

Spectroscopic binaries in M 67[†]

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Abstract. We summarize the characteristics of 85 spectroscopic orbits derived from more than two decades of radial-velocity monitoring of stars in the old open cluster M 67, with special emphasis on the blue stragglers and other members that do not fall on the evolutionary tracks expected for isolated single stars.

Keywords. stars: binaries: spectroscopic, Galaxy: open clusters and associations: individual (M 67)

In November 1979 one of the CfA Digital Speedometers (Latham 1992) was used for the first time to obtain a spectrum of a star in the old open cluster M 67. Not long after that first exposure, Bob Mathieu arrived at CfA and convinced us to undertake a serious radial-velocity survey of the brightest cluster members, with the goals of confirming cluster membership, and identifying spectroscopic binaries and deriving their orbits. The initial project was successful (Mathieu & Latham 1986), and the survey was extended to fainter objects in stages, eventually reaching $V = 15.5$ mag. Altogether 6921 spectra have now been obtained of 411 proper-motion members. For 39 of the targets the mean radial velocities are inconsistent with cluster membership. Among the confirmed members we have identified more than 100 stars with variable velocity and have derived 85 spectroscopic orbits that are of publication quality. Twenty-five of our orbits are double-lined, while eight of our orbits are for members of triple systems.

From the beginning we had a special interest in the 13 classical blue stragglers, and we soon confirmed Armin Deutch's unpublished short-period eccentric orbit for S 1284 = F 190 with $P = 4.18$ d and $e = 0.24$ (Milone & Latham 1992). Four of the hottest and brightest blue stragglers (S 977 = F 81, S 1066 = F 156, S 1280 = F 184, and S 1434 = F 280) rotate too rapidly for the CfA Digital Speedometers to provide reliable velocities. Another two hot blue stragglers (S 968 = F 153 and S 1263 = F 185) rotate slowly enough to give good velocities but show no velocity variation. Five of the cooler blue stragglers (S 752 = F 55, S 975 = F 90, S 997 = F 124, S 1195 = F 207, and S 1267 = F 238) show long-period orbits with moderate or low eccentricity. These results were the subject of Ale Milone's PhD thesis (Latham & Milone 1996). Subsequently Sandquist *et al.* (2003) showed that S 1082 = F 131 is a triple composed of an eclipsing binary with $P = 1.06$ d and a third star with $P = 1189$ d and $e = 0.57$. It is tempting to suppose that the system is a bound hierarchical triple, but this has not yet been demonstrated conclusively.

Two short-period binaries (S 1063 and S 1113) lie well below the subgiant branch. Both appear to be cluster members based on their proper motions and radial velocities (Mathieu *et al.* 2003). The evolutionary history of these binaries is not clear and may require dynamical interactions. In addition there are other binaries, such as S 1072, which occupy puzzling positions in the color-magnitude diagram for the cluster and may also require dynamical interactions to understand their formation and evolution.

[†] Some of the observations reported here were obtained with the Multiple Mirror Telescope, operated jointly by the Smithsonian Institution and the University of Arizona.

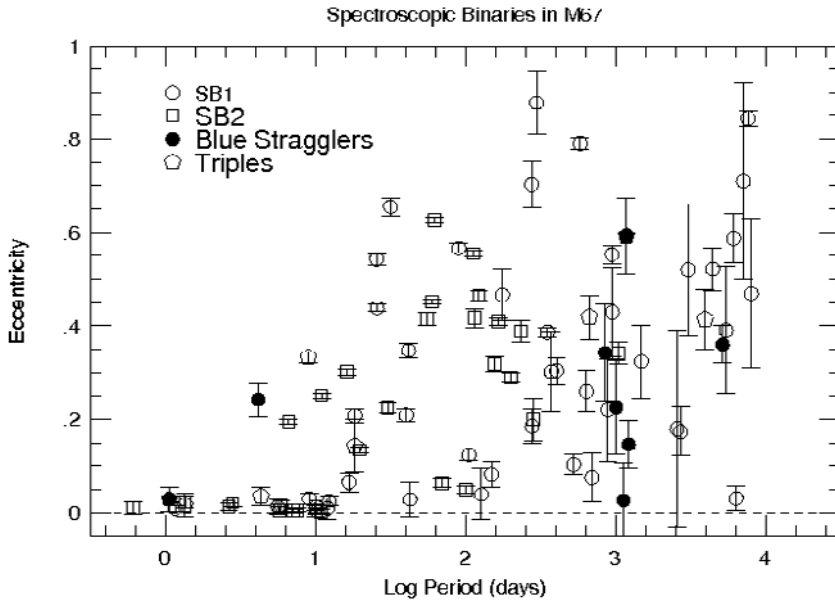


Figure 1. Eccentricity e versus period $\log(P)$ for 85 spectroscopic binaries in M 67.

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References

Latham, D. W. 1992, in: H. McAlister & W. Hartkopf (eds.), *Complementary Approaches to Binary and Multiple Star Research*, Proc. IAU Coll. No. 135, ASP-CS, 32, 110,
 Latham, D. W., & Milone, A. A. E. 1996, in: E. F. Milone & J.-C. Mermilliod (eds.), *The Origins, Evolution, and Destinies of Binary Stars in Clusters*, ASP-CS, 90, 385
 Mathieu, R. D., & Latham, D. W. 1986, *AJ*, 92, 1364
 Mathieu, R. D., van den Berg, M., Torres, G., Latham, D. W., Verbunt, F., & Stassun, K. 2003, *AJ*, 125, 246
 Milone, A. A. E., & Latham, D. W. 1992, in: Y. Kondo, R. F. Sistero, & R. S. Polidan (eds.), *Evolutionary Processes in Interacting Binary Stars*, Proc. IAU Symp. No. 151 (Dordrecht: Kluwer Academic Publishers), p. 475
 Sandquist, E. L., Latham, D. W., Shetrone, M. D., & Milone, A. A. E. 2003, *AJ*, 125, 810