

NOTICE: Ukraine: Read IOP Publishing's statement.

---

# A Dance with Dragons: *TESS* Reveals $\alpha$ Draconis is a Detached Eclipsing Binary

Timothy R. Bedding<sup>1,2</sup> , Daniel R. Hey<sup>1,2</sup> , and Simon J. Murphy<sup>1,2</sup> 

Published October 2019 • © 2019. The American Astronomical Society. All rights reserved.

Research Notes of the AAS, Volume 3, Number 10

**Citation** Timothy R. Bedding *et al* 2019 *Res. Notes AAS* **3** 163


---


tim.bedding@sydney.edu.au


<sup>1</sup> Sydney Institute for Astronomy, School of Physics, University of Sydney 2006, Australia;

tim.bedding@sydney.edu.au

<sup>2</sup> Stellar Astrophysics Centre, Aarhus University, DK-8000 Aarhus C, Denmark

Timothy R. Bedding  <https://orcid.org/0000-0001-5222-4661>

Daniel R. Hey  <https://orcid.org/0000-0003-3244-5357>

Simon J. Murphy  <https://orcid.org/0000-0002-5648-3107>

Received October 2019

Accepted October 2019

Published October 2019

<https://doi.org/10.3847/2515-5172/ab5112>

Eclipsing binary stars; Stellar photometry

Create or edit your corridor alerts

What are corridors?

Create citation alert

Export citation and abstract

BibTeX

RIS

◀ **Previous** article in issue

**Next** article in issue ▶

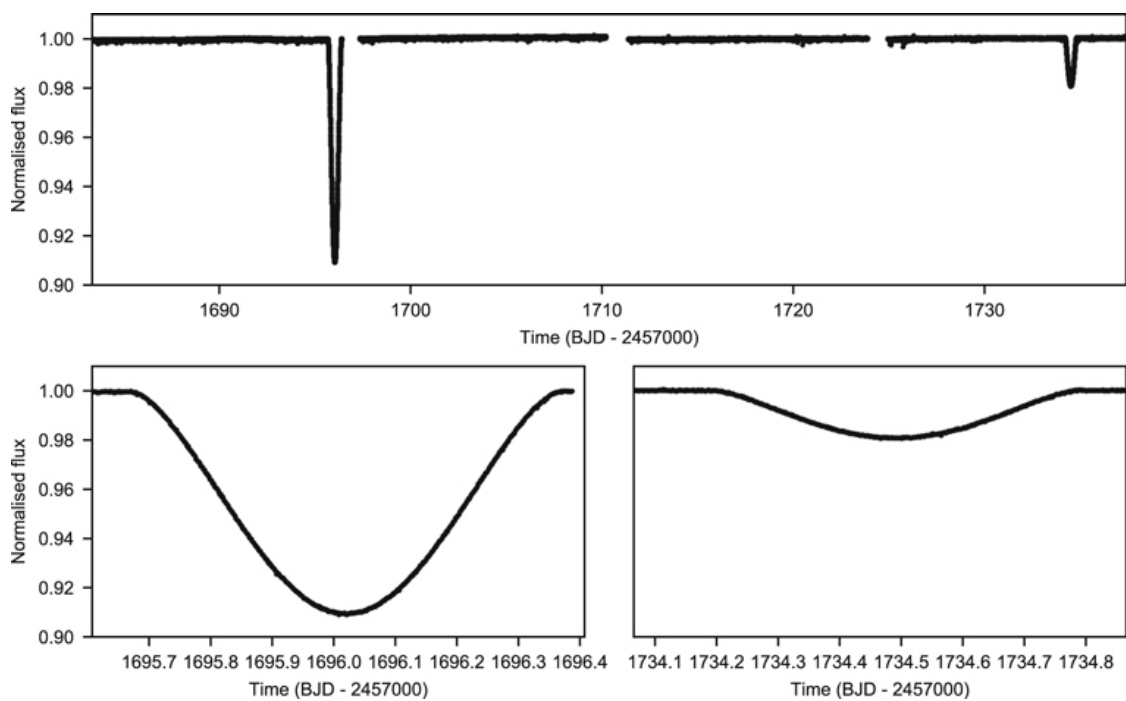
This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.



