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Dissertation Summary

A Search for Eclipsing Binaries in Galactic Globular Clusters

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Variable stars have historically served as tools and laboratories in our understanding of stellar formation and evolution, the formation of star clusters, the calibration of distance determination methods, and a variety of other areas. In particular, the study of eclipsing binaries (EBs) in globular clusters (GCs) can provide direct distance estimates to clusters as well as constraints for the turnoff masses of GC stars. Knowing precise distances to GCs would constitute an independent check of widely used distance determination methods in astronomy. Obtaining masses of GC turnoff stars provides a fundamental test of low-metallicity stellar models that calculate ages for these stars—and thus the GCs themselves—and thereby allow a lower limit estimate of the age of the universe.

My dissertation research with M. Mateo at the University of Michigan consists of a monitoring survey of 10 Galactic GCs with the aim of identifying photometrically variable EBs around or below the main-sequence turnoff (MSTO). My thesis work comprises the results of our research on the GCs NGC 3201, M10, and M12. Our observing strategy is aimed at detecting variables with periods between 0.2 and around 5 days and $16.5 < V < 20$, thereby optimizing our chance to find the valuable detached EBs in the target clusters. In addition, we correct for differential reddening variations across the cluster fields of up to several tenths of magnitudes in V by internally creating a differential extinction map with an arcminute resolution from our cluster photometry data and calculate the additional reddening zero point using isochrone fitting. The resulting improvement in the appearance of the color-magnitude diagrams (CMDs) of the clusters is considerable (see K. von Braun & M. Mateo 2001, AJ, 121, 1522).

We obtained approximately 200 *VI* epochs with about 20,000 stars per image for each of the three clusters. Analysis of these data revealed the existence of 14 variable stars (11 EBs) in the field of NGC 3201, three variables (one EB) in the field of M10, and two EBs in the field of M12. Spectroscopic follow-up work showed that only one variable (a blue straggler W Ursa Majoris contact EB) in the field of NGC 3201 is associated with the cluster. Another W UMa EB is most likely a member of M12, based on its location in M12's CMD and its empirically calculated absolute magnitude. The rest of the variable stars we detected are members of the Galactic disk (see K. von Braun & M. Mateo 2002, AJ, 123, 279; and K. von Braun et al. 2002, AJ, 124, 2067 for details). We thus calculate a ratio of observable, short-period, main-sequence binaries to main-sequence stars of around 1/500 for the Galactic disk (consistent with literature estimates) and 1/9000 for GC members. The latter value is considerably smaller than the commonly quoted value of 1/1000. While the discrepancy may be due to small number statistics, we attribute it to the fact that we lose about 20% of our fields to crowding toward the cluster center where the binary fraction should be highest after a few cluster relaxation times.

In my dissertation, I show the cluster fields and CMDs (before and after dereddening) with the locations of the variable stars and our differential extinction maps, as well as the phased light curves and spectra (wherever applicable) of the variable stars. For additional information or to obtain a copy of the dissertation, please contact me or visit http://www.ciw.edu/vonbraun.

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