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CCD photometry of the dwarf nova Trianguli 2008 - a new WZ Sge-type object

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Abstract.
We present the $UBV(RI)_C$ photometry of the dwarf nova Tri 2008 = OT J023839.1+355648 obtained during its superoutburst started on October 25, 2008. The object can be classified as a WZ Sge-type dwarf nova. The period of early superhumps 0.05307 days was detected in the first 7 days of the superoutburst. The period of ordinary superhumps 0.053663 days, detected in days 8-23 of the superoutburst, is the shortest one among WZ Sge-type objects. After one month, the dwarf nova returned to its pre-outburst state. A sudden increase of activity of the object during its quiescent stage was detected on January 11, 2009.
Key words: dwarf novae – photometry, superoutburst

1. Introduction

Dwarf novae (DNe) are a subclass of cataclysmic variable stars, which are semi-detached binaries containing a white dwarf primary and a red dwarf secondary (see Cherepashchuk et al., 1996, Warner, 1995, Kato et al., 2001). SU UMa-type DNe exhibit two types of outbursts: normal - lasting a few days and superoutbursts lasting tens of days. A characteristic feature of the superoutbursts is the presence of periodic light oscillations called superhumps. Periods of superhumps are a few percents longer than their binary periods. WZ Sge-type DNe are a subgroup of SU UMa-type DNe, which exhibit large amplitude superoutbursts (~ 8 mag) with the recurrence time of the order of decades. In the early phase of the superoutburst "early superhumps" or "outburst orbital humps" with the binary orbital period are detected.

A number of papers have been devoted to the explanation of "early superhumps" phenomenon (Osaki & Meyer, 2002, Kato, 2002) and "late superhumps" (see, Kato et al., 2008).

On October 26, 2008, Maehara (2008) reported an outburst of the dwarf nova in Triangulum at the coordinates $\alpha_{2000} = 2^h38^m39\overset{s}{.}11$, $\delta_{2000} = +35°56'48\overset{''}{.}3$. The brightness of the DNe at the time of the discovery was 14.12 mag, measured with an unfiltered CCD. They found a faint counterpart with 21.74 mag in the

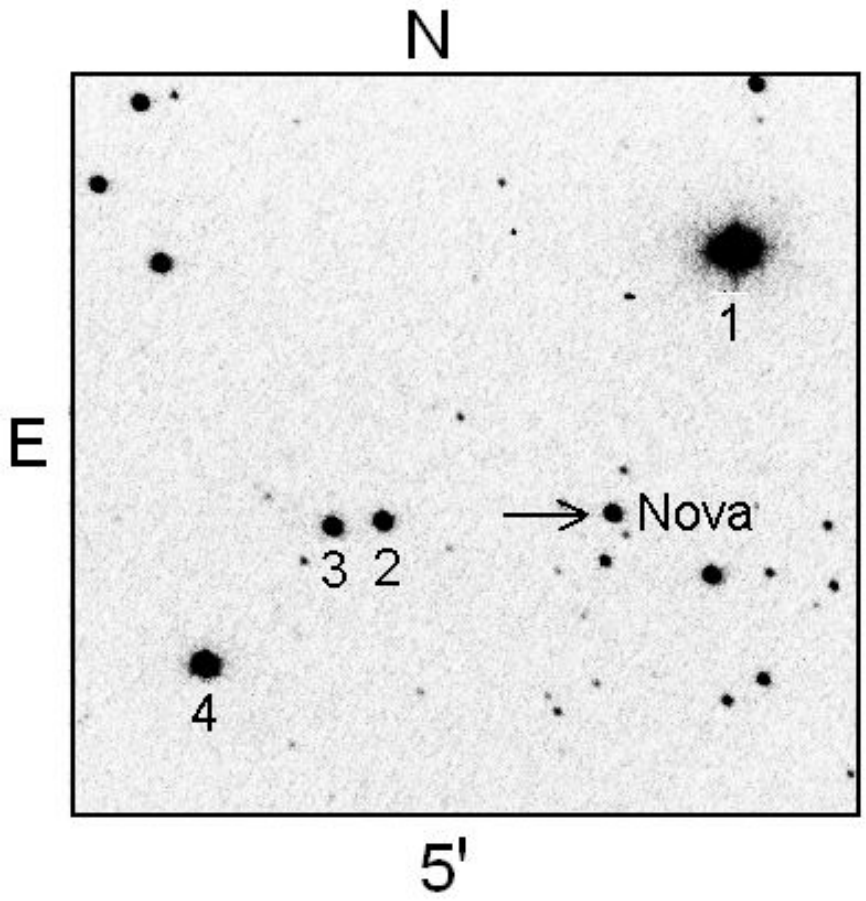

Figure 1. The $UBV(RI)_C$ photometric comparison sequence around the dwarf nova Tri 2008.

Table 1. The magnitudes of the comparison stars.

GSC	V	$U-B$	$B-V$	$V-R_C$	R_C-I_C	Sp	Star
2336 2105	9.955(3)	0.12(1)	0.166(7)	0.05(1)	0.04(2)	A6 V	1
2336 2285	12.433(6)	1.28(3)	1.241(9)	0.66(1)	0.53(2)	K2 III	2
2336 2307	13.035(7)	0.12(1)	0.688(11)	0.42(1)	0.35(2)	G5 V	3
2336 2309	11.482(4)	0.20(1)	0.638(7)	0.37(1)	0.28(2)	G2 V	4

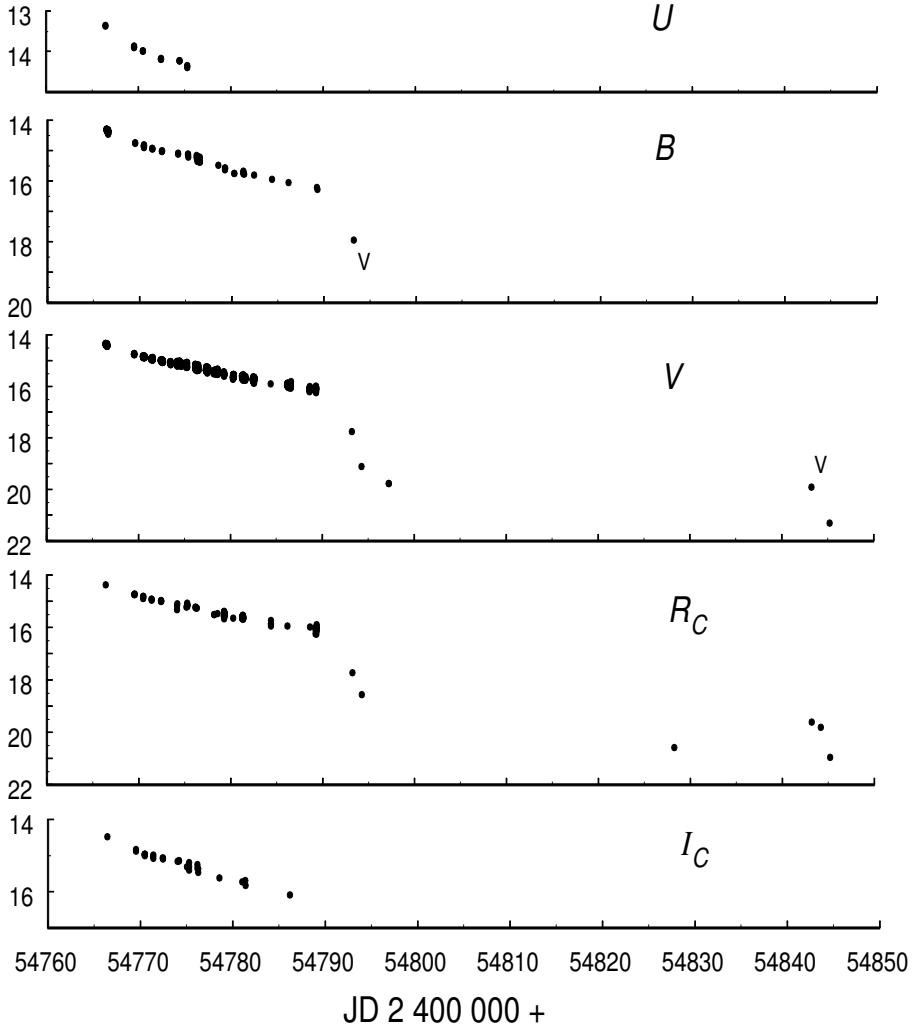

Figure 2. $UBV(RI)_C$ observations of the dwarf nova Tri 2008 during its superoutburst.

blue region in GSC2.3 (photoemulsion Kodak 103aJ, POSS II blue, see Fig. 8). We estimated the error of this figure to be about 0.5 mag, typical for GSC photometry of the stars close to the photometric limit of the plate. Nevertheless, it still indicates a large amplitude superoutburst typical for WZ Sge-type DNe. Nakajima (see Kato, 2008a) did not detect any clear superhumps larger than 0.1 mag during the 7.5 hour observations of this object before October 28, 2008. The early superhumps with the period 0.0531 days and ordinary superhumps with the period 0.0537 days were discovered by Shugarov et al. (2008). Similar periods were found independently by Maehara and Ohsima (see Kato, 2008b).

2. CCD photometry and data reduction

2.1. Photometry

Our $UBV(RI)_C$ CCD observations were taken with the SBIG ST10-XME camera mounted in the Newton focus of the 0.5 m(f/5) reflector at the Stará Lesná Observatory and with the Apogee 47p camera mounted in the Cassegrain focus of the 0.6 m(f/12.5) reflector at the Crimean Laboratory of the Sternberg Astronomical Institute. We determined the $UBVR$ magnitudes of the star "1" from Fig. 1, which is the brightest in the region, with the photoelectric photometer (photomultiplier R 2949S) and 0.6 m(f/12.5) reflector of the Stará Lesná Observatory in photometric quality night on November 3, 2008. The standard procedure of differential photometry was applied and HD15656 and HD16028 served as a standard and check star, respectively. The $UBV(RI)_C$ magnitudes of these stars were taken from Argue (1967), Eggen (1967) and Kornilov et al.(1991). Our photometric measurements for the star "1" are very close ($\sim 0^m.005$) to the reliable value $V = 9.95$ mag, which one can find in VizieR Service and Simbad. The magnitudes of the stars 2-4 (see Fig. 1) were found relatively to the star "1" in CCD-frames made with the optimal exposition for this purpose in different nights. It means that the peak counts for this bright star did not exceed 40 000 ADU. These data are presented in Table 1. We determined the spectral types of the comparison stars using their color indices and the standard $U-B, B-V$ diagram. The Maxim DL4 package and the special software designed by V. Goranskij were used for the processing of the CCD frames.

