Publ. Astron. Soc. Japan (2014) 00(0), 1–88
doi: 10.1093/pasj/xxx000

Survey of Period Variations of Superhumps in SU UMa-Type Dwarf Novae. X: The Tenth Year (2017)

Taichi KATO,[1*] Keisuke ISOGAI,[1,2] Yasuyuki WAKAMATSU,[1] Franz-Josef HAMBSCH,[3,4,5] Hiroshi ITOH,[6] Tamás TORDAI,[7] Tonny VANMUNSTER,[8] Pavol A. DUBOVSKY,[9] Igor KUDZEJ,[9] Tomáš MEDULKA,[9] Mariko KIMURA,[1] Ryuhei OHNISHI,[1] Berto MONARD,[10,11] Elena P. PAVLENKO,[12] Kirill A. ANTONYUK,[12] Nikolaj V. PIT,[12] Oksana I. ANTONYUK,[12] Julia V. BABINA,[12] Aleksei V. BAKLANOV,[12] Aleksei A. SOSNOVSKIJ,[12] Roger D. PICKARD,[13,14] Ian MILLER,[15] Yutaka MAEDA,[16] Enrique DE MIGUEL,[17,18] Stephen M. BRINCAT,[19] Domenico LICCHELLI,[20,21] Lewis M. COOK,[22] Sergey Yu. SHUGAROV,[23,24] Anna M. ZAOSTROJNYKH,[25] Drahomir CHOCHOL,[24] Polina GOLYSHEVA,[23] Natalia KATYSHEVA,[23] Alexandra M. ZUBAREVA,[26,23] Geoff STONE,[27] Kiyoshi KASAI,[28] Peter STARR,[29] Colin LITTLEFIELD,[30] Seiichiro KIYOTA,[31] Maksim V. ANDREEV,[32,33] Alexandr V. SERGEEV,[32,33] Javier RUIZ,[34,35,36] Gordon MYERS,[37] Andrii O. SIMON,[38] Volodymyr V. VASYLENKO,[38] Francisco SOLDÁN,[39] Yenal ÖGMEN,[40] Kazuhiro NAKAJIMA,[41] Peter NELSON,[42] Gianluca MASI,[43] Kenneth MENZIES,[44] Richard SABO,[45] Greg BOLT,[46] Shawn DVORAK,[47] Krzysztof Z. STANEK,[48] Joseph V. SHIELDS,[48] Christopher S. KOCHANEK,[48] Thomas W.-S. HOLOIEN,[48] Benjamin SHAPPEE,[49] José L. PRIETO,[50,51] Tadashi KOJIMA,[52] Hideo NISHIMURA,[53] Shizuo KANEKO,[54] Shigehisa FUJIKAWA,[55] Rod STUBBINGS,[56] Eddy MUYLLAERT,[57] Gary POYNER,[58] Masayuki MORIYAMA,[59] Hiroyuki MAEHARA,[60] Patrick SCHMEER,[61] Denis DENISENKO,[23]

[1] Department of Astronomy, Kyoto University, Kyoto 606-8502, Japan
[2] Okayama Observatory, Kyoto University, 3037-5 Honjo, Kamogatacho, Asakuchi, Okayama 719-0232, Japan
[3] Groupe Européen d'Observations Stellaires (GEOS), 23 Parc de Levesville, 28300 Bailleau l'Evêque, France
[4] Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne (BAV), Munsterdamm 90, 12169 Berlin, Germany
[5] Vereniging Voor Sterrenkunde (VVS), Oude Bleken 12, 2400 Mol, Belgium
[6] Variable Star Observers League in Japan (VSOLJ), 1001-105 Nishiterakata, Hachioji, Tokyo 192-0153, Japan
[7] Polaris Observatory, Hungarian Astronomical Association, Laborc utca 2/c, 1037 Budapest, Hungary
[8] Center for Backyard Astrophysics Belgium, Walhostraat 1A, B-3401 Landen, Belgium
[9] Vihorlat Observatory, Mierova 4, 06601 Humenne, Slovakia

[10] Bronberg Observatory, Center for Backyard Astrophysics Pretoria, PO Box 11426, Tiegerpoort 0056, South Africa
[11] Kleinkaroo Observatory, Center for Backyard Astrophysics Kleinkaroo, Sint Helena 1B, PO Box 281, Calitzdorp 6660, South Africa
[12] Federal State Budget Scientific Institution “Crimean Astrophysical Observatory of RAS”, Nauchny, 298409, Republic of Crimea
[13] The British Astronomical Association, Variable Star Section (BAA VSS), Burlington House, Piccadilly, London, W1J 0DU, UK
[14] 3 The Birches, Shobdon, Leominster, Herefordshire, HR6 9NG, UK
[15] Furzehill House, Ilston, Swansea, SA2 7LE, UK
[16] Kaminishiyamamachi 12-14, Nagasaki, Nagasaki 850-0006, Japan
[17] Departamento de Ciencias Integradas, Facultad de Ciencias Experimentales, Universidad de Huelva, 21071 Huelva, Spain
[18] Center for Backyard Astrophysics, Observatorio del CIECEM, Parque Dunar, Matalascañas, 21760 Almonte, Huelva, Spain
[19] Flarestar Observatory, San Gwann SGN 3160, Malta
[20] R. P. Feynman Observatory, Gagliano del Capo, 73034, Italy
[21] Center for Backyard Astrophysics – Gagliano del Capo, 73034, Italy
[22] Center for Backyard Astrophysics Concord, 1730 Helix Ct. Concord, California 94518, USA
[23] Sternberg Astronomical Institute, Lomonosov Moscow State University, Universitetsky Ave., 13, Moscow 119992, Russia
[24] Astronomical Institute of the Slovak Academy of Sciences, 05960 Tatranska Lomnica, Slovakia
[25] Institute of Physics, Kazan Federal University, Ulitsa Kremlevskaya 16a, Kazan 420008, Russia
[26] Institute of Astronomy, Russian Academy of Sciences, Moscow 119017, Russia
[27] American Association of Variable Star Observers, 49 Bay State Rd., Cambridge, MA 02138, USA
[28] Baselstrasse 133D, CH-4132 Muttenz, Switzerland
[29] Warrumbungle Observatory, Tenby, 841 Timor Rd, Coonabarabran NSW 2357, Australia
[30] Department of Physics, University of Notre Dame, 225 Nieuwland Science Hall, Notre Dame, Indiana 46556, USA
[31] VSOLJ, 7-1 Kitahatsutomi, Kamagaya, Chiba 273-0126, Japan
[32] Terskol Branch of Institute of Astronomy, Russian Academy of Sciences, 361605, Peak Terskol, Kabardino-Balkaria Republic, Russia
[33] International Center for Astronomical, Medical and Ecological Research of NASU, Ukraine 27 Akademika Zabolotnoho Str. 03680 Kyiv, Ukraine
[34] Observatorio de Cántabria, Ctra. de Rocamundo s/n, Valderredible, 39220 Cantabria, Spain
[35] Instituto de Física de Cantabria (CSIC-UC), Avenida Los Castros s/n, E-39005 Santander, Cantabria, Spain
[36] Agrupación Astronómica Cántabria, Apartado 573, 39080, Santander, Spain
[37] Center for Backyard Astrophysics San Mateo, 5 inverness Way, Hillsborough, CA 94010, USA
[38] Astronomy and Space Physics Department, Taras Shevshenko National University of Kyiv, Volodymyrska str. 60, Kyiv, 01601, Ukraine
[39] Observatorio Amanecer de Arrakis, Alcalá de Guadaíra, Petrarca 6, 1A 41006. Seville, Spain
[40] Green Island Observatory, Geçitkale, Magosa, via Mersin, North Cyprus
[41] Variable Star Observers League in Japan (VSOLJ), 124 Isatotyo, Teradani, Kumano, Mie 519-4673

[42] 1105 Hazeldean Rd, Ellinbank 3820, Australia
[43] The Virtual Telescope Project, Via Madonna del Loco 47, 03023 Ceccano (FR), Italy
[44] Center for Backyard Astrophysics (Framingham), 318A Potter Road, Framingham, MA 01701, USA
[45] 2336 Trailcrest Dr., Bozeman, Montana 59718, USA
[46] Camberwarra Drive, Craigie, Western Australia 6025, Australia
[47] Rolling Hills Observatory, 1643 Nightfall Drive, Clermont, Florida 34711, USA
[48] Department of Astronomy, the Ohio State University, Columbia, OH 43210, USA
[49] Carnegie Observatories, 813 Santa Barbara Street, Pasadena, CA 91101, USA
[50] Núcleo de Astronomía de la Facultad de Ingeniería, Universidad Diego Portales, Av. Ejército 441, Santiago, Chile
[51] Department of Astrophysical Sciences, Princeton University, NJ 08544, USA
[52] Kanbara, Tsumagoi-mura, Agatsuma-gun, Gunma 377-1524, Japan
[53] Miyawaki 302-6, Kakegawa, Shizuoka 436-0086, Japan
[54] 14-7 Kami-Yashiki, Kakegawa, Shizuoka 436-0049, Japan
[55] 107 Iseki, Oonohara-cho, Kannonji, Kagawa 769-1621, Japan
[56] Tetoora Observatory, 2643 Warragul-Korumburra Road, Tetoora Road, Victoria 3821, Australia
[57] Vereniging Voor Sterrenkunde (VVS), Moffelstraat 13 3370 Boutersem, Belgium
[58] BAA Variable Star Section, 67 Ellerton Road, Kingstanding, Birmingham B44 0QE, UK
[59] 290-383, Ogata-cho, Sasebo, Nagasaki 858-0926, Japan
[60] Subaru Telescope Okayama Branch Office, National Astronomical Observatory of Japan, NINS, Asakuchi, Okayama 719-0232, Japan
[61] Bischmisheim, Am Probstbaum 10, 66132 Saarbrücken, Germany

*E-mail: *tkato@kusastro.kyoto-u.ac.jp

Received 201 0; Accepted 201 0

Abstract

Continuing the project described by Kato et al. (2009, PASJ, 61, S395), we collected times of superhump maxima for 102 SU UMa-type dwarf novae observed mainly during the 2017 season and characterized these objects. WZ Sge-type stars identified in this study are PT And, ASASSN-17ei, ASASSN-17el, ASASSN-17es, ASASSN-17fn, ASASSN-17fz, ASASSN-17hw, ASASSN-17kd, ASASSN-17la, PNV J20205397+2508145 and TCP J00332502−3518565. We obtained new mass ratios for 7 objects using growing superhumps (stage A). ASASSN-17gf is an EI Psc-type object below the period minimum. CRTS J080941.3+171528 and DDE 51 are objects in the period gap and both showed long-lasting phase of stage A superhumps. We also summarized the recent advances in understanding of SU UMa-type and WZ Sge-type dwarf novae.

Key words: accretion, accretion disks — stars: novae, cataclysmic variables — stars: dwarf novae

1 Introduction

This is a continuation of series of papers Kato et al. (2009), Kato et al. (2010), Kato et al. (2012a), Kato et al. (2013a), Kato et al. (2014b), Kato et al. (2014a), Kato et al. (2015), Kato et al. (2016b) and Kato et al. (2017a) reporting new observations of superhumps in SU UMa-type dwarf novae. [see e.g. Warner (1995) for SU UMa-type dwarf novae and CVs in general].

Upon recommendation from the previous reviewer and the PASJ office, we provide the result in a concise form: presenting the results in the Supporting Information (SI) and only the list the objects (table 1), the obtained parameters (table 2) and the references (section 5) are given in the main paper. For the details of the analysis, terminology and definitions see Kato et al. (2009) and for the initial and current aims of this survey, see Kato et al. (2009) and Kato et al. (2017a), respectively. For superhump stages, see Kato et al. (2009) and a concise version in e-section 1 in SI. A short description of the data analysis is given in e-section 2 in SI. In table 2, P_1 and P_2 represent periods in stage B and C, respectively (P_1 is averaged during the entire course of the observed segment of stage B), and E_1 and E_2 represent intervals (in cycle numbers) to determine P_1 and P_2, respectively.

2 Data source

The CCD time-series observations were were obtained under campaigns led by the VSNET Collaboration (Kato et al. 2004). We also used the public data from the AAVSO International Database[1].

Outburst detections of many new and known objects relied on the ASAS-SN CV patrol (Davis et al. 2015)[2], the MASTER network (Gorbovskoy et al. 2013), and Catalina Real-time Transient Survey (CRTS; Drake et al. 2009)[3]. There were also outburst detections reported to VSNET, AAVSO[4], BAAVSS alert[5] and cvnet-outburst.[6]

3 Major findings in objects in this paper

We list major findings in this paper.

- Suspected WZ Sge-type dwarf novae XY Psc and V406 Vir underwent long-awaited superoutbursts, but neither of them showed WZ Sge-type characteristics.
- ASASSN-17fo is a deeply eclipsing SU UMa-type dwarf nova.
- ASASSN-17gf is an EI Psc-type object below the period minimum.
- ASASSN-17kg showed a dip before the termination of the superoutburst.
- ASASSN-17la is a WZ Sge-type dwarf nova with an intermediate mass ratio [0.084(5)] and a medium long orbital period [0.06039(3) d].
- CRTS J080941 and DDE 51 are in the period gap and had a long-lasting stage A.
- MASTER J212624 is a long-period system with a long-lasting stage A.
- WZ Sge-type stars identified in this study are PT And, ASASSN-17ei, ASASSN-17el, ASASSN-17es, ASASSN-17fn, ASASSN-17fz, ASASSN-17hw, ASASSN-17kd, ASASSN-17la, PNV J202053 and TCP J003325.
- New mass ratios from stage A superhumps (using Kato and Osaki 2013) are: ASASSN-17ei 0.074(3), ASASSN-17el 0.071(3), ASASSN-17es 0.095(9), ASASSN-17fn 0.097(1), ASASSN-17hw 0.078(1), CRTS J122221 0.032(2), PNV J202053 0.090(3)

4 Summary of recent progress in understanding of SU UMa-type dwarf novae

In this section, we provide brief descriptions of recent progress in understanding of SU UMa-type dwarf novae based on this series of papers and other published papers upon the request from the reviewer.

4.1 SU UMa-type dwarf novae and superhump stages

For SU UMa-type dwarf novae in general, we have verified that the relation between the period derivative ($P_{\rm dot}$) for stage B versus the oribital period ($P_{\rm orb}$) that we found in Kato et al. (2009) essentially applies to most of ordinary superoutbursts. The refined relation was shown in Kato et al. (2016b) and Kato et al. (2017a) [we consider that Kato et al. (2017a) to be the final regular summary of the statistics]. The stage A, B and C are now well-established and used in many publications by various authors: Katysheva et al. (2014), Bąkowska et al. (2014), Sklyanov et al. (2016), Neustroev et al. (2017), Bąkowska et al. (2017), Neustroev et al. (2018), Sklyanov et al. (2018), Littlefield et al. (2018), Pala et al. (2018), Pala et al. (2019), Pavlenko et al. (2019), McAllister et al. (2019), Court et al. (2019) (this work also illustrates the difficulty in determining superhump times in a deeply eclipsing system). The rapid growth of papers referring to our superhump stages indicates that this concept and application are now widely accepted in this field.

4.2 SU UMa-type/WZ Sge-type relation and period bouncers

The SU UMa-type/WZ Sge-type relation and the nature of period bouncers would be one of the most intriguing subjects for many readers. We have already give a conclusion to this subject as a review (Kato 2015). The distinction between SU UMa-type and WZ Sge-type dwarf novae is the manifestaion of the 2:1 resonance in the latter, and this classification is now widely accepted (such as in AAVSO VSX[7]). After the release of Kato (2015), there have been increasing number of WZ Sge-type dwarf no-

[1] <http://www.aavso.org/data-download>.
[2] <http://cv.asassn.astronomy.ohio-state.edu/>.
[3] <http://nesssi.cacr.caltech.edu/catalina/>. For the information of the individual Catalina CVs, see <http://nesssi.cacr.caltech.edu/catalina/AllCV.html>.
[4] <https://www.aavso.org/>.
[5] <https://groups.yahoo.com/neo/groups/baavss-alert/>.
[6] <https://groups.yahoo.com/neo/groups/cvnet-outburst/>.
[7] <https://www.aavso.org/vsx/>.

Table 1. List of Superoutbursts.

Object	Year	Observers or references*	ID†
PT And	2017	DPV, Ioh	
DH Aql	2017	Ioh	
V1047 Aql	2017	SGE, deM, Trt	
NN Cam	2017	DPV	
V391 Cam	2017	Kato et al. (2017a)	
KP Cas	2017	Ioh	
VW CrB	2017	COO, Kis	
V503 Cyg	2017	IMi	
V632 Cyg	2017	deM	
GP CVn	2017	Trt	
GQ CVn	2017	deM, Mdy, COO	
HO Del	2017	BSM	
MN Dra	2017	COO	
OV Dra	2015	Trt	
	2017	DPV, Lis, Ioh, Trt	
V1454 Cyg	2006	Kato et al. (2009)	
BE Oct	2017	HaC	
V521 Peg	2017	Ioh, BSM, RPc	
V368 Per	2017	CRI, Ter, Ioh, Trt, IMi, RPc, DPV	
XY Psc	2017	KU, HaC, Ioh	
V701 Tau	2017	BSM	
V1208 Tau	2017	MZK, CRI, Trt	
TU Tri	2017	Trt, Ioh, RPc, DPV	
SU UMa	2017	DPV	

*Key to observers: BSM‡(S. Brincat), CRI (Crimean Astrophys. Obs.), deM (E. de Miguel), DKS‡(S. Dvorak), DPV (P. Dubovsky), GBo (G. Bolt), HaC (F.-J. Hambsch, remote obs. in Chile), IMi‡(I. Miller), Ioh (H. Itoh), KU (Kyoto U., campus obs.), Kai (K. Kasai), Kis (S. Kiyota), LCO (C. Littlefield), Lic (D. Licchelli), Lis (Lisnyky Obs.), NGW‡(G. Myers), MLF (B. Monard), MZK‡(K. Menzies), Mas (G. Masi), Mdy (Y. Maeda), NKa (N. Katysheva and S. Shugarov), Nel (P. Nelson), Njh (K. Nakajima), OYE‡(Y. Ögmen), RPc‡(R. Pickard), Rui (J. Ruiz), SGE‡(G. Stone), SPE‡(P. Starr), SRI‡(R. Sabo), Shu (S. Shugarov team), Sol (F. Soldán), Ter (Terskol Obs.), Trt (T. Tordai), Van (T. Vanmunster), AAVSO (AAVSO database)
†Original identifications, discoverers or data sou rce.
‡Inclusive of observations from the AAVSO database .

vae mainly thanks to the ASAS-SN survey. The major advance since then has been the increase of examples of type-E outbursts. The objects with type-E outbursts have an initial superoutburst corresponding to the 2:1 resonance (high-inclination systems show early superhumps) and the second superoutburst showing the development of ordinary superhumps. They are considered to be the best candidates for the still elusive population of period bouncers. The papers dealing with type-E outbursts are Kimura et al. (2016a) (ASASSN-15jd), Kimura et al. (2018) (ASASSN-16dt and ASASSN-16hg), Isogai et al. (2019) (NSV 1440, AM CVn star). Among them ASASSN-15jd and ASASSN-16hg showed a transitional feature between single superoutburst and the type-E outburst. These observations suggest that type-E outbursts can be understood as a smooth extension of WZ Sge-type dwarf novae toward a lower mass ratio (i.e. period bouncers). The examples are still increasing and the results are pending publication.

4.3 Systems near stability border of 3:1 resonance

The major recent advance in SU UMa-type dwarf novae is around the stability borderline of the 3:1 resonance. When Kato et al. (2009) was published, it was a mystery why some long-$P_{\rm orb}$ systems show a strong decrease of the superhump periods [cf. MN Dra and UV Gem, see subsection 4.10 in Kato et al. (2009)]. An idea to solve this is-

Table 1. List of Superoutbursts (continued).

Object	Year	Observers or references*	ID†
HS Vir	2007	Njh	
	2017	HaC, DPV, Mdy	
V406 Vir	2017	MLF, MGW, HaC, Nel	
NSV 35	2017	MGW, HaC	
1RXS J161659	2017	deM, IMi	1RXS J161659.5+620014
ASASSN-13ce	2017	Van, Ioh	
ASASSN-13dh	2017	SGE, DPV, IMi, BSM	
ASASSN-14ca	2017	Ter, Trt, Lis, DPV	
ASASSN-14cr	2017	DPV	
ASASSN-14kb	2017	HaC	
ASASSN-14lk	2017	MLF	
ASASSN-15fu	2017	HaC	
ASASSN-15fv	2017	Van	
ASASSN-15qu	2017	MLF, HaC	
ASASSN-17ei	2017	MLF, HaC, SPE	
ASASSN-17el	2017	MLF, HaC	
ASASSN-17eq	2017	Van, Ioh	
ASASSN-17es	2017	HaC, Van, Ioh	
ASASSN-17et	2017	MLF, HaC	
ASASSN-17ew	2017	HaC	
ASASSN-17ex	2017	HaC	
ASASSN-17fh	2017	Van	
ASASSN-17fi	2017	Van	
ASASSN-17fj	2017	HaC	
ASASSN-17fl	2017	HaC	
ASASSN-17fn	2017	Van, Ioh, DPV, Trt, Mdy, Shu, Lic, CRI	
ASASSN-17fo	2017	Mdy, Kis, HaC, Lic, COO, RPc, Ioh, CRI	
ASASSN-17fp	2017	MLF, HaC	
ASASSN-17fz	2017	MLF, HaC, SPE	
ASASSN-17gf	2017	MLF, HaC	
ASASSN-17gh	2017	Ioh, Van	
ASASSN-17gv	2017	MLF, HaC	

sue required five years to appear and Kato et al. (2014a) gave a working hypothesis that the 3:1 resonance grows slowly in systems near the stability border of the 3:1 resonance. This idea has been reinforced by subsequent observations (Kato et al. 2016c). Kato et al. (2016b) and Kato et al. (2017a) increased the number of candidate systems showing this feature. Some of these objects are known to show post-superoutburst rebrightenings, which had been usually considered to be a feature unique to WZ Sge-type dwarf novae (cf. Kato 2015). With the increasing number of long-$P_{\rm orb}$ object showing rebrightenings [V1006 Cyg, Kato et al. (2016c); ASASSN-14ho Kato (2019)], it is now considered that the weak 3:1 resonance could cause the decoupling of the tidal and thermal instabilities, leading to premature quenching of the superoutburst. This idea was originally proposed for extremely low mass-ratio systems such as WZ Sge-type dwarf novae (Hellier 2001). Recent findings suggest that the same mechanism could work in systems near the stability border of the 3:1 resonance and that such systems can mimic WZ Sge-type outbursts. A long precursor followed by a dip and an ordinary superoutburst in CS Ind (Kato et al. 2019a) also strengthens this interpretation. Theoretical supports are still lacking and a futher advance would be expected in this regime.

4.4 SU UMa-type dwarf nova showing standstills

Currently there is only one known SU UMa-type dwarf nova (NY Ser) which showed standstills in 2018 (Kato

Table 1. List of Superoutbursts (continued).

Object	Year	Observers or references*	ID†
ASASSN-17hm	2017	HaC	
ASASSN-17hw	2017	MLF, HaC, BSM, Ioh, SPE, Shu, Van	
ASASSN-17hy	2017	HaC	
ASASSN-17id	2017	HaC	
ASASSN-17if	2017	HaC	
ASASSN-17ig	2017	GBo, HaC	
ASASSN-17il	2017	Van	
ASASSN-17iv	2017	HaC	
ASASSN-17iw	2017	HaC	
ASASSN-17ix	2017	HaC	
ASASSN-17ji	2017	IMi, Trt, RPc	
ASASSN-17jr	2017	HaC	
ASASSN-17kc	2017	HaC	
ASASSN-17kd	2017	HaC	
ASASSN-17kg	2017	HaC, RPc, Van, Trt	
ASASSN-17kp	2017	Trt, Van, RPc	
ASASSN-17la	2017	COO, Van, DPV, IMi, Trt, NKa, KU	
ASASSN-17lr	2017	IMi	
ASASSN-17me	2017	LCO, CRI	
ASASSN-17np	2017	MLF, HaC	
ASASSN-17nr	2017	HaC	
ASASSN-17of	2017	Van, Ioh, KU, IMi, CRI	
ASASSN-17oo	2017	KU, HaC	
ASASSN-17ou	2017	Shu, KU, HaC, Trt	
ASASSN-17pb	2017	Van, CRI, IMi, KU	
CRTS J044027	2017	HaC, Van	CRTS J044027.1+023301
CRTS J080941	2017	Van, HaC, CRI, Trt	CRTS J080941.3+171528
CRTS J120052	2017	Mdy	CRTS J120052.9−152620
CRTS J122221	2017	Neustroev et al. (2017)	CRTS J122221.6−311524
CRTS J162806	2017	Trt	CRTS J162806.2+065316
CRTS J214934	2017	HaC, Ioh	CRTS J214934.1−121908

et al. 2019b). This is a single known bona-fide a hybrid SU UMa + Z Cam-type dwarf nova. It was shown that superoutbursts arose from standstills in NY Ser, and the disk should grow in radius to reach the 3:1 resonance during standstills.

5 List of references

The references cited in SI are: Alksnis and Zharova (2000), Antipin (1996), Antipin and Pavlenko (2002), Augusteijn et al. (2010), Aviles et al. (2010), Balanutsa et al. (2013), Balanutsa et al. (2014a), Balanutsa et al. (2012), Balanutsa et al. (2017), Balanutsa et al. (2014b), Boyd et al. (2010), Cannon (1925), Cartier et al. (2017), Cleveland (1979), Davis et al. (2014), Denisenko (2017), Denisenko et al. (2013), Dillon et al. (2008), Drake et al. (2014), Erastova (1973), Fernie (1989), Green et al. (1982), Green et al. (1986), Grubissich and Rosino (1958), Harvey et al. (1995), Henden et al. (2001), Hoffmeister (1949a), Hoffmeister (1949b), Hoffmeister (1957a), Hoffmeister (1957b), Hoffmeister (1963), Hoffmeister (1964), Hoffmeister (1967), Imada et al. (2017), Kato et al. (2002), Kato (2015), Kato et al. (2016a), Kato et al. (2014a), Kato et al. (2015), Kato et al. (2013a), Kato et al. (2014b), Kato et al. (2016b), Kato et al. (2009), Kato et al. (2017a), Kato et al. (2012a), Kato et al. (2012b), Kato et al. (2010), Kato et al. (2013b), Kato et al. (1998), Kato et al. (1995), Kato et al. (2016c), Kato et al. (2001), Kato et al. (2001), Kato et al. (2017b), Khruslov (2005), Kimura et al. (2016b), Kinnunen and Skiff (2000), Littlefield et al. (2013), Liu and Hu (2000), Liu et al. (1999), Luyten (1938), Marsh et al. (2017), Mason and Howell

Table 1. List of Superoutbursts (continued).

Object	Year	Observers or references*	ID†
CRTS J223235	2017	IMi, Van	CRTS J223235.4+304105
CTCV J1940	2017	HaC	CTCV J1940−4724
DDE 51	2017	Mdy, Trt, RPc, Rui, CRI, IMi	
MASTER J132501	2017	Kai, Lic, deM, Van	MASTER OT J132501.00+431846.1
MASTER J174305	2017	Mdy, Kai, DPV, Lic, Trt	MASTER OT J174305.70+231107.8
MASTER J192757	2017	Van	MASTER OT J192757.03+404042.8
MASTER J200904	2017	KU, deM, Lic	MASTER OT J200904.69+825153.6
MASTER J205110	2017	LCO, Lic, Ioh, KU, Trt	MASTER OT J205110.36+044842.2
MASTER J212624	2017	Shu, DPV, BSM, Trt, RPc, Ioh	MASTER OT J212624.16+253827.2
OT J182142	2017	DPV, Ioh	OT J182142.8+212154
OT J204222	2017	Ioh, LCO, Mas, RPc, Trt, Mdy	OT J204222.3+271211
PNV J202053	2017	deM, CRI, AAVSO, COO, SGE, Lic, Ioh, Trt, Van, OYE, Sol, DPV, Rui, RPc, Kis	PNV J20205397+2508145
SDSS J152857	2017	Van	SDSS J152857.86+034911.7
SDSS 153015	2017b	KU, Trt, CRI	SDSS J153015.04+094946.3
SDSS J204817	2017	BSM, Ioh	SDSS J204817.85−061044.8
TCP J003325	2017	MLF, HaC	TCP J00332502−3518565
TCP J201005	2017	Van, Kai, deM, HaC, SRI, SGE, Trt, DKS, Ioh, Kai, BSM, DPV	TCP J20100517+1303006

(2003), Mennickent et al. (1999), Motch et al. (1996), Mróz et al. (2015), Nakata et al. (2013), Namekata et al. (2017), Neustroev et al. (2017), Nogami and Kato (1995), Nogami et al. (2003), Novák (1997), Osaki and Kato (2013a), Osaki and Kato (2013b), Ohnishi et al. (2019), Ohshima et al. (2012), Osminkin (1985), Patterson et al. (2005), Patterson et al. (2003), Patterson et al. (2008), Pavlenko et al. (2012), Pojmański (2002), Prieto et al. (2014), Richter (1969), Ringwald (1993), Rodríguez-Gil et al. (2005), Romano (1978), Rosino and Pigatto (1972a), Rosino and Pigatto (1972b), Sharov (1991), Sharov and Alksnis (1989), Sharov et al. (1992), Shears and Boyd (2007), Shears et al. (2008), Sheets et al. (2007), Shumkov et al. (2017), Stanek et al. (2013), Stellingwerf (1978), Szkody et al. (2009), Szkody et al. (2003), Szkody et al. (2006), Thorstensen et al. (2002), Uemura et al. (2002), Waagen (2017), Wakamatsu et al. (2017), Wenzel (1989), Williams et al. (2010), Wood et al. (2011), Woudt and Warner (2010), Woudt et al. (2012), Wyrzykowski et al. (2014), Zemko et al. (2013), Zharikov et al. (2006), Zheng et al. (2010), Zloczewski (2004).

Acknowledgements

This work was also partially supported by Grant VEGA 2/0008/17 (by Shugarov, Chochol) and APVV-15-0458 (by Shugarov, Chochol, Dubovsky, Kudzej, Medulka), RSF-14-12-00146 (Golysheva for processing observation data from Slovak Observatory). ASAS-SN is supported by the Gordon and Betty Moore Foundation through grant GBMF5490 to the Ohio State University and NSF grant AST-1515927. The authors are grateful to observers of VSNET Collaboration and VSOLJ observers who supplied vital data. We acknowledge with thanks the variable star observations from the AAVSO International Database contributed by observers worldwide and used in this research. We are also grateful to the VSOLJ database. This work is helped by outburst detections and announcement by a number of variable star observers worldwide, including participants of CVNET and BAA VSS alert. The CCD operation of the Bronberg Observatory is partly sponsored by the Center for Backyard Astrophysics. We are grateful to the Catalina Real-time Transient Survey team for making their real-time detection of transient objects and the past photometric database available to the public. We are also grateful to the ASAS-3 team for making the past photometric database available to the public. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France. This research has made use of the International Variable Star Index (VSX) database, operated at AAVSO, Cambridge, Massachusetts, USA.

Supporting information

For reader's convenience, supporting information (sections, figures and tables starting with E-) is combined in this arXiv version.

Table 2. Superhump Periods and Period Derivatives

Object	Year	P_1 (d)	err	E_1*		P_{dot}†	err†	P_2 (d)	err	E_2*		P_{orb} (d)‡	Q§
V1047 Aql	2017	0.073914	0.000098	0	19	–	–	–	–	–	–	–	C
V391 Cam	2017	–	–	–	–	–	–	0.056728	0.000012	209	263	0.05620	C
KP Cas	2017	–	–	–	–	–	–	0.085143	0.000242	0	13	–	C
VW CrB	2017	0.071985	0.000528	0	11	–	–	–	–	–	–	–	C
V632 Cyg	2017	0.0655	0.0003	0	2	–	–	–	–	–	–	–	C
OV Dra	2017	0.060398	0.000033	0	98	14.5	2.4	0.060032	0.000057	94	150	0.058736	B
GQ CVn	2017	0.089476	0.000091	0	37	–	–	–	–	–	–	–	C
BE Oct	2017	0.077115	0.000132	0	40	–	–	–	–	–	–	–	C
V521 Peg	2017	0.061646	0.000065	0	29	–	–	–	–	–	–	–	C
V368 Per	2017	0.079224	0.000028	0	41	–	–	0.078602	0.000166	63	79	–	B
XY Psc	2017	0.060675	0.000045	0	83	13.7	2.3	0.060230	0.000053	82	99	–	C
V701 Tau	2017	0.069026	0.000037	0	31	–	–	–	–	–	–	–	C
V1208 Tau	2017	0.0698	0.0040	0	3	–	–	–	–	–	–	0.0681	C
TU Tri	2017	0.076246	0.000080	0	20	–	–	–	–	–	–	–	C
SU UMa	2017b	0.078924	0.000123	0	64	–	–	–	–	–	–	0.07635	C
HS Vir	2017	0.080313	0.000063	0	103	3.7	4.9	–	–	–	–	0.0769	CG
V406 Vir	2017	0.056960	0.000016	0	88	8.1	1.5	–	–	–	–	0.05592	B
1RXS J161659	2017	0.071028	0.000032	0	70	−10.6	3.3	–	–	–	–	–	CG
ASASSN-13dh	2017	–	–	–	–	–	–	0.091322	0.000056	38	100	–	B

*Interval used for calculating the period.

†Unit 10^{-5}.

‡References:

V391 Cam (Kapusta and Thorstensen 2006), V1208 Tau (Patterson et al. 2005), SU UMa (Thorstensen et al. 1986), HS Vir (Mennickent et al. 1999), V406 Vir (Zharikov et al. 2006), ASASSN-14kb (Wyrzykowski et al. 2014), PT And, OV Dra, ASASSN-17ei, ASASSN-17el, ASASSN-17es, ASASSN-17fn, ASASSN-17fo, ASASSN-17hw, ASASSN-17la, PNV J202053, TCP J003325 (this work)

§Data quality and comments. A: excellent, B: partial coverage or slightly low quality, C: insufficient coverage or observations with large scatter, G: P_{dot} denotes global P_{dot}, M: observational gap in middle stage, U: uncertainty in alias selection, 2: late-stage coverage, the listed period may refer to P_2, a: early-stage coverage, the listed period may be contaminated by stage A superhumps, E: P_{orb} refers to the period of early superhumps.

In the final form of PASJ publication, supporting information is separated in the online version.

E-section 1 Superhump Stages

It has become evident since Kato et al. (2009) that the superhump periods systematically vary in a way common to many objects. Kato et al. (2009) introduced superhump stages (stages A, B and C): initial growing stage with a long period (stage A) and fully developed stage with a systematically varying period (stage B) and later stage C with a shorter, almost constant period (see figure 1). [This part is an excerpt from Kato et al. (2017a)].

E-section 2 Data Analysis

This part includes an excerpt from Kato et al. (2017a).

The data analysis was performed in the same way described in Kato et al. (2009) and Kato et al. (2014a) and we mainly used R software[8] for data analysis.

In de-trending the data, we mainly used locally-weighted polynomial regression (LOWESS: Cleveland 1979) and sometimes lower (1–3rd order) polynomial fitting when the observation baseline was short. The times of superhumps maxima were determined by the template fitting method as described in Kato et al. (2009). The times of all observations are expressed in barycentric Julian days (BJD).

We used phase dispersion minimization (PDM; Stellingwerf 1978) for period analysis and 1σ errors for the PDM analysis was estimated by the methods of Fernie (1989) and Kato et al. (2010). We have used a variety of

[8] The R Foundation for Statistical Computing: <http://cran.r-project.org/>.

Table 2. Superhump Periods and Period Derivatives (continued)

Object	Year	P_1	err	E_1		$P_{\rm dot}$	err	P_2	err	E_2		$P_{\rm orb}$	Q
ASASSN-14ca	2017	0.067036	0.000014	0	45	−4.7	3.0	–	–	–	–	–	C
ASASSN-14cr	2017	–	–	–	–	–	–	0.068698	0.000055	0	45	–	C
ASASSN-14kb	2017	0.070420	0.000030	0	86	3.0	3.9	–	–	–	–	0.068106	CG
ASASSN-14lk	2017	–	–	–	–	–	–	0.061054	0.000094	0	34	–	C
ASASSN-15fu	2017	0.074592	0.000071	0	28	–	–	–	–	–	–	–	CG
ASASSN-15fv	2017	0.0682	0.0040	0	1	–	–	–	–	–	–	–	C
ASASSN-15qu	2017	0.080449	0.000038	0	78	−7.5	3.8	–	–	–	–	–	CG
ASASSN-17ei	2017	0.057257	0.000011	34	247	3.4	0.4	–	–	–	–	0.05646	BE
ASASSN-17el	2017	0.055183	0.000013	48	213	5.1	0.3	0.054911	0.000184	230	271	0.05434	BE
ASASSN-17eq	2017	0.072197	0.000069	0	28	–	–	–	–	–	–	–	C
ASASSN-17es	2017	0.057858	0.000023	33	105	0.6	4.4	–	–	–	–	0.05719	BE
ASASSN-17et	2017	–	–	–	–	–	–	0.095636	0.000060	0	63	–	C
ASASSN-17ew	2017	–	–	–	–	–	–	0.078497	0.000027	0	65	–	C
ASASSN-17ex	2017	–	–	–	–	–	–	0.068306	0.000096	0	31	–	C
ASASSN-17fh	2017	0.064	0.001	0	1	–	–	–	–	–	–	–	C
ASASSN-17fi	2017	0.058833	0.000011	0	52	–	–	–	–	–	–	–	C
ASASSN-17fj	2017	0.066266	0.000021	0	77	8.4	2.3	0.065950	0.000044	75	135	–	B
ASASSN-17fl	2017	0.062632	0.000123	0	18	–	–	–	–	–	–	–	C
ASASSN-17fn	2017	0.061584	0.000014	37	169	−2.8	1.4	–	–	–	–	0.06096	BE
ASASSN-17fo	2017	0.063240	0.000028	8	80	7.3	3.8	–	–	–	–	0.061548	B
ASASSN-17fz	2017	0.054404	0.000025	41	152	7.0	2.0	–	–	–	–	–	B
ASASSN-17gf	2017	0.052551	0.000010	31	129	5.2	1.0	–	–	–	–	–	B
ASASSN-17gh	2017	0.061394	0.000348	0	9	–	–	–	–	–	–	–	C
ASASSN-17gv	2017	0.060897	0.000039	0	88	–	–	–	–	–	–	–	CG
ASASSN-17hm	2017	0.088586	0.000073	0	37	–	–	0.088140	0.000059	34	59	–	C
ASASSN-17hw	2017	0.059717	0.000013	29	218	0.3	0.9	–	–	–	–	0.05886	BE
ASASSN-17hy	2017	0.071475	0.000048	0	72	16.3	4.3	–	–	–	–	–	C
ASASSN-17id	2017	0.078613	0.000074	0	39	–	–	–	–	–	–	–	C2
ASASSN-17if	2017	0.058827	0.000031	0	154	8.2	0.8	0.058568	0.000041	153	223	–	B

bootstrapping in estimating the robustness of the result of the PDM analysis since Kato et al. (2012a).

We used Kato and Osaki (2013) to determine the mass ratio (q) from the superhump period ($P_{\rm SH}$) and the orbital period ($P_{\rm orb}$, when early superhumps were observed, we assumed them to have the same period as the orbital one). The fractional superhump excess (in frequency) $\epsilon^* \equiv 1 - P_{\rm orb}/P_{\rm SH}$ is equal to the dynamical precession rate when the pressure effect can be neglected as in stage A superhumps (Kato and Osaki 2013).

E-section 3 Individual Objects

E-section 3.1 PT Andromedae

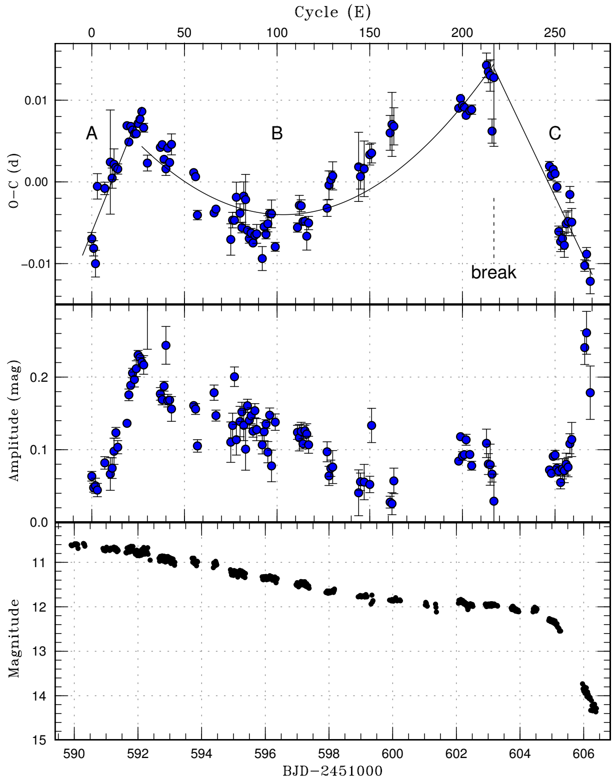
PT And was originally discovered as a nova in M31 (R15 = M31N 1957-10b in Grubissich and Rosino 1958). Sharov and Alksnis (1989) reported a short outburst in 1983 and a long one in 1986. Sharov and Alksnis (1989) suggested this object to be an SU UMa-type dwarf nova as judged from the outburst behavior. Alksnis and Zharova (2000) studied the 1998 outburst and past ones and suggested that this object is more likely a recurrent nova in M31 based on the lack of plateau phase in SU UMa-type superoutbursts.

There was a long outburst in 2010 December (originally reported as M31N 2010-12a on 2010 December 1 by K. Nishiyama and F. Kabashima, cf. Zheng et al. 2010). During this outburst, likely superhumps were detected (vsnet-alert 12484, 12497, 12527).[9] Due to the short observational runs and interference by the moonlight, it was difficult to determine the superhump period. A spectrum by A. Arai showed no prominent lines, confirming the dwarf nova-type nature of this object (vsnet-alert

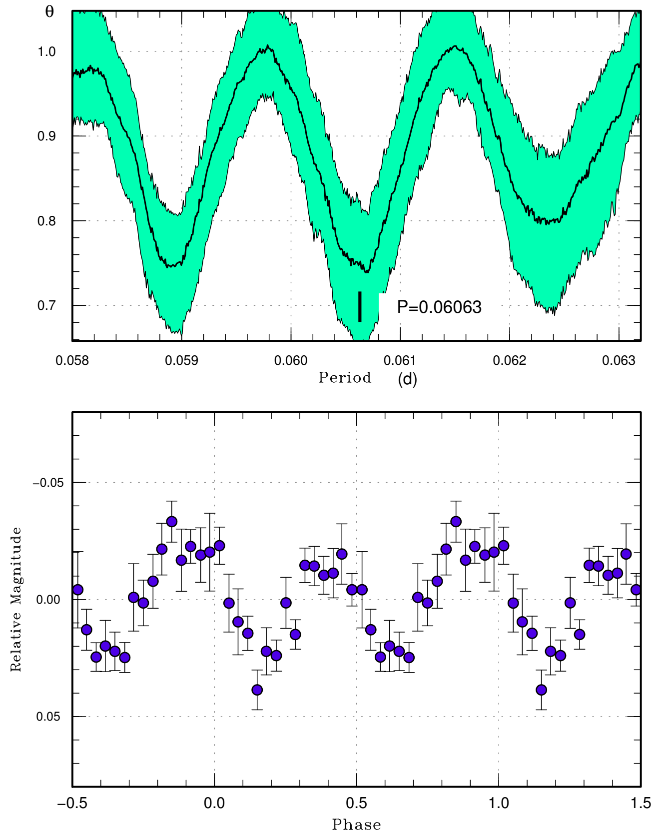
[9] These vsnet-alert messages can be seen at <http://ooruri.kusastro.kyoto-u.ac.jp/pipermail/vsnet-alert/>.

