

Parameters estimation of new eclipsing variable HD 182144 using multicolor and spectral data

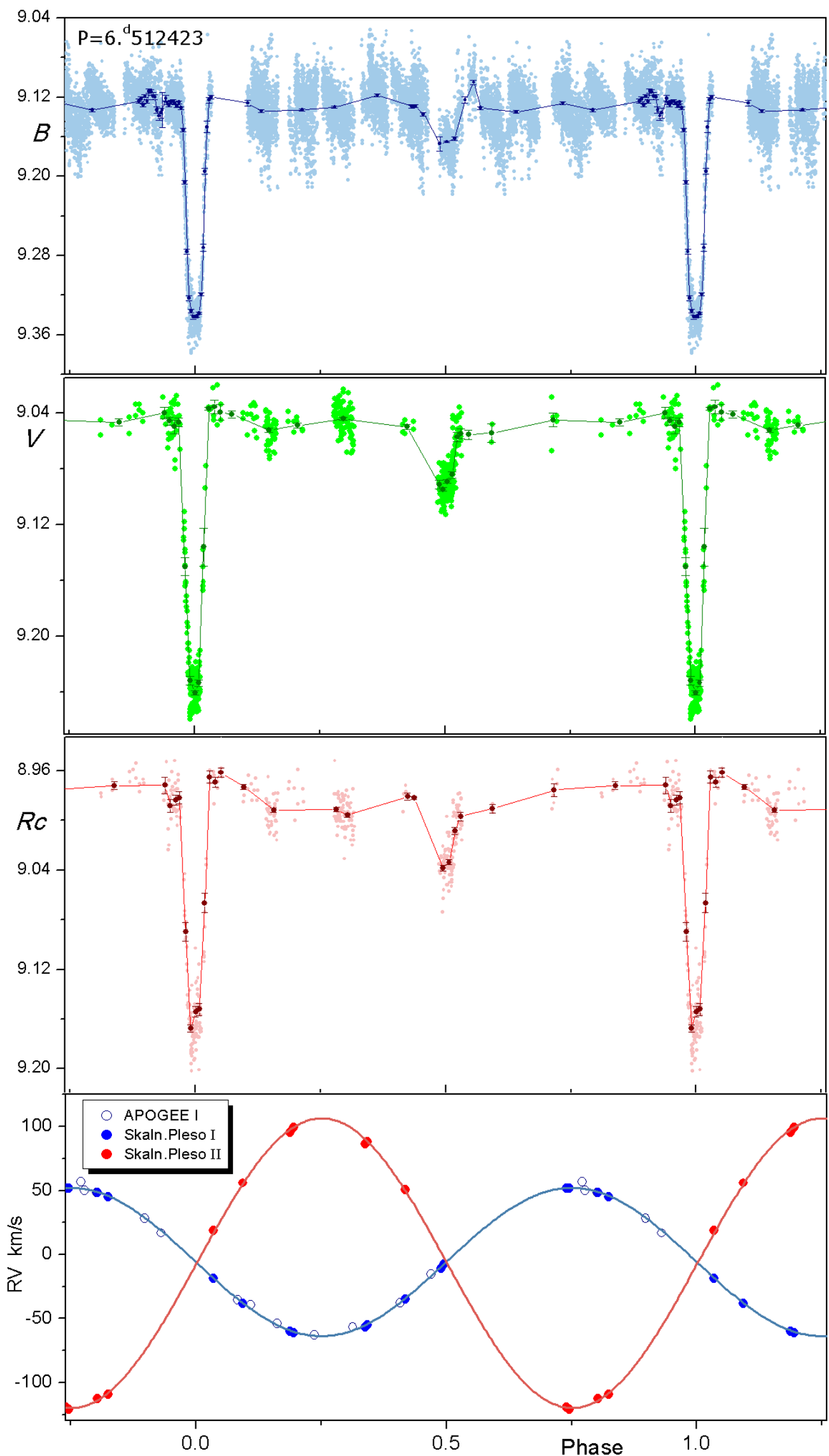
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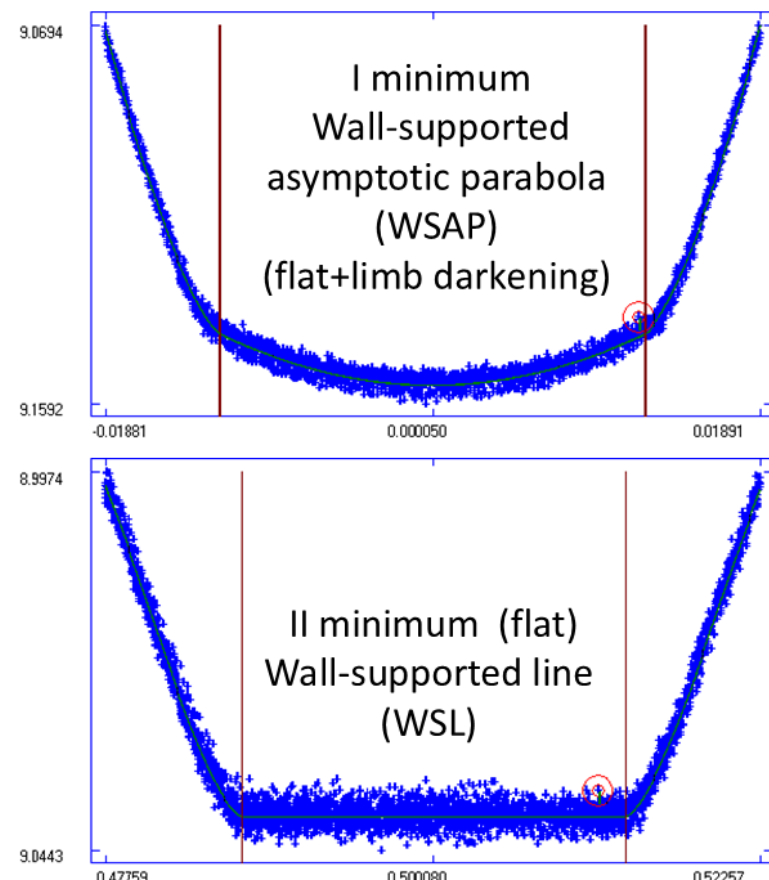
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The EA type of variability of this object was revealed while processing CCD-frames of CH Cyg field. For O-C analysis we used the observations made in the Astronomical Institute Slovak Academy of Science (AI SAS), TESS data and brightness estimates using archival photographic plates from the Sonneberg Observatory. We used TESS photometry and radial velocity measurements (using observations at AI SAS and APOGEE-2 data) to estimate the parameters of the orbits in the binary system and the physical parameters of the components. Estimated parameters are given in the tables below. The variable is represented in The International Variable Star Index (VSX).

