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The ZZ Ceti instability strip as seen by VLT-ULTRACAM*

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Abstract. In this paper we present some preliminary results of a recent VLT/ULTRACAM run on a few DA white dwarfs located near the blue edge of the ZZ Ceti instability strip. The DA white dwarf GD 133 ($T_{\rm eff} \simeq$ 12300K, $\log g \simeq 8.0$), that was believed to be a stable star, shows short period oscillations at about 2 min with an amplitude of about 4 mma in the g band.

Key words. Stars: white dwarfs – Stars: pulsation – Stars: individual: GD 133

1. Introduction

In May 2005 the ultra-fast instrument ULTRACAM was mounted for the first time at the VLT UT3 (*Melipal*). ULTRACAM[1] is a unique 3-CCD camera that can reach a maximum speed of 300 frames per second in three photometric bands at the same time, selected among the *ugriz* filters of the Sloan Digital Sky Survey (SDSS) photometric system. VLT–ULTRACAM is therefore an ideal combination to search for p-modes oscillations in white dwarfs (WDs). These modes are expected to have very low amplitudes and very short pulsation periods, of the order of tenths of seconds, requiring particularly short sampling times to be detected. During almost five hours of VLT time assigned to our programme, we observed a sample of 8 DA WDs located near the blue edge of the ZZ Ceti (or DAV) instability strip, with the main goal of searching for p-modes oscillations. The filters selected were u, g and r. As a secondary goal, the same data were used also to test the g-mode stability of the observed stars.

In this paper we concentrate only on the preliminary results obtained on GD 133.

2. GD 133: it is a pulsator !

GD 133 has been considered for a quite long time a non-variable star very close (but slightly off) the blue edge of the ZZ Ceti instability strip (Kepler et al. 1995, Giovannini et al. 1997, Silvotti et al. 1997, Bergeron et al. 2004). Kepler et al. (1995) found an upper limit to the pulsation amplitude of 2.7 mma.

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Its atmospheric parameters, $T_{\rm eff}$=12090 and log g=8.06 (Fontaine et al. 2003), were then revised by Bergeron et al. (2004), who obtained log g=8.04 and $T_{\rm eff}$=12290, a temperature high enough to explain the apparent stability of GD 133.

In May 2005 GD 133 was observed in a single VLT run of 65 min with a sampling time of about 36 ms. These very short exposures were chosen in order to sample a wide range of very short pulsation periods which are expected for the p-modes. Then, in order to check also the possible presence of g-modes, the data were binned to an effective resolution of 10 s.

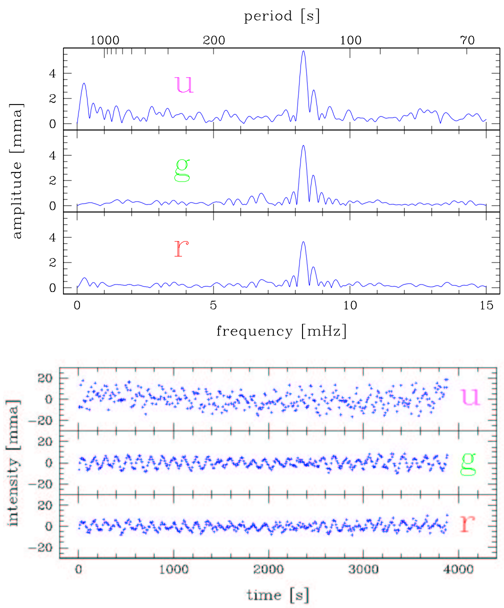

Fig. 1. Light curve and amplitude spectrum of GD 133. Note the very low level of the average noise in the Fourier transform, which is of the order of a few tenths of mma (milli modulation amplitude = 10^{-3} intensity variations) in the g and r bands, with just 65 min of observation.

The light curve shown in Fig. 1 is only preliminary as the photometry is obtained from the ULTRACAM software which gives on-line results, without applying BIAS and Flat Field corrections (which however should not have much influence at such high acquisition speed). The light curve has a quite sinusoidal shape due to one dominant pulsation period at about 120 s. However, the amplitude spectrum shows two close peaks at 8.30 and 8.63 mHz (120 and 116 s), with amplitudes of about 4.6 and 1.5 mma respectively (in the g band). If we apply a pre-whitening to the data, a third possible pulsation mode appears at 6.81 mHz (147 s), with an amplitude of about 1.1 mma (again in g band). The beating effects due to the presence of more then one active mode and the small amplitudes observed can explain why this star was found to be stable by different authors. The very short periods found in GD 133, listed in Table 1, are typical of all the ZZ Ceti stars close to the blue edge of the strip.

Table 1. Preliminary results from a least-square sinusoidal fit.

	u **band**	*g* **band**	*r* **band**
F1 (mHz)	8.294	8.303	8.309
P1 (s)	120.6	120.4	120.4
A1 (mma)	5.5	4.6	3.6
F2 (mHz)	8.692	8.629	8.595
P2 (s)	115.0	115.9	116.3
A2 (mma)	1.5	1.5	1.0
F3 (mHz)	–	6.809	6.848
P3 (s)	–	146.9	146.0
A3 (mma)	–	1.1	0.8

References

Bergeron P., Fontaine G., Billères M. et al. 2004, ApJ 600, 404

Fontaine G., Bergeron P., Billères M., Charpinet S. 2003, ApJ 591, 1184

Giovannini O., Kepler S.O., Kanaan A., Wood M.A., Claver C.F., Koester D. 1998, Baltic Astron. vol. 7, 131

Kepler S.O., Giovannini O., Kanaan A., Wood M.A., Claver C.F. 1995, Baltic Astron. vol. 4, 157

Silvotti R., Bartolini C., Cosentino G., Guarnieri A., Piccioni A. 1997, 10th Europ. Workshop on White Dwarfs, eds. J. Isern, M. Hernanz & E. Garcia-Berro, Dordrecht: Kluwer Academic, 489