Irradiation effects in HW Vir-type binaries

Maja Vučković,
Instituto de Física y Astronomía,
Universidad de Valparaíso,
Chile

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The Extreme Horizontal Branch

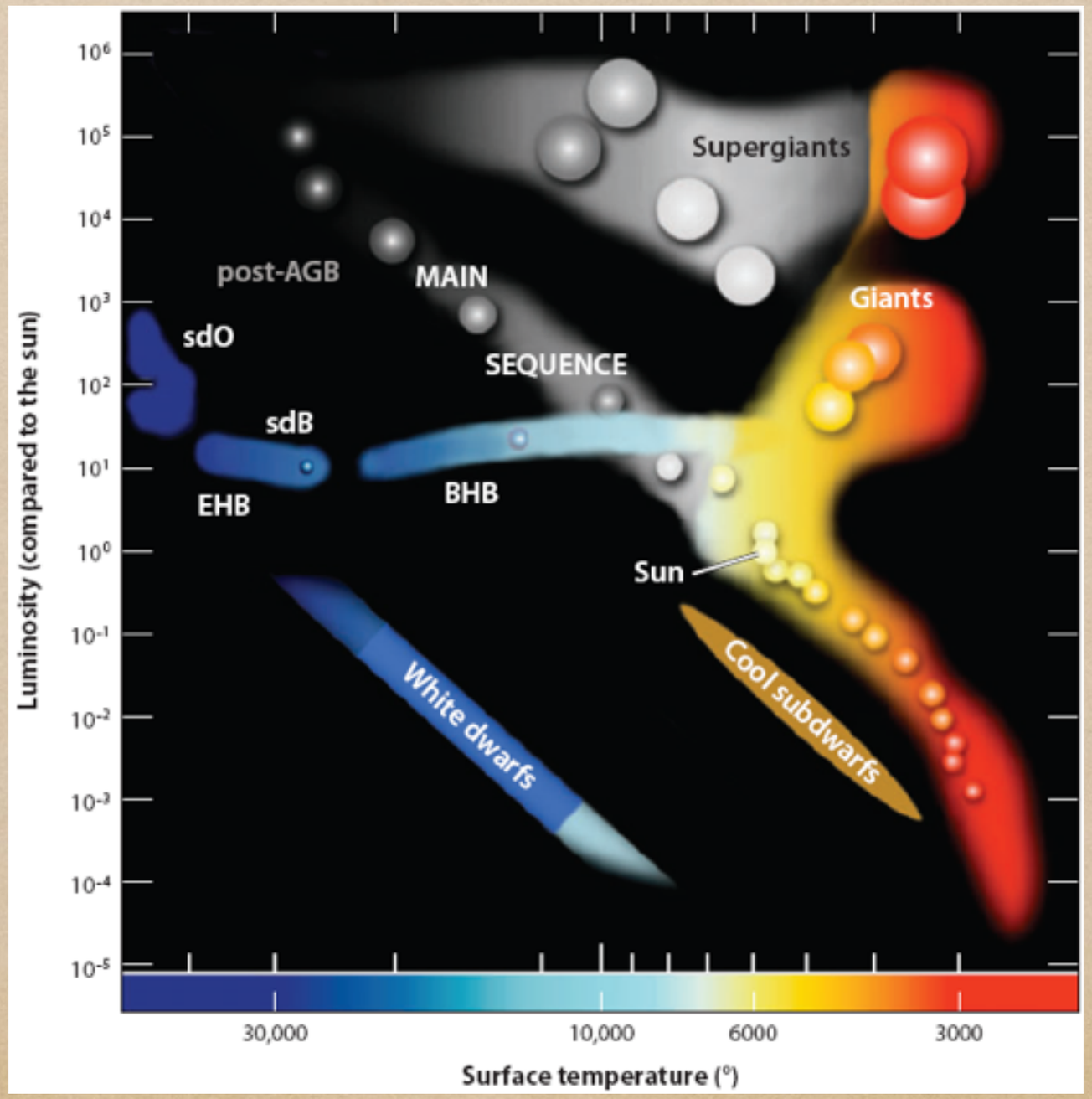
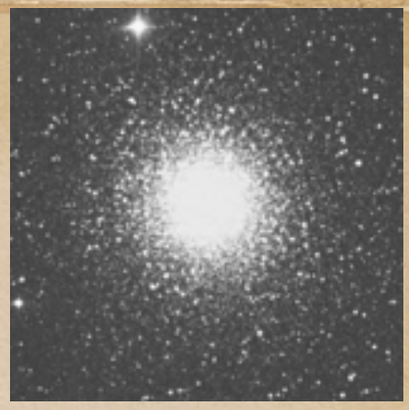
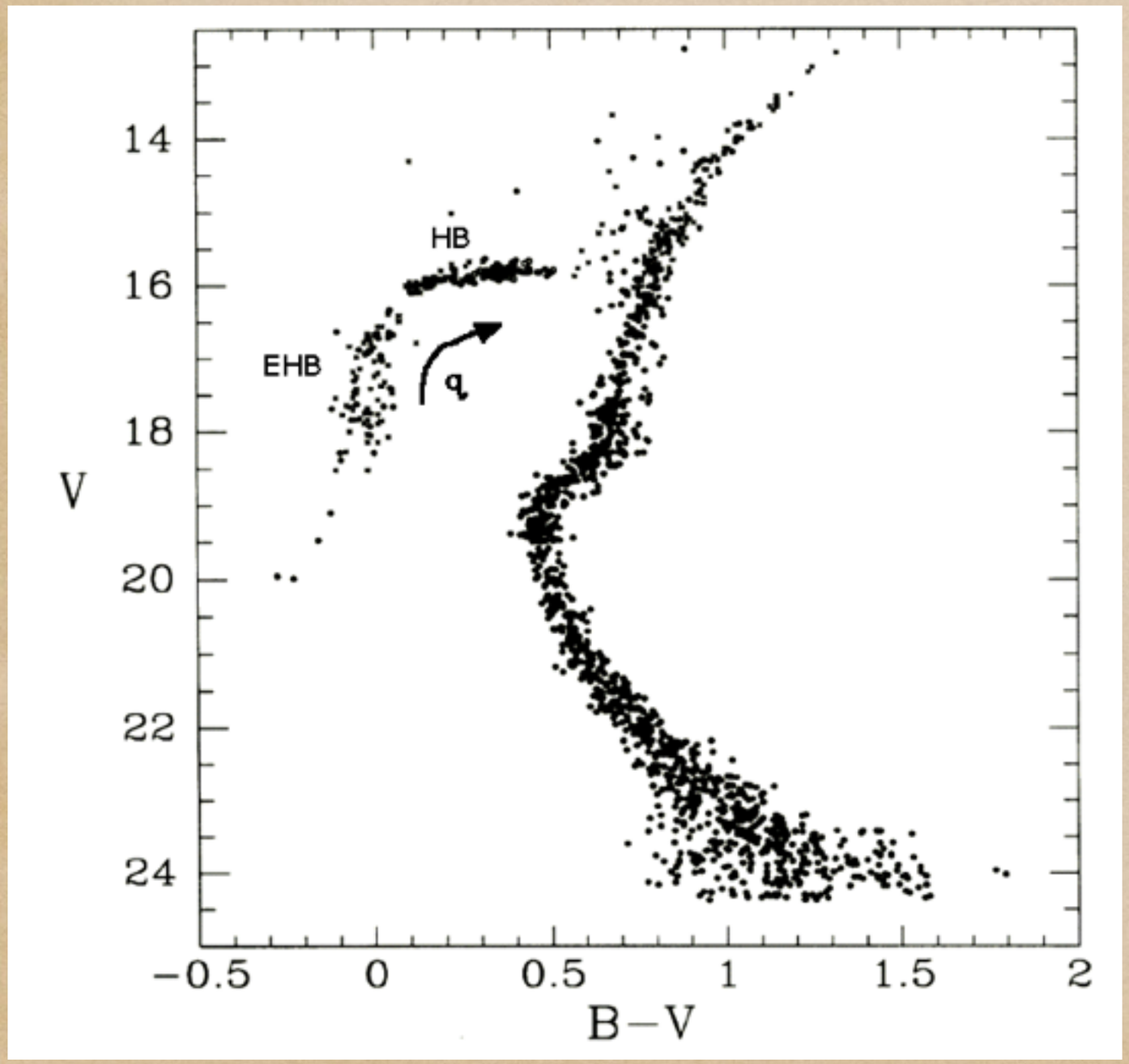


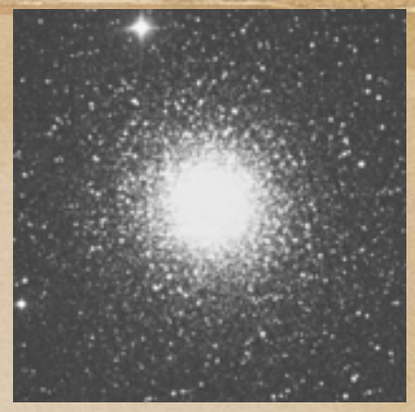
Fig: Heber (2009)

