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On the progenitor system of V392 Persei

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On 2018 April 29.474 UT Nakamura (2018) reported the discovery of a new transient, TCP J04432130+4721280, at $m = 6.2$ within the constellation of Perseus. Follow-up spectroscopy by Leadbeater (2018) and Wagner et al. (2018) independently verified the transient as a nova eruption in the 'Fe II curtain' phase; suggesting that the eruption was discovered before peak. Buczynski (2018) reported that the nova peaked on April 29.904 with $m = 5.6$. Nakamura (2018) noted that TCP J04432130+4721280 is spatially coincident with the proposed Z Camelopardalis type dwarf nova (DN) V392 Persei (see Downes & Shara 1993). V392 Per is therefore among just a handful of DNe to subsequently undergo a nova eruption (see, e.g., Mróz et al. 2016).

The AAVSO[1] 2004–2018 light curve for V392 Per indicates a quiescent system with $V \sim 16-17$ mag, punctuated with three of four DN outbursts, the last in 2016. Downes & Shara (1993) recorded a quiescent range of $15.0 \leq m_{\rm pg} \leq 17.5$, Zwitter & Munari (1994) reported a magnitude limit of $V > 17$. These observations suggest an eruption amplitude of $\lesssim 12$ magnitudes, which could indicate the presence of an evolved donor in the system.

The eruption spectroscopy indicated relatively high ejecta velocities ($\sim 5000\,{\rm km\,s^{-1}}$) for a classical nova (CN), with the Hα profile possibly containing extended – even higher velocity – emission around the central peak (see the spectrum contained within Wagner et al. 2018). Such high velocities, coupled with a low eruption amplitude, and also the prompt post-eruption detection of γ-ray emission (Li et al. 2018), are features one might expect to see from a recurrent nova (RN), particularly one within a symbiotic binary.

The following photometry of the quiescent V392 Per is contained within the 2MASS All-Sky Catalog of Point Sources (Cutri et al. 2003) and *WISE* All-Sky Source Catalog (Cutri et al. 2012): $J = 13.766 \pm 0.031$, $H = 13.290 \pm 0.038$, $K_{\rm S} = 13.062 \pm 0.037$, $w1 = 12.878 \pm 0.030$ ($3.3\,\mu$m), $w2 = 12.761 \pm 0.032$ ($4.6\,\mu$m), the system was not detected in *WISE* bands 3 and 4 (12 and $22\,\mu$m).

Gaia Data Release 2 (DR2; Gaia Collaboration et al. 2016, 2018) contains a parallax measurement for V392 Per of 0.442 ± 0.053 mas, which *could* indicate a distance of $3.9^{+1.0}_{-0.6}$ kpc. We note the caveats regarding DR2 distance determinations (see Lindegren et al. 2018), particularly those regarding unresolved binary systems. The 3D dust maps of Green et al. (2015, 2018) yield a reddening of $E_{\rm B-V} = 0.9 \pm 0.1$ over the *Gaia* distance range. Taking both this distance and reddening at face value, the absolute magnitude of the eruption could have reached $M_V = -9.5^{-0.8}_{+0.7}$ (or $-10.1^{-0.8}_{+0.7}$ assuming a peak of $m_V = 5.6$) – in either case, this could be inherently a very luminous eruption.

Figure 1 shows the quiescent spectral energy distribution (SED) of V392 Per using *WISE* and 2MASS data, the *Gaia* distance, and extinction as above. The quiescent SED is compared to the RNe RS Ophiuchi, T Coronae Borealis, M31N 2008-12a, and U Scorpii, and that of the CN, DN, and intermediate polar, GK Persei, using data within Darnley et al. (2012, 2017) and Evans et al. (2014). We utilise the *Gaia* distances for all objects (except U Sco and M31N 2008-12a), these are consistent with those recorded in Darnley et al. (2012). As noted by Evans et al. (2014), the *WISE* photometry of U Sco may be affected by strong emission lines and therefore is not included.

