

Asteroseismology from Space: WIRE Monitoring of the δ Sct Star θ^2 Tauri

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Soon after launch in March 1999, the primary science instrument onboard the *Wide-Field Infrared Explorer* (WIRE) satellite failed due to loss of coolant. However, it proved possible to begin an asteroseismology program using the 52-mm aperture star camera. A few bright stars were monitored with the 512x512 SITE CCD in a bandpass approximately equivalent to $V + R$; further details about the orbit, the detector and the raw data reduction can be found in Buzasi et al. (2000) and Buzasi (2000). We included the binary star θ^2 Tauri among the targets. It is composed of an A7IV primary and an A5V secondary ($P = 140.728$ d). The primary is a δ Scuti star which has been observed several times in the last twenty years. Five terms have been determined in its light curve (Breger, 1989 and references therein); Li et al. (1997) demonstrated the amplitude variability of some of these terms by comparing different campaigns.

About 1,200,000 data points (time sampling 0.5 sec) were collected on θ^2 Tau, over a time baseline of 15 days (Fig. 1, top panel). Spurious terms introduced by the satellite orbit and drift of the stellar image have been removed from these datapoints. To do that, we iteratively analyzed the data in frequency. After the subsequent data binning, we were left with a time series of about 9,000 data points (Fig. 1, bottom panel).

Twelve independent frequencies were detected down to the 0.5 mmag amplitude level when analyzing this new time-series: all of them have $S/N > 4.0$. They were detected both using the CLEAN and the Least-Squares Iterative sine-wave fitting algorithms. Moreover, their reality was confirmed by subdividing the whole dataset into two subsets and then finding the same terms. The rms residual of the least-squares fit is 1.5 mmag, about half than that usually ob-

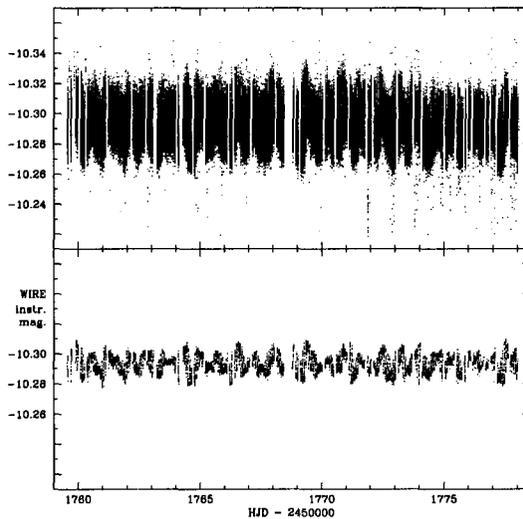


Figure 1. The light curves obtained by WIRE on θ^2 Tau: original (top panel) and binned (bottom panel) datapoints.

tained from successful ground-based multisite campaigns involving very good photometric sites.

All the frequencies are in the range $10.8\text{--}14.6\text{ d}^{-1}$. The fundamental radial mode is expected at 7.79 d^{-1} , i.e. in a region where the noise level is very low ($55\mu\text{mag}$). However, this mode was not detected. The lack of observed radial overtones, in spite of the improved amplitude detection limit, implies that nonradial modes can largely predominate in δ Scuti stars. The comparison of the results of previous campaigns with the new ones establishes the amplitude variability of some modes. The detailed analysis of the WIRE time-series will be discussed elsewhere (Poretti et al., 2002).

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