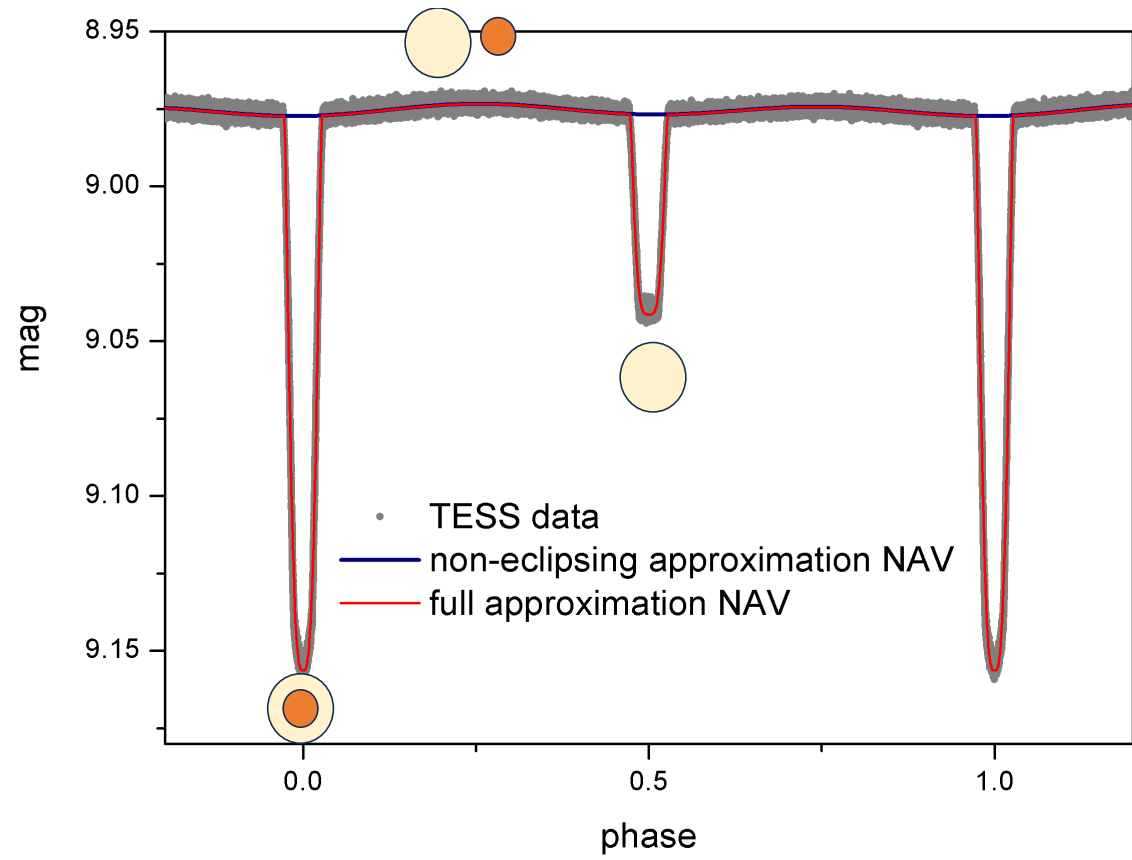
Name	Gaia DR3 2129633355901684480			The International Variable Star Index
AAVSO UID	000-BPX-830 (No observations)			
Constellation	Cygnus			
J2000.0	19 20 55.48 +49 26 23.5 (290.23117 +49.43986)			
B1950.0	19 19 34.96 +49 20 39.7			
Galactic coord.	80.852 +15.793			
Other names (Internal only)	2MASS J19205548+4926234	AG+49 1532	AP J19205548+4926234	
	BD+49 2986	GSC 03551-01685	HD 182144	
	PPM 58202	SAO 48361	TD1 24549	
	TIC 406949643	TYC 3551-1685-1		
				» Add name
Variability type	EA			?
Spectral type	A0			
Mag. range	9.08 - 9.28 V			?
Discoverer	Gaia collaboration; Marsakova Vladyslava and Shugarov Sergey			
Epoch	13 Aug 2022 (HJD 2459804.8065)			» Ephemeris
Outburst	--			
Period	6.512423 d			
Rise/eclipse dur.	5.4% (8.44 h)			

