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Visual and CCD minima of eclipsing binaries during 1998

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Following table is summary of minima of eclipsing binary reported from VSOLJ members.

star	min. 2450000+	O-C	E		n	obs.	inst.
XZ And	1111.978	+0.085	19992	v	40	Hrm	16L
EL Aqr	1137.981	+0.013	24202	V	41	Nga	10L+ST-5
ST Aqr	1140.8683	-0.0295	12682	V	40	Nga	10L+ST-5
ZZ Aur	1160.174	+0.018	42673	v	16	Mhh	20L
FZ CMa	1146.2376	-0.1806	7387	V	63	Kis	25SC+BT-20
RT CMa	0830.1223	-0.3570	9687	V	52	Kis	25SC+ST-6
AB Cas	1111.224	+0.056	6143	v	13	Mhh	20L
RZ Cas	1023.232	+0.034	6545	v	58	AUU	7B
RZ Cas	1077.015	+0.031	6590	v	32	Kit	7B
RZ Cas	1077.0185	+0.0345	6590	v	20	AUU	7B
RZ Cas	1077.020	+0.036	6590	v	32	Mhh	200mm+T-MAX400+BPB55
RZ Cas	1077.021	+0.037	6590	v	40	Mhh	6R
RZ Cas	1088.967	+0.030	6600	v	10	Mkn	3.5B
RZ Cas	1088.967	+0.030	6600	v	62	Kit	7B
RZ Cas	1096.138	+0.030	6606	v	32	Mkn	13L
RZ Cas	1096.139	+0.031	6606	v	19	Mhh	6R
RZ Cas	1096.142	+0.034	6606	v	95	Kit	7B
RZ Cas	1096.146	+0.038	6606	v	22	AUU	7B
RZ Cas	1126.0148	+0.0256	6631	v	15	Mkn	13L
RZ Cas	1126.0150	+0.0291	6631	Rc	64	Kis	50mm+ST-6
RZ Cas	1126.0201	+0.0309	6631	v	5	AUU	7B
RZ Cas	1126.022	+0.033	6631	v	15	Mhh	6R
RZ Cas	1126.0225	+0.0333	6631	v	18	AUU	7B
RZ Cas	1126.0242	+0.0350	6631	v	19	Wny	10B
RZ Cas	1126.0261	+0.0369	6631	v	13	AUU	7B
RZ Cas	1131.9809	+0.0155	6636	v	20	Kyh	6R
RZ Cas	1131.9929	+0.0309	6636	Rc	72	Kis	50mm+ST-6
RZ Cas	1131.9932	+0.0278	6636	v	32	Stm	10B
RZ Cas	1131.9948	+0.0294	6636	v	215	AUU	7B

