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AN SX Phe STAR IN THE GLOBULAR CLUSTER M15

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We present observational results of a newly discovered SX Phe star, SX1 ($RA_{2000} = 21^{\text{h}}29^{\text{m}}39^{\text{s}}.4$, $DEC_{2000} = 12^{\circ}11'43''.4$, $V = 18^{\text{m}}450$, $B - V = 0^{\text{m}}225$, from our observation), in a field located $102''.4$ north and $283''.5$ west from the center of the globular cluster M15 ($21^{\text{h}}29^{\text{m}}58^{\text{s}}.3$, $+12^{\circ}10'01''$, Djorgovski & Meylan 1993). We could not find this star at the recent catalogue of variable stars in globular clusters (Clement 2000).

Time-series BV CCD photometry was performed over four nights from August 12th to 16th, 1999. The observations were done with an SITe 2048×2048 CCD camera attached to the 1.8-m telescope at the Bohyunsan Optical Astronomy Observatory (BOAO). The size of the field of view of a CCD image is $11'.6 \times 11'.6$ at the $f/8$ Cassegrain focus of the telescope.

Using IRAF/CCDRED package, we processed images to correct overscan regions, trim sections, subtract bias frames and correct flat field images. Instrumental magnitudes were obtained using the Point Spread Function fitting photometry routine in IRAF/DAOPHOT package (Stetson 1987, Massey & Davis 1992). We applied the ensemble normalization technique (Gilliland & Brown 1988, Kim *et al.* 1999) to standardize the instrumental magnitudes of all stars in the time-series CCD frames.

A finding chart of SX1 is shown in Figure 1. Light curves of SX1 are displayed in Figure 2, which shows amplitude modulating features implying the excitation of closely-separated pulsating frequencies. We have obtained power spectra for SX1 from the multiple frequency analysis (Kim & Lee 1996), as shown in Figure 3. Table 1 lists the results

Table 1: Results of the multiple frequency analysis

	B -band				V -band			
	Freq. (c/d)	Amp. ¹	Phase ¹	S/N^2	Freq. (c/d)	Amp. ¹	Phase ¹	S/N^2
f_1	24.626	$0^{\text{m}}054$	3.67	13.7	24.626	$0^{\text{m}}049$	3.62	14.2
f_2	24.350	$0^{\text{m}}031$	-1.21	6.7	24.353	$0^{\text{m}}025$	3.63	5.9
s.d. ³		$0^{\text{m}}023$				$0^{\text{m}}020$		

¹ B or $V = \text{constant} + \sum_j A_j \cos 2\pi f_j(t - t_0) + \phi_j$, $t_0 = \text{HJD } 2451400$

² Amplitude signal to noise ratio introduced by Breger *et al.* (1993)

³ Standard deviation after fitting synthetic curves to the data

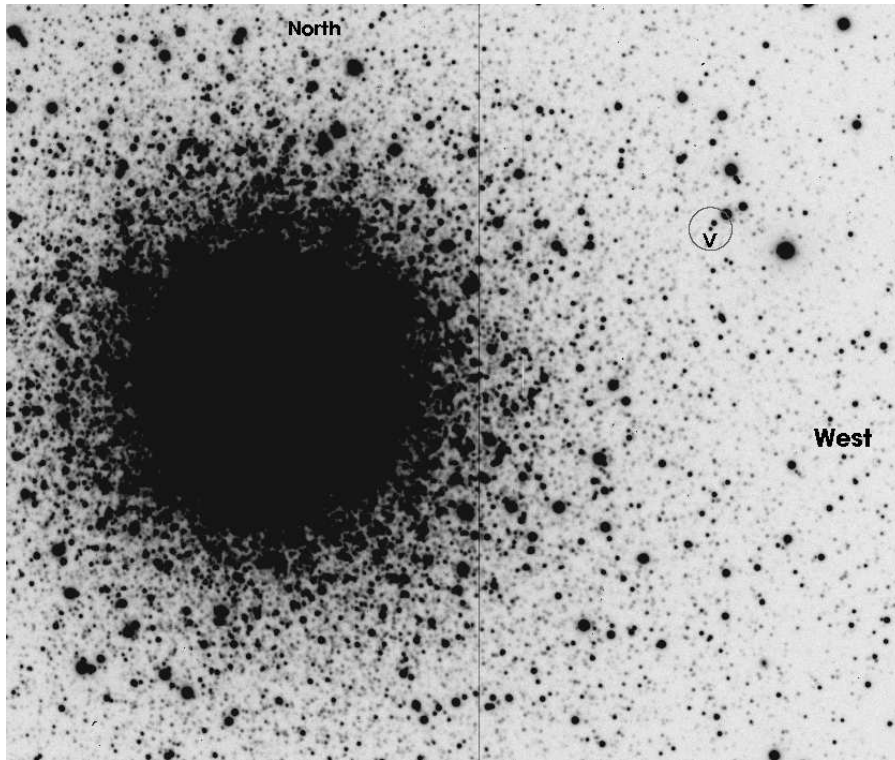


Figure 1. A greyscale map of a V -band CCD image of the globular cluster M15. The new SX Phe star SX1 is denoted by 'V' in the center of the small circle.

