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BV(RI)_C OBSERVATIONS OF FY Vul

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FY Vul is a poorly known dwarf nova (DN) of the Z Cam subtype, characterized by a typical interval time between two subsequent outbursts of 30-50 days (Richter, 1961). The star varies between $B=13^m.4$ to $B=15^m.3$ (Downs and Shara, 1993). First photometric studies were made by Meinunger (1965), while Bruch (1984) reported the color index of the variable: $(U - B) = -0^m.65$ and $(B - V) = 0^m.53$. Spectroscopic observations were taken by Downes et al. (1995): they revealed $H\alpha$ in emission, while $H\beta$ and $H\gamma$ are in absorption with an emission core. Although, the spectrum is typical of a dwarf nova near the end of an outburst and it confirms the DN classification for the object, the overall variability is less than 2 magnitudes.

In this paper we report photometric observations of FY Vul obtained at the Teramo Astronomical Observatory of Collurania in August-September 1998, and at the Perugia Astronomical Observatory in July-August 2001. The first series of observations were taken with the 0.72 m Ritchey-Chretien reflector of Collurania, equipped with a Tektronix 512 CCD camera and B , V (Johnson), R_C , I_C (Cousins) filters: the data are reported in Table 1. The photometric techniques used have already been described in two parallel papers about V503 Cyg (Spogli et al. 2000a) and V516 Cyg (Spogli et al. 2000b). The standard magnitudes of the comparison stars are reported by Misselt (1996), additionally, we calibrated the standard magnitudes of some of these stars with the I_C filter: $I_C(2) = 13^m.24 \pm 0^m.04$, $I_C(3) = 12^m.96 \pm 0^m.04$, $I_C(4) = 13^m.82 \pm 0^m.04$, $I_C(5) = 13^m.99 \pm 0^m.04$, and $I_C(11) = 13^m.13 \pm 0^m.04$.

Table 1: $BV(RI)_C$ magnitudes of FY Vul in August-September 1998

| Date | JD (2451000+) | B | V | R_C | I_C |
|------------|---------------|------------------|------------------|------------------|------------------|
| 30/08/1998 | 56.385 | 15.11 ± 0.08 | 14.76 ± 0.05 | 14.47 ± 0.04 | 14.23 ± 0.04 |
| 31/08/1998 | 57.368 | 14.98 ± 0.05 | 14.66 ± 0.04 | 14.31 ± 0.04 | 14.10 ± 0.04 |
| 01/09/1998 | 58.351 | 14.89 ± 0.05 | 14.52 ± 0.04 | 14.28 ± 0.04 | 13.99 ± 0.04 |
| 02/09/1998 | 59.355 | 14.83 ± 0.06 | 14.50 ± 0.04 | 14.21 ± 0.04 | 13.97 ± 0.04 |

We observed FY Vul in July-September 2001 with the 0.40 m Automatic Imaging Telescope at the Perugia University Observatory. The equipment used and the procedures

of data analysis have already been described in Spogli et al. (1998). The $BV(RI)_C$ data collected are reported in Table 2.

Table 2: $BV(RI)_C$ magnitudes of FY Vul in July-September 2001

| Date | JD (2451000+) | B | V | R_C | I_C |
|----------|------------------|------------|------------|------------|------------|
| 15/07/01 | 1106.589 | 14.65±0.08 | 14.19±0.02 | 14.01±0.03 | 13.59±0.04 |
| 17/07/01 | 1108.551 | 14.88±0.03 | 14.25±0.01 | 14.72±0.02 | 13.91±0.04 |
| 22/07/01 | 1113.517 | 14.79±0.13 | 14.61±0.05 | 14.29±0.06 | 13.74±0.04 |
| 23/07/01 | 1114.479 | 14.77±0.11 | 14.49±0.03 | 14.26±0.07 | 13.97±0.04 |
| 24/07/01 | 1115.469 | 14.85±0.08 | 14.59±0.07 | 14.26±0.03 | 13.97±0.04 |
| 27/07/01 | 1118.480 | 14.74±0.09 | 14.47±0.06 | 14.27±0.03 | 13.92±0.04 |
| 28/07/01 | 1119.541 | 14.71±0.09 | 14.34±0.06 | 14.14±0.04 | 13.57±0.04 |
| 04/08/01 | 1126.415 | 14.22±0.12 | 14.09±0.04 | 13.92±0.04 | |
| 05/08/01 | 1127.406 | 14.55±0.13 | 14.13±0.07 | 14.08±0.05 | |
| 06/08/01 | 1128.413 | 14.52±0.13 | 14.39±0.05 | 14.25±0.05 | 13.83±0.04 |
| 09/08/01 | 1131.408 | 14.81±0.08 | 14.62±0.04 | 14.39±0.03 | 14.06±0.04 |
| 11/08/01 | 1133.414 | 14.79±0.11 | 14.38±0.03 | 14.15±0.05 | 13.88±0.04 |
| 12/08/01 | 1134.413 | 14.58±0.04 | 14.39±0.03 | 14.09±0.07 | 13.93±0.04 |
| 13/08/01 | 1135.562 | 14.63±0.08 | 14.43±0.03 | 14.26±0.07 | 13.88±0.04 |
| 14/08/01 | 1136.395 | 14.65±0.07 | 14.37±0.05 | 14.11±0.05 | 13.88±0.04 |
| 18/08/01 | 1140.389 | 14.15±0.09 | 13.94±0.05 | 13.71±0.04 | 13.49±0.04 |
| 19/08/01 | 1141.419 | 14.28±0.07 | 13.97±0.05 | 13.85±0.04 | |
| 20/08/01 | 1142.366 | 14.32±0.07 | 14.05±0.05 | 13.85±0.04 | 13.64±0.04 |
| 21/08/01 | 1143.421 | 14.32±0.09 | 14.16±0.05 | 13.94±0.04 | 13.66±0.04 |
| 27/08/01 | 1149.443 | 14.87±0.06 | 14.45±0.06 | 14.23±0.04 | 13.92±0.04 |
| 28/08/01 | 1150.382 | 14.64±0.14 | 14.44±0.07 | 14.23±0.06 | 13.74±0.04 |
| 12/09/01 | 1165.328 | 14.83±0.13 | 14.55±0.09 | 14.32±0.07 | 14.09±0.05 |

