ERC Grant No. 951549 "UniverScale"

NCN OPUS 2023/49/B/ST9/01671

Two CBP candidates detected with RVs around DEBs with solar analogs

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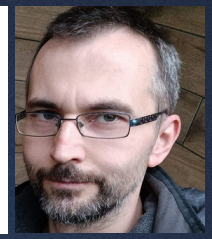
"Exploring Tatooine and Beyond:
Circumbinary Planets with ESA Missions"
Madrid, 2025

Projects with DEBs



The Araucaria Project
(PI: G. Pietrzyński)

- The goal is to improve the calibration of the cosmic distance scale in the local Universe.
- Targeting various objects, mainly Cepheids, RR Lyraes, and DEBs (DG).
- Spectroscopic observations since 2000.

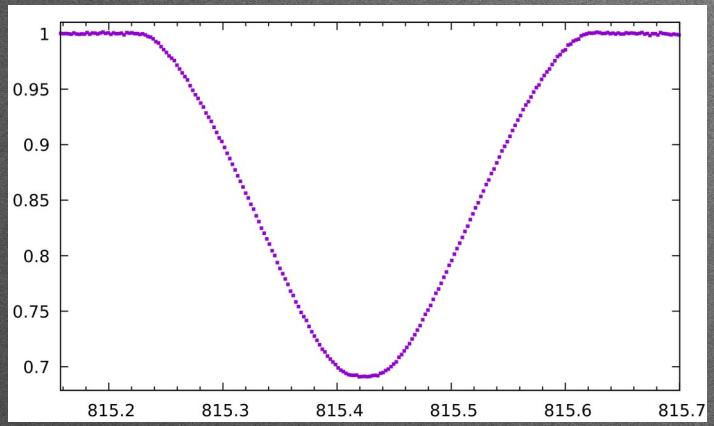
The CRÉME Project
(PI: K. Hełminiak)

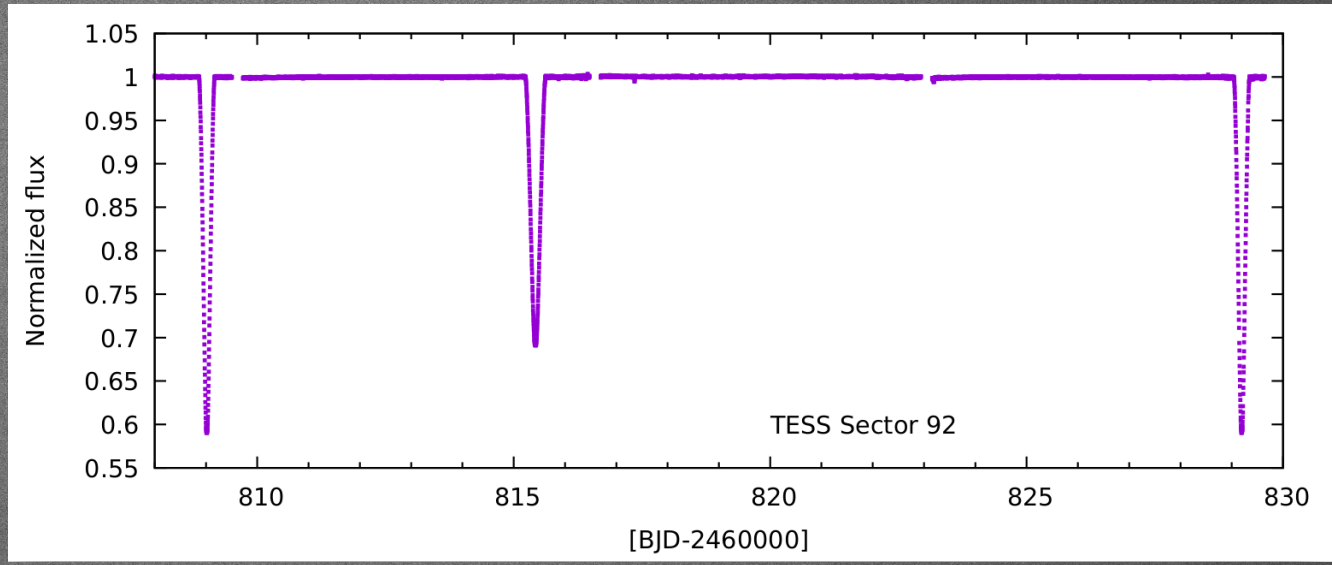
- The goal is to discover and characterize DEBs with stars of rare and interesting characteristics.
- Targeting DEBs almost exclusively.
- Spectroscopic observations since 2011.