RV parameters	Values
RV ampl. for the pr. comp., K_1 , km/s	58.0 ± 0.4
RV ampl. for the sec. comp., K_2 , km/s	113.1 ± 0.5
γ -velocity, km/s	-6.5 ± 0.2
Eccentricity of the orbit	0
$a_1 \sin i$, a.u.	0.0347 ± 0.0002
$a_2 \sin i$, a.u.	0.0677 ± 0.0003
$M_1 \sin^3 i$, $M_\odot$	2.23 ± 0.02
$M_2 \sin^3 i$, $M_\odot$	1.15 ± 0.01
Mass ratio, q	0.513 ± 0.004



Approximation of the minima. MAVKA Software [2]

Other estimated parameters	Values
Distance to the system, pc	475 ± 4
Color excess, $E(B-V)$, mag	0.093 [1]
Absolute magnitude	0.42 ± 0.03
Semi-major axis a , a.u.	0.1024 ± 0.0005
Pr. comp. radius R_1 , $R_\odot$	2.72 ± 0.03
R_1/a	0.123 ± 0.002
Main sequence prediction for $R_1=M_1^{0.8}$, $R_\odot$	1.90
Sec. comp. radius R_2 , $R_\odot$	1.02 ± 0.01
R_2/a	0.046 ± 0.001
Main sequence prediction for $R_2=M_2^{0.8}$, $R_\odot$	1.12
Temperature T_1 , K	~ 9000
Temperature T_2 , K	~ 6000



Phase light curve (TESS) with New Algol Variable approximation [1]