The light curve (see Figure 1) seems to show quasi-periodic variation with a period of ~ 15 -20 days, and a full amplitude of ~ 0.7 mag. Probably FY Vul was in a long phase of standstill, but it is not excluded in a previously unrecognized group of low-amplitude dwarf novae (see Kato et al. 1999). Table 3 resumes the main photometric characteristics of the variable during this phase.

Table 3: Photometric characteristics of FY Vul in July-September 2001

| | B | V | R_C | I_C |
|------------------|-----------|-------------|---------------|-------------|
| Maximum | 14.15 | 13.94 | 13.71 | 13.57 |
| Minimum | 14.88 | 14.62 | 14.49 | 14.09 |
| Mean color index | $(B - V)$ | $(V - R_C)$ | $(R_C - I_C)$ | $(V - I_C)$ |
| | 0.29 | 0.18 | 0.33 | 0.51 |

To study the behavior of the optical continuum of FY Vul, we computed the spectral index α using the same procedure used in Spogli et al. (1998), neglecting interstellar reddening. We find that in this phase the spectral distribution is probably dominated by the emission of the secondary star. However, more observations are needed to clarify the nature of this interesting object.

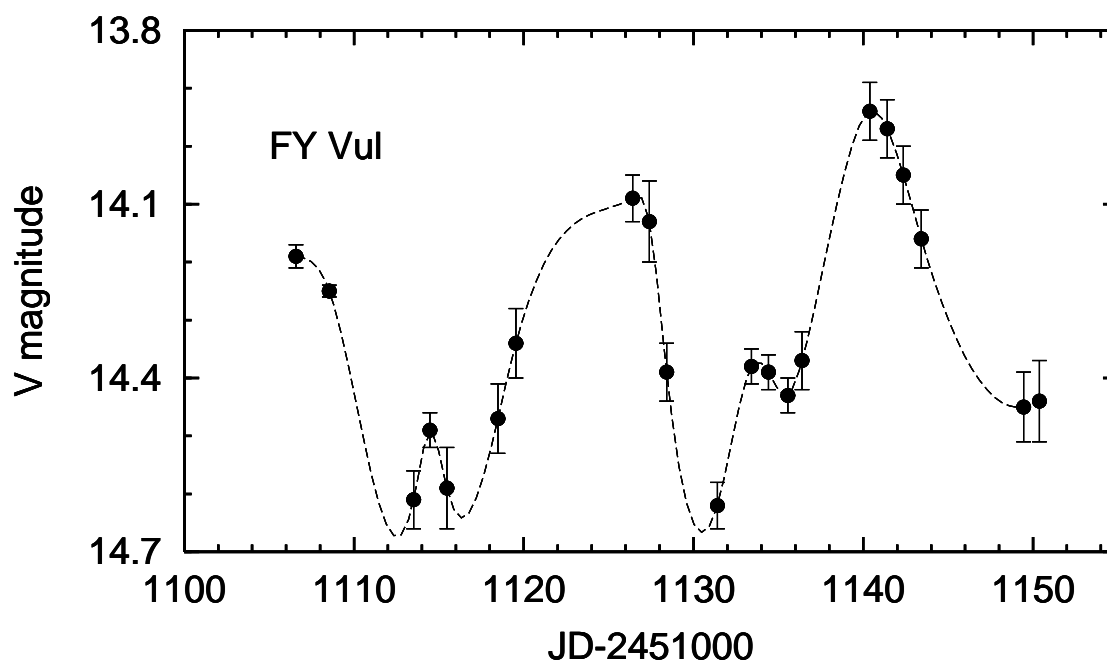


Figure 1. Light curve of FY Vul. Dashed line connects consecutive points by natural cubic spline after rendering the data monotonic

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