star	min. 2450000+	O-C	E		n	obs.	inst.
RZ Cas	1131.9951	+0.0297	6636	v	14	Mom	7B
RZ Cas	1131.9961	+0.0307	6636	v	24	Tku	5B
RZ Cas	1131.9970	+0.0316	6636	V	43	Nga	20SC+PMT
RZ Cas	1131.9994	+0.0340	6636	v	63	Kit	7B
RZ Cas	1132.0035	+0.0381	6636	v	9	Nsa	7B
RZ Cas	1133.1873	+0.0267	6637	v	23	Kyh	6R
TV Cas	1145.9150	-0.0085	3610	v	26	Kit	12B
TV Cas	1153.1702	-0.0037	3614	v	42	Kit	10B
V523 Cas	1042.125	+0.036	42065	v	19	Mhh	20L
AA Cet	1095.069	-0.007	18327	V	182	Kis	25SC+BT-20
VY Cet	1157.0377	-0.0101	46149	C	85	Kis	25SC+ST-6
XY Cet	1089.153	+0.008	4573	Rc	63	Kis	25SC+BT-20
XY Cet	1096.1072 *1	+0.0050	4575.5	Rc	95	Kis	25SC+BT-20
CC Com	0890.088	-0.011	51460	v	18	Mhh	20L
RZ Com	0890.076	+0.023	47422	v	18	Mhh	20L
TW CrB	0956.070	+0.026	22174	v	26	Mhh	20L
V1147 Cyg	1140.006	-0.003 *2	25	v	35	Stm	20L
WZ Cyg	1070.042	+0.049	17528	v	29	Mhh	20L
AS Eri	1098.105	+0.000	8468	Rc	153	Kis	25SC+ST-6
BC Eri	1138.1001 *3			V	134	Nga	10L+ST-5
BC Eri	1176.0617 *3			V	105	Nga	10L+ST-5
BV Eri	1116.1509 *1	-0.0609	15101.5	Rc	101	Kis	25SC+ST-6
YY Eri	0819.9885 *1	+0.0514	28735.5	V	92	Nga	10L+ST-5
YY Eri	0829.9538 *1	+0.0504	28766.5	V	133	Nga	10L+ST-5
YY Eri	0834.9382	+0.0696	28282	V	84	Nga	10L+ST-5
YY Eri	0843.9400	+0.0695	28810	V	71	Nga	10L+ST-5
YY Eri	1126.0528	+0.0712	29687	V	129	Nga	10L+ST-5
YY Eri	1129.1100	+0.0742	29697	V	136	Nga	10L+ST-5
YY Eri	1179.105 *1	+0.077	29852.5	v	12	Mhh	6R
AV Hya	0879.9691	-0.0550	20813	V	94	Nga	10L+ST-5
AV Hya	0897.0584	-0.0508	20788	V	66	Nga	10L+ST-5
DF Hya	0853.0464	-0.0538	59634	Rc	50	Kis	25SC+BT-20
DF Hya	0853.0693	-0.0527	59637	Rc	66	Kis	25SC+BT-20
DF Hya	0879.9902 *1	-0.0538	59715.5	Rc	56	Kis	25SC+BT-20
HS Hya	0923.9797	+0.0085	6090	V	61	Nga	10L+ST-5
WY Hya	1172.1848	+0.0171	14806	V	35	Kis	25SC+BT-20
CM Lac	1042.042	-0.002	14966	v	23	Mhh	20L
AP Leo	0906.9919	-0.0283	26421	V	76	Nga	10L+ST-5
UV Leo	0897.009 *1	+0.023	20757.5	v	37	Mhh	20L
UV Leo	0902.1053	+0.0184	20766	Rc	27	Kis	25SC+BT-20
UV Leo	0908.111	+0.023	20776	v	36	Mhh	20L
UV Leo	1138.2404 *1	+0.0202	21160.5	v	16	Kit	12B
UV Leo	1144.2414 *1	+0.0203	21169.5	v	36	Kit	12B
DD Mon	1168.1707	+0.1119	36701	V	71	Kis	25SC+BT-20
V566 Oph	1022.0073 *1	+0.0458	22424.5	V	94	Nga	10L+ST-5
V566 Oph	1023.0357	+0.0501	22427	V	99	Nga	10L+ST-5
ER Ori	0838.9556 *1	+0.0200	21758.5	V	139	Nga	10L+ST-5
ER Ori	1177.0402	+0.0207	22557	V	294	Nga	10L+ST-5
FF Ori	1158.0833	+0.0142	10462	V	44	Kis	25SC+BT-20
RT Per	1176.9854	+0.0446	20957	v	25	Ioh	30SC
V432 Per	1167.007	+0.001 *4	6693.5	v	24	Mhh	20L
beta Per	1138.1690	+0.0332	1917	v	28	Kit	N
beta Per	1141.0300	+0.0269	1918	v	37	Kit	N
VZ Psc	1111.9135	-0.0826	27872	V	34	Nga	10L+ST-5
Y Sex	0907.9557	+0.0262	21775	V	90	Nga	10L+ST-5
V505 Sgr	1048.9906	-0.0118	5569	2V	59	Nga	10L+ST-5

star	min. 2450000+	O-C	E		n	obs.	inst.
X Tri	0819.028	-0.035	8560	v	18	Wnt	32L
X Tri	1090.086	-0.035	8839	v	27	Mom	15MC
X Tri	1126.037	-0.030	8876	v	28	Mhh	20L
XY UMa	0891.129	+0.009	32724	v	28	Mhh	20L

*1: secondary minimum
*2: minI=2450758.7233 + 15.25141 x E (IBVS4568)
*3: no epoch listed in GCVS
*4: minI=2448601.3745 + 0.38331234 x E (IBVS3797)

Minimum was observed on V; Johnson V, Rc; Kron-Cousins Rc, v; visual. pv; photo-visual
O-C: elements from GCVS IV (Kholopov et al, Moscow 1986)
n: number of estimates
Obs: abbreviation for observers

