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MULTICOLOUR OBSERVATIONS OF THE FLICKERING OF V425 CASSIOPEIA

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Abstract. We report our investigation of the flickering variability of the cataclysmic variable V425 Cas on the basis of observations in 5 bands ($UBVR_cI_c$). We find for the flickering source a temperature $T_{fl} \approx 12000\ K$, and a radius $r \sim 0.05 - 0.10\ R_\odot$. We analyze the flickering amplitude (ΔF) and search for a relation with the mean flux (F_{av}). Using all five bands, we find that $\Delta F \propto F_{av}^k$, where $k = 1.22 \pm 0.12$. The value is more similar to that of the symbiotic stars CH Cyg and T CrB, than to that of the cataclysmic varaibale KR Aur.

1. INTRODUCTION

The cataclysmic variables are close semi-detached binary systems in which a white dwarf primary accretes matter from a red dwarf via Roche lobe overflow. V425 Cas is a novalike, member of VY Scl-type stars (antidwarf novae). The antidwarf novae are a small group of novalike variables, which show temporary reduction or cessation of the mass accretaion (see Kato et al. 2001 and references therein). The orbital period is $P_{orb} = 0.14964$ days (Shafter and Ulrich 1982), the distance to the system is about 700 pc (see e.g. Ak et al. 2007). The masses of the components are $M_1 = 0.86 \pm 0.32$ $M_\odot$ and $M_2 = 0.31 \pm 0.02\ M_\odot$. The V brightness changes in the range $14 - 19\,mag$.

2. OBSERVATIONAL DATA

We present 25 sets of observations of the flickering of antidwarf novae V425 Cas, obtained during the period 2006 – 2009. The duration of the observations was from 30 min to 2 hours. An example is given in Fig. 1. In 8 nights, we also obtained simultaneous multicolor observations of the flickering in U, B, V, R_c, I_c (see Table 1).

The observations are obtained with the telescopes of the National Astronomical Observatory Rozhen and AO Belogradchik: 1) the 2m RCC telescope of NAO Rozhen using a dual channel focal reducer FoReRo2, equipped with a CCD Photometrics 1024x1024 px for the blue channel, and a CCD VersArray 512x512 px for the red channel, respectively; 2) the 50/70 cm Schmidt telescope of NAO-Rozhen equipped with CCD cameras SBIG ST8 or STL11000M; 3) the 60 cm telescope of NAO Rozhen (FLI PL 9000); 4) the 60 cm telescope of AO Belogradchik (SBIG ST8 or FLI PL 9000).

Table 1: Simultaneous observations of V425 Cas. In the table are given date of observations, average magnitudes in UBVRI, the ratio of fluxes. The two bottom rows give the average value of the ratios and the calculated minimum flux (F_{min}) in each band in units $10^{-18}\ W \times m^{-2} \times nm^{-1}$.

Date	*U*	*B*	*V*	*R*	*I*	F_B/F_U	F_B/F_V	F_B/F_R	F_B/F_I
25/08/2006		15.27			14.61				2.94
16/09/2006		15.00			14.42				3.16
28/10/2008		14.95	14.78				1.57		
18/01/2009		15.34	15.09		14.66		1.46		2.88
20/01/2009		15.58			14.91				2.91
20/01/2009	14.82	15.53	15.35	14.92	14.80	0.82	1.56	1.67	2.75
22/07/2009		15.51	15.27		14.82		1.47		2.86
23/07/2009	14.08	14.94	14.69	14.34	14.25	0.71	1.46	1.69	2.86
Average						0.76	1.50	1.68	2.91
F_{min}	3.46	2.63	1.75	1.57	0.90				

3. RESULTS AND DISCUSSION

On the base of the observations, we calculate the flickering amplitude $\Delta F = F_{max}$-F_{min} and the average flux F_{av} of the hot component (see also Bruch 1992, Zamanov et al. 2004). We correct F_{av} for the minimum flux of the system, supposing that at the minimum light the contribution of the accretion disk could be neglected. From the literature, the minimum magnitude only in B band is known. We calculate the minimum fluxes for other bands with the assumption that the ratios of those fluxes are constant (Table 1).

Following Bruch (1992), we consider the light curves as composed from (1) constant part evaluated by minimum flux F_{min} for the set and (2) variable flickering light source, which can be represented as $F_{fl} = F_{av}$-F_{min} with the assumption of 100 % modulation of the source. We used Bessel (1979) calibration for the flux of a zero magnitude star. For the distance to V425 Cas we adopt $d = 700$ pc and interstellar extinction $E_{B-V} = 0.10$ (Szkody 1985).

Using together the data for all five bands (Fig. 2), we find that the flickering amplitude depends on the average flux as $\Delta F \propto F_{av}^{1.22}$. Similar relations are found for a few systems – CH Cyg ($k = 1.40 - 1.45$, Mikolajewski et al. 1990), T CrB ($k = 1.03 \pm 0.09$, Zamanov et al. 2004) and KR Aur ($k = 0.70 - 0.75$, Boeva et al. 2007). The value $k = 1.22 \pm 0.12$ for V425 Cas is closer to the values $1.0 - 1.4$ derived for the symbiotic stars, than to $k = 0.75$ for the cataclysmic variable KR Aur.

In Table 2 we present calculated magnitudes of the flickering light source, its temperature and radius for our data obtained on 20/01/2009 and 23/07/2009.