Table 2. Superhump Periods and Period Derivatives (continued)

Object	Year	P_1	err	E_1		P_{dot}	err	P_2	err	E_2		P_{orb}	Q
ASASSN-17ig	2017	0.094947	0.000084	0	25	–	–	0.094393	0.000024	25	96	–	C
ASASSN-17iv	2017	–	–	–	–	–	–	0.070237	0.000044	15	87	–	C
ASASSN-17iw	2017	0.055906	0.000047	0	90	11.3	5.9	–	–	–	–	–	C
ASASSN-17ix	2017	0.062449	0.000048	0	82	18.2	4.0	–	–	–	–	–	C
ASASSN-17ji	2017	0.0589	0.0001	0	18	–	–	–	–	–	–	–	C
ASASSN-17jr	2017	0.061706	0.000038	0	98	8.0	3.0	–	–	–	–	–	C
ASASSN-17kc	2017	0.063764	0.000028	0	81	12.8	1.4	0.063320	0.000024	80	160	–	B
ASASSN-17kd	2017	0.060919	0.000016	33	213	2.7	0.8	–	–	–	–	–	B
ASASSN-17kg	2017	0.057620	0.000017	36	228	5.4	0.5	0.057427	0.000025	242	297	–	A
ASASSN-17kp	2017	0.057957	0.000030	0	51	9.3	5.7	–	–	–	–	–	C
ASASSN-17la	2017	0.061571	0.000021	27	175	7.9	0.5	–	–	–	–	0.06039	BE
ASASSN-17lr	2017	0.058635	0.000057	0	102	−8.8	3.2	–	–	–	–	–	CG
ASASSN-17me	2017	0.0614	0.0004	0	1	–	–	–	–	–	–	–	C
ASASSN-17np	2017	0.089227	0.000047	0	26	–	–	0.088730	0.000032	25	82	–	C
ASASSN-17nr	2017	0.056376	0.000027	0	107	5.8	1.6	–	–	–	–	–	CU
ASASSN-17of	2017	0.064175	0.000067	0	74	–	–	0.063567	0.000030	74	109	–	C
ASASSN-17oo	2017	0.06781	0.00005	–	–	–	–	–	–	–	–	–	C2
ASASSN-17ou	2017	0.057128	0.000045	0	70	–	–	–	–	–	–	–	C
ASASSN-17pb	2017	0.076092	0.000049	47	101	−1.0	8.6	–	–	–	–	–	C
CRTS J044027	2017	–	–	–	–	–	–	0.064361	0.000034	49	97	–	C
CRTS J080941	2017	0.100467	0.000122	20	62	–	–	–	–	–	–	–	B
CRTS J214934	2017	0.071482	0.000005	0	65	–	–	0.071222	0.000041	64	107	–	C
CRTS J223235	2017	0.062994	0.000136	0	32	–	–	–	–	–	–	–	C
CTCV J1940	2017	0.076668	0.000027	0	79	−3.7	3.2	–	–	–	–	–	CU
DDE 51	2017	0.100277	0.000020	49	108	−0.5	2.1	–	–	–	–	–	B
MASTER J174305	2017	0.069949	0.000079	0	14	–	–	0.069425	0.000074	27	44	–	C
MASTER J192757	2017	0.08161	0.00005	0	12	–	–	–	–	–	–	–	C
MASTER J200904	2017	0.073646	0.000115	0	20	–	–	–	–	–	–	–	C
MASTER J205110	2017	0.080710	0.000044	0	59	7.6	4.7	–	–	–	–	–	C
MASTER J212624	2017	0.090888	0.000074	43	75	–	–	–	–	–	–	–	B
NSV 35	2017	0.081034	0.000039	0	112	−1.1	2.4	–	–	–	–	–	BG
OT J182142	2017	0.082140	0.000095	0	40	–	–	–	–	–	–	–	C2
OT J204222	2017	0.056152	0.000045	65	167	−1.1	6.6	–	–	–	–	–	C
PNV J202053	2017	0.057392	0.000010	53	250	4.3	0.4	0.056443	0.000153	246	263	0.056509	AE
SDSS J152857	2017	0.06319	0.00024	0	3	–	–	–	–	–	–	–	C
SDSS J153015	2017b	0.075310	0.000134	0	32	–	–	–	–	–	–	–	C
TCP J003325	2017	0.055222	0.000019	91	256	4.6	0.3	–	–	–	–	0.05485	BE
TCP J201005	2017	0.081030	0.000046	0	44	–	–	–	–	–	–	–	B2



E-figure 1. Representative $O-C$ diagram showing three stages (A–C) of $O-C$ variation. The data were taken from the 2000 superoutburst of SW UMa. (Upper:) $O-C$ diagram. Three distinct stages (A – evolutionary stage with a longer superhump period, B – middle stage, and C – stage after transition to a shorter period) and the location of the period break between stages B and C are shown. (Middle): Amplitude of superhumps. During stage A, the amplitude of the superhumps grew. (Lower:) Light curve. (Reproduction of figure 1 in Kato and Osaki 2013)



E-figure 2. Early superhumps in PT And (2017), drawn with a period of 0.06063 d. (Upper): PDM analysis. (Lower): Phase-averaged profile.

12528). The outburst showed a plateau phase followed by rapid fading on 2010 December 24–25 (vsnet-alert 12530). This feature also supported the SU UMa-type interpretation contrary to what was stated in Alksnis and Zharova (2000).

The 2017 outburst was detected on 2017 August 15 at an unfiltered CCD magnitude of 16.02 by E. Muyllaert (cvnet-outburst 7623). Time-resolved CCD photometry recorded double-wave modulations (vsnet-alert 21356). They were most likely early superhumps. Due to the lack of observations, we could not select the alias. The two most likely periods were 0.06063(7) d or 0.05893(7) d. These periods are equally acceptable and phase-averaged profiles are in e-figures 2 and 3. Although there were observations after these two nights, the data quality was not sufficient and we could not determine the superhump period. The object is thus a WZ Sge-type dwarf nova. The rapidly fading light curves resembling those of fast novae were probably caused by viscous decay at the start of the superoutburst (cf. Kato 2015).

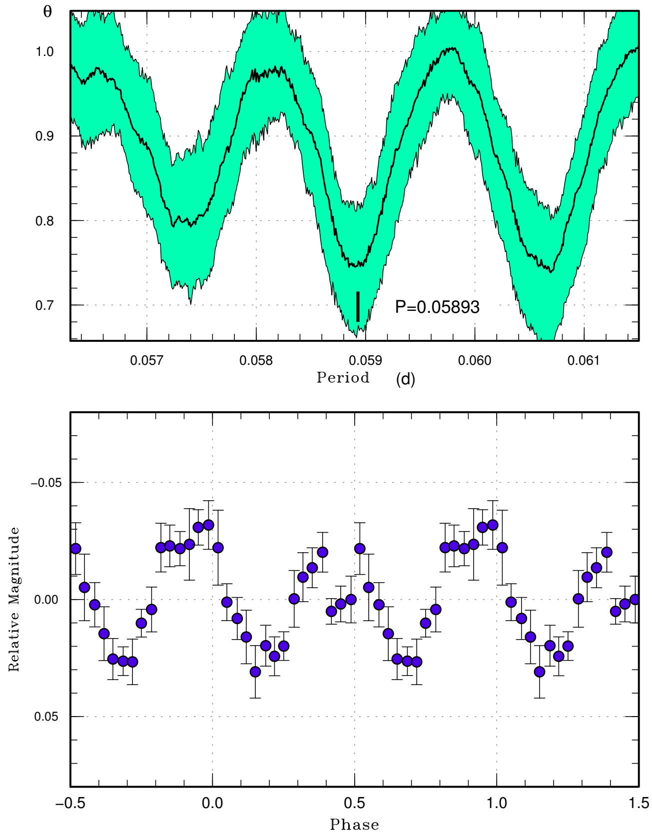
E-section 3.2 DH Aquilae

DH Aql was discovered as a Mira-type variable (=HV 3899) with a range of 12.5 to fainter than 16 in photographic range (Cannon 1925). The SU UMa-type nature of this object was clarified by Nogami and Kato (1995). Refer to Kato et al. (2014a) for more history.

The 2017 superoutburst was detected by M. Noriyama at an unfiltered CCD magnitude of 14.5 while the object was still rising. The object was observed to be at peak magnitude of 12.4 on the next night. Two superhump maxima were obtained from single-night observations: BJD 2458036.9216(4) (N=106) and 2458037.0013(2) (N=152).

E-section 3.3 V1047 Aquilae

V1047 Aql was discovered as a dwarf nova (S 8191) by Hoffmeister (1964). The object was identified to be an SU UMa-type dwarf nova in 2005 by Greg Bolt. Observations



E-figure 3. Early superhumps in PT And (2017), drawn with a period of 0.05893 d. (Upper): PDM analysis. (Lower): Phase-averaged profile.

of the 2016 superoutburst were reported in Kato et al. (2017a), which obtained only two superhump maxima.

The 2017 superoutburst was visually detected by R. Stubbings at a magnitude of 15.2 on 2017 June 26. The ASAS-SN data recorded it at V=16.2 on 2017 June 20, which further brightened to V=15.5 on 2017 June 24. The times of superhump maxima are listed in e-table 1. The superhump stage is unknown.

As reported in Kato et al. (2017a), this object shows regular superoutbursts with a short supercycle. We extracted superoutbursts in the ASAS-SN data (e-table 2). These superoutbursts can be well expressed by a supercycle of 89.1(3) d with maximum $|O-C|$ of 4 d. There were also apparently frequent normal outbursts expected for this short supercycle.

E-section 3.4 NN Camelopardalis

NN Cam = NSV 1485 was identified as a dwarf nova by Khruslov (2005). For more history, see Kato et al. (2015). The 2017 superoutburst was detected by the ASAS-SN team at V=13.14 on 2017 August 30. Only single superhump maximum was recorded at BJD 2458004.4408(9) (N=76).

E-table 1. Superhump maxima of V1047 Aql (2017)

E	max*	error	$O-C^\dagger$	$N^\ddagger$
0	57931.4690	0.0026	−0.0030	29
1	57931.5464	0.0006	0.0006	52
4	57931.7697	0.0005	0.0021	90
5	57931.8408	0.0005	−0.0007	95
6	57931.9159	0.0008	0.0004	48
13	57932.4346	0.0005	0.0018	67
14	57932.5088	0.0005	0.0021	72
18	57932.8002	0.0011	−0.0022	85
19	57932.8752	0.0009	−0.0011	92

*BJD−2400000.
†Against max = 2457931.4719 + 0.073914E.
‡Number of points used to determine the maximum.

E-table 2. List of superoutbursts of V1047 Aql in the ASAS-SN data

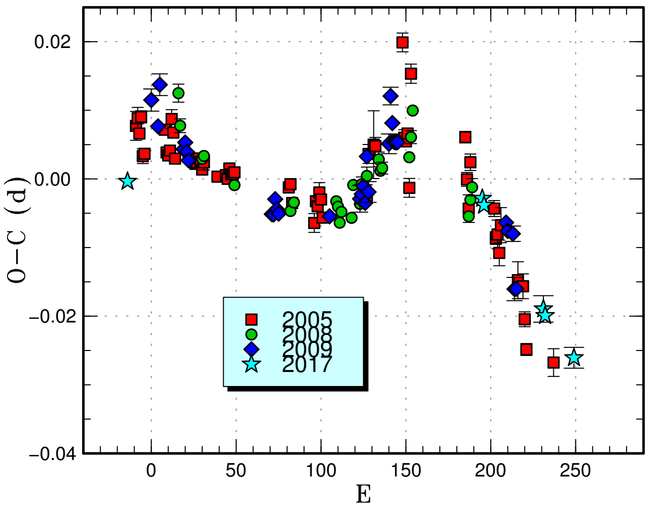
Year	Month	Day	max*	V mag
2015	7	19	57222	15.0
2015	10	13	57308	15.1
2016	4	10	57489	15.2
2016	7	8	57578	15.0
2016	10	9	57671	15.2
2017	4	3	57847	15.1
2017	6	27	57932	15.1
2017	9	26	58022	15.1

*JD−2400000.

E-section 3.5 V391 Camelopardalis

The material is the same as in Kato et al. (2017a). A reanalysis of the data yielded a positive detection of postsuperoutburst superhumps whose period is consistent with the past observations of stage C superhumps (e-table 3). Note that we used a narrower range than in Kato et al. (2017a) to determine the maximum on BJD 2457829, resulting a slightly different value.

A comparison of $O-C$ diagrams of V391 Cam between different superoutbursts (e-figure 4) suggests that there was a separate precursor outburst in the 2017 superoutburst and the initial superhump detection referred to a stage A superhump, when the object was still rising toward the full maximum of the superoutburst.



E-figure 4. Comparison of $O-C$ diagrams of V391 Cam between different superoutbursts. A period of 0.05716 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used. For the 2005 and 2008 superoutbursts, we used the zero points as defined in Kato et al. (2009). The 2005 superoutburst had a separate precursor and the zero point was shifted by 9 cycles. For the 2017 superoutburst, we had to shift by 40 cycles if we assume the the superoutburst started at the time of the ASAS-SN detection. It was likely that this detection referred to a precursor outburst, which is consistent with the declining trend on 2017 March 16–17 in AAVSO visual observations.

E-table 3. Superhump maxima of V391 Cam (2017)

E	max*	error	$O-C$†	N‡
0	57829.3181	0.0002	−0.0035	185
209	57841.2621	0.0005	0.0102	41
210	57841.3182	0.0007	0.0093	59
245	57843.3037	0.0019	−0.0031	58
246	57843.3599	0.0011	−0.0040	58
263	57844.3255	0.0015	−0.0088	59

*BJD−2400000.
†Against max = 2457829.3216 + 0.057083E.
‡Number of points used to determine the maximum.

E-table 4. Superhump maxima of KP Cas (2017)

E	max*	error	$O-C$†	N‡
0	58076.0720	0.0008	0.0014	81
1	58076.1541	0.0007	−0.0016	92
10	58076.9245	0.0012	0.0025	96
11	58077.0035	0.0012	−0.0036	92
13	58077.1786	0.0010	0.0012	94

*BJD−2400000.
†Against max = 2458076.0705 + 0.085143E.
‡Number of points used to determine the maximum.

E-section 3.6 KP Cassiopeiae

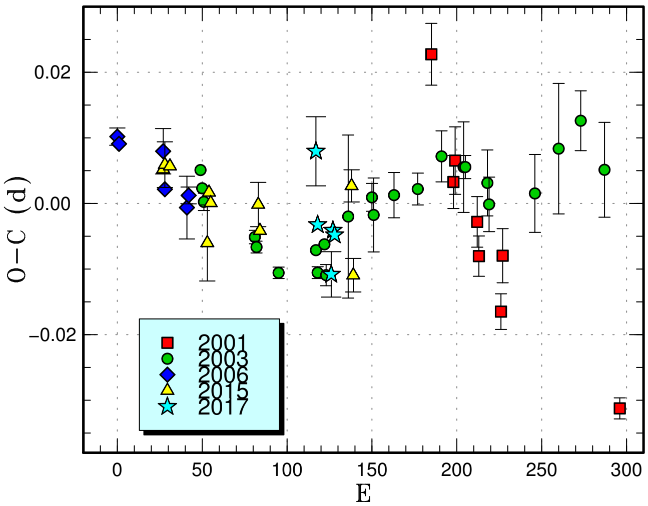
This object (S 3865) was discovered by Hoffmeister (1949a). A finding chart was provided in Hoffmeister (1957b). Kinnunen and Skiff (2000) provided correct identification. The object, however, has not been regularly monitored before the chance detection of a bright (13.0 mag) outburst by Y. Sano on 2008 October 25 (cf. vsnet-alert 10629). The 2008 outburst was well observed and the object was confirmed to be an SU UMa-type dwarf nova (Kato et al. 2009; Boyd et al. 2010). Although several outbursts were recorded since 2008, all of them were likely normal outbursts.

The 2017 superoutburst was recorded by Y. Maeda at an unfiltered CCD magnitude of 13.5 and H. Maehara at a visual magnitude of 14.2 on 2017 November 11 (cf. vsnet-alert 21581). Observations starting on 2017 November 18 detected superhumps. The times of maxima are listed in e-table 4. The observations covered the relatively late phase of the superoutburst, and these superhumps were likely stage C ones. The resultant period agrees with the period of stage C superhumps during the 2008 superoutburst.

E-section 3.7 VW Coronae Borealis

VW CrB was discovered as a dwarf nova (Antipin Var 21) by Antipin (1996). Novák (1997) established the SU UMa-type nature of this object. For more information, see Kato et al. (2016b). The 2017 superoutburst was detected by the ASAS-SN team at V=14.4 on 2017 May 11 (we later knew that an AAVSO observer detected a rising phase at V=15.69 on May 10). The outburst was also detected by M. Hiraga at an unfiltered CCD magnitude of 14.2 on May 13.

We observed this superoutburst on two nights and detected superhumps (e-table 5). Although our observations were carried out relatively late, they were likely in the middle of stage B (see e-figure 5) since the duration of superoutbursts in VW CrB is long.



E-figure 5. Comparison of $O-C$ diagrams of VW CrB between different superoutbursts. A period of 0.07290 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used.

E-table 5. Superhump maxima of VW CrB (2017)

E	max*	error	$O-C$†	N‡
0	57892.0529	0.0053	0.0053	84
1	57892.1146	0.0013	−0.0050	117
9	57892.6903	0.0035	−0.0053	37
10	57892.7699	0.0005	0.0024	106
11	57892.8421	0.0005	0.0026	108

*BJD−2400000.

†Against max $= 2457892.0476 + 0.071985E$.

‡Number of points used to determine the maximum.

E-section 3.8 GP Canum Venaticorum

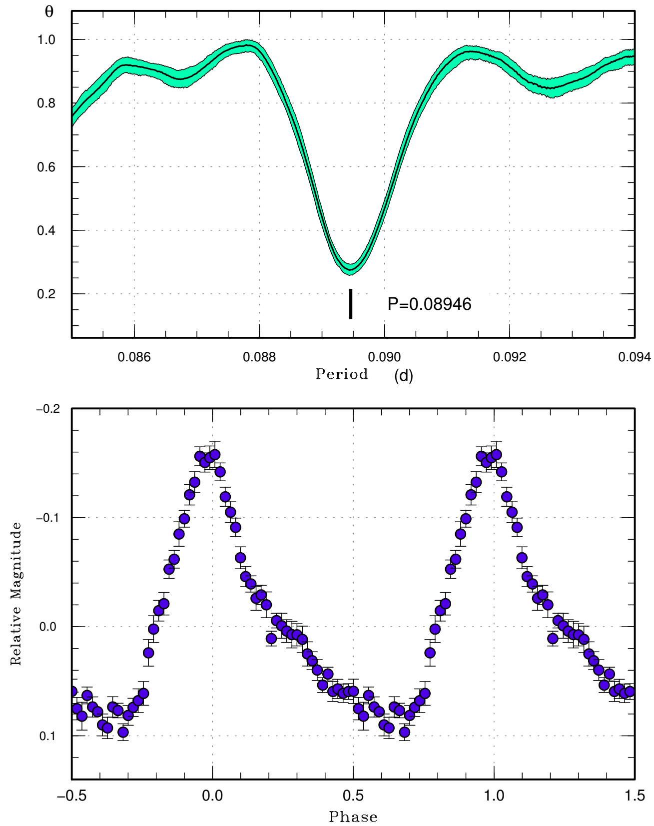
This object was originally selected as a CV (SDSS J122740.83+513925.0) during the course of the SDSS (Szkody et al. 2006). The object is an eclipsing SU UMa-type dwarf nova. The SU UMa-type nature was confirmed during the 2017 superoutburst (Shears et al. 2008; Kato et al. 2009). For more history, see Kato et al. (2017a).

The 2017 superoutburst was detected by the ASAS-SN team at V=14.8 on 2017 July 5. Subsequent single-night observations detected two superhumps: BJD 2457941.3788(3) (N=40) and 2457941.4457(3) (N=50).

E-section 3.9 GQ Canum Venaticorum

This object was discovered as ASASSN-13ao by the ASAS-SN team on 2013 June 8 (Stanek et al. 2013). The 2013 superoutburst was studied in Kato et al. (2014b) yielding only two superhump maxima.

The 2017 superoutburst was detected by the ASAS-SN team at V=14.7 on 2017 April 8. Superhumps were better observed than in the 2013 superoutburst (vsnet-alert 20899, 20913; e-figure 6). The times of superhump maxima are listed in e-table 6. Although there was some tendency of a period decrease, we could not determine the superhump stages.



E-figure 6. Superhumps in GQ CVn (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

Three superoutbursts have been known in the ASAS-SN data (2013 June 7, V=15.0; 2016 January 27, V=14.8 and the present one). The shortest interval between superoutbursts was 437 d.

E-section 3.10 V503 Cygni

For this famous SU UMa-type dwarf nova with a short supercycle and negative superhumps (Harvey et al. 1995). Kato et al. (2002) reported a dramatic variation in the number of normal outbursts, and this finding led to the discovery of the state with negative superhumps suppressing the number of normal outbursts in other objects (Ohshima et al. 2012; Zemko et al. 2013; Osaki and Kato 2013a; Osaki and Kato 2013b). Pavlenko et al. (2012) indeed confirmed temporal disappearance of negative su-

E-table 6. Superhump maxima of GQ CVn (2017)

E	max*	error	$O-C$†	N‡
0	57854.4146	0.0005	−0.0022	97
1	57854.5026	0.0009	−0.0037	81
11	57855.4046	0.0006	0.0035	97
12	57855.4919	0.0006	0.0013	94
13	57855.5820	0.0007	0.0020	78
14	57855.6713	0.0010	0.0018	68
29	57857.0064	0.0044	−0.0052	71
30	57857.1038	0.0006	0.0027	181
31	57857.1941	0.0015	0.0035	53
37	57857.7236	0.0004	−0.0038	169

*BJD−2400000.
†Against max = 2457854.4168 + 0.089476E.
‡Number of points used to determine the maximum.

perhumps in 2010 and shortening of the outburst cycle. The 2017 July superoutburst was detected at a visual magnitude of 14.1 by Alain Klotz on 2017 July 11. Single-night observations detected two superhumps: BJD 2457951.4358(28) (N=54) and 2457951.5257(3) (N=121).

E-section 3.11 V632 Cygni

This object was discovered by Hoffmeister (1949b), who recorded three outbursts on 1938 December 11 (13.9 mag), 1939 November 3 (12.8 mag) and 1940 June 13 (magnitude unknown). Hoffmeister (1957a) provided a finding chart. Although this object had long been introduced in monitoring programs by the AAVSO and AFOEV, the position of the object was not correctly marked (Wenzel 1989). Outbursts started to be detected by visual observers since 1988–1989 when the chart error was corrected (the old AAVSO chart marked the object at a 16 mag unrelated star). Unpublished I-band photometry by one of the authors (T.K) in 1991 suggested a large outburst amplitude and the object was suspected to be an SU UMa-type dwarf nova. Based on this information, VSOLJ observers monitored the object and obtained some time-resolved CCD photometry, but it did not lead to a successful detection of superhumps. Liu et al. (1999) reported a spectrum and suggested that the orbital period is likely short. Sheets et al. (2007) determined its orbital period to be 0.06377(8) d. The SU UMa-type nature was finally established during the 2008 superoutburst (Kato et al. 2009).

The 2017 superoutburst was visually detected by L. Kocsmaros at a magnitude of 13.8 on 2017 June 16 (cvnet-outburst 7520). Only single-night observations were obtained. The times of superhump maxima are listed in e-table 7. The superhump period of 0.0655(3) d was determined by the PDM method.

E-table 7. Superhump maxima of V632 Cyg (2017)

E	max*	error	$O-C$†	N‡
0	57926.3774	0.0012	−0.0002	56
1	57926.4438	0.0009	0.0004	68
2	57926.5089	0.0006	−0.0002	57

*BJD−2400000.
†Against max = 2457926.3776 + 0.065742E.
‡Number of points used to determine the maximum.

E-table 8. List of recent superoutbursts V632 Cyg

Year	Month	Day	max*	mag	source
2013	10	22	56588	14.0V	AAVSO
2016	5	5	57513	13.7V	ASAS-SN
2016	11	28	57721	13.8v	AAVSO
2017	6	16	57920	14.1V	ASAS-SN

*JD−2400000.

We give a list of recent superoutburst in e-table 8. The supercycle is around 210 d.

E-section 3.12 V1454 Cygni

Since it turned out the alias selection in Kato et al. (2009) was wrong for the 2006 superoutburst, we list a corrected $O-C$ table (e-table 9). The $P_{\rm dot}$ for stage B has been corrected to be $P_{\rm dot}$ of $+7.4(1.4)\times10^{-5}$ ($120\le E\le277$).

E-section 3.13 HO Delphini

HO Del (=S 10066) was discovered as a dwarf nova by Hoffmeister (1967). The SU UMa-type nature was confirmed during the 1994 superoutburst. See Kato et al. (2016b) for more history. The 2017 superoutburst was detected by the ASAS-SN team at V=14.75 on 2017 July 30. The outburst was also visually detected at 14.0 mag on 2017 July 31 by R. Stubbings. Single-night observations detected three superhumps: BJD 2457969.4926(15) (N=13), 2457969.5558(10) (N=23) and 2457969.6212(17) (N=19).

E-section 3.14 MN Draconis

This object was discovered as a dwarf nova (Antipin and Pavlenko 2002). The object was identified as an SU UMa-type dwarf nova in the period gap (Nogami et al. 2003). The object has both a short supercycle and negative superhumps in quiescence citeppav10mndra. It was suggested that the large negative $P_{\rm dot}$ for superhumps reflected stage A-B transition (Kato et al. 2014a). For more information,

E-table 9. Superhump maxima of V1454 Cyg (2006)

E	max*	error	$O-C$†	N‡
0	54063.9540	0.0017	−0.0013	77
120	54070.8827	0.0008	0.0082	84
121	54070.9396	0.0011	0.0075	85
173	54073.9205	0.0046	−0.0099	81
190	54074.9047	0.0015	−0.0059	83
207	54075.8866	0.0025	−0.0042	63
208	54075.9447	0.0032	−0.0038	64
248	54078.2566	0.0022	0.0017	32
277	54079.9323	0.0010	0.0052	70
294	54080.9099	0.0017	0.0026	84

*BJD−2400000.
†Against max = 2454063.9553 + 0.057660E.
‡Number of points used to determine the maximum.

see Kato et al. (2014a).

The 2017 June superoutburst was detected by G. Poyner at an unfiltered CCD magnitude of 16.43 on 2017 June 19 (vsnet-alert 21143). Only one superhump maximum was measured: BJD 2457926.8051(11) (N=208).

E-section 3.15 OV Draconis

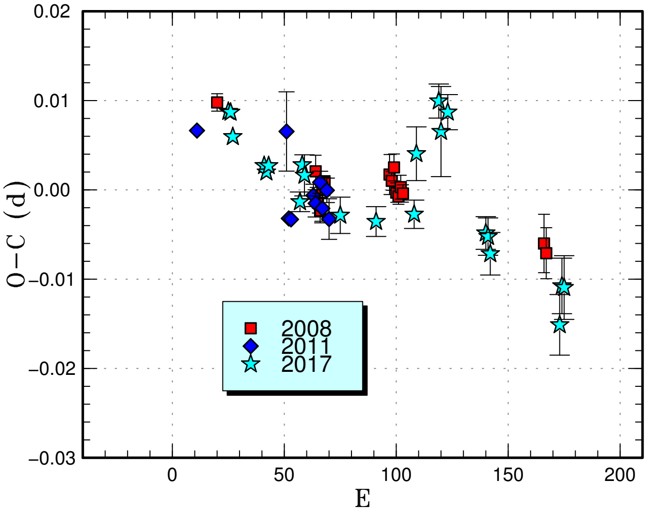
This object (=SDSS J125023.85+665525.5) is a CV selected during the course of the Sloan Digital Sky Survey (SDSS) (Szkody et al. 2003). Dillon et al. (2008) confirmed the deeply eclipsing nature. The 2008 and 2009 superoutbursts were reported in Kato et al. (2010) and another one in 2011 was reported in Kato et al. (2012a). The 2013 superoutburst was reported in Kato et al. (2014b).

The 2015 superoutburst was detected by the ASAS-SN team at V=15.9 on 2015 February 11. Although time-resolved observations were reported on two nights, we could not detect convincing superhumps. These observations are used in refining the eclipse ephemeris.

The 2017 superoutburst was detected by the ASAS-SN team at V=15.56 on 2017 May 26. We updated the eclipse ephemeris using our 2008–2017 observations using the MCMC analysis (Kato et al. 2013a):

$$\mathrm{Min(BJD)} = 2456305.98940(7) + 0.0587356736(13)E. \quad \text{(E1)}$$

The epoch corresponds to the center of all the observations. The times of superhump maxima are listed in e-table 10. Stages B and C are clearly seen (e-figure 7). It is the first time to show a positive P_{dot} and transition to stage C so clearly in a deeply eclipsing system.

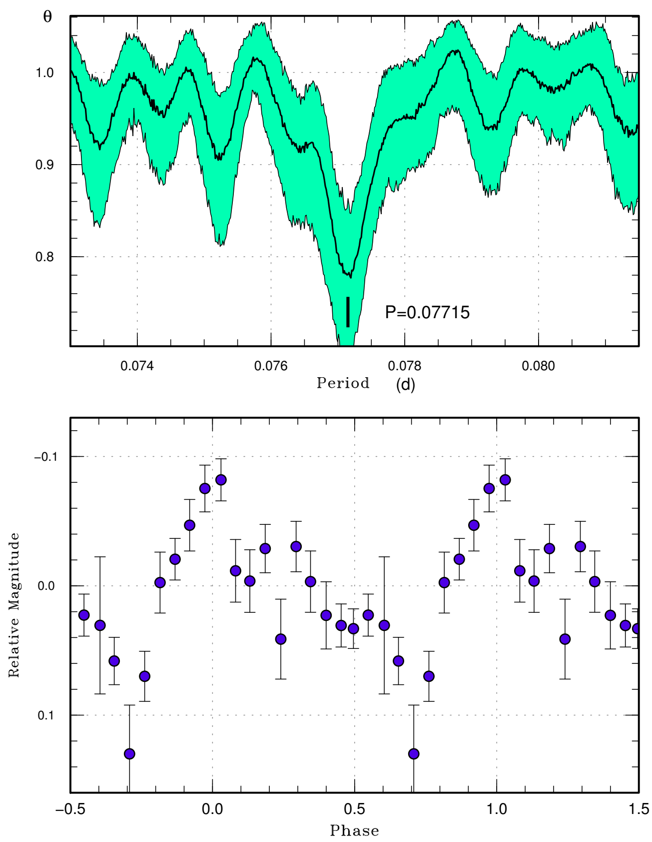


E-figure 7. Comparison of $O-C$ diagrams of OV Dra between different superoutbursts. A period of 0.06040 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used. For the 2008 superoutburst, we shifted by 20 cycles to best match the others.

E-table 10. Superhump maxima of OV Dra (2017)

E	max*	error	$O-C$†	phase‡	N§
0	57901.4366	0.0003	0.0024	0.17	69
1	57901.4969	0.0004	0.0024	0.20	65
2	57901.5546	0.0008	−0.0003	0.18	35
16	57902.3969	0.0009	−0.0022	0.52	36
17	57902.4566	0.0006	−0.0028	0.54	65
18	57902.5177	0.0010	−0.0020	0.58	27
32	57903.3593	0.0011	−0.0048	0.91	25
33	57903.4238	0.0010	−0.0005	0.01	26
34	57903.4830	0.0023	−0.0016	0.01	16
50	57904.4450	0.0020	−0.0046	0.39	35
66	57905.4107	0.0017	−0.0038	0.83	39
83	57906.4383	0.0016	−0.0014	0.33	27
84	57906.5055	0.0030	0.0054	0.47	21
94	57907.1154	0.0019	0.0123	0.86	58
95	57907.1723	0.0050	0.0089	0.83	37
98	57907.3557	0.0020	0.0114	0.95	27
115	57908.3690	0.0018	−0.0006	0.20	28
116	57908.4290	0.0021	−0.0009	0.22	27
117	57908.4875	0.0024	−0.0027	0.22	25
148	57910.3519	0.0034	−0.0078	0.96	21
149	57910.4167	0.0031	−0.0033	0.06	28
150	57910.4769	0.0036	−0.0034	0.09	27

*BJD−2400000.
†Against max = 2457901.4342 + 0.060307E.
‡Orbital phase.
§Number of points used to determine the maximum.



E-figure 8. Superhumps in BE Oct (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-section 3.16 BE Octantis

BE Oct was discovered as a possible dwarf nova (S 6633) (Hoffmeister 1963). J. Kemp and J. Patterson obtained a superhump period of 0.07712(13) d from observations on 1996 August 17 and 18 (vsnet-obs 3461). Although outbursts have been rather regularly recorded, no further observations of superhumps were reported. Mason and Howell (2003) reported a typical dwarf nova-type spectrum in quiescence.

The 2017 superoutburst was detected at a visual magnitude of 15.4 by R. Stubbings and at V=15.97 by the ASAS-SN team on 2017 July 1. Subsequent observations detected superhumps (figure 8). The times of superhump maxima are listed in e-table 11. Although there were observations after BJD 2457941, the object became too faint to measure individual superhump maxima. The light curve indicated brightening on July 7 (BJD 2457941), suggesting that there was stage B-C transition around here. The best superhump period based on the first four nights (figure 8) was determined to be 0.07715(7) d by the PDM method.

E-table 11. Superhump maxima of BE Oct (2017)

E	max*	error	$O-C$†	N‡
0	57938.7720	0.0058	−0.0062	12
1	57938.8606	0.0026	0.0053	23
14	57939.8594	0.0020	0.0016	23
39	57941.7878	0.0038	0.0021	19
40	57941.8600	0.0032	−0.0028	23

*BJD−2400000.
†Against max = 2457938.7782 + 0.077115E.
‡Number of points used to determine the maximum.

E-section 3.17 V521 Pegasi

This object (=HS 2219+1824) is a dwarf nova reported in Rodríguez-Gil et al. (2005). The SU UMa-type nature was confirmed by Rodríguez-Gil et al. (2005). For more information, see Kato et al. (2014b) and Kato et al. (2014a).

The 2017 outburst was detected by the ASAS-SN team at V=12.8 on 2017 August 24 and was found to be fading rapidly on the same night by K. Wenzel and E. Muyllaert. This outburst turned out to be a precursor outburst and the true superoutburst occurred 7 d after (cf. vsnet-alert 21384: detection by the ASAS-SN team at V=12.0 and visually by H. Maehara on 2017 August 31). The times of superhump maxima are listed in e-table 12. Although there were observations during the rapidly fading part, we could not determine superhump maxima.

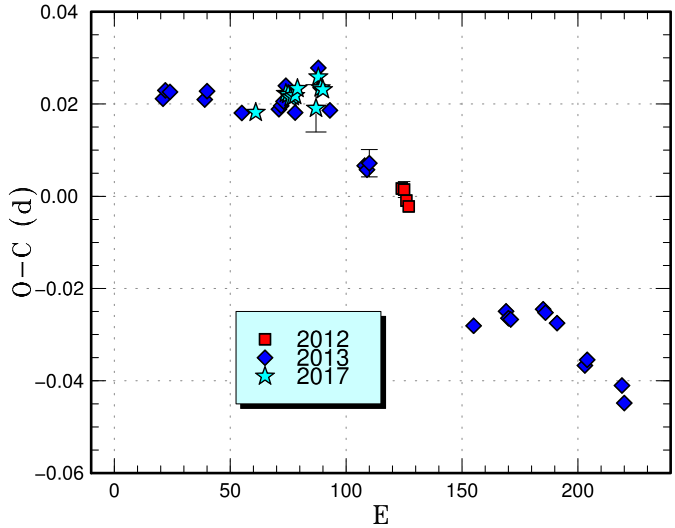
A comparison of $O-C$ diagrams suggests that the 2017 observations recorded the final part of stage B and superhump started to develop 52 cycles (3.2 d) before the detection of the superoutburst. This suggests that superhumps started to develop several days after the precursor outburst [the actual growth time may have been longer, see Kato et al. (2016a), Imada et al. (2017)].

E-section 3.18 V368 Persei

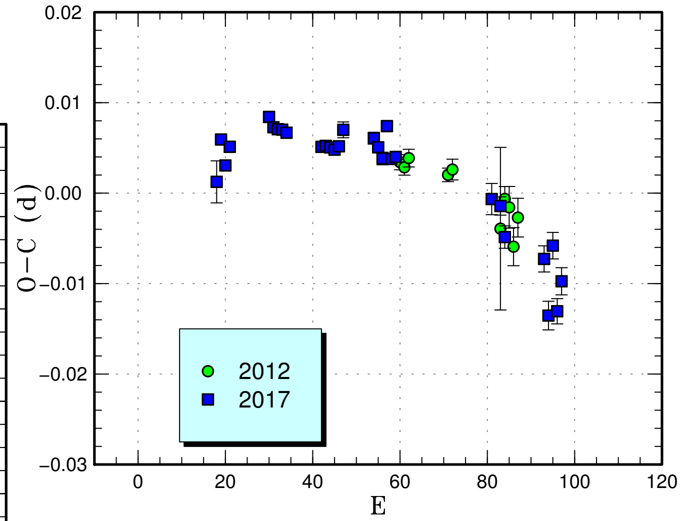
V368 Per was discovered by Richter (1969). The SU UMa-type nature was identified by I. Miller in 2012 (BAAVSS alert 3113). For more information see Kato et al. (2014b).

The 2017 superoutburst was detected by the ASAS-SN team at V=15.43 on 2017 September 26. Subsequent observations detected superhumps (vsnet-alert 21477, 21485, 21500). In contrast to the 2012 superoutburst, when only stage C superhumps were observed, we could observe both stages B and C (e-figure 10; the maxima for $E \le$ may be stage A superhumps). The $P_{\rm dot}$ for stage B was not determined due to the shortness of stage B for this relatively long-$P_{\rm SH}$ object.

Although this field has been monitored by the ASAS-SN team since 2012 January, the present outburst was the



E-figure 9. Comparison of $O-C$ diagrams of V521 Peg between different superoutbursts. A period of 0.06150 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used. The 2017 diagram was shifted by 52 cycles (against the start of the main superoutburst) to best match the others.



E-figure 10. Comparison of $O-C$ diagrams of V368 Per between different superoutbursts. A period of 0.07922 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used. The start of the 2012 superoutburst was not well constrained and we shifted the $O-C$ diagram by 38 cycles to best fit the 2017 one.

E-table 12. Superhump maxima of V521 Peg (2017)

E	max*	error	$O-C$†	N‡
0	57997.5283	0.0004	−0.0011	64
13	57998.3319	0.0003	0.0011	42
14	57998.3931	0.0004	0.0007	45
15	57998.4539	0.0004	−0.0002	41
16	57998.5157	0.0003	−0.0001	47
17	57998.5774	0.0004	0.0000	46
18	57998.6404	0.0018	0.0014	12
26	57999.1281	0.0051	−0.0040	22
27	57999.1964	0.0003	0.0026	128
28	57999.2556	0.0003	0.0001	129
29	57999.3167	0.0009	−0.0005	67

*BJD−2400000.

†Against max = 2457997.5294 + 0.061646E.

‡Number of points used to determine the maximum.

first well-recorded superoutburst. Although the 2012 superoutburst was detected on a single night, it was impossible to recognize it to be a superoutburst by the ASAS-SN data only.

E-section 3.19 XY Piscium

XY Psc was discovered as a transient located close to the galaxy UGC 729 on 1972 October 5 at a photographic magnitude of 13.0 and was detected at a magnitude of 15.0 on 1972 October 17 (Rosino and Pigatto 1972a). Although the object was suspected to be a supernova of this galaxy, it was suggested to be a dwarf nova based on the rapid rise and decline (Rosino and Pigatto 1972b).

VSOLJ members started monitoring this object in 1984 and S. Fujino recorded a possible outburst at a photographic magnitude (using a filter adjusted to reproduce the V band) of 15.0 on 1984 January 21. There was only one positive record and, unfortunately, a negative film was lost and the identity of the object remained unclear. Since the 1990s, the object started to be monitored more regularly by observers worldwide. No outburst, however, was recorded.

In the meantime, Henden et al. (2001) obtained deep CCD images of this field and identified a quiescent blue counterpart of V=21.1. Henden et al. (2001) also provided some more details of historical observations of this object. Kato et al. (2001) listed this object as a candidate WZ Sge-type dwarf nova.

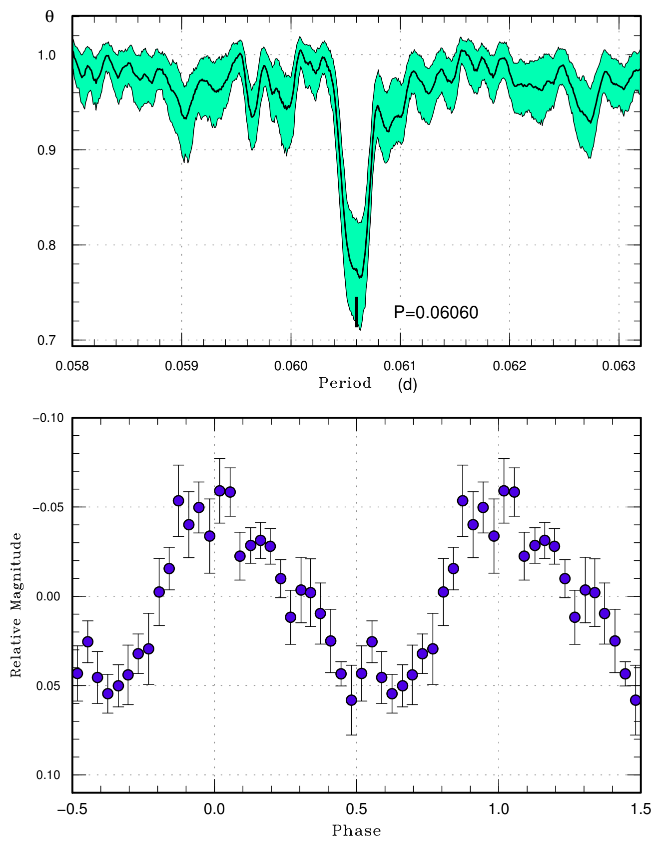
E-table 13. Superhump maxima of V368 Per (2017)

E	max*	error	$O-C$†	N‡
0	58024.3453	0.0023	−0.0081	26
1	58024.4292	0.0003	−0.0032	163
2	58024.5056	0.0004	−0.0059	86
3	58024.5869	0.0002	−0.0036	83
12	58025.3031	0.0004	0.0015	79
13	58025.3812	0.0003	0.0006	86
14	58025.4602	0.0003	0.0006	160
15	58025.5394	0.0002	0.0007	263
16	58025.6183	0.0004	0.0006	84
24	58026.2505	0.0005	0.0007	135
25	58026.3298	0.0004	0.0010	85
26	58026.4088	0.0003	0.0010	151
27	58026.4878	0.0002	0.0010	235
28	58026.5674	0.0003	0.0015	209
29	58026.6485	0.0009	0.0036	37
36	58027.2021	0.0007	0.0041	104
37	58027.2803	0.0005	0.0033	191
38	58027.3583	0.0007	0.0022	95
39	58027.4411	0.0004	0.0060	86
40	58027.5167	0.0003	0.0026	86
41	58027.5961	0.0004	0.0030	74
63	58029.3343	0.0017	0.0028	27
65	58029.4920	0.0010	0.0025	83
66	58029.5677	0.0012	−0.0008	83
75	58030.2783	0.0014	−0.0013	44
76	58030.3513	0.0016	−0.0074	44
77	58030.4382	0.0015	0.0005	44
78	58030.5102	0.0014	−0.0065	29
79	58030.5927	0.0015	−0.0030	33

*BJD−2400000.