Our $UBV(RI)_C$ observations of the dwarf nova Tri 2008 during its superoutburst were taken in 21 nights between October 26 and November 23, 2008. Further VR_C observations were taken on December 28, 2008, and January 11, 12 and 13, 2009. They are presented together with heliocentric JD in Tables 2-6 and Fig. 2. The higher resolution observations taken on JD 2454766+ and JD 2454776+ and JD 2454781+ showing early and ordinary superhumps, are shown in Fig. 3.

Table 2. The U magnitudes of Nova Tri obtained at the Stará Lesná observatory. JD = JD* + 2 454 700.

JD*	U	JD*	U	JD*	U	JD*	U
66.4301	13.35	70.5023	13.99	72.4548	14.16	75.2997	14.39
66.4318	13.36	70.5035	13.98	74.4671	14.23		
69.5341	13.90	72.4519	14.18	74.4686	14.23		
69.5356	13.86	72.4534	14.19	75.2981	14.36		

Table 3. The B magnitudes of Nova Tri obtained at the Stará Lesná ("s"), and Crimea ("c") observatories. JD = JD* + 2 454 700.

JD*	B	JD*	B	JD*	B	JD*	B
66.4261	14.29 s	66.4961	14.32 s	66.5596	14.35 s	70.4816	14.84 s
66.4342	14.28 s	66.4978	14.33 s	66.5613	14.34 s	70.4868	14.81 s
66.4359	14.30 s	66.4995	14.35 s	66.5630	14.32 s	70.4886	14.80 s
66.4376	14.30 s	66.5011	14.35 s	66.5646	14.33 s	70.4947	14.85 s
66.4392	14.31 s	66.5028	14.31 s	66.5663	14.36 s	71.3887	14.91 s
66.4409	14.30 s	66.5045	14.33 s	66.5680	14.32 s	71.3949	14.94 s
66.4426	14.31 s	66.5062	14.33 s	66.5696	14.34 s	71.4020	14.93 s
66.4443	14.31 s	66.5078	14.33 s	66.5713	14.36 s	72.4336	15.02 s
66.4460	14.31 s	66.5095	14.33 s	66.5730	14.32 s	72.4397	15.00 s
66.4476	14.30 s	66.5112	14.33 s	66.5747	14.34 s	72.4456	15.00 s
66.4493	14.32 s	66.5128	14.32 s	66.5763	14.34 s	74.1909	15.07 s
66.4510	14.30 s	66.5145	14.35 s	66.5780	14.35 s	74.1940	15.11 s
66.4527	14.31 s	66.5162	14.35 s	66.5797	14.35 s	75.2725	15.11 s
66.4543	14.31 s	66.5178	14.32 s	66.5814	14.38 s	75.2758	15.14 s
66.4560	14.32 s	66.5195	14.33 s	66.5830	14.34 s	75.2779	15.11 s
66.4577	14.30 s	66.5212	14.35 s	66.5847	14.37 s	75.2932	15.21 s
66.4593	14.31 s	66.5229	14.32 s	66.5864	14.36 s	76.1904	15.15 s
66.4610	14.32 s	66.5245	14.33 s	66.5880	14.37 s	76.1937	15.23 s
66.4627	14.32 s	66.5262	14.35 s	66.5897	14.36 s	76.2772	15.35 s
66.4644	14.32 s	66.5279	14.34 s	66.5914	14.39 s	76.2778	15.30 s
66.4661	14.34 s	66.5295	14.34 s	66.5930	14.35 s	76.4695	15.32 s
66.4677	14.30 s	66.5312	14.34 s	66.5947	14.32 s	76.4733	15.31 s
66.4694	14.34 s	66.5329	14.32 s	66.5964	14.36 s	76.4770	15.30 s
66.4711	14.36 s	66.5345	14.33 s	66.5981	14.35 s	76.4808	15.33 s
66.4727	14.33 s	66.5362	14.34 s	66.5997	14.36 s	76.4846	15.36 s
66.4744	14.35 s	66.5379	14.32 s	66.6014	14.36 s	76.4883	15.36 s
66.4761	14.34 s	66.5396	14.32 s	66.6031	14.35 s	76.4921	15.32 s
66.4777	14.34 s	66.5412	14.34 s	66.6047	14.39 s	76.4958	15.28 s
66.4794	14.33 s	66.5429	14.34 s	66.6064	14.42 s	76.4996	15.30 s
66.4811	14.37 s	66.5446	14.35 s	66.6081	14.42 s	76.5033	15.23 s
66.4828	14.33 s	66.5462	14.34 s	66.6098	14.38 s	76.5108	15.20 s
66.4844	14.32 s	66.5479	14.36 s	66.6114	14.37 s	76.5146	15.21 s
66.4861	14.30 s	66.5496	14.36 s	66.6131	14.41 s	76.5184	15.26 s
66.4878	14.32 s	66.5513	14.33 s	66.6148	14.45 s	76.5221	15.30 s
66.4894	14.30 s	66.5529	14.34 s	69.5166	14.75 s	76.5259	15.30 s
66.4911	14.29 s	66.5546	14.32 s	69.5278	14.73 s	76.5296	15.35 s
66.4928	14.31 s	66.5563	14.35 s	70.4695	14.84 s	76.5334	15.34 s
66.4944	14.33 s	66.5579	14.34 s	70.4755	14.89 s	76.5371	15.37 s

Table 3. Continued.

JD*	B	JD*	B	JD*	B	JD*	B
76.5409	15.37 s	80.2921	15.74 c	82.4390	15.83 s	86.1810	16.04 s
78.5534	15.47 s	81.2674	15.75 c	82.4413	15.79 s	89.2501	16.21 s
79.2762	15.62 c	81.2712	15.71 c	82.4436	15.78 s	89.3000	16.27 c
79.2819	15.56 c	81.2749	15.66 c	84.3731	15.99 c	93.2400	17.94 c
79.2848	15.57 c	81.2786	15.71 c	84.3772	15.95 c	94.2800	(19 c
80.2881	15.74 c	81.3683	15.77 s	84.3809	15.87 c		

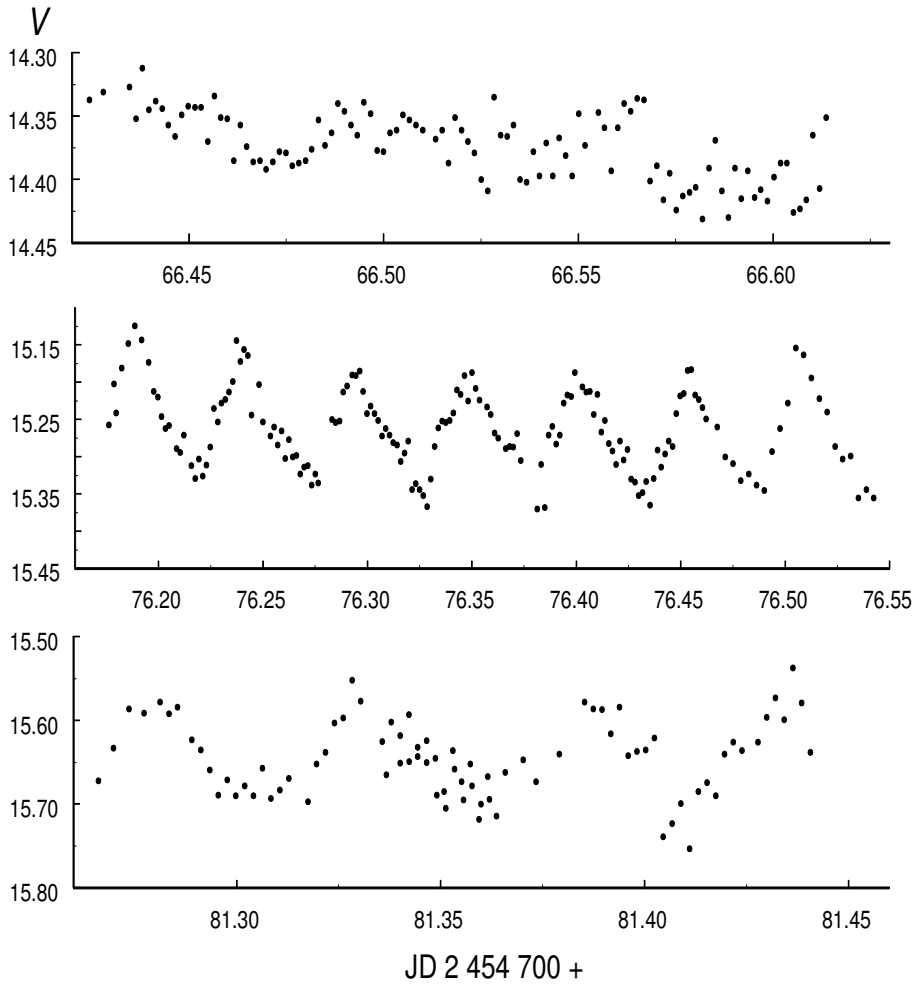

Figure 3. The early (top) and ordinary superhumps (middle and bottom) of the dwarf nova Tri 2008.

Table 4. The V magnitudes of Nova Tri obtained at the Stará Lesná ("s"), and Crimea ("c") observatories. JD = JD* + 2 454 700. Symbols "**" after JD in the last observations mean JD = JD* + 2 454 800.