LOTS OF INTERESTING RESULTS

Araucaria-CBP-1

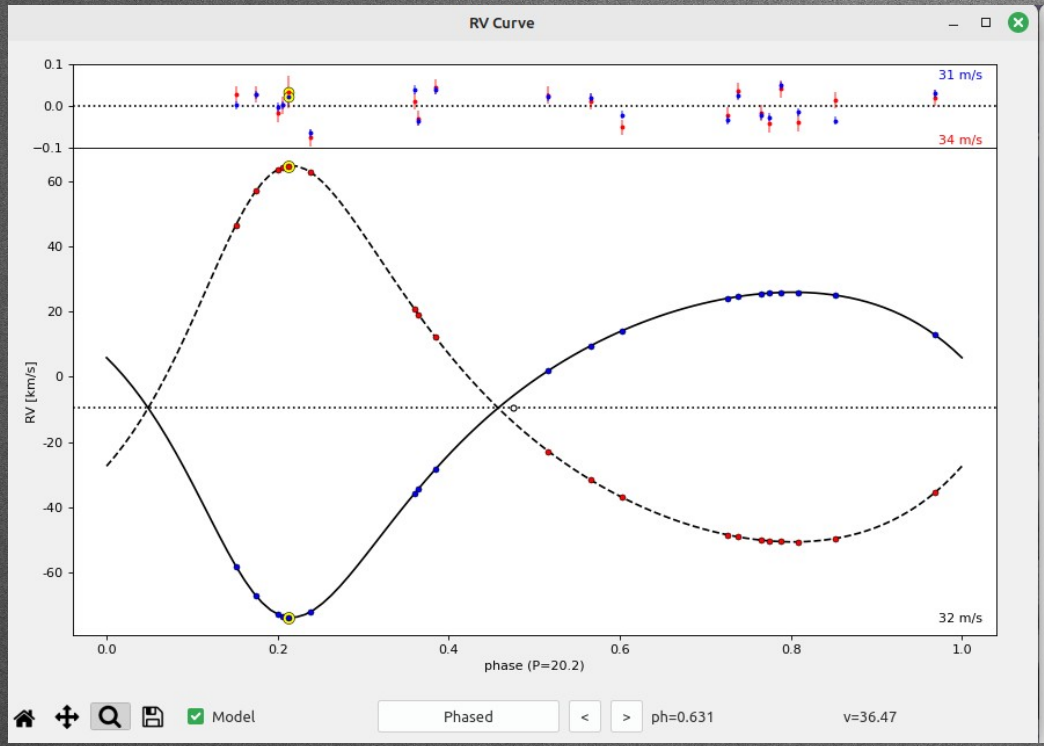
- Solar type stars: F8V+G2V
- P_{orb}=20.2 days, e =0.32
- High inclination – total primary eclipses and grazing secondary ones

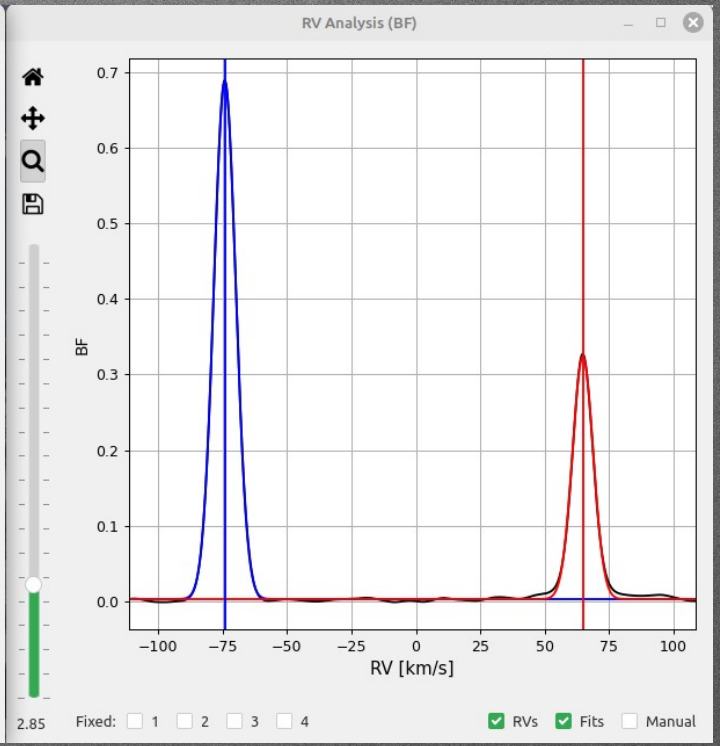




Araucaria-CBP-1

- 21 HARPS spectra over 14 years
- $v_1 \sin(i)=3.5$ km/s $v_2 \sin(i)=3.5$ km/s – slow, synchronous rotation