†Against max = 2458024.3534 + 0.079017E.

‡Number of points used to determine the maximum.



E-figure 11. Superhumps in XY Psc (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

The 2017 outburst was detected by the ASAS-SN team at V=13.1 on 2017 June 2 (vsnet-alert 21085). Two night before, the object was fainter than V=16.3. Since the object was still low in the morning sky, amateur observers had not yet started monitoring. Due to the short observing windows, it took several days to detect superhumps (vsnet-alert 21111). Later observations pinned down the superhump period as observations accumulated (vsnet-alert 21119, 21131; e-figure 11).

The times of superhump maxima are listed in e-table 14. Despite the limited number of observations, stage B with a clearly positive $P_{\rm dot}$ and transition to stage C were recorded.

The initial sign of superhumps was recorded on 2017 June 10 (8 d after the outburst detection). Although there were earlier observations, it was impossible to detect modulation due to the shortness of observations. The relatively early appearance of ordinary superhumps and a strongly positive $P_{\rm dot}$ would suggest either an ordinary SU UMa-type dwarf nova or a WZ Sge/SU UMa-type borderline object. Since the object is not suited for observation around the solar conjunction, past outbursts near solar conjunctions may have been easily missed. We probably need to wait for a superoutburst occurring in the favorable season of the year to possibly detect early superhumps.

The object showed a rebrightening at V=15.9 on 2017 June 27 (ASAS-SN detection, vsnet-alert 21171). According to the ASAS-SN observations, there was no evidence of multiple rebrightenings. Regular monitoring by the ASAS-SN team started in 2012 October without any previous detection.

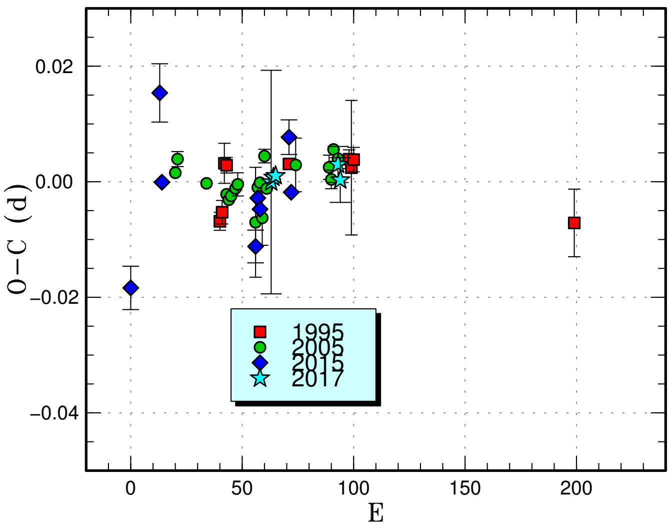
E-section 3.20 V701 Tauri

V701 Tau was discovered by Erastova (1973) as an eruptive object. The SU UMa-type nature was confirmed in

E-table 14. Superhump maxima of XY Psc (2017)

E	max*	error	$O-C$†	N‡
0	57915.8730	0.0006	0.0043	17
17	57916.8986	0.0011	−0.0013	17
33	57917.8665	0.0010	−0.0040	24
50	57918.9012	0.0012	−0.0004	16
56	57919.2630	0.0006	−0.0026	53
66	57919.8703	0.0013	−0.0018	22
82	57920.8461	0.0011	0.0034	17
83	57920.9077	0.0012	0.0044	11
89	57921.2686	0.0009	0.0014	48
99	57921.8706	0.0013	−0.0032	21

*BJD−2400000.
†Against max = 2457915.8687 + 0.060658E.
‡Number of points used to determine the maximum.



E-figure 12. Comparison of $O-C$ diagrams of V701 Tau between different superoutbursts. A period of 0.06899 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used. We assumed that the 2015 superoutburst was detected soon after the maximum and shifted other superoutbursts to get the best fit.

1995 (reported in Kato et al. 2009). Shears and Boyd (2007) further reported the 2005 superoutburst. For more details, see Kato et al. (2015).

The 2017 superoutburst was detected by the ASAS-SN team at V=14.88 on 2017 August 17. Time-resolved photometric observations were carried out on two nights and the times of superhump maxima are listed in e-table 15. A comparison of $O-C$ diagrams suggests that we observed the late part of stage B superhumps (e-figure 12).

E-table 15. Superhump maxima of V701 Tau (2017)

E	max*	error	$O-C$†	N‡
0	57987.4742	0.0193	−0.0006	11
1	57987.5440	0.0014	0.0002	31
2	57987.6132	0.0014	0.0004	29
30	57989.5469	0.0031	0.0014	21
31	57989.6132	0.0039	−0.0014	31

*BJD−2400000.
†Against max = 2457987.4748 + 0.069026E.
‡Number of points used to determine the maximum.

E-table 16. Superhump maxima of V1208 Tau (2017)

E	max*	error	$O-C$†	N‡
0	58068.7076	0.0009	−0.0010	40
1	58068.7797	0.0016	0.0017	39
2	58068.8471	0.0012	−0.0003	40
3	58068.9165	0.0011	−0.0003	39

*BJD−2400000.
†Against max = 2458068.7086 + 0.069413E.
‡Number of points used to determine the maximum.

E-section 3.21 V1208 Tauri

V1208 Tau was originally identified as a CV during the course of identification of ROSAT sources (=1RXS J045942.9+192625, Motch et al. 1996). P. Schmeer detected the first-ever recorded outburst in 2000 (vsnet-alert 4118). The SU UMa-type nature was confirmed during this outburst. Although Patterson et al. (2005) gave an orbital period of 0.0681(2) d, the source was unclear. The 2000 and 2002 superoutbursts were reported in Kato et al. (2009). The 2011 superoutburst was reported in Kato et al. (2013a). The entire course of the superoutburst, however, has not yet been well observed.

The 2017 superoutburst was detected at an unfiltered CCD magnitude of 14.8 on 2017 November 8 by Y. Maeda. This superoutburst was also recorded in the ASAS-SN data (V=15.90 on 2017 November 9, vsnet-alert 21576). Superhumps were detected on 2017 November 11 (vsnet-alert 21576). The times of superhump maxima are listed in e-table 16. Although there were observations on three nights after these observations, no clear superhumps were detected. It may have been that we only observed the terminal portion of the superoutburst, and that there could have been a rebrightening on 2017 November 17. The data were too sparse to depict the outburst behavior unambiguously. This object still need better observations to obtain precise values of superhump and orbital periods.

E-table 17. Superhump maxima of TU Tri (2017)

E	max*	error	$O-C$†	N‡
0	58050.0377	0.0023	−0.0038	42
1	58050.1166	0.0009	−0.0009	64
16	58051.2561	0.0018	−0.0017	51
17	58051.3355	0.0005	0.0017	87
18	58051.4131	0.0005	0.0032	105
19	58051.4875	0.0006	0.0017	44
20	58051.5639	0.0006	0.0020	24
59	58054.5242	0.0009	−0.0022	84

*BJD−2400000.

†Against max = 2458050.0416 + 0.076015E.

‡Number of points used to determine the maximum.

E-section 3.22 TU Trianguli

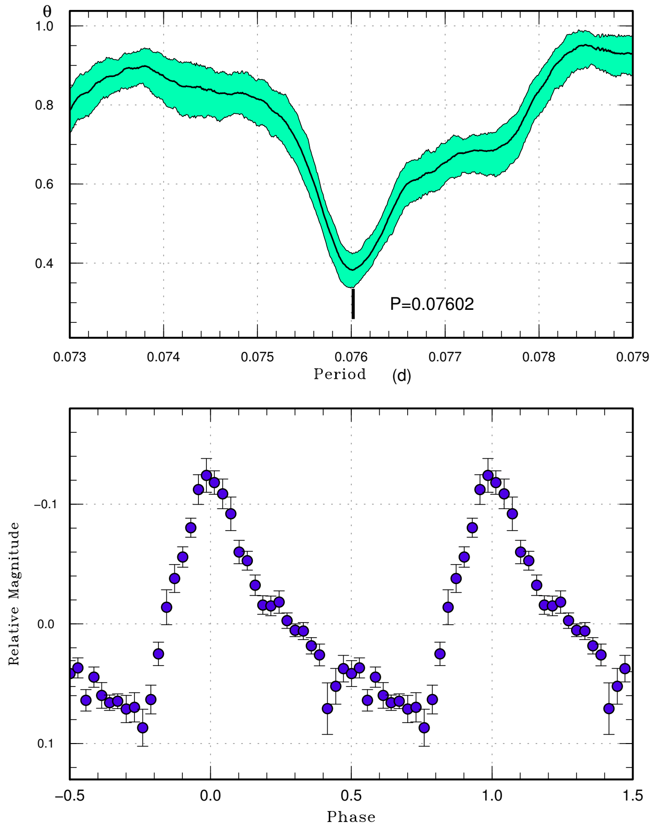
TU Tri was discovered as a dwarf nova (GR 287) with a photographic range of 14.8 to fainter than 18.0 by Romano (1978). The coordinates given in this paper, however, was incorrect (Sharov et al. 1992) and Sharov (1991) independently discovered this dwarf nova. The observation by Sharov (1991) recorded a long outburst starting on 1982 November 9 and lasted at least up to 1982 November 14. Liu and Hu (2000) obtained a spectrum in quiescence without emission lines.

There was an outburst on 2013 January 1 at a visual magnitude of 14.6 detected by M. Simonsen. Although K. Torii's observations could not detect superhumps (vsnet-campaign-dn 3237, 3262), Zloczewski (2004) recorded superhumps with a period of 0.0745 d from single-night observations.

Although an outburst on 2017 January 29 was observed (P. Dubovsky), it faded quickly and must have been a normal outburst. The 2017 superoutburst was detected by the ASAS-SN team at V=14.98 on 2017 October 19. Subsequent observations detected superhumps (vsnet-alert 21540, 21544). The resultant period of 0.07602(2) d (e-figure 13) was significantly longer than the measurement by Zloczewski (2004). The times of superhump maxima are listed in e-table 17. There looks like to have been stage B-C transition between E=20 and E=59.

E-section 3.23 SU Ursae Majoris

This object is the prototype of SU UMa-type dwarf novae. See Kato et al. (2015) for the history. The second superoutburst in 2017 was detected by P. Schmeer at a visual magnitude of 12.3 on 2017 October 16. The object further brightened to 11.2 on 2017 October 18 (J. Toone, baavss-alert 4810). Superhumps were observed on two nights and the times of superhump maxima are listed in e-table 18.



E-figure 13. Superhumps in TU Tri (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 18. Superhump maxima of SU UMa (2017b)

E	max*	error	$O-C$†	N‡
0	58046.5183	0.0003	0.0027	111
1	58046.5920	0.0006	−0.0026	140
63	58051.4806	0.0015	−0.0073	149
64	58051.5740	0.0009	0.0072	140

*BJD−2400000.

†Against max = 2458046.5157 + 0.078924E.

‡Number of points used to determine the maximum.

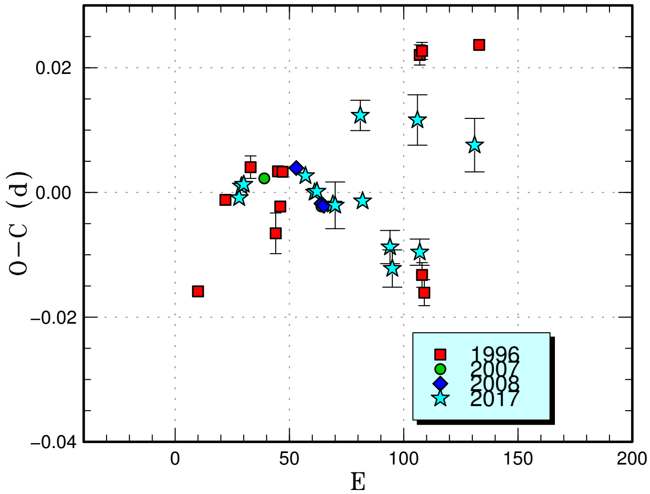
E-section 3.24 HS Virginis

HS Vir was discovered as an ultraviolet excess object PG 1341−079, and was confirmed by spectroscopy to be a cataclysmic variable (Green et al. 1982; Green et al. 1986). Osminkin (1985) reported from photographic observations that this object shows relatively abundant short, faint outbursts, together with a bright (∼12.8 mag) one. Ringwald (1993) suggested an orbital period of 0.0836 day (with possible aliasing problems) from radial-velocity measurements. Since this observation, HS Vir has been considered to be a candidate for an SU UMa-type dwarf nova. Kato et al. (1995) reported frequent occurrence of short outbursts. Although the bright outburst in Osminkin (1985) was suggestive of a superoutburst, it was only in 1996 March when superhumps with a mean period of 0.08059(3) d were indeed detected, confirming the SU UMa-type nature (Kato et al. 1998). Patterson et al. (2003) observed the same superoutburst and reported a superhump period of 0.08045(19) d. Mennickent et al. (1999) obtained an orbital period of 0.07692(3) d from radial-velocity measurements. Kato et al. (2001) suggested a supercycle of 186 d or 371 d. Kato et al. (2009) analyzed the 1996 data again, and yielded a slightly shorter superhump period of 0.08003(3) d.

Although this object was observed several times during later superoutbursts [2007 March, 2008 June (Kato et al. 2009), and 2014 February], these observations were performed only for a short time and there have been no new measurement of the superhump period.

The 2017 superoutburst was detected by H. Maehara at a visual magnitude of 13.5 on 2017 April 22. Superhumps were observed (vsnet-alert 20958). The times of superhump maxima are listed in e-table 19. There was a gap in the observation following the initial superhump detection and maxima from later observations were not of very good quality due to the low sampling rate and the complex profile of superhumps. The derived mean superhump period was 0.08031(6) d. Since observations were made during the relatively late phase, this period was probably affected by stage C superhumps, which were not apparent on the $O-C$ diagram due to scatter.

We also provide yet unpublished maxima of the 2007 superoutburst: BJD 2454188.0930(5) (N=57) and 2454190.0962(6) (N=89). A comparison of the $O-C$ diagram (e-figure 14) cannot tell much other than the presence of stage A in the 1996 superoutburst.



E-figure 14. Comparison of $O-C$ diagrams of HS Vir between different superoutbursts. A period of 0.08031 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used. Since the start of the 1996 superoutburst was not well constrained, we shifted to best match the others. Growing superhumps were observed during the 1996 superoutburst (Kato et al. 1998), confirming the validity of this treatment.

E-table 19. Superhump maxima of HS Vir (2017)

E	max*	error	$O-C$†	N‡
0	57868.3646	0.0003	−0.0007	75
1	57868.4468	0.0002	0.0012	73
2	57868.5274	0.0006	0.0014	57
29	57870.6971	0.0010	0.0027	14
33	57871.0157	0.0013	0.0001	83
34	57871.0962	0.0008	0.0002	99
41	57871.6563	0.0009	−0.0019	22
42	57871.7364	0.0037	−0.0021	11
53	57872.6343	0.0024	0.0123	25
54	57872.7008	0.0011	−0.0014	22
66	57873.6572	0.0027	−0.0088	19
67	57873.7340	0.0030	−0.0123	15
78	57874.6413	0.0040	0.0115	19
79	57874.7004	0.0021	−0.0097	21
103	57876.6450	0.0043	0.0074	22

*BJD−2400000.

†Against max = 2457868.3653 + 0.080313E.

‡Number of points used to determine the maximum.

E-section 3.25 V406 Virginis

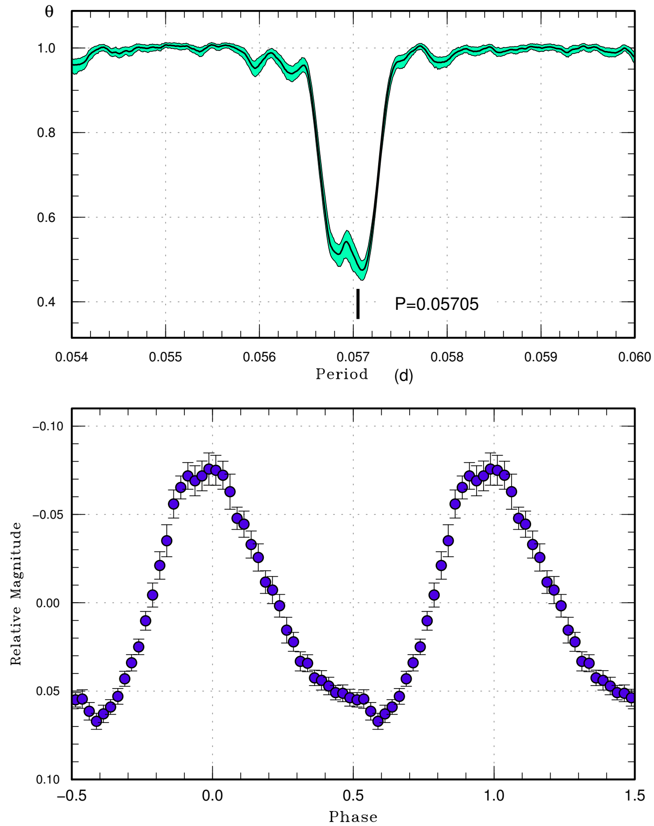
V406 Vir was originally selected as a CV (SDSS J123813.73−033933.0) during the course of the SDSS (Szkody et al. 2003). Szkody et al. (2003) suggested a high inclination and an orbital period of 76 min. Zharikov et al. (2006) performed time-resolved photometric and spectroscopic observations and obtained an orbital period of 0.05592(35) d. Zharikov et al. (2006) classified the object a WZ Sge-like one but with cyclic brightening up to 0.4 mag with periods of the order of 8–12 hr in quiescence. Aviles et al. (2010) performed infrared JHK photometry and optical spectroscopy and indicated that the system has a L4-type brown dwarf. The Doppler mapping of the system showed the permanent presence of a spiral arm pattern in the accretion disk and Aviles et al. (2010) suggested that they can be a result of the 2:1 resonance. Aviles et al. (2010) classified this object to be a period bouncer.

Despite that the object has long been suspected to be a WZ Sge-type dwarf nova, no outburst was recorded until 2017. The 2017 outburst was detected by the ASAS-SN team at V=11.86 on 2017 July 31 (cf. vsnet-alert 21308). Despite poor seasonal location in the sky, the outburst was observed and superhumps were detected (vsnet-alert 21325, 21328, 21330; e-figure 15). These superhumps were detected already on 2017 August 4 (they were already stage B superhumps), indicating that the waiting time for the appearance of ordinary superhumps was short. The times of superhump maxima are listed in e-table 20. All superhumps were stage B ones and $P_{\rm dot}$ was relatively large $+8.1(1.5) \times 10^{-5}$

The short waiting time for ordinary superhumps, large amplitude of superhumps (e-figure 15) and the relatively large $P_{\rm dot}$ for stage B superhumps indicate that this object is not an extreme WZ Sge-type dwarf nova as expected from the conclusion by Aviles et al. (2010). By using the relation between q and $P_{\rm dot}$ for WZ Sge-type dwarf novae (equation 6 in Kato 2015), the q value is expected to be 0.095(6) (the error corresponds to the measurement error only). This value is not particularly small for WZ Sge-type dwarf novae (cf. figure 17 in Kato 2015), particularly considering the high-mass white dwarf claimed by Aviles et al. (2010). The ASAS-SN observations in 2017 only consisted of three nights and there was 7 d gap before the outburst detection. The waiting time for the appearance of ordinary superhumps may have been longer if the true maximum was missed. In any case, the conclusion by Aviles et al. (2010) would be worth revisiting using higher quality observations.

E-section 3.26 NSV 35

NSV 35 was discovered as a variable (HV 8001 = AN 97.1933) with a photographic range of 14.5–16.5 during a proper-motion survey (Luyten 1938). The object is located in the region of the Small Magellanic Cloud and is also given a variable star name of SMC V2. Augusteijn et al. (2010) found a cataclysmic variable (CTCV J0006−6900) at this location and gave a possible identification with NSV 35. Augusteijn et al. (2010) obtained an orbital period of 0.0790(12) d by a radial-velocity study with rather limited baselines. Augusteijn et al. (2010) also noted the presence of outbursts in the ASAS-3 data (Pojmański 2002).



E-figure 15. Superhumps in V406 Vir (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

A bright outburst was detected on 2017 October 15 by S. Hovell at a visual magnitude of 13.3 (vsnet-alert 21533). G. Myers detected superhumps, confirming the SU UMa-type nature of this object. This superoutburst reached V=12.6 on 2017 October 18. The times of superhump maxima are listed in e-table 21. Although there were observations after BJD 2458054 (rapid fading from the superoutburst), individual superhump maxima could not be measured.

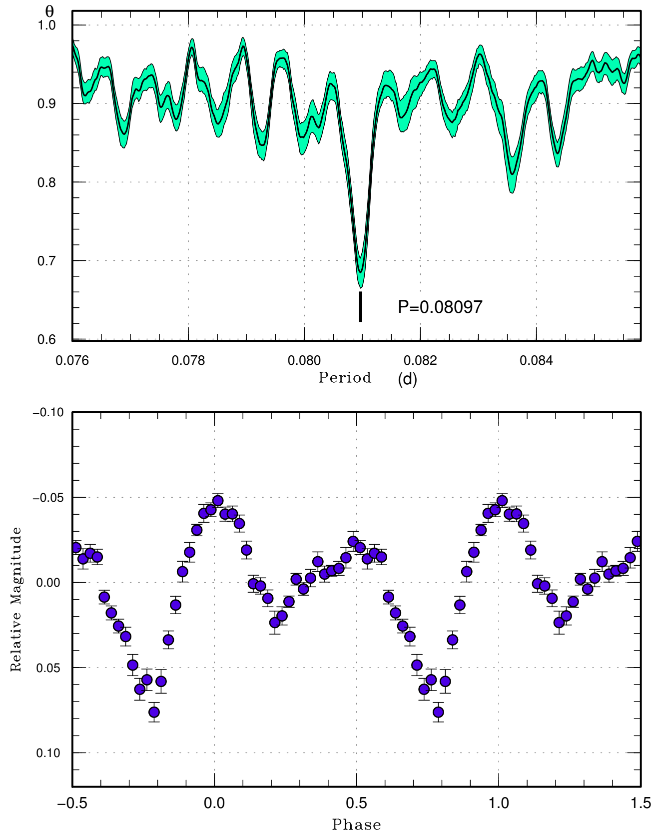
The mean profile of the superhumps is given in e-figure 16. There is a prominent secondary maximum. The profile is similar to the one in the late phase of V344 Lyr in Kepler data (cf. Wood et al. 2011). Wood et al. (2011) interpreted the secondary maximum as the accretion stream bright spot sweeping around the rim of the non-axisymmetric disk. This signal corresponds to the traditional late superhumps, and it is associated with a high mass-transfer rate from the secondary. Both V344 Lyr and NSV 35 have frequent normal outbursts, and the origin of the secondary maximum in these systems is likely the same.

This object has been monitored by the ASAS-SN team

E-table 20. Superhump maxima of V406 Vir (2017)

E	max*	error	$O-C$†	N‡
0	57970.8436	0.0024	0.0026	18
1	57970.8993	0.0005	0.0013	34
7	57971.2403	0.0002	0.0005	131
12	57971.5255	0.0006	0.0009	13
18	57971.8666	0.0003	0.0003	129
24	57972.2081	0.0002	0.0000	92
25	57972.2652	0.0005	0.0002	87
29	57972.4925	0.0004	−0.0004	31
36	57972.8893	0.0003	−0.0024	55
42	57973.2308	0.0002	−0.0026	131
47	57973.5153	0.0007	−0.0029	22
53	57973.8572	0.0005	−0.0027	70
60	57974.2562	0.0005	−0.0024	86
64	57974.4852	0.0005	−0.0013	38
70	57974.8316	0.0035	0.0033	14
71	57974.8862	0.0004	0.0009	85
77	57975.2273	0.0003	0.0003	131
82	57975.5133	0.0019	0.0016	14
88	57975.8562	0.0006	0.0027	68

*BJD−2400000.
†Against max $= 2457970.8411 + 0.056960E$.
‡Number of points used to determine the maximum.



E-figure 16. Superhumps in NSV 35 (2017). (Upper): PDM analysis. The interval BJD 2458044–2458055 was used. (Lower): Phase-averaged profile.

since 2014 May (e-figure 17). There were no definite superoutburst in the past data. It may have been either that this object rarely showed superoutbursts despite frequent normal outbursts or that past superoutbursts escaped detection around solar conjunctions. The mean brightness (in quiescence) in 2014 gradually rose from 16 mag to 15 mag, suggesting long-term variation of the mass-transfer rate. There was also an interval between 2015 November and 2016 January, when no outbursts were recorded with gradually varying quiescent brightness from 16 mag to 15 mag. This interval was difficult to interpret as a standstill since the brightness was similar to that in 2017. Outbursts in this system may have been somehow suppressed in certain epochs, and this system deserves a further detailed study.

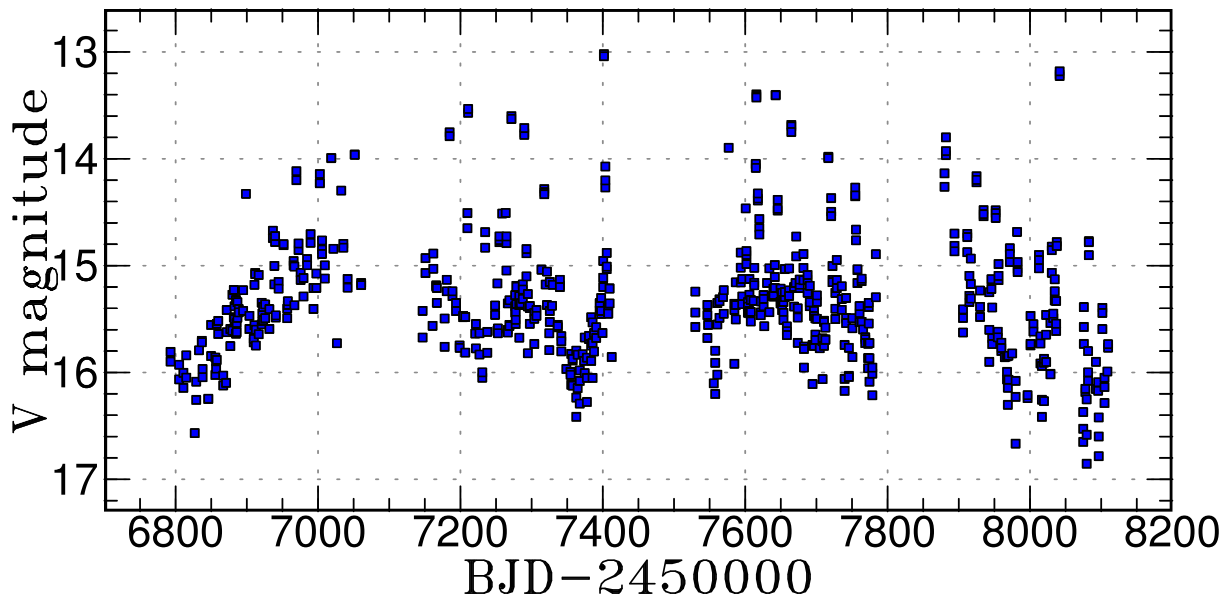
E-section 3.27 1RXS J161659.5+620014

This object (hereafter 1RXS J161659) was initially identified as an X-ray selected variable (also known as MASTER OT J161700.81+620024.9), which was first detected in bright state on 2012 September 11 at an unfiltered CCD magnitude of 14.4 (Balanutsa et al. 2013). The SU UMa-type nature was confirmed during the 2016 outburst (Kato et al. 2017a). For more information, see Kato et al. (2017a).

The 2017 superoutburst was detected by the ASAS-SN team at V=14.9 on 2017 August 31. Subsequent observations detected superhump (vsnet-alert 21429). The time of superhump maxima are listed in e-table 22. A comparison of the $O-C$ diagram suggests that the 2017 observation recorded mostly stage C. The 2017 superoutburst apparently was not detected early enough, since it started fading rapidly on August 6, only 6 d since the initial outburst detection.

E-section 3.28 ASASSN-13ce

This object was detected as a transient at V=16.27 on 2013 August 19 by the ASAS-SN team. The 2017 outburst was detected by the ASAS-SN team at V=15.55 on 2017 September 21 and announced after the observation of V=15.68 on 2017 September 24. The object had a blue SDSS counterpart and was suggested to be an SU UMa-type dwarf nova (vsnet-alert 21466). Subsequent observations indeed detected superhumps (vsnet-alert 21471; e-figure 19). Although only two superhump maxima were measured, we could reasonably choose the su-



E-figure 17. Long-term light curve of NSV 35 from ASAS-SN observations from 2014 through 2017. The only superoutburst was around BJD 2458042, which was not followed by ASAS-SN observations.

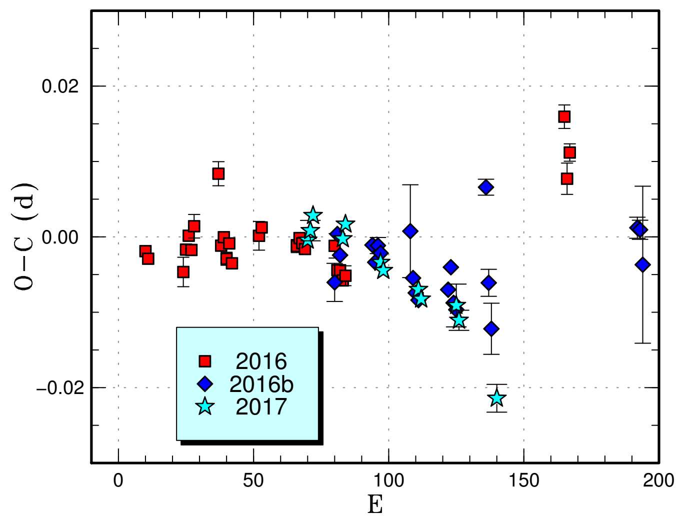
E-table 21. Superhump maxima of NSV 35 (2017)

E	max*	error	$O-C$†	N‡
0	58044.9118	0.0004	−0.0017	94
37	58047.9148	0.0012	0.0030	61
58	58049.6117	0.0022	−0.0018	24
59	58049.6872	0.0057	−0.0073	13
61	58049.8509	0.0126	−0.0058	39
62	58049.9398	0.0007	0.0022	236
63	58050.0220	0.0009	0.0033	230
64	58050.1011	0.0008	0.0013	236
65	58050.1844	0.0010	0.0037	235
66	58050.2644	0.0012	0.0026	133
70	58050.5848	0.0040	−0.0011	17
71	58050.6723	0.0017	0.0054	16
72	58050.7474	0.0044	−0.0005	13
83	58051.6379	0.0028	−0.0014	21
84	58051.7272	0.0050	0.0068	13
87	58051.9587	0.0006	−0.0048	228
95	58052.6119	0.0026	0.0001	24
96	58052.6874	0.0068	−0.0054	13
100	58053.0213	0.0007	0.0043	231
109	58053.7392	0.0049	−0.0070	13
112	58053.9936	0.0033	0.0043	232

*BJD−2400000.

†Against max = 2458044.9136 + 0.081034E.

‡Number of points used to determine the maximum.



E-figure 18. Comparison of $O-C$ diagrams of 1RXS J161659 between different superoutbursts. A period of 0.07130 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used. The 2017 curve was shifted by 46 cycles to best match the others.

perhump period since observations were relatively well spaced. The maxima were BJD 2458023.4409(16) (N=43) and 2458023.6647(11) (N=62). The period determined by the PDM method was 0.07511(3) d.

E-section 3.29 ASASSN-13dh

This object was detected as a transient at V=15.61 on 2013 October 2 by the ASAS-SN team. This outburst

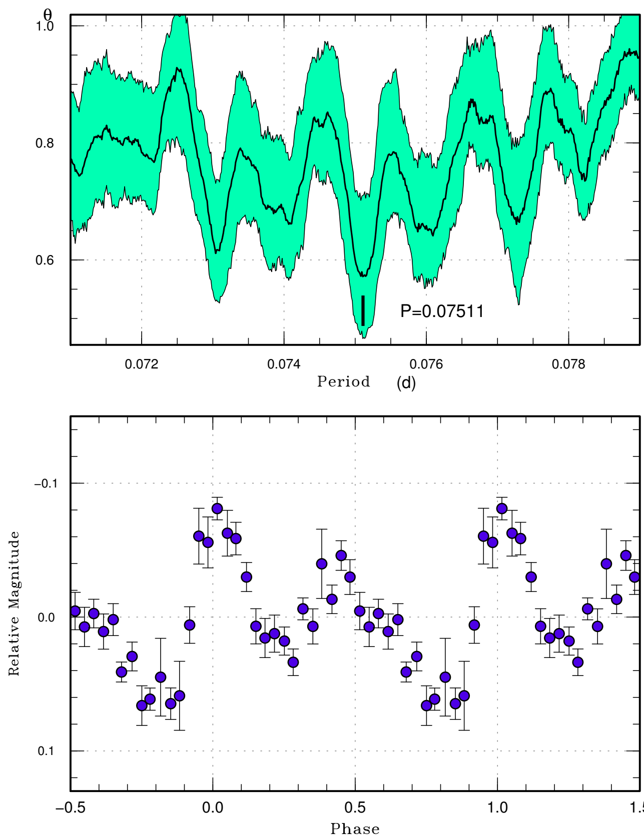
E-table 22. Superhump maxima of 1RXS J161659 (2017)

E	max*	error	$O-C$†	N‡
0	57998.4361	0.0007	−0.0034	75
1	57998.5087	0.0014	−0.0018	52
2	57998.5820	0.0006	0.0005	72
13	57999.3632	0.0008	0.0004	60
14	57999.4365	0.0008	0.0026	74
27	58000.3583	0.0008	0.0010	50
28	58000.4285	0.0006	0.0002	59
41	58001.3529	0.0011	0.0013	55
42	58001.4229	0.0010	0.0003	62
55	58002.3490	0.0028	0.0029	51
56	58002.4183	0.0013	0.0013	75
70	58003.4062	0.0018	−0.0053	58

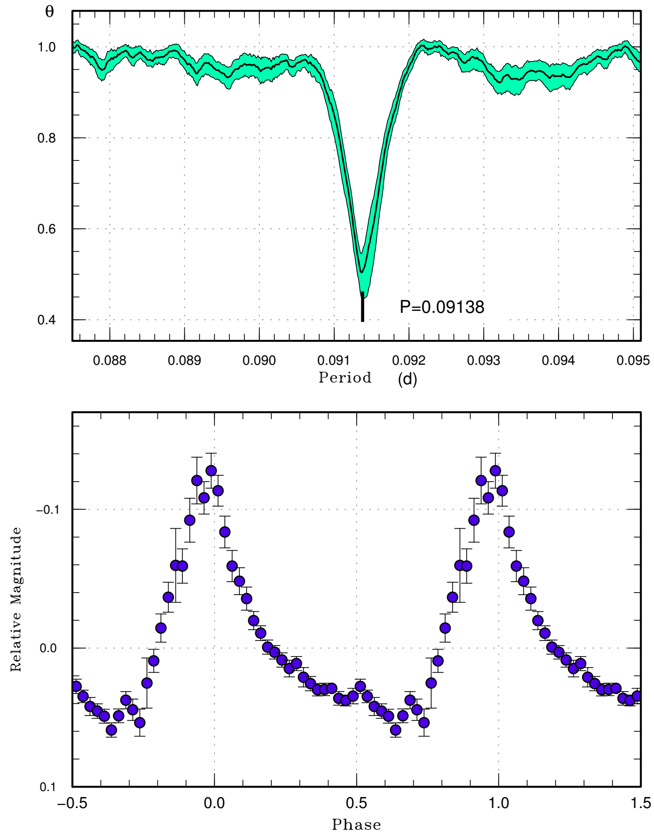
*BJD−2400000.

†Against max $= 2457998.4395 + 0.071028E$.

‡Number of points used to determine the maximum.



E-figure 19. Superhumps in ASASSN-13ce (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 20. Superhumps in ASASSN-13dh (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

was retrospectively detected on MASTER-Amur images on 2013 September 30 (13.1–13.3 unfiltered CCD magnitudes, vsnet-alert 16504). This outburst appears to be a normal outburst.

The 2017 outburst was detected at an unfiltered CCD magnitude of 13.62 by E. Muyllaert on 2017 September 8 (cvnet-outburst 7688). The outburst was immediately confirmed (vsnet-alert 21417) and time-resolved photometry detected superhumps (vsnet-alert 21419, 21432; figure 20). There was a post-superoutburst rebrightening at V=15.87 on 2017 September 25 (ASAS-SN data).

The times of superhump maxima are listed in e-table 23. Although initial two maxima may have been stage B superhumps, we could not determine the period. We consider that the later maxima correspond to stage C superhumps since they were recorded before termination of the superoutburst.

This object have undergone superoutbursts relatively regularly (e-table 24). These superoutburst can be expressed by a supercycle of 450(8) d.

E-table 23. Superhump maxima of ASASSN-13dh (2017)

E	max*	error	$O-C$†	N‡
0	58005.4910	0.0004	−0.0020	85
1	58005.5821	0.0004	−0.0022	94
38	58008.9676	0.0003	0.0013	91
49	58009.9730	0.0004	0.0013	95
59	58010.8929	0.0034	0.0072	39
60	58010.9771	0.0004	−0.0001	88
75	58012.3493	0.0006	0.0011	81
76	58012.4403	0.0009	0.0007	92
92	58013.8953	0.0073	−0.0068	38
93	58013.9920	0.0006	−0.0015	82
100	58014.6342	0.0019	0.0009	62

*BJD−2400000.
†Against max = 2458005.4929 + 0.091404E.
‡Number of points used to determine the maximum.

E-table 24. List of superoutbursts (including possible) of ASASSN-13df in the ASAS-SN data

Year	Month	Day	max*	V mag
2012	10	3	56204	13.4†
2013	12	17	56644	13.3
2015	2	11	57065	14.1
2017	9	8	58005	13.3

*JD−2400000.
†Single detection.

E-section 3.30 ASASSN-14ca

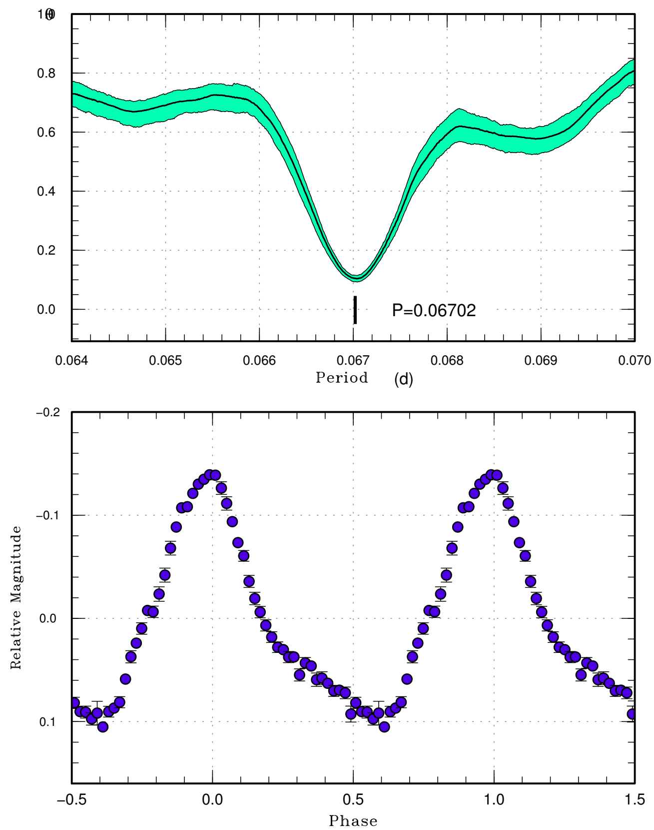
This object was detected as a transient at V=15.5 on 2014 June 7 by the ASAS-SN team (Davis et al. 2014). The object was confirmed to be an SU UMa-type dwarf nova during the 2015 superoutburst, but the details were unknown (Kato et al. 2016b). Refer to Kato et al. (2016b) for more history.

The 2017 superoutburst was detected by the ASAS-SN team at V=14.87 on 2017 October 17 and was announced after observation at V=14.86 on 2017 October 18. Subsequent observations detected superhumps (vsnet-alert 21529, 21538; e-figure 21). The times of superhump maxima are listed in e-table 25.

The object was recorded in superoutburst three times in the ASAS-SN data (e-table 26). Two of them showed a separate precursor outburst. The supercycle is estimated to be 391(20) d.

E-section 3.31 ASASSN-14cr

This object was detected as a transient at V=15.20 on 2014 June 19 by the ASAS-SN team. Although there



E-figure 21. Superhumps in ASASSN-14ca (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 25. Superhump maxima of ASASSN-14ca (2017)

E	max*	error	$O-C$†	N‡
0	58046.3695	0.0003	−0.0009	74
1	58046.4376	0.0004	0.0001	72
13	58047.2422	0.0002	0.0002	173
14	58047.3094	0.0002	0.0004	171
15	58047.3762	0.0002	0.0001	150
16	58047.4435	0.0003	0.0004	124
44	58049.3191	0.0006	−0.0009	48
45	58049.3876	0.0005	0.0005	66

*BJD−2400000.
†Against max = 2458046.3705 + 0.067036E.
‡Number of points used to determine the maximum.

E-table 26. List of superoutbursts of ASASSN-14ca in the ASAS-SN data

Year	Month	Day	max*	V mag
2014	8	12	56882	15.4†
2015	7	11	57215	15.4†
2017	10	16	58043	14.9

*JD−2400000.
†Precursor and superoutburst.