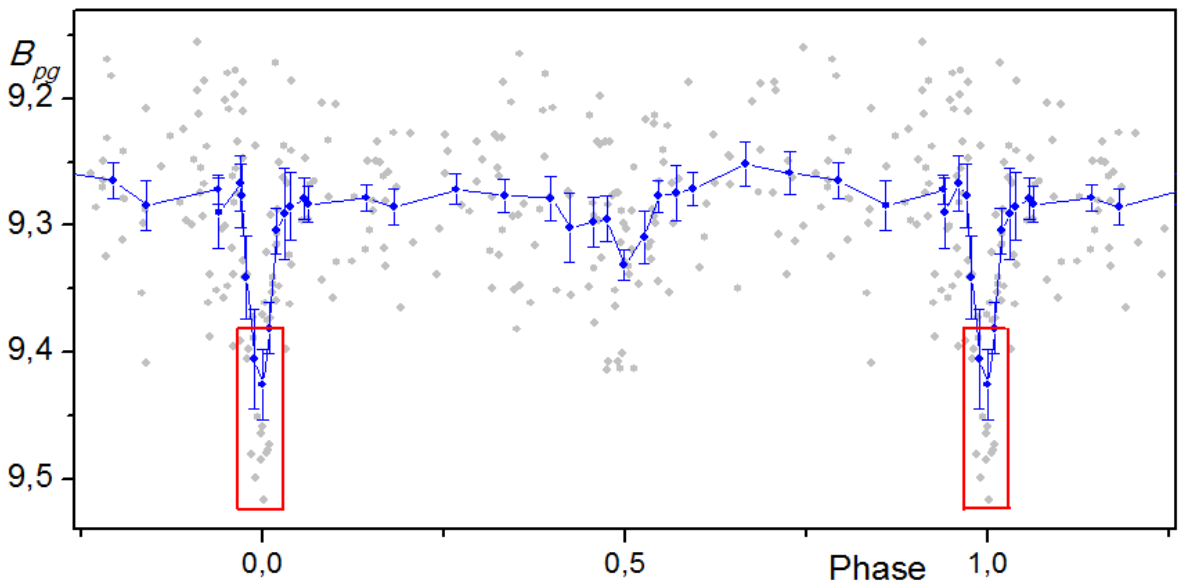
Photometric parameters (TESS)	Method	Value
Primary minimum depth, Δm_1 , mag	NAV	0.1790 ± 0.0005
Secondary minimum depth, Δm_2 , mag	NAV	0.0645 ± 0.0004
Eclipse width, phases	NAV	0.0545 ± 0.0001
Total eclipse width, phases	WSAP	0.0246 ± 0.0001
Ellipticity effect, mag	NAV	0.00161 ± 0.00009
Radii ratio, R_2/R_1	(1)	0.4015 ± 0.0006
Inclination of orbit, i , $^\circ$	(2)	89.1 ± 0.1

$$\frac{R_2}{R_1} = \sqrt{\frac{1 - 10^{-0.4\Delta m_1}}{10^{-0.4\Delta m_2}}} \quad (1)$$

