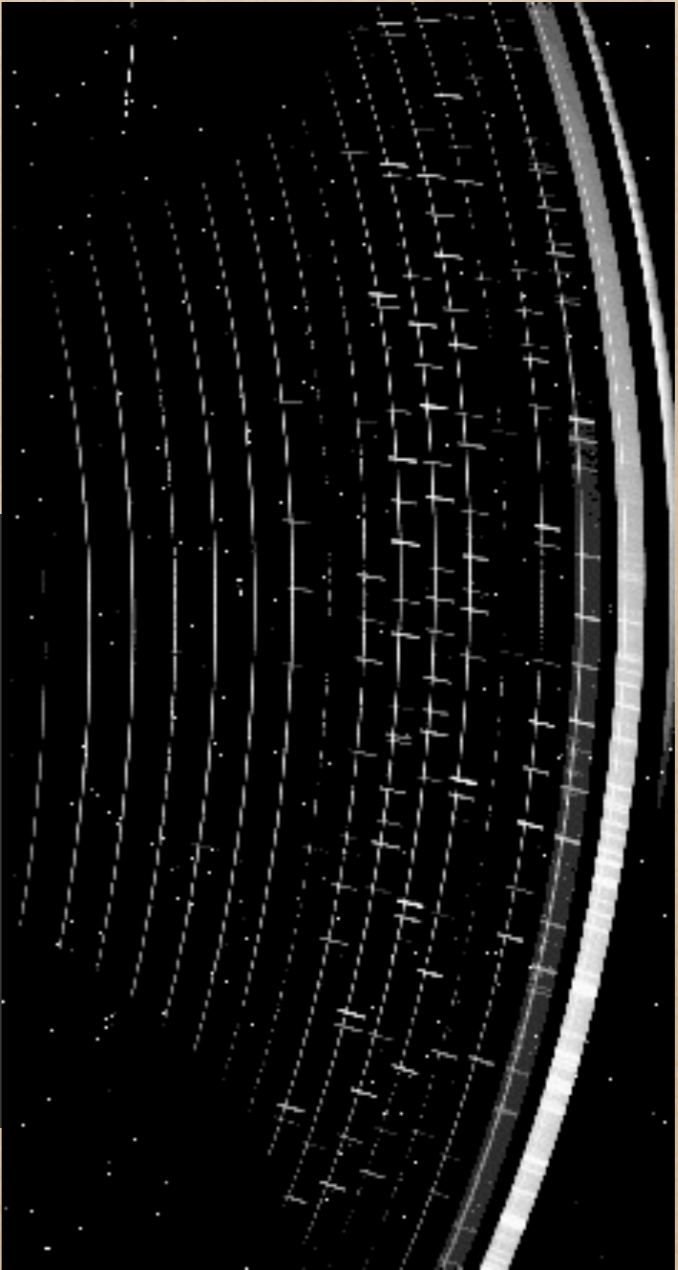
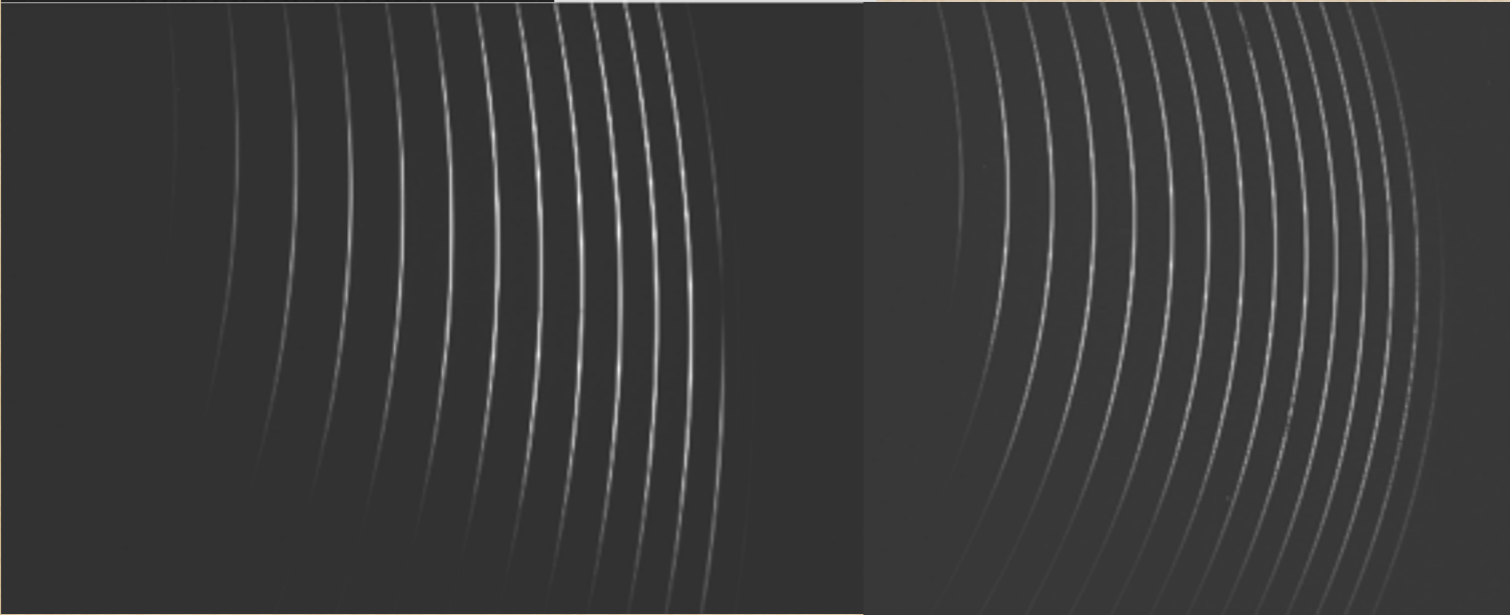
HW Vir