E-table 27. Superhump maxima of ASASSN-14cr (2017)

E	max*	error	$O-C$†	N‡
0	57964.3638	0.0010	−0.0003	34
1	57964.4313	0.0013	−0.0015	37
2	57964.5014	0.0035	−0.0001	36
3	57964.5707	0.0007	0.0006	10
14	57965.3267	0.0055	0.0009	23
15	57965.3957	0.0017	0.0012	36
16	57965.4647	0.0038	0.0015	37
32	57966.5577	0.0013	−0.0047	26
44	57967.3920	0.0015	0.0052	37
45	57967.4525	0.0010	−0.0030	37

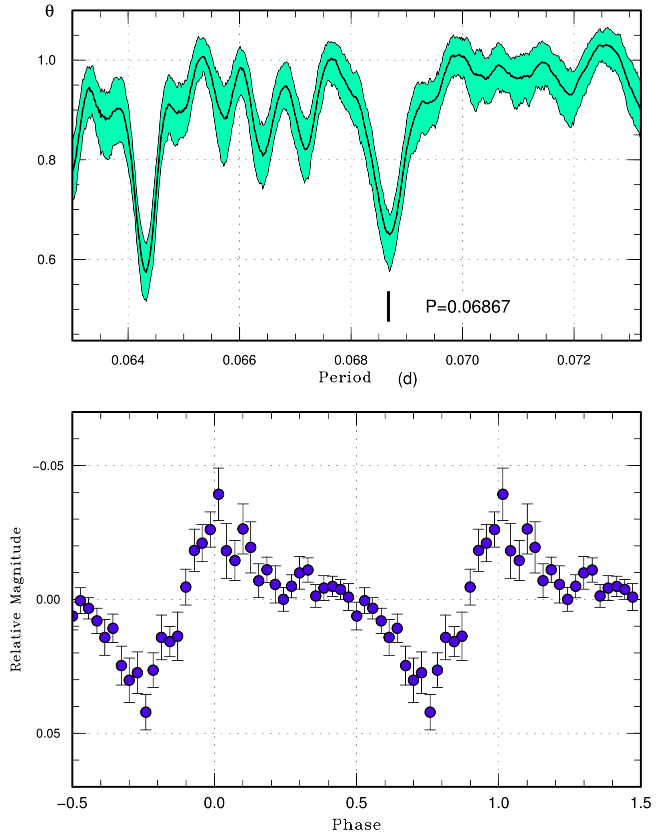
*BJD−2400000.
†Against max = 2457964.3640 + 0.068698E.
‡Number of points used to determine the maximum.

were time-resolved observations during long outbursts on 2016 August 5 (T. Vanmunster), observations were too short to detect superhumps (there were also observations on 2015 August 22 by T. Vanmunster during a normal outburst). The 2017 outburst was detected by the ASAS-SN team at V=15.08 on 2017 July 26 (ASAS-SN data indicated that the object was already in outburst 8 d before). Subsequent observations detected superhumps (vsnet-alert 21301). The times of superhump maxima are listed in e-table 27. Although a PDM analysis prefers a period around 0.0646 d (as in vsnet-alert 21301; e-figure 22), an alias of 0.0687 d gives much smaller $O-C$ values and we adopted it. The superhump stage is likely C since the observation covered the final part of the superoutburst.

The object showed relatively regular superoutbursts in the past (e-table 28). The detection 2014 December 13 looks likely a superoutburst as judged from the brightness. If this was indeed a superoutburst, the supercycle is 190(3) d.

E-section 3.32 ASASSN-14kb

This object was detected as a transient at V=15.4 on 2014 December 11 by the ASAS-SN team (Prieto et al.



E-figure 22. Superhumps in ASASSN-14cr (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 28. List of superoutbursts (including possible) of ASASSN-14cr in the ASAS-SN data

Year	Month	Day	max*	V mag
2014	6	18	56827	14.9
2014	12	13	57005	15.0†
2015	6	7	57181	14.9
2016	7	26	57596	14.9
2017	7	17	57952	15.1

*JD−2400000.
†Single detection.

2014). Wyrzykowski et al. (2014) reported from OGLE-IV Magellanic System monitoring program observations that this object (=OGLE-LMC529.30.114) is an eclipsing SU UMa-type dwarf nova with an orbital period of 0.0681057 d. Further details of the OGLE-IV observations were reported in Mróz et al. (2015), which provides all photometric observations.[10] Although the OGLE-IV observations recorded the outburst pattern characteristic to an SU UMa-type dwarf nova, no time-resolved photometry was made by the OGLE-IV team.

The 2017 superoutburst was detected by the ASAS-SN team at V=15.72 on 2017 April 14. Subsequent observations detected superhumps (vsnet-alert 20935; e-figure 23).

By using the OGLE-IV CVOM data (outside outbursts) and our 2017 observations, we refined the eclipse ephemeris using the MCMC analysis (Kato et al. 2013a) as follows:

$$\mathrm{Min(BJD)} = 2457865.24389(2) + 0.0681057201(10)E. \quad \text{(E2)}$$

The epoch corresponds to the center of all the observations.

The times of superhump maxima are listed in e-table 29. Since stages were unclear due to the limited observations (low sampling rate and low signal-to-noise ratio when the object faded), we provided a globally averaged period.

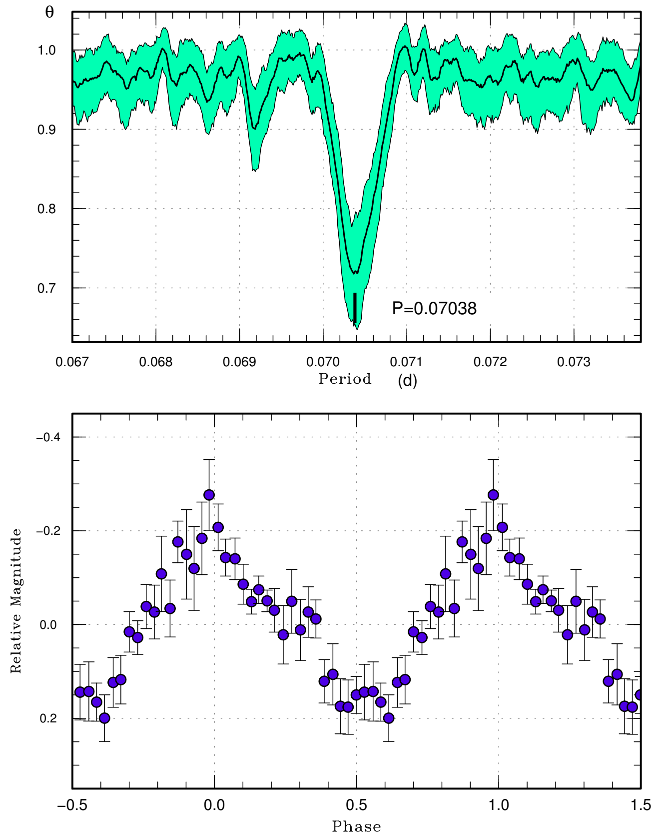
The object shows superoutburst relatively regularly (e-table 30). These superoutburst can be expressed by a mean supercycle of 150.4(9) d with maximum residuals of 42 d. There appear to have been variations of supercycles: 162(1) d for the interval JD 2455276–2456255 and 144.4(5) d for the interval JD 2456255–2457699. The supercycle lengthened again until now.

E-section 3.33 ASASSN-14lk

This object was detected as a transient at V=13.48 on 2014 December 1 by ASAS-SN team (vsnet-alert 18032). It may be identical to NSV 12802 = HV 9672 (see Kato et al. 2015). The 2014 observations detected superhumps (Kato et al. 2015).

The 2017 superoutburst was detected by the ASAS-SN team at V=14.16 on 2017 October 30 and was visually observed at 14.2 mag on 2017 November 3 by R. Stubbings (vsnet-alert 21566). Subsequent observations starting on 2017 November 9 detected superhumps (vsnet-alert 21575). The times of superhump maxima are

[10] CVOM: OGLE Monitoring system of cataclysmic variable stars: <http://ogle.astrouw.edu.pl/ogle4/cvom/cvom.html>, under OGLE-MC-DN-0016.



E-figure 23. Superhumps in ASASSN-14kb outside the eclipses (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 29. Superhump maxima of ASASSN-14kb (2017)

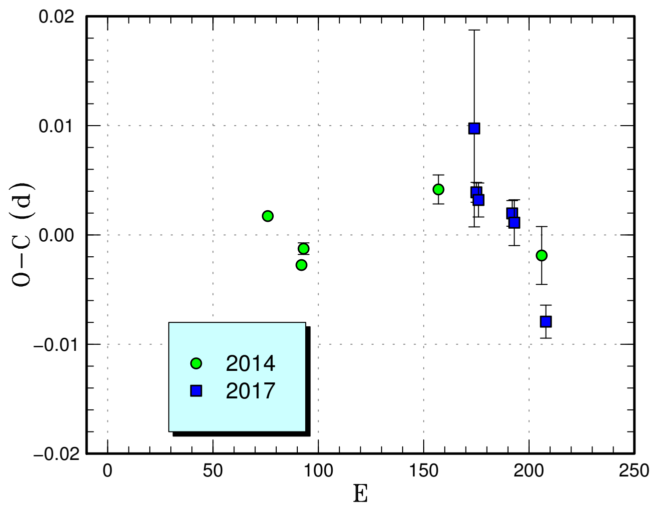
E	max*	error	$O-C$†	phase‡	N§
0	57860.5214	0.0005	−0.0003	0.66	20
1	57860.5915	0.0007	−0.0006	0.69	14
15	57861.5805	0.0021	0.0025	0.21	14
43	57863.5502	0.0017	0.0005	0.13	29
57	57864.5366	0.0008	0.0009	0.61	29
58	57864.6051	0.0009	−0.0010	0.62	14
71	57865.5174	0.0012	−0.0041	0.02	22
72	57865.5873	0.0012	−0.0046	0.04	13
85	57866.5112	0.0032	0.0038	0.61	24
86	57866.5806	0.0031	0.0028	0.63	15

*BJD−2400000.
†Against max = 2457860.5217 + 0.070420E.
‡Orbital phase.
§Number of points used to determine the maximum.

E-table 30. List of past outbursts of ASASSN-14kb

Year	Month	Day	max*	mag	Source
2010	3	22	55276	15.7I	OGLE-IV
2010	9	15	55455	15.3I	OGLE-IV
2011	2	14	55607	15.4I	OGLE-IV
2012	1	3	55930	15.3I	OGLE-IV
2012	11	23	56255	15.9I	OGLE-IV
2014	11	10	56972	15.2V	ASAS-SN
2015	4	13	57126	15.8V	ASAS-SN, OGLE-IV
2015	9	1	57267	15.1V	ASAS-SN, OGLE-IV
2016	1	18	57406	15.7I	OGLE-IV
2016	11	6	57699	15.5V	ASAS-SN, OGLE-IV
2017	4	14	57858	15.6V	ASAS-SN
2017	9	24	58021	15.5V	ASAS-SN

*JD−2400000.



E-figure 24. Comparison of $O-C$ diagrams of ASASSN-14lk between different superoutbursts. A period of 0.06143 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used.

E-table 31. Superhump maxima of ASASSN-14lk (2017)

E	max*	error	$O-C$†	N‡
0	58067.2468	0.0090	0.0031	86
1	58067.3024	0.0009	−0.0024	142
2	58067.3631	0.0016	−0.0027	108
18	58068.3447	0.0012	0.0021	141
19	58068.4053	0.0021	0.0016	73
34	58069.3177	0.0015	−0.0018	94

*BJD−2400000.
†Against max = 2458067.2437 + 0.061054E.
‡Number of points used to determine the maximum.

E-table 32. List of superoutbursts of ASASSN-14lk in the ASAS-SN data

Year	Month	Day	max*	V mag
2014	11	30	56992	13.6
2016	5	14	57523	14.2
2017	10	30	58056	14.2

*JD−2400000.

listed in e-table 31. The short superhump period and low amplitudes (initially 0.11 mag and later decreased to 0.09 mag) suggest that these superhumps were stage C ones. The object started fading rapidly on 2017 November 11, supporting the stage C nature of the superhumps. The $O-C$ values also support this interpretation (e-figure 24).

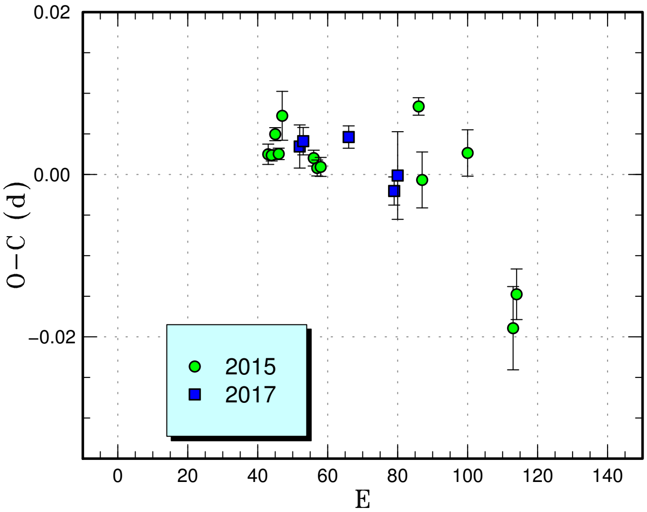
A list of past superoutbursts recorded in the ASAS-SN data are listed in e-table 32. The supercycle is around 540 d or its N-th.

E-section 3.34 ASASSN-15fu

This object was detected as a transient at V=15.6 on 2015 March 27 by the ASAS-SN team. Observations of superhumps during the 2015 superoutburst were reported in Kato et al. (2016b).

The 2017 superoutburst was detected by the ASAS-SN team at V=15.4 on 2017 May 29. The times of superhump maxima are listed in e-table 33. Since the resultant period was between those of stages B and C in 2015 (Kato et al. 2016b), the 2017 observations were likely performed near stage B-C transition. A comparison of $O-C$ diagrams is also consistent with this interpretation (e-figure 25).

There were three known superoutbursts: 2015 March 26 (JD 2457108), 2015 December 28 (JD 2457385) and the present one. The supercycle is around 260–270 d.



E-figure 25. Comparison of $O-C$ diagrams of ASASSN-15fu between different superoutbursts. A period of 0.07477 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used.

E-table 33. Superhump maxima of ASASSN-15fu (2017)

E	max*	error	$O-C$†	N‡
0	57906.4982	0.0027	−0.0010	19
1	57906.5736	0.0017	−0.0002	11
14	57907.5461	0.0014	0.0026	13
27	57908.5115	0.0017	−0.0017	23
28	57908.5882	0.0054	0.0004	8

*BJD−2400000.

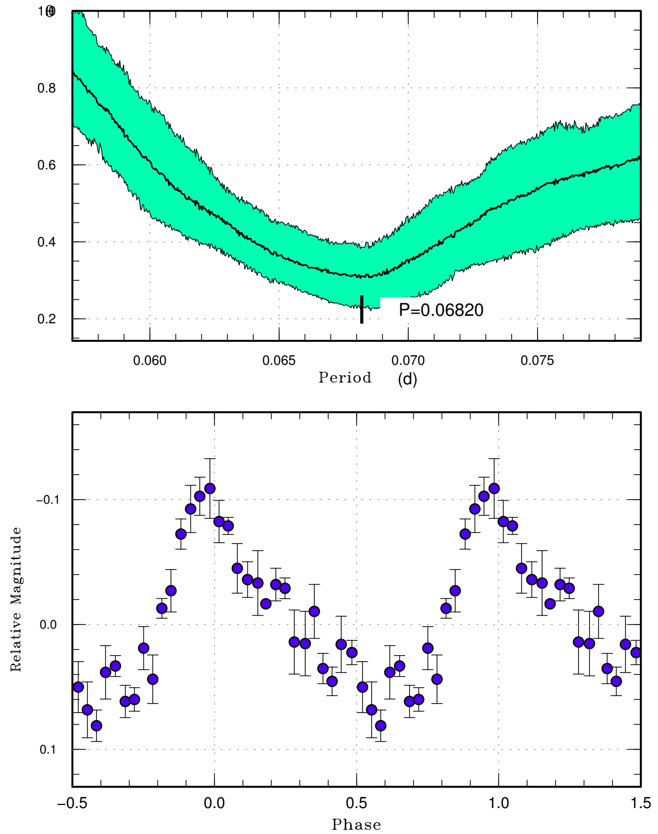
†Against max = 2457906.4992 + 0.074592E.

‡Number of points used to determine the maximum.

E-section 3.35 ASASSN-15fv

This object was detected as a transient at V=15.7 on 2015 March 27 by the ASAS-SN team. The 2017 outburst was detected by the ASAS-SN team at V=15.76 on 2017 May 19. Single-night observations detected superhumps (vsnet-alert 21073; e-figure 26). The times of superhump maxima were BJD 57898.4260(6) (N=50) and 2457898.4967(13) (N=49).

There was also a superoutburst in the ASAS-SN data on 2016 September 26. The interval between the 2016 and 2017 superoutbursts suggests a supercycle of 235 d.



E-figure 26. Ordinary superhumps in ASASSN-15fv (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-section 3.36 ASASSN-15qu

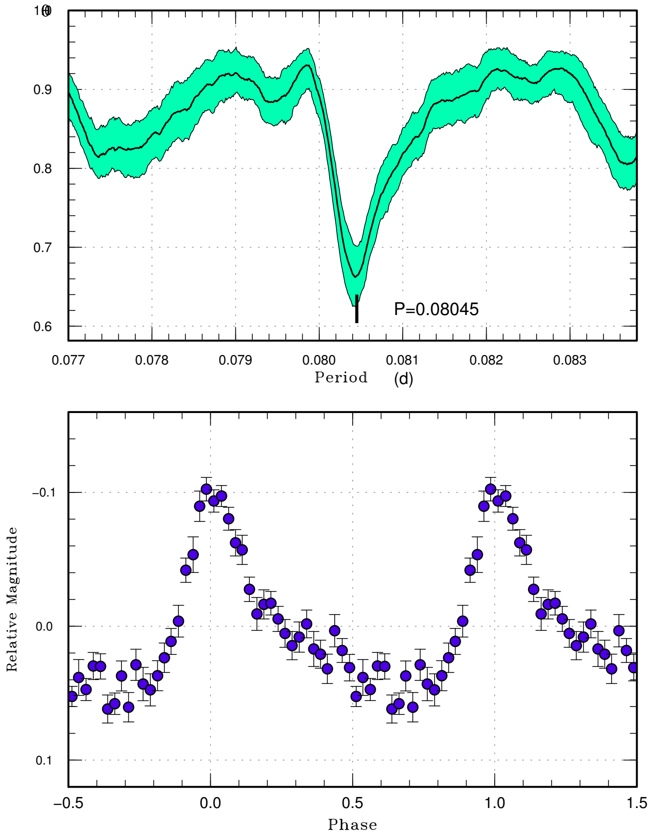
This object was detected as a transient at V=15.9 on 2015 October 8 by the ASAS-SN team. The 2017 outburst was detected by the ASAS-SN team at V=14.37 on 2017 August 30. Subsequent observations detected well-developed superhumps (vsnet-alert 21390, 21398; e-figure 27). The times of superhump maxima are listed in e-table 34. The period apparently increase between E=0 and E=28. We, however, did not adopt $P_{\rm dot}$ from this segment since the baseline was too short and instead gave a global $P_{\rm dot}$.

Although this field was monitored by the ASAS-SN team since 2014 May, no other outbursts were recorded. The 2015 outburst was much fainter and it must have been a normal outburst. ASAS-3 probably recorded a superoutburst in 2005 November (V=15.14 on 2005 November 3 and V=14.66 on 2015 November 6).

E-section 3.37 ASASSN-17ei

This object was detected as a transient at V=13.0 on 2017 April 1 by the ASAS-SN team (cf. vsnet-alert 20849). Subsequent observations detected low-amplitude modulations (vsnet-alert 20857), which were later identified to be early superhumps (vsnet-alert 20867; e-figure 28). The object started to show ordinary superhumps on 2017 April 9–10 (vsnet-alert 20894, 20900; e-figure 29).

The times of superhump maxima are listed in e-table



E-figure 27. Ordinary superhumps in ASASSN-15qu (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 34. Superhump maxima of ASASSN-15qu (2017)

E	max*	error	$O-C$†	N‡
0	57998.4052	0.0005	−0.0025	185
1	57998.4880	0.0006	−0.0001	184
2	57998.5677	0.0005	−0.0009	185
15	57999.6124	0.0016	−0.0021	19
16	57999.6925	0.0016	−0.0024	19
26	58000.5036	0.0019	0.0043	163
27	58000.5817	0.0023	0.0019	188
28	58000.6636	0.0024	0.0033	51
40	58001.6261	0.0021	0.0004	23
65	58003.6410	0.0023	0.0041	24
77	58004.6038	0.0016	0.0015	19
78	58004.6752	0.0023	−0.0075	20

*BJD−2400000.

†Against max $= 2457998.4077 + 0.080449E$.

‡Number of points used to determine the maximum.

35. The data between E=53 and E=90 were not very good and the times of superhump maxima had relatively large uncertainties. It is, however, apparent that the superhump stage was already B at E=34–36, when the amplitudes of the superhumps may have not yet reached the maximum. An $O-C$ analysis has shown that times of low-amplitude maxima on April 9 were on the smooth extension of the supposed stage A before E=34 and we consider they were already stage A superhump rather than early superhumps (cf. e-figure 30). This identification appears to be supported by the duration of the phase of stage A superhumps (2 d), which is a normal value for a WZ Sge-type dwarf nova.

The period of early superhumps with the PDM method was 0.056460(9) d. The value for ϵ^* of stage A superhumps was 0.0275(9), which corresponds to q=0.074(3). This small q is consistent with the small $P_{\rm dot}$ for stage B superhumps (cf. Kato 2015).

The entire light curve (e-figure 30) indicates that there was a plateau-type rebrightening. Note that original ASAS-SN measurements gave brighter values than our CCD measurements when the object was faint. This was due to the contamination since the aperture size is large in ASAS-SN measurements. We corrected this difference by subtracting a constant contribution of V=16.64 from neighboring stars (this value was determined to make the best match to our CCD measurements). There was some indication that the object faded slightly after the initial rise to the rebrightening phase, particularly at around BJD 2457873.5. This may be evidence of damping oscillation as seen in some WZ Sge-type dwarf novae (ASASSN-15po: Namekata et al. 2017, ASASSN-17el: in this paper).

The ASAS-SN started to observe this field on 2014 April 29 and no past outburst was detected. ASAS-3 recorded no outburst between 2001 and 2009.

E-section 3.38 ASASSN-17el

This object was detected as a transient at V=13.7 on 2017 April 1 by the ASAS-SN team (cf. vsnet-alert 20849). The object further brightened to an unfiltered CCD magnitude of 11.1 on April 2. The object immediately showed likely early superhumps (vsnet-alert 20866; e-figure 31). These modulations were confirmed to be early superhumps by the detection of ordinary superhumps (vsnet-alert 20901, 20936; e-figure 32). The object was thereby confirmed to be a WZ Sge-type dwarf nova. The times of superhump maxima are listed in e-table 36, which also includes post-superoutburst superhumps. There was typical stage B with a positive $P_{\rm dot}$ between E=48 and E=213 (e-figure 33). It looks like that the epoch E=36 was obtained during

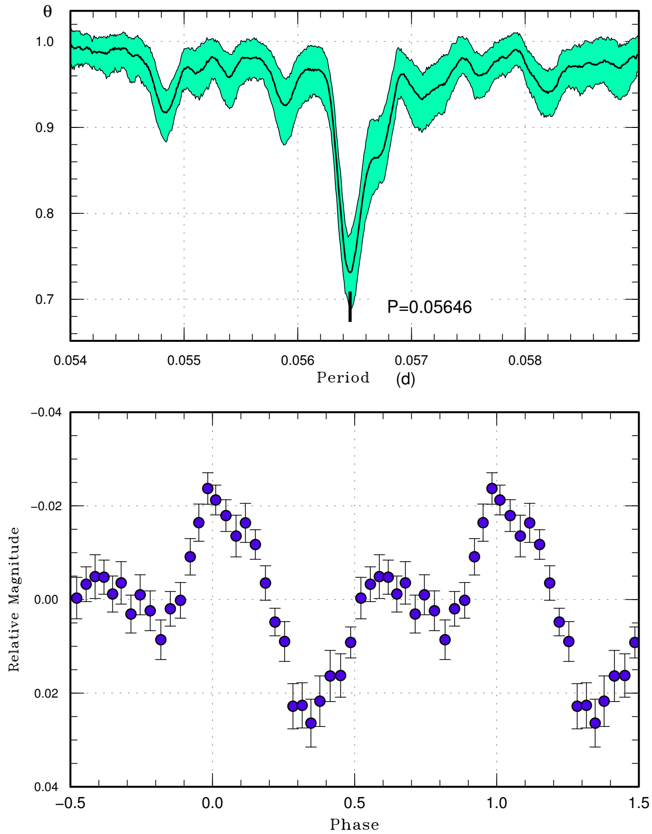
E-table 35. Superhump maxima of ASASSN-17ei (2017)

E	max*	error	$O-C$†	N‡	E	max*	error	$O-C$†	N‡
0	57852.7066	0.0097	−0.0153	20	140	57860.7367	0.0013	−0.0045	11
1	57852.7652	0.0028	−0.0139	22	141	57860.7949	0.0014	−0.0036	21
2	57852.8263	0.0020	−0.0101	22	142	57860.8527	0.0014	−0.0031	24
18	57853.7520	0.0008	−0.0009	22	151	57861.3669	0.0010	−0.0043	128
34	57854.6820	0.0012	0.0126	18	152	57861.4237	0.0007	−0.0048	132
35	57854.7392	0.0010	0.0125	22	157	57861.7123	0.0043	−0.0027	11
36	57854.7962	0.0009	0.0122	29	158	57861.7678	0.0016	−0.0044	14
47	57855.4222	0.0006	0.0082	131	159	57861.8253	0.0013	−0.0042	23
48	57855.4804	0.0005	0.0090	132	160	57861.8845	0.0026	−0.0023	14
49	57855.5348	0.0006	0.0062	132	168	57862.3452	0.0010	0.0001	111
50	57855.5936	0.0007	0.0077	133	169	57862.4016	0.0009	−0.0007	129
51	57855.6532	0.0009	0.0101	113	170	57862.4581	0.0010	−0.0015	132
53	57855.7604	0.0018	0.0027	21	171	57862.5161	0.0012	−0.0008	132
54	57855.8140	0.0025	−0.0010	36	186	57863.3728	0.0009	−0.0033	130
72	57856.8387	0.0032	−0.0073	36	187	57863.4334	0.0008	0.0000	132
82	57857.4214	0.0034	0.0026	48	188	57863.4881	0.0009	−0.0026	116
89	57857.8257	0.0029	0.0059	36	191	57863.6579	0.0013	−0.0046	19
90	57857.8884	0.0030	0.0113	22	192	57863.7226	0.0018	0.0028	10
104	57858.6792	0.0015	0.0001	17	193	57863.7724	0.0020	−0.0047	14
105	57858.7379	0.0014	0.0016	11	194	57863.8331	0.0028	−0.0012	17
106	57858.7922	0.0013	−0.0014	15	203	57864.3520	0.0021	0.0021	86
107	57858.8509	0.0011	0.0000	18	204	57864.4056	0.0011	−0.0016	132
116	57859.3597	0.0040	−0.0067	64	205	57864.4624	0.0010	−0.0020	132
117	57859.4228	0.0005	−0.0009	132	209	57864.6926	0.0041	−0.0010	9
118	57859.4798	0.0007	−0.0012	131	211	57864.8076	0.0019	−0.0005	15
119	57859.5364	0.0008	−0.0019	132	212	57864.8628	0.0023	−0.0026	16
120	57859.5945	0.0011	−0.0010	112	221	57865.3853	0.0019	0.0044	131
121	57859.6591	0.0009	0.0063	49	222	57865.4390	0.0013	0.0008	132
122	57859.7005	0.0029	−0.0096	11	223	57865.4932	0.0015	−0.0023	132
123	57859.7650	0.0009	−0.0024	11	224	57865.5577	0.0022	0.0050	129
124	57859.8239	0.0010	−0.0007	17	225	57865.6120	0.0057	0.0020	82
125	57859.8811	0.0019	−0.0009	12	228	57865.7878	0.0031	0.0059	15
134	57860.3945	0.0006	−0.0030	132	244	57866.7173	0.0032	0.0189	15
135	57860.4505	0.0006	−0.0043	132	245	57866.7579	0.0025	0.0022	17
136	57860.5094	0.0008	−0.0027	132	246	57866.8194	0.0027	0.0065	21
137	57860.5645	0.0007	−0.0048	131	247	57866.8663	0.0046	−0.0040	23
139	57860.6812	0.0019	−0.0027	14	–	–	–	–	–

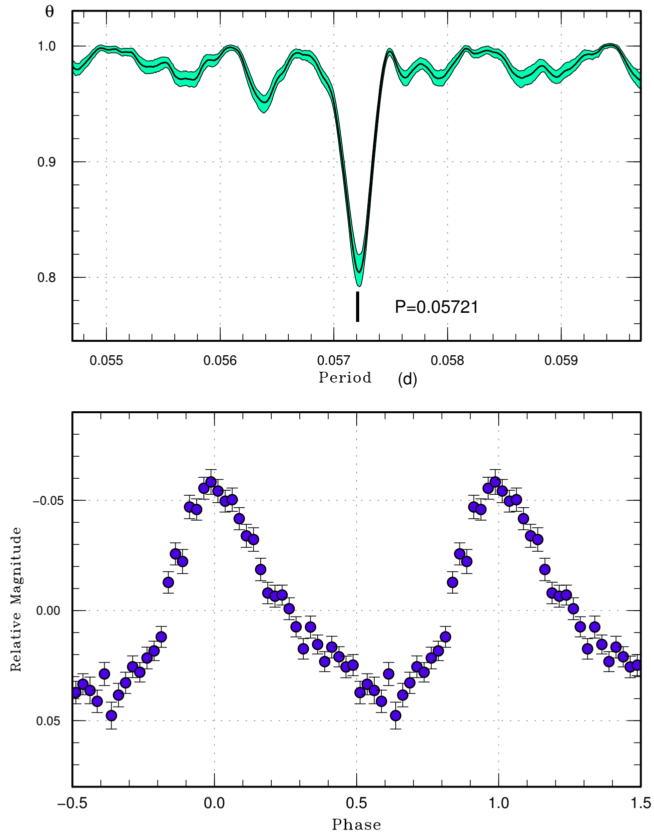
*BJD−2400000.

†Against max = 2457852.7218 + 0.057281E.

‡Number of points used to determine the maximum.



E-figure 28. Early superhumps in ASASSN-17ei (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 29. Ordinary superhumps in ASASSN-17ei (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

the final phase of stage A. Considering the typical duration of stage A of WZ Sge-type dwarf novae, we identified a hump maximum on BJD 2457852 as appearance of stage A superhumps. As the superoutburst plateau terminated, there was a apparent phase jump after E=213. We listed a period derived from E=230–271 as stage C superhumps. There were also superhumps during the rebrightening phase (vsnet-alert 20961, 20966, 20974) and the mean period was 0.05509(3) d (E=357–466).

The period of early superhumps was determined to be 0.05434(3) d by the PDM method. The period of stage A superhumps gave ϵ^*=0.0265(10), which corresponds to q=0.071(3).

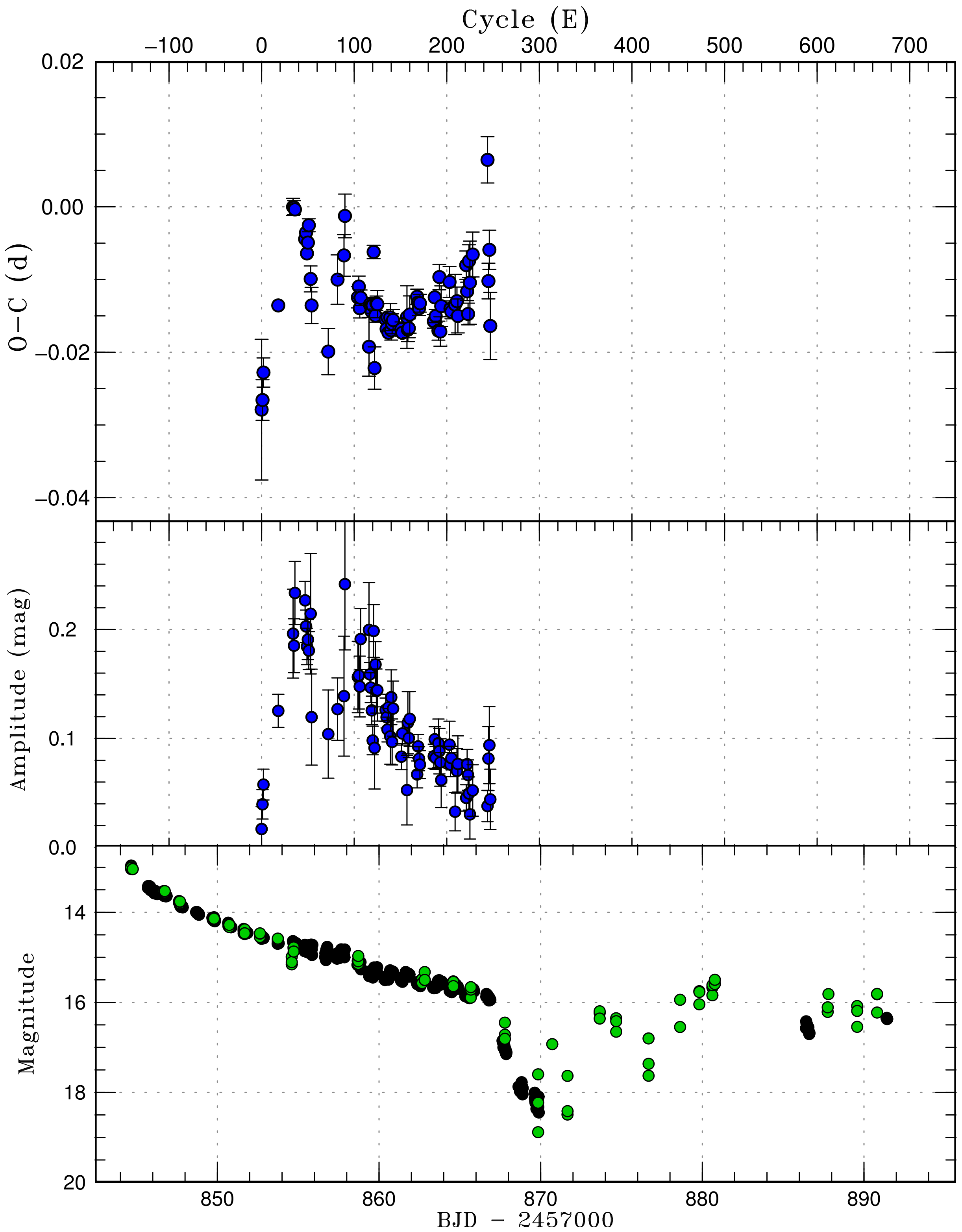
The light curve was composed of the main superoutburst, the main dip (BJD 2457865–2457867), a short rebrightening (BJD 2457868–2457869), a smaller dip (BJD 2457870.5) and a plateau-type rebrightening (BJD 2457871–2457878) (e-figure 33). This type of phenomenon (damping oscillation when entering the plateau-type rebrightening) was seen in the WZ Sge-type dwarf nova ASASSN-15po (Namekata et al. 2017).

The object was recorded in outburst in 2006 by ASAS-3 (D. Denisenko, vsnet-alert 20853). It was also a superoutburst and reached at least V=11.6 (the peak may have been missed). This outburst was not accompanied by a rebrightening as far as the ASAS-3 data could tell. There were no other outbursts in the 9-year coverage in the ASAS-3 data and ASAS-SN observations since 2014 April. The outburst cycle length of 11 yr is typical for a WZ Sge-type dwarf nova (Kato 2015).

E-section 3.39 ASASSN-17eq

This object was detected as a transient at V=13.7 on 2017 April 11 by the ASAS-SN team. Subsequent observations detected superhumps (vsnet-alert 20917, 20920; e-figure 34). The times of superhump maxima are listed in e-table 37. Well-developed superhumps suggest that they were most likely stage B ones.

There was a normal outburst in the ASAS-SN data at V=14.3 on 2016 January 20, which faded to V=15.2 on the next night. There was no indication of a past superoutburst in the ASAS-SN data.



E-figure 30. $O-C$ diagram of superhumps in ASASSN-17ei (2017). (Upper:) $O-C$ diagram. We used a period of 0.05728 d for calculating the $O-C$ residuals. (Middle:) Amplitudes of superhumps. (Lower:) Light curve. The black filled circles are our CCD data binned to 0.019 d. The green filled circles are ASAS-SN V measurements. A constant flux corresponding to V=16.64 has been subtracted to best match time-series CCD observations.

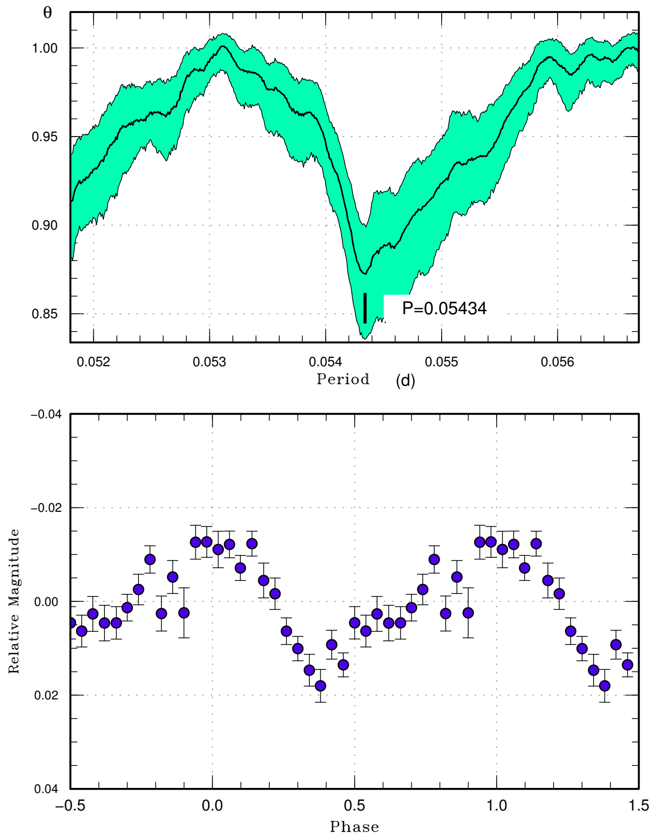
E-table 36. Superhump maxima of ASASSN-17el (2017)

E	max*	error	$O-C$†	N‡
0	57852.5344	0.0021	−0.0231	29
36	57854.5439	0.0006	0.0017	18
48	57855.2077	0.0008	0.0039	67
49	57855.2626	0.0001	0.0037	127
50	57855.3166	0.0002	0.0025	126
54	57855.5362	0.0005	0.0016	17
72	57856.5280	0.0004	0.0010	15
85	57857.2438	0.0022	0.0002	39
86	57857.2975	0.0002	−0.0013	127
87	57857.3514	0.0005	−0.0026	114
90	57857.5184	0.0005	−0.0010	17
108	57858.5097	0.0011	−0.0020	14
109	57858.5631	0.0022	−0.0038	12
121	57859.2262	0.0003	−0.0022	78
122	57859.2814	0.0003	−0.0022	126
123	57859.3366	0.0004	−0.0021	98
126	57859.5049	0.0023	0.0008	12
127	57859.5595	0.0029	0.0003	12
139	57860.2189	0.0004	−0.0019	75
140	57860.2754	0.0002	−0.0005	127
141	57860.3304	0.0005	−0.0007	78
145	57860.5505	0.0011	−0.0011	17
157	57861.2155	0.0004	0.0023	97
158	57861.2691	0.0003	0.0008	127
159	57861.3243	0.0004	0.0009	101
163	57861.5457	0.0012	0.0017	18
175	57862.2099	0.0005	0.0043	96
176	57862.2658	0.0003	0.0052	126
177	57862.3212	0.0014	0.0054	53
193	57863.2025	0.0027	0.0046	61
194	57863.2633	0.0005	0.0103	127
195	57863.3168	0.0007	0.0087	114
212	57864.2588	0.0006	0.0134	127
213	57864.3132	0.0006	0.0127	89
230	57865.2369	0.0014	−0.0009	127
231	57865.2887	0.0015	−0.0042	117
235	57865.5188	0.0034	0.0054	26
248	57866.2222	0.0009	−0.0080	115
266	57867.2012	0.0056	−0.0213	61
267	57867.2707	0.0009	−0.0070	127
271	57867.4982	0.0038	0.0001	15
357	57872.2431	0.0007	0.0036	126
358	57872.2946	0.0017	−0.0001	79
375	57873.2298	0.0005	−0.0021	127
376	57873.2848	0.0007	−0.0022	108
430	57876.2653	0.0006	0.0012	124
466	57878.2427	0.0065	−0.0061	127

*BJD−2400000.

†Against max = 2457852.5575 + 0.055132E.

‡Number of points used to determine the maximum.



E-figure 31. Early superhumps in ASASSN-17el (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

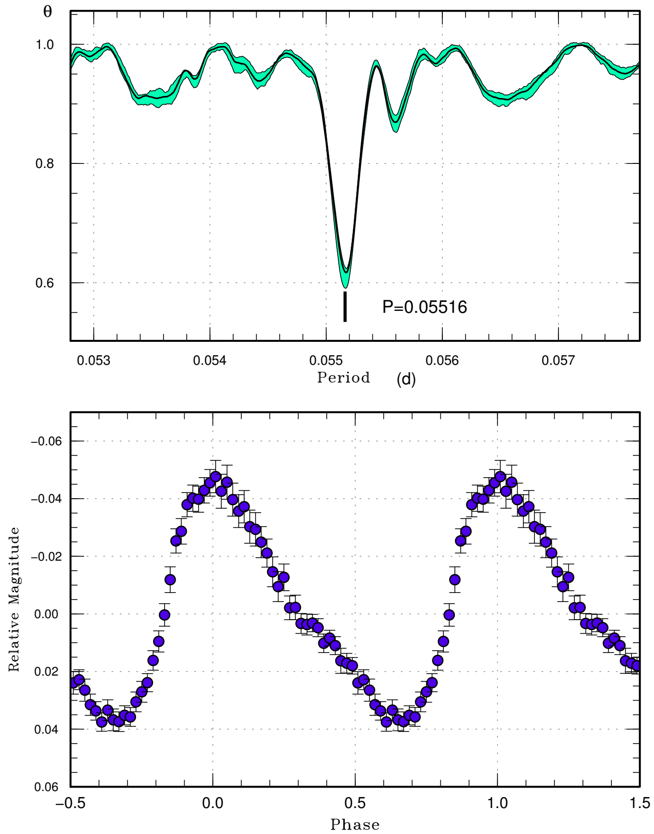
E-table 37. Superhump maxima of ASASSN-17eq (2017)

E	max*	error	$O-C$†	N‡
0	57857.5031	0.0002	0.0013	111
10	57858.2251	0.0012	0.0013	52
11	57858.2930	0.0029	−0.0030	37
12	57858.3679	0.0005	−0.0002	29
25	57859.3053	0.0024	−0.0015	26
26	57859.3783	0.0002	−0.0006	95
27	57859.4512	0.0003	0.0001	112
28	57859.5259	0.0007	0.0026	44

*BJD−2400000.

†Against max = 2457857.5018 + 0.072197E.

‡Number of points used to determine the maximum.



