

44 Tauri: Observations and Analysis

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ABSTRACT:

Between 2000 and 2003 more than 600 hours of photometric data of the Delta Scuti star 44 Tauri (HD 26322) were collected in Strömgren v and y as well as in Johnson V . Observations were carried out at Washington Camp (Arizona), Sierra Nevada Observatory (Spain) and at the Ege University Observatory (Turkey). After analyzing the data with Period98 (Sperl 1998) more than 30 frequencies were found to be significant. We present the data and results of our observational campaigns.

Delta scuti stars are pulsating variables of spectral types A to F of luminosity class III to V. They are situated in the lower part of the classical instability strip on and above the hydrogen-burning main sequence: the adult stage of stellar evolution. Most of these stars pulsate simultaneously in radial and nonradial modes, which makes them excellent candidates for asteroseismic studies.

With a very small value of $v \sin i = 6.8 \pm 1.6$ km/s (Solano & Fernley 1997), 44 Tau (spectral type F2 IV) is one of the most promising candidates for asteroseismology. The star rotates either very slowly or it is seen almost pole-on. In the case of slow rotation, the overlap of rotationally split modes of different orders is prevented, so that mode identification is simplified. Furthermore the small rotational velocity gives rise to easily recognizable equidistant multiplets.

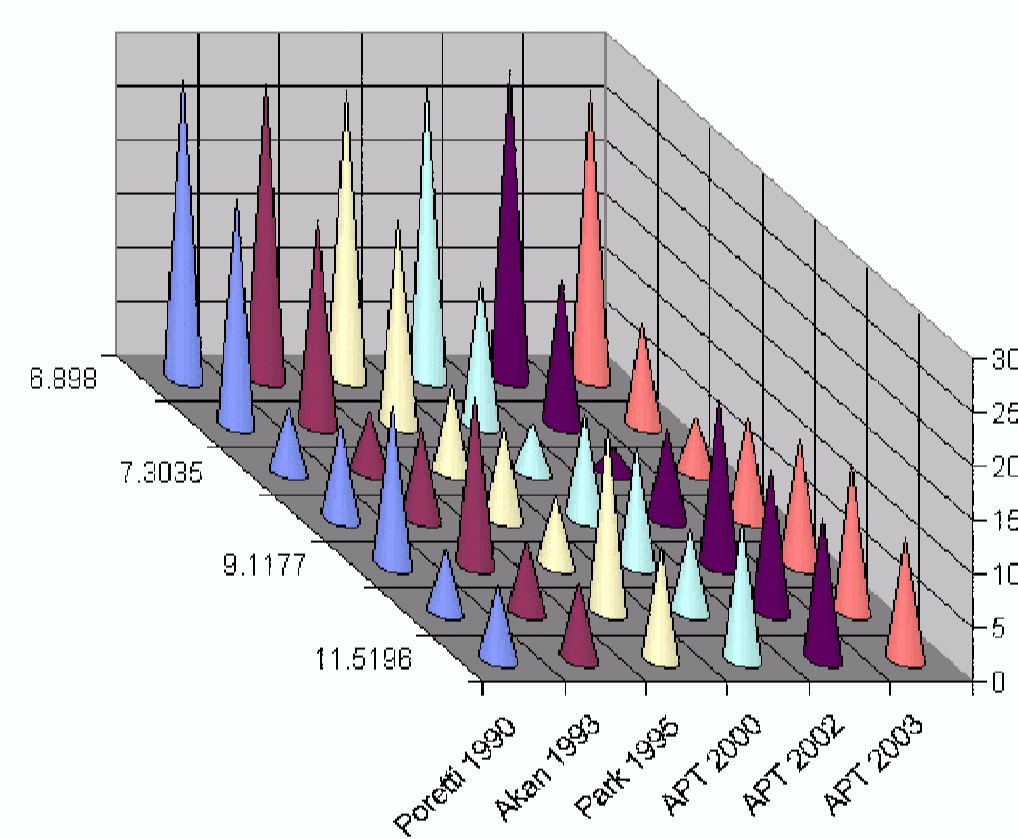
Mode identification

The identification of f_1 as the fundamental radial mode and of f_2 as its first overtone is suggested by the agreement of the period ratio model 3.1 by Stellingwerf (1979). These results also correspond to those of Kirbiyk (2003), Civelek (2001) and Poretti (1992).

