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INFORMATION BULLETIN ON VARIABLE STARS

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**CCD MINIMA FOR SELECTED ECLIPSING BINARIES IN 2002**

NELSON, ROBERT H.

1393, Garvin Street, Prince George, BC, Canada, V2M 3Z1; e-mail: bob.nelson@shaw.ca

<b>Observatory and telescope:</b>
Sylvester Robotic Observatory <sup>1</sup> (SRO): 33 cm f/4.5 Newtonian on Paramount GT-1100s mount.

<b>Detector:</b>	SBIG ST7e, 1 <sup>u</sup> 24 pixels, 15 <sup>u</sup> 8 × 10 <sup>u</sup> 5 FOV, cooled to −10°C < <i>T</i> < −30 °C
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<b>Method of data reduction:</b>
Aperture photometry using MIRA, by Axiom Research

<b>Method of minimum determination:</b>
Digital tracing paper method, bisection of chords, curve fitting, and (occasionally) Kwee and van Woerden (1956). See Nelson (2000) for more information.

<b>Observed star(s):</b>						
Star Name	GCVS type	J2000 RA* Dec		Comp. Star	Epoch – 2400000	Latest Period (d)
RT And	EA/DW/RS	23.1110	53.0133	GSC 3998:2212	52566.7024	0.6289283
WZ And	EB/KE:	1.0143	38.0550	GSC 2799:1170	52513.7977	0.6956630
AB And	EW/KW	23.1132	36.5335	GSC 2763:0735	52559.6322	0.3318910
AD And	EB/DW:	23.3645	48.4016	GSC 3641:0023	52633.6243	0.9862163
BX And	EW/DW:	2.0903	40.4739	GSC 2833:0089	52604.6742	0.6101144
LO And	EW/KW	23.2706	45.3331	GSC 3637:0299	52524.7879	0.3808220
EP And	EW/KW	1.4229	44.4542	GSC 2827:0575	52601.6481	0.4041105
ZZ Aur	EB/KE	5.4542	41.0859	GSC 2915:0220	52633.7473	0.6012168
BF Aur	EB	5.0503	41.1719	GSC 2899:0175	52600.6934	1.5832226
HL Aur	EB/SD	6.1913	49.4207	GSC 3383:0823	52600.8134	0.6225055
KU Aur	EA/SD:	6.2756	30.2323	GSC 2422:0809	52618.8453	1.3195725
WW Cam	EA/DM	4.3125	64.2145	GSC 4073:0510	52528.907	2.2743633
AO Cam	EW/KW	4.2813	53.0245	GSC 3732:1016	52631.7377	0.3299284
BU Cas	EA/DM	1.2841	61.0755	GSC 4031:1639	52619.5771	2.2551969
GT Cas	EA/SD	0.1330	58.1659	GSC 3665:0996	52524.6942	2.9897984
MM Cas	EA/SD	0.5435	54.2636	GSC 3672:0189	52639.5873	1.1584800
MN Cas	EA/DM	1.4203	54.5736	GSC 3675:1855	52493.8614	1.9169249
OX Cas	EA/DM	1.0900	61.2814	GSC 4030:0987	52608.5841	2.4893439
V357 Cas	EB	23.2951	54.5800	GSC 4033:1848	52563.7916	0.7607589
V366 Cas	EW/DW	1.0826	58.4417	GSC 3681:0642	52537.8238	0.7292900
V459 Cas	EA/DM	1.1130	61.0848	GSC 4030:0348	52565.6717	8.4582654