E-figure 32. Ordinary superhumps in ASASSN-17el (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 38. Superhump maxima of ASASSN-17es (2017)

E	max*	error	$O-C$†	N‡
0	57864.7608	0.0027	−0.0213	12
16	57865.7118	0.0027	0.0021	9
17	57865.7675	0.0035	−0.0001	13
18	57865.8257	0.0017	0.0002	16
33	57866.7008	0.0023	0.0058	15
34	57866.7592	0.0021	0.0062	18
35	57866.8137	0.0020	0.0028	21
36	57866.8730	0.0021	0.0041	17
46	57867.4518	0.0010	0.0032	19
50	57867.6838	0.0022	0.0034	14
51	57867.7464	0.0033	0.0080	16
52	57867.7944	0.0017	−0.0020	21
53	57867.8555	0.0014	0.0012	24
69	57868.7815	0.0032	−0.0003	15
70	57868.8390	0.0023	−0.0008	16
85	57869.7111	0.0025	0.0019	12
86	57869.7671	0.0036	−0.0001	13
87	57869.8212	0.0025	−0.0039	15
88	57869.8853	0.0181	0.0022	5
102	57870.6927	0.0029	−0.0019	10
103	57870.7468	0.0026	−0.0057	10
104	57870.8058	0.0054	−0.0047	14
105	57870.8683	0.0038	−0.0003	10

*BJD−2400000.
†Against max = 2457864.7822 + 0.057965E.
‡Number of points used to determine the maximum.

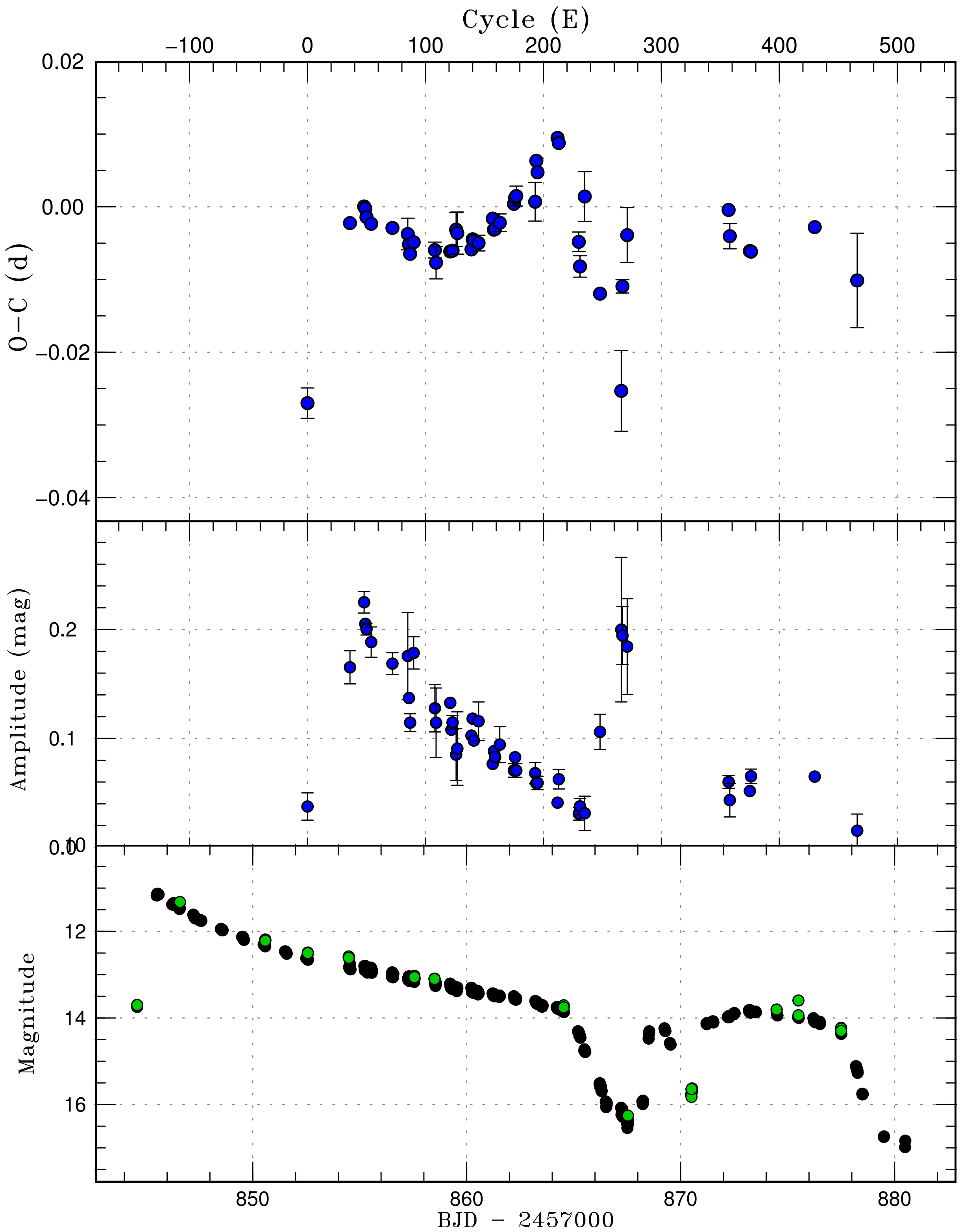
E-section 3.40 ASASSN-17es

This object was detected as a transient at V=14.8 on 2017 April 11 by the ASAS-SN team. Subsequent observations detected early superhumps (vsnet-alert 20929, 20945; e-figure 35), qualifying this object to be a WZ Sge-type dwarf nova. The object then showed ordinary superhumps (vsnet-alert 20972; e-figure 36). The times of superhump maxima are listed in e-table 38. There was a rather smooth transition from stage A to B between E=0 and E=33. Assuming that the interval between E=0 and E=18 reflected stage A, we determined the period to be 0.05924(16) d. Using the best period of early superhumps [0.05719(3) d, PDM method], ϵ^* for stage A superhump is 0.037(4), which corresponds to q=0.095(9).

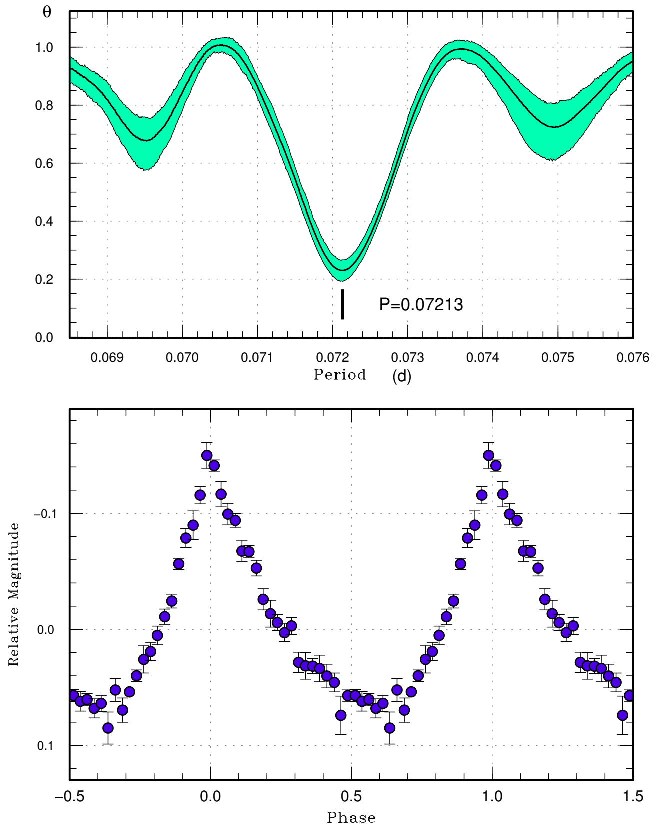
According to the ASAS-SN data, there was no past outburst and the 2017 outburst was detected up to May 20 (39 d after the initial rise) at V=15.7. Since the object was close to the detection limit in late May to June, the actual termination of the superoutburst was somewhat uncertain. Although the long duration of the outbursting stage suggested the combination of the superoutburst and a plateau-type rebrightening, there was no strong suggestion of a dip in the ASAS-SN data. Time-resolved photometry terminated on April 30 and these observations did not constrain the duration of the superoutburst.

E-section 3.41 ASASSN-17et

This object was detected as a transient at V=14.9 on 2017 April 10 by the ASAS-SN team. The outburst was announced after observation of V=15.1 on 2017 April 13. There is an X-ray counterpart 2XMM J175924.9−231503. Superhumps were immediately detected (vsnet-alert 20919; e-figure 37). Their period qualified this object to be an SU UMa-type dwarf nova in the period gap. The times of superhump maxima are listed in table 39. Since we observed the final part of the superoutburst, we tentatively classified the observed superhumps to be stage C ones. Since period variations of superhumps in long-period systems may not be similar to those in short-period systems (cf. Kato et al. 2012a; Kato et al. 2014a; Kato et al. 2016c), interpretation of super-



E-figure 33. $O-C$ diagram of superhumps in ASASSN-17el (2017). (Upper:) $O-C$ diagram. We used a period of 0.055132 d for calculating the $O-C$ residuals. (Middle:) Amplitudes of superhumps. (Lower:) Light curve. The black filled circles are our CCD data binned to 0.018 d. The green filled circles are ASAS-SN V measurements. There were also our CCD observations at the same locations of a dip in ASAS-SN measurements at BJD 2457870.5.



E-figure 34. Superhumps in ASASSN-17eq (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

humps in such a system may not be straightforward.

There was no past outburst detection in the ASAS-SN data starting on 2015 February 24.

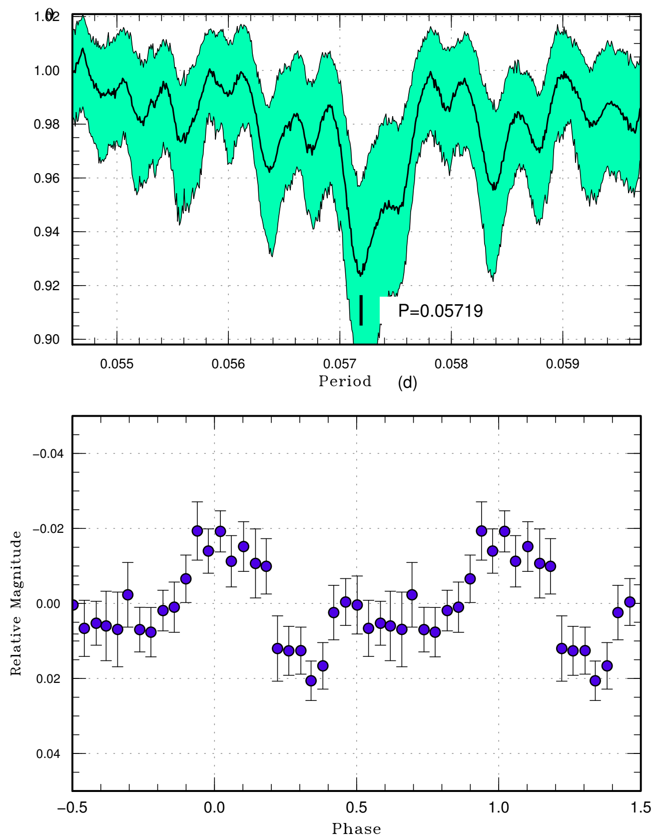
E-section 3.42 ASASSN-17ew

This object was detected as a transient at V=14.9 on 2017 April 13 by the ASAS-SN team. Superhumps were immediately detected (vsnet-alert 20925; e-figure 38). The times of superhump maxima are listed in table 40. Since we observed the final part of the superoutburst, we tentatively classified the observed superhumps to be stage C ones.

There were two past outbursts (most likely normal ones) in the ASAS-SN data starting on 2016 February 19: 2016 June 30 (V=15.5) and 2017 January 7 (V=15.2).

E-section 3.43 ASASSN-17ex

This object was detected as a transient at V=15.8 on 2017 April 10 by the ASAS-SN team. The outburst was announced after the observation at V=15.6 on 2017 April 13. Subsequent observations detected superhumps (vsnet-

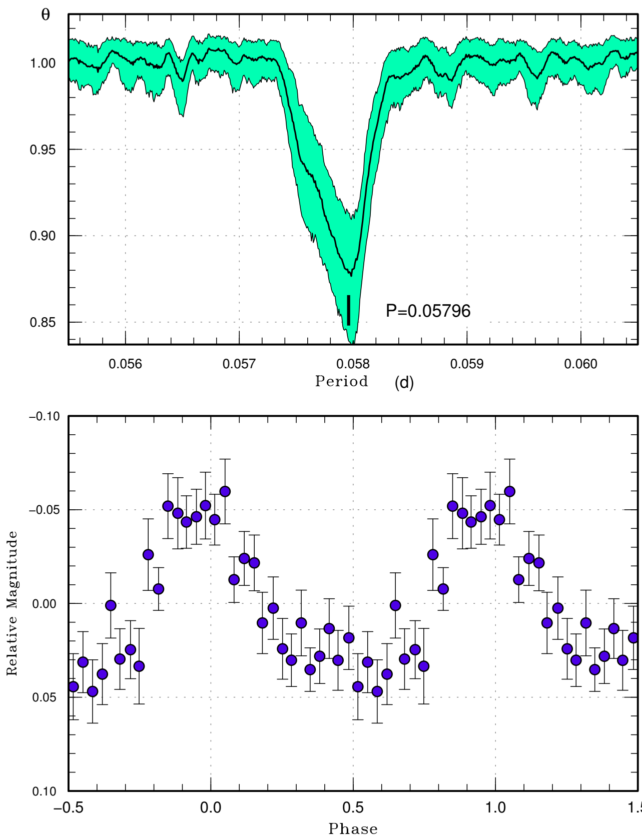


E-figure 35. Early superhumps in ASASSN-17es (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

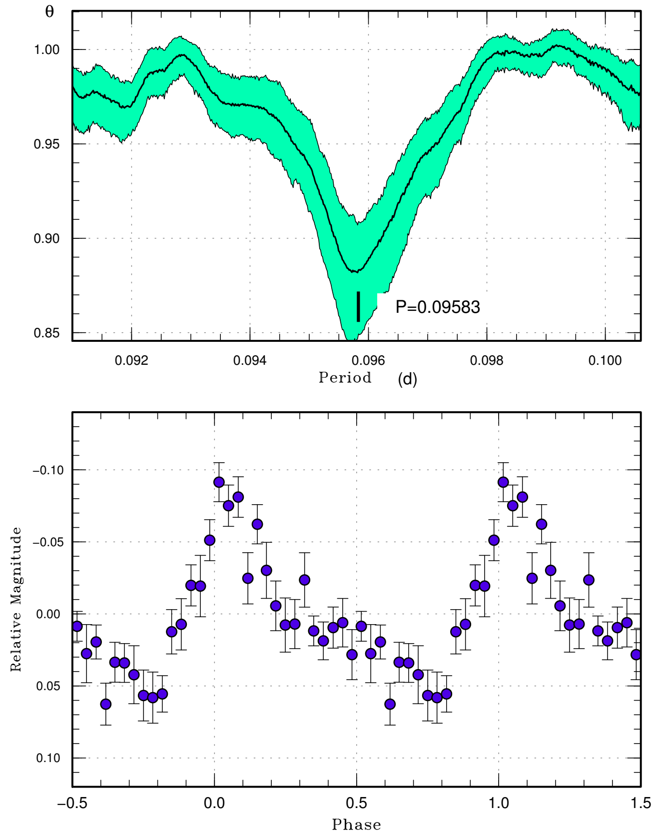
E-table 39. Superhump maxima of ASASSN-17et (2017)

E	max*	error	$O-C$†	N‡
0	57858.7842	0.0015	−0.0001	23
1	57858.8814	0.0027	0.0015	15
40	57862.6077	0.0015	−0.0021	221
50	57863.5650	0.0019	−0.0011	220
51	57863.6580	0.0029	−0.0037	171
52	57863.7583	0.0020	0.0009	21
53	57863.8503	0.0032	−0.0027	28
60	57864.5318	0.0029	0.0094	203
61	57864.6216	0.0042	0.0035	115
62	57864.7144	0.0032	0.0007	14
63	57864.8031	0.0037	−0.0063	25

*BJD−2400000.
†Against max = 2457858.7843 + 0.095636E.
‡Number of points used to determine the maximum.



E-figure 36. Ordinary superhumps in ASASSN-17es (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 37. Superhumps in ASASSN-17et (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 40. Superhump maxima of ASASSN-17ew (2017)

E	max*	error	$O-C$†	N‡
0	57858.7842	0.0015	−0.0001	23
1	57858.8814	0.0027	0.0015	15
40	57862.6077	0.0015	−0.0021	221
50	57863.5650	0.0019	−0.0011	220
51	57863.6580	0.0029	−0.0037	171
52	57863.7583	0.0020	0.0009	21
53	57863.8503	0.0032	−0.0027	28
60	57864.5318	0.0029	0.0094	203
61	57864.6216	0.0042	0.0035	115
62	57864.7144	0.0032	0.0007	14
63	57864.8031	0.0037	−0.0063	25

*BJD−2400000.

†Against max = 2457859.6395 + 0.078497E.

‡Number of points used to determine the maximum.

E-table 41. Superhump maxima of ASASSN-17ex (2017)

E	max*	error	$O-C$†	N‡
0	57859.6447	0.0020	−0.0003	20
1	57859.7121	0.0016	−0.0012	12
15	57860.6704	0.0014	0.0008	17
16	57860.7399	0.0026	0.0020	13
29	57861.6252	0.0036	−0.0007	14
30	57861.6985	0.0041	0.0043	15
31	57861.7576	0.0035	−0.0049	11

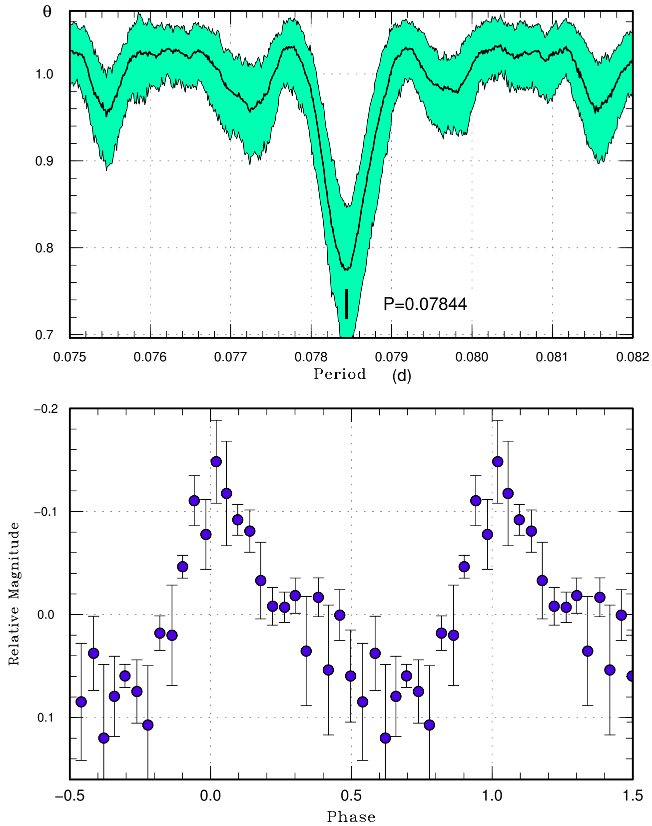
*BJD−2400000.

†Against max = 2457859.6450 + 0.068306E.

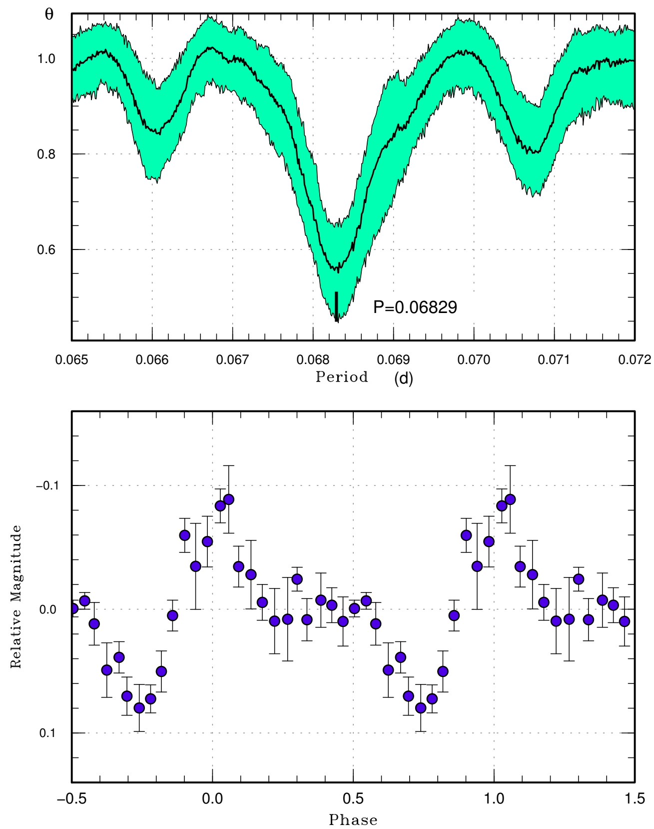
‡Number of points used to determine the maximum.

alert 20926, 20948; e-figure 39). The times of superhump maxima are listed in table 41. Since we observed the final part of the superoutburst, we tentatively classified the observed superhumps to be stage C ones.

There were no definite past outburst in the ASAS-SN data starting on 2015 September 18. There may have been a borderline detection at V=16.3 on 2017 January 28.



E-figure 38. Superhumps in ASASSN-17ew (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

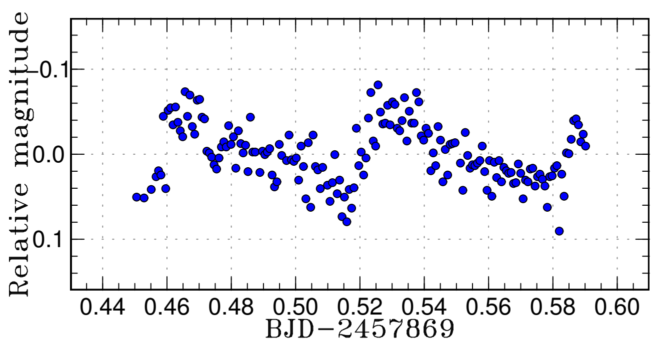


E-figure 39. Superhumps in ASASSN-17ex (2017). (Upper): PDM analysis. The analysis was restricted before BJD 2457862 since later observations were too noisy. (Lower): Phase-averaged profile.

E-section 3.44 ASASSN-17fh

This object was detected as a transient at V=16.0 on 2017 April 20 by the ASAS-SN team. Only two superhumps were recorded in single-night observations: BJD 2457869.4704(12) (N=55) and 2457869.5343(8) (N=66) (vsnet-alert 20963; e-figure 40). The superhump stage was unknown.

The ASAS-SN data since 2013 June 4 did not detect other superoutbursts. There was possible single positive detection at V=16.2 on 2015 April 1, but it may have been a noise.

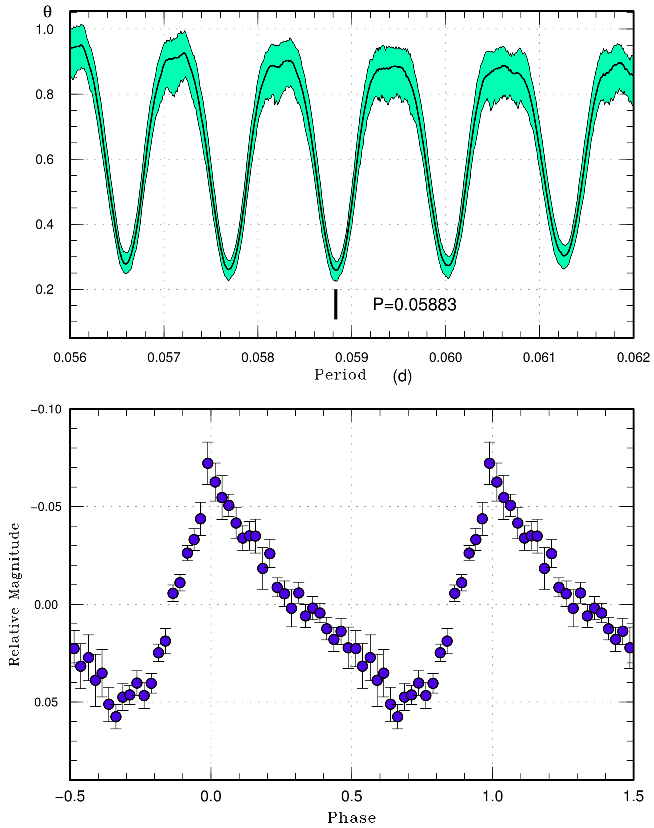


E-figure 40. Superhumps in ASASSN-17fh (2017).

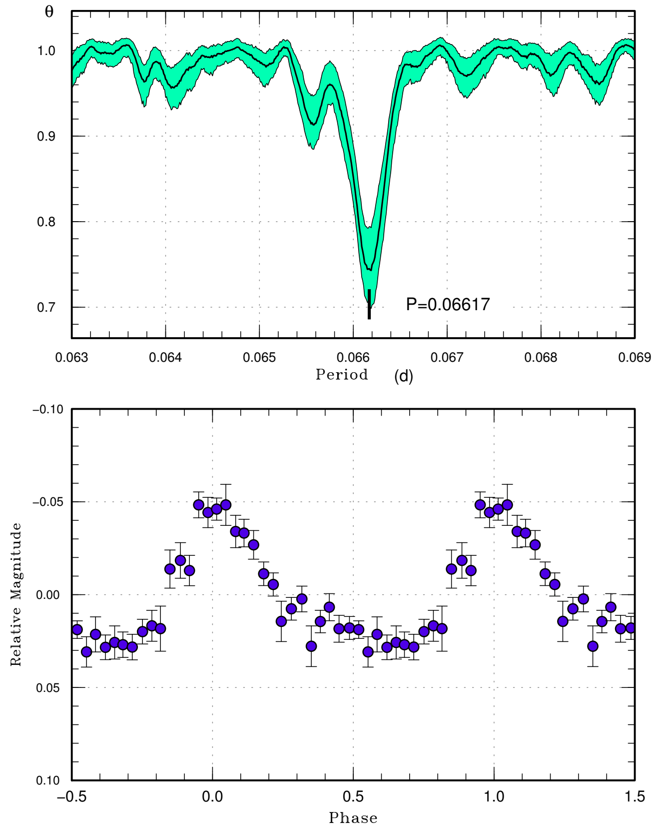
E-section 3.45 ASASSN-17fi

This object was detected as a transient at V=14.5 on 2017 April 20 by the ASAS-SN team. Subsequent observations detected superhumps (vsnet-alert 20952; e-figure 41). According to the ASAS-SN data, the outburst lasted at least up to 2017 April 27.

The ASAS-SN data covered this region since 2013 October 28. There is nearby ∼14.4 mag (Gaia G magnitude) star which affected ASAS-SN photometry.



E-figure 41. Superhumps in ASASSN-17fi (2017). (Upper): PDM analysis. The alias selection was based on a long single-night observation. (Lower): Phase-averaged profile.



E-figure 42. Superhumps in ASASSN-17fj (2017). (Upper): PDM analysis. The analysis was restricted before BJD 2457878 since later observations were too noisy. (Lower): Phase-averaged profile.

E-table 42. Superhump maxima of ASASSN-17fi (2017)

E	max*	error	$O-C$†	N‡
0	57867.4925	0.0005	−0.0000	62
1	57867.5513	0.0004	−0.0001	58
2	57867.6102	0.0006	0.0001	55
51	57870.4937	0.0004	0.0007	62
52	57870.5511	0.0009	−0.0007	32

*BJD−2400000.
†Against max = 2457867.4925 + 0.058833E.
‡Number of points used to determine the maximum.

Although the detection limit was shallow due to this companion star, there was no indication of an outburst as bright as in the 2017 one.

E-section 3.46 ASASSN-17fj

This object was detected as a transient at V=15.7 on 2017 April 21 by the ASAS-SN team. The outburst was announced after the observation at V=15.7 on April 22. Subsequent observations detected superhumps (vsnet-alert 20965; e-figure 42). The times of superhump maxima are listed in e-table 43. Stages B and C can be identified.

This field has been observed by the ASAS-SN team since 2016 March 10. There was an apparent superoutburst on 2016 March 10 at V=15.7 and probably lasted at least up to March 15. The supercycle looks likely to be an order of a year.

E-section 3.47 ASASSN-17fl

This object was detected as a transient at V=16.3 on 2017 April 21 by the ASAS-SN team. The outburst was announced after several confirmatory observations up to 2017 April 26 (V=17.3). Although the object was very faint, superhumps were detected (vsnet-alert 20973; e-figure 43). The times of superhump maxima are listed in e-table 44.

Although ASAS-SN observations of this field started on 2016 March 9, no past outburst was detected. Since the object is very faint, past outbursts may have escaped detection even if they existed.

E-table 43. Superhump maxima of ASASSN-17fj (2017)

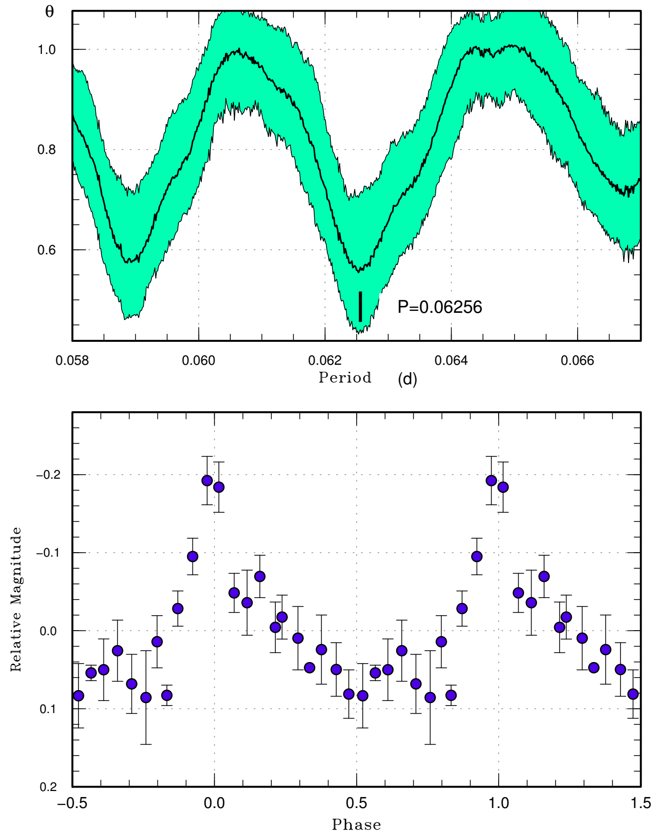
E	max*	error	$O-C$†	N‡
0	57868.7539	0.0009	−0.0016	15
1	57868.8200	0.0010	−0.0017	17
2	57868.8903	0.0026	0.0025	9
14	57869.6791	0.0012	−0.0030	11
15	57869.7466	0.0018	−0.0017	13
16	57869.8118	0.0014	−0.0026	17
17	57869.8797	0.0026	−0.0009	10
30	57870.7369	0.0012	−0.0041	10
31	57870.8060	0.0013	−0.0011	16
32	57870.8718	0.0046	−0.0016	12
46	57871.8011	0.0023	0.0011	17
47	57871.8628	0.0036	−0.0033	16
59	57872.6630	0.0037	0.0027	12
61	57872.7966	0.0017	0.0039	23
62	57872.8598	0.0032	0.0010	25
75	57873.7256	0.0017	0.0063	17
76	57873.7914	0.0016	0.0059	23
77	57873.8550	0.0028	0.0033	26
90	57874.7175	0.0014	0.0055	18
91	57874.7842	0.0017	0.0060	23
92	57874.8479	0.0016	0.0035	25
105	57875.7017	0.0037	−0.0030	18
106	57875.7775	0.0026	0.0065	24
107	57875.8349	0.0030	−0.0022	25
120	57876.6957	0.0015	−0.0018	15
121	57876.7561	0.0022	−0.0076	19
122	57876.8256	0.0021	−0.0043	25
135	57877.6826	0.0026	−0.0077	15

*BJD−2400000.
†Against max = 2457868.7555 + 0.066184E.
‡Number of points used to determine the maximum.

E-table 44. Superhump maxima of ASASSN-17fl (2017)

E	max*	error	$O-C$†	N‡
0	57870.7141	0.0079	0.0014	10
1	57870.7761	0.0018	0.0008	13
2	57870.8353	0.0019	−0.0027	15
16	57871.7179	0.0043	0.0031	11
17	57871.7756	0.0017	−0.0018	14
18	57871.8392	0.0022	−0.0009	17

*BJD−2400000.
†Against max = 2457870.7127 + 0.062632E.
‡Number of points used to determine the maximum.

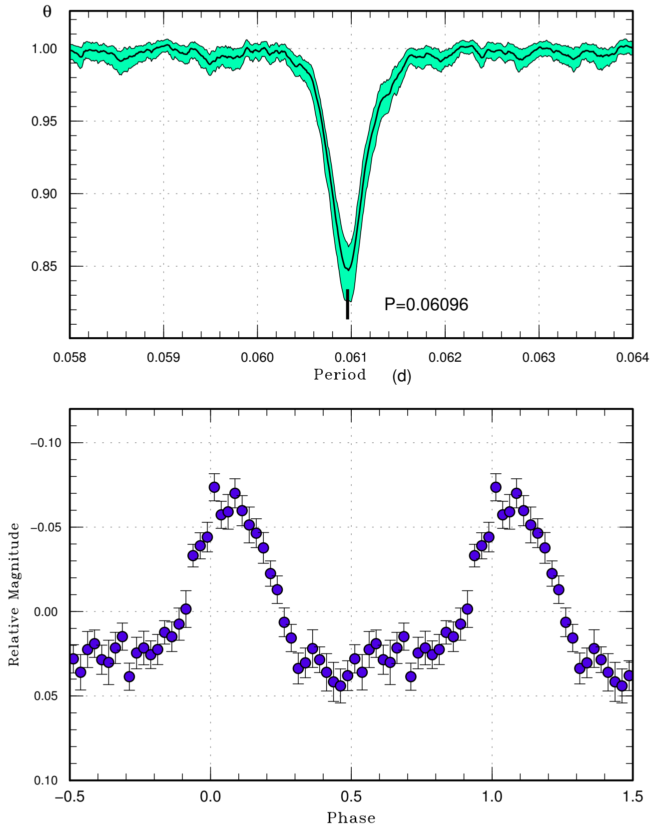


E-figure 43. Superhumps in ASASSN-17fl (2017). (Upper): PDM analysis. The alias selection was also supported by $O-C$ analysis. (Lower): Phase-averaged profile.

E-section 3.48 ASASSN-17fn

This object was detected as a transient at V=17.4 on 2017 April 22 by the ASAS-SN team. The outburst was announced after the observation at V=14.8 on 2017 April 26. There is also an X-ray counterpart 2RXP J103528.7+541910 (=2RXP J103527.8+541852). Subsequent observations detected likely early superhumps (vsnet-alert 20971, 20975; e-figure 44). Ordinary superhumps appeared on May 7 and developed further (vsnet-alert 20997; e-figure 45). Although initially detected superhumps were singly-peaked, the development of ordinary superhumps confirmed the identification as early superhumps. The object is confirmed to be a WZ Sge-type dwarf nova. The times of superhump maxima are listed in e-table 45.

Although stage A superhumps were only marginally recorded, the fractional excess ϵ^* was estimated to be 0.0352(3), which corresponds to q=0.097(1). The object appears to have a rather high q despite the long orbital period. The relatively large q appears to be consistent with the large superhump amplitudes (0.20 mag, e-figure



E-figure 44. Early superhumps in ASASSN-17fn (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

45). WZ Sge-type dwarf novae with such features tend to show multiple rebrightenings (Nakata et al. 2013). In this object, its faintness prevented us from detecting such rebrightenings.

There were no definite past outburst in the ASAS-SN data starting on 2013 October 9.

E-section 3.49 ASASSN-17fo

This object was detected as a transient at V=16.0 on 2017 April 27 by the ASAS-SN team. Two previous outbursts were detected in the CRTS data. Subsequent observations detected deep eclipses and superhumps (vsnet-alert 20977; e-figures 46, 47).

The times of superhump maxima are listed in e-table 46. Except for E=0 all superhumps were probably observed during stage B.

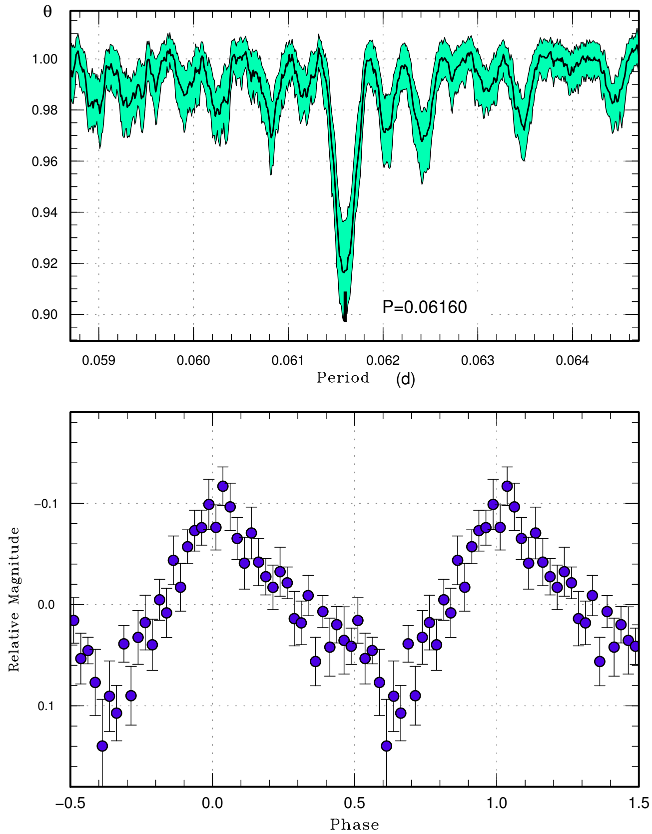
We obtained the following eclipse ephemeris using the MCMC analysis (Kato et al. 2013a) on the quiescent observations in the CRTS data:

$$\mathrm{Min(BJD)} = 2457877.05448(13) + 0.061548044(3)E. \quad \text{(E3)}$$

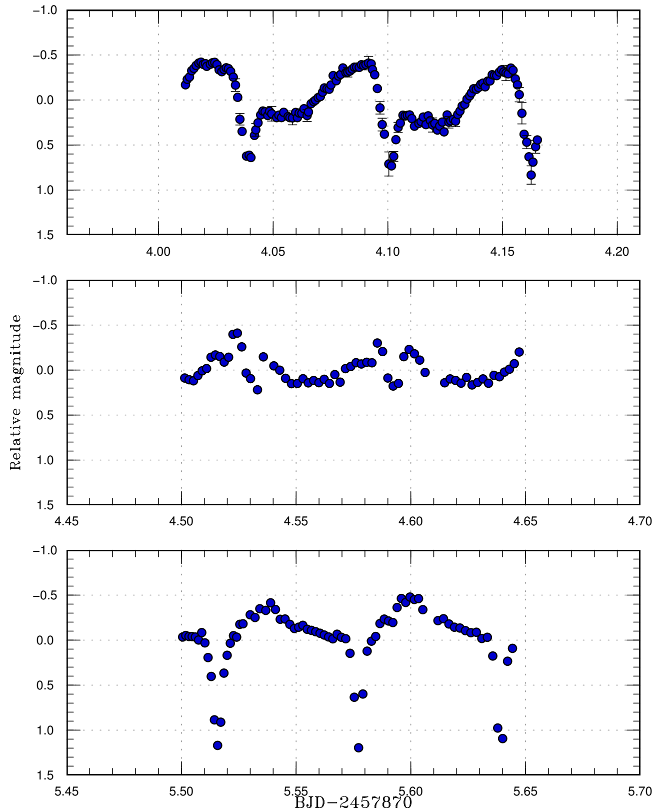
E-table 45. Superhump maxima of ASASSN-17fn (2017)

E	max*	error	$O-C$†	N‡
0	57881.0463	0.0028	−0.0353	85
21	57882.3772	0.0018	0.0010	18
22	57882.4362	0.0009	−0.0016	51
23	57882.4982	0.0010	−0.0013	63
24	57882.5620	0.0006	0.0008	63
37	57883.3655	0.0013	0.0029	49
38	57883.4289	0.0008	0.0047	72
39	57883.4915	0.0005	0.0056	76
40	57883.5531	0.0010	0.0056	61
41	57883.6130	0.0100	0.0039	15
53	57884.3553	0.0013	0.0063	27
54	57884.4152	0.0006	0.0047	92
55	57884.4751	0.0008	0.0028	61
56	57884.5389	0.0008	0.0051	55
65	57885.0902	0.0027	0.0015	77
103	57887.4350	0.0008	0.0037	56
104	57887.4966	0.0013	0.0037	40
118	57888.3592	0.0011	0.0032	31
119	57888.4223	0.0012	0.0046	30
120	57888.4781	0.0009	−0.0013	71
121	57888.5398	0.0012	−0.0012	44
122	57888.6043	0.0055	0.0017	17
135	57889.4043	0.0015	0.0003	31
136	57889.4781	0.0036	0.0124	11
150	57890.3236	0.0034	−0.0052	19
151	57890.3861	0.0013	−0.0043	30
152	57890.4492	0.0009	−0.0028	73
153	57890.5096	0.0032	−0.0041	33
154	57890.5690	0.0065	−0.0063	13
167	57891.3711	0.0031	−0.0057	32
168	57891.4329	0.0015	−0.0055	31
169	57891.5001	0.0022	0.0000	31

*BJD−2400000.
†Against max = 2457881.0816 + 0.061648E.
‡Number of points used to determine the maximum.



E-figure 45. Ordinary superhumps in ASASSN-17fn (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 46. Eclipses and superhumps in ASASSN-17fo in the earliest phase (2017). The data were binned to 0.001 d. Strong beat phenomenon was present.

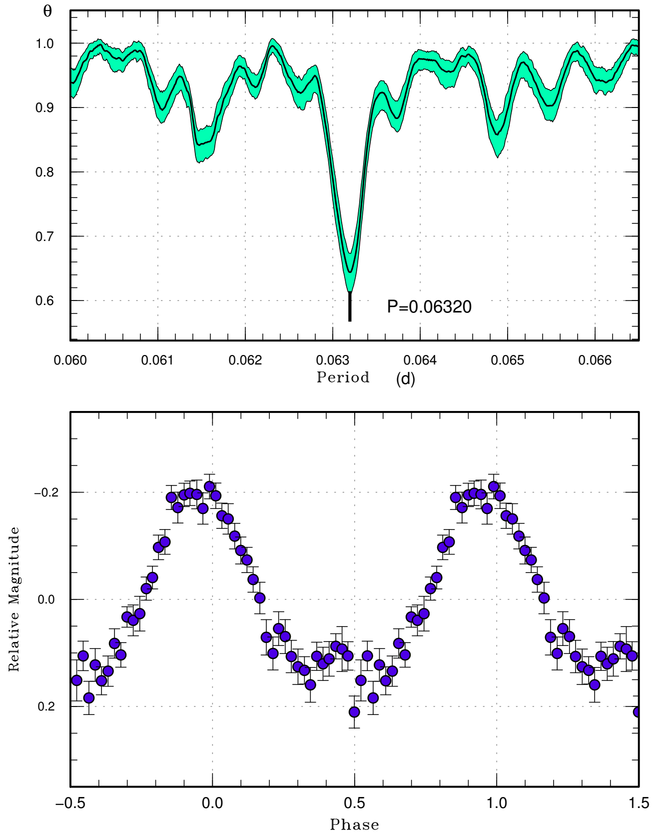
The epoch corresponds to the center of our observations during the outburst. This period was uniquely determined both by the PDM method and the MCMC method, and is consistent with the period [0.061536 d] determined from observations during the current outburst. The orbital light curve (e-figure 48) indicates the presence of double-wave orbital variations and an orbital hump. The depth of eclipsed was probably underestimated since the object becomes too faint for CRTS at eclipse centers. The quiescent orbital light curve suggests a low-mass transfer rate, which is compatible with the relatively rare outbursts in the past data. Since the object appears to have a very high orbital inclination as judged from high amplitudes of superhumps and low outburst amplitudes, detailed analysis of the quiescent light curve is desired.