AAU:	Astronomical Union of Universities	Hrm:	Mitsutaka Hiraga
Ioh:	Hiroshi Itoh	Kis:	Seiichiro Kiyota
Kit:	Kiyotaka Kanai	Kyh:	Hiroshi Koyama
Mhh:	Hiroyuki Maehara	Mkn:	Nobuhiro Makiguchi
Mom:	Masahiko Momose	Nga:	Kazuo Nagai
Nsa:	Atsushi Nishimura	Stm:	Minoru Satho
Tku:	Ukyou Takaki	Wnt:	Tutomu Watanabe
Wny:	Yasunori Watanabe		

Inst: instrument(s) used for observation: number indicates diameter of mirror or lens.
SCT; Schmidt cassegrain telescope, L; re°ector, R; refractor, B; binocular, N: naked eye.
MC; Macstov cassegrain, ST-5, ST-6; CCD camera (SBIG), BT-20; CCD camera (Bitran)
PMT; photomultiplier tube

Detection of an Eclipse during the 1987 Outburst of U Sco

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U Sco is a recurrent nova which showed recorded outbursts in 1863, 1906, 1936, 1979, 1987, and most recently in 1999 (for a summary of the 1987 outburst, see Sekiguchi et al. 1988). The eclipsing nature of the object was discovered (Shaefer and Bradley 1990) after the 1987 outburst. Shaefer and Ringwald (1995) further obtained eclipse timings yielding a precise ephemeris. We examined our time-series photographic observations obtained during on 1987 May 20, which fortuitously covered the primary minimum. This makes the ¯rst epoch observation of the U Sco eclipse during the 1987{1999 outburst interval.

Table 1. Photographic observations of U Sco

HJD-2400000	mag	HJD-2400000	mag	HJD-2400000	mag
46936.086	12.39	46936.138	12.50	46936.190	13.05
46936.089	12.52	46936.144	12.92	46936.195	12.92
46936.093	12.78	46936.150	12.11	46936.201	12.92
46936.097	13.13	46936.155	12.31	46936.206	13.45
46936.102	13.06	46936.168	12.59	46936.212	13.07
46936.109	12.43	46936.173	12.85	46936.218	12.53
46936.128	12.53	46936.179	12.84		
46936.134	13.40	46936.184	12.91		

The observations were made using a 13-cm re°ector (°=1.0m) and Sakura SR-400 ¯lms. The exposure time was typically 475 sec. The negatives and prints were measured by eye, using up to ¯ve comparison stars. The estimated step values were analyzed by the least-squares method (Kato 1997). Three comparison stars with known visual magnitudes (AAVSO) were used to calibrate the zero point and the scale. The resultant values are listed in table 1. There was no considerable systematic di®erence between photographically yielded magnitudes and other visual observations obtained quasi-simultaneously.

Figure 1 shows the overall light curve of U Sco during the 1987 outburst, drawn from the VSOLJ database and the above estimates (the corresponding data in the VSOLJ database have been superseded by the updated magnitudes). Superimposed on the general smooth fading, a temporary fading is apparent (at HJD 2446936), corresponding to the eclipse minimum. According to the ephemeris by Shaefer and Ringwald (1995), there is no other eclipses a®ecting the overall light curve. Figure 2 presents the enlarged light curve of the time-series photographic observations. Although the scatter is relatively large (especially in the ¯rst half of the observation was slightly a®ected by slightly poor tracking and occasionally truncated exposures), there is a clear fading in the last half of the observation. The exposure centered on HJD 2446936.206 shows the object markedly faint, possibly catching the mid-eclipse.

By using the VSOLJ database between 1987 May 18 and 24, and subtracting the smooth fading trend, all available positive observations (using the same comparison sequence) were converted to the orbital phases based on the ephemeris by Shaefer and Ringwald (1995). The resultant modulations were averaged to 0.02 phase bins (¯gure 3), on which the primary eclipse with a depth of »0.8 mag is clearly seen. The relative insu±ciency of the points during the egress phase makes determining the accurate eclipse timing from the phase-averaged light curve relatively di±cult, but the still fading trend on the time-resolved light curve at the expected minimum (HJD 46936.199) may be an indication of a slight positive O ¡ C. If we adopt the epoch of the faintest estimate (HJD 2446936.206), O ¡ C becomes +0.007 d.

