Will the radio source b Persei be eclipsed?

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The ellipsoidal variable star b Persei (HR1324, HD26961, V=4.6) consists of a non-eclipsing close binary (A-B) with a 1.5 day orbital period within a hierarchical triple system (AB-C) with a 701 day orbit (Hill et al. 1976). As with other close binary systems (e.g. β Per) b Per exhibits flares of non-thermal radio emission (Hjellming & Wade 1973). As noted by Hill et al. (1976) the evolutionary nature of the close binary in b Per is uncertain. It may already be a mass-transferring Algol binary, or it may be a precursor to the mass-transfer stage. The absence of eclipses in the close binary and b Per's status as a single-lined spectroscopic binary limit our knowledge of this stellar radio source.

Our observations using the Navy Precision Optical Interferometer (NPOI) resolved the AB-C components for the first time. The triple system orbit is nearly edge-on with an inclination of approximately 90 degrees (Fig. 1). This suggests the possibility of observing eclipses of the non-eclipsing (i ~ 40 degrees; Hill et al. 1976) close binary and the third star. The third star may eclipse both components of the close binary depending on the close binary orbital phase. Eclipses are important as they allow us to add lightcurve modeling to our arsenal of techniques for investigating the evolutionary state of the close binary components. The reality of our edge-on orbit for b Per C is supported by Hill et al. (1976). They suggested that eclipses of b Per AB by C could explain residuals in their radial velocity orbit. Furthermore, Hegedűs et al. (1996) reported photometric observations of an eclipse that is in phase (11.5 times the AB-C period) with the eclipse suggested by Hill et al. (1976). Koubský, Hadrava and Šarounová also report a possible spectroscopic detection of the C component. Tycho photometry were examined but did not conclusively reveal an eclipse detection. See Figure 1 for a depiction b Per based on the NPOI derived orbit of the tertiary and a plausible orientation of the close binary.

Our NPOI astrometry is current through 2012 December and allows a revision of Hill's period and an estimate of the next time of minimum. Our revised period is

$$702.45 \pm 0.05 \text{ days.}$$

Using our astrometric fit we estimate the next time of minimum light as

$$HJD = 2456321.35 \pm 0.05$$
20:24UT ± 1.5 hours UT 2013 January 28

Based on the expected stellar diameters (Hill et al. 1976) the eclipse duration could be as long as 4 days from ingress to egress assuming the C component totally transits the diameters of A and B. It may be possible to observe two distinct times of minima should C eclipse the secondary and the primary stars of b Persei. Eclipses of the secondary component will be useful observational constraints in the poorly understood close binary orbit.

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Based on this discussion we request multi-color photometric observations during the period 2013 January 23 through 2012 February 02. This window should allow a baseline out-of-eclipse lightcurve to be established and provide the multi-color photometry for an eventual lightcurve solution.

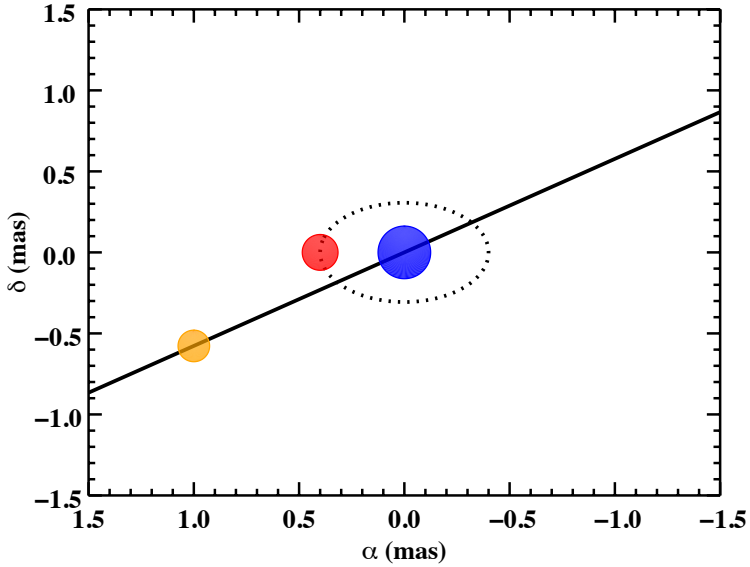

Figure 1: A close-up view of the expected geometry of b Per approaching an eclipse. The blue primary is in the center and a dashed line represents a plausible orbit of the orange secondary star. The yellow tertiary is shown on a solid line representing its nearly edge-on orbit. Diameters are based on Hill et al. (1976) assuming the close binary is detached.

REFERENCES

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