JD*	V	JD*	V	JD*	V	JD*	V
66.4244	14.34 s	66.4949	14.34 s	66.5618	14.34 s	69.5313	14.73 s
66.4280	14.33 s	66.4966	14.35 s	66.5634	14.35 s	69.5386	14.75 s
66.4347	14.33 s	66.4983	14.38 s	66.5652	14.34 s	69.5426	14.71 s
66.4364	14.35 s	66.4999	14.38 s	66.5669	14.34 s	69.5458	14.72 s
66.4380	14.31 s	66.5016	14.36 s	66.5684	14.40 s	69.5518	14.75 s
66.4397	14.34 s	66.5033	14.36 s	66.5702	14.39 s	69.5535	14.77 s
66.4414	14.34 s	66.5049	14.35 s	66.5718	14.42 s	70.4899	14.80 s
66.4431	14.34 s	66.5066	14.35 s	66.5735	14.39 s	70.4960	14.83 s
66.4447	14.36 s	66.5083	14.36 s	66.5752	14.42 s	70.5005	14.82 s
66.4464	14.37 s	66.5100	14.36 s	66.5768	14.41 s	70.5054	14.84 s
66.4481	14.35 s	66.5133	14.37 s	66.5786	14.41 s	70.5065	14.82 s
66.4498	14.34 s	66.5150	14.36 s	66.5801	14.41 s	70.5076	14.83 s
66.4515	14.34 s	66.5166	14.39 s	66.5819	14.43 s	70.5087	14.83 s
66.4531	14.34 s	66.5183	14.35 s	66.5836	14.39 s	70.5109	14.82 s
66.4548	14.37 s	66.5200	14.36 s	66.5852	14.37 s	70.5120	14.86 s
66.4565	14.33 s	66.5216	14.37 s	66.5869	14.41 s	70.5131	14.88 s
66.4581	14.35 s	66.5233	14.38 s	66.5885	14.43 s	70.5142	14.82 s
66.4598	14.35 s	66.5250	14.40 s	66.5903	14.39 s	70.5153	14.84 s
66.4615	14.38 s	66.5267	14.41 s	66.5918	14.41 s	70.5164	14.84 s
66.4632	14.36 s	66.5283	14.33 s	66.5936	14.39 s	70.5175	14.84 s
66.4648	14.37 s	66.5300	14.36 s	66.5953	14.41 s	70.5186	14.83 s
66.4665	14.39 s	66.5317	14.37 s	66.5969	14.41 s	70.5197	14.84 s
66.4682	14.38 s	66.5333	14.36 s	66.5986	14.42 s	70.5208	14.85 s
66.4698	14.39 s	66.5350	14.40 s	66.6002	14.40 s	70.5219	14.85 s
66.4715	14.39 s	66.5367	14.40 s	66.6020	14.39 s	70.5230	14.87 s
66.4732	14.38 s	66.5384	14.38 s	66.6035	14.39 s	70.5241	14.84 s
66.4749	14.38 s	66.5400	14.40 s	66.6053	14.43 s	70.5252	14.85 s
66.4765	14.39 s	66.5417	14.37 s	66.6070	14.42 s	70.5263	14.83 s
66.4782	14.39 s	66.5434	14.40 s	66.6085	14.42 s	70.5274	14.84 s
66.4799	14.38 s	66.5450	14.37 s	66.6103	14.36 s	70.5285	14.84 s
66.4815	14.38 s	66.5467	14.38 s	66.6119	14.41 s	70.5296	14.85 s
66.4832	14.35 s	66.5484	14.40 s	66.6137	14.35 s	70.5307	14.83 s
66.4849	14.37 s	66.5501	14.35 s	69.5155	14.75 s	70.5318	14.84 s
66.4866	14.36 s	66.5517	14.37 s	69.5173	14.72 s	70.5329	14.84 s
66.4882	14.34 s	66.5551	14.35 s	69.5187	14.74 s	70.5340	14.86 s
66.4899	14.35 s	66.5567	14.36 s	69.5224	14.75 s	70.5351	14.85 s
66.4916	14.36 s	66.5585	14.39 s	69.5264	14.73 s	70.5362	14.85 s
66.4932	14.36 s	66.5601	14.36 s	69.5288	14.75 s	70.5373	14.85 s

Table 4. Continued.

JD*	V	JD*	V	JD*	V	JD*	V
70.5385	14.84 s	70.5858	14.83 s	70.6298	14.84 s	71.4145	14.93 s
70.5396	14.81 s	70.5869	14.83 s	70.6309	14.82 s	71.4156	14.93 s
70.5418	14.82 s	70.5880	14.84 s	70.6320	14.83 s	71.4167	14.94 s
70.5439	14.84 s	70.5891	14.79 s	70.6331	14.86 s	71.4178	14.89 s
70.5461	14.84 s	70.5902	14.84 s	70.6342	14.86 s	71.4189	14.92 s
70.5472	14.82 s	70.5913	14.84 s	70.6353	14.84 s	71.4200	14.92 s
70.5483	14.85 s	70.5924	14.84 s	70.6364	14.85 s	71.4237	14.93 s
70.5494	14.85 s	70.5935	14.85 s	70.6375	14.85 s	71.4248	14.88 s
70.5505	14.84 s	70.5946	14.84 s	70.6386	14.86 s	71.4259	14.92 s
70.5516	14.84 s	70.5957	14.82 s	70.6397	14.84 s	71.4270	14.90 s
70.5528	14.85 s	70.5968	14.85 s	70.6408	14.85 s	71.4281	14.90 s
70.5539	14.87 s	70.5979	14.85 s	70.6419	14.82 s	71.4292	14.90 s
70.5550	14.84 s	70.5990	14.83 s	70.6430	14.83 s	71.4303	14.89 s
70.5561	14.85 s	70.6001	14.83 s	70.6441	14.83 s	71.4314	14.91 s
70.5572	14.84 s	70.6012	14.84 s	70.6452	14.82 s	71.4325	14.92 s
70.5583	14.83 s	70.6023	14.84 s	70.6463	14.84 s	71.4336	14.92 s
70.5594	14.84 s	70.6034	14.83 s	70.6474	14.82 s	71.4347	14.90 s
70.5605	14.82 s	70.6045	14.83 s	70.6496	14.85 s	71.4358	14.91 s
70.5616	14.84 s	70.6056	14.84 s	70.6540	14.87 s	71.4369	14.89 s
70.5627	14.82 s	70.6067	14.82 s	70.6551	14.86 s	71.4380	14.91 s
70.5638	14.84 s	70.6078	14.86 s	70.6562	14.84 s	71.4391	14.90 s
70.5649	14.85 s	70.6089	14.83 s	70.6573	14.87 s	71.4402	14.92 s
70.5660	14.83 s	70.6100	14.84 s	70.6584	14.85 s	71.4413	14.91 s
70.5671	14.85 s	70.6111	14.83 s	70.6595	14.86 s	71.4424	14.90 s
70.5682	14.85 s	70.6122	14.86 s	70.6606	14.82 s	71.4435	14.93 s
70.5693	14.85 s	70.6133	14.86 s	70.6617	14.85 s	71.4446	14.92 s
70.5704	14.84 s	70.6144	14.85 s	70.6628	14.83 s	71.4457	14.92 s
70.5715	14.83 s	70.6155	14.87 s	70.6639	14.85 s	71.4468	14.87 s
70.5726	14.83 s	70.6166	14.86 s	70.6650	14.86 s	71.4479	14.92 s
70.5737	14.84 s	70.6177	14.86 s	70.6661	14.84 s	71.4490	14.91 s
70.5748	14.82 s	70.6188	14.85 s	70.6672	14.87 s	71.4501	14.91 s
70.5759	14.82 s	70.6199	14.84 s	70.6683	14.84 s	71.4512	14.91 s
70.5770	14.84 s	70.6210	14.84 s	71.3900	14.91 s	71.4535	14.90 s
70.5781	14.82 s	70.6221	14.84 s	71.3961	14.91 s	71.4557	14.93 s
70.5792	14.81 s	70.6232	14.84 s	71.4032	14.92 s	71.4567	14.91 s
70.5803	14.83 s	70.6243	14.82 s	71.4079	14.93 s	71.4583	14.90 s
70.5814	14.83 s	70.6254	14.82 s	71.4090	14.94 s	71.4600	14.91 s
70.5825	14.83 s	70.6265	14.84 s	71.4101	14.93 s	71.4617	14.88 s
70.5836	14.83 s	70.6276	14.85 s	71.4112	14.92 s	71.4633	14.91 s
70.5847	14.83 s	70.6287	14.84 s	71.4134	14.90 s	71.4644	14.93 s

Table 4. Continued.

JD*	V	JD*	V	JD*	V	JD*	V
71.4655	14.92 s	71.5129	14.95 s	72.4348	14.98 s	72.5106	15.00 s
71.4667	14.90 s	71.5140	14.96 s	72.4381	14.97 s	72.5120	15.00 s
71.4678	14.90 s	71.5151	14.93 s	72.4409	14.97 s	72.5135	15.01 s
71.4689	14.90 s	71.5162	14.93 s	72.4441	14.97 s	72.5149	15.01 s
71.4700	14.93 s	71.5173	14.92 s	72.4468	14.96 s	72.5178	14.98 s
71.4711	14.89 s	71.5184	14.95 s	72.4500	14.98 s	72.5193	15.01 s
71.4722	14.95 s	71.5195	14.95 s	72.4571	14.99 s	72.5207	15.00 s
71.4733	14.93 s	71.5206	14.97 s	72.4612	15.00 s	72.5222	15.00 s
71.4744	14.88 s	71.5228	14.92 s	72.4634	15.00 s	72.5236	15.01 s
71.4755	14.92 s	71.5250	14.96 s	72.4656	15.00 s	72.5251	15.00 s
71.4766	14.90 s	71.5261	14.94 s	72.4671	15.00 s	72.5265	15.02 s
71.4777	14.93 s	71.5277	14.89 s	72.4685	15.00 s	72.5279	15.04 s
71.4788	14.93 s	71.5294	14.91 s	72.4700	15.00 s	72.5294	15.01 s
71.4799	14.94 s	71.5305	14.92 s	72.4714	15.01 s	72.5308	15.03 s
71.4810	14.93 s	71.5316	14.94 s	72.4729	14.98 s	72.5323	15.02 s
71.4821	14.95 s	71.5360	14.93 s	72.4743	15.02 s	72.5337	15.03 s
71.4832	14.91 s	71.5371	14.94 s	72.4758	14.99 s	72.5352	15.04 s
71.4843	14.94 s	71.5382	14.92 s	72.4772	15.01 s	72.5381	15.02 s
71.4854	14.92 s	71.5404	14.90 s	72.4787	14.98 s	72.5395	15.01 s
71.4865	14.94 s	71.5415	14.92 s	72.4801	15.01 s	72.5424	15.01 s
71.4876	14.95 s	71.5426	14.96 s	72.4816	15.02 s	72.5439	14.99 s
71.4887	14.92 s	71.5437	14.89 s	72.4830	15.03 s	72.5453	15.01 s
71.4898	14.92 s	71.5448	14.91 s	72.4845	15.02 s	72.5468	14.99 s
71.4909	14.95 s	71.5448	14.92 s	72.4859	15.03 s	72.5482	14.98 s
71.4920	14.93 s	71.5459	14.92 s	72.4873	15.01 s	72.5497	14.97 s
71.4931	14.91 s	71.5459	14.92 s	72.4888	15.00 s	72.5511	14.98 s
71.4942	14.93 s	71.5470	14.93 s	72.4902	15.00 s	72.5526	14.97 s
71.4953	14.92 s	71.5470	14.93 s	72.4917	14.99 s	72.5540	14.97 s
71.4964	14.91 s	71.5481	14.93 s	72.4931	15.00 s	72.5554	14.96 s
71.4975	14.93 s	71.5481	14.94 s	72.4946	14.98 s	72.5569	14.96 s
71.4986	14.90 s	71.5492	14.90 s	72.4960	14.97 s	72.5583	14.97 s
71.4997	14.93 s	71.5492	14.90 s	72.4975	15.00 s	72.5598	14.96 s
71.5008	14.96 s	71.5503	14.87 s	72.4989	14.98 s	72.5612	14.96 s
71.5019	14.93 s	71.5508	14.93 s	72.5004	14.98 s	72.5627	14.98 s
71.5030	14.91 s	71.5525	14.90 s	72.5018	14.98 s	72.5641	14.98 s
71.5041	14.94 s	71.5525	14.91 s	72.5033	15.00 s	72.5656	14.96 s
71.5052	14.92 s	71.5536	14.94 s	72.5047	14.98 s	72.5670	14.99 s
71.5074	14.92 s	71.5536	14.95 s	72.5062	14.98 s	72.5685	14.98 s
71.5107	14.93 s	72.4281	14.99 s	72.5077	14.99 s	72.5699	15.00 s
71.5118	14.94 s	72.4321	14.98 s	72.5091	14.98 s	72.5714	14.99 s