UVB 1" R ~ 4300

VIS 0.9" R ~ 7000

NIR 0.9" R ~ 5300



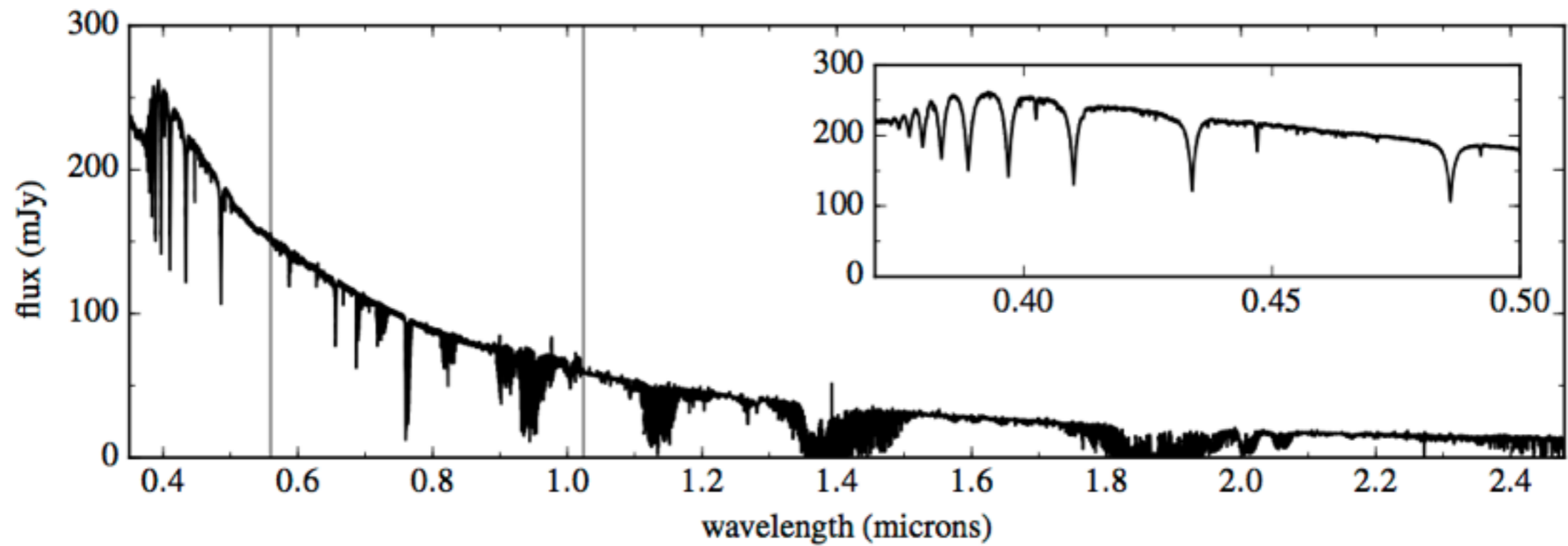
3000 - 5600 Å

5500 - 10200 Å

10200 - 24800 Å

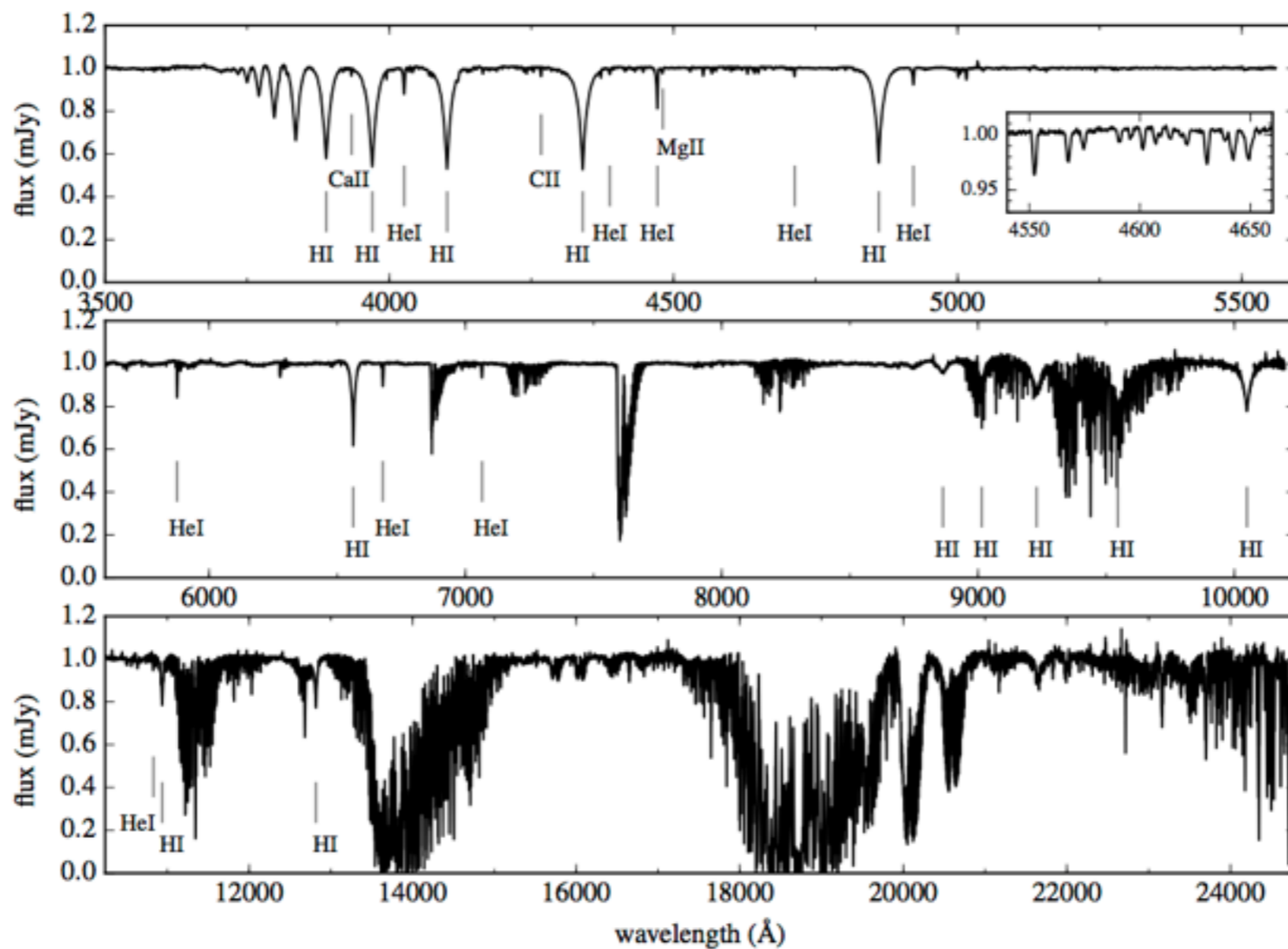
HW Vir

Xshooter spectrum at $\varphi=0.25$



