THE MYSTERIOUS BRIGHTNESS VARIATIONS FROM SYMBIOTIC STAR STHA 169

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Previous Kepler observations of the symbiotic binary StHA~169, in which a white dwarf accretes from a red-giant companion, revealed an unexpected modulation in its optical flux with a period of around 40 days. The goal of the proposed research is to use additional Kepler short- and long-cadence observations to determine the origin of this modulation. We will test possible explanations such as: 1) the existence of some structure at the outer edge of a large accretion disk; 2) a modulation of the flow through the disk producing a variation in the luminosity of the burning shell on the surface of the white dwarf; 3) pulsation of the red giant; and 4) the presence of a third body in the system. The two challenges for interpreting this modulation are its period and the expectation that the accretion disk produces much less optical emission than the red giant and the surrounding nebula. At 40 days, the period is too short to be due to orbital motion of the binary or rotation of the red giant. It is also unusually short for a red-giant pulsation. Although the period of the oscillation could reasonably be tied to a dynamical or viscous time scale at the outer edge of a large accretion disk, the lack of rapid stochastic variations, or "flickering", from this source on a time scale of minutes suggests that emission directly from the disk does not contribute significantly to the optical light. So, an origin for the modulation in an accretion disk also seems problematic. And to add to the mystery, the pulse profile varies and is often double-humped. To crack this problem, we will combine Kepler monitoring with ground-based photometry and optical spectroscopy throughout several cycles of the oscillation. We also request one month of short-cadence observations to confirm the continued absence of disk flickering. Determining whether the oscillation is dominated by red or blue light will reveal whether it is associated with the red giant or the accreting white dwarf, and pinning spectroscopic changes to each phase of the oscillation will provide evidence for the underlying physics. Although spectroscopy and multi-color photometry require ground-based observations, we need Kepler data to place these observations in the context of the 40-day modulation. Furthermore, increasing the length of the Kepler light curve will give improved frequency resolution to the power spectrum, which is needed to distinguish between models. In summary, explaining the cause of the optical brightness oscillation from StHA 169 could be relevant for understanding the nature of the accretion processes in wide binaries and/or the structure of a Roche-lobe filling red giant. This research program could thus turn a very small allocation of Kepler pixel resources into a finding with broad implications.