COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5928

Konkoly Observatory
Budapest
8 March 2010

HU ISSN 0374 – 0676

MAXIMA OF HIGH-AMPLITUDE DELTA SCUTI STARS

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We report further times of maximum for a number of High-Amplitude Delta Scuti Stars (HADS), following the report of Wils et al. (2009). For the first time, time series photometry was obtained for GSC 2815-790 (Khruslov, 2008), and for the following objects found to be variable in ASAS-3 data (Pojmanski, 2002): GSC 2108-1564 (= HD 343024 = ASAS 184744+2313.2), GSC 4923-693 (= ASAS 112518-0047.3), GSC 6678-0579 (= ASAS 115336-2905.9) and GSC 7027-0700 (= ASAS 033219-3539.3), confirming these stars to be δ Scuti stars. Three stars known to be multi-periodic are included as well in this paper. For these stars a second frequency was not detected in our data (AN Lyn, see Zhou, 2002 and V1162 Ori, see Arentoft, 2001), or, in the case of BL Cam, the amplitude of the secondary frequency is so low compared to the main frequency, that it does not significantly alter the time of maximum. Although we have only one night of data, GSC 6678-0579 is likely to be multiperiodic as well.

The method used to calculate the times of maximum is described in Wils et al. (2009). The templates used to fit the light curves for those stars not included in that paper are available electronically through the IBVS website as `5928-t3.txt` These have been calculated using Period04 (Lenz & Breger, 2005).

The observers and their instruments are given in Table 1. The 218 times of maximum obtained for 25 HADS are listed in Table 2. When the same maximum was observed in more than one filter, the table shows the average value of the times obtained in each filter individually. The suggestion of a companion in a 22-year orbit around AN Lyn (Hintz et al., 2005) does not seem to be confirmed by our data. A linear ephemeris which better fits the available data since 2000 (Zhou, 2002; Agerer & Hübscher, 2003; Hintz et al., 2005; Hübscher, 2005; Hübscher et al., 2005, 2006; Klingenberg et al., 2006 and from this paper) is given by:

$$\text{HJD Max} = 2451583.0767(3) + 0.098274972(13) \times E \quad (1)$$

Fig. 1 shows an $O-C$ plot using this ephemeris of these data, and also including older data discussed by Hintz et al. (2005). The period is slightly longer (0.18 seconds) than the one derived by these authors. The $O-C$ plot also assumes that they miscounted the number of cycles in the ten year gap between the observations in the 1980s and 1990s (one cycle too many).

Table 1: List of instruments used for the observations.

Code	Observers	Telescope type	Aperture	Observatory	CCD
AO1	SO+EB	Refractor	9 cm	Astropilar Observatory	SBIG ST-10XME
AO2	SO+EB	Catadioptric	25 cm	Astropilar Observatory	SBIG ST-10XME
BHO1	PL+PVC	Refractor	18 cm	Beersel Hills Observatory	SBIG ST-10XME
BHO2	PL+PVC	Newton	40 cm	Beersel Hills Observatory	SBIG ST-10XME
ET	ET	Newton	25 cm	Pegasus Observatory Brakel	SBIG ST402-ME
HMB	FJH	Cassegrain	28, 35, 40 cm	Mol, Belgium	SBIG ST-8
HMB2	FJH	Ritchey-Chrétien	50 cm	New Mexico, USA	STL11000XM
HO18	PL+PVC	Refractor	18 cm	R.O.B.-Humain	SBIG ST-10XME
HO40	PL+PVC	Newton	40 cm	R.O.B.-Humain	SBIG ST-10XME
JVW	JVW	Refractor	8 cm	Hooglede, Belgium	SBIG ST-7XME
MVL	MVL	Catadioptric	26 cm	Willebroek Observatory	SBIG ST-10XME
RP	RDP	Catadioptric	30 cm	Shobdon, UK	Starlight XPress SXV-H9
SBL	BS	Cassegrain	28, 23.5 cm	Patrick Mergan Observatory	Starlight XPress MX-716
SK	SK	Catadioptric	30 cm	Zagori Observatory	SBIG ST-7XMEI