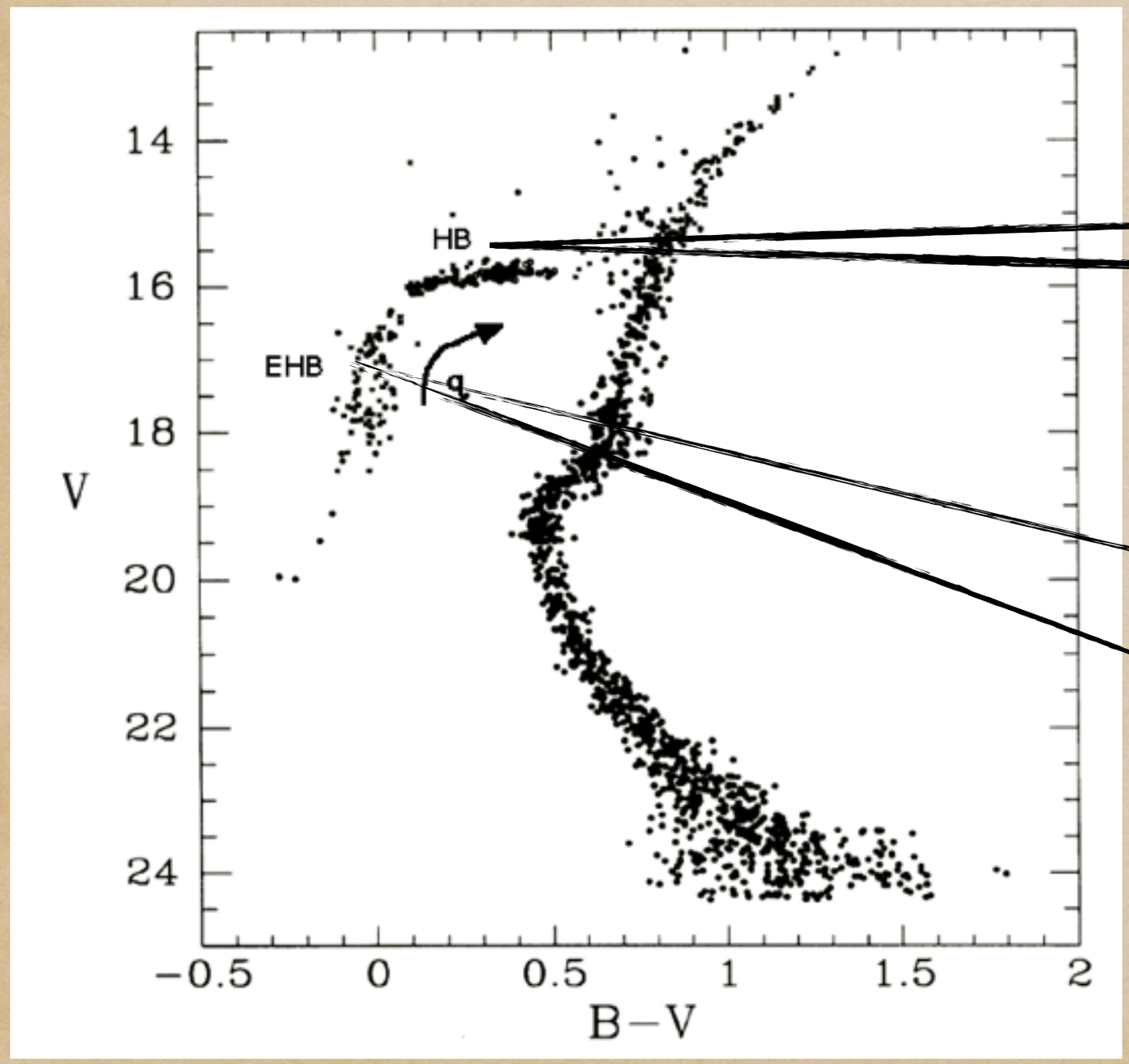
The Extreme Horizontal Branch

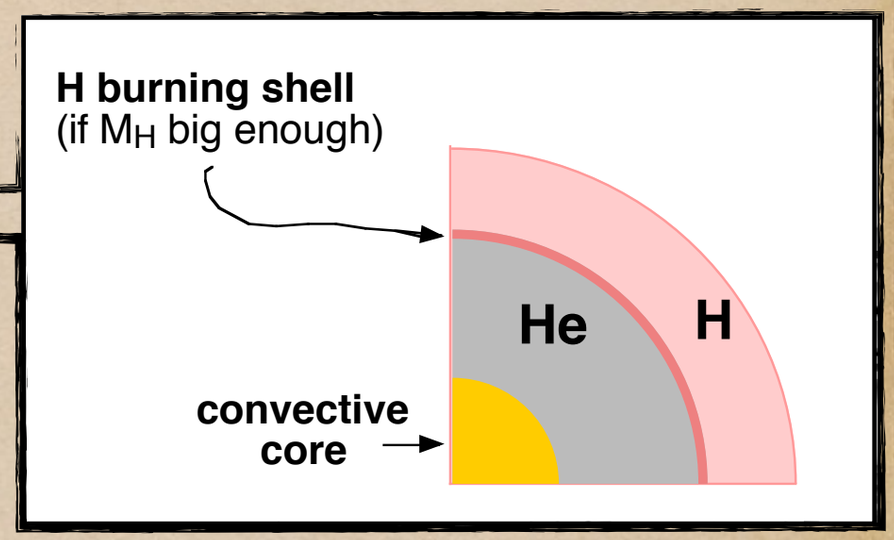


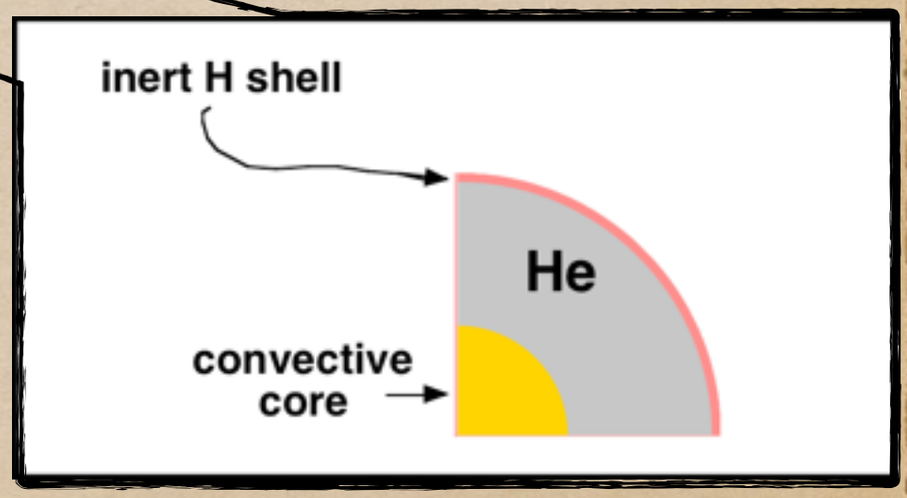


The Extreme Horizontal Branch









Common envelope ejection

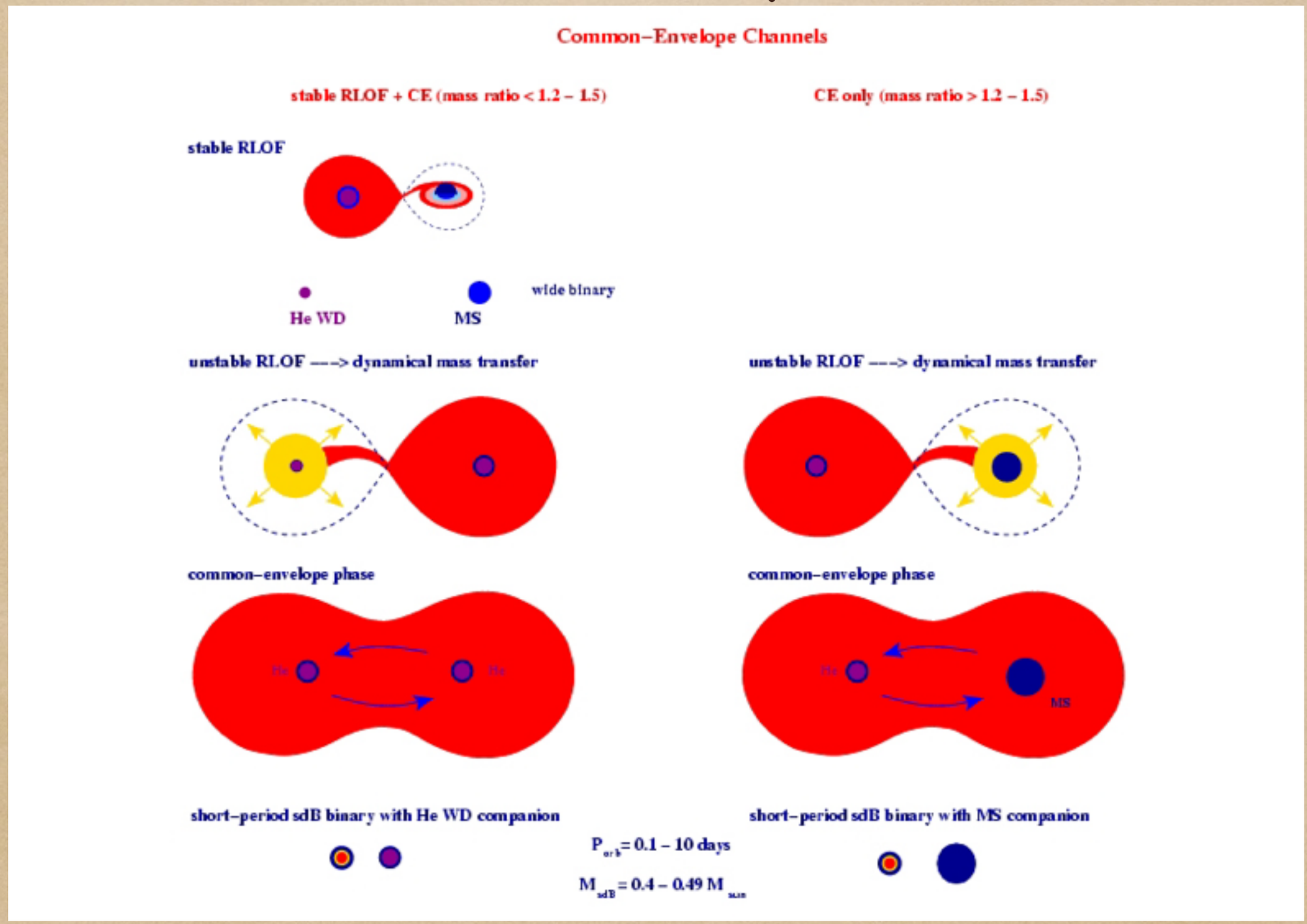
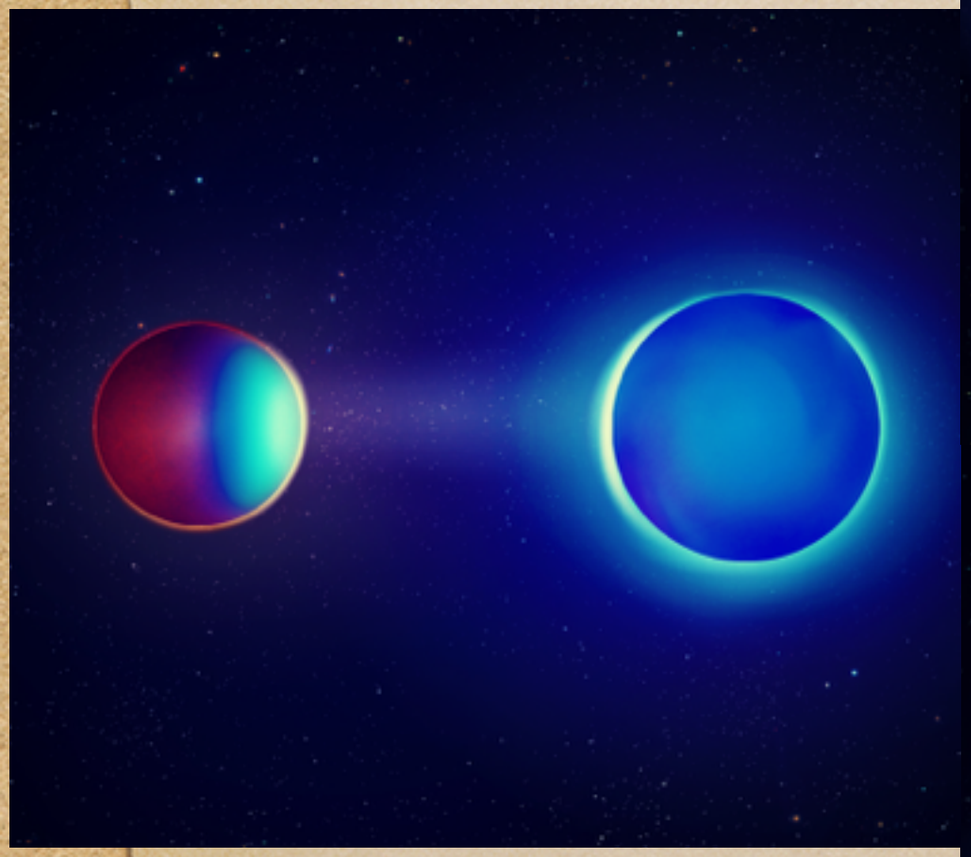
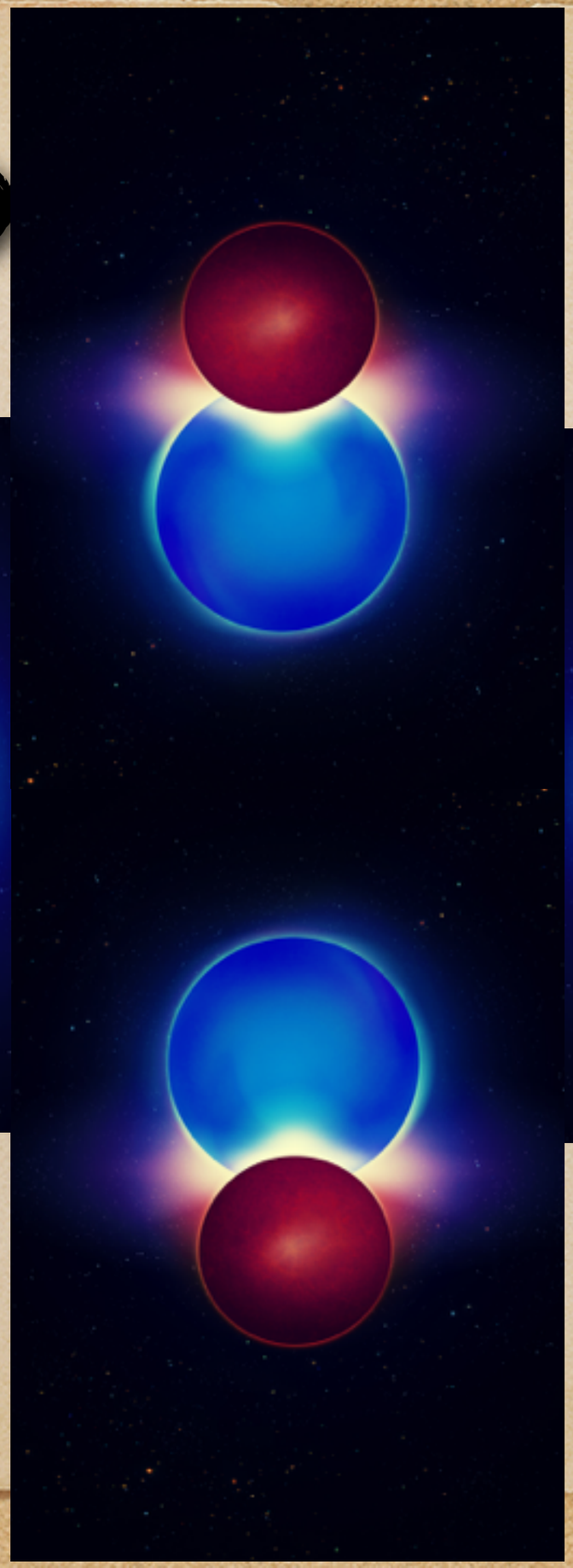
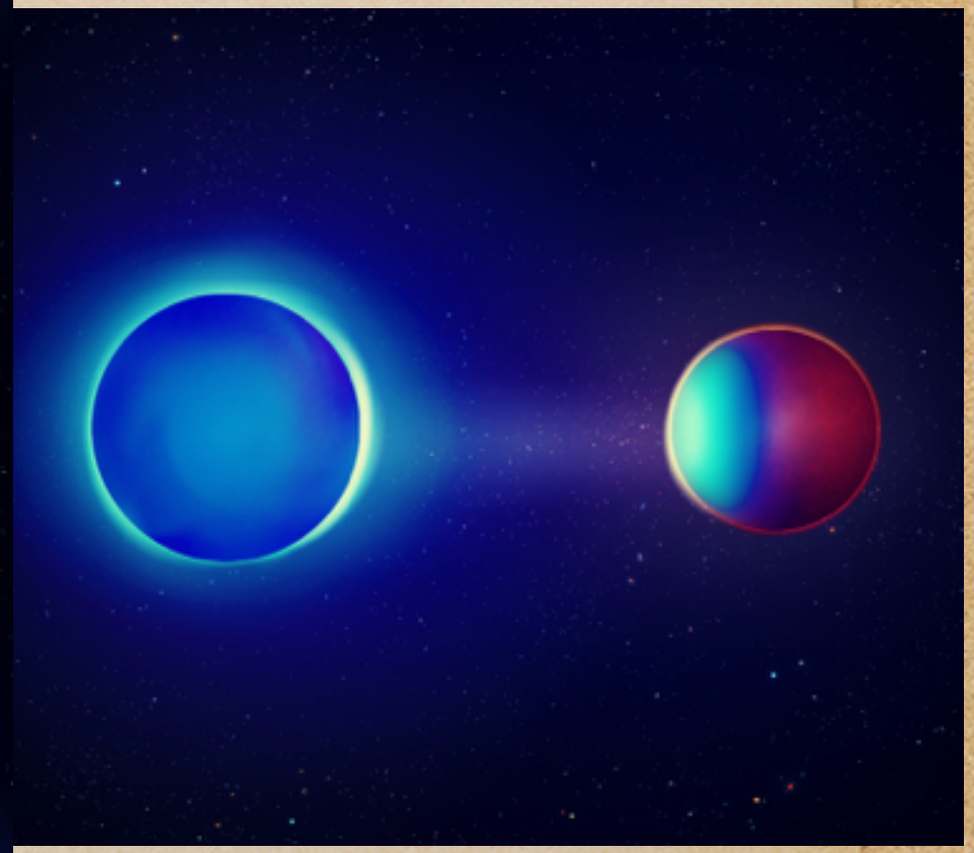


Fig: Podsiadlowski(2008)

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

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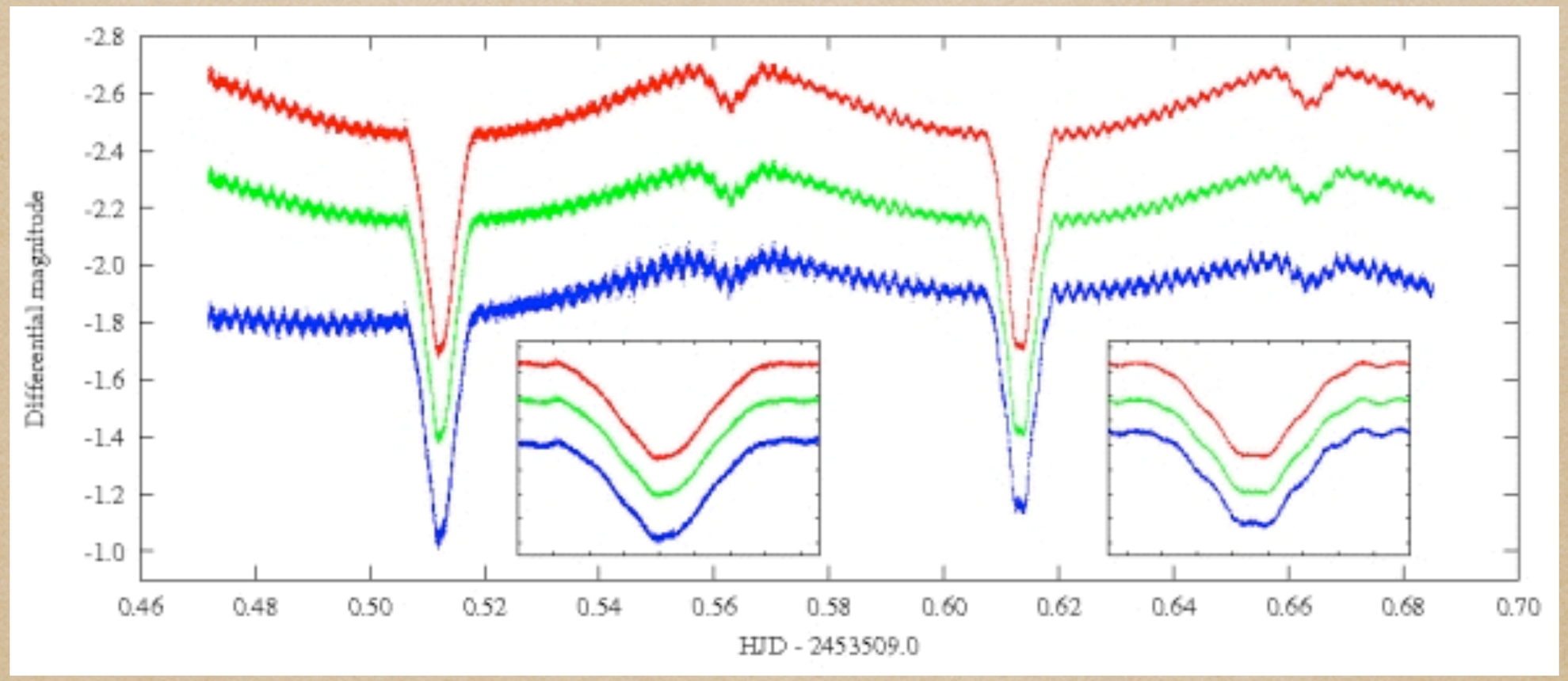
2M 1533+3759	0.162	86.6	1
ASAS 102322-3737	0.139	65.7	1
J 08205+0008	0.096	85.9	0.7

> 50 systems by now!

