THE B-TYPE SEMIDETACHED BINARY BF CEN IN NGC 3766

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Binaries in clusters are particularly important: If unevolved, they may provide a check of the mass predicted for the point on the cluster isochrone where they are found. If mass-exchange has occurred, the age and chemical abundance inferred from other cluster stars provide useful boundary conditions for theoretical models of binary evolution involving mass exchange. With these goals in mind, we have studied the early-type (B2+B6), 3.7-day eclipsing binary BF Cen in the young cluster NGC 3766.

Our observations consist of 11 ESO coudé spectrograms (20 Å mm^{-1}, IIIa-J emulsion) and complete *uvby* light curves (876 points) from the Danish 50-cm telescope at ESO, La Silla. Spectroscopic orbits have been determined (from He I lines) and yield masses of 8.7 $M_\odot$ (primary) and 3.8 $M_\odot$ (secondary). The orbit is circular and primary eclipse total, which facilitates the analysis. Adjusting the gravity-darkening coefficient of the secondary was found necessary for an acceptable fit. However, the light curve shows asymmetries which cannot be modeled with the Wilson-Devinney program, which we have used for the analysis. BF Cen is found to be semi-detached, with photometric and spectroscopic mass ratios in excellent agreement. The primary component (of radius 5.1 $R_\odot$) is in the upper part of the main-sequence band, the secondary (7.1 $R_\odot$) well above it. The line profiles show the secondary to rotate in synchronism as expected, while the primary rotates ~60% faster than the synchronous rate - not unusual in post-mass-exchange systems.

BF Cen is located in the outer part of NGC 3766, but its systemic velocity and colour excess agree precisely with the cluster means, so it probably *is* a cluster member; its position in the HR diagram is roughly consistent with this. The estimated cluster age (~22 10^6) yr is slightly (but not significantly) larger than we find for the primary star from standard evolutionary models, as would be expected if the star has been refueled since its formation. The differences between standard models and models with mass loss and/or convective overshooting appear mainly in the early post-main-sequence phases of evolution, with significant consequences for the evolution of close binaries experiencing mass loss. Systems like BF Cen may therefore, in fact, prove potentially more useful in testing models for massive stars than main-sequence binaries.

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