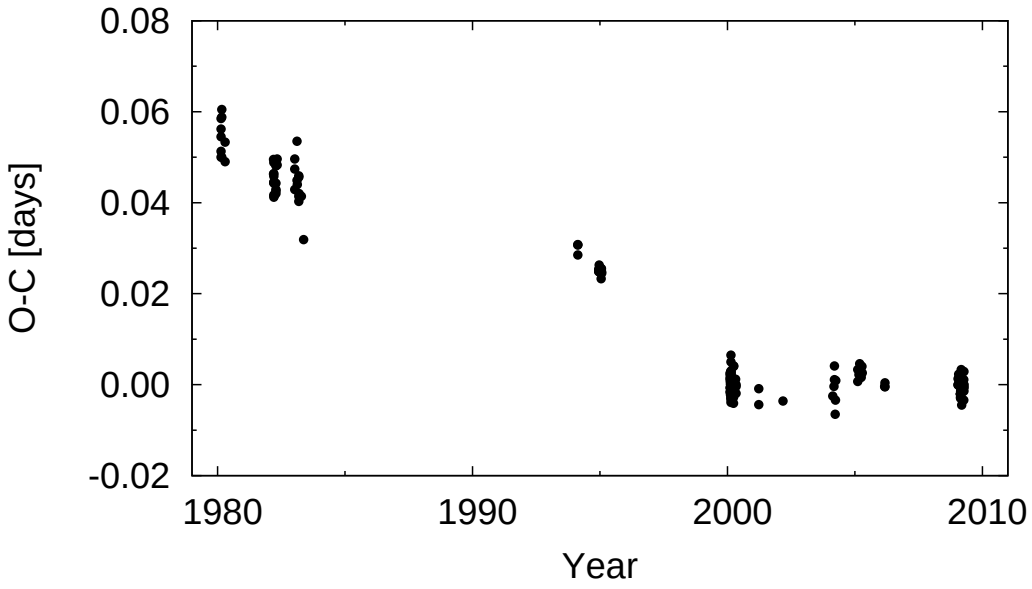

Figure 1. $O-C$ curve of AN Lyn with respect to the elements given in Eq. 1.

Acknowledgements:
This work has made use of the SIMBAD database, operated at CDS, Strasbourg, France. PVC is grateful for support from Astrotechniek. and Baader Planetarium PL thanks the directors of the Royal Observatory of Belgium (ROB) for purchasing and operating an optical telescope at the radio-astronomy site of Humain under the project name *HOACS* (Humain Optical Observatory for Astrophysics of Coeval Stars). The BHO and *HOACS* data were acquired with equipment purchased thanks to a research fund financed by the Belgian National Lottery (1999).

Table 2: Observed times of maximum (Epoch = HJD - 2400000).