<b>Observed star(s):</b>						
Star Name	GCVS type	J2000		Comp. Star	Epoch – 2400000	Latest Period (d)
		RA*	Dec			
BE Cep	EW/KW	22.4121	58.3636	GSC 3996:0441	52490.8752	0.4243941
EF Cep	EW	4.4540	80.4426	GSC 4523:0854	52535.812	0.6061075
OT Cep	EA	0.2922	82.1005	GSC 4504:0663	52557.7838	0.4812310
SS Cet	EA/SD	2.4836	1.4827	GSC 0047:0638	52565.8290	2.9739807
XZ CMi	EA	7.5407	3.3854	GSC 0185:1509	52605.9685	0.5788091
V387 Cyg	EW/K:	21.1537	37.2952	GSC 2714:0043	52517.7527	0.6405973
V628 Cyg	EW	21.3404	47.1422	GSC 3595:1315	52538.7802	0.6516518
V700 Cyg	EW/KW	20.3113	38.4741	GSC 3153:0819	52609.5920	0.3400219
V1073 Cyg	EW/KE	21.2500	33.4115	GSC 2711:2412	52569.6317	0.7858582
YY Eri	EW/KW	4.1209	-10.2810	GSC 5315:0565	52550.9432	0.3214990
RW Gem	EA/SD:	6.0128	23.0828	GSC 1864:1888	52619.8506	2.8654963
EY Gem	EB/KE	6.4532	17.1331	GSC 1334:0226	52626.7388	0.9411168
GW Gem	EB/SD	7.5229	27.0916	GSC 1933:0570	52585.8672	0.6594456
DF Hya	EW/KW	8.5502	6.0537	GSC 0225:0943	52600.9568	0.3306063
SW Lac	EW/KW	22.5342	37.5619	GSC 3215:1406	52607.5828	0.3207186
VX Lac	EA/SD	22.4101	38.1920	GSC 3214:1036	52489.8547	1.0745058
VY Lac	EB/KE	22.4959	45.0016	GSC 3227:0195	52482.8311	1.0362311
CM Lac	EA/DM	22.0005	44.3308	GSC 3197:1602	52537.6998	1.6046917
EM Lac	EW/KW	22.2355	54.0108	GSC 3982:1914	52551.6860	0.3891346
SW Lyn	EA/DW	8.0742	41.4802	GSC 2976:1660	52607.8091	0.6440658
FR Ori	EB/SD:	5.5104	9.2633	GSC 0718:0690	52635.7590	0.8831629
BX Peg	EW/KW	21.3853	26.4223	GSC 2197:1871	52546.6670	0.2804186
CC Peg	E	21.3942	28.2455	GSC 2201:0061	52534.7137	0.6056033
RT Per	EA/SD	3.2340	46.3436	GSC 3312:1534	52554.7167	0.8494059
RV Per	EA/SD	4.1038	34.1555	GSC 2366:1876	52547.8658	1.9734905
WY Per	EA/SD	3.3825	42.4041	GSC 2870:1440	52546.8189	3.3270740
XZ Per	EA/SD	4.0928	46.3358	GSC 3328:1131	52555.8134	1.1516284
V432 Per	EW/KW	3.1011	42.5210	GSC 2855:0585	52516.9010	0.3833116
V449 Per	EA/KE	2.5733	35.1401	GSC 2334:0150	52517.9391	0.9462100
V579 Per	EW?	3.3912	41.1658	GSC 2870:2649	52559.7957	0.4656232
UV Psc	EA/D:/RS	1.1655	6.4842	GSC 0026:0669	52607.6729	0.8610407
RZ Tau	EW/KW	4.3638	18.4518	GSC 1270:0877	52551.941	0.4156706
CU Tau	EW/KW	3.4737	25.2313	GSC 1804:2270	52551.8458	0.4122054
EQ Tau	EW/KW	3.4813	22.1922	GSC 1260:0575	52608.6852	0.3413479
V781 Tau	EW/KW	5.5013	26.5743	GSC 1870:0514	52554.9210	0.3449080
V Tri	EB/SD	1.3147	30.2202	GSC 2293:1331	52528.7718	0.5852056
RV Tri	EA/SD	2.1318	37.0101	GSC 2321:1715	52548.734	0.7536616
XY UMa	EB/DW/RS	9.0956	54.2917	GSC 3805:0479	52559.9583	0.4789863

\* RA values are in the format HH.MMSS, Dec in DD.MMSS. 'G' stands for 'GSC'.

**Source(s) of the ephemeris:**

*O – C* charts using all available published times of minima. See 'Bob Nelson's *O – C* Files' in the references. The epochs above are the latest and best times of minima (which usually coincide with the times newly reported here).

**Times of minima:**

Star name	Time of min. HJD 2400000+	Error	Type	Filter	<i>O – C</i> [day]	Rem.
RT And	52566.7024	0.0002	s	V	–	
WZ And	52513.7977	0.0002	s	clear	–	
AB And	52559.6322	0.0002	s	R	–	
AD And	52633.6243	0.0003	p	clear	–	
BX And	52604.6742	0.0001	p	I	–	
LO And	52524.7879	0.0001	s	clear	–	
EP And	52601.6481	0.0001	s	clear	–	

