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# $\tau^1$ HYDRAE: NOT A $\gamma$ DORADUS VARIABLE

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The F6 V star $\tau^1$ Hydrae (= 31 Hya = HR 3759 = HD 81997 A) is listed as a candidate $\gamma$ Doradus variable by Krisciunas & Handler (1995) and Handler & Krisciunas (1997). The $\gamma$ Dor stars have spectral types near F0 and low-amplitude photometric variability with periods between about 0.5 and 3 days. The inclusion of $\tau^1$ Hya in the candidate list was based on photometric variability reported by Lockwood, Skiff, & Thompson (1993). A more complete analysis of its photometric variability is given by Lockwood, Skiff, & Radick (1997, hereafter LSR). They reported $\tau^1$ Hya to be slightly variable from night to night (at greater than 95% significance) within five of their twelve observing seasons but did not have sufficient observations to search for periodicity. The average night-to-night rms variation for their twelve seasons was 0.0021 mag in the combined Strömgren $(b+y)/2$ wavelength band. They also noted significant long-term variability of 0.01 mag.

Duquennoy & Mayor (1991) discovered $\tau^1$ Hya to be a single-lined spectroscopic binary with a period of 7.7 yr. No photometric variability was detected by Perryman et al. (1997) in the *HIPPARCOS* catalogue, which gives $V = 4.59$, $B - V = 0.411$, and $\pi = 58.48$ mas. However, the *HIPPARCOS* color index is probably in error and should be 0.461; the catalogue cites ground-based photometry as the source of the color index, and the General Catalogue of Photometric Data lists 11 determinations of $B - V$ with a mean of 0.461 (Mermilliod, Hauck, & Mermilliod 1997). Thus, the apparent magnitude, color index, and parallax are consistent with a spectral classification of F6 V.

We have observed $\tau^1$ Hya for six seasons with a 0.75 m automatic photoelectric telescope (APT). Our Strömgren $b$ and $y$ observations were made differentially with respect to the comparison star HD 81342 ($V = 6.88$, F5), the same one used by LSR. HD 81997 B, located 66 arcseconds from $\tau^1$ Hya, was excluded from the diaphragm during our measurements. Each differential magnitude was corrected for extinction and transformed to the Strömgren system. We also combined our $b$ and $y$ observations into a single $(b+y)/2$ band to increase precision. Further details on the reductions can be found in Henry (1995).

The analysis of our APT photometry is summarized in Table 1. Column 1 gives the year, column 2 the Julian Date range, column 3 the number of observations, and column 4 the seasonal-mean differential magnitudes in the Strömgren $(b + y)/2$ band. Column 5 lists the night-to-night variability ($\sigma_{\rm short}$) for each observing season, computed as the standard deviation of a single observation from the seasonal mean. The final column

Table 1: Photometric Analysis of $\tau^1$ Hya

| Year | Date Range HJD − 2400000 | $n$ | Seasonal Mean (mag) | $\sigma_{\rm short}$ (mag) | $\sigma_{\rm mean}$ (mag) |
|---|---|---|---|---|---|
| 1993 | 49094–49121 | 8 | −2.3170 | 0.0013 | 0.0005 |
| 1994 | 49295–49482 | 78 | −2.3162 | 0.0011 | 0.0001 |
| 1995 | 49662–49840 | 74 | −2.3163 | 0.0015 | 0.0002 |
| 1996 | 50030–50213 | 46 | −2.3157 | 0.0013 | 0.0002 |
| 1997 | 50405–50552 | 30 | −2.3154 | 0.0014 | 0.0002 |
| 1998 | 50761–50944 | 47 | −2.3144 | 0.0018 | 0.0003 |

gives the uncertainty in the seasonal means ($\sigma_{\rm mean}$), computed as the standard deviation from Column 5 divided by the square root of the number of observations from Column 3.

Our observations overlap those of LSR for the 1993–1995 seasons and are considerably more numerous; within these three seasons, LSR reported variability in 1995. The mean of our six seasons of night-to-night variability is only 0.0014 mag. This level of variation is just what we observe for the most constant stars and so represents the precision limit of this telescope (Henry 1995). Furthermore, periodogram analysis of our six seasons of observations, taken separately and also combined into a single data set, show no significant periodicities in the range 0.1 to 10 days. Thus, we can find no evidence at all for short-term photometric variability in $\tau^1$ Hya. This precludes its classification as a $\gamma$ Dor star.

Our seasonal means, however, *do* confirm the long-term variability observed by LSR, although the shorter time span of our observations gives a smaller range of only 0.002 or 0.003 mag. Given the location of the star in the HR diagram, these slow variations are probably the result of a magnetic-activity cycle (see, e.g., Baliunas et al. 1998).

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