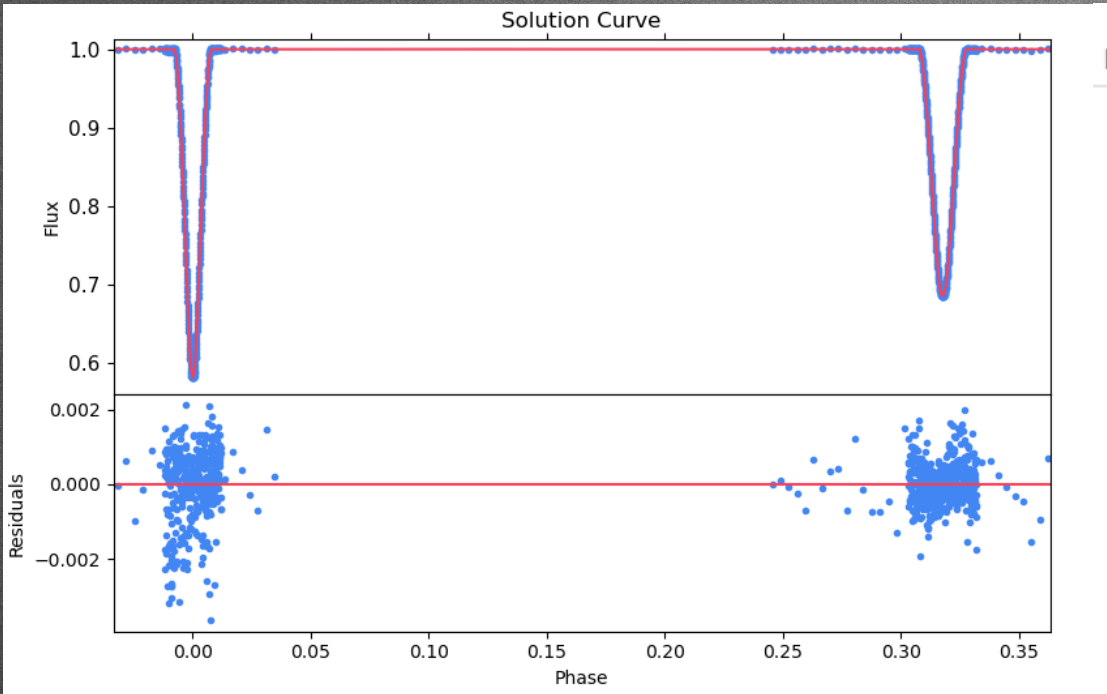




Two ways of RV determining with the Broadening function – the same results

Araucaria-CBP-1

- Simultaneous fitting of light- and RV curves with the WD code ver. 2015.
- The secondary is a solar twin: similar mass, radius, temperature and metallicity.

