# STUDY OF THE VARIABILITY OF THE DELTA SCUTI STARS

## II. *Photometric Observations of HR 5492*

MICHELE BOSSI, GIANANTONIO GUERRERO, LUCIANO MANTEGAZZA and MARCO SCARDIA

*Osservatorio Astronomico di Brera, Merate, Italy*

(Received 30 March, 1981)

**Abstract.** Photoelectric observations of the suspected Delta-Scuti star HR 5492 are given. The present data do not show any light variation greater than 0.01 mag. In spite of the very small light variations, the data analysis shows the presence of two periodicities, which are statistically significant. While the longest period ($1^d.296$) cannot be justified with the present data, the shorter one ($0^d.044$) is in excellent agreement with the hypothesis of an F4V star that is radially pulsating in the fundamental mode, even if this star is well outside the cold border of the instability strip.

### 1. Introduction

HR 5492 is catalogued as an F2IV star with $m_v = 6.25$ and trigonometric parallax of $0''.018 \pm 0''.006$. It is an interesting object because, notwithstanding it lies beyond the cold border of the instability strip (Breger, 1979), it shows, according to Percy (1973), some light variations of an amplitude of 0.03 mag and a possible period of about 3 or 7 hr.

Through the use of the unreddened color indices $[c_1]$, $[m_1]$, $[u - b]$ (Hauck, 1980) (from these colours it results also that the star is practicly unreddened, as we must expect from the fact that it has a measurable trigonometric parallax) and the calibration of Philip *et al.* (1976), we obtain the following physical parameters: $T_e = 6700$ K, $\log g = 4.3$, $M_v = 3.4$.

Said parameters define an F4V star, and, if correct, they place the star well on the right of the cold border of the instability strip.

Our observations, made in the $V$ colour (for the instrumental equipment and the observational procedure see Bossi *et al.* (1977)), are distributed during two observational seasons: 1978 (three nights), 1979 (seven nights), and they are collected in Table I. HD 13173 was the comparison star and HD 129226 and HD 129865 the check stars.

### 2. Analysis of the observations and discussion

By a first look it is apparent that the star does not shows any light variation with an amplitude larger than 0.01 mag.

The data were analyzed with a method similar to that proposed by Vaníček (1971). For each trial frequency, a least-squares solution is made simultaneously for the amplitudes of all known constituents of the data and the amplitude and phase of the

*Astrophysics and Space Science* **79** (1981) 463–468. 0004–640X/81/0792–0463$00.90.

