EVIDENCE FOR PERIOD CHANGE IN V393 CARINAE

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Abstract

This paper describes a joint campaign carried out by Instituto Copérnico and Observatorio Cristo Rey, both in Argentina, in a typical professional-amateur relationship. The target object was the bright δ Scuti star V393 Carinae, lying close to the open cluster NGC 2516 in the southern Milky Way.

We performed several CCD observing runs during different nights. The complete set of observations appears to show slight variations in the mean period and phase shift, compared to previous observations.

1. Introduction

V393 Carinae (HD 66260, RA = $07^{h} 59^{m} 02.77^{s}$, Decl. = -61° 35' 30.76" (2000.0), SpT = A7III/IV, mean *V* magnitude = 7.48) is a bright δ Scuti star close to the open cluster NGC 2516. Like some δ Scuti stars, its light variations are very regular, and its amplitude is about 0.2 magnitude.

V393 Car is described in the main δ Scuti catalogues as a normal high-amplitude star. According to Helt (1984) it is a Population I star in the shell-burning phase of its evolution.

The star attracts our interest because of its large amplitude and the length of time since the last observations were made (1979) and published by Helt (1984).

2. Observations

We made 149 unfiltered CCD observations during six nights between February 13 and March 27, 2001.

We used a Pictor 416XT camera with the KAF400 CCD chip unfiltered attached to a 60-mm refractor, giving an effective focal length of 240 mm. The observations were carried out in Rosario city, at the Cristo Rey Amateur Observatory. Comparison and check stars are listed in Table 2.

Figure 1 shows an image of the field with the stars identified.

The reduction of the images was performed with IRIS software at the Universidad Nacional Mayor de San Marcos, and also at Insituto Copérnico, using DAOPHOT. We also made images of M67 in order to calibrate the observations using the method described by Henden (2000). Our measurements were then transformed from instrumental to *V* band. The complete set of observations, transformed to *V*, is given in Table 1.

3. Searching for periods

Using Discrete Fourier Transforms, the period analysis was done using the software package PERIOD from the University of Vienna.

As a result, we found a fundamental period of 0.1462828 ±0.0000002 day, with an amplitude of 0.298 magnitude in *V*, and a mean magnitude of 7.475. The power spectrum is shown in Figure 2.

We determined several maxima, but one of them is better in terms of quality: HJD 2451953.731.

The folded light curve based on these elements is shown in Figure 3.

Using the period of 0.1412937 ±0.0000002 day, and the phase at HJD 2443597.001 ±0.001 determined by Helt (1984), the maximum at HJD 2451953.731 is closest to the epoch 59144 and the phase shift is 0.0554 day. Instead, using our period of 0.1462828 day and our phase at HJD 2451953.731, the phase by Helt at HJD 2443597.001 is closest to the epoch -57127 and the phase shift appears to be 0.0583 day.

Table 1. CCD observations of V393 Car.

JD	*ΔV*	*JD*	*ΔV*	*JD*	*ΔV*
2451953.5814	1.947	2451957.6931	1.987	2451969.5935	1.858
2451953.7007	1.928	2451957.6971	1.933	2451969.5975	1.875
2451953.7020	1.953	2451957.7011	1.902	2451969.6015	1.820
2451953.7043	1.936	2451957.7054	1.963	2451969.6055	1.805
2451953.7067	1.955	2451957.7095	1.875	2451969.6095	1.827
2451953.7115	1.967	2451957.7395	1.856	2451969.6107	1.820
2451953.7155	1.963	2451957.7437	1.843	2451982.7296	1.895
2451953.7194	1.972	2451957.7477	1.885	2451982.7336	1.877
2451953.7234	2.015	2451957.7518	1.854	2451982.7376	1.867
2451953.7274	1.978	2451957.7632	1.807	2451982.7416	1.868
2451953.7314	1.919	2451957.7683	1.864	2451982.7456	1.885
2451953.7353	1.988	2451957.7743	1.872	2451982.7496	1.853
2451953.7393	2.019	2451957.7802	1.865	2451982.7535	1.845
2451953.7433	1.968	2451961.5152	1.981	2451982.7580	1.825
2451953.7472	1.915	2451961.5168	1.917	2451982.7622	1.827
2451953.7512	1.967	2451961.5210	1.911	2451982.7661	1.826
2451953.7552	1.901	2451961.5260	1.911	2451982.7701	1.814
2451953.7640	1.897	2451961.5297	1.926	2451982.7823	1.840
2451953.7680	1.881	2451961.5337	1.903	2451982.7862	1.797
2451953.7720	1.882	2451961.5377	1.872	2451982.7902	1.843
2451953.7760	1.863	2451961.5417	1.915	2451995.6329	1.822
2451953.7799	1.884	2451961.5460	1.878	2451995.6369	1.826
2451953.7839	1.844	2451961.5543	1.867	2451995.6409	1.864
2451953.7879	1.856	2451961.5585	1.837	2451995.6448	1.826
2451953.7918	1.825	2451961.5625	1.829	2451995.6489	1.820
2451953.7958	1.860	2451961.5667	1.844	2451995.6529	1.842
2451953.7998	1.840	2451961.5709	1.822	2451995.6569	1.847
2451953.8038	1.828	2451961.5751	1.878	2451995.6607	1.821
2451953.8077	1.821	2451961.5787	1.871	2451995.6648	1.876
2451957.6549	1.908	2451961.5828	1.881	2451995.6688	1.870
2451957.6583	1.895	2451961.5878	1.877	2451995.6728	1.893
2451957.6609	1.995	2451961.5918	1.857	2451995.6769	1.897
2451957.6650	1.992	2451961.5958	1.896	2451995.6809	1.934
2451957.6690	1.960	2451969.5736	1.912	2451995.6850	1.942
2451957.6730	2.003	2451969.5776	1.900	2451995.6891	1.928
2451957.6769	1.963	2451969.5816	1.901	2451995.6932	1.955
2451957.6809	1.984	2451969.5856	1.869	2451995.6971	1.972
2451957.6880	1.988	2451969.5895	1.858	2451995.7012	1.972

Table 2. Comparison and check stars used.

