

The yellow hypergiant HR 5171 A: Resolving a massive interacting binary in the common envelope phase

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We initiated long-term optical interferometry monitoring of the diameters of unstable yellow hypergiants (YHG) with the goal of detecting both the long-term evolution of their radius and shorter term formation related to large mass-loss events. We observed HR5171 A with AMBER/VLT1. We also examined archival photometric data in the visual and near-IR spanning more than 60 years, as well as sparse spectroscopic data. HR5171A exhibits a complex appearance. Our AMBER data reveal a surprisingly large star for a YHG $R^* = 1315 \pm 260 R_{\text{sun}}$ ($\sim 6.1 \text{ AU}$) at the distance of $3.6 \pm 0.5 \text{ kpc}$. The source is surrounded by an extended nebulosity, and these data also show a large level of asymmetry in the brightness distribution of the system, which we attribute to a newly discovered companion star located in front of the primary star. The companion's signature is also detected in the visual photometry, which indicates an orbital period of $P_{\text{orb}} = 1304 \pm 6 \text{ d}$. Modeling the light curve with the NIGHTFALL program provides clear evidence that the system is a contact or possibly over-contact eclipsing binary. A total current system mass of 39^{+40}_{-22} solar mass and a high mass ratio $q > 10$ is inferred for the system. The low-mass companion of HR5171 A is very close to the primary star that is embedded within its dense wind. Tight constraints on the inclination and $v \sin i$ of the primary are lacking, which prevents us from determining its influence precisely on the mass-loss phenomenon, but the system is probably experiencing a wind Roche-Lobe overflow. Depending on the amount of angular momentum that can be transferred to the stellar envelope, HR5171 A may become a fast-rotating B[e]/Luminous Blue Variable (LBV)/Wolf-Rayet star. In any case, HR5171 A highlights the possible importance of binaries for interpreting the unstable YHGs and for massive star evolution in general.

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Comments:

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