V444 CYGNI AND CQ CEPHEI, KEY WOLF-RAYET BINARY STARS

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Radial-velocity and photometric observations of eclipsing binaries allow one to estimate the masses of the stars in such systems, their relative brightnesses and sizes. If polarization variations are detected throughout the binary period, one may confirm the inclination of the system. All three types of information are available for V444 Cygni and CQ Cephei, see Underhill, Yang, and Hill (1988a,b), Underhill, Gilroy, and Hill (1990), and the references quoted in those papers.

The properties of the stars are summarized in the following table:

TABLE 1
Orbital Properties of V444 Cygni and CQ Cephei

Quantity	V444 Cygni	CQ Cephei
Period (days)	4.212424	1.6412436
Polarization (%)	≈ 0.5	≈ 5.0
i (degrees)	78 ± 4	74 ± 6
a_{WR} ($R_\odot$)	27.4	9.7
$a_{companion}$ ($R_\odot$)	9.1	8.2
M_{WR} ($M_\odot$)	9.8	13.6[a]
$M_{companion}$ ($M_\odot$)	29.6	16.0[a]

[a]Assuming $M_{WR}/M_{companion} = 0.85$. This mass ratio is determined by matching the observed brightness ratio in the V band by a theoretical brightness ratio, see Underhill, Gilroy, and Hill (1990). The observed brightness ratio of CQ Cephei in the V band is approximately 0.9.

The effective temperatures, log $L/L_\odot$, and radii of hydrogen-burning stars having the masses found for the Wolf-Rayet components of V444 Cygni and CQ Cephei can be estimated from the properties of the models by Maeder and Meynet (1988). They are 27,200 K, 3.91, and 4.0 $R_\odot$ for V444 Cygni and 29,000, 4.27, and 5.5 $R_\odot$ for CQ Cephei. These properties, with the estimated properties of the companions, are compatible with the observed light curves. Evolved models of Maeder and Meynet in the stage which they call "Wolf-Rayet" are more than 6 times too luminous with respect to the companion star, and these models will not produce UV and visible light curves like what are observed.

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