A MODEL FOR V4 IN THE GLOBULAR CLUSTER M3

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The images used in this study were obtained with the No. 1 0.9-meter telescope at the Kitt Peak National Observatory using "Harris" B and V filters. The field was first observed for six nights during May 1992 and again for seven nights in April 1993. Follow-up observations were made in 1995 and 1997. The data presented here are the 83 B frames from 1992 and the 100 B frames from 1993. The raw data frames were processed and reduced following standard procedures using ALLSTAR in DAOPHOTX in IRAF. Twenty-three Landolt standards were observed during the 1993 run and used to place the stars on the standard system. The 1993 V data has been reduced and used to determine color.

V4 has been recognized as a possible blend of variable stars (Goranskij, 1994) and in this paper we are able to account for the color of V4 and the shape of its light curve with a superposition of three stars: a single nonvariable star and two RRab variables of differing amplitude and phase but with very nearly the same period.

There are almost certainly two variable stars in the light curve of V4. The period, the amplitudes, and the shape of the light curves all suggest RRab variables. The intensity averaged magnitude for V4 is approximately one magnitude brighter than the horizontal branch (and specifically, greater than 0.75 mag), and the color of V4 is well to the red of the instability strip. Thus, it does not seem likely that V4 is simply a combination of two variable stars.

We have been able to model the color and light curves of V4 with a superposition of three stars: a nonvariable star and two RRab variables. The magnitude averaged B magnitude of V4 is 15.047 and its magnitude averaged V magnitude is 14.538 for a color of 0.509, well to the red of the instability strip. The two RRab variables in our model have an intensity averaged B magnitude of 15.999. The intensity averaged B magnitude of V4 is 15.015. Thus, the nonvariable in the model has B = 16.786. Using a typical value for the color of an RRab variable, the color of the nonvariable is approximately 1.0. Unfortunately, a star with these properties would be well to the red of the red giant branch of M3 and thus unlikely to be a member of the cluster. The B amplitudes of the two RRab stars in the model are 1.73 and 1.00 respectively. In our model we have used the same period for stars 1 and 2 (0.5868 day) because this period seems to phase the data reasonably well and to try to model V4 using two different periods would have been very difficult. The shift in phase between the primary and secondary maxima from 1992 to 1993 shows that the periods are not exactly the same. Light curves for V4, star 1, star 2, and the three-star model are given in Figures 1 and 2. In these Figures, the squares represent the light curve of V4 and X represents the light curve of the three-star model.
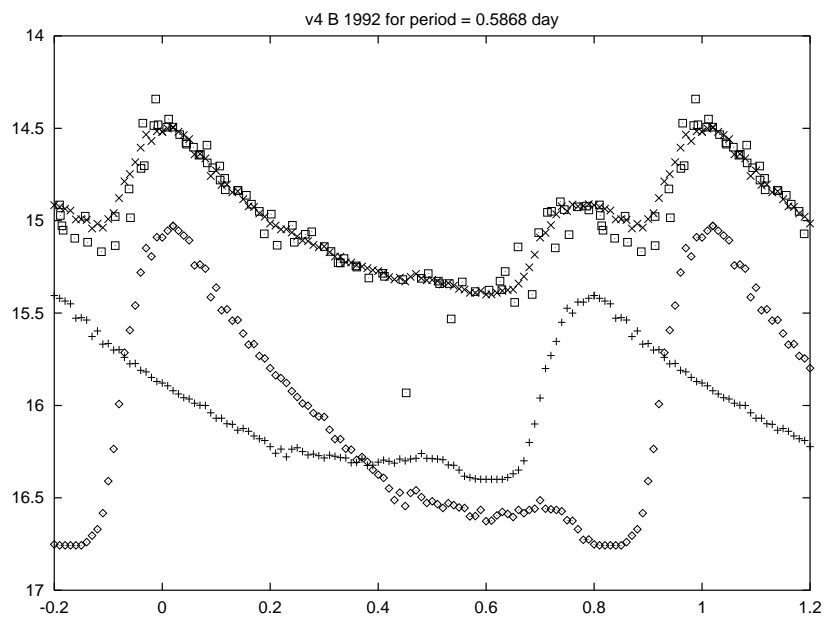
v4 B 1992 for period = 0.5868 day
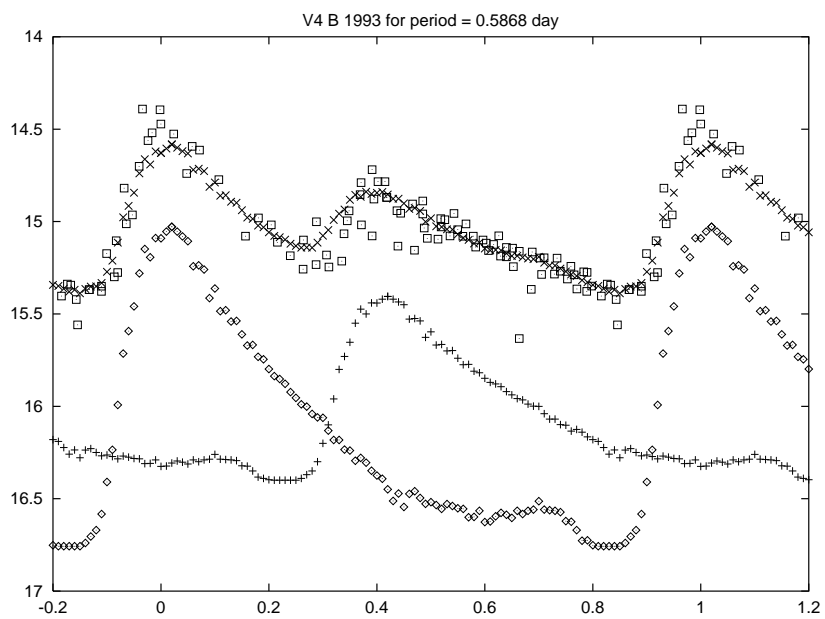

Figure 1.

V4 B 1993 for period = 0.5868 day

Figure 2.

Reference:

Goranskij, V.P., 1994, *IBVS*, No. 4129