PG1336+018

NY Vir

P = 0.101d

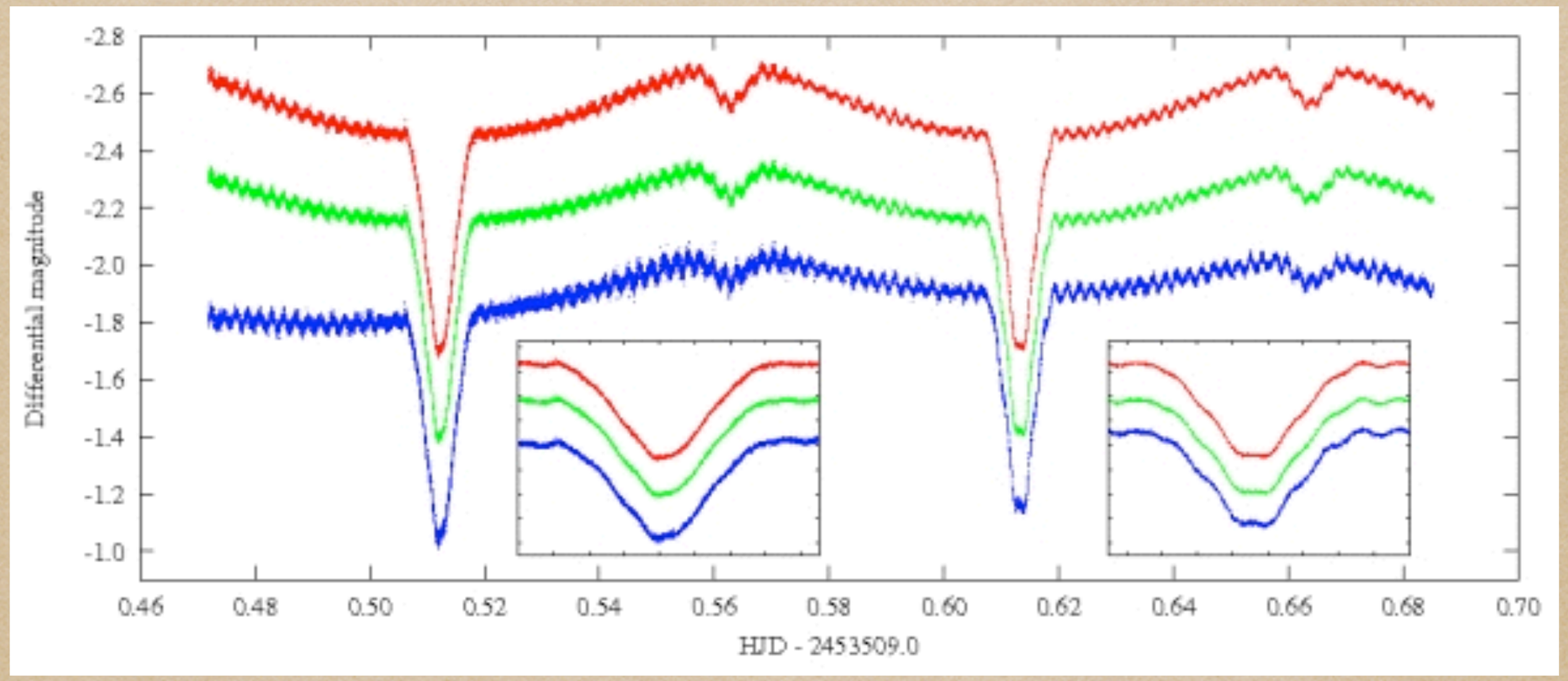


Vučković et al. 2007

PG1336+018

NY Vir

P = 0.101d



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

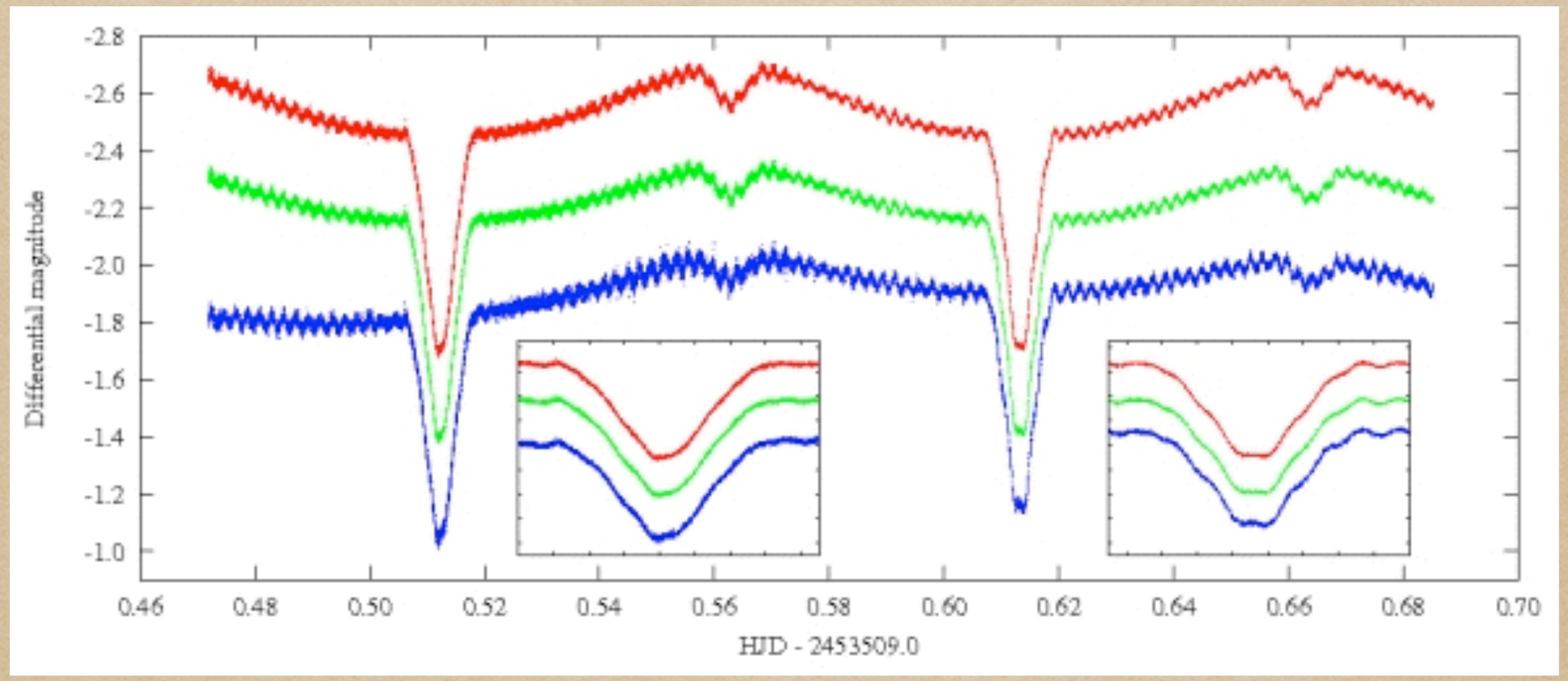
R = 0.15 (0.01) $R_\odot$

Vučković et al. 2009

PG1336+018

NY Vir

P = 0.101d



M = 0.466 (0.006) M ⊙

R = 0.15 (0.01) R ⊙

Vučković et al. 2009

Vučković et al. 2007

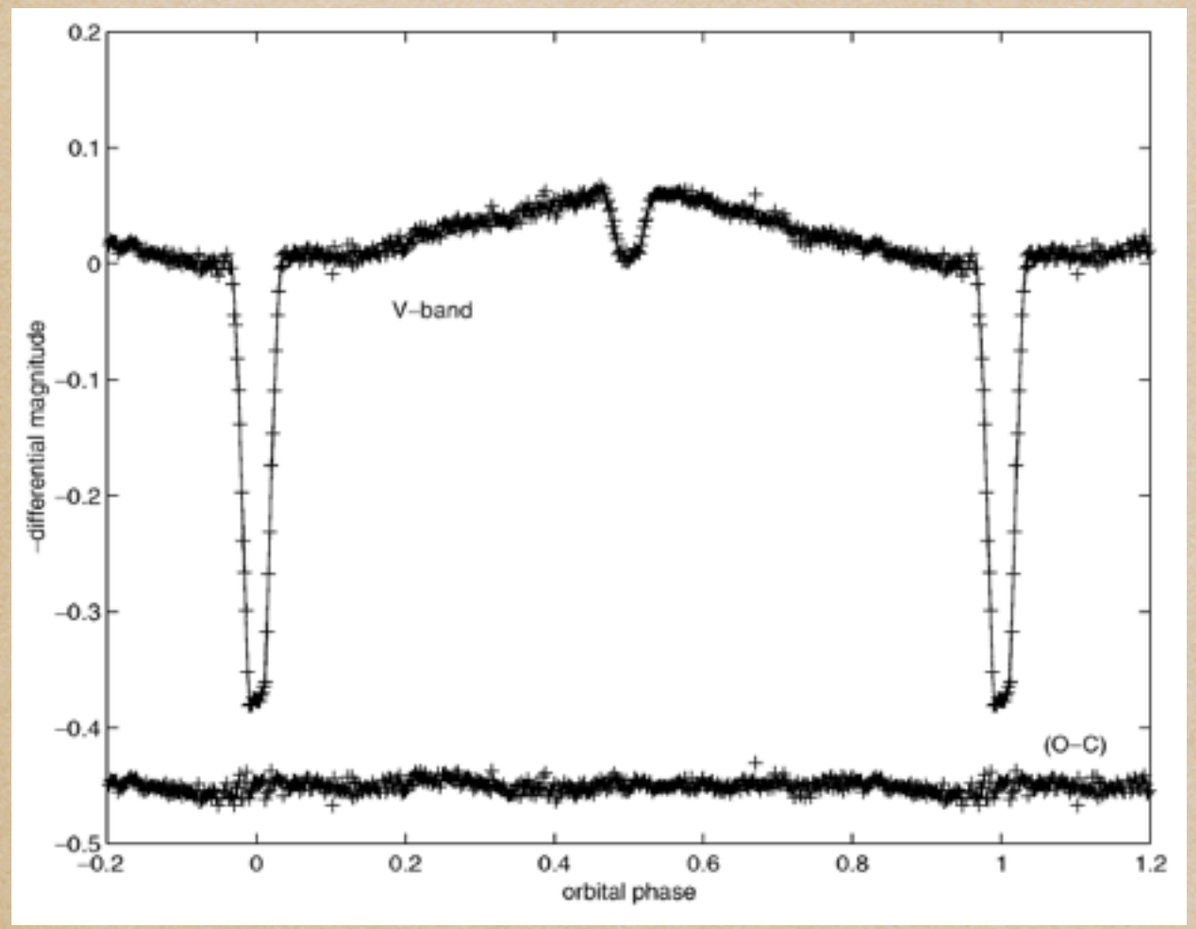
M = 0.459 (0.005) M ⊙

R = 0.151 (0.001) R ⊙

Charpinet et al . 2010

AA Dor

P = 0.26d



Hilditch et al. (2003)