Table 4. Continued.

JD*	V	JD*	V	JD*	V	JD*	V
72.5728	15.02 s	72.6417	15.01 s	73.5007	15.08 s	74.4605	15.01 s
72.5743	15.00 s	72.6438	15.03 s	73.5025	15.08 s	74.4616	15.01 s
72.5757	14.99 s	72.6459	15.01 s	73.5043	15.08 s	74.4637	15.02 s
72.5772	14.99 s	72.6481	15.01 s	73.5061	15.08 s	74.4649	15.02 s
72.5786	15.00 s	72.6502	15.04 s	73.5079	15.07 s	74.4709	15.06 s
72.5801	15.00 s	72.6524	15.02 s	73.5097	15.09 s	74.4723	15.07 s
72.5815	15.03 s	72.6545	15.07 s	73.5115	15.14 s	74.4738	15.08 s
72.5829	15.01 s	72.6584	15.03 s	73.5133	15.14 s	74.4752	15.09 s
72.5844	15.01 s	72.6606	15.04 s	73.5151	15.14 s	74.4767	15.10 s
72.5858	15.02 s	72.6627	15.00 s	73.5169	15.10 s	74.4781	15.11 s
72.5873	15.04 s	72.6649	15.03 s	73.5187	15.10 s	74.4796	15.16 s
72.5887	15.03 s	73.4462	15.06 s	73.5205	15.07 s	74.4811	15.16 s
72.5902	15.03 s	73.4501	15.05 s	74.1777	15.11 s	74.4825	15.13 s
72.5916	15.00 s	73.4523	15.08 s	74.1814	15.10 s	74.4840	15.13 s
72.5931	15.03 s	73.4541	15.07 s	74.1863	15.07 s	74.4854	15.15 s
72.5945	14.99 s	73.4559	15.08 s	74.1891	15.06 s	74.4869	15.15 s
72.5960	15.02 s	73.4577	15.08 s	74.1923	15.03 s	74.4883	15.14 s
72.5974	14.99 s	73.4595	15.08 s	74.1954	15.04 s	74.4898	15.13 s
72.5989	14.98 s	73.4613	15.08 s	74.1975	15.02 s	74.4912	15.17 s
72.6003	15.02 s	73.4631	15.10 s	74.1989	15.04 s	74.4927	15.15 s
72.6018	14.98 s	73.4648	15.10 s	74.2004	15.05 s	74.4941	15.18 s
72.6032	15.00 s	73.4666	15.09 s	74.2018	15.08 s	74.6347	15.10 s
72.6047	14.96 s	73.4684	15.11 s	74.2033	15.04 s	74.6393	15.14 s
72.6061	15.01 s	73.4702	15.08 s	74.2047	15.10 s	74.6429	15.10 s
72.6076	15.01 s	73.4720	15.09 s	74.2062	15.11 s	74.6447	15.14 s
72.6090	14.99 s	73.4738	15.06 s	74.2076	15.10 s	74.6465	15.16 s
72.6104	14.98 s	73.4756	15.05 s	74.2091	15.13 s	74.6483	15.18 s
72.6119	14.99 s	73.4774	15.06 s	74.2105	15.12 s	74.6501	15.16 s
72.6133	14.97 s	73.4792	15.07 s	74.2120	15.14 s	74.6519	15.19 s
72.6155	14.99 s	73.4810	15.03 s	74.2134	15.13 s	74.6537	15.18 s
72.6202	14.99 s	73.4828	15.04 s	74.2149	15.15 s	74.6555	15.21 s
72.6224	15.02 s	73.4846	15.03 s	74.2163	15.15 s	74.6573	15.21 s
72.6245	15.02 s	73.4864	15.05 s	74.2178	15.16 s	74.6591	15.19 s
72.6267	15.00 s	73.4882	15.05 s	74.2192	15.20 s	74.6609	15.18 s
72.6288	15.03 s	73.4900	15.03 s	74.2221	15.19 s	74.6627	15.16 s
72.6309	15.02 s	73.4918	15.04 s	74.2236	15.19 s	74.6645	15.15 s
72.6331	15.03 s	73.4936	15.04 s	74.2250	15.19 s	74.6663	15.14 s
72.6352	15.03 s	73.4954	15.10 s	74.2264	15.16 s	74.6691	15.10 s
72.6374	15.02 s	73.4972	15.04 s	74.2279	15.17 s	74.6717	15.09 s
72.6395	15.01 s	73.4989	15.06 s	74.2294	15.14 s	74.6735	15.06 s

Table 4. Continued.

JD*	V	JD*	V	JD*	V	JD*	V
75.1812	15.17 s	75.2673	15.06 s	76.2356	15.20 s	76.3160	15.31 s
75.1854	15.22 s	75.2706	15.08 s	76.2374	15.14 s	76.3178	15.29 s
75.1875	15.22 s	75.2742	15.07 s	76.2392	15.17 s	76.3196	15.28 s
75.1897	15.24 s	75.2769	15.08 s	76.2410	15.16 s	76.3214	15.34 s
75.1918	15.22 s	75.2787	15.12 s	76.2428	15.16 s	76.3232	15.34 s
75.1940	15.24 s	75.2796	15.10 s	76.2446	15.24 s	76.3250	15.34 s
75.2085	15.21 s	75.2803	15.11 s	76.2482	15.20 s	76.3268	15.35 s
75.2096	15.15 s	75.2836	15.14 s	76.2500	15.25 s	76.3286	15.37 s
75.2111	15.19 s	75.2869	15.14 s	76.2536	15.27 s	76.3304	15.33 s
75.2125	15.12 s	75.2917	15.20 s	76.2554	15.26 s	76.3322	15.29 s
75.2139	15.10 s	75.2943	15.23 s	76.2571	15.28 s	76.3340	15.26 s
75.2153	15.08 s	75.2954	15.23 s	76.2590	15.26 s	76.3358	15.25 s
75.2177	15.07 s	75.3021	15.24 s	76.2607	15.30 s	76.3376	15.25 s
75.2191	15.08 s	76.1763	15.26 s	76.2625	15.28 s	76.3394	15.25 s
75.2206	15.08 s	76.1787	15.20 s	76.2643	15.30 s	76.3412	15.24 s
75.2223	15.11 s	76.1798	15.24 s	76.2661	15.30 s	76.3429	15.21 s
75.2242	15.14 s	76.1824	15.18 s	76.2679	15.32 s	76.3447	15.22 s
75.2260	15.14 s	76.1856	15.15 s	76.2697	15.31 s	76.3465	15.19 s
75.2278	15.14 s	76.1887	15.12 s	76.2715	15.31 s	76.3483	15.22 s
75.2296	15.15 s	76.1920	15.14 s	76.2733	15.34 s	76.3501	15.19 s
75.2314	15.15 s	76.1953	15.17 s	76.2751	15.32 s	76.3519	15.21 s
75.2332	15.15 s	76.1977	15.21 s	76.2765	15.33 s	76.3537	15.22 s
75.2349	15.18 s	76.1997	15.22 s	76.2831	15.25 s	76.3573	15.23 s
75.2368	15.20 s	76.2015	15.25 s	76.2849	15.25 s	76.3591	15.24 s
75.2386	15.22 s	76.2033	15.26 s	76.2867	15.25 s	76.3609	15.27 s
75.2404	15.19 s	76.2051	15.26 s	76.2885	15.21 s	76.3627	15.27 s
75.2422	15.20 s	76.2087	15.29 s	76.2903	15.20 s	76.3663	15.29 s
75.2440	15.24 s	76.2104	15.29 s	76.2927	15.19 s	76.3681	15.29 s
75.2458	15.24 s	76.2122	15.27 s	76.2945	15.19 s	76.3699	15.29 s
75.2475	15.23 s	76.2158	15.31 s	76.2963	15.18 s	76.3717	15.27 s
75.2494	15.24 s	76.2176	15.33 s	76.2980	15.21 s	76.3735	15.30 s
75.2512	15.23 s	76.2194	15.30 s	76.2998	15.24 s	76.3814	15.37 s
75.2529	15.25 s	76.2212	15.33 s	76.3016	15.23 s	76.3832	15.31 s
75.2548	15.26 s	76.2230	15.31 s	76.3034	15.24 s	76.3850	15.37 s
75.2565	15.23 s	76.2248	15.29 s	76.3052	15.25 s	76.3868	15.27 s
75.2583	15.22 s	76.2266	15.23 s	76.3070	15.27 s	76.3886	15.26 s
75.2601	15.22 s	76.2284	15.25 s	76.3088	15.26 s	76.3904	15.28 s
75.2619	15.22 s	76.2302	15.23 s	76.3106	15.27 s	76.3922	15.27 s
75.2637	15.18 s	76.2320	15.22 s	76.3124	15.28 s	76.3940	15.23 s
75.2655	15.11 s	76.2338	15.21 s	76.3142	15.28 s	76.3958	15.22 s

Table 4. Continued.