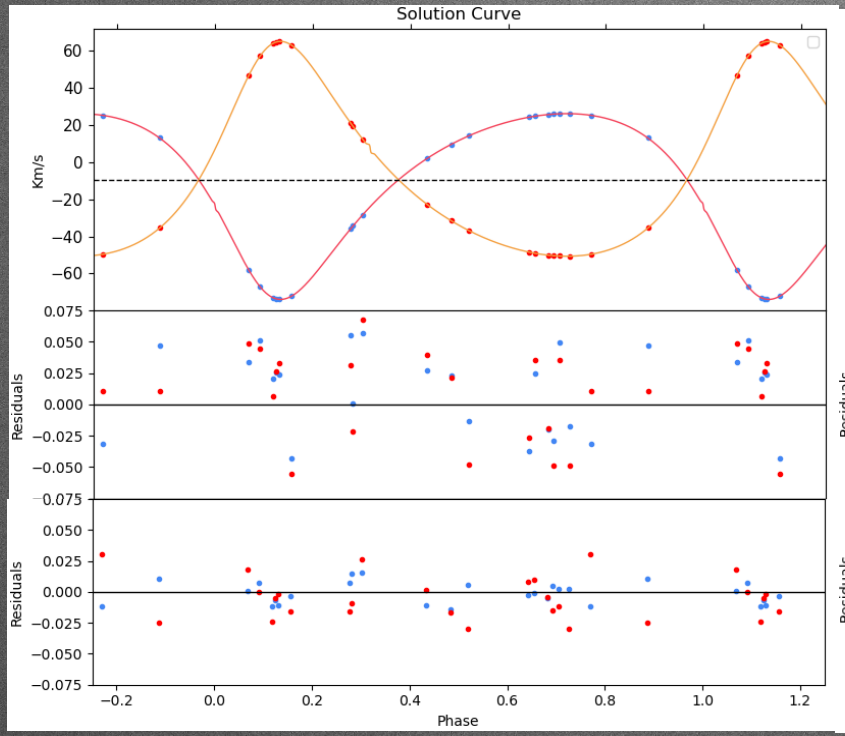


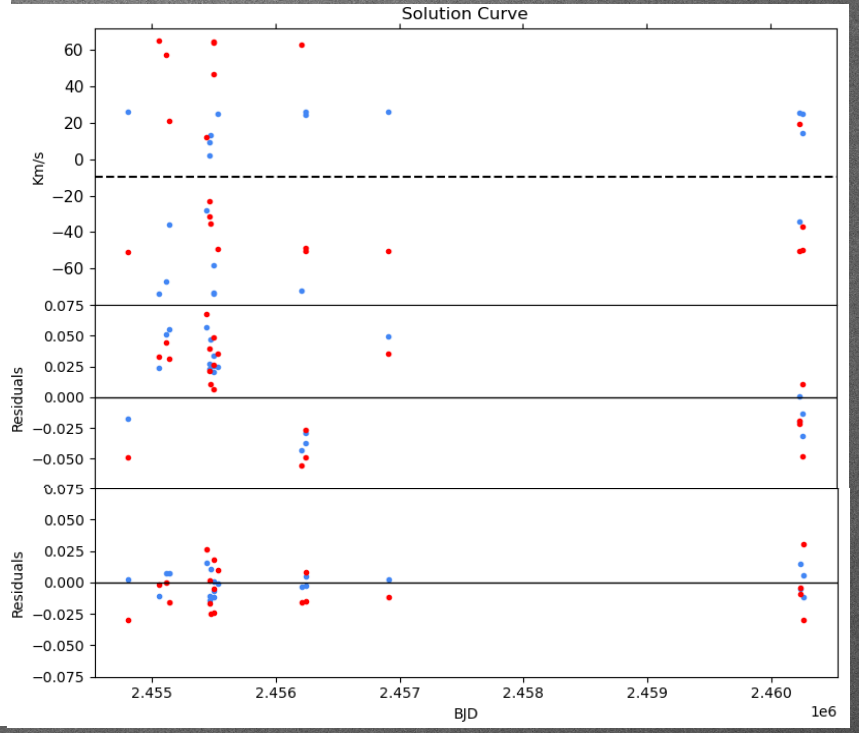
Results | Statistical Curve Information | System Information

Abs. Parameters	Value	LC Info	Value	RV Info	Value
a (R⊙)	40.7389	r1 (R1/a)	0.03236	K1 (km/s)	49.935
M1 (M⊙)	1.19485	r2 (R2/a)	0.02445	K2 (km/s)	57.738
M2 (M⊙)	1.03337	r1+r2	0.05681		
R1 (R⊙)	1.3185	k (r2/r1)	0.75537		
R2 (R⊙)	0.99596	x1	0.574		
Teff1 (K)	6200	x2	0.603		
Teff2 (K)	5808	y1	0.269		
logg1 (cgs)	4.2752	y2	0.251		
logg2 (cgs)	4.4558	L2/L1	0.46067		
Mbol1 (mag)	3.829				
Mbol2 (mag)	4.722				
log (L1/L⊙)	0.3620				
log (L2/L⊙)	0.0049				