P = 6.3h

$a \approx 1.2\ R_\odot$

i = 90

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

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

$\log g_1 \approx 5.2\text{–}5.4$? ; $\log g_2 \approx 5.2$

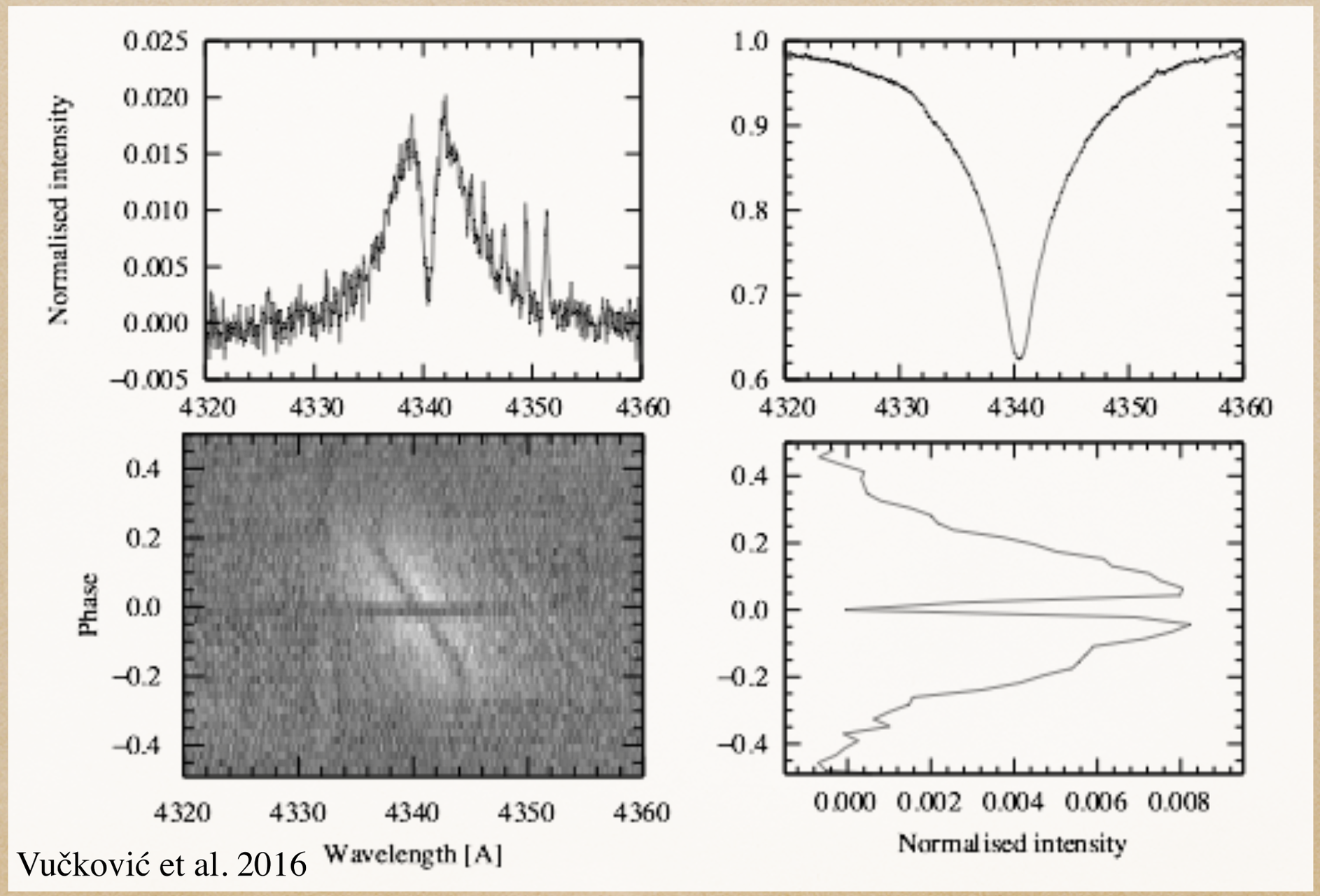
$V_{rot} = 34 - 47$ km/s

$M_1 \approx 0.33\ M_\odot$

$M_2 \approx 0.066\ M_\odot$

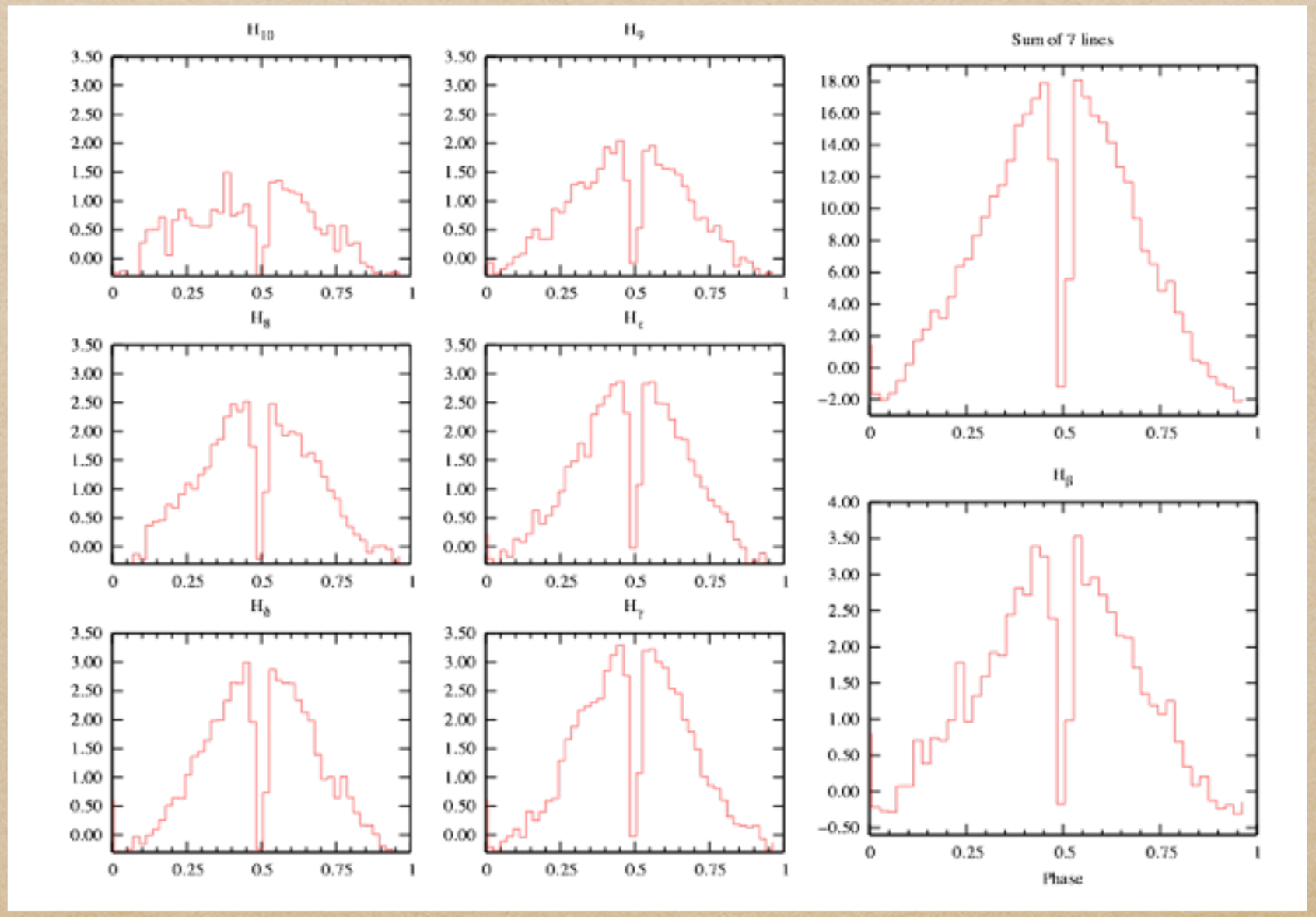
Rauch & Werner (2003)