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O - C$ [day]	Rem.
ZZ Aur	52633.7473	0.0001	p	clear	—	
BF Aur	52600.6934	0.0005	P	clear	—	
HL Aur	52600.8134	0.0002	p	clear	—	
HL Aur	52635.6739	0.0001	p	clear	—	
KU Aur	52618.8453	0.0003	p	clear	—	C-K slope
WW Cam	52528.907	0.002	p	clear	—	
AO Cam	52631.7377	0.0001	p	clear	—	
BU Cas	52619.5771	0.0001	p	clear	—	
GT Cas	52524.6942	0.0004	p	clear	—	
MM Cas	52639.5873	0.0002	p	clear	—	
MN Cas	52493.8614	0.0003	p	clear	—	
OX Cas	52608.5841	0.0004	p	clear	—	
V357 Cas	52563.7916	0.0004	s	clear	—	
V366 Cas	52537.8238	0.0003	s	clear	—	
V459 Cas	52565.6717	0.00005	p	clear	—	
BE Cep	52490.8752	0.00005	s	clear	—	
EF Cep	52535.812	0.001	s	clear	—	
OT Cep	52557.7838	0.0002	p	clear	—	
SS Cet	52565.8290	0.0003	p	clear	—	
XZ CMi	52605.9685	0.0001	p	clear	—	
V387 Cyg	52517.7527	0.0001	p	clear	—	
V628 Cyg	52538.7802	0.0001	p	clear	—	
V700 Cyg	52609.5920	0.0003	p	clear	—	
V1073 Cyg	52569.6317	0.0002	p	V	—	
YY Eri	52550.9432	0.0001	s	V	—	
YY Eri	52619.7447	0.0002	s	V	—	
RW Gem	52619.8506	0.0001	p	clear	—	
EY Gem	52626.7397	0.0003	p	clear	—	C-K slope
GW Gem	52585.8672	0.0003	p	clear	—	
DF Hya	52600.9568	0.0002	s?	clear	—	
SW Lac	52607.5828	0.0001	p	I	—	
VX Lac	52489.8547	0.00003	p	clear	—	
VY Lac	52482.8311	0.0002	p	clear	—	C-K slope
CM Lac	52537.6998	0.0001	p	V	—	
EM Lac	52551.6860	0.0001	p	clear	—	
SW Lyn	52607.8091	0.0001	p	V	—	
FR Ori	52635.7585	0.0005	p	clear	—	C-K slope
BX Peg	52546.6670	0.00005	s	clear	—	
CC Peg	52534.7137	0.0003	s	clear	—	
RT Per	52554.7167	0.0001	p	clear	—	
RV Per	52547.8658	0.0005	p	clear	—	
WY Per	52546.8189	0.00008	p	clear	—	
XZ Per	52555.8134	0.00005	p	clear	—	
V432 Per	52516.9010	0.00004	p	clear	—	
V432 Per	52550.8236	0.0004	s	clear	—	
V449 Per	52517.9391	0.0004	p	clear	—	
V579 Per	52559.7957	0.0005	p	V	—	
UV Psc	52607.6729	0.0001	p	clear	—	
RZ Tau	52551.941	0.001	p	clear	—	
CU Tau	52551.8458	0.0001	p	clear	—	
EQ Tau	52608.6852	0.0002	p	clear	—	
V781 Tau	52554.9210	0.0003	p	V	—	
V Tri	52528.7718	0.0002	s	clear	—	
V Tri	52547.792	0.001	p	clear	—	
V Tri	52554.8155	0.0001	p	clear	—	
RV Tri	52548.734	0.001	p	clear	—	
XY UMa	52559.9583	0.0001	p	clear	—	

**Explanation of the remarks in the table:**

'C-K slope' refers to a change in the C-K plot of 0.01 magnitudes or greater over the observing run. See below.

**Remarks:**

In the case of bright stars, V, R or I filters were used to maintain the same exposures (of 1-5 minutes) which were required for low random errors. Check stars (K1, K2, ...) were used for all program stars in addition to the comparison (C). However, for some, the plot of comparison-check (C-K) magnitude difference versus time revealed a disturbing change of 0.01 - 0.02 magnitudes over a time span of 0.05 - 0.08 days.

Further analysis of one of the stars, FR Ori, revealed that check stars having nearly equal airmasses gave a check2-check1 (i.e, K2-K1) plot versus time constant to within 0.004 (2) magnitudes whereas a third check star (K3) having a line of centres with K1 perpendicular to the horizon gave K3-K1 changes of 0.023 (3) magnitudes. Since the C-V (variable) line was also perpendicular to the horizon, a tentative correction was applied to the light curve resulting in a disturbing 0.00055 day shift in the time of minimum. This calls into question the accuracy with which some times of minima are reported, here and elsewhere. (For now, no corrections are included in any of the times reported here.)

Further discussion and analysis will be presented in a future IBVS note.

**Acknowledgements:**

Thanks are due to Environment Canada for the website satellite images (see below) that were essential in predicting clear times for observing runs in this cloudy locale. Thanks are also due to Attila Danko for his Clear Sky Clocks, (see below). Much use was made of the Eclipsing Binary Ephemeris Generator; thanks Shawn.

The author is also a Guest User of the Canadian Astronomy Data Centre, which is operated by the Dominion Astrophysical Observatory for the National Research Council of Canada's Herzberg Institute of Astrophysics.

## References:

Danko, A., *Clear Sky Clocks*, <http://cleardarksky.com/>

Dvorak, S., *Eclipsing Binary Ephemeris Generator*,

<http://rollinghillsobs.dyn.dhs.org:8000/cgi-bin/calceBephem.pl>

Kwee, K. K., & van Woerden, H., 1956, *B.A.N.*, **12**, 327

Nelson, R. H., *Bob Nelson's O-C files*, <http://binaries.boulder.swri.edu/binaries/omc/>

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Satellite images for North America, <http://www.cmc.ec.gc.ca/cmc/htmls/satellite.html>

**ERRATUM FOR IBVS 5040**

In IBVS 5040, the time of minimum for the GW Cep on 2002-03-19 (UT) should read 51622.8521.