Araucaria-CBP-1

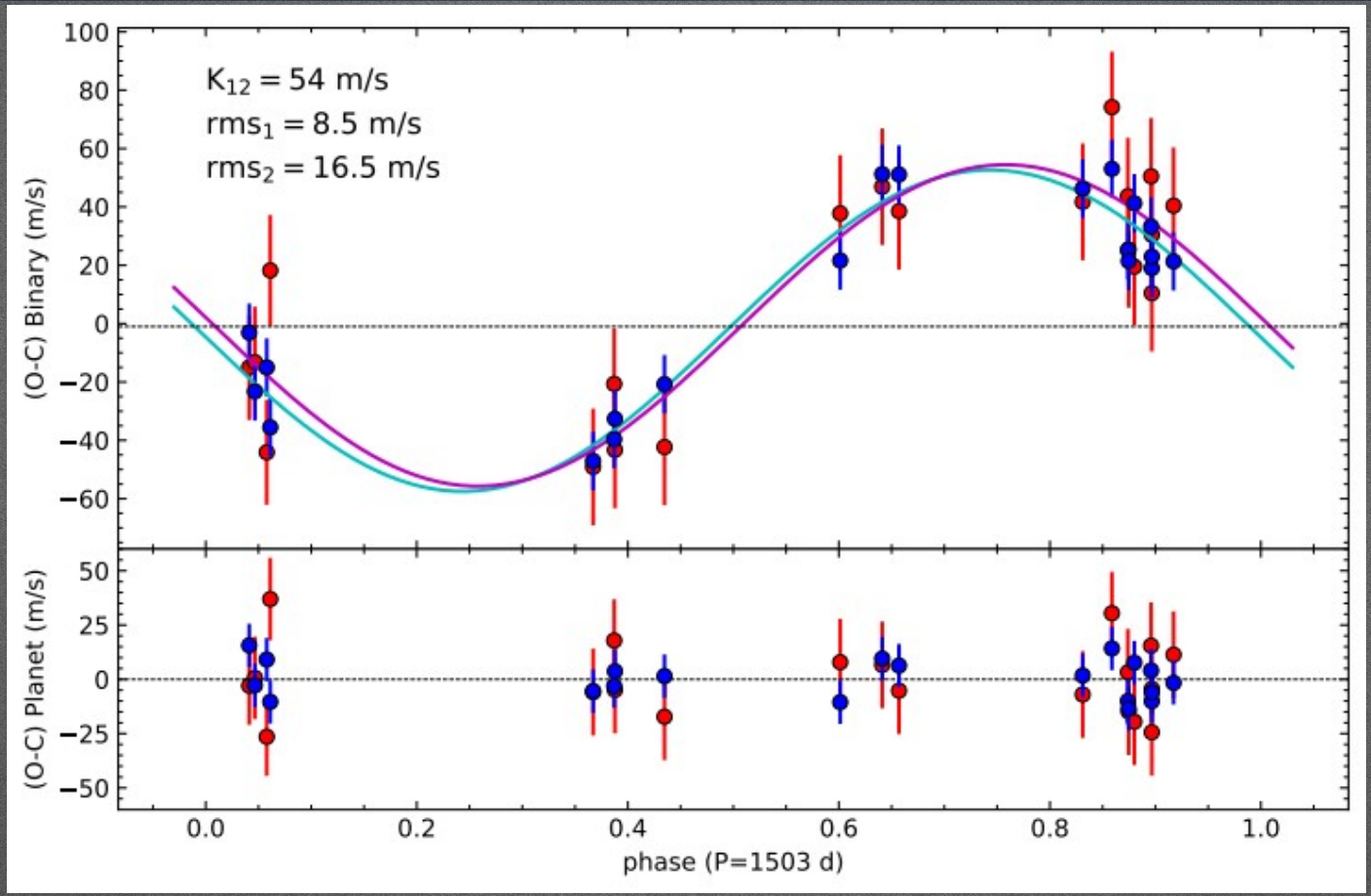
- Solutions to RVs using the WD code without and including the third body orbit.
- **P_3=1503 d, a_3=773 $R_\odot$, e_3=0, M_3 = 5.1 M_J**



