

Part 1.4. Pulsating Stars in Clusters

Time Series CCD Photometry of the Globular Cluster M 53

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Abstract. Through time-series CCD photometry of the globular cluster M 53, we have discovered eight new SX Phoenicis type stars. All the new SX Phoenicis stars are located in the blue straggler star region in the color-magnitude diagram of M 53. In addition, we have obtained light curves for 45 known RR Lyrae stars.

1. Introduction

There are many blue straggler stars in the globular cluster M 53 (Rey et al., 1998). It is expected that some of these blue stragglers are SX Phoenicis stars (short period pulsating variables), but no SX Phoenicis stars are yet known. To find short period variables, we have performed time-series CCD photometry of M 53 over 11 nights from March 30, 2000 to April 1, 2001 using the 1.8m telescope at the Bohyunsan Optical Astronomy Observatory (BOAO, Korea) with a thinned SITE 2k CCD (2048 × 2048 pixels) camera. The size of the field of view of a CCD image is 11.6' × 11.6' at the f/8 Cassegrain focus of the telescope.

2. Results

We applied the ensemble normalization technique (Gilliland & Brown, 1988; Jeon et al., 2001) to normalize instrumental magnitudes between time-series CCD frames. We have discovered eight new SX Phoenicis type variables. In Fig. 1, we show the position of the new SX Phoenicis stars in the color-magnitude diagram (CMD). All the new SX Phoenicis stars are located in the blue straggler

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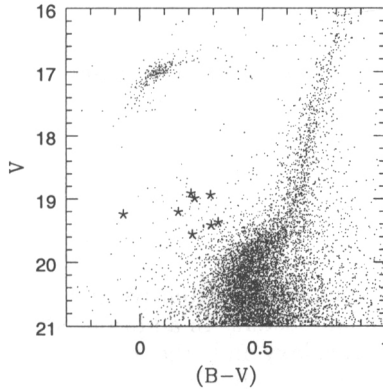


Figure 1. Positions of the SX Phoenixis stars in the CMD of M53. They are located in the blue straggler region except for the SXP3.

star region except for SXP3 which has a very blue color. However, the color of SXP3 contains a large error. Table 1 lists the properties of these stars based on the multiple-frequency analysis. The periods of these stars range from $0^d.0385$ to $0^d.0701$, and the variability amplitudes of these stars vary from 0.060 to 0.374 mag. SXP1 has the longest period among the SX Phoenixis stars, and a $2f_2$ frequency. SXP2 and SXP7 show two frequencies with very small separation (frequency ratio ≥ 0.95). In addition, we have obtained light curves for 45 known RR Lyrae variables.

Table 1. Physical properties of the eight new SX Phoenixis stars.

Star	$\langle V \rangle$	$\langle B \rangle - \langle V \rangle$	Frequencies(c d^{-1})	Amp.	S/N
SXP1	18.91	0.21	14.260 27.523	0.103 0.041	7.66 4.24
SXP2	18.94	0.29	22.045 22.975 43.027 0.117	0.046 0.024 14.29 6.73 4.02	
SXP3	19.24	-0.07	20.877	0.096	5.92
SXP4	19.20	0.16	20.006	0.064	6.75
SXP5	19.42	0.29	22.988	0.044	5.80
SXP6	19.37	0.32	22.600	0.101	11.96
SXP7	19.56	0.21	24.097 22.783	0.089 0.028	12.59 4.17
SXP8	18.99	0.22	25.980	0.030	6.16

References

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