E-section 3.50 ASASSN-17fp

This object was detected as a transient at V=16.2 on 2017 April 28 by the ASAS-SN team. The outburst was announced after the observation on 2017 April 28 (V=15.7). The object was spectroscopically studied on 2017 April 28 and found to show He I lines but lack hydrogen (Cartier et al. 2017). The object was then suggested to be a candidate AM CVn-type object. Marsh et al. (2017) reported 51.0(1)-min modulations on 2017 May 6 and suggested that the object is located at the long period end of the AM CVn period distribution. The object faded quickly after this, but it showed at least one further short outburst (Waagen 2017).

Our observations during the outburst were performed on 2017 May 4–5. A PDM analysis yielded a period of 0.0365(5) d [52.6(7) min], close to the value obtained by Marsh et al. (2017) (e-figure 49).

This field has been monitored by the ASAS-SN team since 2014 April 29 and no past outbursts were recorded. An outburst at V=16.1 on 2017 May 16 was the only positive detection by the ASAS-SN team after the main outburst. This outburst is thus considered to be a post-superoutburst rebrightening.

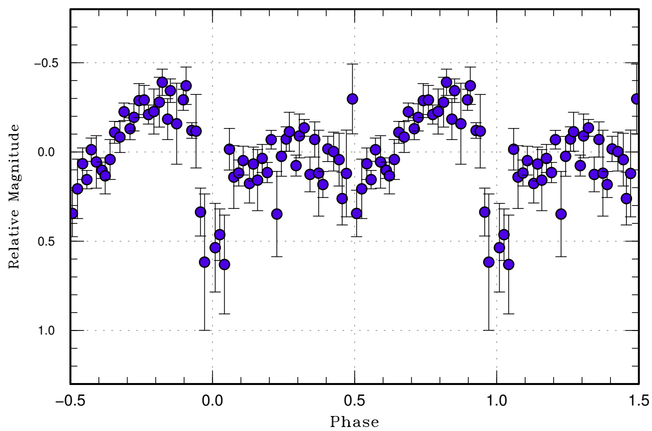


E-figure 47. Superhumps in ASASSN-17fo outside the eclipses (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 46. Superhump maxima of ASASSN-17fo (2017)

E	max*	error	$O-C$†	phase‡	N§
0	57873.5174	0.0006	0.0018	0.52	16
8	57874.0230	0.0003	0.0015	0.74	61
9	57874.0859	0.0004	0.0012	0.76	84
10	57874.1502	0.0003	0.0023	0.80	79
16	57874.5253	0.0013	−0.0020	0.90	17
17	57874.5910	0.0014	0.0005	0.97	14
32	57875.5386	0.0005	−0.0004	0.37	21
33	57875.6016	0.0005	−0.0006	0.39	19
39	57875.9846	0.0009	0.0030	0.61	46
40	57876.0414	0.0007	−0.0034	0.54	83
41	57876.1054	0.0009	−0.0027	0.58	99
45	57876.3583	0.0006	−0.0027	0.69	46
46	57876.4215	0.0007	−0.0027	0.71	27
48	57876.5494	0.0008	−0.0013	0.79	19
49	57876.6113	0.0012	−0.0027	0.80	17
50	57876.6764	0.0004	−0.0008	0.85	45
51	57876.7473	0.0026	0.0069	0.01	38
56	57877.0539	0.0005	−0.0027	0.99	75
57	57877.1174	0.0013	−0.0024	0.02	72
61	57877.3691	0.0034	−0.0036	0.11	18
63	57877.5021	0.0025	0.0029	0.27	20
64	57877.5621	0.0022	−0.0003	0.25	13
72	57878.0675	0.0027	−0.0008	0.46	62
73	57878.1391	0.0028	0.0076	0.62	50
79	57878.5120	0.0019	0.0011	0.68	19
80	57878.5747	0.0023	0.0006	0.70	14

*BJD−2400000.
†Against max $= 2457873.5156 + 0.063232E$.
‡Orbital phase.
§Number of points used to determine the maximum.

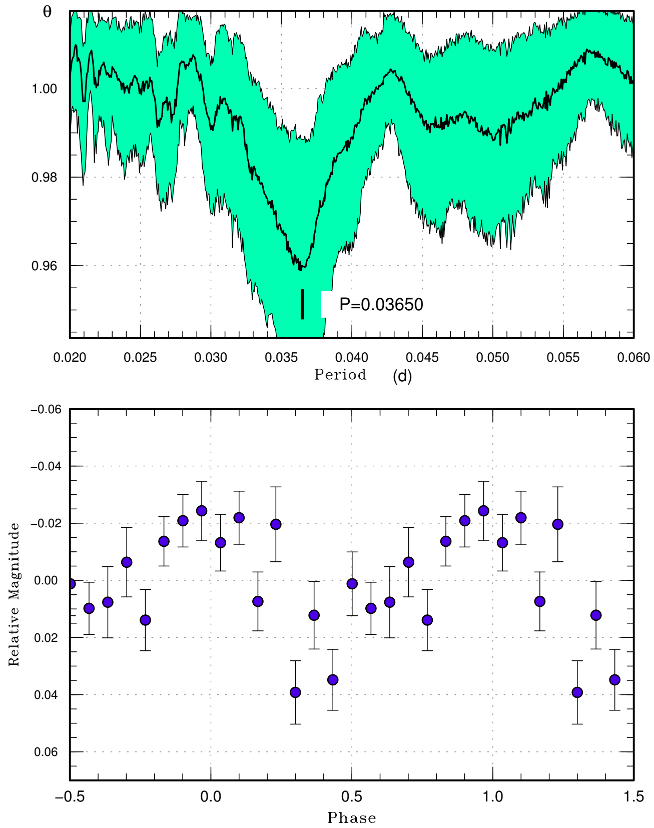


E-figure 48. Mean orbital light curve of ASASSN-17fo. The CRTS data in quiescence were used. The ephemeris of equation (E3) is used.

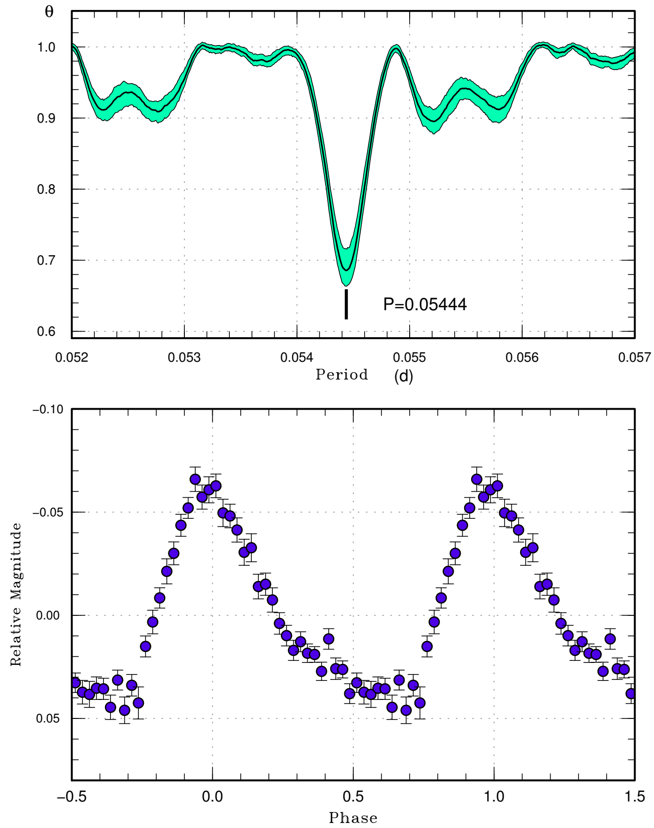
E-section 3.51 ASASSN-17fz

This object was detected as a transient at V=14.2 on 2017 May 5 by the ASAS-SN team. The large outburst amplitude received attention. Although superhump-like features were suggested (vsnet-alert 20992), they were not confirmed by later observations (vsnet-alert 21003). The object developed evolving ordinary superhumps on May 12 (7 d after the initial outburst detection; vsnet-alert 21017, 21026; e-figure 50). The times of superhump maxima are listed in e-table 47. The maxima for $E \leq$41 were clearly stage A superhumps.

Although a possible period of early superhumps was reported in vsnet-alert 21026, we could not confirm it by further analysis. We consider that the object is likely a WZ Sge-type dwarf nova based on long duration of stage A (suggesting a small q). The waiting time (7 d) of the ap-



E-figure 49. Likely superhumps in ASASSN-17fp (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 50. Ordinary superhumps in ASASSN-17fz (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

pearance of ordinary superhump is slight shorter than in most WZ Sge-type dwarf novae. This may have been a result of the lack of observations on three nights preceding the initial ASAS-SN detection and the true waiting time may have been longer.

The object was still in superoutburst plateau on 2017 May 21. ASAS-SN observations on subsequent three nights were not deep enough to see whether the outburst still continued. The object was found to have faded to 19 mag on 2017 May 28. There was no indication of a post-superoutburst rebrightening although our CCD observations were not sufficient and ASAS-SN data were not deep enough to detect a rebrightening. ASAS-SN started regularly observing this field on 2016 February 2 and there were no previous outbursts.

E-section 3.52 ASASSN-17gf

This object was detected as a transient at V=13.05 on 2017 May 14 by the ASAS-SN team. Superhumps soon grew and the object was identified as an SU UMa-type dwarf nova below the period minimum (vsnet-alert 21021; e-figure 51). The times of superhump maxima are listed in e-table 48. The presence of stages A and B is clearly visible.

Although our CCD observations of the superoutburst ended on 2017 May 21, the object was confirmed to be bright at least up to May 26 at a visual magnitude of 14.0 according to the AAVSO observations. The object was found to be fading rapidly on 2017 May 27. There was no indication of post-superoutburst rebrightening. The object was still in quiescence on 2017 May 10. The duration of the superoutburst was between 13 d and 17 d. This duration is typical for an SU UMa-type dwarf nova, and is unlike WZ Sge-type objects below the period minimum, such as ASASSN-15po (Namekata et al. 2017) and OV Boo, which are possibly population II dwarf novae (e.g. Patterson et al. 2008; Namekata et al. 2017; Ohnishi et al. 2019). ASASSN-17gf is thus most likely an EI Psc-like object. EI Psc-like systems are CVs below the period minimum showing hydrogen (likely somewhat reduced in abundance) in their spectra (cf. Thorstensen et al. 2002; Uemura et al. 2002; Littlefield et al. 2013) and are considered to be evolving towards AM CVn-type objects.

E-table 47. Superhump maxima of ASASSN-17fz (2017)

E	max*	error	$O-C$†	N‡
0	57886.2577	0.0062	−0.0176	95
1	57886.3163	0.0021	−0.0135	125
2	57886.3822	0.0076	−0.0021	106
17	57887.2023	0.0007	0.0007	91
18	57887.2579	0.0005	0.0018	125
19	57887.3101	0.0007	−0.0005	125
20	57887.3665	0.0008	0.0014	125
23	57887.5312	0.0013	0.0027	14
36	57888.2445	0.0003	0.0075	124
37	57888.2989	0.0004	0.0075	124
38	57888.3545	0.0004	0.0086	123
41	57888.5185	0.0009	0.0091	13
60	57889.5480	0.0008	0.0033	12
72	57890.2037	0.0006	0.0051	103
73	57890.2557	0.0006	0.0027	124
74	57890.3085	0.0005	0.0010	124
75	57890.3622	0.0007	0.0002	117
78	57890.5287	0.0018	0.0032	12
91	57891.2335	0.0006	−0.0004	125
92	57891.2885	0.0005	0.0001	125
93	57891.3429	0.0010	−0.0000	96
109	57892.2123	0.0005	−0.0024	118
110	57892.2668	0.0005	−0.0024	125
111	57892.3228	0.0007	−0.0009	125
112	57892.3707	0.0033	−0.0074	63
115	57892.5393	0.0015	−0.0024	11
133	57893.5174	0.0023	−0.0051	12
151	57894.4994	0.0013	−0.0038	17
152	57894.5615	0.0048	0.0037	8

*BJD−2400000.
†Against max = 2457886.2753 + 0.054490E.
‡Number of points used to determine the maximum.

This object has been monitored by the ASAS-SN team since 2016 February 2 and there has been no other outburst in the ASAS-SN data. There were, however, rather numerous outburst detections in the ASAS-3 data (e-table 49; since there is a possible nearby contaminating object, only outbursts with more than two positive detections are listed). The listed outbursts were all likely superoutbursts and the frequency of superoutbursts appears to be comparable to or even higher than EI Psc (T. Ohshima et al. in preparation).

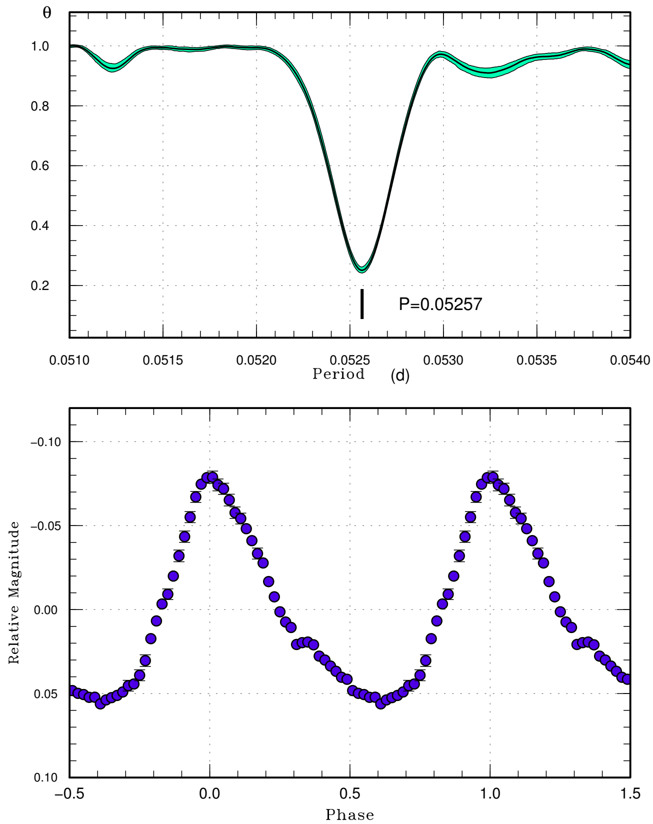
E-section 3.53 ASASSN-17gh

This object was detected as a transient at V=16.2 on 2017 May 16 by the ASAS-SN team. The outburst was an-

E-table 48. Superhump maxima of ASASSN-17gf (2017)

E	max*	error	$O-C$†	N‡
0	57888.5567	0.0013	−0.0124	10
12	57889.2046	0.0011	0.0046	51
13	57889.2498	0.0001	−0.0027	121
14	57889.3025	0.0002	−0.0026	121
15	57889.3569	0.0002	−0.0008	121
16	57889.4083	0.0002	−0.0020	121
18	57889.5174	0.0005	0.0020	11
19	57889.5717	0.0010	0.0037	9
20	57889.6224	0.0003	0.0019	10
31	57890.2035	0.0002	0.0047	92
32	57890.2549	0.0002	0.0035	121
33	57890.3068	0.0001	0.0028	121
34	57890.3588	0.0002	0.0022	121
35	57890.4076	0.0034	−0.0015	32
37	57890.5159	0.0006	0.0016	12
38	57890.5689	0.0009	0.0020	10
39	57890.6219	0.0008	0.0024	10
50	57891.1983	0.0004	0.0005	74
51	57891.2516	0.0002	0.0013	114
52	57891.3030	0.0003	0.0001	106
53	57891.3564	0.0002	0.0009	100
54	57891.4083	0.0003	0.0002	79
56	57891.5126	0.0015	−0.0006	12
57	57891.5649	0.0010	−0.0009	10
58	57891.6162	0.0011	−0.0021	10
69	57892.1970	0.0007	0.0003	62
70	57892.2486	0.0002	−0.0006	121
71	57892.3014	0.0002	−0.0004	121
72	57892.3534	0.0002	−0.0010	121
75	57892.5106	0.0006	−0.0016	12
76	57892.5662	0.0008	0.0015	10
77	57892.6176	0.0006	0.0004	9
89	57893.2461	0.0002	−0.0021	121
90	57893.2995	0.0002	−0.0012	121
91	57893.3518	0.0003	−0.0015	121
92	57893.4036	0.0003	−0.0022	121
94	57893.5108	0.0015	−0.0002	11
95	57893.5597	0.0020	−0.0039	10
96	57893.6183	0.0009	0.0021	9
108	57894.2454	0.0006	−0.0017	68
109	57894.2985	0.0005	−0.0011	84
113	57894.5092	0.0006	−0.0007	18
127	57895.2468	0.0003	0.0009	118
128	57895.3005	0.0005	0.0020	106
129	57895.3534	0.0007	0.0023	56

*BJD−2400000.
†Against max = 2457888.5691 + 0.052574E.
‡Number of points used to determine the maximum.

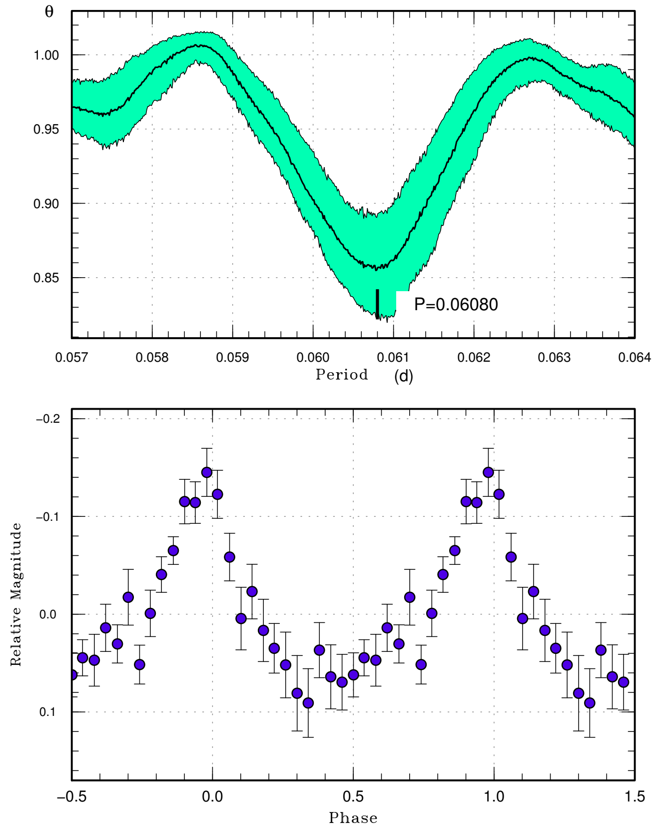


E-figure 51. Superhumps in ASASSN-17gf (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 49. List of past outbursts of ASASSN-17gf

Year	Month	Day	max*	V-mag
2002	10	11	52559	13.00
2003	7	10	52830	13.27
2004	1	3	53008	13.61
2004	5	19	53145	13.56
2005	2	11	53412	13.04
2005	1	21	53656	12.76
2008	2	5	54502	13.27

*JD−2400000.



E-figure 52. Superhumps in ASASSN-17gh (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

nounced after the observation at V=15.9 on 2017 May 16. Subsequent observations detected superhumps (vsnet-alert 21048; e-figure 52). The times of superhump maxima are listed in e-table 50. This table does not include observations on the second night with less quality to determine the times of maxima. The night, however, was included in the PDM analysis giving a period of 0.0608(1) d, which is considered to be more reliable than the one from single-night $O-C$ analysis.

E-section 3.54 ASASSN-17gv

This object was detected as a transient at V=14.2 on 2017 May 28 by the ASAS-SN team. Subsequent observations detected superhumps (vsnet-alert 21065, 21080; e-figure 53). The times of superhump maxima are listed in e-table 51. Although superhumps apparently had not yet fully developed on the first night and a period of stage A superhumps was reported in vsnet-alert 21080, this value was not confirmed by this $O-C$ analysis. The difference between periods of stage A and B superhumps was too large (more than 4%) and we consider that this period was

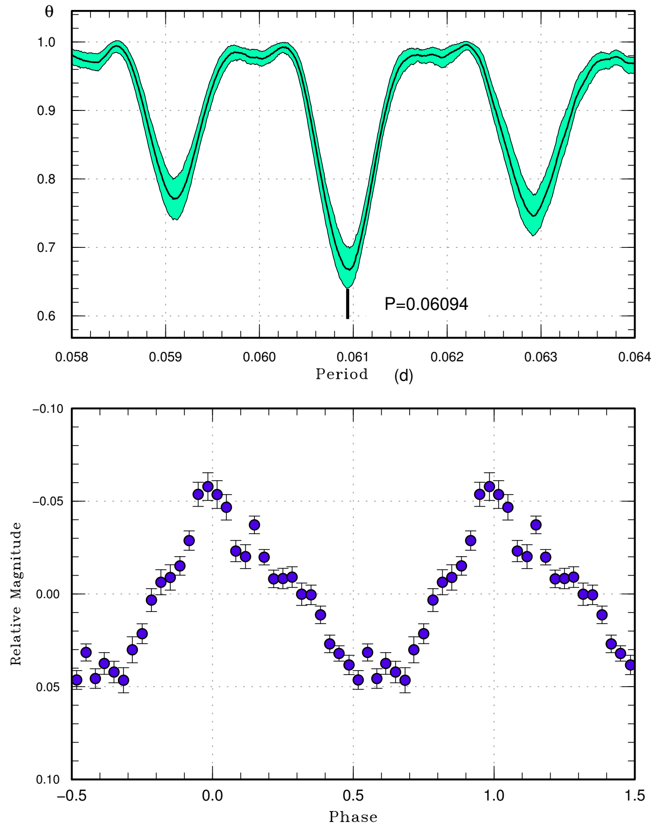
E-table 50. Superhump maxima of ASASSN-17gh (2017)

E	max*	error	$O-C$†	N‡
0	57894.0326	0.0009	0.0019	91
1	57894.0949	0.0013	0.0028	97
2	57894.1480	0.0037	−0.0054	52
6	57894.3972	0.0009	−0.0018	31
7	57894.4623	0.0004	0.0018	63
8	57894.5218	0.0005	−0.0000	62
9	57894.5839	0.0009	0.0007	31

*BJD−2400000.
†Against max = 2457894.0307 + 0.061394E.
‡Number of points used to determine the maximum.

a spurious detection. Although a positive $P_{\rm dot}$ is expected for this superhump period, this $O-C$ analysis did not give such a tendency. The data were probably of limited quality and the data may have also been contaminated by stage C superhumps.

The outburst lasted at least up to June 4, when the ASAS-SN data apparently showed rapid fading. The object faded to ∼18.5 mag on June 9 as recorded by our CCD observations. The region of this object has been covered by the ASAS-SN team since 2016 March 8 and no other outburst was recorded. Although ASAS-3 did not detect any outburst, it may have been due to crowding in this region.



E-figure 53. Superhumps in ASASSN-17gv (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-section 3.55 ASASSN-17hm

This object was detected as a transient at V=14.2 on 2017 June 10 by the ASAS-SN team. The outburst was announced after observations on 2017 June 11 (V=14.3) and 2017 June 12 (V=14.6). The object was not yet in outburst on June 9. Subsequent observations detected superhumps (vsnet-alert 21117; e-figure 54). The times of superhump maxima are listed in e-table 52. The epochs for $E \geq 68$ refer to post-superoutburst superhumps. Although there was an apparent change in the period around the termination of the superoutburst, no phase jump was recorded.

This field has been monitored by the ASAS-SN team since 2016 March 9 and there was another outburst at V=14.1 on 2016 July 16. There were gaps before and after this observation and the outburst type is unknown.

E-section 3.56 ASASSN-17hw

This object was detected as a transient at V=13.2 on 2017 June 20 by the ASAS-SN team. The object started to show superhumps on 2017 July 2 (vsnet-alert 21194, 21208, 21209, 21219; e-figure 55). The times of superhump maxima are listed in e-table 53. There are unambiguous stages A and B. It is remarkable that $P_{\rm dot}$ is almost zero during stage B (cf. vsnet-alert 21251).

An analysis of the early part of the outburst yielded small-amplitude early superhumps (e-figure 56), confirming the WZ Sge-type nature of this object. The period of early superhumps determined by the PDM method was 0.05886(2) d. Combined with the period of stage A superhumps [0.060617(5) d], the value of ϵ^* for stage A is 0.0290(4), which corresponds to q=0.078(1).

Although the object was well monitored after the termination of the outburst, no rebrightening was recorded.

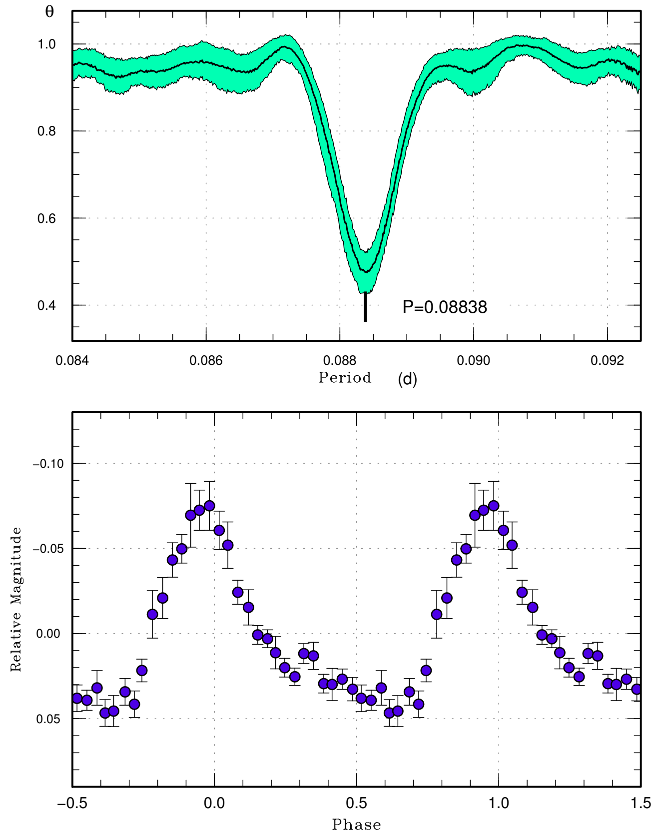
E-section 3.57 ASASSN-17hy

This object was detected as a transient at V=16.1 on 2017 June 18 by the ASAS-SN team. The outburst was announced after observations on 2017 June 19 (V=16.2). Subsequent observations detected superhumps (vsnet-alert 21157; e-figure 57). The times of superhump maxima are listed in e-table 54. The $O-C$ data suggest a positive $P_{\rm dot}$ although the data were relatively well sampled only

E-table 51. Superhump maxima of ASASSN-17gv (2017)

E	max*	error	$O-C$†	N‡
0	57903.2021	0.0056	−0.0117	45
2	57903.3428	0.0021	0.0072	139
3	57903.3959	0.0005	−0.0006	139
6	57903.5845	0.0008	0.0053	16
25	57904.7355	0.0022	−0.0007	16
26	57904.7965	0.0014	−0.0007	17
33	57905.2243	0.0006	0.0009	109
34	57905.2812	0.0003	−0.0031	129
35	57905.3522	0.0010	0.0070	38
41	57905.7167	0.0036	0.0061	12
42	57905.7702	0.0020	−0.0013	13
55	57906.5626	0.0023	−0.0005	10
57	57906.6801	0.0023	−0.0048	13
58	57906.7395	0.0030	−0.0063	12
59	57906.8069	0.0009	0.0002	13
66	57907.2332	0.0014	0.0002	141
67	57907.2969	0.0009	0.0030	140
68	57907.3536	0.0009	−0.0012	102
73	57907.6543	0.0034	−0.0050	11
74	57907.7217	0.0031	0.0015	12
75	57907.7802	0.0042	−0.0009	13
88	57908.5780	0.0023	0.0053	9

*BJD−2400000.
†Against max = 2457903.2138 + 0.060897E.
‡Number of points used to determine the maximum.



E-figure 54. Superhumps in ASASSN-17hm (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

on four nights.

E-section 3.58 ASASSN-17id

This object was detected as a transient at V=16.8 on 2017 June 21 by the ASAS-SN team. The outburst was announced after observations on 2017 June 23 (V=16.8). Subsequent observations detected superhumps (vsnet-alert 21158, 21172; e-figure 58). The times of superhump maxima are listed in e-table 55. Although there were observations after BJD 2457933, the object became too faint to detect superhumps. The object faded to 19.6 mag on 2017 July 2.

E-section 3.59 ASASSN-17if

This object was detected as a transient at V=14.0 on 2017 June 25 by the ASAS-SN team. The outburst was announced after observations on 2017 June 26 (V=14.1). Subsequent observations detected superhumps (vsnet-alert 21183; e-figure 59). The times of superhump maxima are listed in e-table 56. The stages B and C were clearly recorded despite relatively low sampling rates. The positive $P_{\rm dot}$ for stage B superhumps was typical for this $P_{\rm SH}$.

This field has been monitored by the ASAS-SN team since 2013 June 27 and no past outbursts were recorded. It may be that outbursts were relatively rare or past outbursts occurred when the object was invisible near the Sun.

E-section 3.60 ASASSN-17ig

This object was detected as a transient at V=14.8 on 2017 June 24 by the ASAS-SN team. Subsequent observations detected long-period superhumps (vsnet-alert 21168, 21184; e-figure 60). The times of superhump maxima are listed in e-table 57. The superhump period was initially longer, suggesting that they were stage B superhumps (less likely stage A ones, since the amplitudes were already large).

This field has been monitored by the ASAS-SN team since 2015 February 1 and no past outburst was detected. Since the object is an SU UMa-type dwarf nova in the period gap, further observations would be interesting.

E-table 52. Superhump maxima of ASASSN-17hm (2017)

E	max*	error	$O-C$†	N‡
0	57918.5083	0.0011	−0.0021	22
2	57918.6894	0.0008	0.0022	18
3	57918.7739	0.0014	−0.0018	16
11	57919.4738	0.0056	−0.0091	10
12	57919.5709	0.0017	−0.0005	10
13	57919.6589	0.0027	−0.0009	18
14	57919.7482	0.0009	0.0000	19
23	57920.5496	0.0021	0.0058	14
24	57920.6349	0.0030	0.0027	20
25	57920.7225	0.0012	0.0019	21
34	57921.5183	0.0018	0.0020	21
36	57921.6985	0.0012	0.0054	20
37	57921.7850	0.0027	0.0034	12
45	57922.4888	0.0040	0.0000	12
48	57922.7553	0.0022	0.0012	16
58	57923.6347	0.0015	−0.0035	17
59	57923.7243	0.0020	−0.0022	16
68	57924.5175	0.0016	−0.0047	20
69	57924.6084	0.0016	−0.0023	13
70	57924.6962	0.0007	−0.0028	16
81	57925.6702	0.0044	−0.0014	16
82	57925.7666	0.0051	0.0066	12

*BJD−2400000.
†Against max = 2457918.5104 + 0.088409E.
‡Number of points used to determine the maximum.

E-section 3.61 ASASSN-17il

This object was detected as a transient at V=15.3 on 2017 June 30 by the ASAS-SN team. Although observations detected superhump-like variations (vsnet-alert 21202; e-figure 61), we have not been able to determine a unique period using the data on two nights. Observations on July 6 could not detect similar variations. Although the SDSS colors in quiescence suggest an object below the period gap (cf. Kato et al. 2012b), the variations detected on the first night may have been large-amplitude random variations. Further observations are needed to clarify the nature of this object.

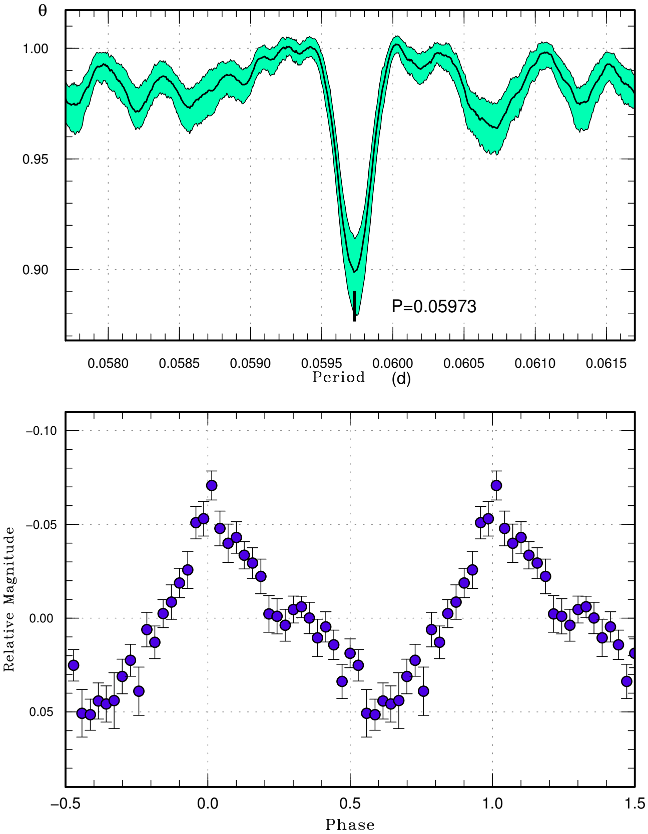
E-section 3.62 ASASSN-17iv

This object was detected as a transient at V=16.8 on 2017 June 30 by the ASAS-SN team. The outburst was announced after observations on 2017 July 2 (V=16.4) and 2017 July 3 (V=16.4). Subsequent observations starting on July 5 detected superhumps (vsnet-alert 21245; e-figure 62). The times of superhump maxima are listed in e-table 58. Maxima for $E \leq 1$ had negative $O-C$ values and there

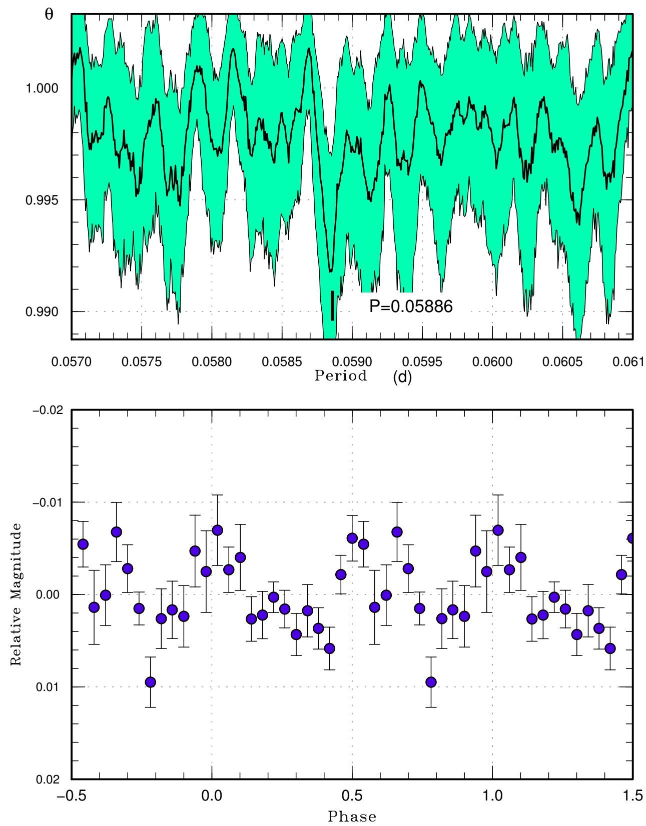
E-table 53. Superhump maxima of ASASSN-17hw (2017)

E	max*	error	$O-C$†	N‡
0	57936.7251	0.0012	−0.0170	13
1	57936.7829	0.0007	−0.0189	10
11	57937.3901	0.0014	−0.0093	43
16	57937.6948	0.0004	−0.0033	11
17	57937.7565	0.0007	−0.0014	13
27	57938.3594	0.0006	0.0039	159
28	57938.4200	0.0006	0.0048	175
29	57938.4830	0.0011	0.0080	81
33	57938.7196	0.0006	0.0056	13
34	57938.7779	0.0010	0.0041	10
44	57939.3763	0.0020	0.0050	23
45	57939.4353	0.0008	0.0042	36
46	57939.4966	0.0026	0.0057	14
60	57940.3362	0.0031	0.0088	16
61	57940.3925	0.0016	0.0052	18
62	57940.4410	0.0061	−0.0059	22
63	57940.4977	0.0022	−0.0090	13
66	57940.6895	0.0011	0.0035	12
67	57940.7509	0.0017	0.0052	12
83	57941.7080	0.0018	0.0061	12
84	57941.7617	0.0040	0.0000	10
93	57942.3023	0.0028	0.0029	137
94	57942.3632	0.0021	0.0040	137
95	57942.4198	0.0021	0.0008	105
100	57942.7209	0.0022	0.0031	13
117	57943.7331	0.0023	−0.0006	12
133	57944.6956	0.0024	0.0059	12
134	57944.7522	0.0015	0.0027	11
143	57945.2867	0.0013	−0.0007	137
144	57945.3468	0.0009	−0.0003	138
145	57945.4042	0.0016	−0.0026	137
146	57945.4630	0.0042	−0.0037	79
150	57945.7034	0.0019	−0.0022	13
176	57947.2585	0.0010	−0.0009	129
177	57947.3197	0.0010	0.0006	136
178	57947.3807	0.0011	0.0018	134
179	57947.4415	0.0010	0.0029	128
198	57948.5587	0.0023	−0.0153	15
199	57948.6312	0.0039	−0.0026	17
201	57948.7551	0.0057	0.0018	15
214	57949.5249	0.0025	−0.0052	16
218	57949.7717	0.0046	0.0025	10

*BJD−2400000.
†Against max = 2457936.7420 + 0.059758E.
‡Number of points used to determine the maximum.



E-figure 55. Ordinary superhumps in ASASSN-17hw (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 56. Early superhumps in ASASSN-17hw (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 54. Superhump maxima of ASASSN-17hy (2017)

E	max*	error	$O-C$†	N‡
0	57929.4948	0.0018	0.0019	22
1	57929.5704	0.0012	0.0060	20
2	57929.6395	0.0013	0.0036	21
28	57931.4910	0.0012	−0.0038	17
29	57931.5633	0.0009	−0.0031	15
30	57931.6346	0.0018	−0.0033	15
42	57932.4927	0.0012	−0.0031	16
43	57932.5663	0.0013	−0.0011	14
56	57933.4965	0.0054	−0.0004	16
57	57933.5645	0.0021	−0.0039	15
58	57933.6342	0.0029	−0.0057	14
70	57934.4953	0.0023	−0.0026	16
71	57934.5719	0.0020	0.0025	17
72	57934.6502	0.0054	0.0093	10
100	57936.6466	0.0042	0.0037	18

*BJD−2400000.

†Against max = 2457929.4929 + 0.071500E.

‡Number of points used to determine the maximum.

E-table 55. Superhump maxima of ASASSN-17id (2017)

E	max*	error	$O-C$†	N‡
0	57929.4795	0.0025	−0.0019	22
1	57929.5587	0.0027	−0.0013	23
2	57929.6406	0.0034	0.0020	22
26	57931.5270	0.0023	0.0017	18
27	57931.6065	0.0039	0.0026	18
38	57932.4634	0.0039	−0.0052	12
39	57932.5493	0.0019	0.0021	17

*BJD−2400000.

†Against max = 2457929.4814 + 0.078613E.

‡Number of points used to determine the maximum.

E-table 56. Superhump maxima of ASASSN-17if (2017)

E	max*	error	$O-C$†	N‡
0	57931.8329	0.0004	0.0074	13
17	57932.8273	0.0004	0.0022	16
34	57933.8234	0.0003	−0.0014	16
35	57933.8810	0.0003	−0.0026	18
68	57935.8179	0.0016	−0.0063	21
69	57935.8776	0.0020	−0.0054	17
86	57936.8767	0.0008	−0.0059	21
102	57937.8201	0.0012	−0.0034	15
103	57937.8789	0.0008	−0.0034	17
119	57938.8203	0.0011	−0.0029	16
120	57938.8808	0.0011	−0.0012	18
121	57938.9408	0.0025	−0.0000	11
137	57939.8838	0.0034	0.0021	11
153	57940.8364	0.0034	0.0138	9
154	57940.8868	0.0018	0.0055	11
170	57941.8285	0.0041	0.0063	9
171	57941.8877	0.0013	0.0067	11
187	57942.8249	0.0027	0.0030	9
188	57942.8854	0.0024	0.0048	11
204	57943.8218	0.0041	0.0003	8
205	57943.8810	0.0024	0.0006	10
221	57944.8093	0.0030	−0.0119	9
222	57944.8782	0.0017	−0.0018	14
223	57944.9320	0.0022	−0.0068	10

*BJD−2400000.

†Against max = 2457931.8255 + 0.058804E.

‡Number of points used to determine the maximum.

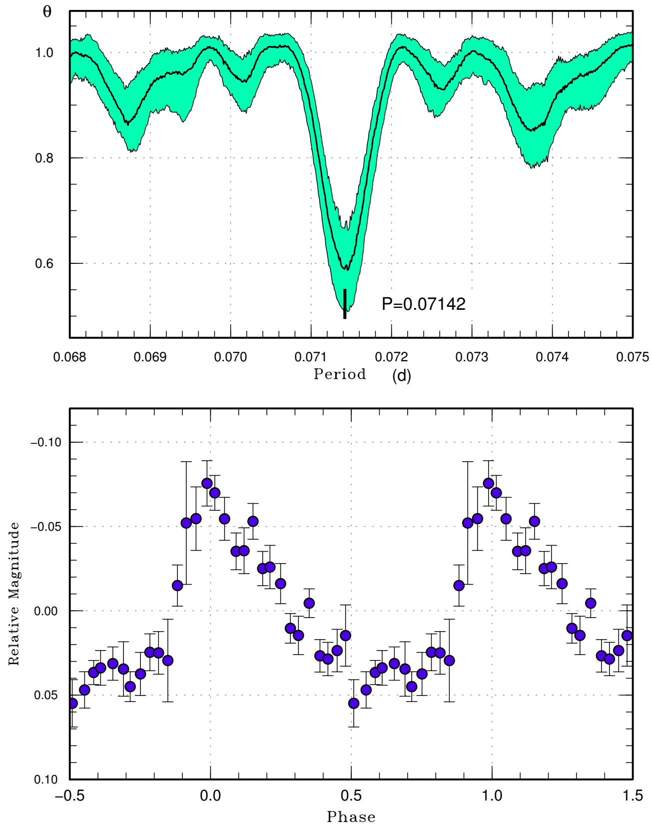
E-table 57. Superhump maxima of ASASSN-17ig (2017)

E	max*	error	$O-C$†	N‡
0	57931.6531	0.0024	−0.0084	12
1	57931.7519	0.0006	−0.0042	30
12	57932.7977	0.0016	0.0021	19
14	57932.9861	0.0008	0.0015	123
15	57933.0785	0.0005	−0.0006	136
22	57933.7444	0.0007	0.0037	30
25	57934.0283	0.0005	0.0041	190
32	57934.6898	0.0007	0.0040	29
54	57936.7688	0.0009	0.0039	17
64	57937.7102	0.0010	0.0002	20
75	57938.7479	0.0013	−0.0016	20
85	57939.6946	0.0022	−0.0001	19
96	57940.7296	0.0043	−0.0046	19

*BJD−2400000.