Future work

Theoretical line-profile calculations have shown that, though the star is slowly rotating, spectroscopic mode identification is possible. As for FG Vir, due to the low value of the projected rotational velocity, photometry and spectroscopy are expected to reveal the same frequencies, which helps to disentangle the different modes.

The goal of the next observing campaign (starting next autumn) is the collection of sufficient photometric and spectroscopic data which will enable us to identify additional oscillation modes and to calculate theoretical models of 44 Tau.



	6.9	7.01	7.3	8.96	9.12	9.56	11.5
Poretti 1990	27.9	21.2	6	8.8	14.8	6	6.9
Akan 1993	27.6	19.2	5.7	8.6	15.8	6.7	7.2
Park 1995	27	19.2	8.1	8.5	6.4	16.9	10.6
APT 2000	27.1	13.5	4.5	9.9	11.1	7.7	12.7
APT 2002	28.9	13.6	2.3	8.4	15.4	13.4	13.1
APT 2003	27	9.6	5.1	9.5	11.9	13.9	11.4

Fig. 1: Amplitude variations between 1990 and 2003 in Strömgren y .

Photometry

In order to acquire the photometric data, the three-star technique (Breger 1993) was adopted, in which measurements of the variable star are alternated with those of the comparison stars *HD 25867* and *HD 25678*, for which no variability has been detected.

Frequency detection:

The combined photometric data were searched for periodic signals using Period98 (a package based on Fourier and multiple-least-squares techniques). 29 frequencies were found to be significant adopting the amplitude signal to noise (Breger 1993) criterion of 4.0, and for linear combination frequencies a S/N of 3.5. Furthermore, amplitude variations could be detected (Fig. 1). Table 1 summarizes the results.

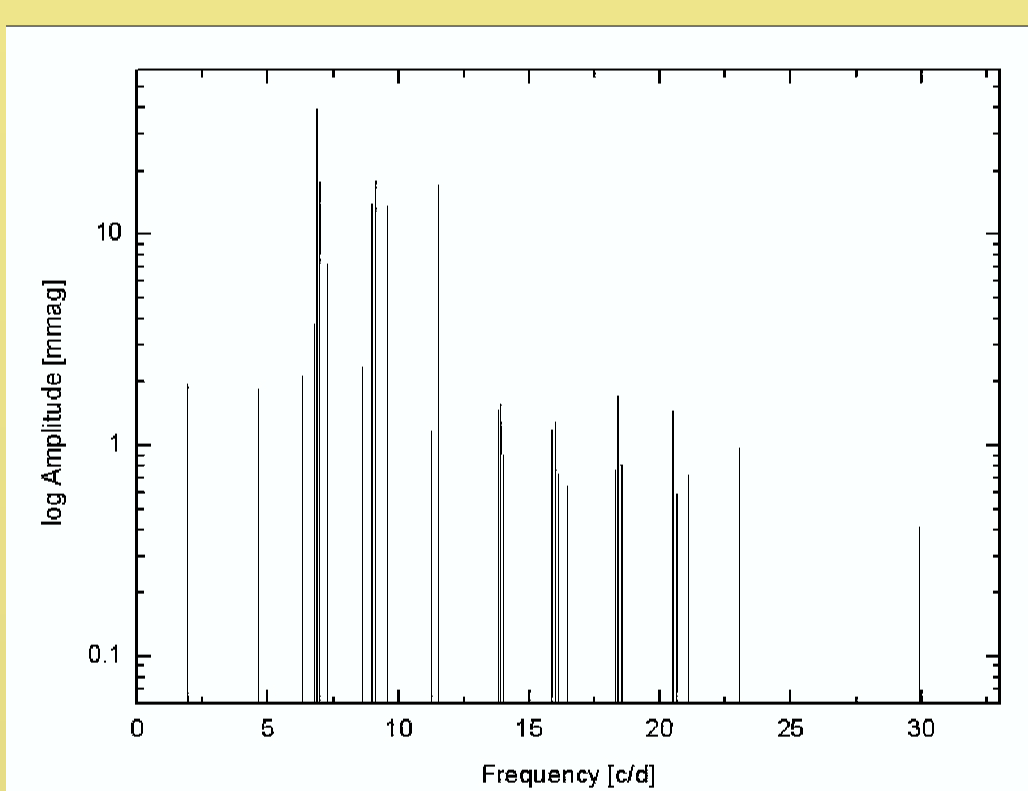


Fig. 2: Frequency spectrum of 44 Tau in Strömgren v .