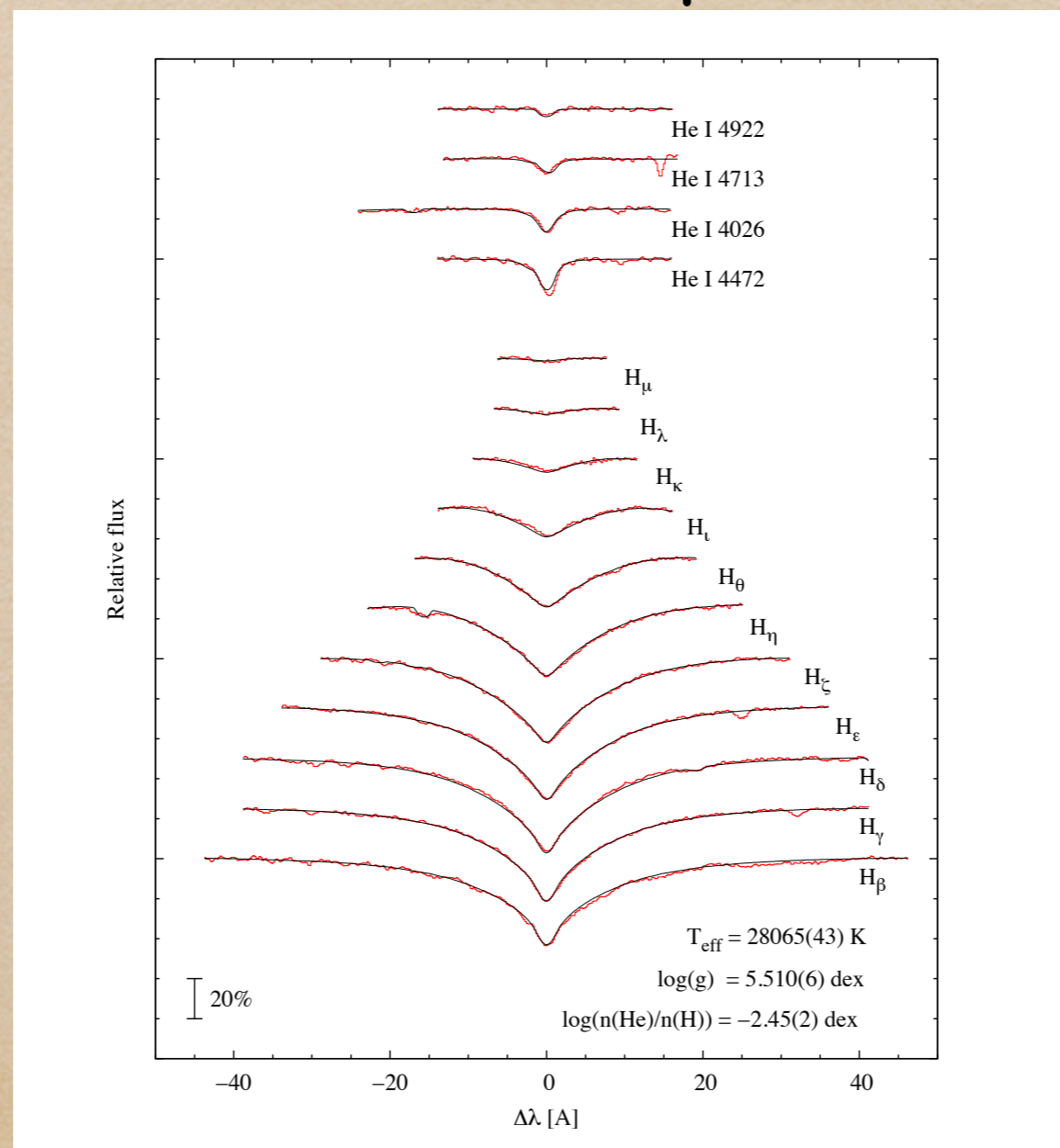
HW Vir

Xshooter sdB spectrum



HW Vir

Xshooter sdB spectrum



$T_{\text{eff}} = 28\,065 (50)$ K

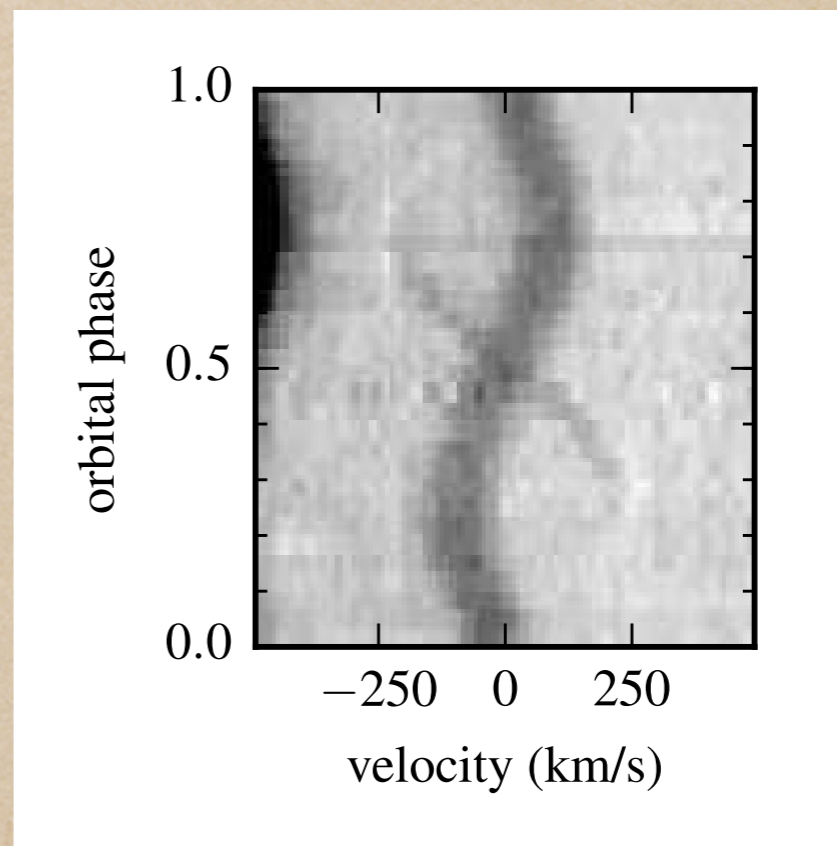
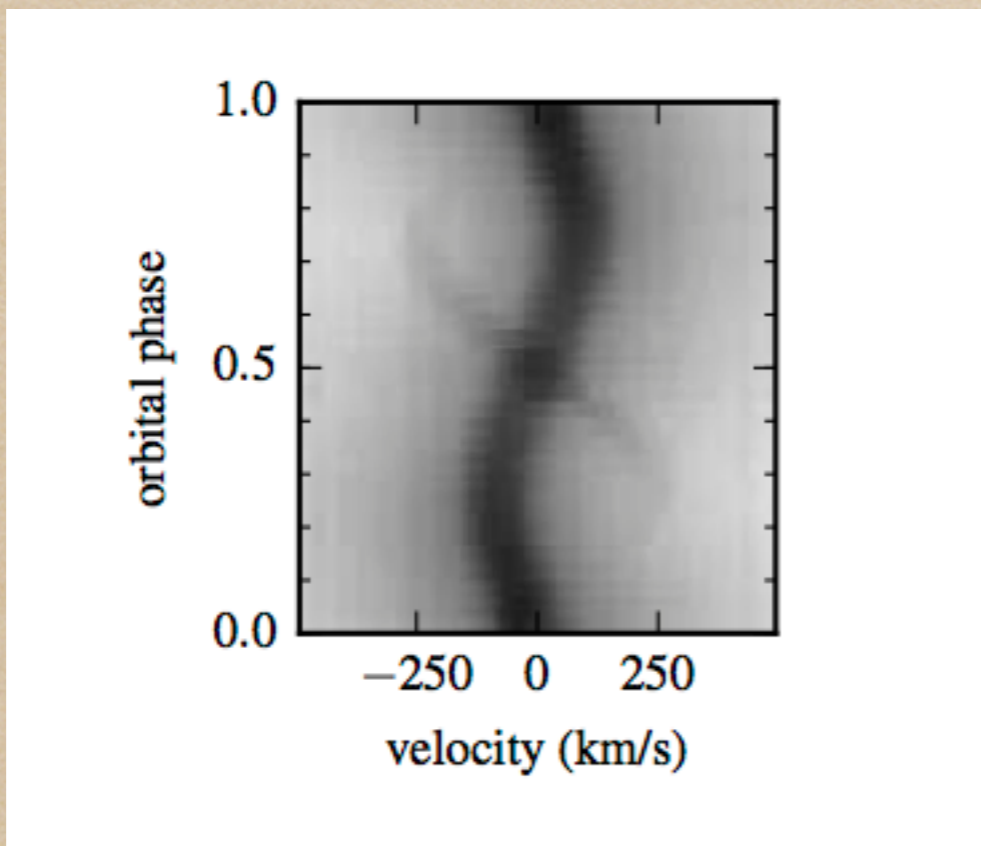
$\log g = 5.510 (6)$ dex