JD*	V	JD*	V	JD*	V	JD*	V
76.3976	15.22 s	76.4826	15.32 s	77.3824	15.33 s	77.4576	15.36 s
76.3994	15.19 s	76.4863	15.34 s	77.3842	15.37 s	77.4594	15.34 s
76.4030	15.21 s	76.4901	15.34 s	77.3860	15.34 s	77.4612	15.31 s
76.4048	15.21 s	76.4938	15.29 s	77.3878	15.35 s	77.4630	15.31 s
76.4066	15.21 s	76.4976	15.26 s	77.3896	15.37 s	77.4648	15.29 s
76.4084	15.24 s	76.5013	15.23 s	77.3914	15.37 s	77.4666	15.27 s
76.4102	15.22 s	76.5051	15.15 s	77.3932	15.38 s	77.4684	15.26 s
76.4120	15.27 s	76.5089	15.16 s	77.3950	15.38 s	77.4702	15.25 s
76.4138	15.25 s	76.5126	15.19 s	77.3968	15.41 s	77.4720	15.27 s
76.4156	15.28 s	76.5164	15.22 s	77.3994	15.37 s	77.4738	15.25 s
76.4174	15.29 s	76.5201	15.24 s	77.4012	15.39 s	77.4756	15.25 s
76.4191	15.31 s	76.5239	15.29 s	77.4030	15.36 s	77.4774	15.26 s
76.4209	15.28 s	76.5276	15.30 s	77.4048	15.35 s	77.4792	15.27 s
76.4227	15.30 s	76.5314	15.30 s	77.4067	15.32 s	77.4810	15.31 s
76.4245	15.29 s	76.5351	15.35 s	77.4085	15.33 s	77.4827	15.33 s
76.4263	15.33 s	76.5389	15.34 s	77.4104	15.32 s	77.4846	15.32 s
76.4281	15.33 s	76.5424	15.35 s	77.4123	15.32 s	77.4863	15.34 s
76.4299	15.35 s	77.3320	15.37 s	77.4141	15.29 s	77.4881	15.33 s
76.4317	15.35 s	77.3338	15.36 s	77.4159	15.27 s	77.4899	15.36 s
76.4335	15.33 s	77.3356	15.36 s	77.4177	15.26 s	77.4917	15.36 s
76.4353	15.36 s	77.3383	15.36 s	77.4195	15.25 s	77.4936	15.38 s
76.4371	15.33 s	77.3410	15.37 s	77.4213	15.24 s	77.4963	15.36 s
76.4389	15.29 s	77.3428	15.37 s	77.4232	15.25 s	77.4990	15.38 s
76.4407	15.31 s	77.3455	15.37 s	77.4250	15.27 s	77.5008	15.40 s
76.4425	15.30 s	77.3482	15.37 s	77.4269	15.30 s	77.5026	15.42 s
76.4443	15.28 s	77.3500	15.39 s	77.4287	15.29 s	77.5044	15.47 s
76.4461	15.29 s	77.3518	15.34 s	77.4305	15.32 s	77.5080	15.41 s
76.4479	15.24 s	77.3536	15.34 s	77.4324	15.33 s	77.5098	15.39 s
76.4497	15.22 s	77.3572	15.31 s	77.4351	15.35 s	77.5116	15.34 s
76.4515	15.21 s	77.3590	15.28 s	77.4379	15.34 s	77.5134	15.35 s
76.4533	15.18 s	77.3626	15.23 s	77.4397	15.37 s	77.5152	15.32 s
76.4551	15.18 s	77.3644	15.25 s	77.4415	15.33 s	77.5188	15.31 s
76.4569	15.22 s	77.3662	15.27 s	77.4433	15.36 s	77.5205	15.25 s
76.4587	15.22 s	77.3680	15.26 s	77.4451	15.37 s	77.5223	15.27 s
76.4604	15.23 s	77.3698	15.25 s	77.4469	15.37 s	77.5241	15.26 s
76.4622	15.25 s	77.3716	15.26 s	77.4487	15.40 s	77.5274	15.24 s
76.4675	15.26 s	77.3734	15.31 s	77.4504	15.38 s	77.5292	15.25 s
76.4713	15.30 s	77.3770	15.32 s	77.4522	15.40 s	77.5310	15.29 s
76.4751	15.31 s	77.3788	15.33 s	77.4540	15.40 s	77.5327	15.30 s
76.4788	15.33 s	77.3806	15.35 s	77.4558	15.36 s	77.5345	15.32 s

Table 4. Continued.

JD*	V	JD*	V	JD*	V	JD*	V
77.5363	15.33 s	78.2058	15.49 s	78.3247	15.35 s	78.5876	15.40 s
77.5382	15.33 s	78.2080	15.46 s	78.3268	15.35 s	78.5898	15.45 s
77.5400	15.34 s	78.2112	15.41 s	78.3343	15.36 s	78.5919	15.41 s
77.5418	15.36 s	78.2165	15.39 s	78.3363	15.35 s	78.5940	15.35 s
77.5436	15.37 s	78.2229	15.44 s	78.3375	15.39 s	78.5962	15.35 s
77.5454	15.36 s	78.2283	15.40 s	78.3397	15.39 s	78.5983	15.32 s
77.5472	15.36 s	78.2315	15.39 s	78.3418	15.43 s	78.6005	15.32 s
77.5490	15.34 s	78.2337	15.42 s	78.3440	15.41 s	78.6225	15.48 s
77.5508	15.38 s	78.2358	15.40 s	78.3461	15.45 s	78.6247	15.50 s
77.5526	15.36 s	78.2379	15.43 s	78.3482	15.47 s	78.6268	15.49 s
77.5544	15.38 s	78.2401	15.41 s	78.3504	15.45 s	78.6300	15.52 s
77.5562	15.41 s	78.2426	15.45 s	78.3543	15.49 s	78.6332	15.49 s
77.5580	15.38 s	78.2465	15.45 s	78.3579	15.51 s	78.6418	15.46 s
77.5599	15.40 s	78.2508	15.47 s	78.3611	15.48 s	78.6439	15.40 s
77.5617	15.40 s	78.2551	15.48 s	78.3632	15.48 s	78.6482	15.35 s
77.5635	15.36 s	78.2572	15.46 s	78.3654	15.46 s	78.6525	15.40 s
77.5653	15.38 s	78.2594	15.47 s	78.3675	15.44 s	78.6547	15.40 s
77.5671	15.38 s	78.2615	15.44 s	78.3697	15.44 s	78.6579	15.41 s
77.5696	15.36 s	78.2636	15.45 s	78.3718	15.44 s	79.2751	15.52 c
77.5734	15.35 s	78.2658	15.44 s	78.3758	15.40 s	79.2809	15.51 c
77.5770	15.28 s	78.2679	15.40 s	78.3838	15.36 s	79.2838	15.52 c
77.5865	15.28 s	78.2701	15.40 s	78.3859	15.38 s	79.2866	15.47 c
77.5896	15.33 s	78.2722	15.38 s	78.3881	15.41 s	79.2889	15.47 c
77.5931	15.33 s	78.2744	15.42 s	78.3924	15.41 s	79.2909	15.44 c
77.5958	15.35 s	78.2765	15.38 s	78.3967	15.46 s	79.2927	15.42 c
77.5976	15.38 s	78.2786	15.38 s	78.3988	15.45 s	79.2945	15.44 c
77.5994	15.37 s	78.2808	15.37 s	78.4010	15.45 s	79.2963	15.46 c
77.6021	15.35 s	78.2851	15.41 s	78.5480	15.40 s	79.2981	15.48 c
77.6057	15.39 s	78.2894	15.44 s	78.5501	15.41 s	79.2999	15.49 c
77.6102	15.40 s	78.2915	15.44 s	78.5556	15.46 s	79.3017	15.44 c
77.6201	15.36 s	78.2958	15.43 s	78.5602	15.46 s	79.3035	15.48 c
77.6227	15.30 s	78.3011	15.46 s	78.5641	15.47 s	79.3053	15.49 c
77.6245	15.32 s	78.3043	15.48 s	78.5662	15.47 s	79.3071	15.48 c
77.6282	15.29 s	78.3097	15.49 s	78.5683	15.48 s	79.3089	15.51 c
78.1815	15.46 s	78.3118	15.43 s	78.5715	15.52 s	79.3108	15.50 c
78.1860	15.44 s	78.3140	15.42 s	78.5748	15.49 s	79.3126	15.53 c
78.1903	15.45 s	78.3161	15.45 s	78.5780	15.51 s	79.3144	15.53 c
78.1935	15.47 s	78.3183	15.41 s	78.5812	15.49 s	79.3162	15.51 c
78.1957	15.50 s	78.3204	15.42 s	78.5833	15.45 s	79.3180	15.50 c
78.2008	15.48 s	78.3225	15.41 s	78.5855	15.47 s	79.3198	15.51 c

Table 4. Continued.