TABLE I

| JD | $\Delta m_v$ | JD | $\Delta m_v$ | JD | $\Delta m_v$ | JD | $\Delta m_v$ |
|---|---|---|---|---|---|---|---|
| 43 595.4739 | 0.563 ± 0.003 | 44 002.3500 | 0.556 ± 0.008 | 44 062.3720 | 0.575 ± 0.011 | 44 064.4176 | 0.566 ± 0.002 |
| .4858 | 0.548 ± 0.006 | .3564 | 0.564 ± 0.003 | .3868 | 0.565 ± 0.005 | .4350 | 0.564 ± 0.001 |
| 43 596.4700 | 0.559 ± 0.001 | .3628 | 0.568 ± 0.001 | .3990 | 0.562 ± 0.003 | .4455 | 0.560 ± 0.002 |
| .4872 | 0.562 ± 0.001 | .3684 | 0.558 ± 0.002 | .4178 | 0.559 ± 0.002 | .4577 | 0.559 ± 0.002 |
| .5058 | 0.556 ± 0.004 | .3746 | 0.556 ± 0.004 | .4272 | 0.565 ± 0.003 | .4817 | 0.563 ± 0.002 |
| .5240 | 0.554 ± 0.004 | .3805 | 0.562 ± 0.003 | .4337 | 0.574 ± 0.004 | .5020 | 0.565 ± 0.002 |
| .5423 | 0.557 ± 0.003 | 44 008.3652 | 0.562 ± 0.003 | .4444 | 0.557 ± 0.008 | .5129 | 0.571 ± 0.002 |
| .5589 | 0.563 ± 0.002 | .3968 | 0.557 ± 0.002 | .4559 | 0.559 ± 0.005 | 44 065.3543 | 0.556 ± 0.006 |
| .5764 | 0.570 ± 0.005 | .4038 | 0.561 ± 0.002 | .4622 | 0.552 ± 0.011 | .3647 | 0.556 ± 0.004 |
| .5980 | 0.555 ± 0.004 | .4083 | 0.556 ± 0.002 | .4860 | 0.563 ± 0.003 | .3762 | 0.557 ± 0.002 |
| .6159 | 0.556 ± 0.002 | .4157 | 0.560 ± 0.003 | .4971 | 0.566 ± 0.005 | .3886 | 0.565 ± 0.006 |
| .6407 | 0.566 ± 0.003 | .4276 | 0.559 ± 0.003 | 44 063.3555 | 0.580 ± 0.005 | .4062 | 0.557 ± 0.004 |
| .6584 | 0.566 ± 0.002 | .4435 | 0.560 ± 0.002 | .3698 | 0.563 ± 0.004 | .4181 | 0.547 ± 0.010 |
| 43 632.4020 | 0.559 ± 0.002 | .4560 | 0.557 ± 0.002 | .3840 | 0.565 ± 0.003 | .4305 | 0.556 ± 0.003 |
| .4258 | 0.559 ± 0.001 | .4646 | 0.556 ± 0.002 | .3962 | 0.569 ± 0.002 | .4465 | 0.560 ± 0.008 |
| .4488 | 0.559 ± 0.001 | .4723 | 0.560 ± 0.003 | .4085 | 0.565 ± 0.001 | 44 070.3497 | 0.564 ± 0.003 |
| .4730 | 0.561 ± 0.001 | .4789 | 0.558 ± 0.003 | .4200 | 0.567 ± 0.002 | .3600 | 0.553 ± 0.002 |
| .4950 | 0.560 ± 0.001 | .4901 | 0.561 ± 0.003 | .4316 | 0.562 ± 0.001 | .3688 | 0.559 ± 0.001 |
| .5158 | 0.558 ± 0.001 | .5023 | 0.561 ± 0.003 | .4427 | 0.565 ± 0.003 | .3802 | 0.560 ± 0.001 |
| .5371 | 0.557 ± 0.001 | .5182 | 0.561 ± 0.002 | .4540 | 0.566 ± 0.005 | .3917 | 0.555 ± 0.002 |
| .5608 | 0.561 ± 0.001 | .5326 | 0.565 ± 0.002 | .4659 | 0.562 ± 0.002 | .4037 | 0.555 ± 0.003 |
| .5826 | 0.558 ± 0.002 | .5443 | 0.559 ± 0.003 | .4794 | 0.561 ± 0.003 | .4146 | 0.557 ± 0.001 |
| .6032 | 0.559 ± 0.001 | .5531 | 0.562 ± 0.003 | 44 064.3812 | 0.563 ± 0.002 | .4254 | 0.559 ± 0.002 |
| .6241 | 0.561 ± 0.001 | .5658 | 0.559 ± 0.003 | .3923 | 0.565 ± 0.002 | .4400 | 0.553 ± 0.002 |
| | | | | .4057 | 0.563 ± 0.002 | .4507 | 0.559 ± 0.003 |