good agreement with
Wood & Saffer 1999

HW Vir

H α

MgII at 4481 Å



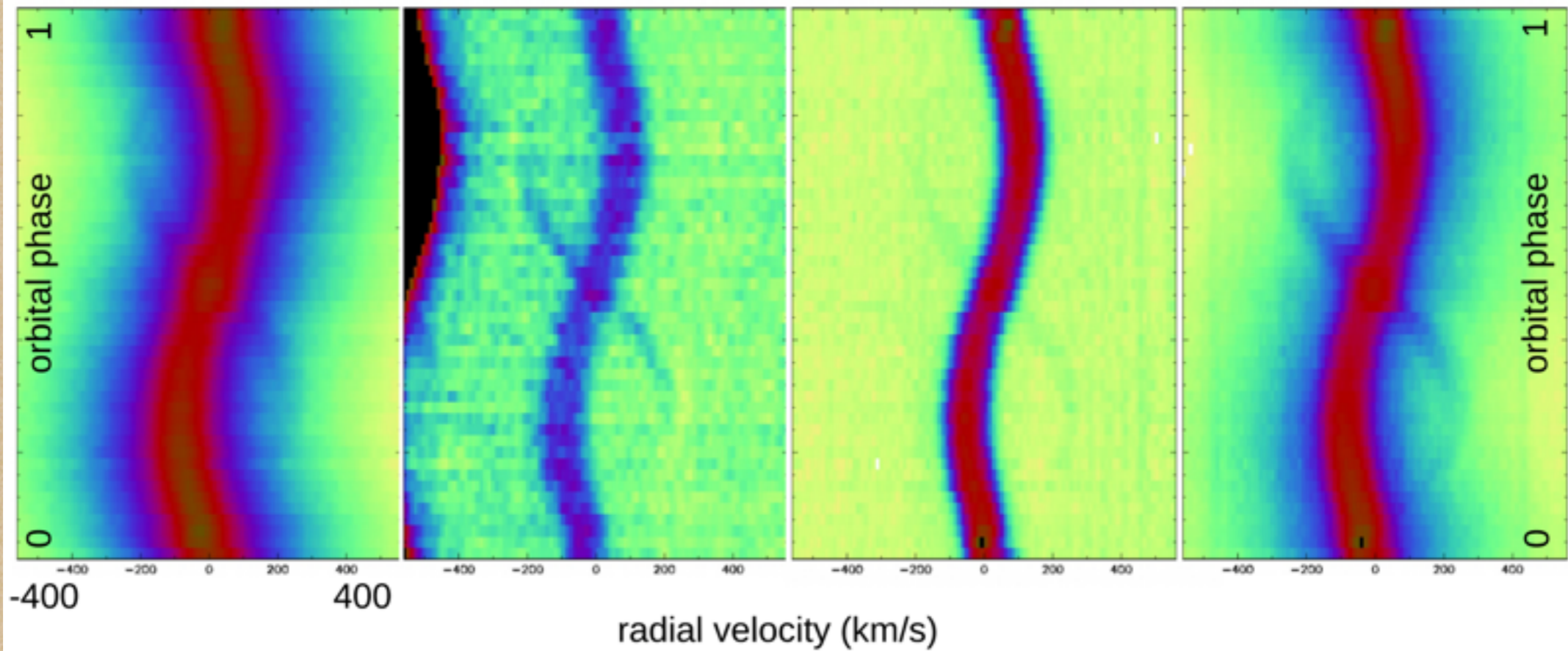
HW Vir

H β
4861.3 Å

Mg II
4481.3 Å