Emission from irradiated secondary



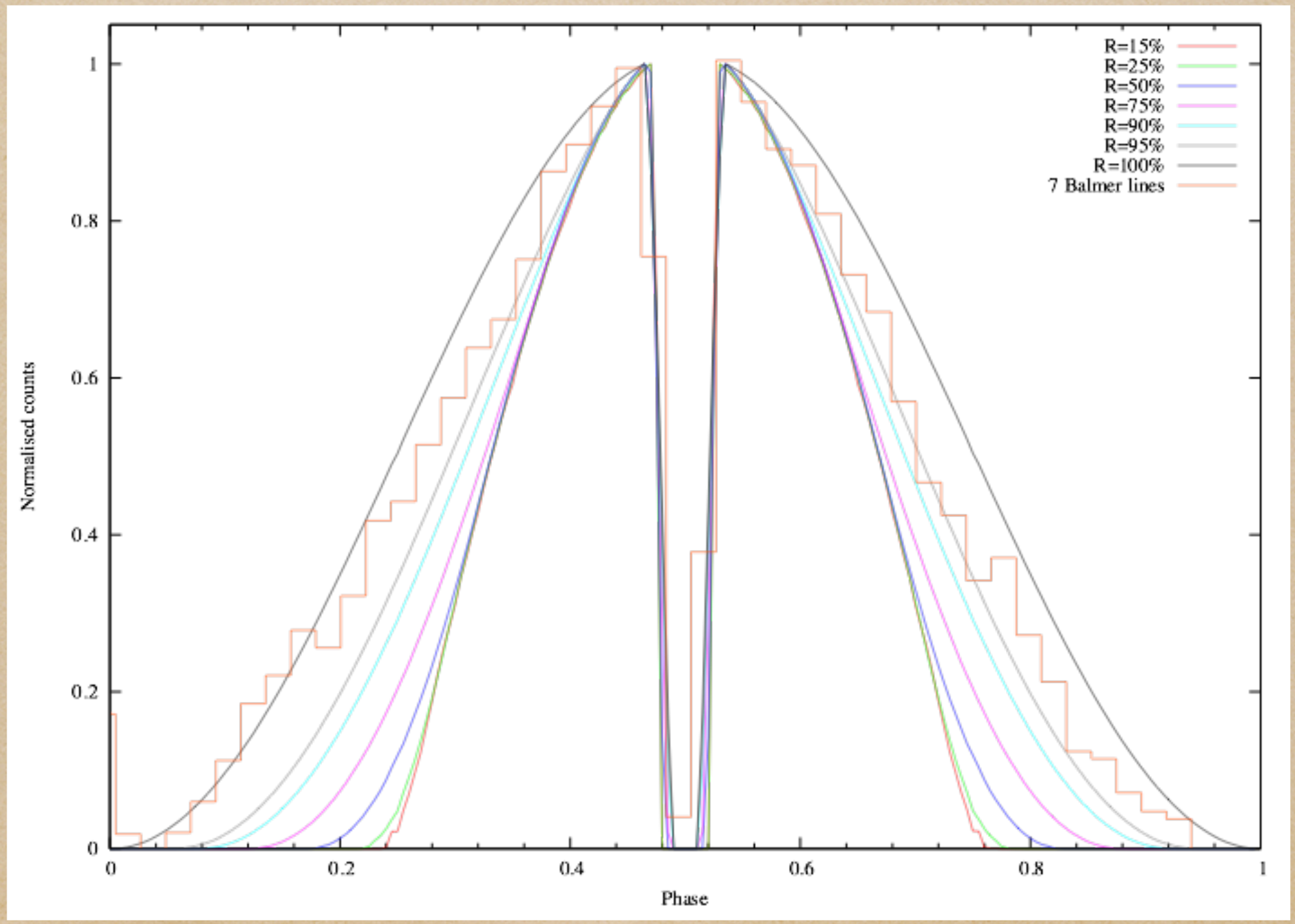
Vučković et al. 2016

Phase profiles of Balmer lines



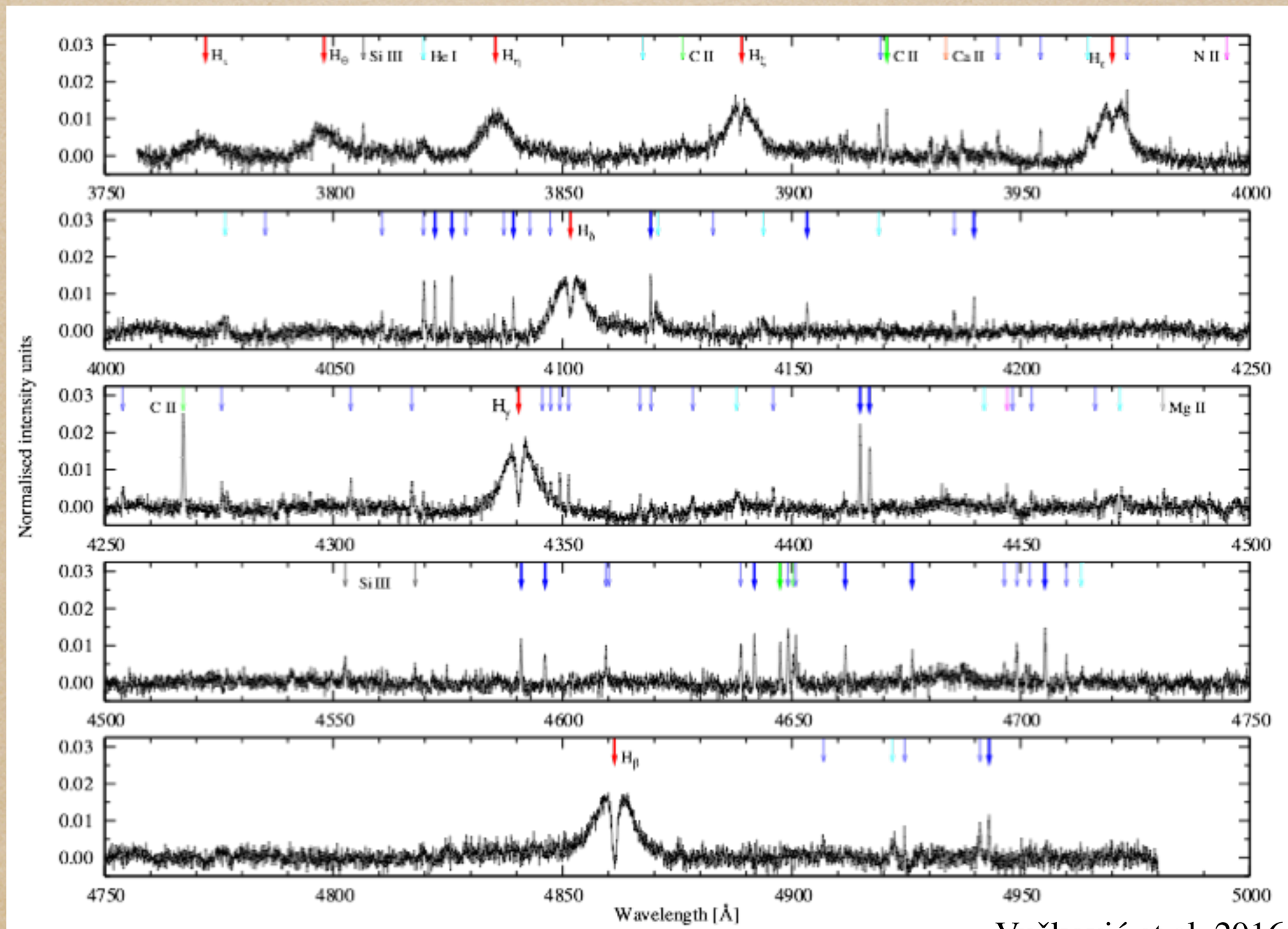
Vučković et al. 2016

Phase profiles vs models



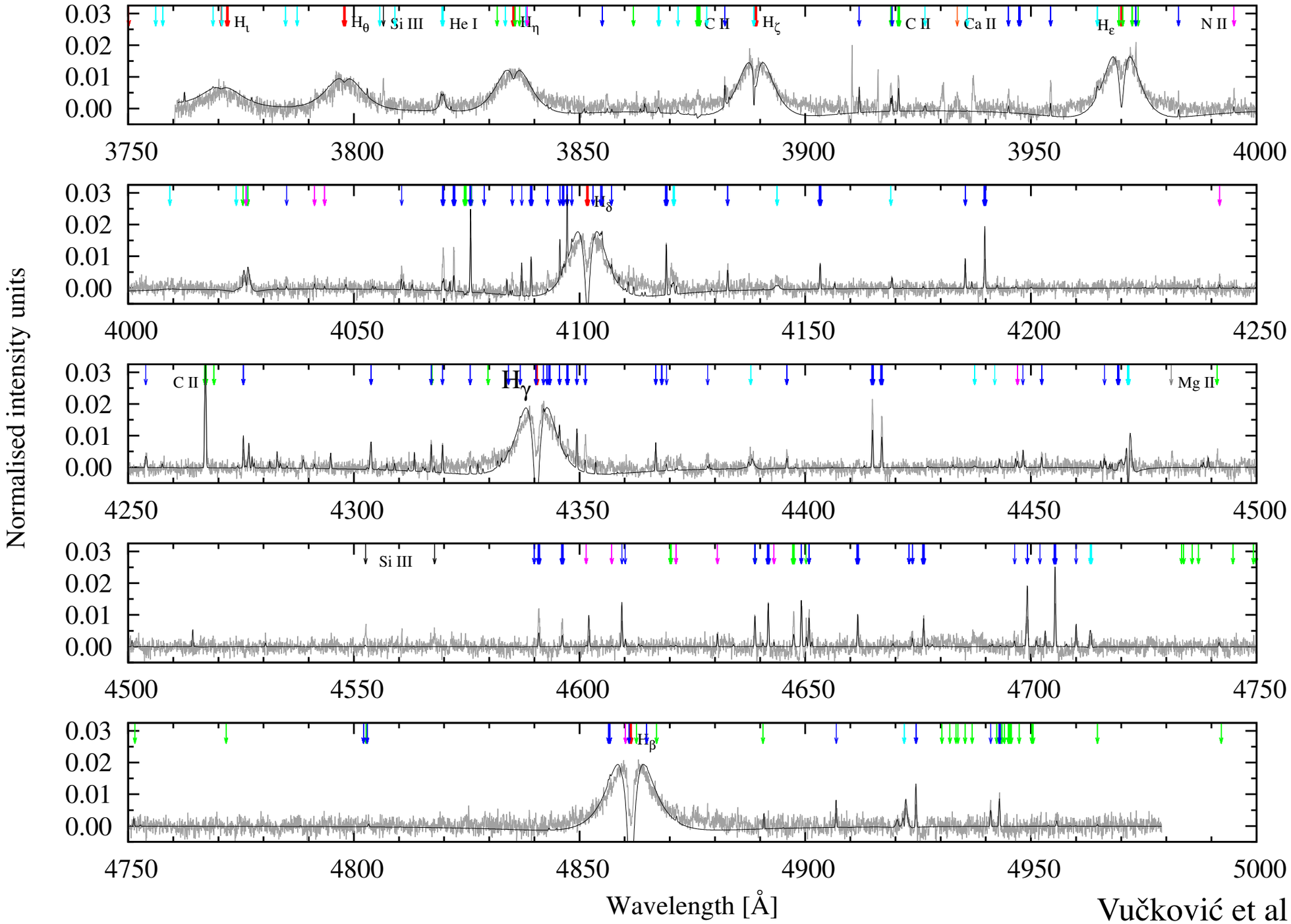
Vučković et al. 2016

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

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

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

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

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

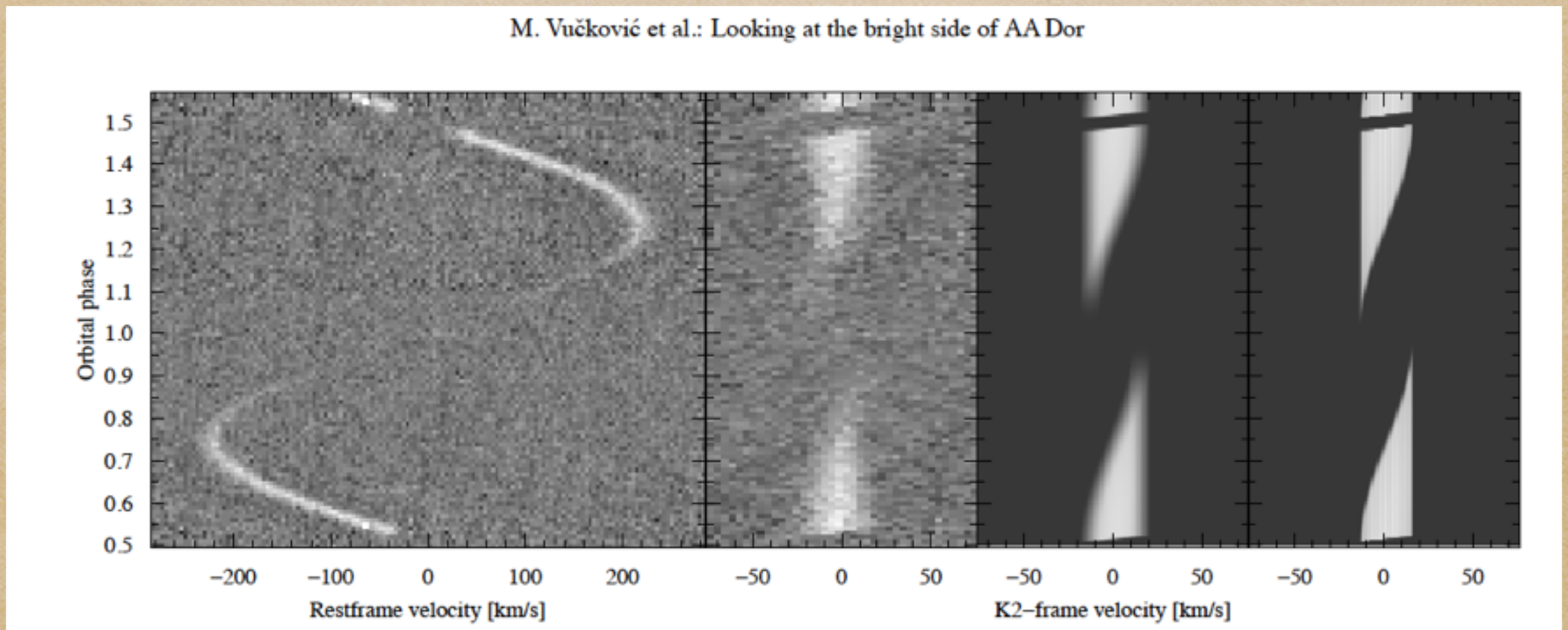
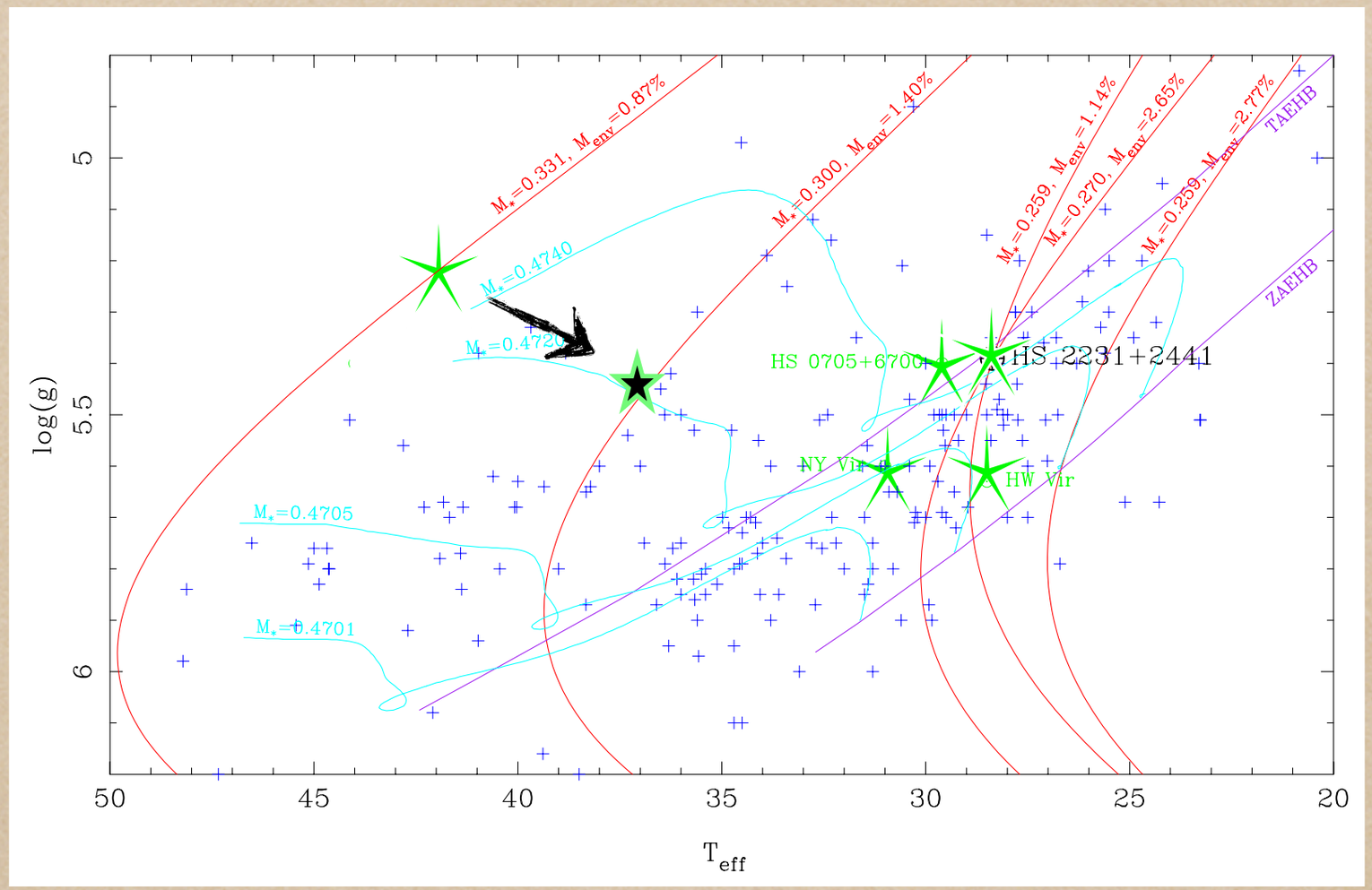


Fig. 5. Grayscale plot of the sum of all the metal lines in the rest frame of the system (left) and shifted to the rest frame of the secondary (middle). The last two panels show a geometrical model line profile for comparison, with the first having been subjected to a Gaussian broadening.