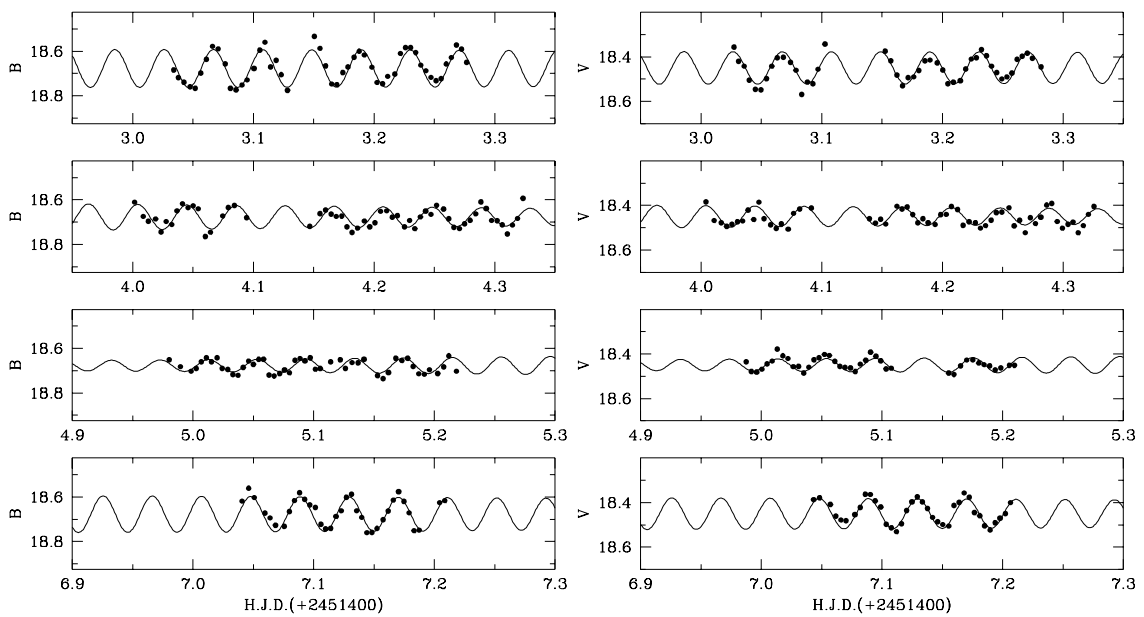


Figure 2. Light curves of SX1, B -band (left) and V -band (right). Synthetic curves obtained from the multiple frequency analysis (see Table 1) are superimposed to the data.

