5 Ceti: A Long-Period Binary Evolving Through Mass Exchange*

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Binaries with very wide spearations are thought to evolve to small separations through a catastrophic form of mass exchange/loss known as common-envelope evolution. The theory of this process is fairly well developed, but proper tests remain elusive. Simply put, the theory argues that the rapidly shrinking Roche lobe of the mass losing giant will strip away the giant's main-sequence companion. Loss of mass from the system during the process carries away orbital angular momentum, thereby strengthening the effect.

In 5 Cet we have a binary, containing a K giant, that seems to be caught in this stage of mass loss from a more massive giant to a less massive companion. Mass-loss rates do not seem to be extreme enough for common envelope evolution, however.

Critical properties are inferred from a variety of evidence. Ellipsoidal light variation requires the K giant to be near its Roche lobe. The K giant's companion, however, is too bright in the ultraviolet to be in the main-sequence. This and its apparently random light variations argue it is an accretion disk around a 1.1 $M_\odot$ star. The luminosity requires a mass transfer rate of no more than 5×10^{-7} $M_\odot$/yr. The more extreme mass loss from the system expected under common-envelope evolution is not detected in the ultraviolet, although it could still exist in the plane of the orbit outside the line of sight. Although a 260 km/s wind from the system is detected in Mg II h + k profiles, its greater strength when the K giant is in front of the hot companion argues that this is a wind of the K giant itself, analogous to the high-speed winds in ζ Aur systems. In this case, it carries away only 10^{-9} $M_\odot$/yr, about the same mass-loss rate per unit surface area as in a ζ Aur star.

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