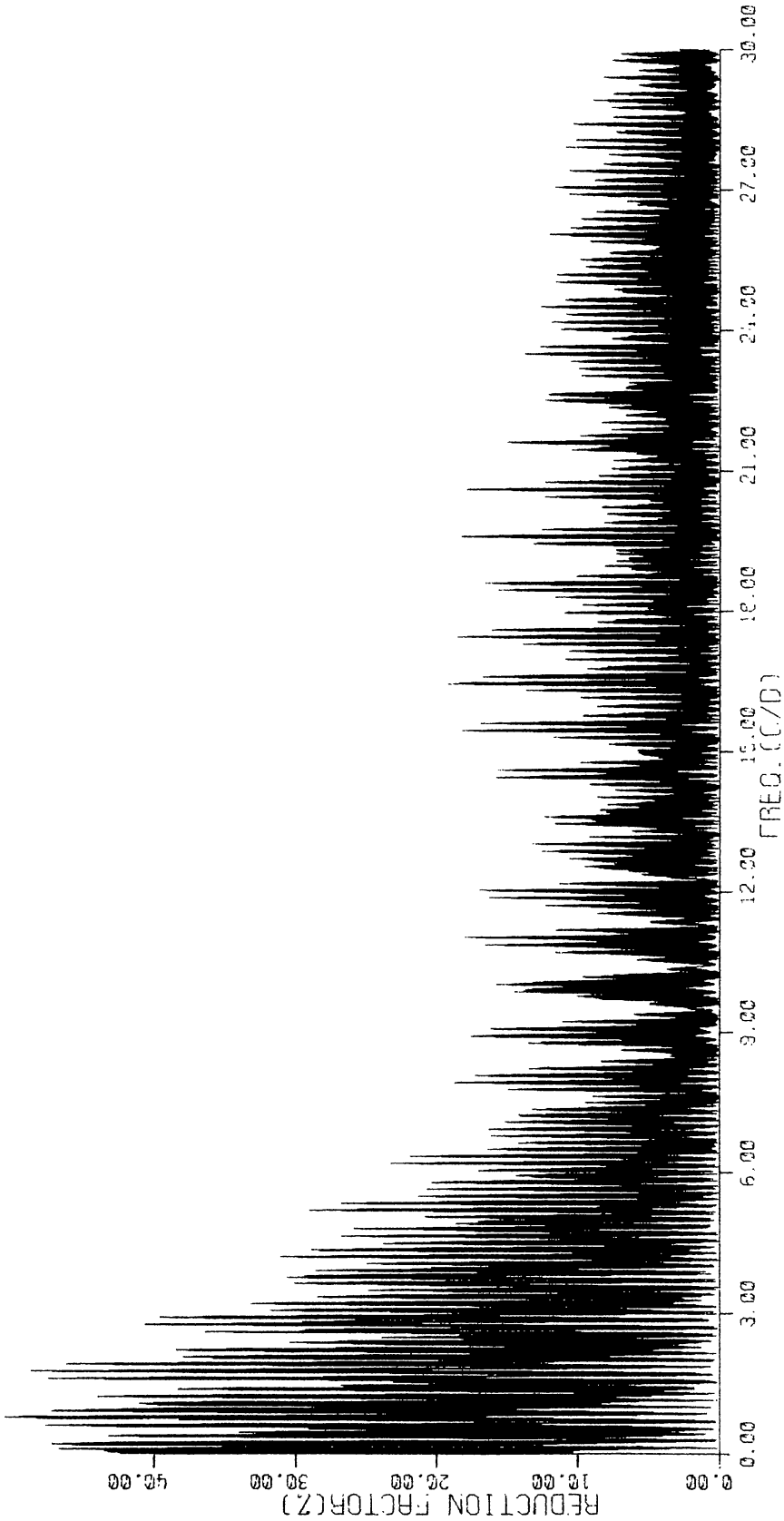


Fig. 1. Power spectrum of the 1979 data computed with the Vaníček method without known constituents.