AA Dor

P = 0.26d

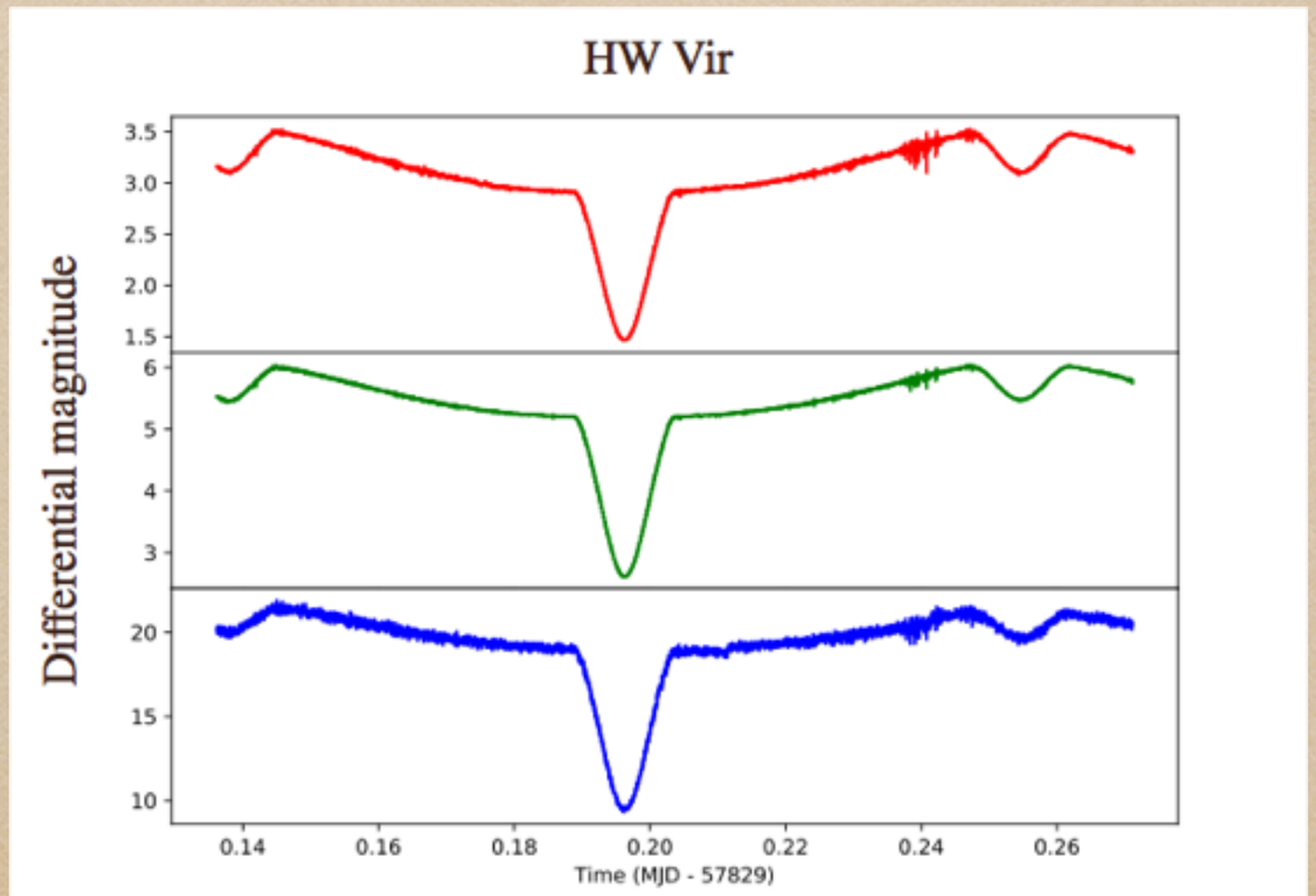


Vučković et al. 2016

M_{sdOB} = 0.46 (1) $M_\odot$ $M_{dM} \approx$ 0.079 (2) $M_\odot$

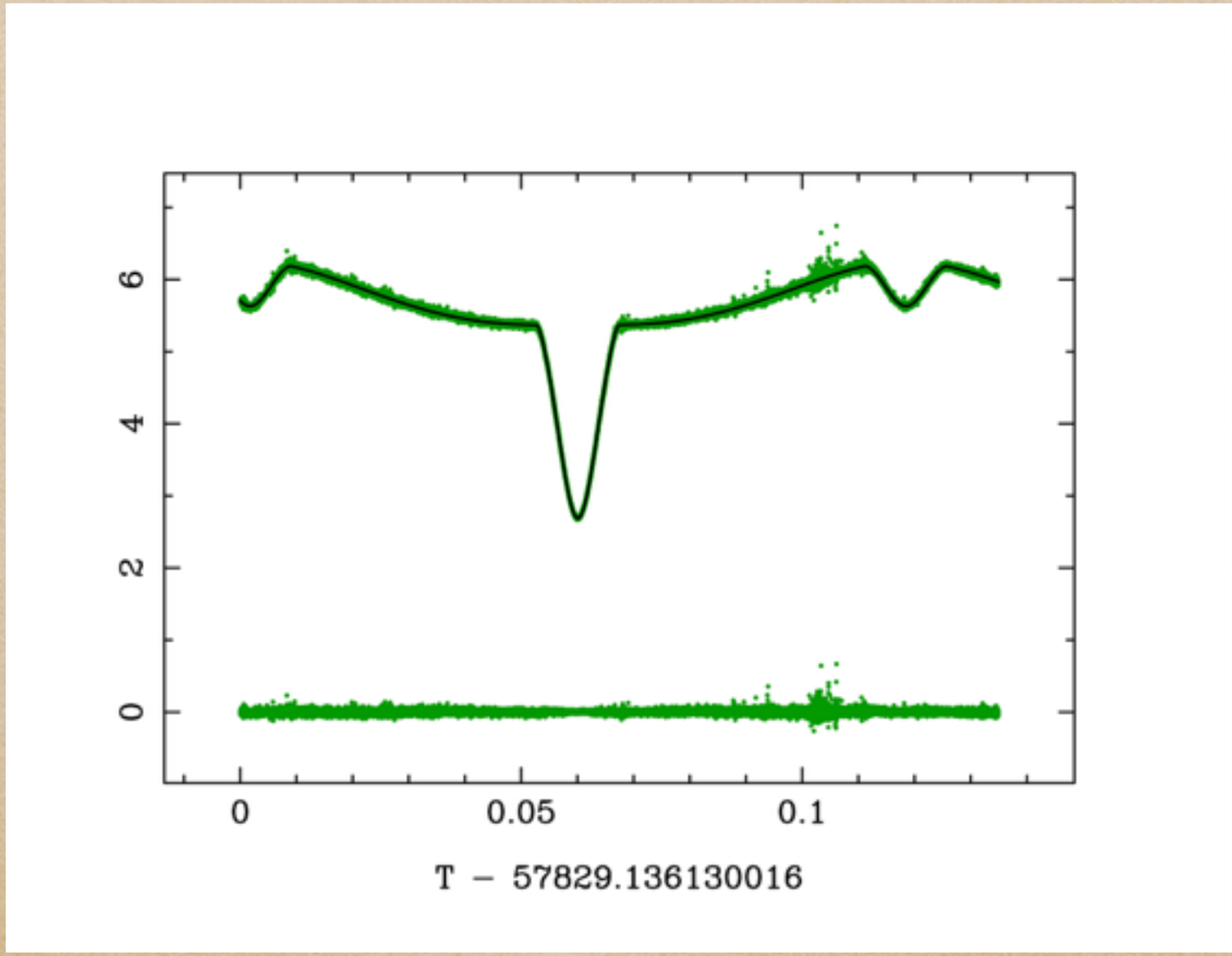
HW Vir

P = 0.117d



HW Vir

P = 0.117d

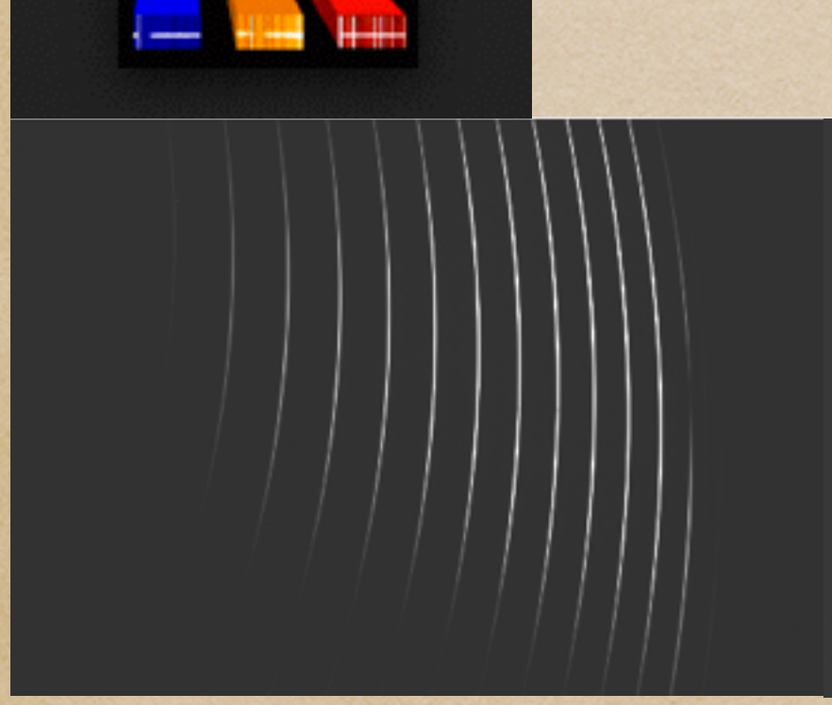


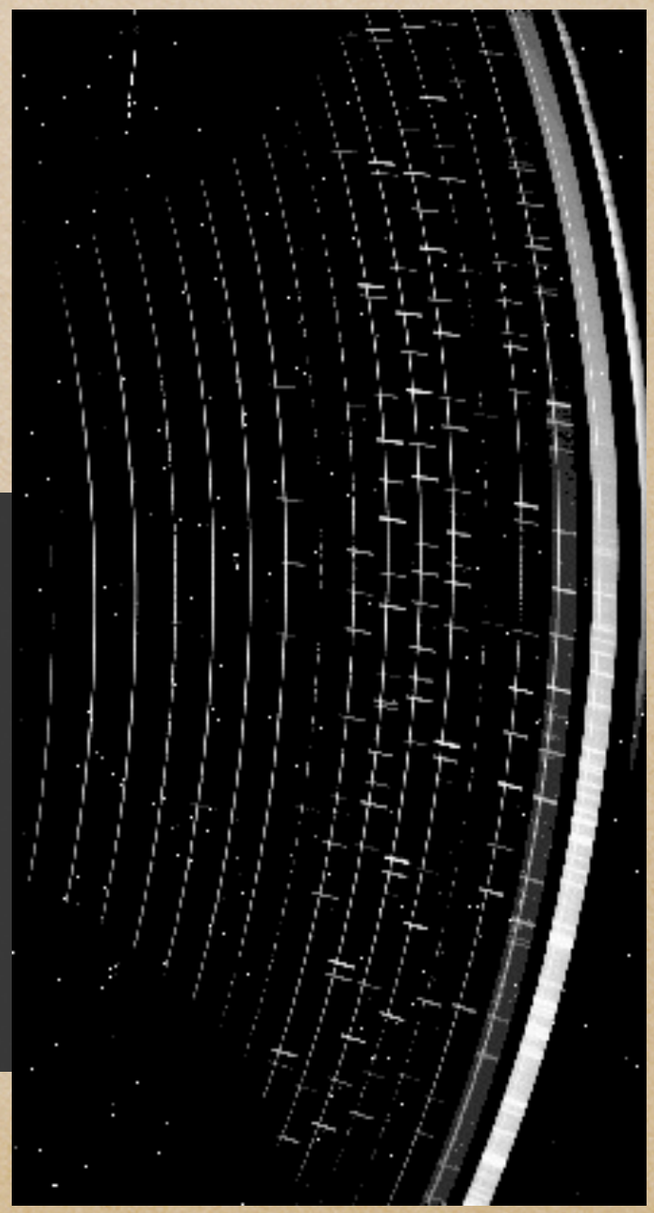
HW Vir

UVB 1” R ~ 4300

VIS 0.9” R ~ 7000

NIR 0.9” R ~ 5300





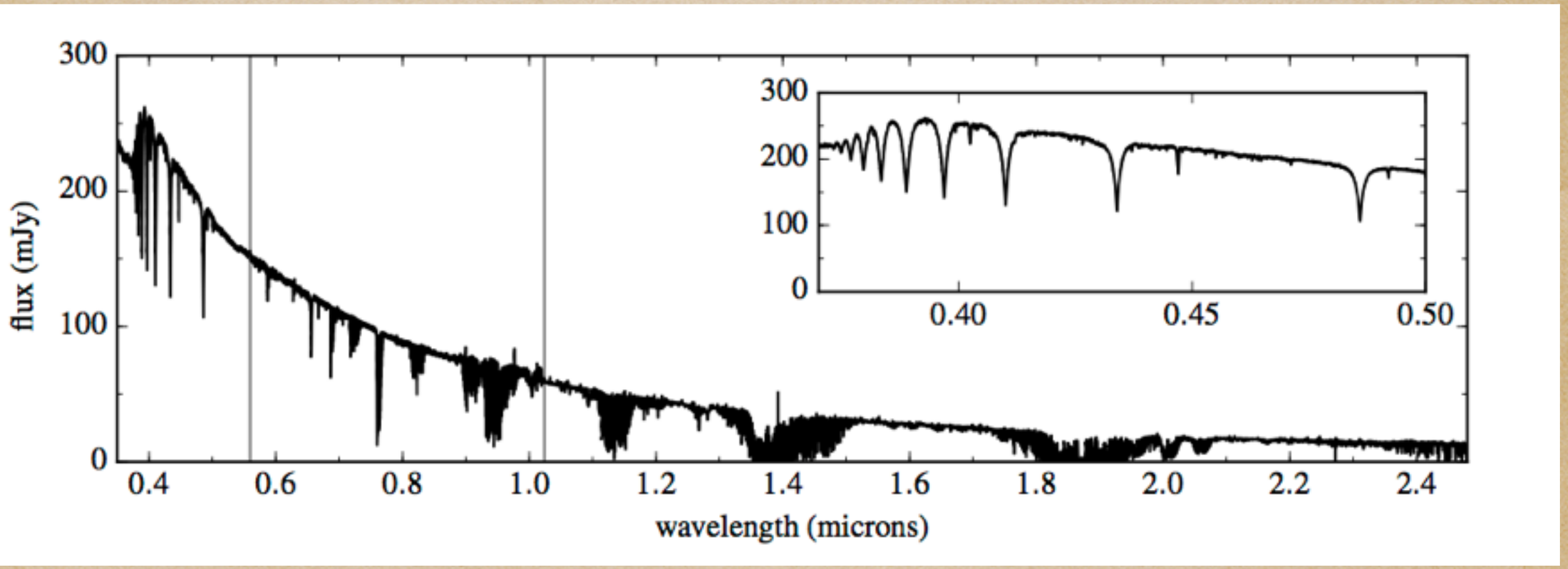
3000 - 5600 Å

5500 - 10200 Å

10200 - 24800 Å

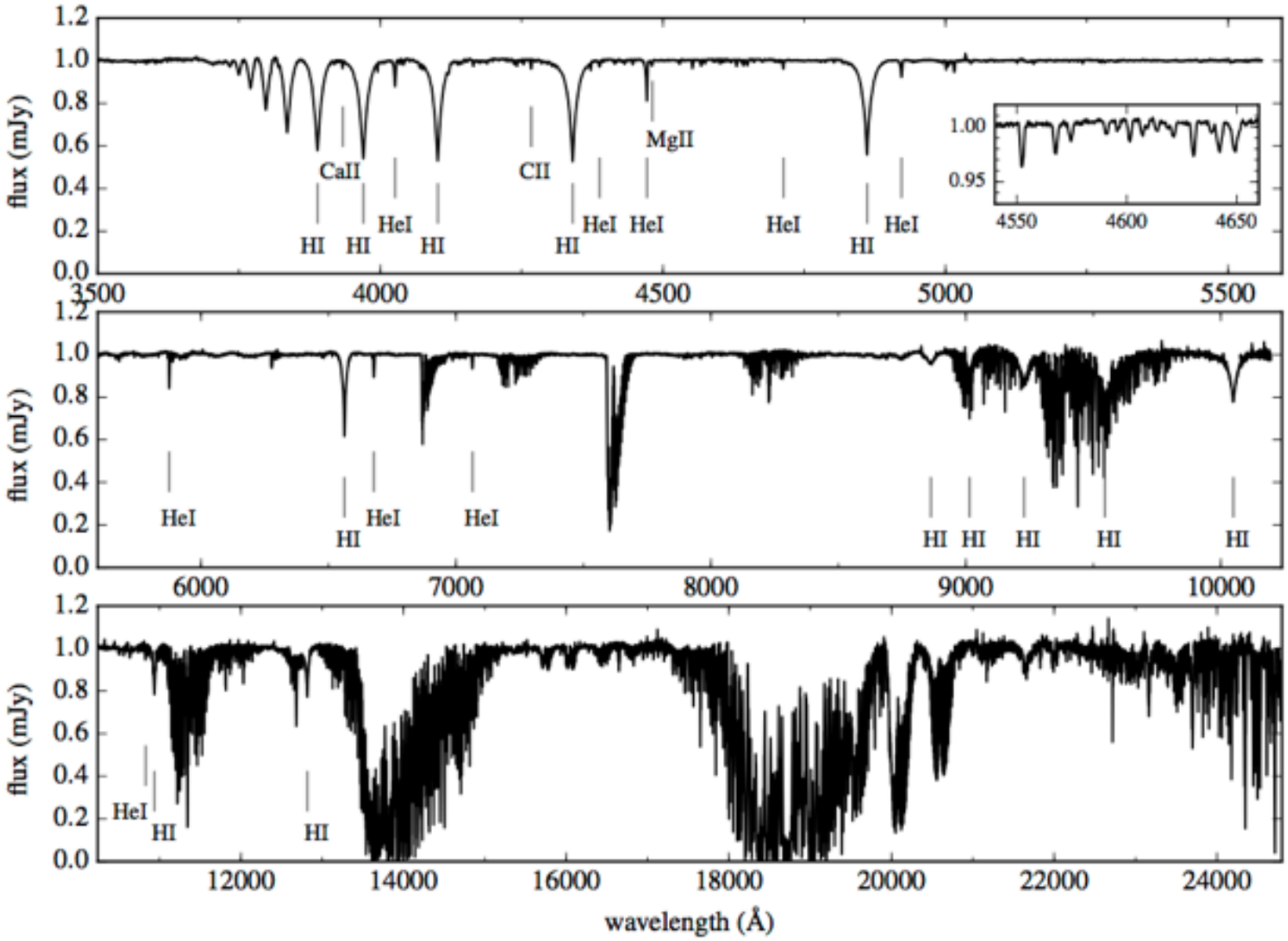
HW Vir

Xshooter spectrum at φ=0.25