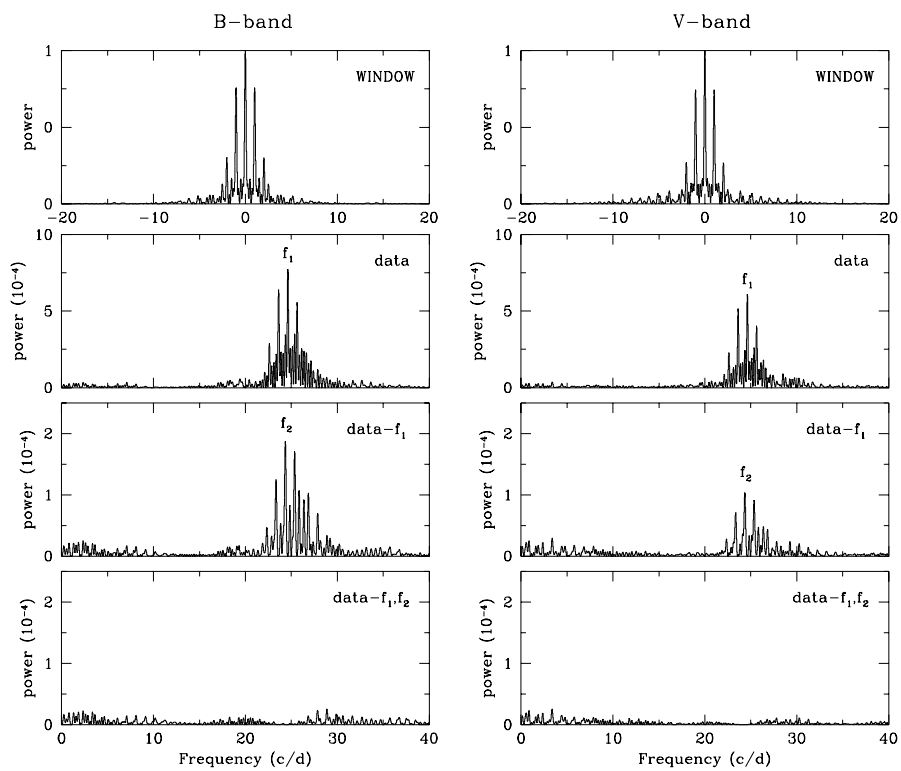


Figure 3. Power spectra of SX1 for the *B*-band (left) and *V*-band (right). Window spectra are in the top panel. Two closely-separated frequencies, f_1 and f_2 , are obviously found.

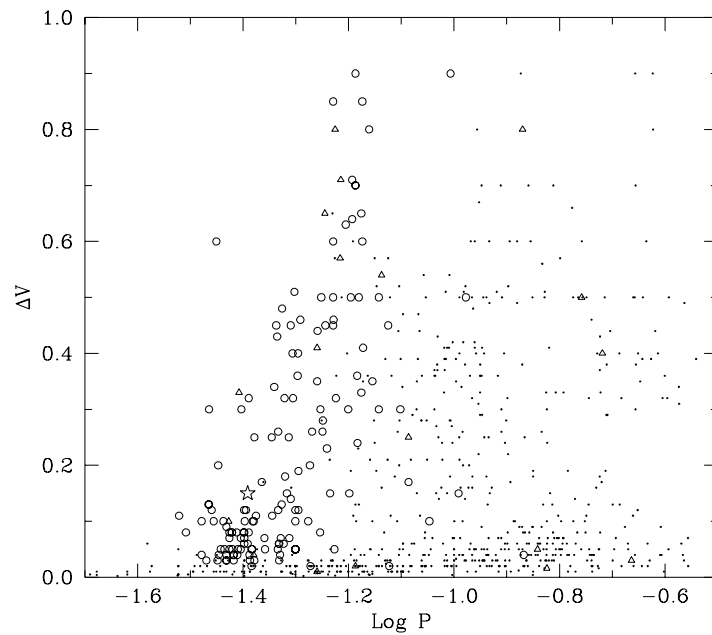


Figure 4. *V* amplitude versus period diagram: star symbol for the new SX Phe star SX1, small dots for δ Sct stars (Rodríguez *et al.* 2000), open triangles for field SX Phe stars (Rodríguez *et al.* 2000) and open circles for SX Phe stars in other globular clusters (Rodríguez & Lopez-Gonzalez 2000).

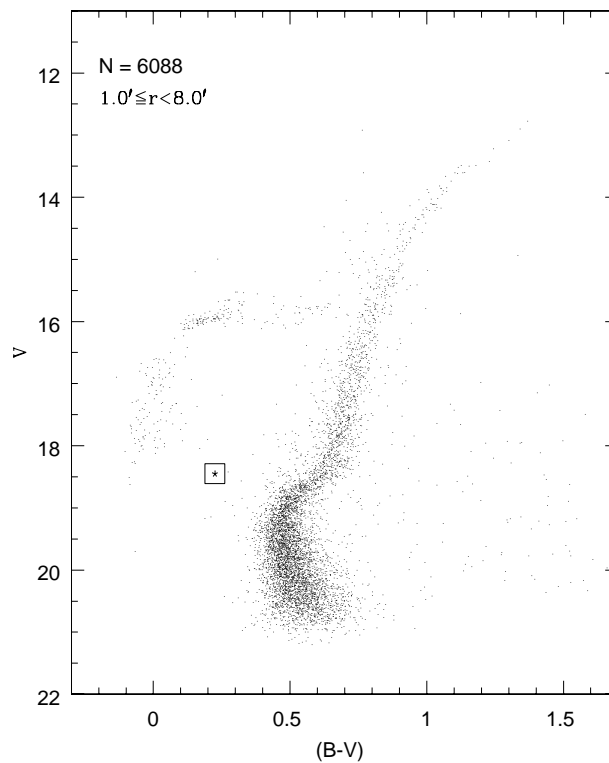


Figure 5. Position of SX1 in the color-magnitude diagram of the globular cluster M15. Note that it is located at the blue straggler region.

of the analysis. Considering the position in the period–amplitude diagram (Figure 4) and the color–magnitude diagram (Figure 5), SX1 might be identified as an SX Phe star and/or a pulsating blue straggler star in the cluster.

Detailed analysis of color variations, pulsation modes and the period–luminosity relation will be given elsewhere.

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