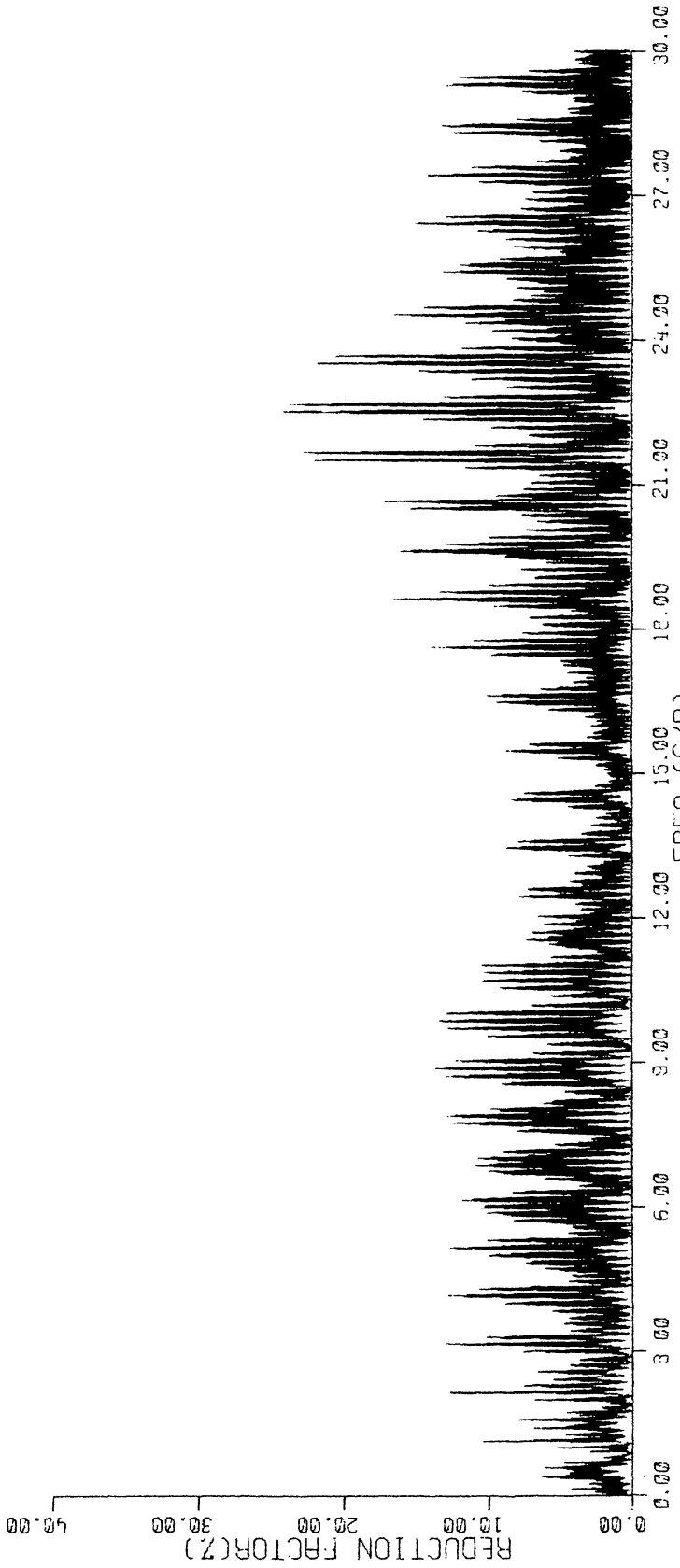


Fig. 2. The same as Figure 1, but with a sinusoid of $p_1 = 1^d.296$ given as a constituent datum.

sine wave with the trial frequency. According to our experience, this analysis scheme, even if more expensive in computational time than the more traditional methods, furnishes more reliable results in the search for multiperiodicity.

The preliminary analysis was conducted using all the 1979 data. We obtain two periods: P1 = $1^d.29$ and P2 = $0^d.044$ (see Figures 1 and 2).

At last we made a comprehensive solution, reported in Table II, utilizing the complete set of the data. We notice that the two periodicities, in spite of their very small amplitude, are statistically significant, since they overcome a partial F-test with a 99% of confidence (Buzzi-Ferraris, 1975).

We are unable to explain the 1.29 days period in the framework of the pulsational theory, also if similar periods were found by Kurtz (1979) in stars of similar kind, which show light variations with small amplitude. On the other hand we are not even sure that said period is to attribute to HR 5492, since the check stars were observed with the same frequency of the variable only for two long nights. In the other nights we made only sporadic observations, not at all suitable to disclose such a periodicity.

The value of the shorter period is in excellent agreement with the hypothesis of an F4V star that is radially pulsating in the fundamental mode. In fact if we introduce into the formula (5) of Petersen *et al.* (1972) the physical parameters given at the beginning of this paper for HR 5492, we obtain for the pulsation constant the value $Q = 0^d.033$ which agrees very well with the theoretical one calculated for the fundamental radial mode (Petersen, 1975). On the contrary, if we consider HR 5492, according to the literature, as a F2IV star, from the same formula we obtain $Q = 0^d.021$ (in this case we would have $T_e = 7000$ K, $\log g = 3.9$, $M_{bol} = 3.05$) which corresponds to higher pulsational mode. The fact that cold Delta Scuti stars tend to pulsate in the radial fundamental mode (Baglin *et al.*, 1980) can be a good argument in support of the first hypothesis.

## 3. Conclusions

We can confirme that HR 5492, in spite of being well outside of the usually adopted instability strip even more than it was believed, shows a pulsation of very small amplitude in the fundamental radial mode. If furthermore we compare the amplitude of the variations observed by Percy (1973) and the ones observed by us, it would rise the

TABLE II

| Periods | Amplitudes |
|---|---|
| $1^d.296 \pm 0.007$ | $0^m.0032 \pm 0.0006$ |
| $0^d.044 \pm 0.007$ | $0^m.0018 \pm 0.0005$ |
| Initial residual | $0^m.0036$ |
| Final residual | $0^m.0025$ |

suspicion of an appreciable variation in the pulsational amplitude on very long time-scale (we note parenthetically that the 1978 observations, if taken by themselves, do not show any appreciable light variations). In order to prove this fact much more observations distributed over a time interval of several years are needed.

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