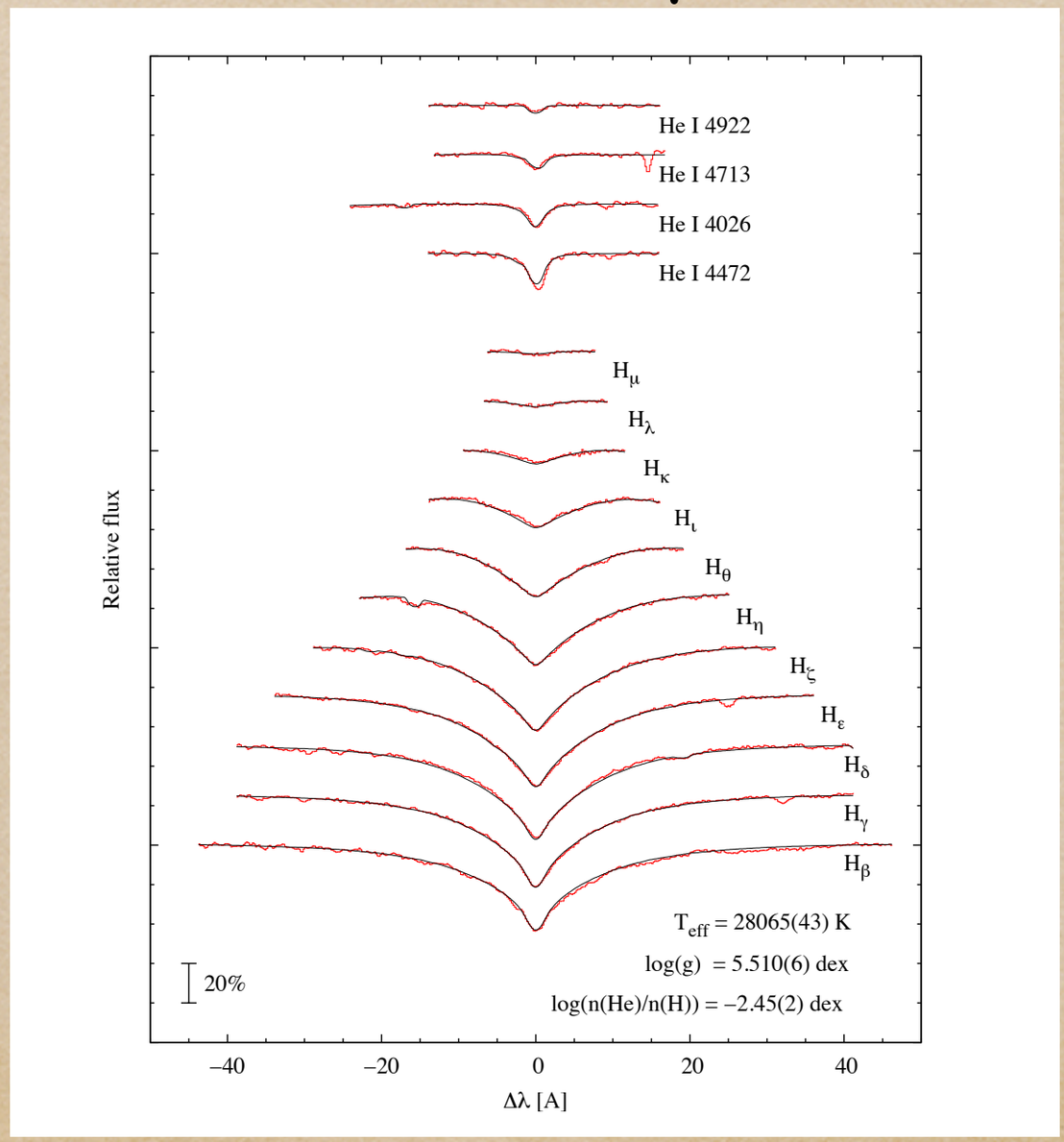
HW Vir

Xshooter sdB spectrum



HW Vir

Xshooter sdB spectrum



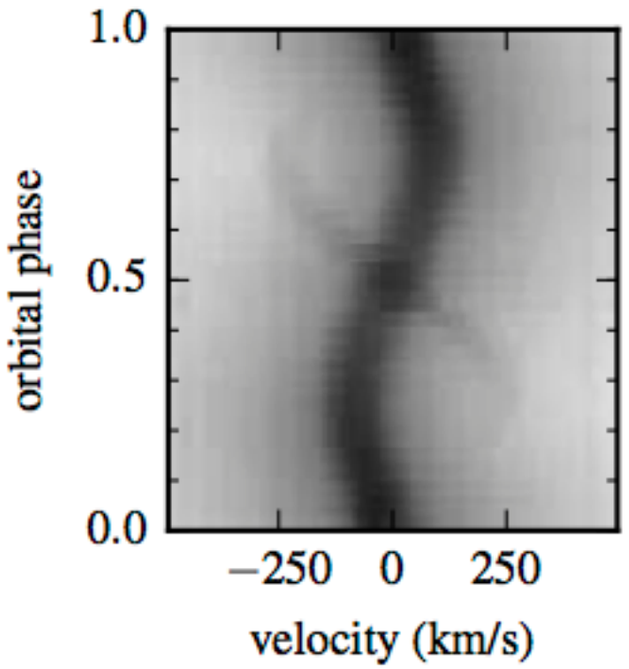
T_{eff} = 28 065 (50) K

log g = 5.510 (6) dex

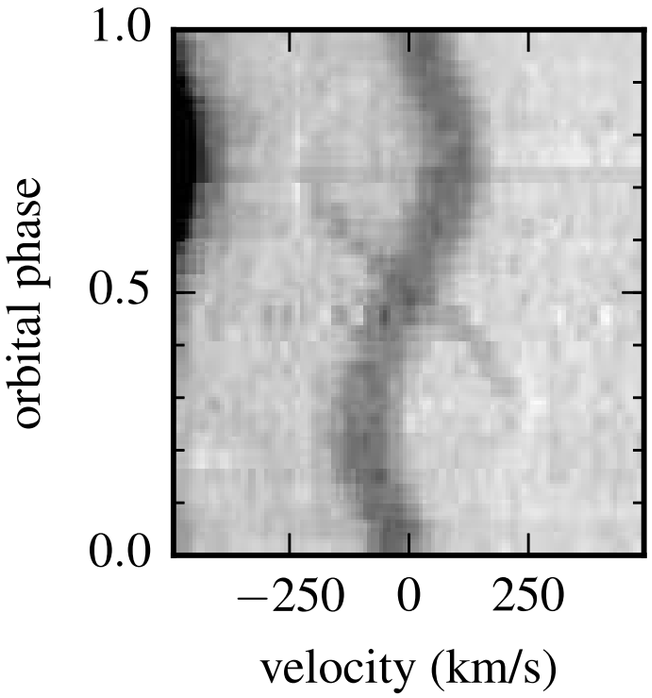
good agreement with Wood & Saffer 1999

HW Vir

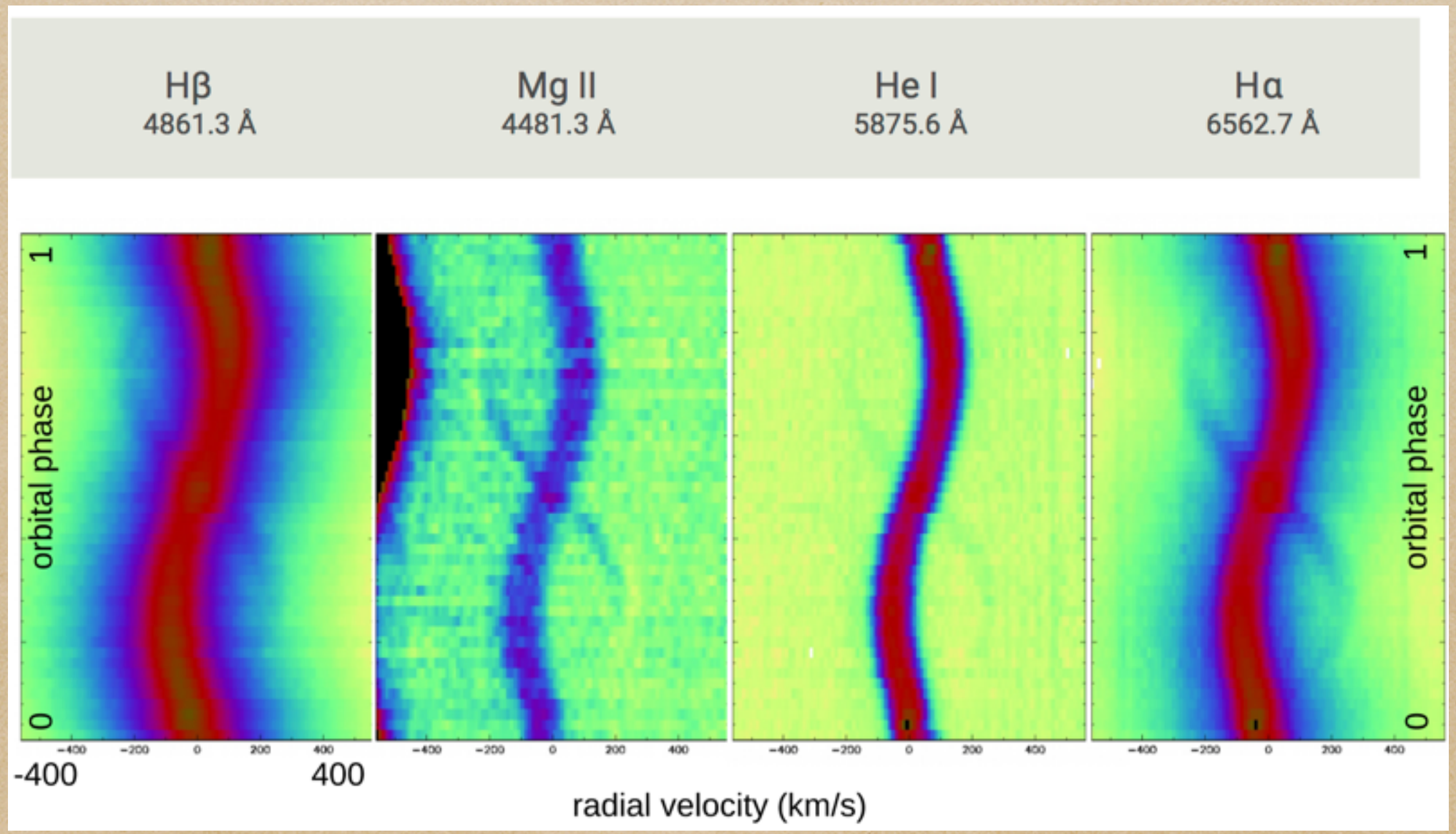
Hα



MgII at 4481 Å

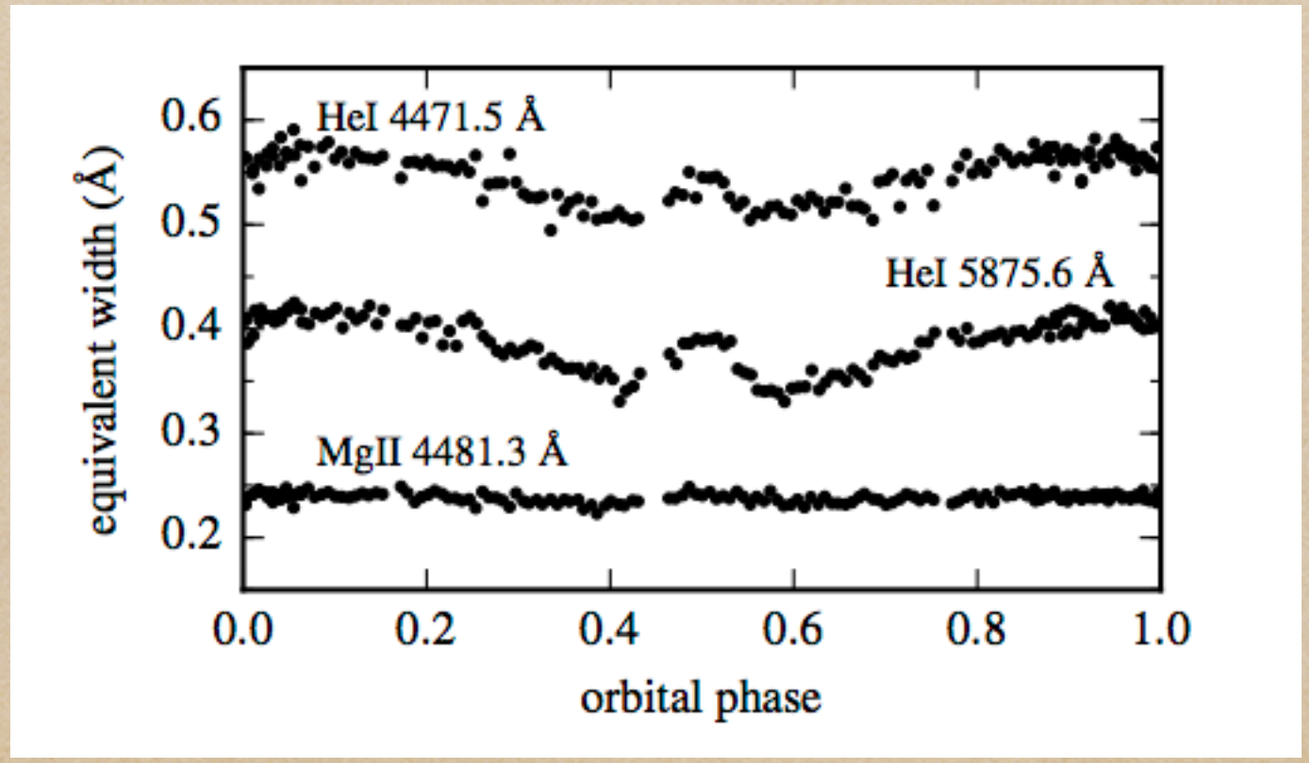


HW Vir

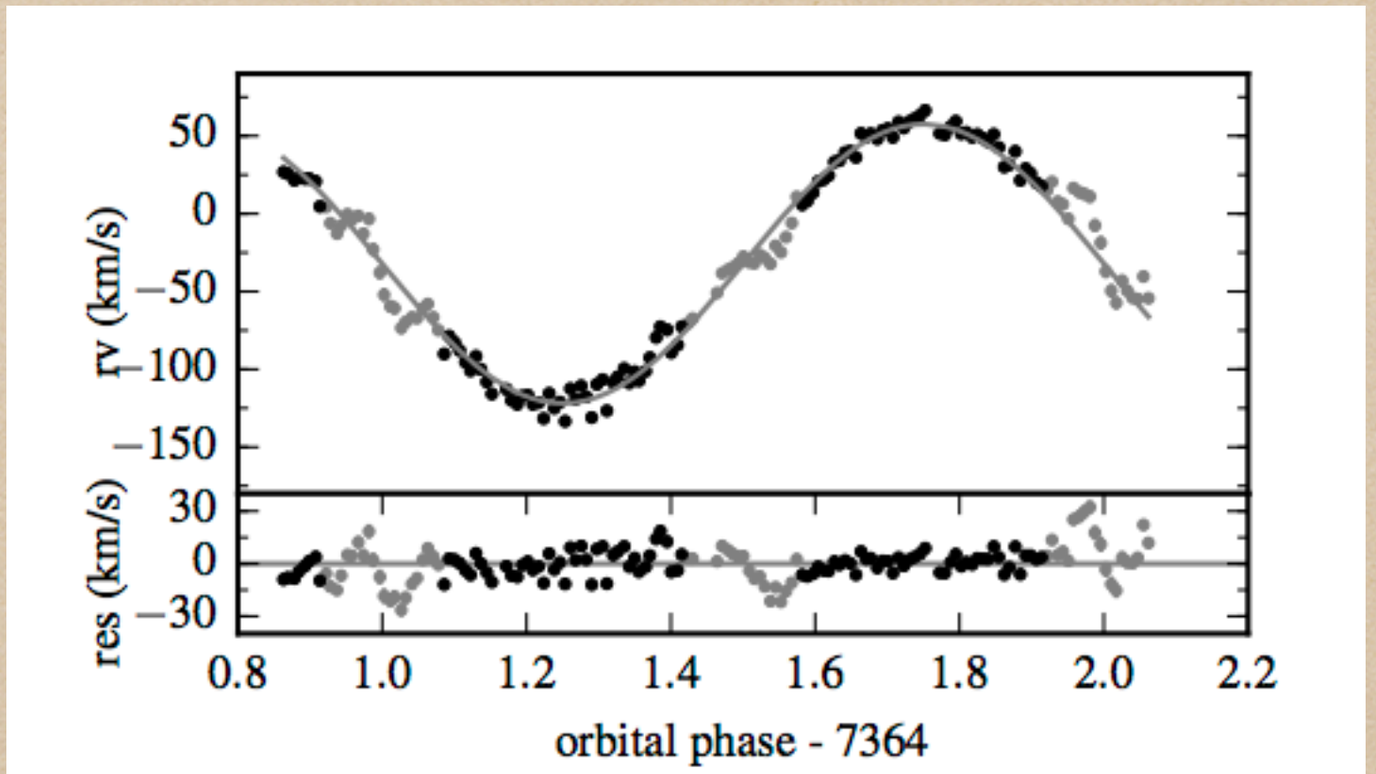

Hβ
4861.3 Å
Mg II
4481.3 Å
He I
5875.6 Å
Hα
6562.7 Å
orbital phase
1
0
-400
-200
0
200
400
-400
400
radial velocity (km/s)

