

OBSERVATION AND STATISTICAL ANALYSIS OF ZZ PISCUM

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Abstract. To examine the non-linear oscillation and period change of white dwarf variables, ZZ Psc is discussed observationally. As a result of data reduction we found two major periods, 680 seconds and 860 seconds, but could not find chaotic behavior of ZZ Psc.

1. Observations

Photoelectric observation of variable DA white dwarf ZZ Psc, one of the ZZ Cet type stars, was carried out for eleven nights from 1989 to 1991 using 91-cm telescope at Dodaria Station of the National Astronomical Observatory, Japan, as in Table I.

TABLE I
Journal of ZZ Psc observations

Date (U.T.)	Starting time (U.T.)	Integration time (s)	Number of points	Quality of data
1989 Dec. 15	10:50	55	80	poor
1990 Jan. 9	10:20	55	126	poor
1990 Nov. 5	10:25	55	1460	good
1990 Dec. 2	8:18	15	2090	poor
1990 Dec. 4	8:35	15	2265	poor
1990 Dec. 21	10:30	15	1250	poor
1990 Dec. 26	9:20	15	560	good
1991 Nov. 22	9:30	15	300	poor
1991 Nov. 24	13:12	15	50	poor
1991 Nov. 25	8:30	15	1560	good
1991 Nov. 26	9:40	15	650	good

All data were obtained by computer-controlled eight-channel ($\lambda\lambda$: 0.36–0.90 μm) photon-counting polarimeter cooled by dry ice and with cathode at

-1.5 kV. The star SAO 128211, very near to ZZ Psc, was chosen as a comparison. In the observation, a pair of diaphragms is used for subtracting sky background effectively ("exchanging diaphragms method"). The aperture of the primary diaphragm (ϕ_1) used was 18" and the secondary diaphragm (ϕ_2) had a diameter about two times larger than primary one.

2. Data Analysis and Conclusion

Our present knowledge suggests that ZZ Psc is pulsating non-radially in g -mode. It has a multi-periodicity and among others has a photometric period of ~ 13.0 minutes and an amplitude of 0.3 at most in visual magnitude. Furthermore, it is confirmed that ZZ Psc has large variation from one cycle to another in the amplitude and shape of the light curve even during a night. Series of data are analyzed after transformation to conventional UBV system. First data, taken on 15 December, 1989 was analyzed with Phase Dispersion Minimization (PDM) Method, which is known as a suitable reduction method in case of small number of data. As a result, we have obtained periods: 678 seconds in V , 665 seconds in B , and 668 seconds in U ; so we concluded, that the period was 668 seconds on average. This is almost in good agreement with observational results of McGraw and Robinson (1975).

The purpose of our observation is to detect the variations of major periods, so we have tried to apply period analysis. The other data were preliminarily analyzed by FFT, AR (Auto-Regressive), AR-MA (AR-Moving Average) models and so on. In the observation, we were interfered by Moon light, so the quality of data is not good. Among them, we could get relatively good data on 25 November, 1991. From power spectrum by AR model, we obtained a period of 860 seconds (25 November, 1991). It corresponds to almost middle of f_2 , f_3 periods of McGraw and Robinson (1975). We have examined whether there is chaotic behavior in the time variation of ZZ Psc by return map, but we have not found clear evidence for existence of chaotic behavior, because of limited amount of the data unequally due to missing observations and noise of the observational data.

We are going to continue observations on ZZ Cet type stars to examine the cause of light variation.

References

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