Star	Epoch	Unc.	Obs.	Filter	Star	Epoch	Unc.	Obs.	Filter
GP And	55155.3448	0.0007	HMB	V	AN Lyn	54890.6197	0.0006	HMB2	BV
	55155.5017	0.0009	HMB	V		54890.7170	0.0012	HMB2	BV
	55172.3392	0.0009	HMB	V		54891.7006	0.0016	HMB2	BV
	55172.4183	0.0013	HMB	V		54892.6821	0.0018	HMB2	BV
	55204.3636	0.0013	HMB	V		54893.6677	0.0019	HMB2	BV
V460 And	55192.3112	0.0005	HMB	V		54901.6265	0.0026	HMB2	V
	55192.3863	0.0012	HMB	V		54901.7236	0.0023	HMB2	V
YZ Boo	54891.5364	0.0008	HMB	V		54901.8180	0.0020	HMB2	V
	54891.6405	0.0006	HMB	V		54901.9206	0.0036	HMB2	V
	54906.5261	0.0007	SBL	V		54928.6517	0.0013	HMB2	BV
	54906.6292	0.0007	SBL	V		54928.7482	0.0025	HMB2	BV
	54931.4034	0.0008	SBL	V		54934.6456	0.0009	HMB2	BV
	54931.5075	0.0009	SBL	V		54934.7457	0.0025	HMB2	BV
	54974.4971	0.0008	ET	V	V593 Lyr	54941.5634	0.0007	HMB	V
BL Cam	54896.3796	0.0008	RP	C		54942.5858	0.0011	HMB	V
	54896.4187	0.0008	RP	C	V337 Ori	54837.4619	0.0016	ET	V
	54896.4585	0.0008	RP	C		54873.4822	0.0020	RP	V
	54896.4965	0.0012	RP	C		54892.4001	0.0047	RP	C
	54896.5360	0.0011	RP	C		54893.4088	0.0009	HMB	V
	54896.5753	0.0009	RP	C	V1162 Ori	51553.3517	0.0006	BHO2	V
	55200.3658	0.0015	RP	C		51553.4297	0.0008	BHO2	V
	55200.4054	0.0009	RP	C		51568.3020	0.0008	BHO2	V
	55200.4446	0.0006	RP	C		51568.3803	0.0008	BHO2	V
	55200.4840	0.0007	RP	C		52223.5414	0.0007	BHO2	V
	55200.5232	0.0012	RP	C		52228.4989	0.0008	BHO2	V
	55200.5616	0.0006	RP	C		52228.5780	0.0008	BHO2	V
	55200.6017	0.0008	RP	C		52254.3889	0.0008	BHO2	V
AD CMi	54891.3291	0.0007	HMB	V		52254.4652	0.0008	BHO2	V
	54893.4197	0.0009	HMB	V		52254.5444	0.0007	BHO2	V
	55180.6865	0.0007	HMB	V		52254.6220	0.0005	BHO2	V
XX Cyg	55044.4658	0.0007	HMB	V		52257.4561	0.0007	BHO2	V
LW Dra	54922.3613	0.0008	HMB	V		52257.5342	0.0007	BHO2	V
	54922.4799	0.0007	HMB	V		52257.6124	0.0011	BHO2	V
	54922.5975	0.0010	HMB	V		52258.4006	0.0009	BHO2	V
	54946.4652	0.0007	JVW	V		52258.4786	0.0007	BHO2	V
	54953.4358	0.0009	JVW	V		52258.5582	0.0010	BHO2	V
	54960.4069	0.0008	JVW	V		52270.3625	0.0009	BHO2	V
	54960.5249	0.0008	JVW	V		52270.4388	0.0009	BHO2	V
SZ Lyn	54912.5263	0.0009	HMB	V		52270.5174	0.0009	BHO2	V
	55189.5234	0.0008	HMB	V		52277.3647	0.0008	BHO2	V
	55191.4519	0.0004	HMB	V		52277.4445	0.0008	BHO2	V
	55191.5722	0.0006	HMB	V		52279.3314	0.0009	BHO2	V
	55191.6931	0.0005	HMB	V		52279.4101	0.0009	BHO2	V
AN Lyn	54848.4592	0.0009	SK	V		52279.4896	0.0007	BHO2	V
	54848.5573	0.0008	SK	V		54829.4874	0.0008	BHO2	V
	54848.6570	0.0010	SK	V		54829.5674	0.0008	BHO2	V
	54858.3862	0.0009	SK	V		54833.4990	0.0009	BHO2	V
	54858.4834	0.0008	SK	V		54838.3803	0.0007	BHO2	V
	54858.5838	0.0009	SK	V		54838.4570	0.0008	BHO2	V
	54882.6568	0.0019	HMB2	V		54838.5365	0.0007	BHO2	V
	54882.7551	0.0016	HMB2	V		54841.3694	0.0007	BHO2	V
	54882.8526	0.0025	HMB2	V		54841.4495	0.0008	BHO2	V
	54883.6408	0.0018	HMB2	BV	DY Peg	55069.3734	0.0004	SBL	V
	54883.7388	0.0013	HMB2	BV		55069.4458	0.0003	SBL	V
	54887.6704	0.0014	HMB2	BV		55069.5190	0.0002	SBL	V
	54887.7674	0.0017	HMB2	BV		55069.5923	0.0002	SBL	V
	54889.6375	0.0007	HMB2	BV		55113.4203	0.0009	SBL	V
	54889.7342	0.0021	HMB2	BV		55113.4933	0.0006	SBL	V

Table 2: Observed times of maximum (continued).