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[1] http://aavso.org

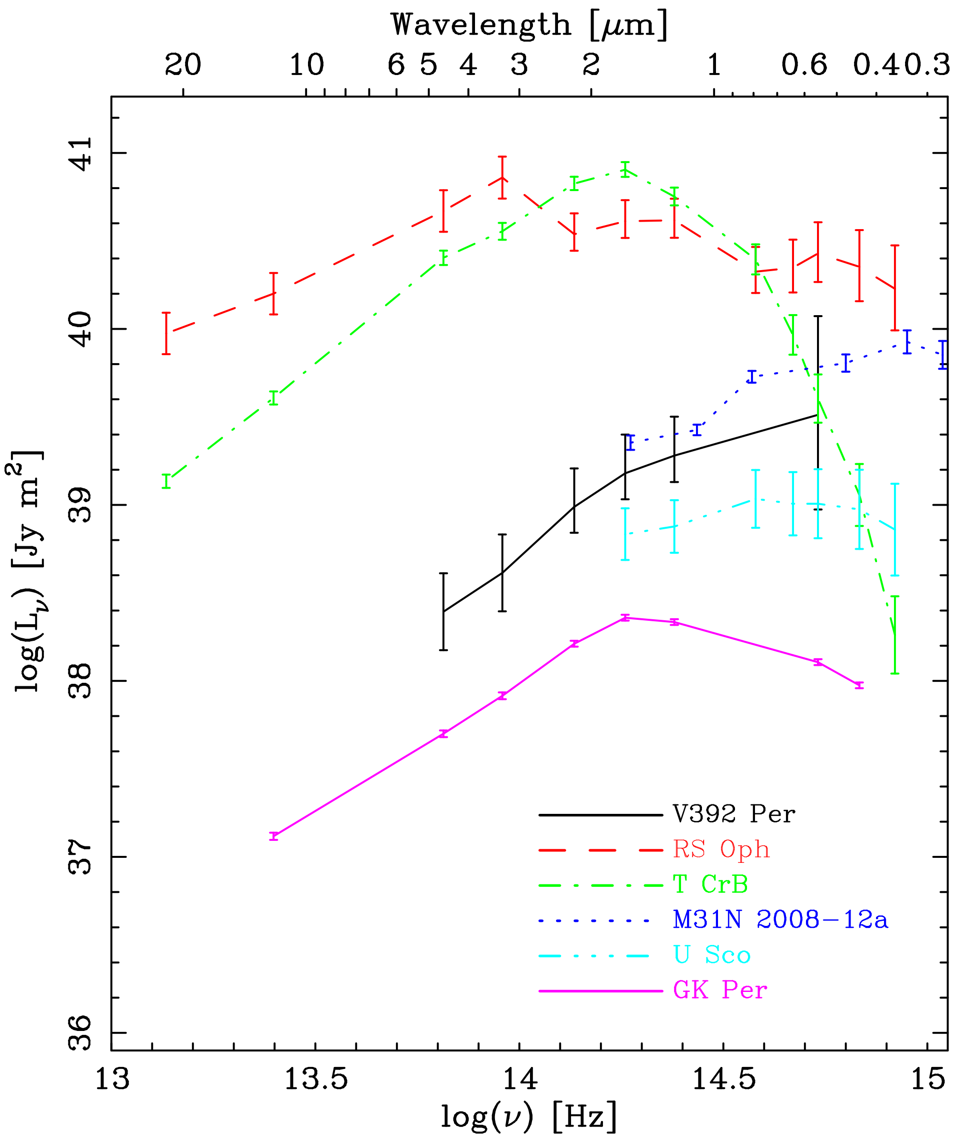

Figure 1. Distance and extinction corrected quiescent SEDs of V392 Per, RS Oph, T CrB, M31N 2008-12a, U Sco, and GK Per. The error bars include photometric, distance, and extinction uncertainties. The lines are to aid the reader.

In conclusion, even after correcting for the large *Gaia* distance and the large extinction, the SED of the V392 Per progenitor is not consistent with the system containing a red giant/symbiotic donor. However, the SED appears similar to those of U Sco and GK Per, a RN and CN, respectively, which contain sub-giant donors, or even that of M31N 2008-12a with it's proposed low luminosity giant or 'red clump' donor. V392 Per is unlikely to be more distant than implied by *Gaia* – but if significantly closer, the photometry could be consistent with a main sequence donor.

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