JD*	V	JD*	V	JD*	V	JD*	V
79.3216	15.54 c	80.3198	15.57 c	80.3600	15.52 c	81.3196	15.65 c
79.3237	15.59 c	80.3208	15.56 c	80.3610	15.55 c	81.3218	15.64 c
79.3255	15.59 c	80.3218	15.57 c	80.3620	15.54 c	81.3240	15.60 c
79.3273	15.57 c	80.3228	15.58 c	80.3630	15.53 c	81.3261	15.60 c
79.3291	15.55 c	80.3238	15.57 c	80.3640	15.55 c	81.3283	15.55 c
79.3309	15.55 c	80.3248	15.61 c	80.3650	15.56 c	81.3304	15.58 c
79.3327	15.54 c	80.3258	15.64 c	80.3660	15.59 c	81.3357	15.63 c
79.3345	15.55 c	80.3268	15.61 c	80.3670	15.53 c	81.3367	15.66 s
79.3363	15.55 c	80.3278	15.61 c	80.3680	15.56 c	81.3379	15.60 c
79.3382	15.51 c	80.3288	15.60 c	80.3690	15.56 c	81.3401	15.65 c
79.3400	15.49 c	80.3298	15.59 c	80.3700	15.58 c	81.3401	15.62 s
79.3418	15.47 c	80.3307	15.59 c	80.3710	15.55 c	81.3423	15.59 s
80.2861	15.60 c	80.3318	15.59 c	80.3720	15.58 c	81.3423	15.65 c
80.2911	15.71 c	80.3328	15.60 c	80.3730	15.59 c	81.3444	15.63 s
80.2935	15.62 c	80.3337	15.61 c	80.3740	15.60 c	81.3444	15.64 c
80.2945	15.66 c	80.3347	15.62 c	80.3750	15.57 c	81.3466	15.62 s
80.2958	15.65 c	80.3357	15.62 c	80.3760	15.56 c	81.3466	15.65 c
80.2968	15.64 c	80.3367	15.62 c	80.3770	15.59 c	81.3487	15.64 s
80.2978	15.65 c	80.3377	15.61 c	80.3780	15.61 c	81.3491	15.69 c
80.2988	15.63 c	80.3387	15.65 c	80.3790	15.62 c	81.3508	15.68 s
80.2998	15.61 c	80.3397	15.63 c	81.2661	15.67 c	81.3513	15.70 c
80.3008	15.57 c	80.3411	15.64 c	81.2698	15.63 c	81.3530	15.64 s
80.3018	15.60 c	80.3421	15.64 c	81.2736	15.59 c	81.3534	15.66 c
80.3028	15.59 c	80.3431	15.65 c	81.2773	15.59 c	81.3551	15.67 s
80.3038	15.59 c	80.3441	15.65 c	81.2812	15.58 c	81.3556	15.69 c
80.3048	15.60 c	80.3451	15.65 c	81.2834	15.59 c	81.3573	15.65 s
80.3058	15.57 c	80.3461	15.65 c	81.2855	15.58 c	81.3577	15.68 c
80.3068	15.55 c	80.3471	15.67 c	81.2890	15.62 c	81.3594	15.72 s
80.3078	15.53 c	80.3481	15.64 c	81.2912	15.63 c	81.3599	15.70 c
80.3088	15.55 c	80.3491	15.65 c	81.2934	15.66 c	81.3616	15.67 s
80.3098	15.57 c	80.3501	15.65 c	81.2955	15.69 c	81.3620	15.69 c
80.3108	15.53 c	80.3510	15.66 c	81.2977	15.67 c	81.3637	15.71 s
80.3118	15.57 c	80.3521	15.62 c	81.2998	15.69 c	81.3658	15.66 s
80.3128	15.54 c	80.3531	15.61 c	81.3020	15.68 c	81.3702	15.65 s
80.3138	15.58 c	80.3540	15.61 c	81.3041	15.69 c	81.3734	15.67 s
80.3148	15.56 c	80.3550	15.57 c	81.3063	15.66 c	81.3791	15.64 s
80.3158	15.55 c	80.3560	15.58 c	81.3084	15.69 c	81.3853	15.58 s
80.3168	15.54 c	80.3570	15.61 c	81.3106	15.68 c	81.3875	15.59 s
80.3178	15.55 c	80.3580	15.57 c	81.3128	15.67 c	81.3896	15.59 s
80.3188	15.56 c	80.3590	15.57 c	81.3175	15.70 c	81.3917	15.62 s

Table 4. Continued.

JD*	V	JD*	V	JD*	V	JD*	V
81.3939	15.58 s	82.4469	15.73 s	82.5817	15.63 s	86.2694	15.91 s
81.3960	15.64 s	82.4520	15.68 s	82.5860	15.77 s	86.2737	15.92 s
81.3982	15.64 s	82.4552	15.66 s	82.5892	15.86 s	86.2759	15.92 s
81.4003	15.63 s	82.4616	15.72 s	82.5924	15.78 s	86.2780	15.94 s
81.4024	15.62 s	82.4659	15.69 s	82.5999	15.77 s	86.2823	15.95 s
81.4046	15.74 s	82.4691	15.69 s	82.6035	15.73 s	86.2866	15.99 s
81.4067	15.72 s	82.4734	15.71 s	82.6096	15.66 s	86.2909	16.01 s
81.4089	15.70 s	82.4777	15.79 s	82.6128	15.66 s	86.2930	16.00 s
81.4110	15.75 s	82.4825	15.73 s	82.6150	15.65 s	86.2994	16.01 s
81.4132	15.68 s	82.4874	15.79 s	82.6171	15.65 s	86.3083	16.01 s
81.4153	15.67 s	82.4917	15.71 s	82.6192	15.72 s	86.3111	15.96 s
81.4174	15.69 s	82.4960	15.76 s	82.6235	15.74 s	86.3176	15.90 s
81.4196	15.64 s	82.5002	15.75 s	82.6278	15.73 s	86.3218	15.93 s
81.4217	15.63 s	82.5025	15.78 s	82.6334	15.73 s	86.3240	15.92 s
81.4239	15.64 s	82.5077	15.71 s	84.3719	16.14 c	86.3261	15.92 s
81.4278	15.63 s	82.5099	15.72 s	84.3759	15.85 c	86.3283	15.95 s
81.4299	15.60 s	82.5120	15.69 s	84.3797	15.69 c	86.3326	15.92 s
81.4321	15.57 s	82.5142	15.62 s	86.1768	15.94 s	86.3390	15.95 s
81.4342	15.60 s	82.5185	15.63 s	86.1853	15.95 s	86.3433	15.92 s
81.4364	15.54 s	82.5227	15.72 s	86.1923	15.95 s	86.3454	15.94 s
81.4385	15.58 s	82.5292	15.81 s	86.1945	15.96 s	86.3497	15.94 s
81.4406	15.64 s	82.5356	15.79 s	86.1966	15.95 s	86.3554	16.03 s
81.6149	15.71 s	82.5377	15.76 s	86.1988	15.95 s	86.3583	15.96 s
81.6192	15.67 s	82.5399	15.74 s	86.2009	15.92 s	86.3604	15.99 s
81.6214	15.65 s	82.5420	15.83 s	86.2030	15.94 s	86.3625	15.95 s
81.6235	15.69 s	82.5442	15.83 s	86.2073	15.90 s	86.3647	15.98 s
81.6256	15.65 s	82.5463	15.86 s	86.2116	15.88 s	86.3690	15.92 s
81.6278	15.69 s	82.5485	15.84 s	86.2138	15.86 s	86.3754	15.94 s
81.6299	15.73 s	82.5506	15.76 s	86.2159	15.86 s	86.3797	15.94 s
81.6321	15.69 s	82.5538	15.70 s	86.2180	15.90 s	86.3840	15.97 s
81.6342	15.67 s	82.5570	15.69 s	86.2202	15.90 s	86.3882	15.92 s
81.6364	15.70 s	82.5592	15.66 s	86.2223	15.91 s	86.3904	15.96 s
81.6385	15.73 s	82.5635	15.68 s	86.2245	15.95 s	86.3925	15.90 s
81.6406	15.75 s	82.5656	15.68 s	86.2287	15.93 s	86.3947	16.00 s
81.6428	15.67 s	82.5678	15.68 s	86.2352	15.97 s	86.3996	15.98 s
81.6449	15.61 s	82.5699	15.74 s	86.2394	15.96 s	86.4043	16.04 s
81.6471	15.61 s	82.5721	15.76 s	86.2437	16.01 s	86.4103	15.99 s
82.4346	15.70 s	82.5742	15.69 s	86.2502	15.95 s	86.4150	15.96 s
82.4367	15.73 s	82.5764	15.68 s	86.2566	15.93 s	86.4182	15.93 s
82.4413	15.73 s	82.5785	15.65 s	86.2630	15.90 s	86.4204	15.91 s

Table 4. Continued.

JD*	V	JD*	V	JD*	V	JD*	V
86.4225	15.94 s	86.5050	16.01 s	88.6272	16.06 s	89.2396	16.08 s
86.4246	15.92 s	86.5114	16.02 s	88.6293	16.07 s	89.2417	16.10 s
86.4268	15.94 s	86.5164	15.95 s	88.6314	16.09 s	89.2931	16.12 c
86.4318	15.89 s	86.5243	15.93 s	88.6336	16.00 s	89.2972	16.20 c
86.4393	15.93 s	86.5308	16.03 s	88.6357	16.04 s	89.3013	16.03 c
86.4429	16.01 s	86.5372	15.98 s	88.6379	16.04 s	89.3054	16.09 c
86.4471	16.01 s	86.5436	15.92 s	88.6428	16.11 s	89.3105	16.12 c
86.4493	15.98 s	86.5500	15.97 s	89.1967	16.10 s	89.3137	15.98 c
86.4543	15.96 s	86.5565	16.03 s	89.1989	16.07 s	89.3265	16.23 c
86.4578	15.96 s	86.5629	16.05 s	89.2010	16.09 s	89.3297	16.10 c
86.4600	15.96 s	86.5693	15.99 s	89.2031	16.11 s	89.3366	16.00 c
86.4621	15.92 s	86.5757	16.01 s	89.2053	16.06 s	89.3405	16.09 c
86.4671	15.98 s	86.5822	16.04 s	89.2074	16.12 s	89.3437	16.18 c
86.4735	15.96 s	86.5879	15.90 s	89.2096	16.10 s	89.3469	16.05 c
86.4771	15.94 s	86.5922	15.80 s	89.2117	16.12 s	89.3514	16.06 c
86.4793	15.86 s	88.6043	16.08 s	89.2139	16.03 s	89.3553	16.11 c
86.4814	15.89 s	88.6067	16.06 s	89.2160	16.09 s	93.2400	17.75 c
86.4835	15.86 s	88.6100	16.14 s	89.2181	16.08 s	94.2800	19.11 c
86.4857	15.94 s	88.6122	16.13 s	89.2203	16.11 s	97.2419	19.77 s
86.4878	15.90 s	88.6143	16.13 s	89.2224	16.15 s	43.22**	19.9 s
86.4900	15.95 s	88.6164	16.09 s	89.2246	16.09 s	44.23**	(19.5 s
86.4921	15.94 s	88.6186	16.20 s	89.2267	16.07 s	45.20**	21.3 s
86.4975	15.95 s	88.6207	16.15 s	89.2299	16.02 s		
86.5007	15.91 s	88.6229	16.07 s	89.2331	16.11 s		
86.5028	15.91 s	88.6250	16.09 s	89.2364	16.16 s		

Table 5. The I_C magnitudes of Nova Tri obtained at the Stará Lesná observatory. JD = JD* + 2 454 700.