Star	Epoch	Unc.	Obs.	Filter	Star	Epoch	Unc.	Obs.	Filter
DY Peg	55130.2666	0.0003	SBL	V	GSC 2977-0238	55244.5580	0.0000	HMB	VR
	55132.3811	0.0006	SBL	V		55244.6337	0.0000	HMB	VR
	55143.3929	0.0007	JVW	V	GSC 3074-0114	54921.4442	0.0006	HO40	C
	55155.3534	0.0004	HMB	VR		54921.4953	0.0005	HO40	C
	55155.4266	0.0001	HMB	VR		54944.5786	0.0007	HMB	V
	55177.3767	0.0007	JVW	V		54944.6299	0.0002	HMB	V
	55180.2940	0.0008	HMB	VR		54945.5532	0.0006	HMB	V
	55180.3671	0.0006	HMB	VR		54945.6044	0.0005	HMB	V
	55192.2535	0.0002	HMB	VR	GSC 3755-0845	54841.2752	0.0009	BHO1	V
	55192.3270	0.0006	HMB	VR		54862.2796	0.0008	SBL	V
GW UMa	54838.5450	0.0009	MVL	V		54862.3559	0.0010	SBL	V
	54877.3546	0.0013	HMB	V		54862.4318	0.0007	SBL	V
	54891.3755	0.0016	HMB	V		55132.5017	0.0014	SBL	V
	54891.5794	0.0019	HMB	V		55132.5772	0.0013	SBL	V
	55198.6049	0.0050	HMB	V		55153.3524	0.0012	SBL	V
	55223.3947	0.0015	HMB	V		55153.4283	0.0010	SBL	V
	55233.3504	0.0017	HMB	V		55153.5046	0.0016	SBL	V
GSC 2108-1564	55047.4141	0.0021	HMB	V		55153.5801	0.0015	SBL	V
	55047.5122	0.0017	HMB	V	GSC 3832-0152	54881.3444	0.0007	HMB	V
GSC 2566-1398	54891.5362	0.0005	HMB	V		54910.3909	0.0008	SBL	V
	54911.4928	0.0008	SBL	V		54910.4823	0.0008	SBL	V
	54911.5831	0.0008	SBL	V		54910.5736	0.0007	SBL	V
	54911.6740	0.0007	SBL	V		55233.4679	0.0005	HMB	V
	54912.4904	0.0007	SBL	V		55233.5592	0.0004	HMB	V
	54941.4279	0.0011	SBL	V	GSC 4556-1113	54842.2812	0.0006	HMB	V
	54944.4213	0.0006	SBL	V		54843.3171	0.0006	HMB	V
	54944.5120	0.0005	SBL	V		54843.4034	0.0008	HMB	V
	54945.4191	0.0008	SBL	V		54850.3111	0.0009	HMB	V
	54945.5098	0.0007	SBL	V		54850.3971	0.0009	HMB	V
	54946.4169	0.0008	SBL	V		54856.3553	0.0010	HMB	V
	54946.5077	0.0006	SBL	V		54856.4415	0.0008	HMB	V
GSC 2815-0790	55117.3778	0.0024	RP	V		54856.5272	0.0008	HMB	V
	55117.4844	0.0018	RP	V		54856.6129	0.0008	HMB	V
	55117.5916	0.0015	RP	V		54858.4273	0.0007	HMB	V
	55121.3342	0.0018	RP	V		54858.5135	0.0008	HMB	V
	55227.3099	0.0012	RP	V		54858.5998	0.0009	HMB	V
	55227.4170	0.0013	RP	V		54858.6862	0.0008	HMB	V
GSC 2977-0238	54922.3720	0.0002	HO40	V		54860.3263	0.0009	HMB	V
	54922.4481	0.0003	HO40	V		54860.4133	0.0007	HMB	V
	54922.5240	0.0003	HO40	V		54860.4995	0.0008	HMB	V
	54930.2691	0.0007	SK	V		54860.5855	0.0010	HMB	V
	54930.3447	0.0010	SK	V		54861.2763	0.0007	HMB	V
	54930.4209	0.0008	SK	V		54861.3627	0.0007	HMB	V
	54963.3004	0.0008	SK	V		54861.4489	0.0009	HMB	V
	55223.2964	0.0008	HO18	V		54861.5354	0.0008	HMB	V
	55223.3725	0.0008	HO18	V		54861.6217	0.0006	HMB	V
	55233.3197	0.0005	HMB	V	GSC 4923-0693	54138.8439	0.0003	HMB2	C
	55233.6236	0.0004	HMB	V	GSC 6678-0579	54953.5297	0.0011	AO2	C
	55244.3300	0.0001	HMB	VR		54953.5991	0.0012	AO2	C
	55244.4060	0.0001	HMB	VR	GSC 7027-0700	55151.7081	0.0004	AO1	C
	55244.4819	0.0001	HMB	VR		55151.7624	0.0004	AO1	C

References:

Agerer F., Hübscher J., 2003, *IBVS*, 5485
Arentoft T., Sterken C., Handler G., Freyhammer L.M., Bruch A., Niarchos P., Gazeas K., Manimanis V., Van Cauteren P., Poretti E., Dawson D.W., Liu Z.L., Zhou A.Y., Du B.T., Shobbrook R.R., Garrido R., Fried R., Akan M.C., Ibanoglu C., Evren S., Tas G., Johnson D., Blake C., Kurtz D.W., 2001, *A&A*, **374**, 1056
Hintz, E.G., Bush T.C., Rose M.B., 2005, *AJ*, **130**, 2876
Hübscher J., 2005, *IBVS*, 5643
Hübscher J., Paschke A., Walter F., 2005, *IBVS*, 5657
Hübscher J., Paschke A., Walter F., 2006, *IBVS*, 5731
Khruslov A.V., 2008, *PZP*, **8**, 5
Klingenberg G., Dvorak S.W., Robertson C.W., 2006, *IBVS*, 5701
Lenz P., Breger M., 2005, *Comm. in Asteroseismology*, **146**, 53
Pojmanski G., 2002, *Acta Astron.*, **52**, 397
Wils P., Kleidis S., Hambsch F.-J., Vidal-Sáinz J., Vanleenhove M., Lampens P., Van Cauteren P., Robertson C.W., Staels B., Pickard R.D., Rozakis I., Dufoer S., Groenendaels R., Gómez-Forrellad J.M., García-Melendo E., Hautecler H., Van der Looy J., 2009, *IBVS*, 5878
Zhou A.-Y., 2002, *A&A*, **385**, 503

*This version of the paper contains corrections, and differs from the one appeared on-line originally. Date of last modification: Wed Mar 10 08:19:53 Europe/Budapest 2010