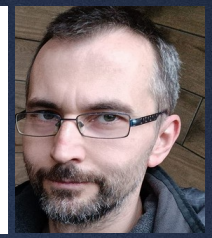


Araucaria PROJECT

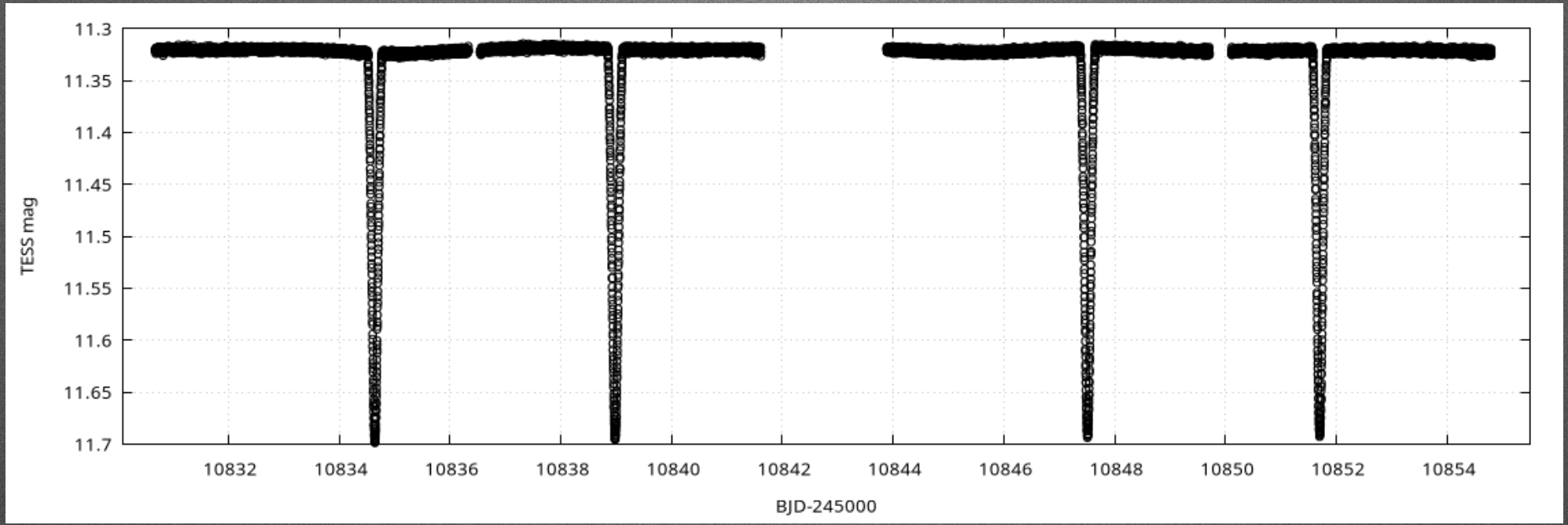
Araucaria-CBP-1



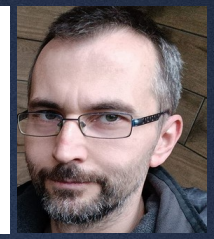
CREME-CBP-1



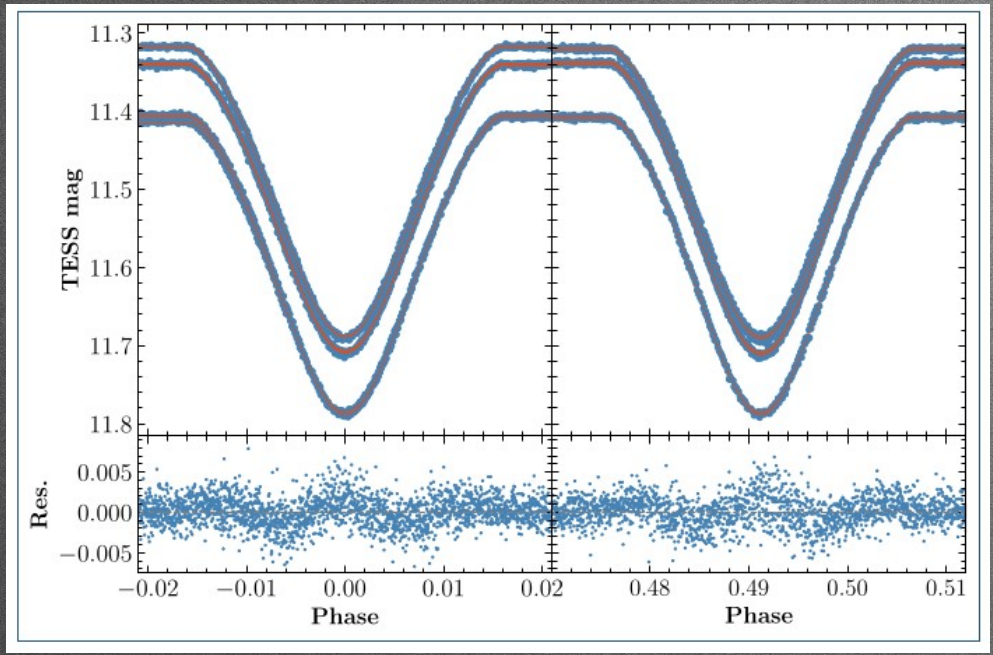
- Solar type dwarfs: F/G+G
- P_{orb} = 8.53 days, e = 0.026



CREME-CBP-1



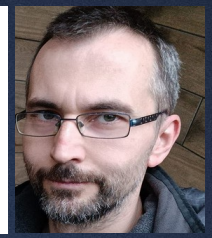
- LC solution: JKTEBOP v43; RV solution V2FIT
- Very similar masses, and T_{eff}s, but not the radii; no [Fe/H] and age estimates yet