Detached eclipsing binaries allow stellar masses and radii to be measured with unrivalled accuracy (Andersen 1991; Torres et al. 2010). While inspecting light curves obtained with the *Transiting Exoplanet Survey Satellite* (*TESS*; Ricker et al. 2015), we noticed that the A0 III star  $\alpha$  Dra shows clear and well-separated primary and secondary eclipses. With a  $V$  magnitude of 3.68,  $\alpha$  Dra is brighter than most previously known detached eclipsing binaries (Malkov et al. 2006; Zasche et al. 2009; Avvakumova et al. 2013), with the only brighter systems apparently being  $\gamma$  Per (Griffin 2007) and  $\delta$  Vel A (Pribulla et al. 2011).

The star  $\alpha$  Dra (Thuban; HR 5291; HD 123299; HIP 68756) is a well-studied single-lined spectroscopic binary, with a period of 51.5 days and an eccentricity of 0.43 (e.g., Harper 1907; Elst & Nelles 1983; Budovicová et al. 2004; Bischoff et al. 2017). The currently available *TESS* observations for  $\alpha$  Dra cover two 27 day sectors.<sup>3</sup> The light curve (Figure 1) shows a primary eclipse in Sector 14 and a secondary eclipse in Sector 15, separated in time by 38.5 days. Optical interferometry shows that the angular separation is a few milliarcsec and the magnitude difference at 700 nm is  $1.83 \pm 0.07$  (Hutter et al. 2016). This flux ratio implies that a total eclipse would have a depth of 16%. The two *TESS* eclipses have depths of 9% and 2%, indicating that the eclipses are partial and the inclination is slightly less than  $90^\circ$ .





**Figure 1.** *TESS* light curve of  $\alpha$  Dra at 2 minute cadence using the Simple Aperture Photometry (SAP) flux, show the primary and secondary eclipses. The bottom panels show close-up views (both 0.8 day wide) of the primary and secondary eclipses (left and right, respectively).

The star lies close to, but not inside, the *TESS* continuous viewing zone and further observations will be available from Sectors 16, 21 and 22.<sup>4</sup> We expect the next primary eclipse to occur at BJD 2458747.4, which falls within Sector 16. Another secondary eclipse will fall in Sector 21 and another primary eclipse will fall in Sector 22.

Spectroscopically,  $\alpha$  Dra is used as the MK standard for spectral type A0 III (Gray & Garrison 1987; Gray & Corbally 2009). Although  $\alpha$  Dra has been reported as a  $\lambda$  Bootis star (showing surface chemical abundances that imply accretion from circumstellar material), it is not a member of this class (Murphy et al. 2015). Its projected rotation velocity is quite low for this spectral type ( $v \sin i \sim 26 \text{ km s}^{-1}$ ; Gray 2014). Now that we know the system is eclipsing, the assumption of reasonable alignment between the rotation and orbital axes implies that the primary is indeed a slow rotator (rather than being a rapid rotator seen pole-on, like the A0 V star, Vega; Hill et al. 2010).

Kallinger et al. (2004) suggested that  $\alpha$  Dra is photometrically variable, with a period of about 53 min and an amplitude of 1–2 mmag. They speculated that  $\alpha$  Dra could belong to the unconfirmed

class of so-called Maia variables (for recent discussions, see Balona et al. 2015; Szewczuk & Daszyńska-Daszkiewicz 2017). White et al. 2017). It was this possibility led us to examine the *TESS*

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, [click here](#).

light curve for this star. However, apart from the eclipses, the light curve shows no evidence for variability and we can rule out variability on timescales shorter than 8 hr at the level of 10 ppm (parts per million).

We thank the *TESS* team for making this research possible, and Daniel Huber for helpful comments. We gratefully acknowledge support from the Australian Research Council, and from the Danish National Research Foundation (Grant DNRF106) through its funding for the Stellar Astrophysics Centre (SAC). D.R.H. acknowledges the support of the Australian Government Research Training Program (AGRTP).

*Facility: TESS - .*

## Footnotes

3 <https://mast.stsci.edu/portal/Mashup/Clients/Mast/Portal.html>

4 <https://heasarc.gsfc.nasa.gov/cgi-bin/tess/webtess/wtv.py>

---