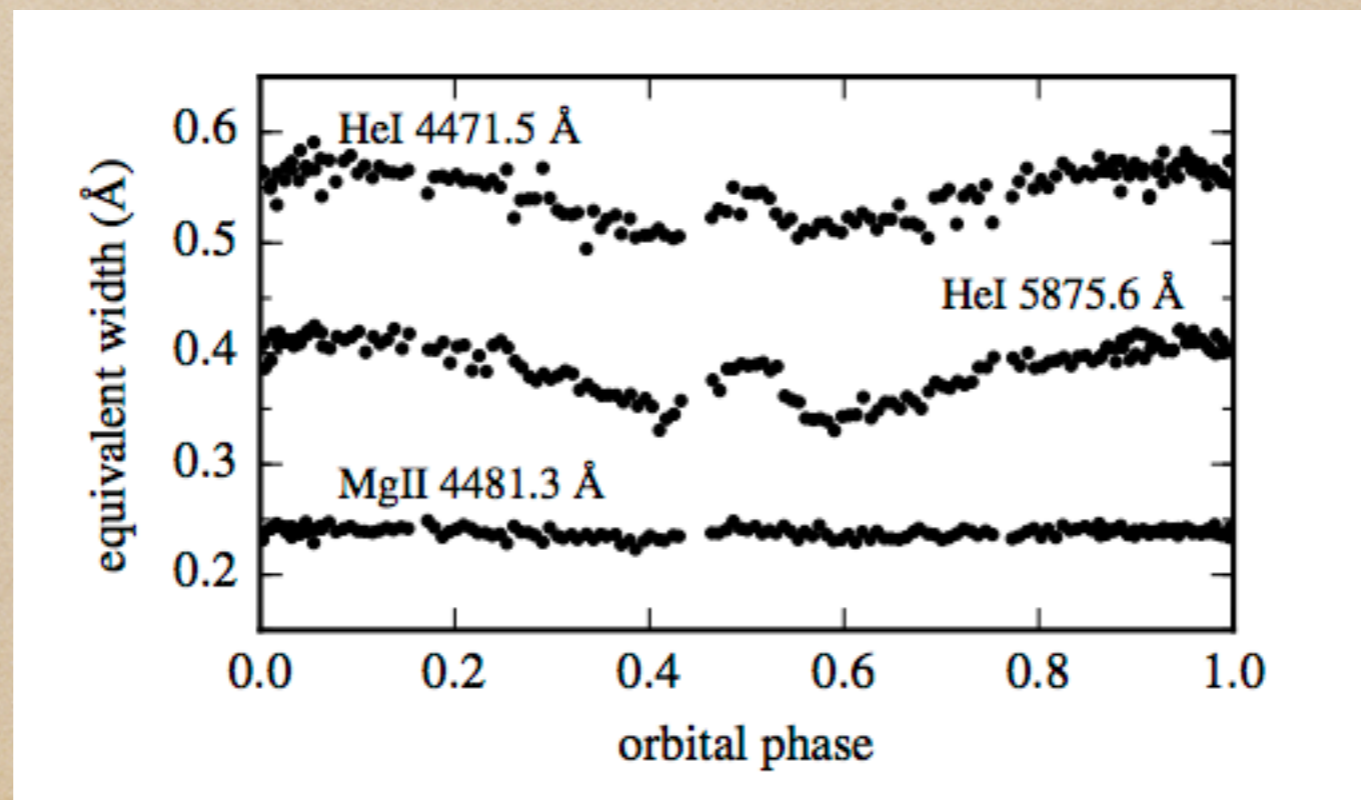
He I
5875.6 Å

H α
6562.7 Å

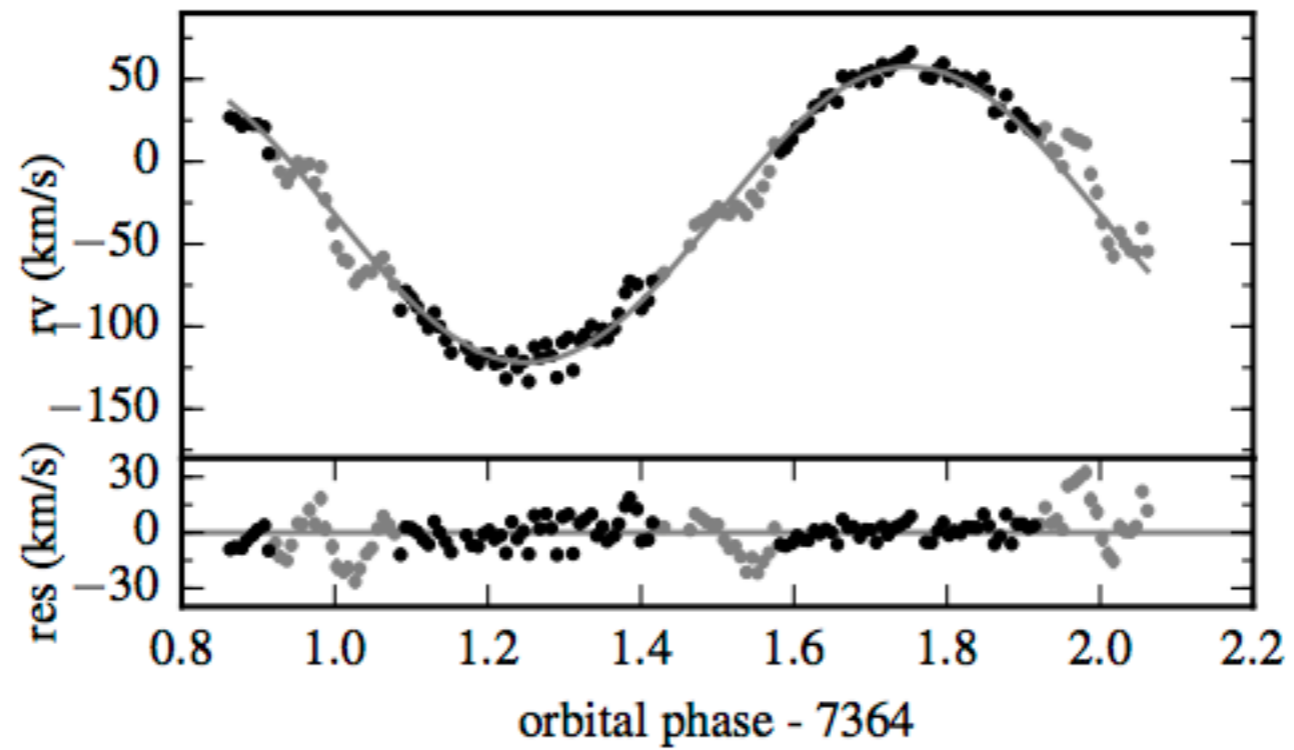


HW Vir

EW over the orbital phase

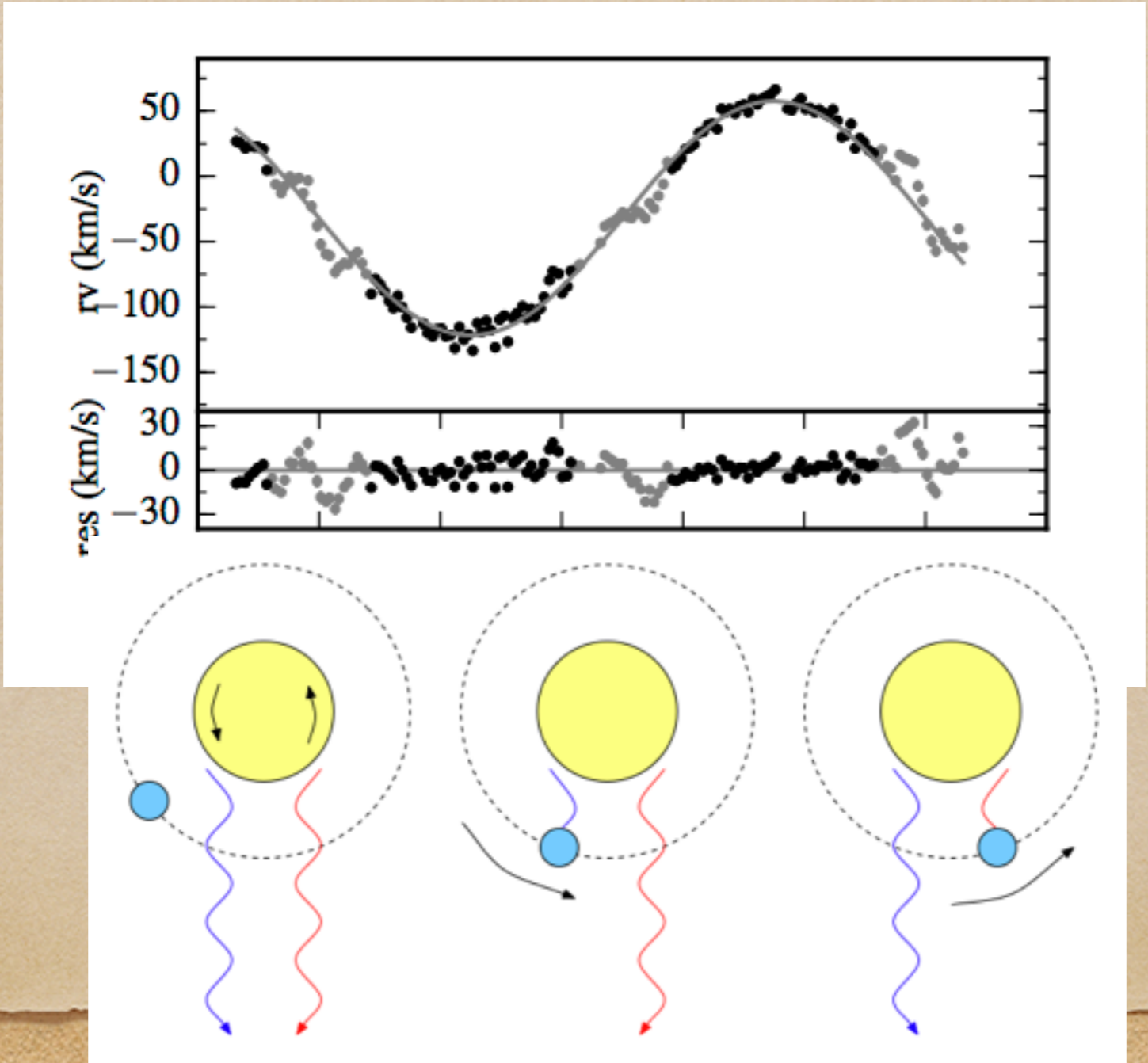


