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New WET Observations of the δ Scuti Star CD−24 7599: amplitude variability and discovery of 13 pulsation modes

G. Handler[1], D. O'Donoghue[2], D. A. H. Buckley[3], O. Giovannini[4], S. O. Kepler[4], J. L. Provencal[5], M. A. Wood[6], J. C. Clemens[7], M. S. O'Brien[7], S. J. Kleinman[8], T. K. Watson[8], R. E. Nather[8], D. E. Winget[8], A. Kanaan[8], A. Nitta[8], M. H. Montgomery[8], E. Klumpe[8], P. A. Bradley[9], D. J. Sullivan[10], K. Wu[11], E. Leibowitz[12]

1. Introduction

The variability of CD−24 7599 (V=11.48 mag) was discovered by JCC during observing run XCOV7 of the Whole Earth Telescope (WET, Nather et al. 1990) network in February, 1992. The star was observed as an additional target and 117 hours of high-quality temporal spectroscopic observations were obtained.

Our analysis of these data revealed the presence of 7 independent pulsation modes between 27.0 and 38.1 cycles per day (313 – 441 μHz) with semi-amplitudes of 2.1 – 10.2 milli-modulation amplitudes (mma). We showed that peaks at linear combination frequencies detected in the power spectra were *not* due to eigenmodes excited to visible amplitude by resonant mode coupling.

The examination of subsequent uvbyβ photometry showed the star to be located on the lower main sequence, near the observed hot border of the classical instability strip. The complete analysis was published by Handler et al. (1995), and the reader is referred to this paper for more information. Due to the suspected presence of several further pulsation modes with photometric amplitudes around 1 mma, CD−24 7599 was re-observed with WET in May, 1994.

[1]Institut für Astronomie, Türkenschanzstraße 17, A-1180 Wien, Austria

[2]Department of Astronomy, University of Cape Town, Rondebosch 7700, South Africa

[3]South African Astronomical Observatory, P. O. Box 9, Observatory 7935, South Africa

[4]Instituto de Fisica, Universidade Federal do Rio Grande do Sul, 90049 Porto Alegre-RS, Brazil

[5]Department of Physics and Astronomy, University of Delaware, Newark, DE 19716, USA

[6]Department of Physics and Space Sciences, Florida Institute of Technology, 150 W. University Boulevard, Melbourne, FL 32901, USA

[7]Department of Physics and Astronomy, Iowa State University, Ames, IA 50211, USA

[8]Department of Astronomy and McDonald Obs., University of Texas, Austin, TX 78712, USA

[9]X-2 MS B-220, Los Alamos National Laboratory, Los Alamos, NM 87545, USA

[10]Department of Physics, Victoria University of Wellington, New Zealand

[11]RCfTA, School of Physics, University of Sydney, NSW 2006, Australia

[12]Department of Physics and Astronomy, University Tel Aviv, Tel Aviv 69978, Israel

2. New WET observations and their analysis

CD−24 7599 was included as 3rd priority target in WET run XCOV 10. Due to good weather, we acquired 86 hours of new measurements during a 14-day time span. Frequency analysis of the new data set confirmed the presence of the previously detected pulsation modes. However, conspicuous amplitude variations occurred within the two years. Moreover, when analysing both data sets together, we were able to establish the presence of 6 further pulsation modes (with frequencies between 315 and 390 μHz and amplitudes between 0.9 and 1.3 mma), bringing the total number to 13.

3. The importance of CD−24 7599 for δ Scuti star asteroseismology

CD−24 7599 is a good (maybe the best) candidate for the application of asteroseismology to δ Scuti stars because:

- Of course, due to its large number of detected pulsation frequencies. It is the δ Scuti star with the most observed pulsation modes at this time.
- Its unevolved state excludes the presence of a large number of mixed modes.
- Only 2 or 3 radial overtones appear to be excited. Therefore, we expect to observe many almost completely rotationally split multiplets.
- Its relatively large photometric amplitudes allow us to determine accurate phase shifts to constrain the ℓ value of many modes by using time-series multi-colour photometry.
- Its amplitude variations may help us to discover even more pulsation frequencies in the future.

What can be said at the present stage?

- We cannot find closely spaced triplets, quintuplets, or septuplets in the amplitude spectrum, suggesting the star is not a slow rotator.
- A regular frequency spacing (about 26 μHz) of the 13 modes may already be detected. This could be due to rotational splitting or to the near degenerate frequencies of modes with the same k, but different ℓ.
- The knowledge of the star's projected rotational velocity is of great importance. A measurement will be obtained soon. Collaboration of the Vienna group with W. Dziembowski and colleagues will enable us to calculate specific pulsational models for CD−24 7599 and other δ Scuti stars.

References

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