†Against max = 2457931.6615 + 0.094507E.

‡Number of points used to determine the maximum.



E-figure 57. Superhumps in ASASSN-17hy (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

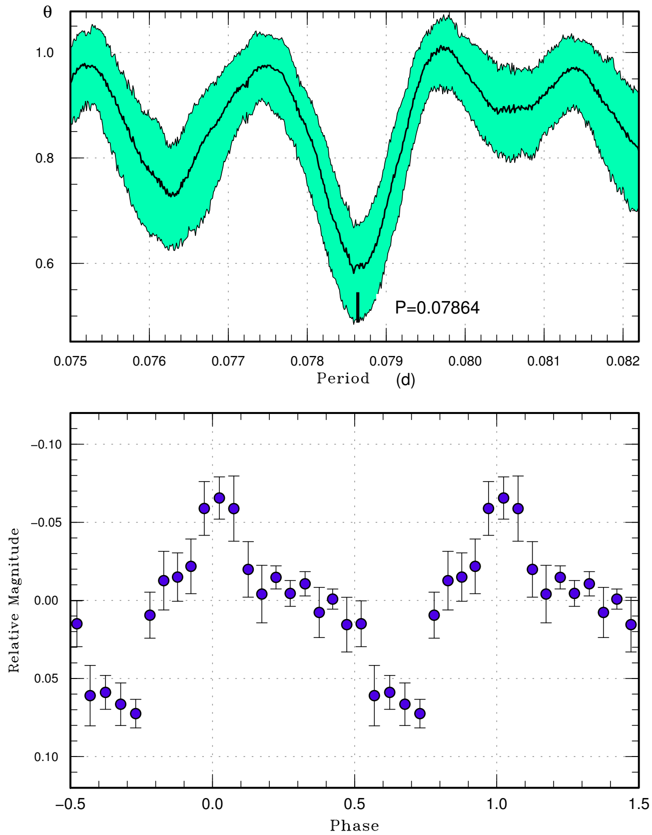
appears to have been a stage transition between E=1 and E=15. Since the observation started relatively late after the initial outburst detection, the majority of observations apparently recorded stage C superhumps. We adopted a period for $E \geq 15$ following this interpretation.

E-section 3.63 ASASSN-17iw

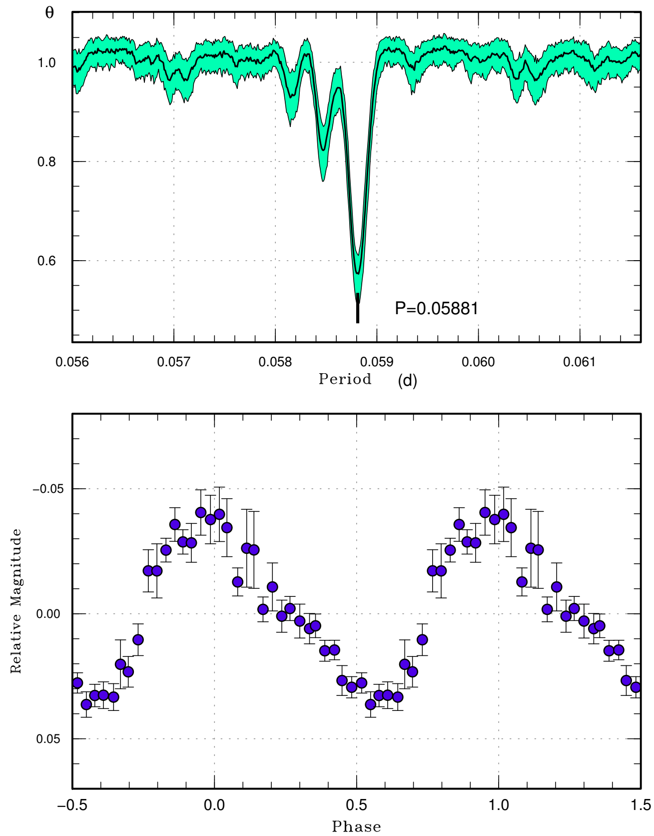
This object was detected as a transient at V=16.6 on 2017 June 28 by the ASAS-SN team. The outburst was announced after observations on 2017 June 30 (V=16.5) and 2017 July 1 (V=17.0). Subsequent observations starting on July 4 detected superhumps (vsnet-alert 21246; e-figure 63). The times of superhump maxima are listed in e-table 59. Although the $O-C$ diagram is noisy due to the faintness of the object, there was apparently stage B-C transition around E=90.

E-section 3.64 ASASSN-17ix

This object was detected as a transient at V=15.2 on 2017 June 29 by the ASAS-SN team. The outburst



E-figure 58. Superhumps in ASASSN-17id (2017). (Upper): PDM analysis. Data before BJD 2457933 were used. (Lower): Phase-averaged profile.



E-figure 59. Superhumps in ASASSN-17if (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 58. Superhump maxima of ASASSN-17iv (2017)

E	max*	error	$O-C$†	N‡
0	57939.8022	0.0014	−0.0061	9
1	57939.8725	0.0011	−0.0061	12
15	57940.8666	0.0030	0.0036	12
16	57940.9377	0.0036	0.0044	8
29	57941.8466	0.0045	−0.0008	11
30	57941.9190	0.0031	0.0013	13
43	57942.8348	0.0017	0.0030	11
44	57942.9078	0.0069	0.0057	14
57	57943.8225	0.0015	0.0063	10
58	57943.8829	0.0014	−0.0036	14
71	57944.8045	0.0026	0.0038	13
72	57944.8646	0.0062	−0.0064	16
73	57944.9431	0.0044	0.0018	12
85	57945.7878	0.0038	0.0027	11
86	57945.8479	0.0023	−0.0075	14
87	57945.9234	0.0041	−0.0023	15

*BJD−2400000.

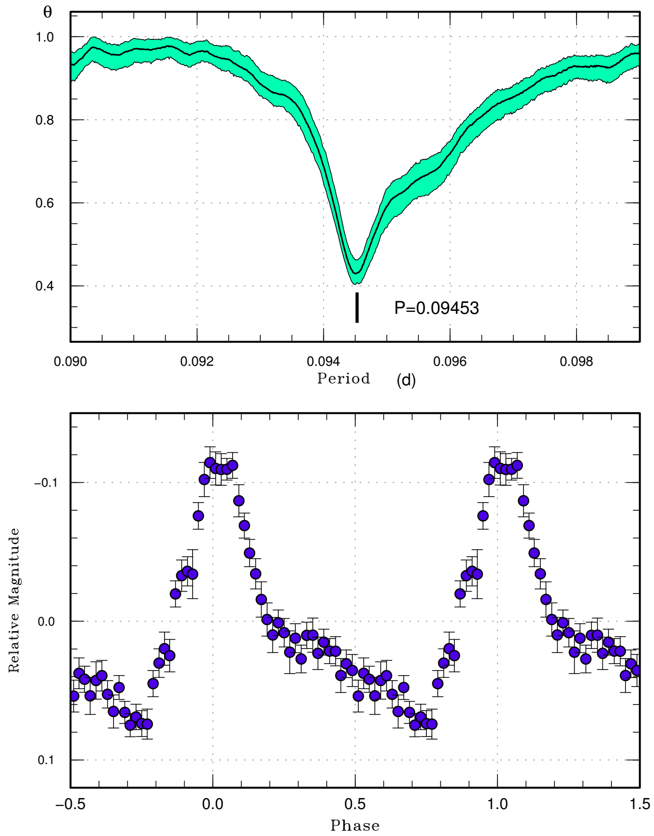
†Against max = 2457939.8083 + 0.070315E.

‡Number of points used to determine the maximum.

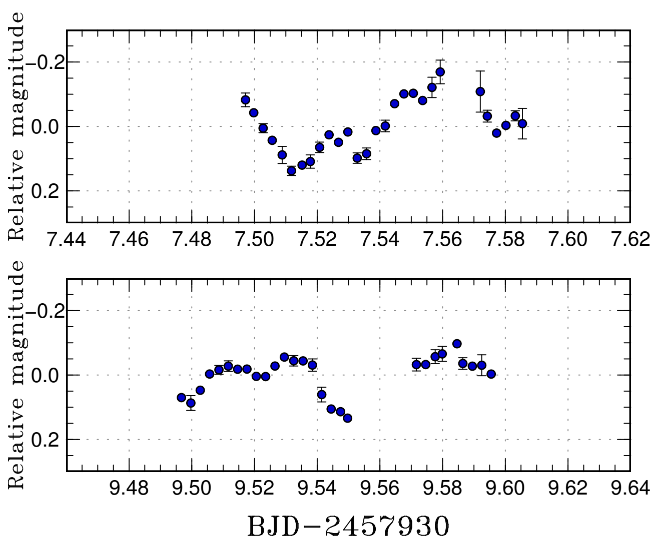
was announced after observations between 2017 June 30 (V=15.5) and 2017 July 2 (V=15.6). Subsequent observations starting on 2017 July 4 detected superhumps (vsnet-alert 21247; e-figure 64). The times of superhump maxima are listed in e-table 60. Although the $O-C$ diagram is noisy due to the faintness of the object, there was apparently stage B-C transition around E=82.

E-section 3.65 ASASSN-17ji

This object was detected as a transient at V=15.2 on 2017 July 14 by the ASAS-SN team. The outburst was announced after the observation on 2017 July 14 (V=15.0). Observations on 2017 July 17 did not show superhumps. Superhumps were later found to have developed at least on 2017 July 24 (vsnet-alert 21275; e-figure 65). The times of superhump maxima are listed in e-table 61. Since the observations on 2017 July 25 were not of good quality, the maximum at E=18 was relatively uncertain. The cycle count, however, appears to be certain from a continuous run on July 24. A PDM analysis of the July 24 data yielded 0.0576(8) d. An $O-C$ analysis favored a longer period of



E-figure 60. Superhumps in ASASSN-17ig (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 61. Possible superhumps in ASASSN-17il (2017). The data were binned to 0.003 d.

E-table 59. Superhump maxima of ASASSN-17iw (2017)

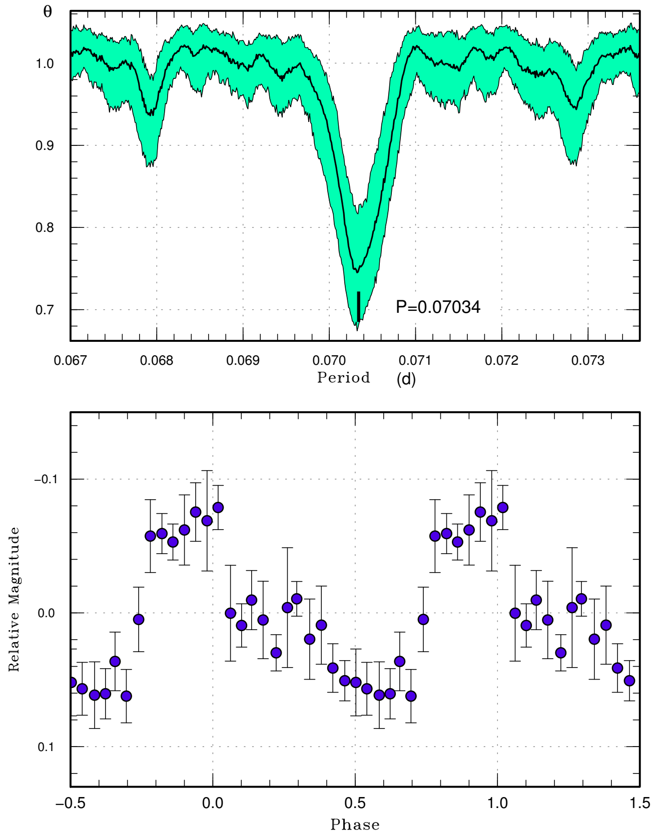
E	max*	error	$O-C$†	N‡
0	57939.5829	0.0031	0.0077	14
1	57939.6286	0.0022	−0.0025	13
18	57940.5839	0.0020	0.0028	14
19	57940.6338	0.0022	−0.0031	13
35	57941.5252	0.0019	−0.0058	17
52	57942.4720	0.0021	−0.0090	15
53	57942.5387	0.0038	0.0018	17
53	57942.5394	0.0071	0.0026	17
55	57942.6448	0.0024	−0.0038	12
70	57943.4820	0.0026	−0.0049	17
71	57943.5418	0.0027	−0.0009	17
72	57943.5997	0.0026	0.0011	13
73	57943.6646	0.0040	0.0101	6
88	57944.4920	0.0018	−0.0007	17
89	57944.5504	0.0034	0.0018	16
90	57944.6134	0.0024	0.0089	13
108	57945.6045	0.0043	−0.0059	13

*BJD−2400000.
†Against max = 2457939.5752 + 0.055881E.
‡Number of points used to determine the maximum.

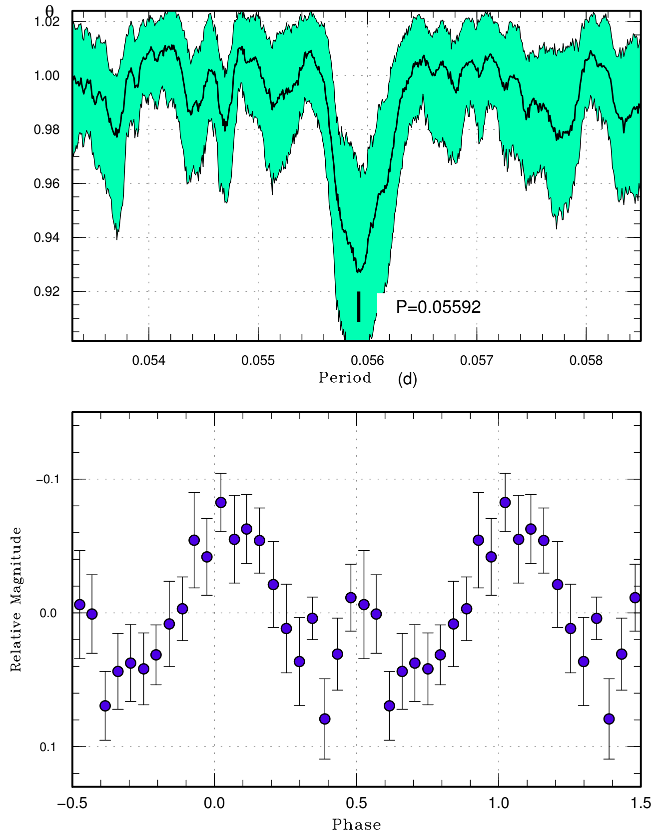
E-table 60. Superhump maxima of ASASSN-17ix (2017)

E	max*	error	$O-C$†	N‡
0	57939.4779	0.0013	0.0043	19
1	57939.5362	0.0024	0.0001	19
2	57939.6021	0.0030	0.0036	16
3	57939.6608	0.0020	−0.0001	10
16	57940.4733	0.0016	0.0007	17
17	57940.5332	0.0020	−0.0018	19
32	57941.4713	0.0024	−0.0002	16
33	57941.5276	0.0017	−0.0062	19
34	57941.5930	0.0032	−0.0033	16
49	57942.5306	0.0077	−0.0021	19
65	57943.5294	0.0044	−0.0023	19
66	57943.5919	0.0043	−0.0021	14
82	57944.6047	0.0031	0.0117	14
96	57945.4739	0.0016	0.0069	16
97	57945.5235	0.0022	−0.0059	19
98	57945.5885	0.0021	−0.0034	15

*BJD−2400000.
†Against max = 2457939.4736 + 0.062431E.
‡Number of points used to determine the maximum.



E-figure 62. Superhumps in ASASSN-17iv (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 63. Superhumps in ASASSN-17iw (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 61. Superhump maxima of ASASSN-17ji (2017)

E	max*	error	$O-C$†	N‡
0	57959.4454	0.0019	−0.0016	56
1	57959.5048	0.0010	−0.0010	61
2	57959.5675	0.0039	0.0029	23
18	57960.5051	0.0019	−0.0003	55

*BJD−2400000.
†Against max $= 2457959.4470 + 0.058798E$.
‡Number of points used to determine the maximum.

0.061(1) d. It is likely that the true period lies between 0.057 d and 0.061 d. The combined data of July 24 and 25 yielded 0.0589(1) d. The one-day alias of 0.0558(1) d appears to be ruled out (see e-figure 65). The superhump stage is unknown.

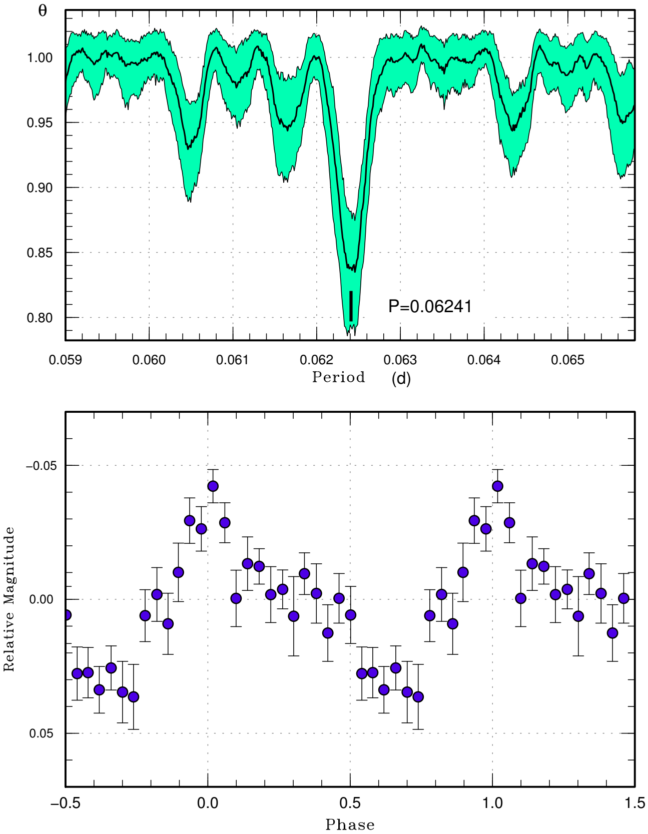
This field has been monitored by the ASAS-SN team since 2013 June 26 and no past outbursts were detected.

E-section 3.66 ASASSN-17jr

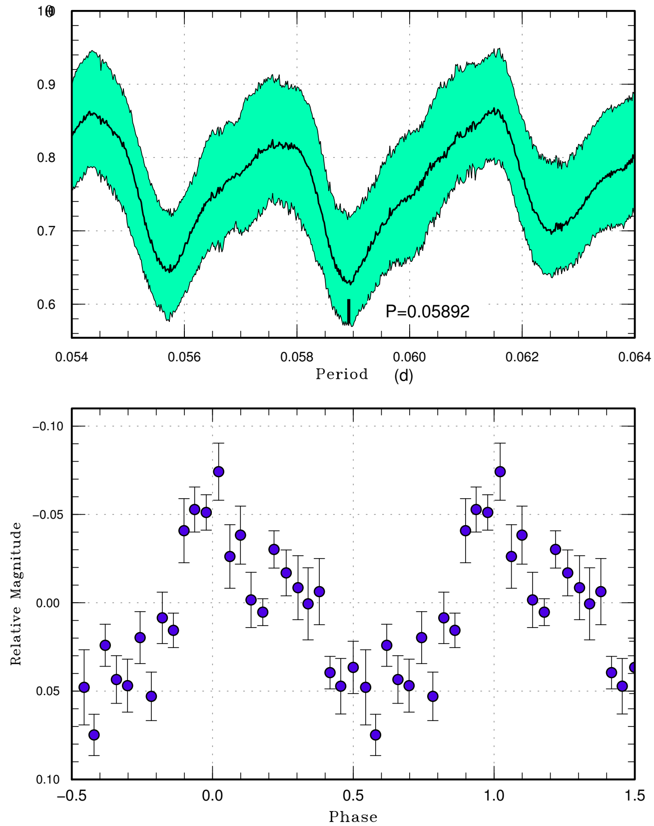
This object was detected as a transient at V=15.9 on 2017 July 25 by the ASAS-SN team. Subsequent observations detected superhumps (vsnet-alert 21280, 21297). The times of superhump maxima are listed in e-table 62. Only stage B with a positive $P_{\rm dot}$ was observed.

E-section 3.67 ASASSN-17kc

This object was detected as a transient at V=13.5 on 2017 July 30 by the ASAS-SN team. There were no past outbursts in the CRTS data and ASAS-3 data. Subsequent observations detected superhumps (vsnet-alert 21316, 21340; e-figure 67). The times of superhump maxima are listed in e-table 63. The maxima for $E \geq$158 refer to post-superoutburst observations. Stages B and C can be clearly recognized and the large positive $P_{\rm dot}$ for stage B is apparent.



E-figure 64. Superhumps in ASASSN-17ix (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 65. Superhumps in ASASSN-17ji (2017). (Upper): PDM analysis. The data after BJD 2457959 were used. (Lower): Phase-averaged profile.

E-table 62. Superhump maxima of ASASSN-17jr (2017)

E	max*	error	$O-C$†	N‡
0	57960.5348	0.0012	0.0034	15
1	57960.5951	0.0009	0.0020	14
16	57961.5198	0.0009	0.0011	16
17	57961.5816	0.0013	0.0012	16
32	57962.5017	0.0017	−0.0043	15
33	57962.5669	0.0015	−0.0008	16
48	57963.4925	0.0018	−0.0008	12
49	57963.5505	0.0024	−0.0045	15
51	57963.6727	0.0034	−0.0057	13
65	57964.5416	0.0028	−0.0007	15
67	57964.6713	0.0085	0.0056	13
98	57966.5821	0.0021	0.0035	13

*BJD−2400000.

†Against max = 2457960.5314 + 0.061706E.

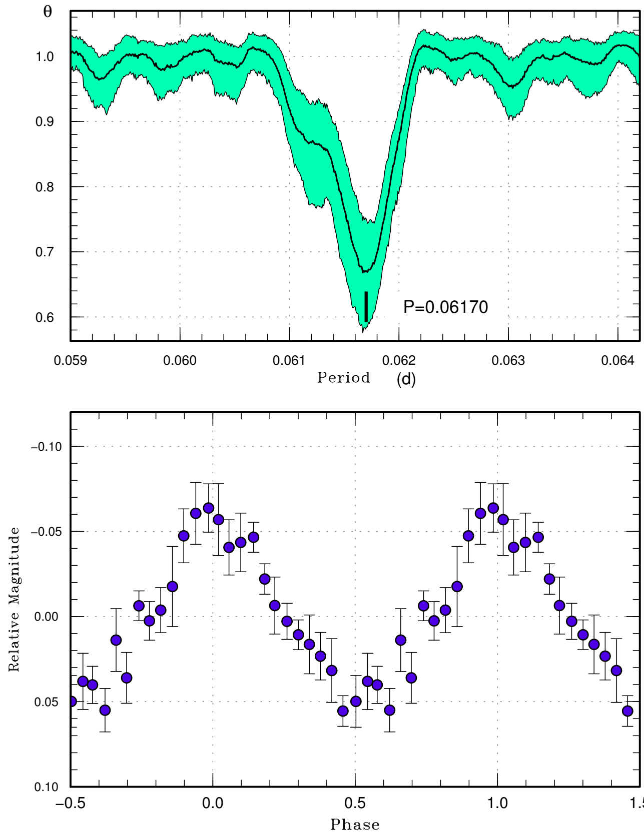
‡Number of points used to determine the maximum.

E-section 3.68 ASASSN-17kd

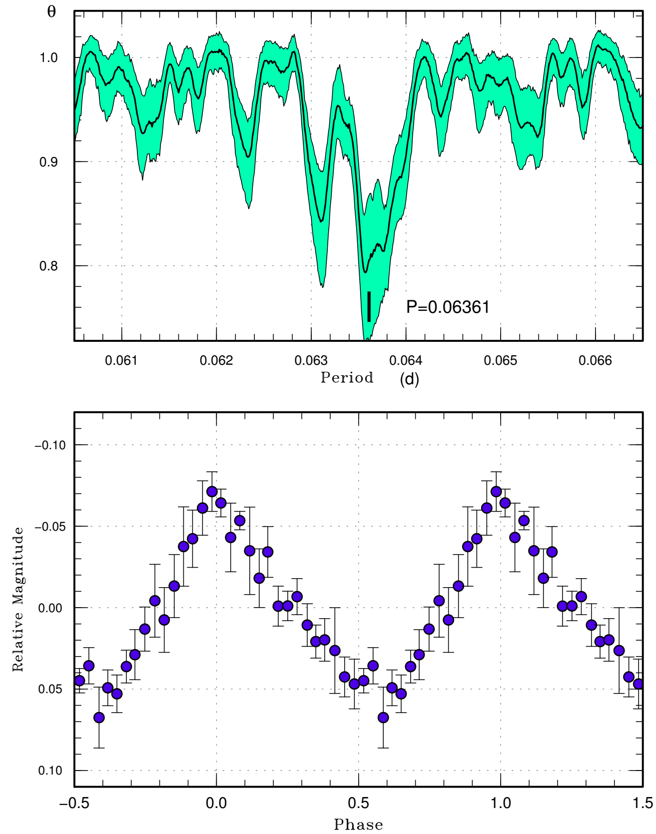
This object was detected as a transient at V=12.4 on 2017 July 29 by the ASAS-SN team. The outburst was announced after the observation of V=12.8 on 2017 July 30. The object started to show superhumps on 2017 August 10 (vsnet-alert 21339; e-figure 68). The times of superhump maxima are listed in e-table 64. Although stage A was recorded ($E\leq$33), observations in the stage was not long enough to measure the period accurately.

We could not detect significant early superhumps to an upper limit of 0.01 mag. Although early superhumps were not observationally confirmed, we consider that the object is a WZ Sge-type dwarf nova since the waiting time to appear ordinary superhumps was long (at least 12 d), which is comparable to typical WZ Sge-type dwarf novae (cf. Kato 2015). At the time of our initial observation on 2017 August 3, the object already faded to 13.5 mag, indicating that the object faded rapidly since the peak brightness. Such a rapid fading is also characteristic to a WZ Sge-type superoutburst (Kato 2015).

No past outbursts are known. Our observations indicated that the object faded close to 18 mag on August



E-figure 66. Superhumps in ASASSN-17jr (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 67. Superhumps in ASASSN-17kc (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

28. According to ASAS-SN observations, the object showed a rebrightening to V=15.6 on 2017 September 3–4. Although there was an observational gap between 2017 August 18 and 31 in the ASAS-SN data, the rebrightening was likely a short one.

E-section 3.69 ASASSN-17kg

This object was detected as a transient at V=13.0 on 2017 August 1 by the ASAS-SN team. The object has an X-ray counterpart of 1RXP J003152+0841.1. Subsequent observations detected superhumps (vsnet-alert 21317, 21326; e-figure 69). The times of superhump maxima are listed in e-table 65. There were "textbook" stage A-B-C superhumps (e-figure 70).

Before the end of the superoutburst, the object showed a dip of ~1.5 mag on 2017 August 21 (e-figure 70). This behavior is very similar to the WZ Sge-type dwarf nova KK Cnc (=OT J080714.2+113812, Kato et al. 2009). Early superhumps, however, were not detected in the case of ASASSN-17kg. The outburst light curve and a relatively small $P_{\rm dot}$ resemble those of WZ Sge-type dwarf novae. ASASSN-17kg may be a WZ Sge-type dwarf nova which failed to develop early superhumps when the stored mass in the disk was not sufficient (e.g. AL Com, Kimura et al. 2016b). There was no further post-superoutburst rebrightening in the ASAS-SN data.

E-section 3.70 ASASSN-17kp

This object was detected as a transient at V=14.8 on 2017 August 6 by the ASAS-SN team. The outburst was announced after observation of V=15.2 on 2017 August 9. Subsequent observations detected superhumps (vsnet-alert 21338; e-figure 71). The times of superhump maxima are listed in e-table 66. The fading on 2017 August 9 may suggest that the outburst on 2017 August 6 was a precursor one.

E-section 3.71 ASASSN-17la

This object was detected as a transient at V=14.5 on 2017 August 17 by the ASAS-SN team. Early superhumps were detected, indicating that this object is a WZ Sge-

E-table 63. Superhump maxima of ASASSN-17kc (2017)

E	max*	error	$O-C$†	N‡
0	57968.6996	0.0007	−0.0018	12
1	57968.7626	0.0005	−0.0025	15
2	57968.8260	0.0004	−0.0027	24
3	57968.8896	0.0004	−0.0027	19
16	57969.7159	0.0008	−0.0032	14
17	57969.7788	0.0008	−0.0039	17
18	57969.8423	0.0007	−0.0040	22
19	57969.9068	0.0011	−0.0031	13
33	57970.7958	0.0010	−0.0046	18
34	57970.8607	0.0012	−0.0033	21
47	57971.6924	0.0013	0.0015	12
48	57971.7510	0.0013	−0.0035	15
49	57971.8172	0.0006	−0.0008	24
50	57971.8830	0.0014	0.0014	20
79	57973.7367	0.0018	0.0105	14
80	57973.8003	0.0013	0.0104	23
81	57973.8643	0.0013	0.0109	19
94	57974.6885	0.0012	0.0083	13
95	57974.7515	0.0012	0.0076	16
96	57974.8150	0.0009	0.0075	23
97	57974.8779	0.0010	0.0069	20
126	57976.7174	0.0014	0.0018	15
127	57976.7811	0.0020	0.0019	21
128	57976.8466	0.0018	0.0038	20
158	57978.7398	0.0033	−0.0112	15
159	57978.8029	0.0020	−0.0117	24
160	57978.8647	0.0038	−0.0135	20

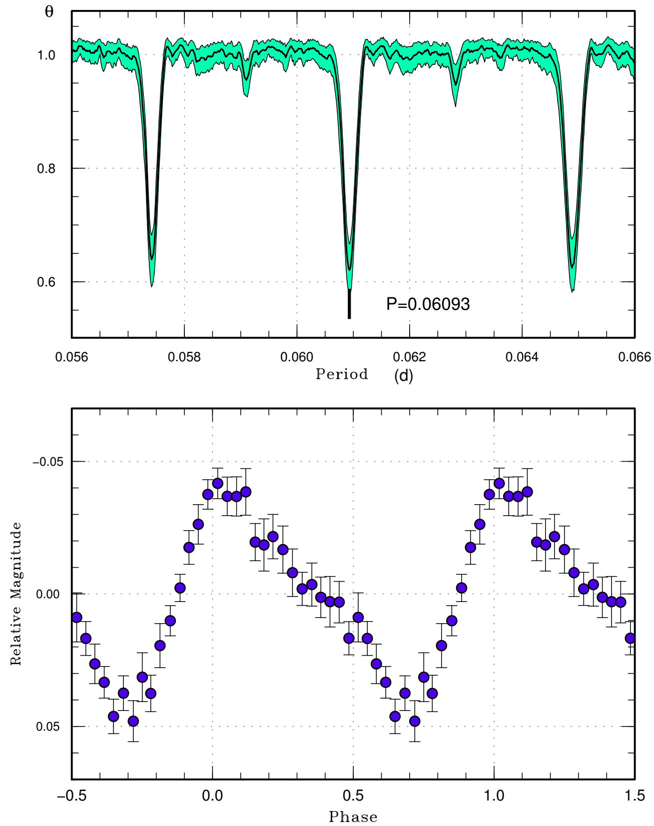
*BJD−2400000.

†Against max = 2457968.7014 + 0.063605E.

‡Number of points used to determine the maximum.

type dwarf nova (vsnet-alert 21349; e-figure 72). Ordinary superhump developed on 2017 October 23 (vsnet-alert 21362, 6 d after the outburst detection; e-figure 73). The times of superhump maxima are listed in e-table 67. This object showed "textbook" stages A and B.

The period of early superhump determined by the PDM method was 0.06039(3) d. The ϵ^* for stage A superhumps was 0.031(2), corresponding to q=0.084(5). This value is somewhat smaller than those of ordinary dwarf novae with the corresponding orbital period (cf. figure 17 in Kato 2015), but somewhat higher than those of typical period bouncers. The resultant parameters were similar to WZ Sge-type dwarf novae with multiple rebrightenings [see Nakata et al. (2013); Kato (2015)]. The $P_{\rm dot}$ for stage B superhumps was not unusually small as in period bouncers. Due to the faintness of the object, we did not have observations after the superoutburst.



E-figure 68. Ordinary superhumps in ASASSN-17kd (2017). (Upper): PDM analysis. The alias was selected by $O-C$ analysis. (Lower): Phase-averaged profile.

E-section 3.72 ASASSN-17lr

This object was detected as a transient at V=14.6 on 2017 September 4 by the ASAS-SN team. The outburst was announced after the observation of V=14.9 on 2017 Semtember 5. Observations on 2017 September 9 and 11 did not show superhump-like modulations. Superhumps were observed since 2017 September 15 (vsnet-alert 21443; e-figure 74). The times of superhump maxima are listed in e-table 68. Although a one-day alias 0.06047(3) d was stronger by the PDM method, we adopted this alias based on $O-C$ analysis of the continuous observations on 2017 September 17–18. Although the object was initially suggested to be a WZ Sge-type dwarf nova (vsnet-alert 21443), this was based on the absence of superhumps for a week after the discovery and not based on detection of early superhumps.

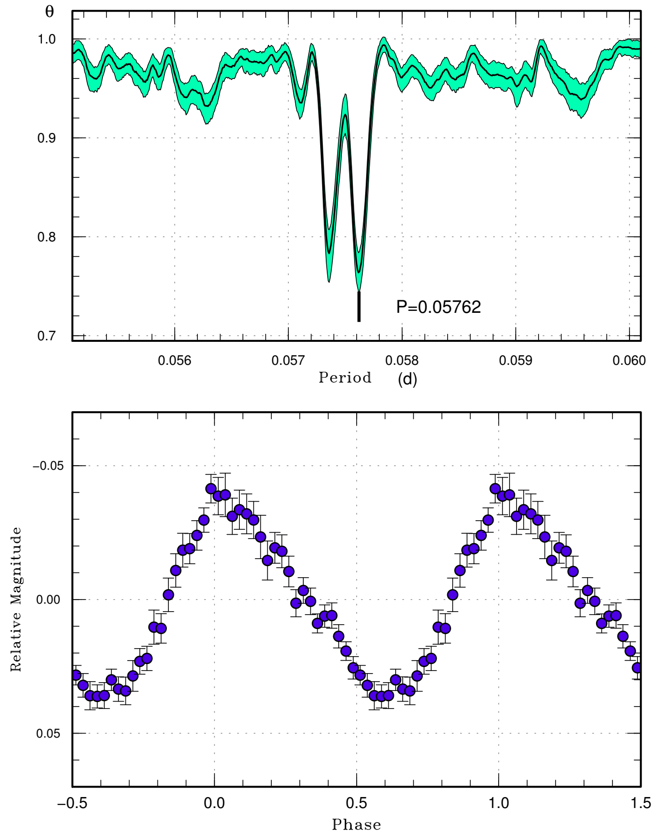
E-section 3.73 ASASSN-17me

This object was detected as a transient at V=15.2 on 2017 September 13 by the ASAS-SN team. The outburst

E-table 64. Superhump maxima of ASASSN-17kd (2017)

E	max*	error	$O-C$†	N‡
0	57974.8537	0.0033	−0.0129	17
17	57975.8959	0.0012	−0.0070	16
33	57976.8877	0.0013	0.0095	16
65	57978.8350	0.0015	0.0063	16
66	57978.8946	0.0007	0.0049	13
82	57979.8690	0.0008	0.0039	25
98	57980.8423	0.0010	0.0020	25
99	57980.9029	0.0022	0.0016	14
115	57981.8770	0.0011	0.0004	25
131	57982.8481	0.0014	−0.0038	25
147	57983.8250	0.0013	−0.0022	23
148	57983.8866	0.0023	−0.0016	21
164	57984.8694	0.0025	0.0060	25
180	57985.8377	0.0038	−0.0010	25
181	57985.9001	0.0030	0.0004	13
196	57986.8129	0.0025	−0.0011	21
197	57986.8729	0.0025	−0.0020	25
213	57987.8557	0.0030	0.0054	20
229	57988.8236	0.0030	−0.0020	20
230	57988.8799	0.0029	−0.0067	18

*BJD−2400000.
†Against max $= 2457974.8666 + 0.060956E$.
‡Number of points used to determine the maximum.



E-figure 69. Ordinary superhumps in ASASSN-17kg (2017). The data before the dip were used. (Upper): PDM analysis. (Lower): Phase-averaged profile.

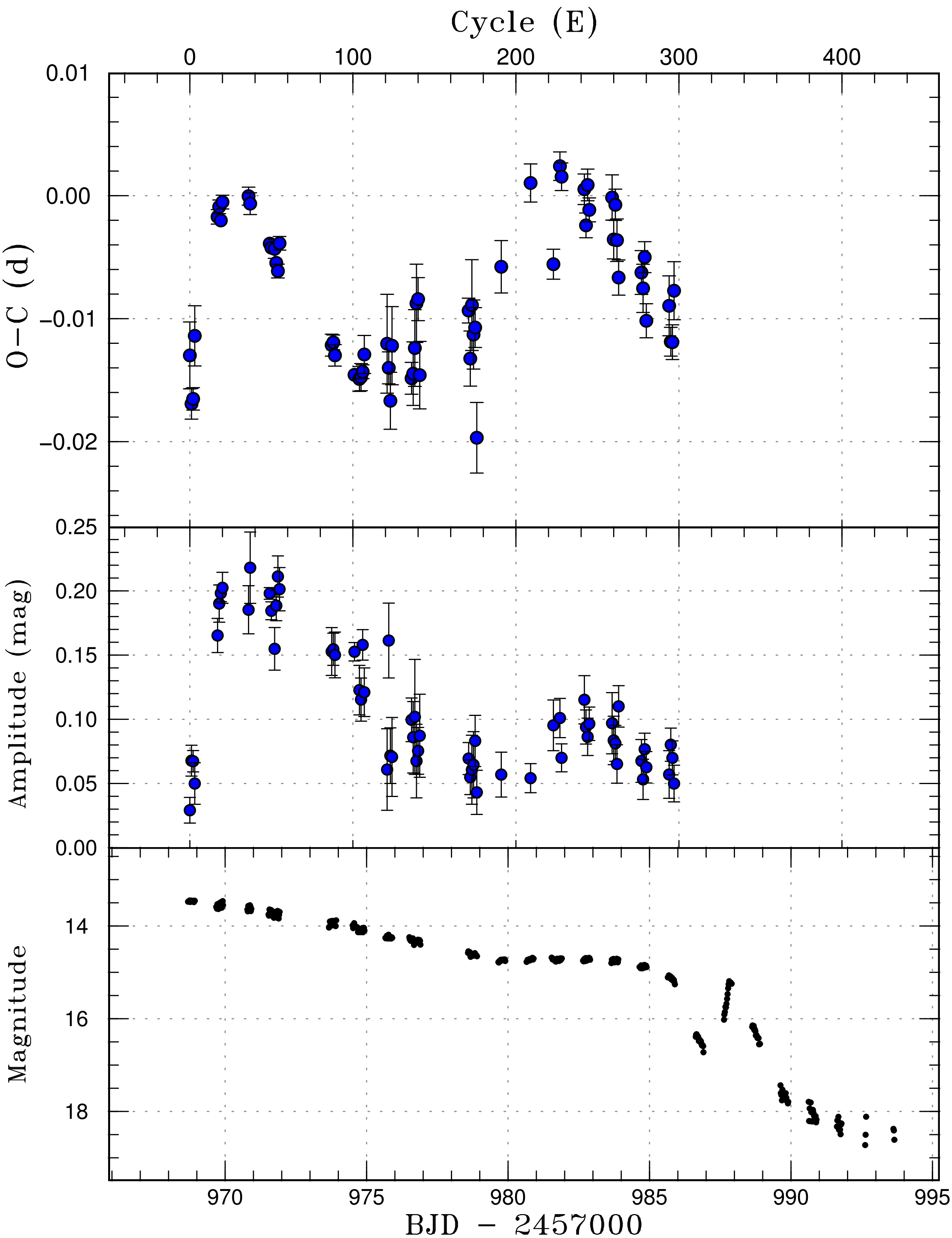
was announced after the observation of V=15.4 on 2017 Semtember 15. There is a likely quiescent counterpart g=21.45 mag object in Pan-STARRS (vsnet-alert 21440). Subsequent observations detected superhumps (vsnet-alert 21447, e-figure 75). Although there were observations on two additional nights, the object already started fading rapidly (2017 September 22 and 23) and superhumps were not detected. The superhump period based on single-nights observations was 0.0614(4) d (PDM method). The times of superhump maxima were BJD 2458013.6486(5) (N=162) and 2458013.7130(4) (N=186).

E-section 3.74 ASASSN-17np

This object was detected as a transient at g=15.0 on 2017 October 18 by the ASAS-SN team. The outburst was announced after the observation of g=15.2 on 2017 October 20. Subsequent observations detected superhumps (vsnet-alert 21534, 21535, 21545; e-figure 76). The times of superhump maxima are listed in e-table 69. Although observations were rather sparse, stages B and C can be recognized. The object called attention due to its absence of a known quiescent counterpart and hence a likely large outburst amplitude (cf. vsnet-alert 21531), the resultant superhump period suggests a rather ordinary SU UMa-type dwarf nova. The outburst amplitude may not be as large as initially suspected, or the object may be indeed unusual with a large outburst amplitude despite the long superhump period. The large amplitude of superhumps suggests an ordinary object rather than a WZ Sge-like object with a long superhump period such as ASASSN-16eg (Wakamatsu et al. 2017).

E-section 3.75 ASASSN-17nr

This object was detected as a transient at V=14.6 on 2017 October 18 by the ASAS-SN team. The outburst was announced after the observation of V=15.4 on 2017 October 21. Subsequent observations detected superhumps (vsnet-alert 21556; e-figure 77). The times of superhump maxima are listed in e-table 70. Although $O-C$ data suggested a positive P_{dot}, the value should be treated with caution due to the limited quality of observations. There remains possibilities of one-day aliases, although the $O-C$ analysis favors this selection (e-figure 77).



E-figure 70. $O-C$ diagram of superhumps in ASASSN-17kg (2017). (Upper:) $O-C$ diagram. We used a period of 0.05762 d for calculating the $O-C$ residuals. (Middle:) Amplitudes of superhumps. (Lower:) Light curve. The data were binned to 0.019 d. Note the presence of a dip just before the termination of the superoutburst.