Star	*RA (2000)*	*Dec (2000)*	*V*	*Spectral Type*
SAO 250078	$08^h\ 01^m\ 37.62^s$	-61° 25' 48.47"	9.40	B9IV
SAO 250072	08 01 01.3	-61 31 57	8.27	B9IV

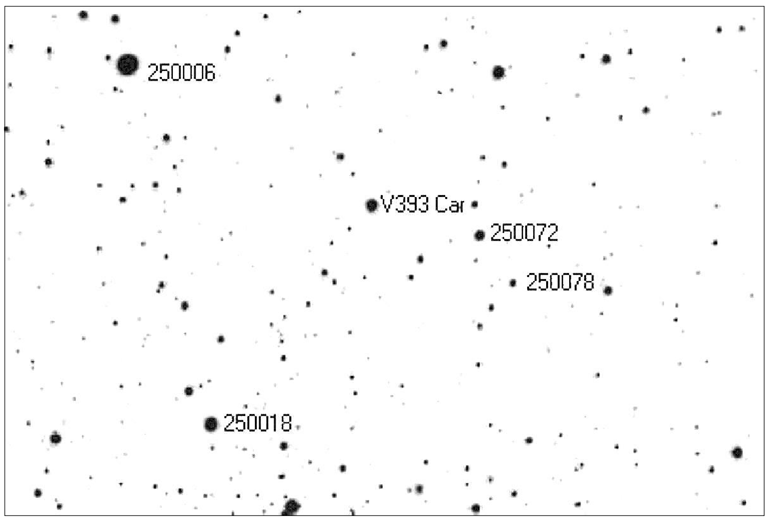

Figure 1. An unfiltered CCD image of the field of V393 Car. SAO stars are labeled. South is up, West to the left.

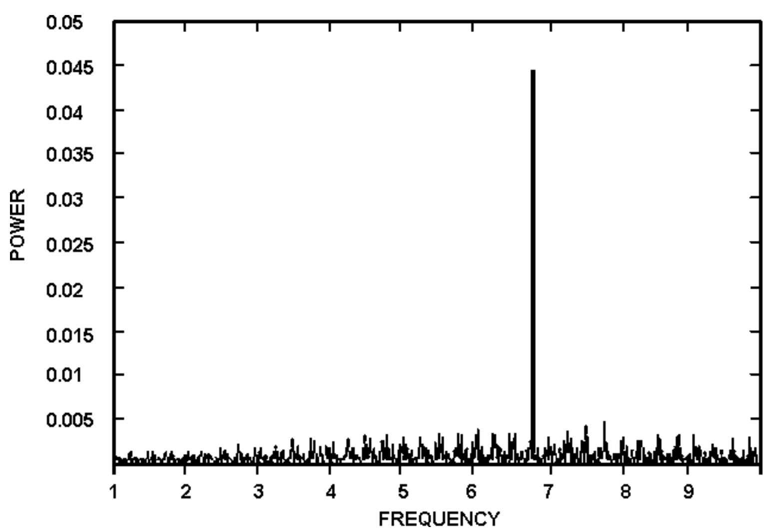

Figure 2. The power spectrum for V393 Car.

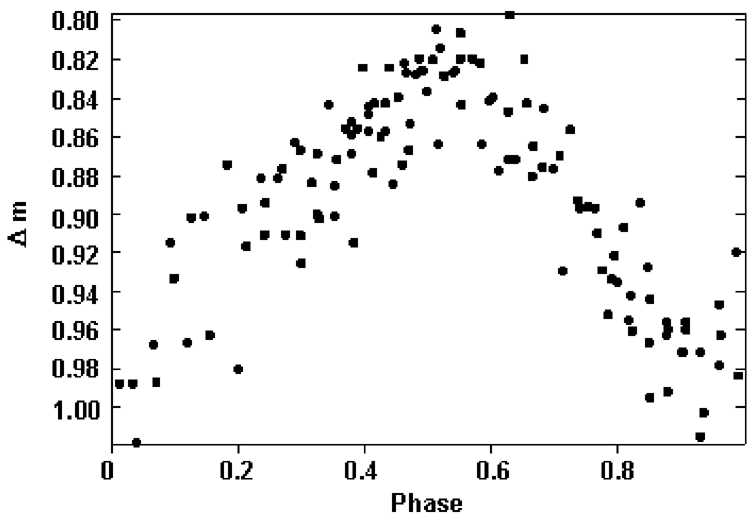

Figure 3. The folded light curve of V393 Car.

4. Conclusions

V393 Car pulsates radially in the fundamental mode with a reasonably large amplitude. The fundamental period had a small change (from 0.1412937 to 0.1462828 day) from that in the earlier observations, and the phase shift is 0.0554 day over 31 years. This shift implies the presence of another period, but one that is very difficult to determine from this set of observations. Further research will be carried out during the next season.

References

Helt, B. E. 1984, *Astron. Astrophys. Suppl.*, **56**, 457.
Henden, A. 2000, *J. Amer. Assoc. Var. Star Obs.*, **29**, 35.