CAN EVOLUTION IN CLOSE BINARIES ACCOUNT FOR THE BLUE STRAGGLERS IN M67?

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For the past 9 years we have been monitoring the radial velocities of 13 blue stragglers in the old open cluster M67. For the 9 blue stragglers with rotational velocities no larger than about 100 km s^{-1} we have used the CfA digital speedometers to measure more than 500 radial velocities. To get reliable velocity correlations we use synthetic rotating templates computed from a grid of Kurucz model atmospheres. Four of the blue stragglers rotate too rapidly to allow successful velocity correlations with the CfA instruments. For three of these we have used a CCD spectrograph at Kitt Peak and similar reduction procedures (Morse *et al.* 1991.

In Table 1 we summarize the status of the radial-velocity measurements as of mid 1991. The identifications are taken from Sanders (1977) and Fagerholm (1906). Positions and photometry may be found in Girard *et al.* (1989). The effective temperatures and rotational velocities were chosen to give the best correlations with synthetic spectra calculated from Kurucz model atmospheres. Note that the probability of membership in M67 is very high for all these blue stragglers, based on their proper motions (Girard *et al.* 1989), and that the mean radial velocities are all consistent with membership as well.

For stars with constant velocities, the *rms* deviations of the CfA velocities should be 1 or 2 km s^{-1}, depending on the rotation. Thus, it appears that at least 5 of the 9 blue stragglers measured with the CfA instruments have variable velocities, with the possibility that as many as 7 may be variable. Are most of the blue stragglers binaries, and has mass transfer been involved in making them into blue stragglers (McCrea 1964, Collier & Jenkins 1984)? One of the blue stragglers, F190, has a short period. An orbital

Y. Kondo et al. (eds.), Evolutionary Processes in Interacting Binary Stars, 473–474.

Table 1. Mean radial velocities for thirteen blue stragglers in M67

Star		T_{eff} (K)	Rotational Velocity (km s^{-1})	$P(\mu,r)$ (%)	N_{obs}	Mean Radial Velocity (km s^{-1})		*rms* (km s^{-1})
S1082	F131	6500	0	99	70	33.37	C	1.75
S975	F90	6500	20	?	35	33.61	C	5.02
S997	F124	6500	20	99	28	35.51	C	5.09
S1195	F207	6500	60	98	29	30.30	C	7.54
S1263	F185	7000	20	100	38	32.06	C	0.99
S1280	F184	7000	>100	100				
S1267	F238	7500	40	99	25	35.08	C	2.88
S752	F55	7500	80	99	45	35.48	C	5.14
S1284	F190	7500	80	99	62	33.70	C	11.33
S968	F153	8000	0	99	72	32.50	C	0.83
S1434	F280	9000	125	95	3	33.04	K	3.81
S1066	F156	9250	80	100	3	34.31	K	1.67
S977	F81	14000	125	99	7	33.42	K	2.50

solution for this star is reported by Milone & Latham (1992), who argue that it is in the final stages of the mass transfer that made it into a blue straggler.

The velocity variations of S975, S997, and S1195 look like they are due to orbital motion with periods longer than 1000 days and semiamplitudes under 10 km s^{-1}. It is not impossible that these three systems are binaries in the final slow stages of mass transfer. The original primary has by now donated a large fraction of its initial mass to the original secondary, which we now see as the blue straggler. The orbital period can easily be thousands of days for this stage of mass transfer, and the lifetime in this stage can be similar to the main-sequence lifetime of the original primary (Paczyński 1971). All three of these blue stragglers lie off of the Zero Age Main Sequence. Normal single stars would not spend very long in this region of the color-magnitude diagram. Perhaps the progress of the blue stragglers across the color-magnitude diagram has been slowed by the ongoing mass transfer.

An alternative mechanism for forming blue stragglers may involve binary-binary interactions (*cf.* Leonard 1989, Leonard & Fahlman 1991). In this scenario the blue straggler would result from a merger of two of the stars, the third star would be the distant companion corresponding to the long periods that we observe, and the fourth would be ejected from the system by the encounter.

We thank Bob Kurucz for his help in calculating the grid of rotating synthetic spectra from his model atmospheres, and Guillermo Torres for his help with the velocity correlations.

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