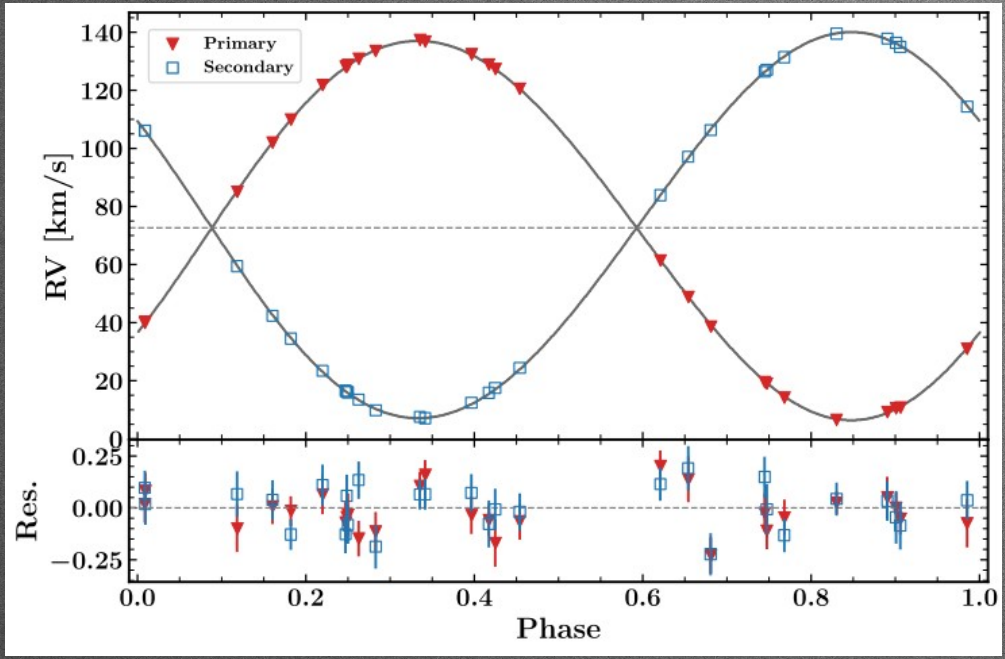
Mass 1	=	1.020661 +/-	0.000951 Msun
Mass 2	=	1.002710 +/-	0.000879 Msun
Separation	=	22.223881 +/-	0.006362 Rsun
Radius 1	=	1.192533 +/-	0.020227 Rsun
Radius 2	=	1.126084 +/-	0.022226 Rsun

Orbit nearly circular,
but τ_{circ} ~ 28 Gyr

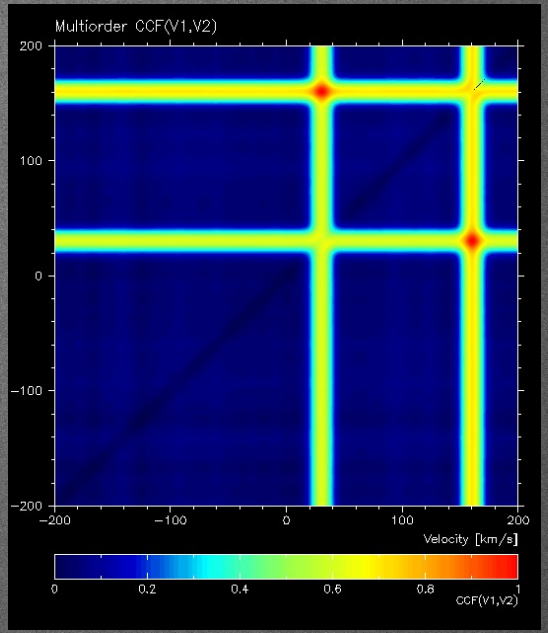
CREME-CBP-1



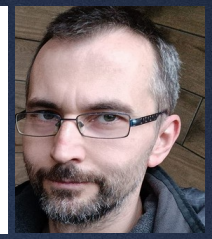
- 17 CHIRON (11 years) + 11 HRS (2 years) spectra; zero-point corrections applied
- $v_1 \sin(i)$=7.0 km/s $v_2 \sin(i)$ =6.7 km/s – synchr. rotation; RV precision affected



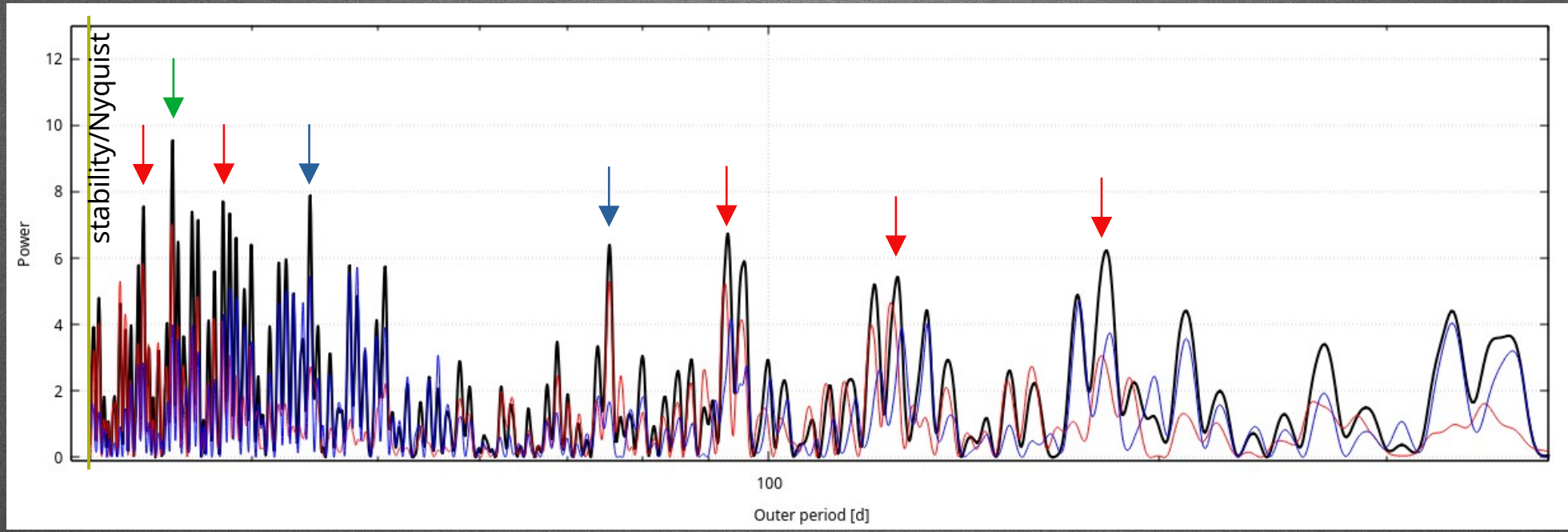
rms_1 = 101 m/s
rms_2 = 105 m/s
χ^2 ~ 2.1