HW Vir



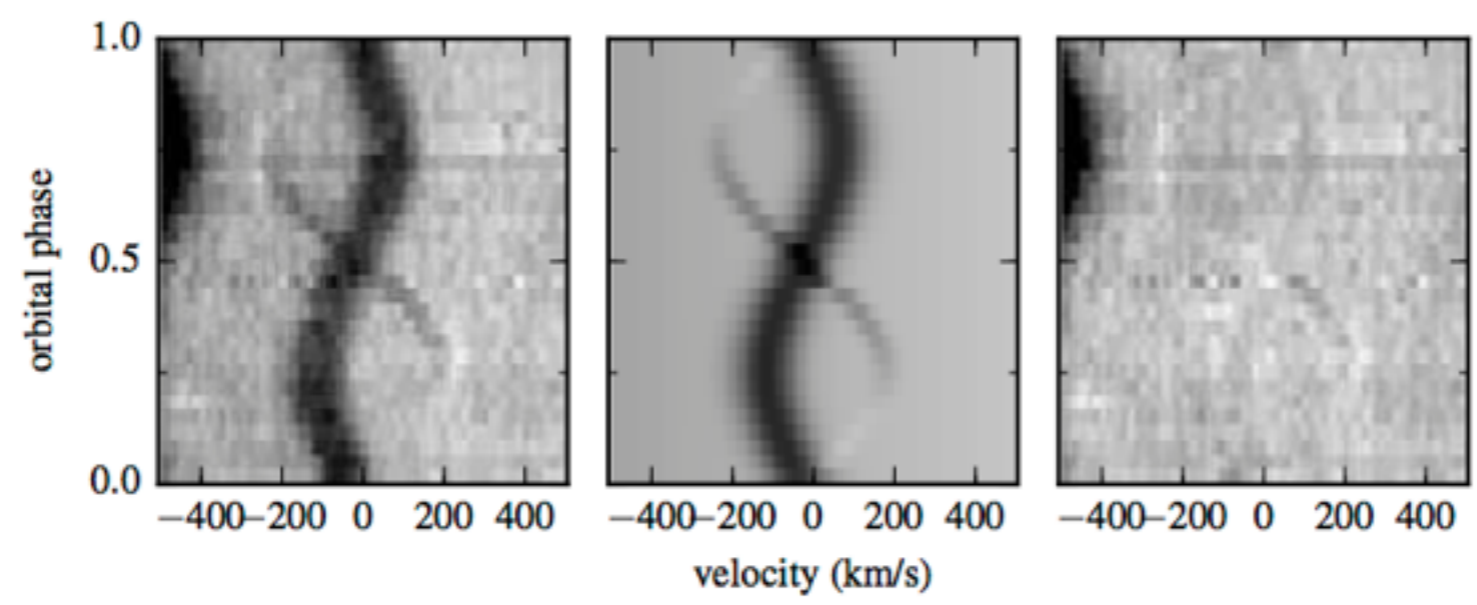
	K_1 (km/s)	K_{irr} (km/s)	γ (km/s)
P91	-89.0 ± 0.4	206.5 ± 1.3	-31.0 ± 0.3
P95	-83.6 ± 0.4	209.5 ± 1.4	-25.8 ± 0.3