JD*	I_C	JD*	I_C	JD*	I_C	JD*	I_C
66.4274	14.47	70.4982	14.96	72.4431	15.09	76.1873	15.24
69.5255	14.83	70.4995	14.96	72.4490	15.06	76.2813	15.46
69.5303	14.87	71.3933	15.01	74.1819	15.14	76.2819	15.36
70.4720	14.97	71.3995	14.98	74.1849	15.15	78.5580	15.62
70.4801	15.00	71.4066	15.07	75.2897	15.31	81.3762	15.72
70.4932	14.95	72.4371	15.06	76.1841	15.34	86.1896	16.08

Table 6. The R_C magnitudes of Nova Tri obtained at the Stará Lesná ("s"), and Crimea ("c") observatories. JD = JD* + 2 454 700. Symbols "**" after JD in the last observations means JD = JD* + 2 454 800.

JD*	R_C	JD*	R_C	JD*	R_C	JD*	R_C
66.4239	14.36 s	79.2800	15.66 s	79.3336	15.53 c	81.3390	15.59 c
69.5199	14.72 s	81.3718	15.60 s	79.3355	15.49 c	81.3412	15.58 c
69.5210	14.73 s	86.1855	15.94 s	79.3373	15.48 c	81.3434	15.63 c
69.5485	14.71 s	88.6401	15.97 s	79.3391	15.50 c	81.3455	15.63 c
69.5502	14.73 s	89.2446	16.02 s	79.3409	15.44 c	81.3480	15.63 c
70.4712	14.88 s	89.2462	16.08 s	80.2902	15.64 c	81.3502	15.58 c
70.4917	14.80 s	89.2477	16.24 s	81.2634	15.66 c	81.3523	15.65 c
70.4975	14.84 s	79.2724	15.58 c	81.2651	15.62 c	81.3545	15.64 c
70.4989	14.81 s	79.2736	15.54 c	81.2688	15.59 c	81.3567	15.66 c
71.3918	14.91 s	79.2800	15.48 c	81.2725	15.57 c	81.3588	15.65 c
71.3979	14.95 s	79.2829	15.49 c	81.2762	15.57 c	81.3610	15.67 c
71.4050	14.91 s	79.2858	15.46 c	81.2801	15.57 c	84.3674	15.87 c
72.4296	14.99 s	79.2880	15.45 c	81.2823	15.55 c	84.3709	15.94 c
72.4361	14.96 s	79.2900	15.40 c	81.2845	15.55 c	84.3746	15.83 c
72.4420	14.97 s	79.2918	15.37 c	81.2866	15.60 c	84.3784	15.72 c
72.4480	14.98 s	79.2936	15.42 c	81.2880	15.58 c	89.2906	16.03 c
74.1761	15.31 s	79.2954	15.42 c	81.2901	15.61 c	89.3001	16.17 c
74.1794	15.15 s	79.2972	15.40 c	81.2923	15.60 c	89.3042	16.06 c
74.1879	15.09 s	79.2990	15.43 c	81.2945	15.62 c	89.3090	16.01 c
75.1722	15.21 s	79.3008	15.40 c	81.2966	15.61 c	89.3122	16.12 c
75.2691	15.06 s	79.3026	15.42 c	81.2988	15.59 c	89.3154	16.25 c
75.2811	15.12 s	79.3044	15.47 c	81.3009	15.66 c	89.3186	16.04 c
75.2817	15.15 s	79.3063	15.48 c	81.3031	15.62 c	89.3250	16.02 c
75.2821	15.12 s	79.3081	15.49 c	81.3052	15.64 c	89.3281	16.02 c
75.2825	15.14 s	79.3099	15.48 c	81.3074	15.65 c	89.3313	15.99 c
75.2849	15.20 s	79.3117	15.49 c	81.3095	15.63 c	89.3350	15.98 c
75.2852	15.12 s	79.3135	15.51 c	81.3117	15.65 c	89.3422	16.05 c
75.2855	15.13 s	79.3153	15.47 c	81.3143	15.61 c	89.3454	15.88 c
75.2858	15.16 s	79.3171	15.49 c	81.3164	15.63 c	89.3495	16.12 c
76.1776	15.23 s	79.3189	15.51 c	81.3186	15.60 c	89.3533	16.06 c
76.1811	15.21 s	79.3207	15.51 c	81.3207	15.64 c	89.3591	15.94 c
76.2799	15.25 s	79.3228	15.54 c	81.3229	15.62 c	93.2500	17.72 c
76.2804	15.24 s	79.3246	15.59 c	81.3250	15.53 c	94.2800	18.55 c
76.2808	15.25 s	79.3264	15.53 c	81.3272	15.52 c	28.26**	20.58 s
78.1977	15.50 s	79.3282	15.54 c	81.3294	15.55 c	43.20**	19.60 s
78.2018	15.50 s	79.3300	15.52 c	81.3347	15.54 c	44.21**	19.80 s
78.5622	15.46 s	79.3318	15.53 c	81.3368	15.56 c	45.21**	20.95 s

3. Results and discussion

A Fourier period analysis of our V CCD observations taken from October 26 till November 2, 2008 (during the first 7 nights of the superoutburst), after the linear declining trend removal in every observational night, revealed the presence of small amplitude early superhumps (double humped variations) with the period 76.42±0.50 minutes (0.05307 days). This period was used to construct the phase diagram of the ΔV residuals. Their mean values with errors are given in Fig. 4.

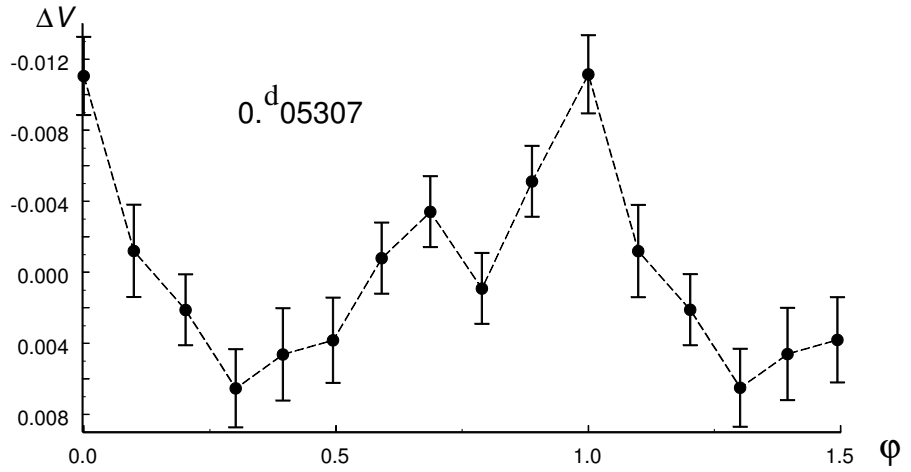

Figure 4. The phase diagram of early superhumps.

A Fourier period analysis of our BVR_C observations taken from November 3 till November 17, 2008, after the linear declining trend removal in every observational night, revealed the presence of 77.27±0.20 minutes (0.053663 days) ordinary superhumps. The phase diagrams of ΔB, ΔV, ΔR_C residuals are presented in Fig. 5.

Due to the fact that the amplitude of superhumps is the same in all 3 passbands, we constructed also the phase diagram of Δm residuals, where the residuals in all 3 passbands were included. The period of superhumps is longer than the orbital period. It is remarkable that the period of superhumps of the dwarf nova Tri 2008 is the shortest one among WZ Sge objects. The previous record belonged to GW Lib with the orbital period 0.05332 days and the period of superhumps 0.05393 days (Kato et al., 2008).

A two colour $(U-B, B-V)$ diagram for the dwarf nova Tri 2008 and the 60 stars located on the same CCD frame with the variable is shown in Fig. 6. The direction of interstellar reddening is indicated by arrow. It is evident that the surrounding stars do not exhibit any interstellar extinction. Therefore, it is very probable that the light of the dwarf nova itself is not influenced by the interstellar extinction, too.