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References

[1] Kato, T. 1997, Variable Star Bulletin 25, 1

[2] Sekiguchi, K., Feast, M. W., Whitelock, P. A., Overbeek, M. D., Wargau, W., Spencer Jones, J. 1988, MNRAS 234, 281

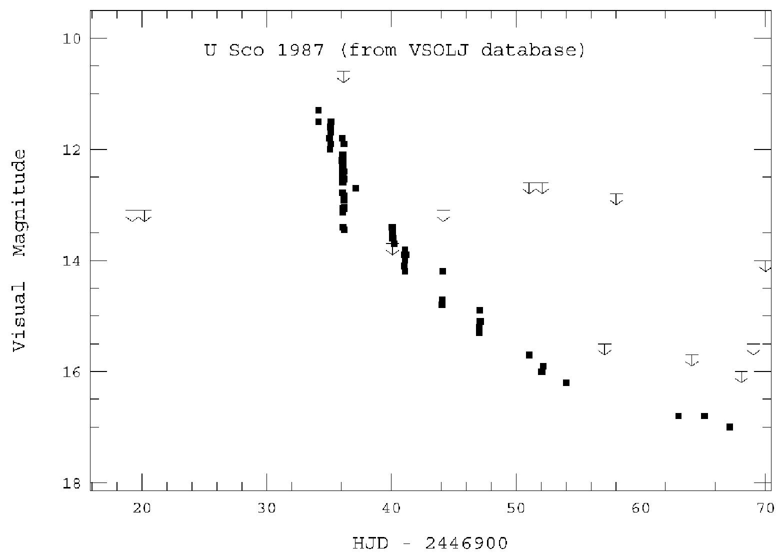

Figure 1: Light curve of the 1987 outburst of U Sco (VSOLJ)

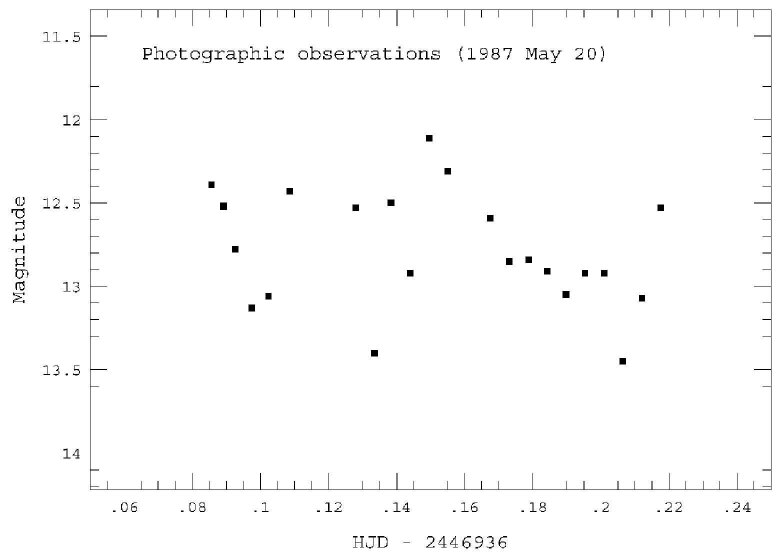

Figure 2: Enlarged light curve on 1987 May 20

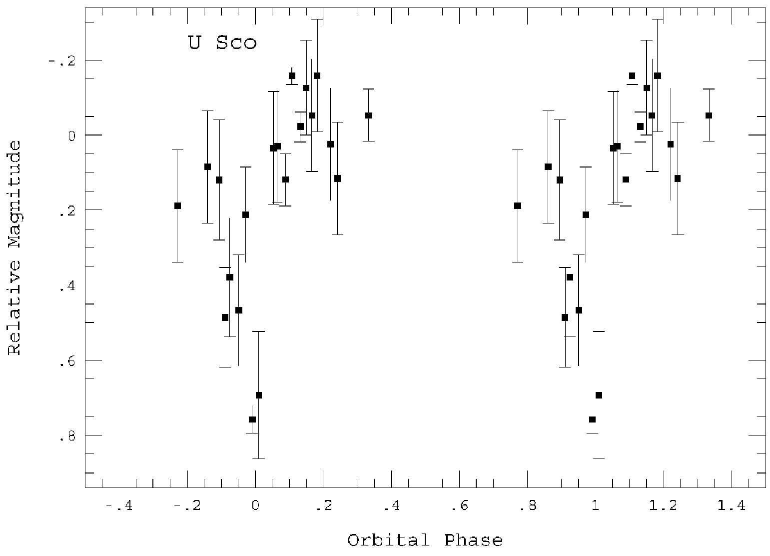

Figure 3: Phase-averaged light curve of the U Sco eclipse

[3] Shaefer, B. E., Bradley, E. 1990, ApJ 355, 39L

[4] Shaefer, B. E., Ringwald, F. A. 1995, ApJ 447, L45

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