HW Vir

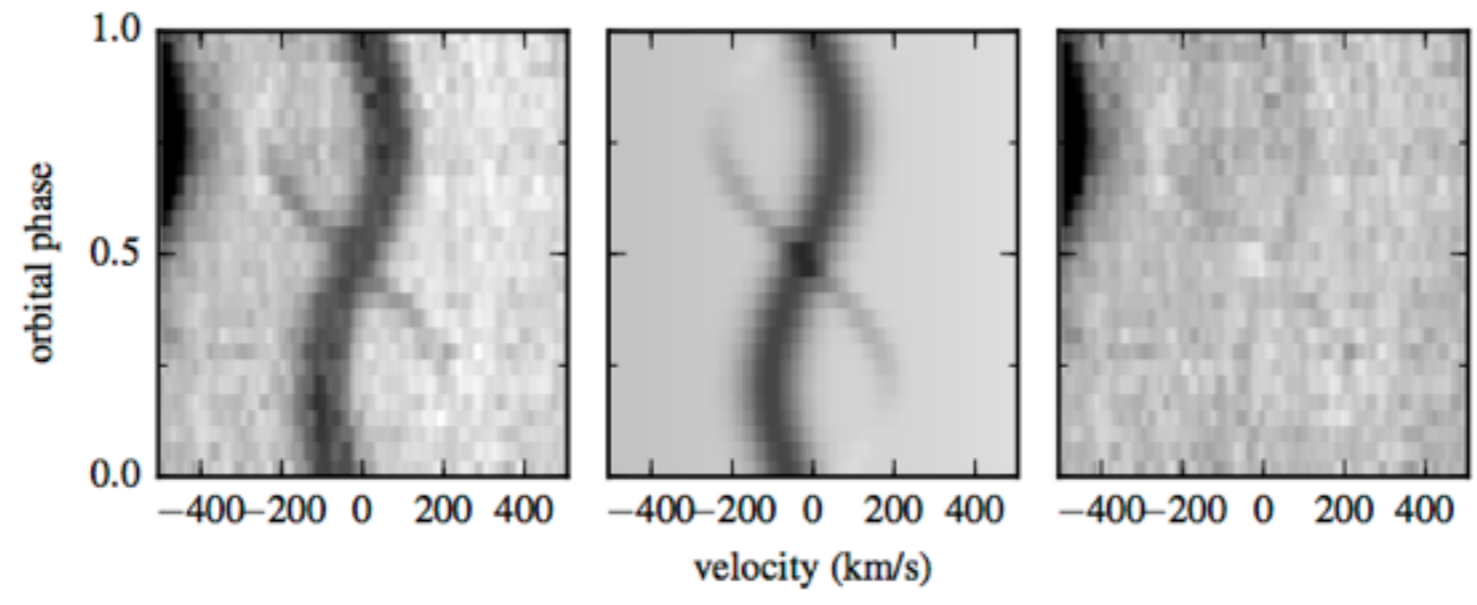


HW Vir

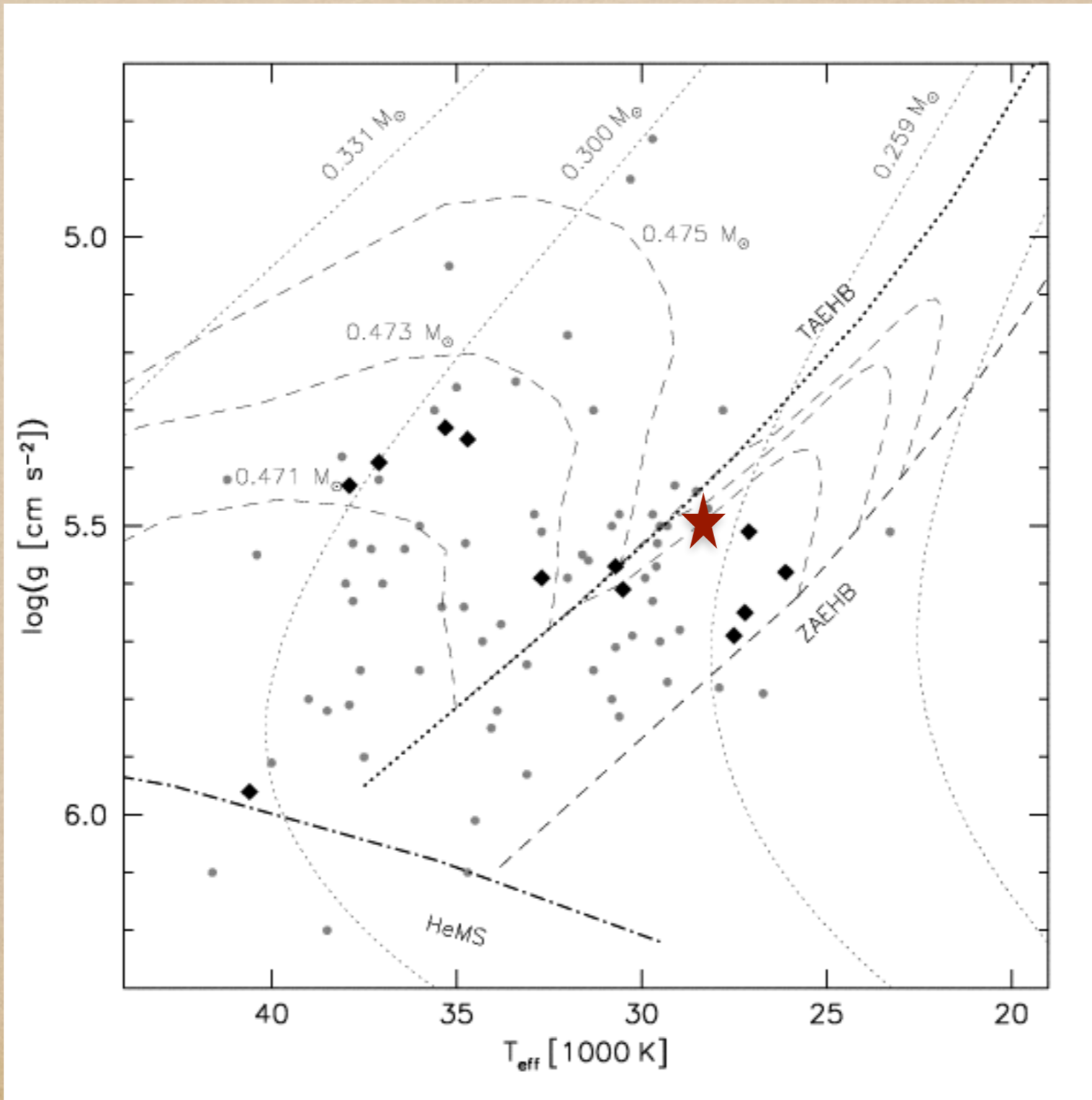
P91



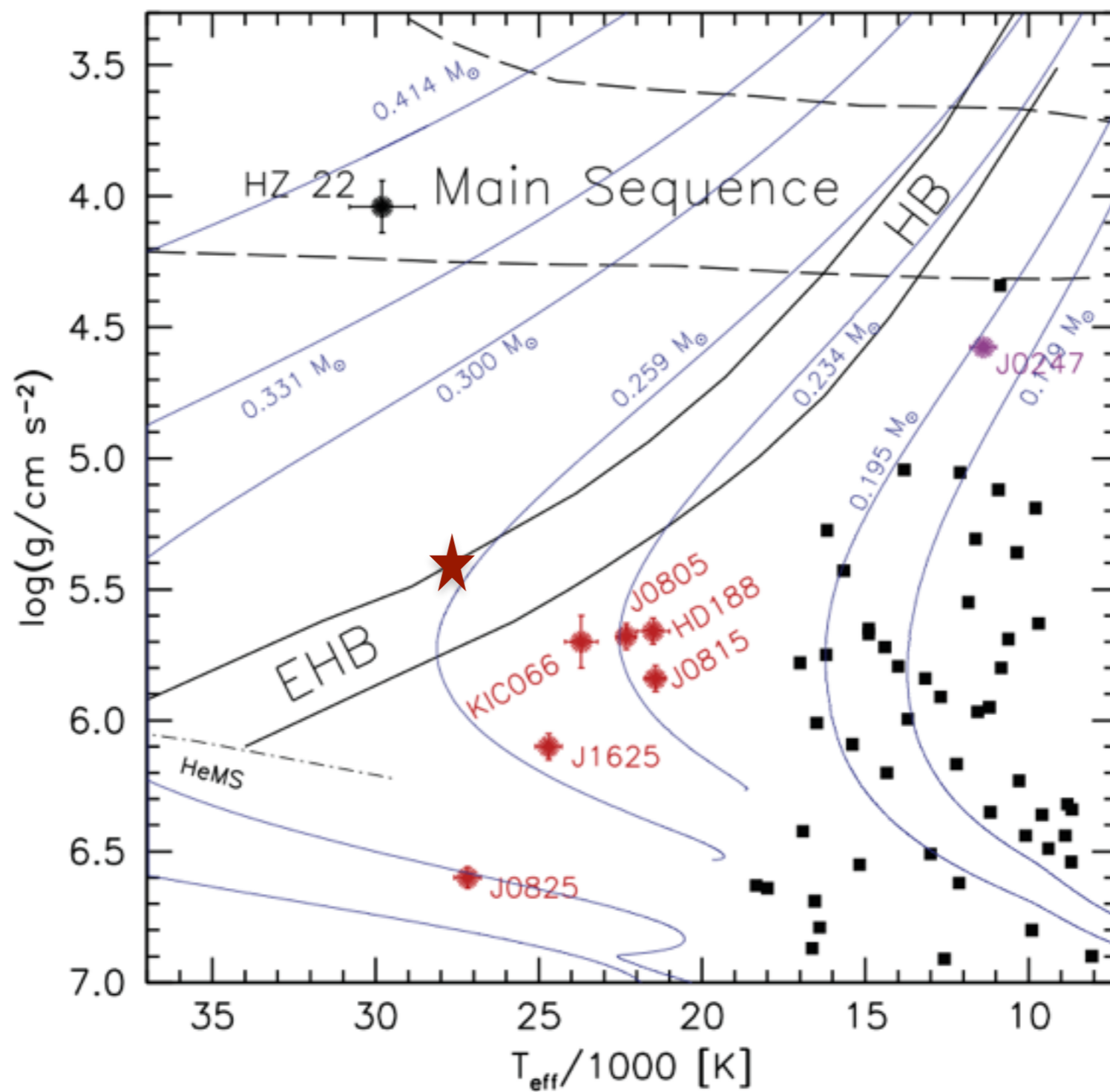
P95



Stellar evolution ?



Stellar evolution ?



Conclusion

- Stellar masses
 - asteroseismology
 - binary characteristics
 - synchronisation (sub-synchronised rotation!)
 - evolution
 - circumbinary planets
 - formation & survival
- Hot subdwarf B stars may not be the canonical sdBs !
- Three PCEBs with "visible" secondaries emission/absorption:
 - NN Ser a WD primary, Parsons et al. 2010, MNRAS 402;
 - AA Dor an sdB primary, Vuckovic et al. 2016, A&A 586;
 - HW Vir, Bours & Vuckovic in prep.

www.ifa.uv.cl/

- Master
- PhD
- Postdoc