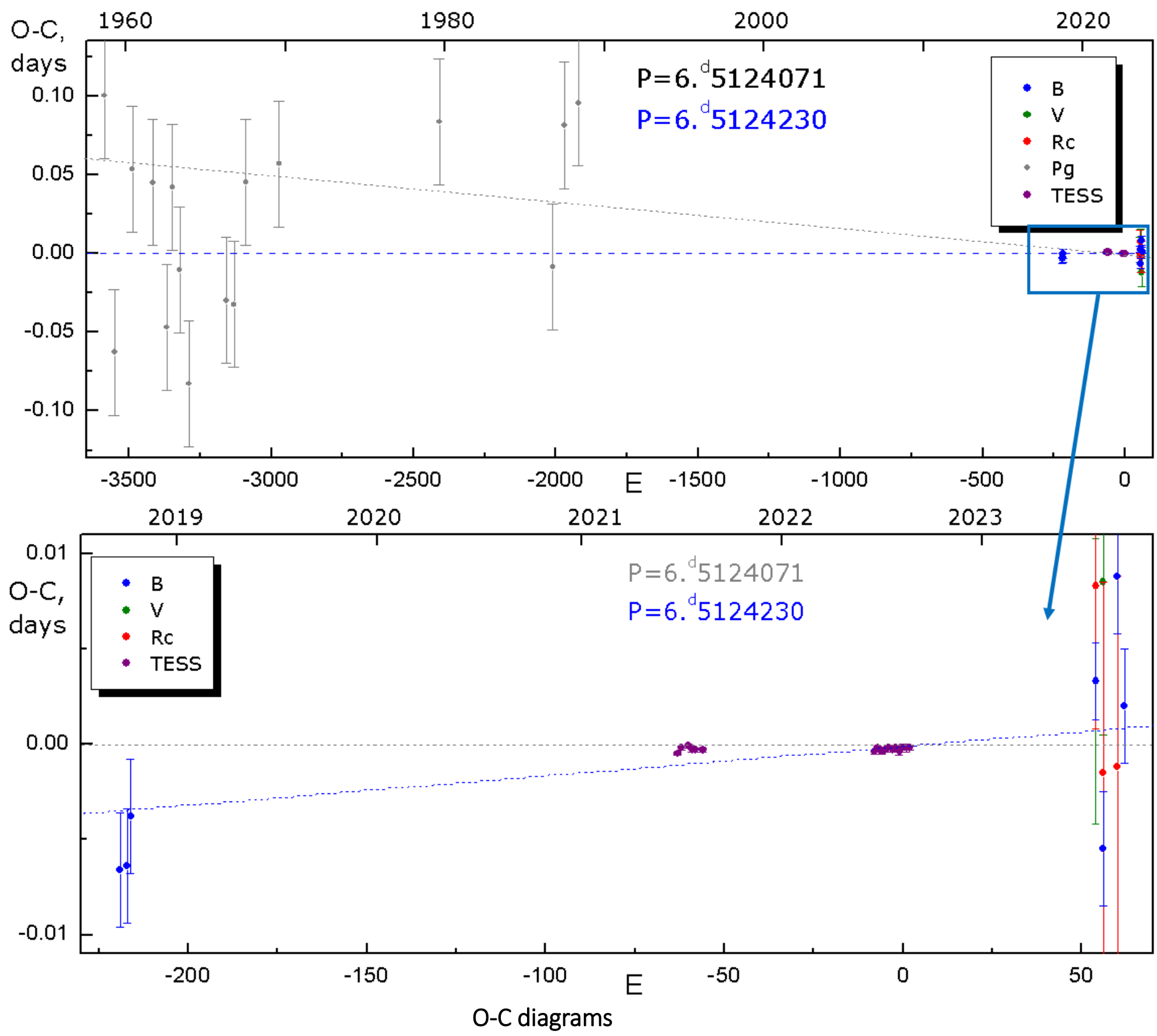
$$i = \arcsin \sqrt{\frac{2 \frac{R_2}{R_1}}{\left(1 + \frac{R_2}{R_1}\right) \cos^2 2\pi\phi_2 - \left(1 - \frac{R_2}{R_1}\right) \cos^2 2\pi\phi_1}} \quad (2)$$

$$\phi_1 = 0.5 - \frac{t_{eclipse}}{2P} \quad \phi_2 = 0.5 - \frac{t_{total}}{2P}$$

Phase light curves (Zeiss-600 cassegrain telescope and 60\180 mm photolens in AI SAS), RVs phase curves (high-dispersion échelle spectrograph, 1.3m Cassegrain-Nasmyth telescope AI SAS and APOGEE-2 RV for the prim. comp. [3])



Brightness estimations by using 260 archive photoplates from Sonneberg Observatory collection (exposed in 1956-1995). Measurements near Minimum I (marked in red) were used for O-C diagram below (Pg).



Conclusion

- HD 182144=Gaia DR3 2129633355901684480 is typical EA type variable with circular orbit.
- The data on the moments of minima for 70 years indicate a period of 6.5124230 ± 0.0000005 d.
- Since the TESS data indicate a slightly lower value for the period, we can suspect small changes in the period.
- Flat secondary minimum argues for full eclipse that allow to estimate some parameters of the system (listed in the tables).
- Our two-colour diagram for the variable indicates spectral classes in the maximum and the secondary minimum (when we see the primary component) close to A0 given in [4,5].
- The estimation of the radii of the components based on the duration of the eclipses shows that the main component is 1.5 times larger than the star of the main sequence of such a mass should be.

References

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