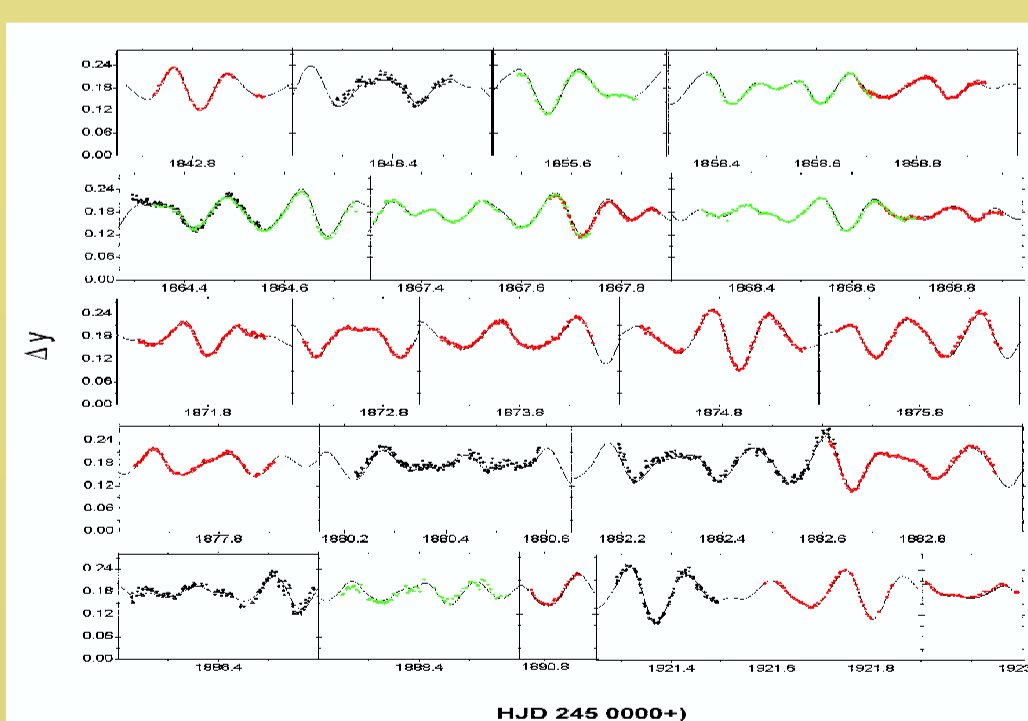


Fig. 3: Multisite photometry of 44 Tau obtained during the DSN campaign 2000/2001. The fit is shown as a solid curve. Red dots: APT, green dots: Sierra Nevada Obs., black dots: Ege University Obs.

	F [c/d]	A [mmag] v	A [mmag] y
f1	6.8980	39.06	26.75
f2	7.0060	17.74	12.43
f3	9.1175	17.91	12.23
f4	11.5196	17.25	12.20
f5	8.9606	14.00	9.71
f6	9.5613	13.72	9.09
f7	7.3034	7.20	4.72
f8	6.7952	3.76	2.95
f9	9.5803	2.44	1.63
f10	6.3390	2.14	1.75
f11	8.6421	2.36	2.04
f12	11.2920	1.17	0.77
f4-f6	1.95833	1.94	S/N < 3.5
f1+f4	18.4176	1.71	1.14
2f1	13.7961	1.47	1.11
f4+f5	20.4802	1.44	1.17
f1+f2	13.9040	1.57	0.80
f1+f5	15.8586	1.18	0.84
f1+f3	16.0155	1.30	0.99
2f4	23.0393	0.98	0.73
2f2	14.0120	0.91	0.69
f2+f4	18.5256	0.81	0.63
f2+f3	16.1235	0.73	S/N < 3.5
f4+f6	21.0809	0.72	S/N < 3.5
f4+f8	18.3149	0.76	0.60
f1+f6	16.4593	0.64	S/N < 3.5
f3+f4	20.6371	0.59	S/N < 3.5
2f4+f1	29.9373	0.41	S/N < 3.5
f4-f1	4.6216	S/N < 3.5	1.25

Table 1: Frequencies of 44 Tauri in Strömgren v and y .

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