HW Vir

EW over the orbital phase

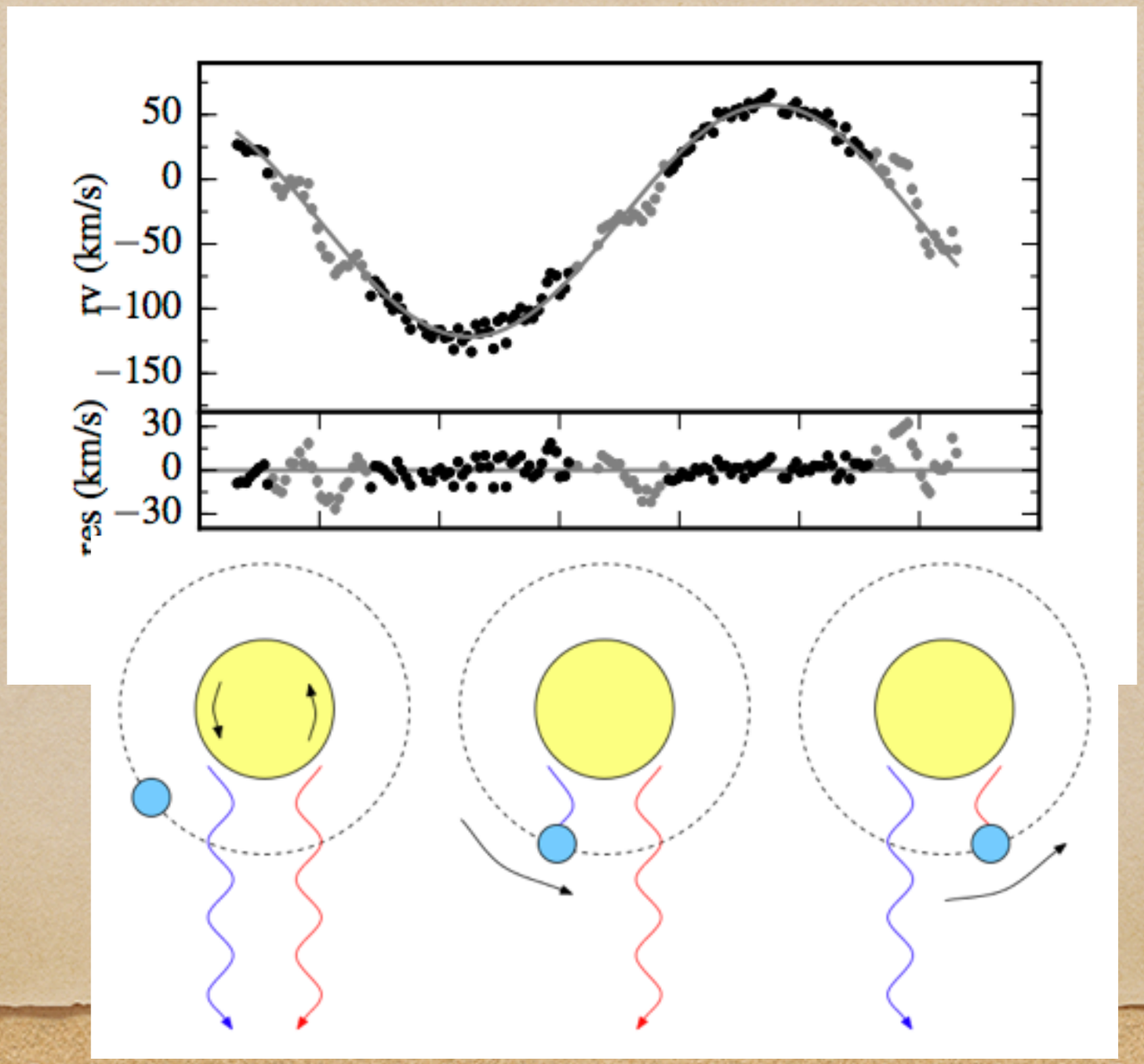


HW Vir



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

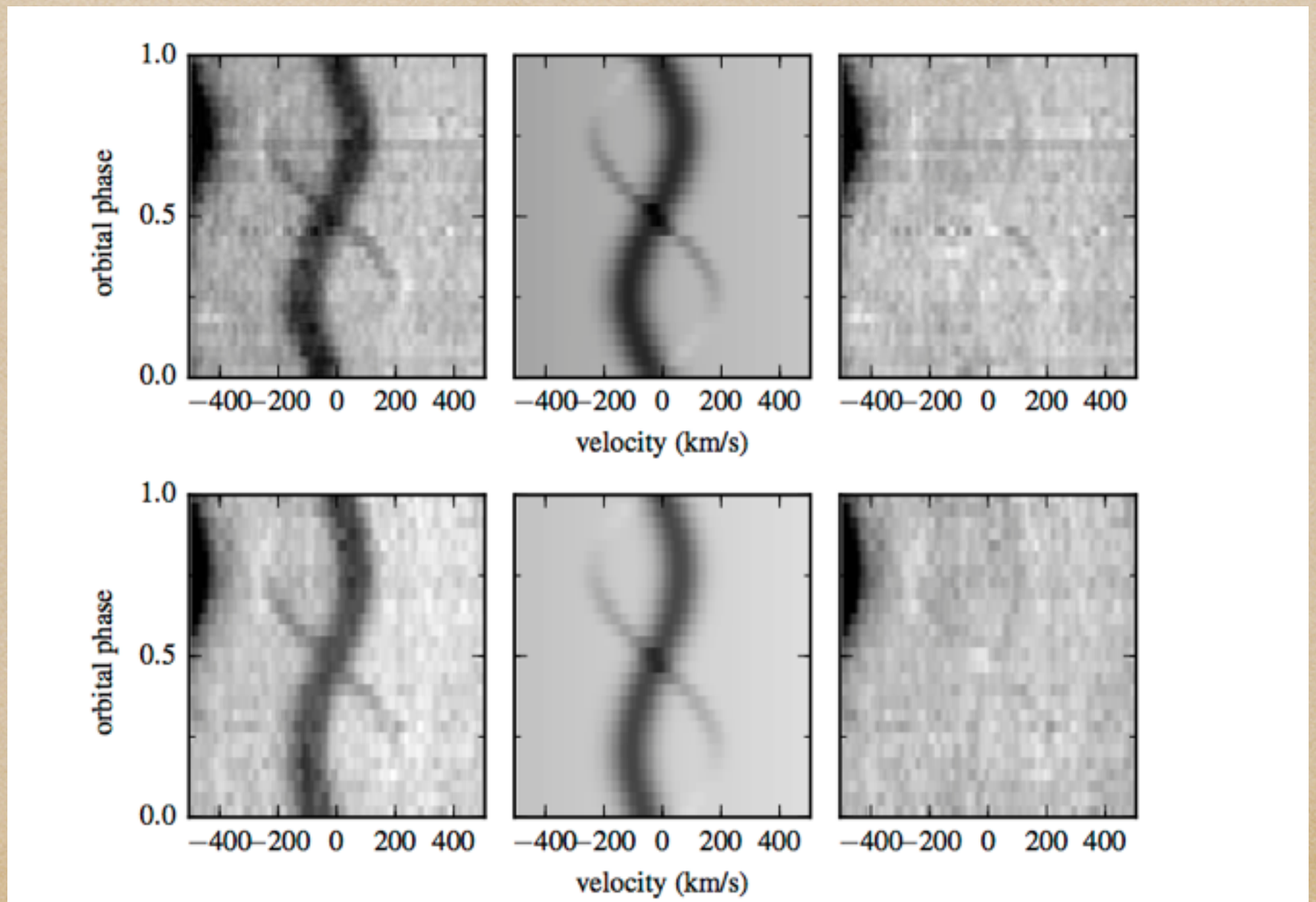
HW Vir



HW Vir

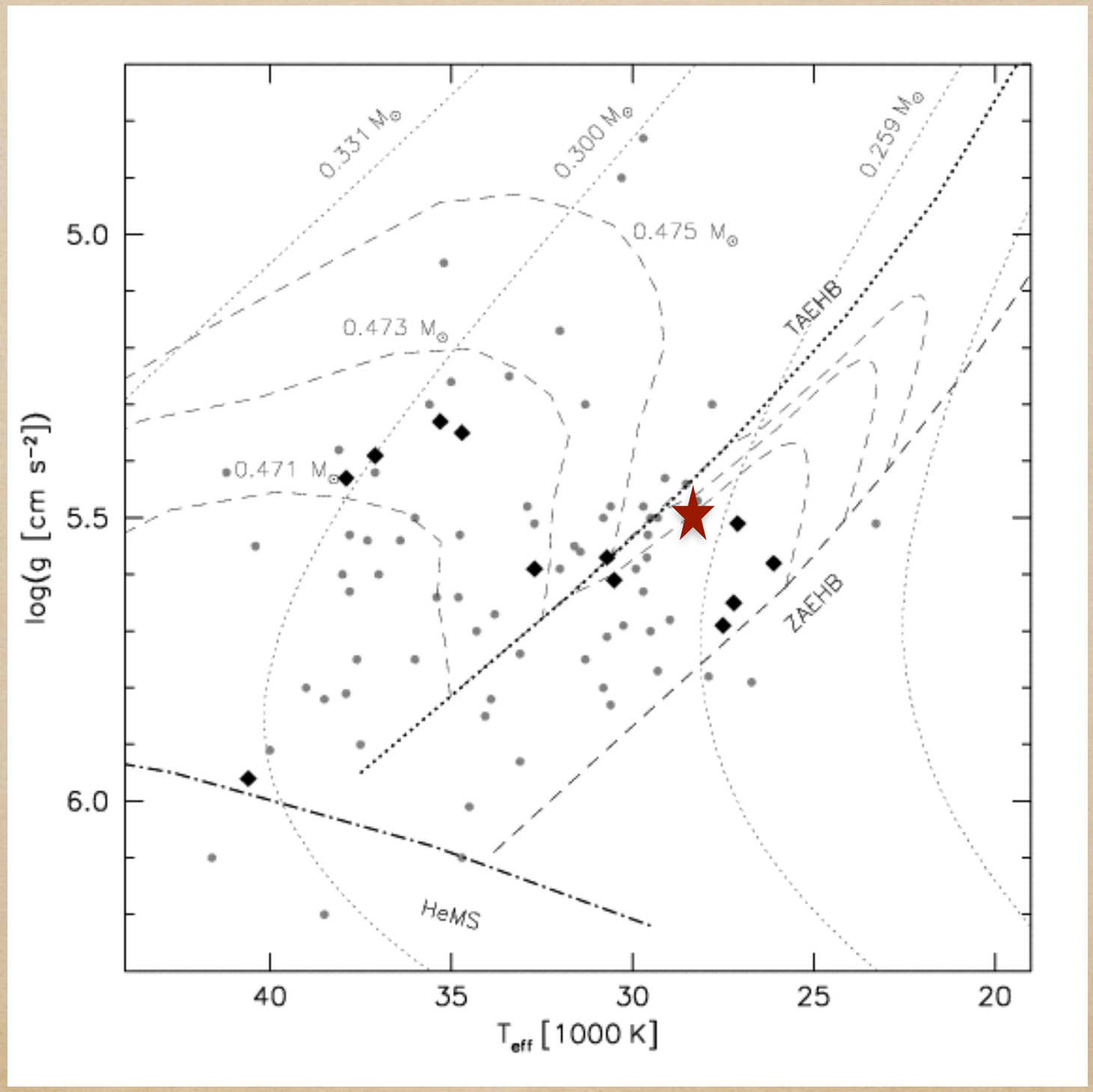
P91

P95



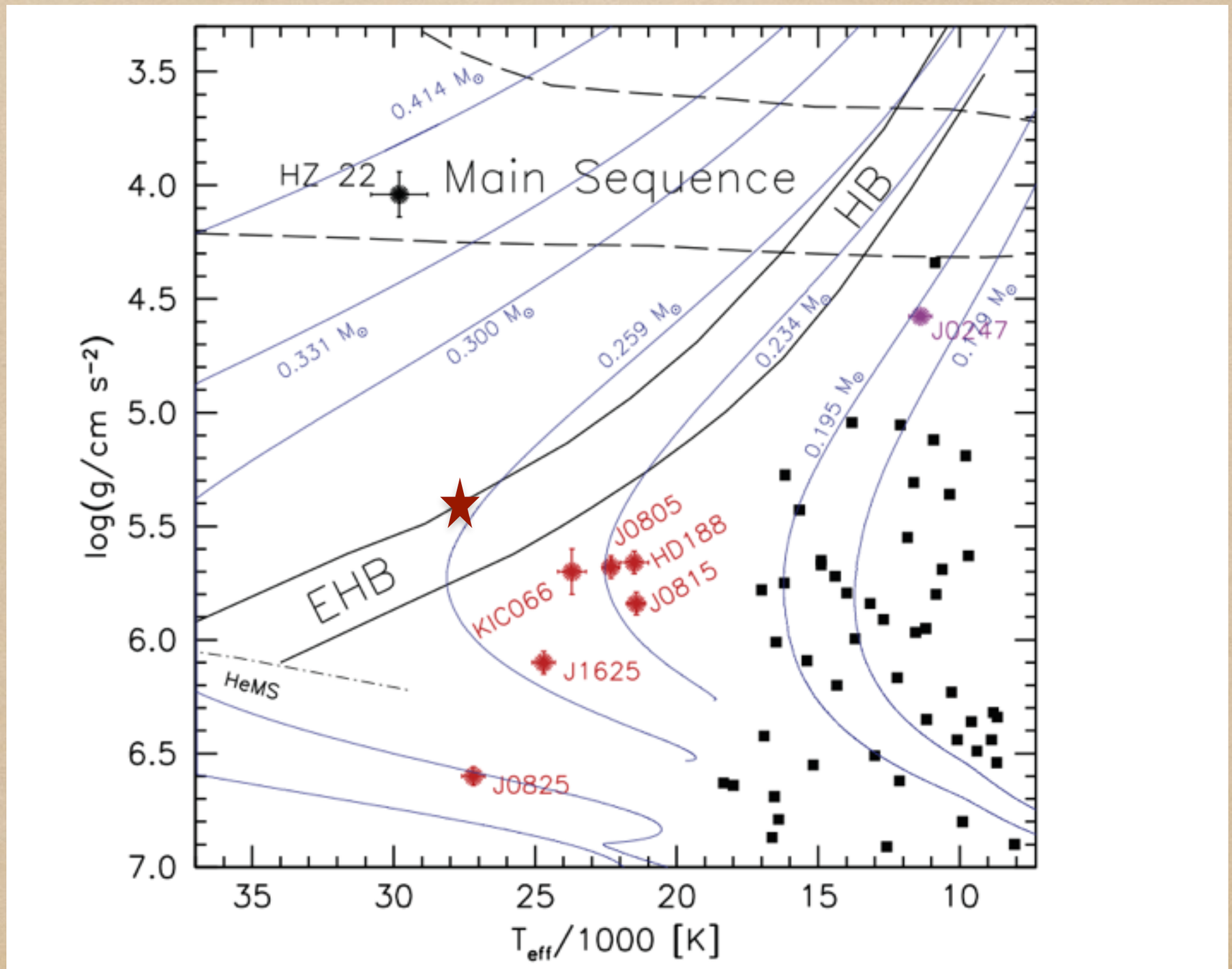
Bours & Vučković in prep.

Stellar evolution ?



Geier et al. 2013

Stellar evolution ?



Heber, U. 2016

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