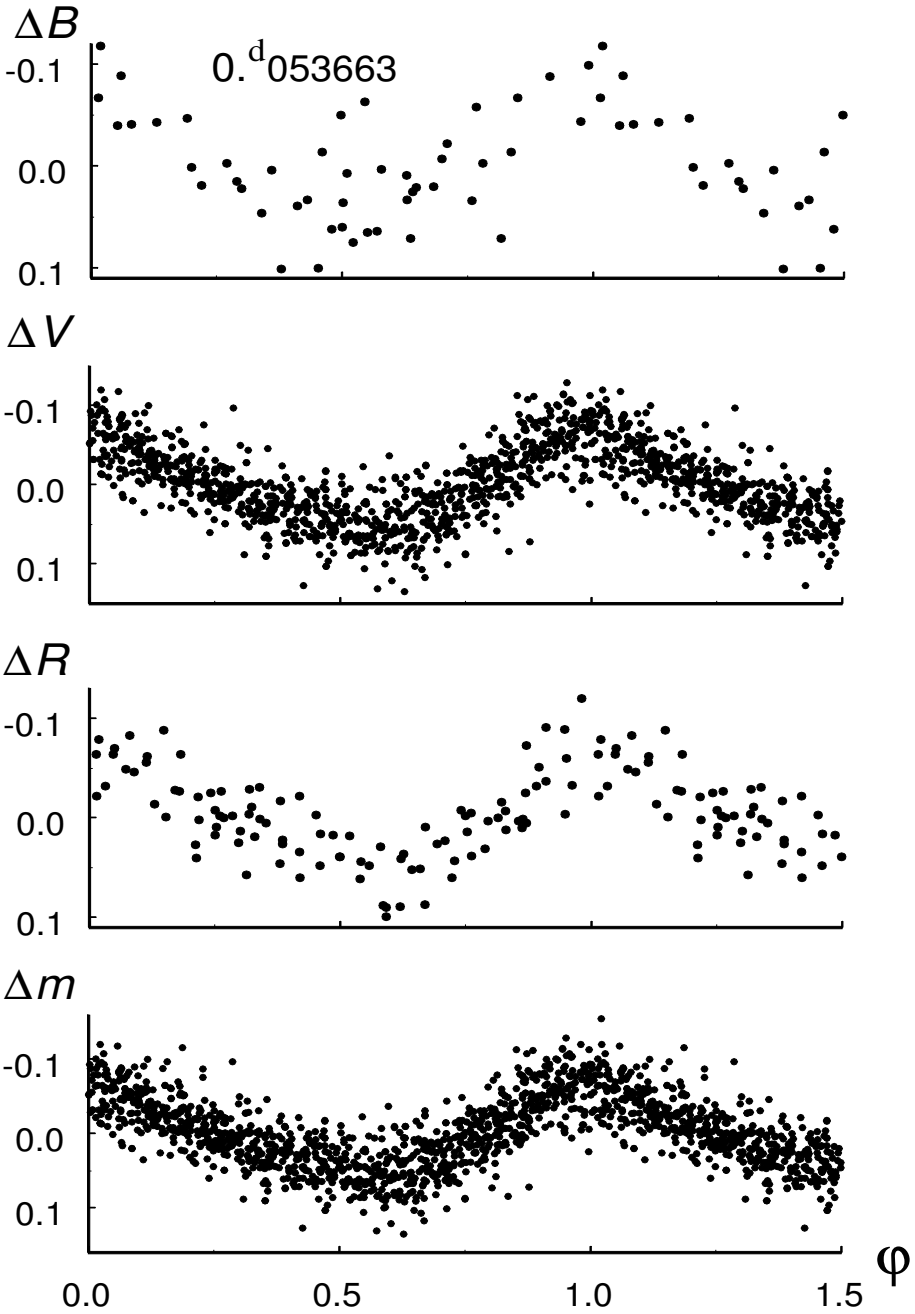

Figure 5. The phase diagram of ordinary superhumps in different passbands.

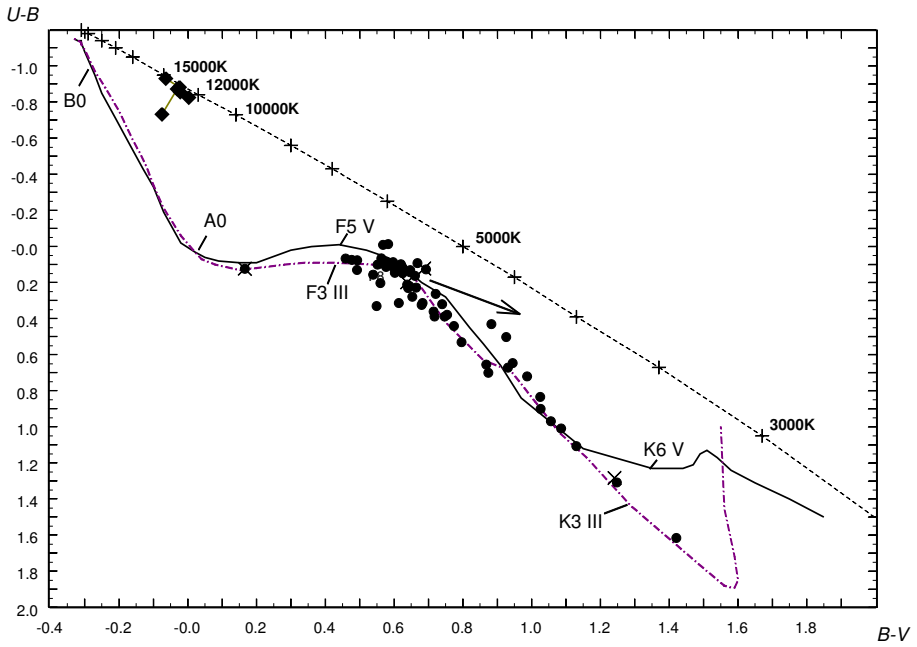

Figure 6. The two color $(U-B, B-V)$ diagram. The dwarf and giant sequences are plotted with solid and dashed lines, respectively. The color indices of black bodies are shown by crosses connected with dashed line. Filled diamonds correspond to DNe, filled circles – to the position of field stars.

The evolution of the object in a two color $(U-B, B-V)$ diagram is shown in Fig. 7 in a great scale. At the date of discovery, the object was located on the blackbody temperature sequence corresponding to the temperature of about 15 000 K. Thereafter, the object moved along the blackbody sequence, corresponding to the decrease and at the day 6th after its discovery the increase of the temperature. On the day 9th after the discovery the index $U-B$ suddenly declined for about 0.14 mag.

The fast decline of the brightness (>1 mag/day) of the dwarf nova occurred during JD 2454792 – 795. The pre-outburst photometric level was reached after JD 2454797.

We observed the object in R_C on December 27, 2008, and on January 11,12, 13, 2009, in the V and R_C passbands. A sudden increase of activity of the object during its quiescent stage was detected on January 11, 2009, when the brightness of the object increased in the R_C passband for about 1 mag. The detail of the POSS print and our R_C images are presented in Fig. 8. In January the $V-R_C$ color was 0.3±0.15 mag, compared to $V-R_C$=–0.01 mag in the superoutburst brightness maximum.

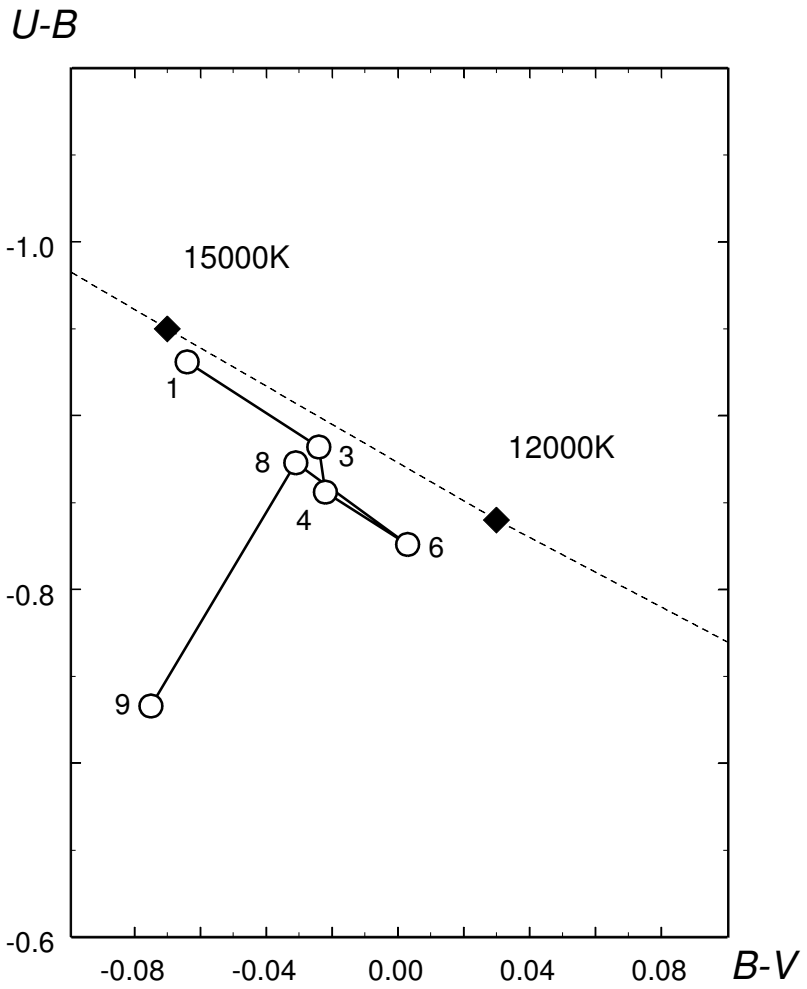

Figure 7. The detail of the two color $(U-B, B-V)$ diagram. The evolution of the object on the black body temperature scale is depicted. Numbers near the observational points exhibit days from the beginning of the flare on JD=2454766.

It should be noted that the several "minioutbursts" were detected a few months after the superoutburst of the star SDSS J080434.20+510349.2 (a new WZ Sge-type system) by Zharikov et al. (2008). They repeated after 16 – 17 days (Pavlenko et al., 2009). We can suppose that such behavior is typical for quiescence of WZ Sge-type stars.

The data published in this paper are also available in a computer readable form at *http://www.astro.sk/caosp/Eedition/FullTexts/vol39no1/pp43-65.dat/*.

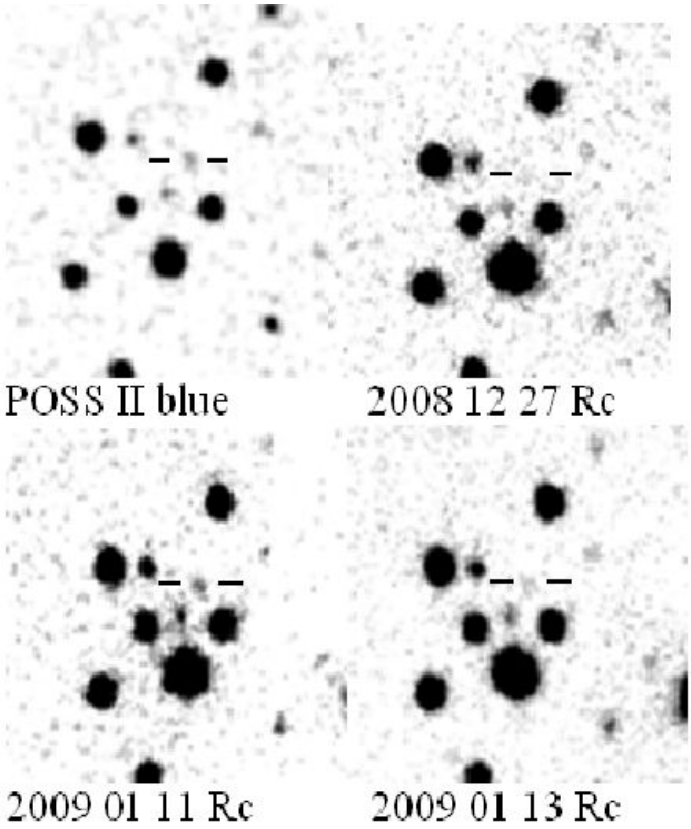

Figure 8. The dwarf nova Tri 2008 in a POSS print and our R_C images. The position of the variable is marked.

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