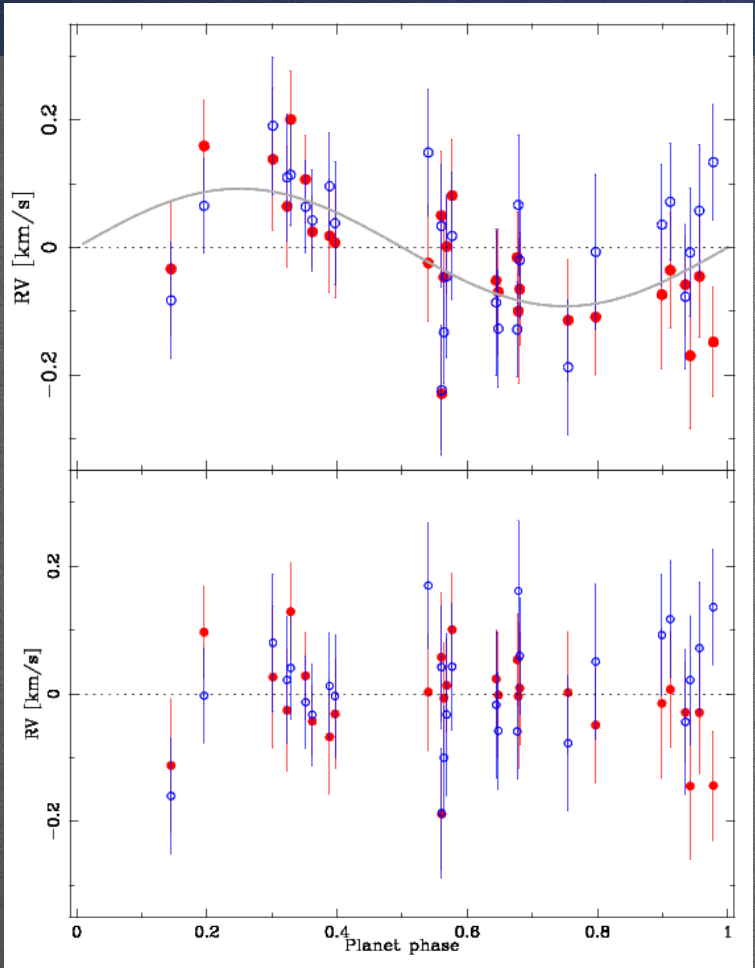
CREME-CBP-1



- Periodogram analysis
- Full RV fits (binary+planet) with V2FIT;



CREME-CBP-1

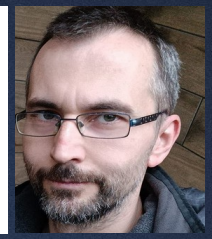


P_3 = 34.7 d
e_3 = 0
K_{12} = 92 m/s
M_3 = 2.3 M_J
a_3 = 56.6 $R_\odot$

rms_1 = 74 m/s
rms_2 = 81 m/s
χ^2 ~ 1.6

Binary only:
rms_1 = 101 m/s
rms_2 = 105 m/s
χ^2 ~ 2.1

Summary



Araucaria-CBP-1b

P_{12} = 20.2 d
a_{12} = 40.7 $R_\odot$
e_{12} = 0.32
M_{12} = 1.19+1.03 $M_\odot$

P_3 = 1503 d
a_3 = 773 $R_\odot$
e_3 = 0
M_3 = 5.1 M_J

CREME-CBP-1b

P_{12} = 8.53 d
a_{12} = 22.2 $R_\odot$
e_{12} = 0.026
M_{12} = 1.02+1.00 $M_\odot$

P_3 = 34.7 d
a_3 = 56.6 $R_\odot$
e_3 = 0
M_3 = 2.3 M_J

THANK YOU