Table 2: The calculated magnitudes, radius and temperature of the flickering light source from the simultaneous observations on 20.01.2009 and 23.07.2009.

	U	B	V	R	I	r/$R_\odot$	T
20.01.2009	16.48	17.56	17.48	17.11	16.97	0.055	13 380 K
23.07.2009	15.80	16.74	16.41	16.45	16.59	0.10	11 310 K

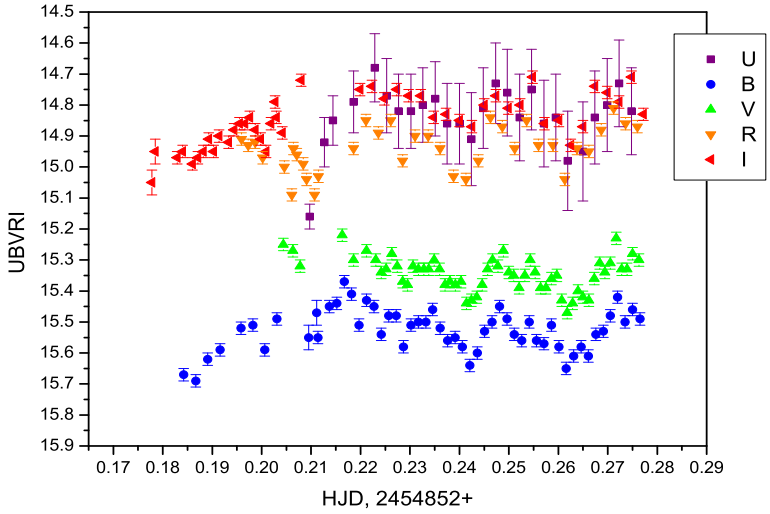

Figure 1: Simultaneous observations of V425 Cas in the $UBVRI$ bands on 2009 January 20.

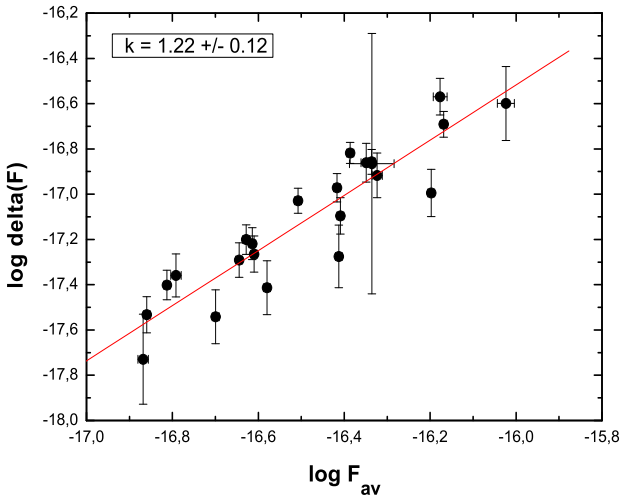

Figure 2: The flickering amplitude (ΔF), versus the average flux of the hot component (F_{av}) in logarithmic scale. The axes are in units of Watt $\mathrm{m}^{-2}\mathrm{nm}^{-1}$. The contribution of the red dwarf has been removed. The solid line is a linear least squares fit of the type $\Delta F \propto F_{av}^{k}$, where $k = 1.22 \pm 0.12$.

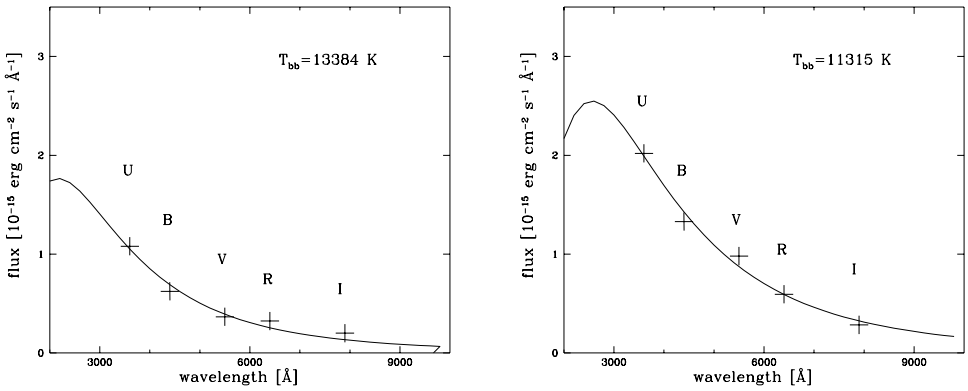

Figure 3: Dereddened fluxes of the flickering light source of V425 Cas. The solid line represents a black body fit. **Left panel:** January 20, 2009, $T = 13380\,K$, radius $r = 0.055\,R_{\odot}$, located at distance d=700 pc. **Right:** July 23, 2009, $T = 11315\,K$, $r = 0.1\,R_{\odot}$.

Using a black body model fit, we calculate the temperature and the radius of the flickering light source in V425 Cas: $T = 11000 - 13000\,K$ and $r = 0.05 - 0.10\,R_{\odot}$ (Fig. 3). The values are similar to the temperatures and radii of the bright spots of other cataclysmic variables. One other place for the origin of the flickering is the boundary layer between the accretion disk and white dwarf. However the value of $T = 11000 - 13000\,K$ is too low for a boundary layer.

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