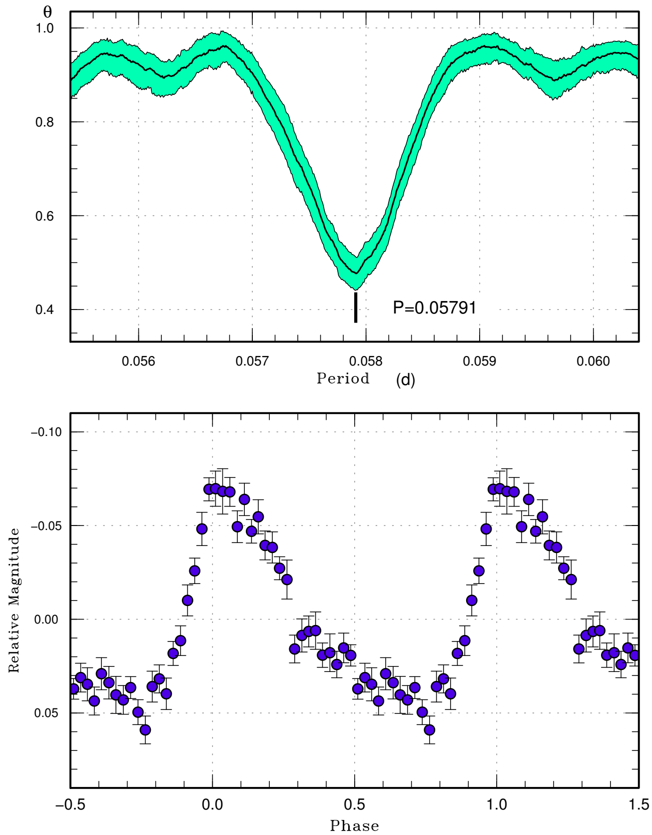
E-table 65. Superhump maxima of ASASSN-17kg (2017)

E	max*	error	$O-C$†	N‡	E	max*	error	$O-C$†	N‡
0	57968.7404	0.0027	−0.0033	13	139	57976.7538	0.0032	−0.0007	15
1	57968.7941	0.0012	−0.0072	17	140	57976.8118	0.0017	−0.0003	20
2	57968.8521	0.0009	−0.0068	20	141	57976.8632	0.0027	−0.0065	18
3	57968.9148	0.0024	−0.0017	10	171	57978.5971	0.0010	−0.0016	52
17	57969.7312	0.0006	0.0078	13	172	57978.6508	0.0022	−0.0055	43
18	57969.7896	0.0006	0.0086	17	173	57978.7127	0.0037	−0.0012	13
19	57969.8461	0.0003	0.0075	20	174	57978.7680	0.0028	−0.0036	17
20	57969.9053	0.0006	0.0090	13	175	57978.8262	0.0016	−0.0030	18
36	57970.8277	0.0007	0.0092	21	176	57978.8748	0.0029	−0.0120	18
37	57970.8847	0.0009	0.0086	18	191	57979.7530	0.0021	0.0017	21
49	57971.5729	0.0002	0.0052	140	209	57980.7970	0.0015	0.0083	35
50	57971.6301	0.0003	0.0049	86	223	57981.5971	0.0012	0.0015	27
52	57971.7453	0.0008	0.0048	14	227	57981.8355	0.0012	0.0095	24
53	57971.8018	0.0004	0.0036	20	228	57981.8923	0.0011	0.0086	20
54	57971.8587	0.0006	0.0030	18	242	57982.6979	0.0012	0.0074	16
55	57971.9186	0.0006	0.0052	8	243	57982.7526	0.0010	0.0045	25
87	57973.7542	0.0009	−0.0035	14	244	57982.8135	0.0013	0.0078	30
88	57973.8120	0.0006	−0.0032	21	245	57982.8691	0.0010	0.0057	24
89	57973.8686	0.0009	−0.0043	18	259	57983.6768	0.0018	0.0066	15
101	57974.5584	0.0004	−0.0060	46	260	57983.7310	0.0016	0.0031	17
104	57974.7310	0.0010	−0.0064	13	261	57983.7915	0.0013	0.0059	35
105	57974.7887	0.0011	−0.0063	19	262	57983.8462	0.0017	0.0031	24
106	57974.8468	0.0006	−0.0058	18	263	57983.9008	0.0014	0.0000	15
107	57974.9058	0.0015	−0.0044	11	277	57984.7079	0.0018	0.0003	17
121	57975.7134	0.0040	−0.0037	13	278	57984.7642	0.0020	−0.0011	31
122	57975.7690	0.0013	−0.0057	16	279	57984.8244	0.0013	0.0015	25
123	57975.8240	0.0023	−0.0084	19	280	57984.8768	0.0014	−0.0037	23
124	57975.8861	0.0032	−0.0039	18	294	57985.6847	0.0024	−0.0027	16
136	57976.5749	0.0013	−0.0067	50	295	57985.7394	0.0012	−0.0056	23
137	57976.6328	0.0026	−0.0064	31	296	57985.7970	0.0014	−0.0056	31
138	57976.6926	0.0031	−0.0043	12	297	57985.8588	0.0024	−0.0015	24

*BJD−2400000.

†Against max = 2457968.7437 + 0.057632E.

‡Number of points used to determine the maximum.



E-figure 71. Ordinary superhumps in ASASSN-17kp (2017). The data before the dip were used. (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 66. Superhump maxima of ASASSN-17kp (2017)

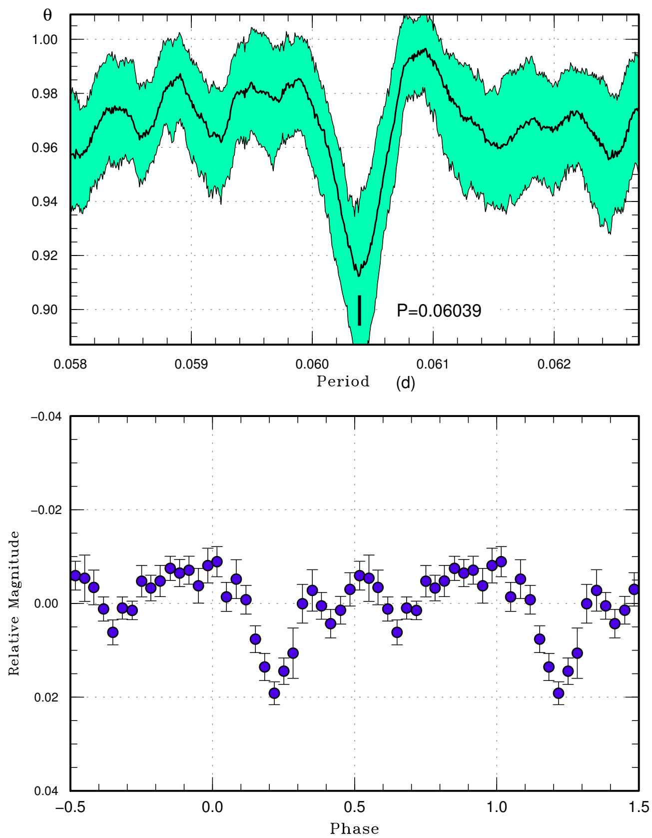
E	max*	error	$O-C$†	N‡
0	57978.5360	0.0007	0.0012	48
15	57979.4042	0.0010	0.0001	63
16	57979.4596	0.0026	−0.0026	24
17	57979.5217	0.0010	0.0016	62
32	57980.3889	0.0005	−0.0005	102
33	57980.4468	0.0007	−0.0006	119
34	57980.5045	0.0006	−0.0009	60
35	57980.5639	0.0017	0.0006	38
36	57980.6211	0.0017	−0.0001	37
51	57981.4919	0.0013	0.0012	41

*BJD−2400000.
†Against max $= 2457978.5348 + 0.057957E$.
‡Number of points used to determine the maximum.

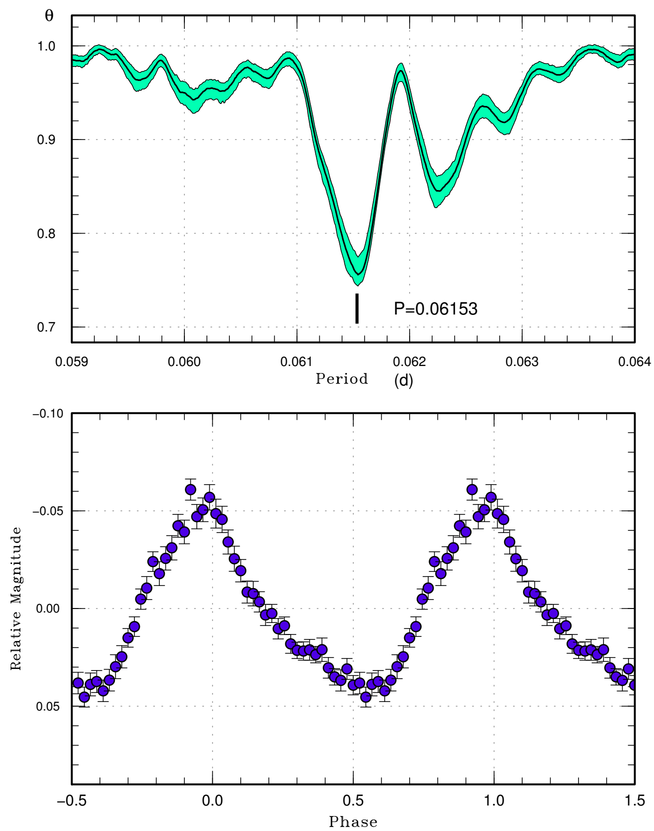
E-table 67. Superhump maxima of ASASSN-17la (2017)

E	max*	error	$O-C$†	N‡
0	57988.7336	0.0010	−0.0064	115
1	57988.7917	0.0012	−0.0098	115
15	57989.6640	0.0012	0.0004	76
16	57989.7291	0.0005	0.0039	116
17	57989.7909	0.0005	0.0041	114
18	57989.8546	0.0005	0.0062	92
27	57990.4106	0.0004	0.0081	85
28	57990.4712	0.0003	0.0071	149
29	57990.5328	0.0003	0.0071	121
30	57990.5938	0.0012	0.0065	46
31	57990.6547	0.0023	0.0059	39
32	57990.7172	0.0004	0.0068	83
33	57990.7775	0.0004	0.0055	92
34	57990.8395	0.0003	0.0059	81
65	57992.7391	0.0005	−0.0033	90
66	57992.8011	0.0006	−0.0029	80
77	57993.4765	0.0005	−0.0048	91
78	57993.5392	0.0006	−0.0037	102
79	57993.6030	0.0007	−0.0016	98
90	57994.2747	0.0006	−0.0072	26
91	57994.3367	0.0007	−0.0067	33
92	57994.4005	0.0006	−0.0045	34
93	57994.4616	0.0008	−0.0050	33
94	57994.5231	0.0007	−0.0051	33
95	57994.5876	0.0010	−0.0022	28
97	57994.7084	0.0008	−0.0045	63
98	57994.7713	0.0009	−0.0032	59
99	57994.8322	0.0013	−0.0039	46
106	57995.2674	0.0041	0.0003	18
107	57995.3243	0.0009	−0.0044	33
108	57995.3867	0.0015	−0.0036	32
109	57995.4481	0.0009	−0.0037	33
110	57995.5133	0.0016	−0.0001	33
111	57995.5716	0.0013	−0.0034	29
113	57995.6961	0.0010	−0.0021	63
114	57995.7573	0.0014	−0.0024	64
115	57995.8207	0.0015	−0.0006	60
116	57995.8775	0.0012	−0.0054	64
123	57996.3116	0.0016	−0.0023	33
124	57996.3726	0.0013	−0.0029	34
125	57996.4345	0.0024	−0.0025	33
126	57996.4985	0.0022	−0.0001	33
127	57996.5630	0.0035	0.0028	33
141	57997.4170	0.0019	−0.0053	37
172	57999.3422	0.0013	0.0110	39
173	57999.4026	0.0011	0.0099	43
174	57999.4644	0.0011	0.0101	42
175	57999.5281	0.0017	0.0122	44

*BJD−2400000.
†Against max $= 2457988.7400 + 0.061577E$.
‡Number of points used to determine the maximum.



E-figure 72. Early superhumps in ASASSN-17la (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 73. Ordinary superhumps in ASASSN-17la (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 68. Superhump maxima of ASASSN-17lr (2017)

E	max*	error	$O-C$†	N‡
0	58012.3909	0.0010	−0.0046	37
34	58014.3925	0.0019	0.0034	42
36	58014.5103	0.0015	0.0039	38
37	58014.5647	0.0014	−0.0003	48
102	58018.3738	0.0037	−0.0024	57

*BJD−2400000.

†Against max = 2458012.3955 + 0.058634E.

‡Number of points used to determine the maximum.

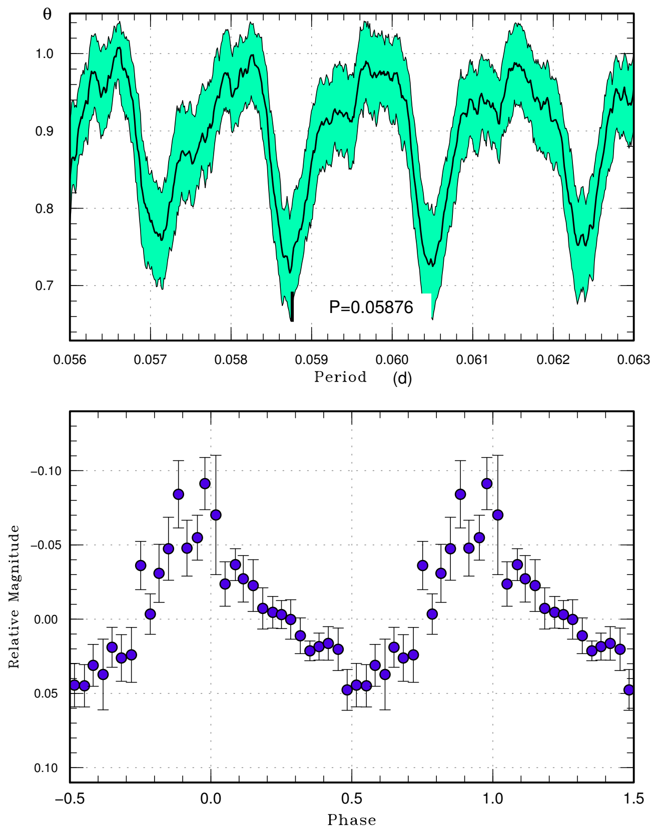
E-table 69. Superhump maxima of ASASSN-17np (2017)

E	max*	error	$O-C$†	N‡
0	58047.4968	0.0005	−0.0055	199
1	58047.5872	0.0004	−0.0039	205
10	58048.3899	0.0003	−0.0009	205
11	58048.4791	0.0003	−0.0006	205
12	58048.5701	0.0004	0.0016	131
25	58049.7293	0.0013	0.0056	11
26	58049.8161	0.0009	0.0036	26
37	58050.7943	0.0016	0.0043	17
48	58051.7706	0.0012	0.0031	16
49	58051.8592	0.0016	0.0029	15
59	58052.7441	0.0014	−0.0008	14
60	58052.8311	0.0019	−0.0027	21
70	58053.7185	0.0026	−0.0039	11
71	58053.8096	0.0016	−0.0016	20
79	58054.5201	0.0010	−0.0020	180
82	58054.7896	0.0059	0.0009	19

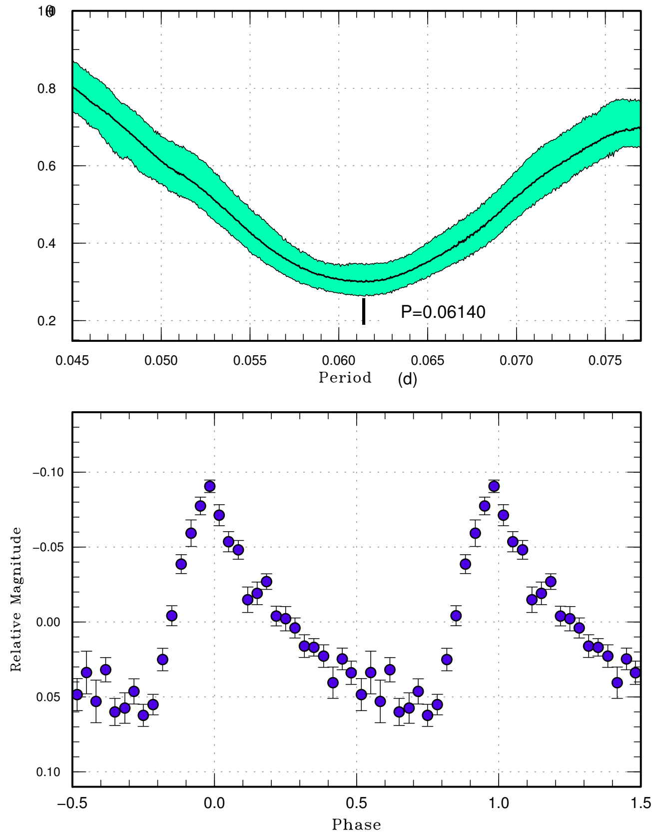
*BJD−2400000.

†Against max = 2458047.5022 + 0.088859E.

‡Number of points used to determine the maximum.



E-figure 74. Superhumps in ASASSN-17lr (2017). (Upper): PDM analysis. The alias selection was based on $O-C$ analysis. (Lower): Phase-averaged profile.



E-figure 75. Superhumps in ASASSN-17me (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 70. Superhump maxima of ASASSN-17nr (2017)

E	max*	error	$O-C$†	N‡
0	58052.8080	0.0029	0.0026	13
36	58054.8301	0.0017	−0.0036	13
53	58055.7903	0.0021	−0.0013	11
54	58055.8449	0.0020	−0.0030	13
71	58056.8071	0.0043	0.0014	16
72	58056.8618	0.0015	−0.0003	11
89	58057.8210	0.0011	0.0011	18
106	58058.7824	0.0051	0.0047	15
107	58058.8364	0.0015	0.0023	19
142	58060.8021	0.0045	−0.0040	17

*BJD−2400000.

†Against max = 2458052.8054 + 0.056343E.

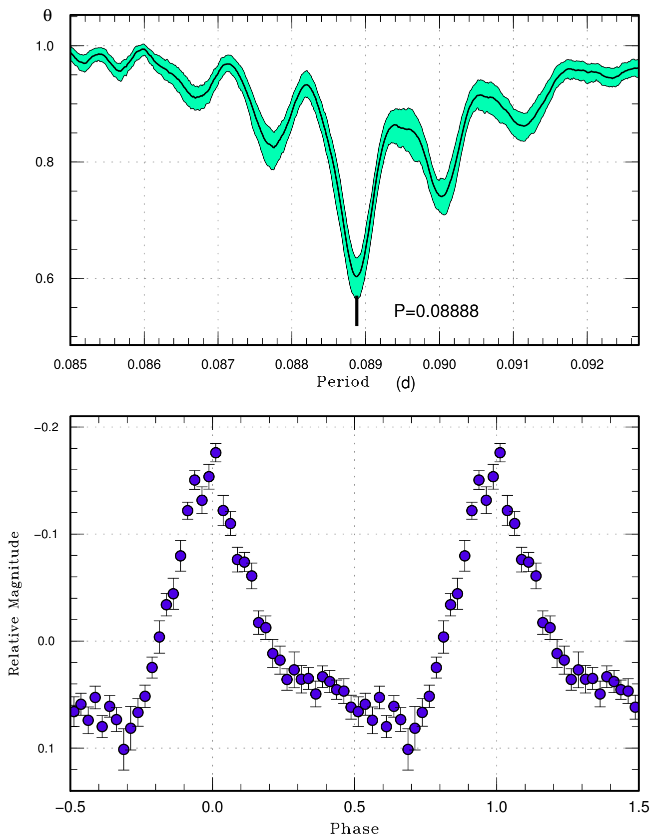
‡Number of points used to determine the maximum.

E-section 3.76 ASASSN-17of

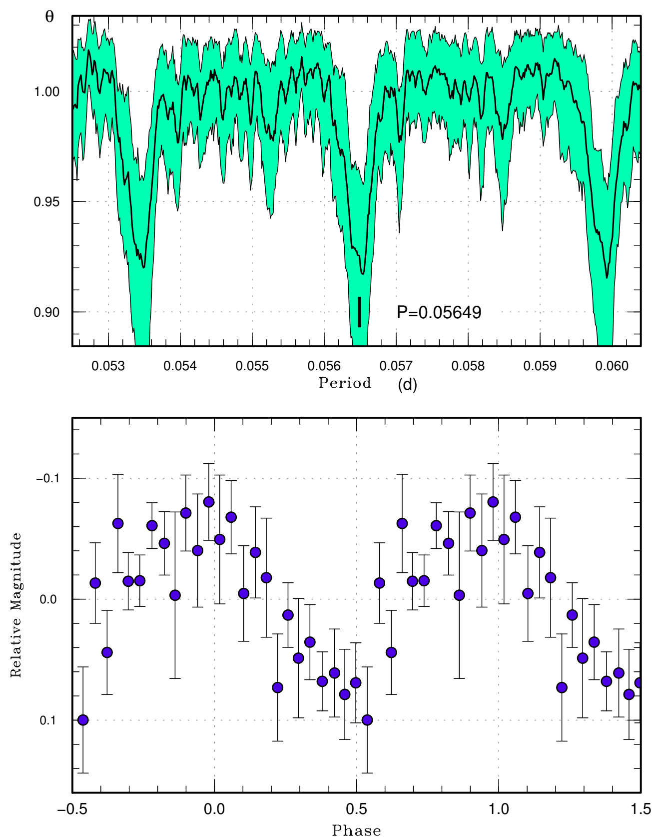
This object was detected as a transient at g=16.2 on 2017 November 3 by the ASAS-SN team. The outburst was announced after observations of g=17.0 on 2017 November 6 and g=16.8 on 2017 November 7. Subsequent observations detected superhumps (vsnet-alert 21567, 21580; e-figure 78). The times of superhump maxima are listed in e-table 71. Stages B and C can be recognized.

E-section 3.77 ASASSN-17oo

This object was detected as a transient at g=15.0 on 2017 November 1 by the ASAS-SN team. The outburst was announced after an observation of g=15.05 on 2017 November 10. Although subsequent observations detected superhumps (vsnet-alert 21591), individual maxima were difficult to measure. The presence of superhumps was, however, secure as shown in the PDM analysis (e-figure 79). It was likely that we observed superhumps with diminished amplitudes near the end of stage B or in stage C (due to the delay in confirmation of the outburst, our observations started 14 d after the initial out-



E-figure 76. Superhumps in ASASSN-17np (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 77. Superhumps in ASASSN-17nr (2017). (Upper): PDM analysis. The alias selection was based on $O-C$ analysis. (Lower): Phase-averaged profile.

E-table 71. Superhump maxima of ASASSN-17of (2017)

E	max*	error	$O-C$†	N‡
0	58065.2348	0.0059	−0.0121	18
1	58065.3140	0.0022	0.0032	21
47	58068.2582	0.0011	0.0021	55
57	58068.8988	0.0028	0.0024	53
58	58068.9647	0.0017	0.0043	62
59	58069.0280	0.0025	0.0036	61
74	58069.9920	0.0024	0.0071	60
79	58070.3085	0.0023	0.0035	48
80	58070.3719	0.0019	0.0028	48
94	58071.2616	0.0016	−0.0038	46
94	58071.2616	0.0016	−0.0038	45
109	58072.2166	0.0016	−0.0093	24

*BJD−2400000.

†Against max = 2458065.2468 + 0.064027E.

‡Number of points used to determine the maximum.

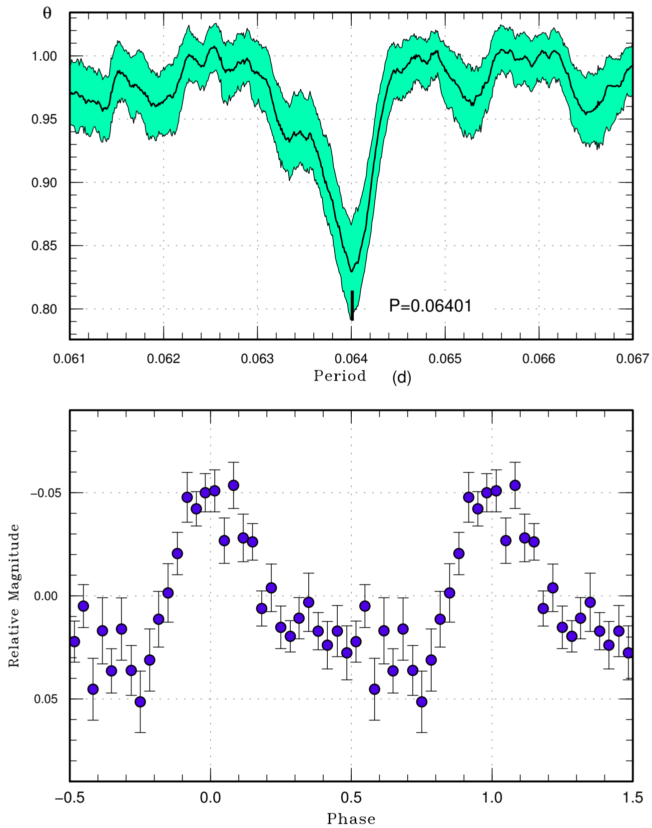
burst detection). The superhump period was measured to be 0.06781(5) d by the PDM method.

E-section 3.78 ASASSN-17ou

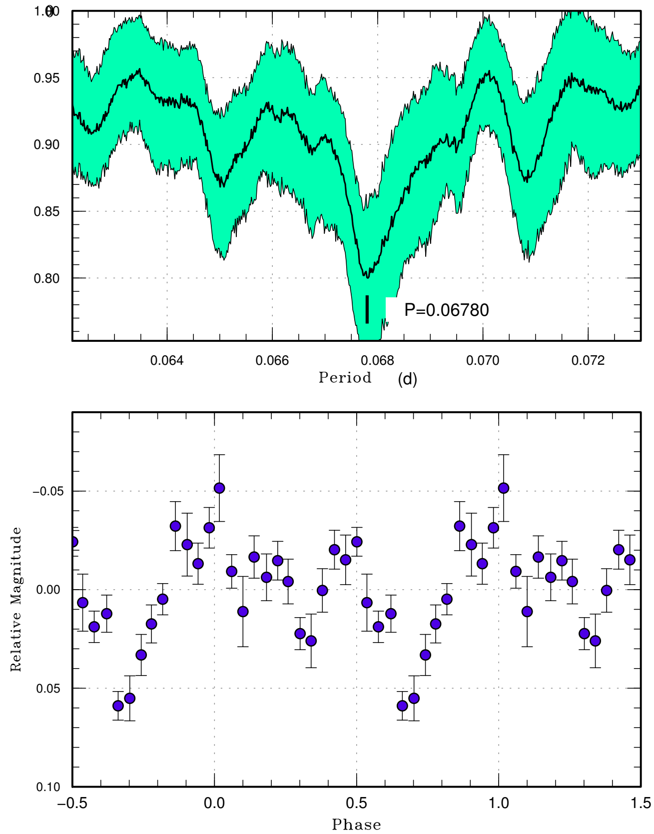
This object was detected as a transient at g=16.6 on 2017 November 10 by the ASAS-SN team. The outburst was announced after observations of g=16.9 on 2017 November 11, g=17.1 on 2017 November 12 and g=17.1 on 2017 November 13. Subsequent observations detected superhumps (vsnet-alert 21588, 21589, 21590; e-figure 80). The times of superhump maxima are listed in e-table 72.

E-section 3.79 ASASSN-17pb

This object was detected as a transient at V=15.8 on 2017 November 13 by the ASAS-SN team. The outburst was announced after an observation of V=16.1 on 2017 November 14. Subsequent observations detected superhumps (vsnet-alert 21599, 21605, 21642; e-figure 81). The times of superhump maxima are listed in e-table 73. The



E-figure 78. Superhumps in ASASSN-17of (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 79. Superhumps in ASASSN-17oo (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 72. Superhump maxima of ASASSN-17ou (2017)

E	max*	error	$O-C$†	N‡
0	58072.2353	0.0014	0.0037	21
1	58072.2901	0.0002	0.0014	262
2	58072.3471	0.0003	0.0012	236
12	58072.9174	0.0029	0.0003	43
13	58072.9753	0.0017	0.0011	58
14	58073.0226	0.0013	−0.0088	49
23	58073.5451	0.0017	−0.0004	19
51	58075.1502	0.0016	0.0051	20
52	58075.1996	0.0006	−0.0027	40
53	58075.2584	0.0008	−0.0010	55
54	58075.3137	0.0008	−0.0027	51
70	58076.2332	0.0004	0.0027	49

*BJD−2400000.

†Against max = 2458072.2316 + 0.057128E.

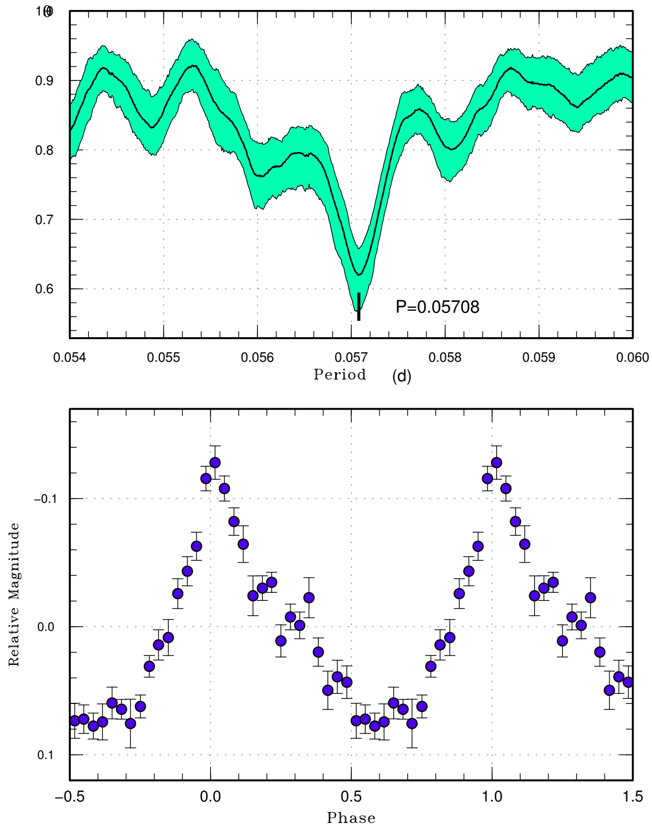
‡Number of points used to determine the maximum.

epoch for E=0 was a stage A superhump. The epochs for E=23 and 24 may be during the transition to stage B. The epoch for E=128 probably corresponds to a stage C superhump. On the first two nights (2017 November 15 and 16), the object did not show superhump-like modulations. There was a suggestion of low-amplitude modulations with a period of 0.0169(2) d (e-figure 82). This period is not related to the superhump one and the origin of this variation is unclear.

E-section 3.80 CRTS J044027.1+023301

This object (=CSS090219:044027+023301, hereafter CRTS J044027) was detected as a transient by CRTS on 2009 February 19. The object has an X-ray counterpart of 1RXS J044027.0+023300.

The 2017 outburst was detected by the ASAS-SN team at V=14.56 on 2017 August 30. This outburst was originally suspected to be a normal one due to its large fading rate (vsnet-alert 21388). Subsequent observations, however, detected superhumps (vsnet-alert 21397, 21411; figure 83). The detection on 2017 August 30 was probably



E-figure 80. Superhumps in ASASSN-17ou (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 73. Superhump maxima of ASASSN-17pb (2017)

E	max*	error	$O-C$†	N‡
0	58075.5735	0.0009	−0.0129	56
23	58077.3332	0.0005	−0.0032	68
24	58077.4116	0.0007	−0.0009	53
47	58079.1640	0.0034	0.0014	11
48	58079.2417	0.0012	0.0030	19
61	58080.2283	0.0017	0.0005	47
62	58080.3070	0.0010	0.0031	70
63	58080.3847	0.0007	0.0047	102
64	58080.4646	0.0023	0.0086	13
74	58081.2182	0.0022	0.0012	32
75	58081.2894	0.0025	−0.0037	46
84	58081.9851	0.0020	0.0072	15
85	58082.0581	0.0190	0.0042	7
88	58082.2825	0.0021	0.0003	28
89	58082.3616	0.0007	0.0034	22
97	58082.9731	0.0019	0.0062	12
100	58083.1950	0.0038	−0.0003	33
101	58083.2748	0.0016	0.0035	58
102	58083.3417	0.0017	−0.0057	28
128	58085.3051	0.0021	−0.0206	20

*BJD−2400000.
†Against max = 2458075.5865 + 0.076088E.
‡Number of points used to determine the maximum.

of a precursor outburst. The times of superhump maxima are listed in e-table 74. Although E=1 appears to be a stage A superhump, we could not determine the period. Later observations probably recorded stage B superhumps since the object faded soon after these observations.

There was another superoutburst in the ASAS-SN data peaking on 2016 February 27 at V=14.56. Another detection on 2012 September 22 at V=15.37 probably corresponds to a normal outburst. CRTS detected additional two faint outbursts in addition to the 2009 one (all of them were apparently normal outbursts).

E-table 74. Superhump maxima of CRTS J044027 (2017)

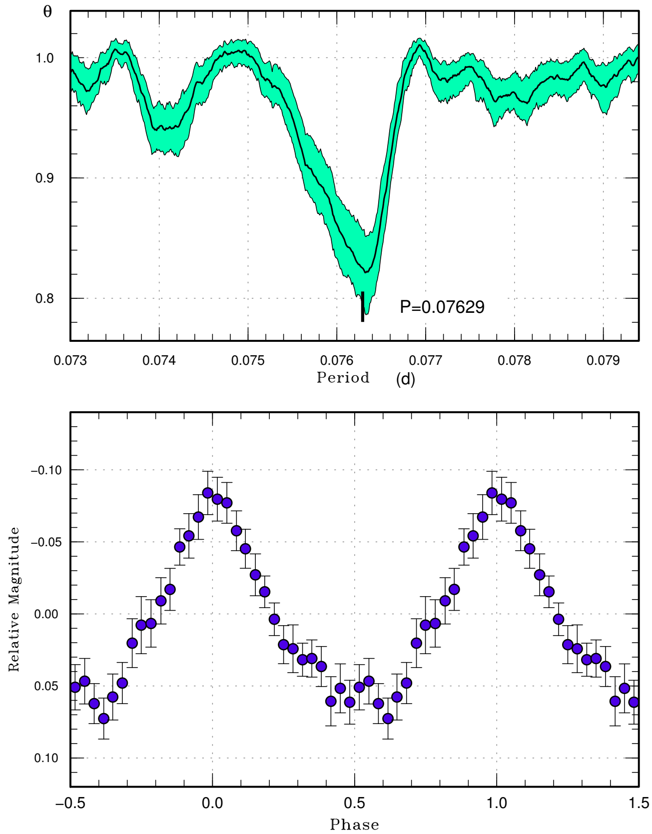
E	max*	error	$O-C$†	N‡
0	57999.6124	0.0005	−0.0031	47
49	58002.7769	0.0012	0.0035	23
50	58002.8377	0.0016	−0.0002	22
64	58003.7440	0.0024	0.0039	22
65	58003.8044	0.0014	−0.0002	22
66	58003.8702	0.0020	0.0011	22
80	58004.7722	0.0024	0.0008	34
81	58004.8343	0.0027	−0.0015	31
96	58005.8013	0.0022	−0.0012	23
97	58005.8641	0.0021	−0.0029	31

*BJD−2400000.
†Against max = 2457999.6154 + 0.064449E.
‡Number of points used to determine the maximum.

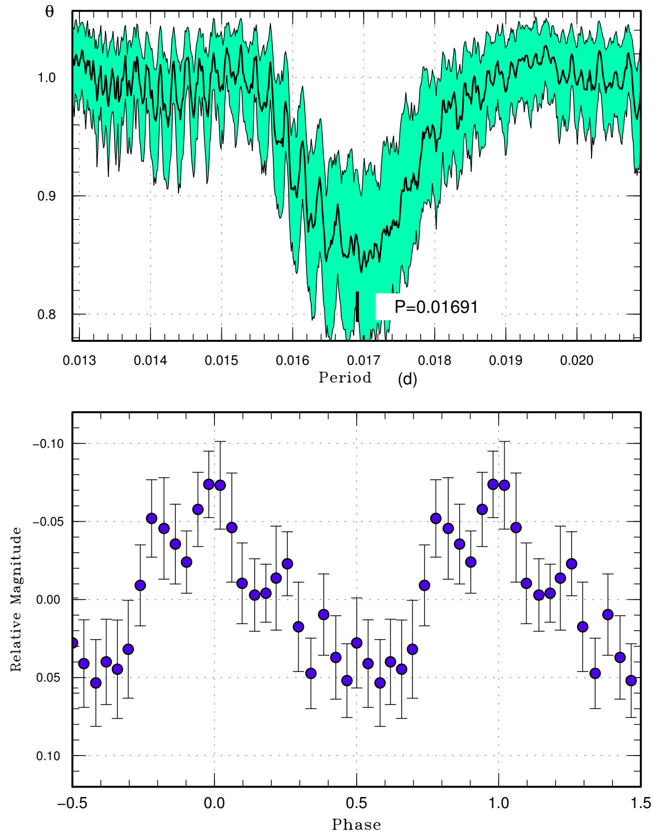
E-section 3.81 CRTS J080941.3+171528

This object (=CSS120120:080941+171528, hereafter CRTS J080941) was detected as a transient by CRTS on 2012 January 20.

The 2017 outburst was detected by the ASAS-SN team at V=15.3 on 2017 April 8 and announced after observation of V=15.4 on 2017 April 9. The large outburst amplitude and past behavior suggested a super-



E-figure 81. Superhumps in ASASSN-17pb (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 82. Short-term modulations on the first two nights in ASASSN-17pb (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

outburst (vsnet-alert 20888). Subsequent observations detected long-period superhumps (vsnet-alert 20893, 20906, 20912; e-figure 84). The times of superhump maxima are listed in e-table 75. The period for $E \leq 12$ was substantially longer. The difference of the periods before and after E=12 was 1.2%, which is too large to be considered as stage B-C transition. We rather consider that this reflects stage A-B transition, as have been recently recorded in many SU UMa-type dwarf novae with long superhump periods (V1006 Cyg and MN Dra: Kato et al. 2016c; CRTS J214738.4+244554 and OT J064833.4+065624: Kato et al. 2015, KK Tel, possibly V452 Cas and ASASSN-15cl: Kato et al. 2016b, MASTER OT J021315.37+533822.7: Kato et al. 2017a, OT J002656.6+284933 = CSS101212:002657+284933: Kato et al. 2017b).

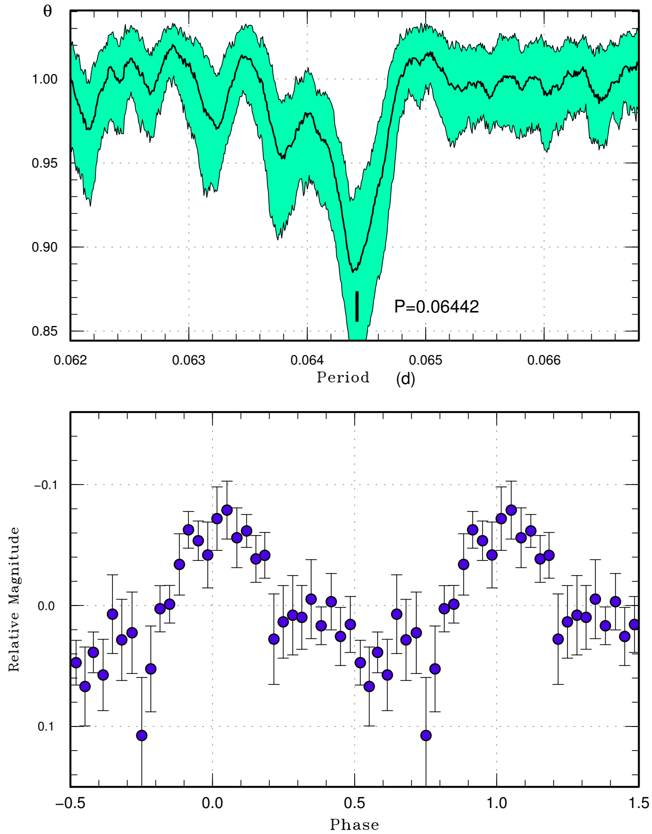
CRTS J080941 is not only an SU UMa-type dwarf nova in the middle of the period gap but also shows superhump evolution common to many long-period SU UMa-type dwarf novae. Since (supposed) stage A superhumps were detected, determination of the orbital period is highly desired to determine the mass ratio in such a system in the middle of the period gap.

CRTS recorded two past outbursts: 2007 May 11 (15.8 mag) and 2012 January 20 (16.3 mag). No past outbursts were detected in the ASAS-SN data starting from 2012 January.

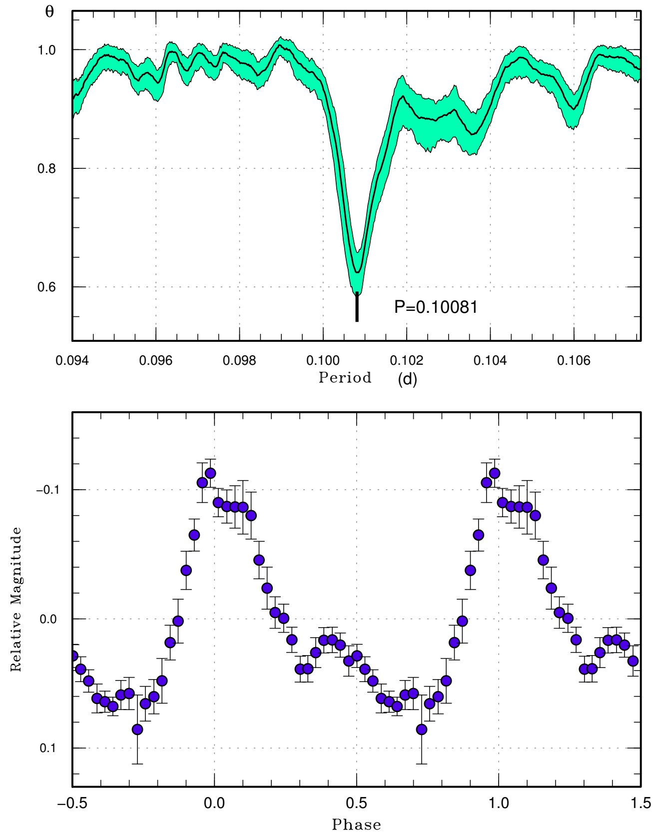
E-section 3.82 CRTS J120052.9−152620

This object (=CSS110205:120053−152620, hereafter CRTS J120052) was discovered by the CRTS on 2011 February 5. The 2011 and 2016 superoutbursts were reported in Kato et al. (2012a) and Kato et al. (2016b), respectively. The 2017 superoutburst was detected by the ASAS-SN team at V=13.8 on 2017 April 24. Single-night observations were performed and obtained two superhump maxima: BJD 2457867.0363(3) (N=159) and 2457867.1236(4) (N=167).

This object showed many outbursts. Among them, we listed likely/possible superoutbursts in e-table 76 (in the case of ASAS-3 and ASAS-SN, the identifications were based on durations; in the case of CRTS, we selected possible ones based on brightness since they were single-night detections). The maxima after 2006 appear to be



E-figure 83. Superhumps in CRTS J044027 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 84. Superhumps in CRTS J080941 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 75. Superhump maxima of CRTS J080941 (2017)

E	max*	error	$O-C$†	N‡
0	57853.3307	0.0008	−0.0056	84
1	57853.4269	0.0004	−0.0101	104
10	57854.3463	0.0005	0.0030	97
11	57854.4452	0.0009	0.0011	63
12	57854.5495	0.0009	0.0047	35
20	57855.3607	0.0048	0.0103	18
22	57855.5545	0.0011	0.0027	33
32	57856.5585	0.0016	−0.0004	27
42	57857.5622	0.0014	−0.0037	35
49	57858.2770	0.0051	0.0060	54
52	57858.5710	0.0016	−0.0021	36
62	57859.5741	0.0040	−0.0060	34

*BJD−2400000.

†Against max = 2457853.3363 + 0.100707E.

‡Number of points used to determine the maximum.

well expressed by a supercycle of 200.7(9) d. The period was stable at 192(2) d between 2006 and 2009 and apparently lengthened to 203(1) d after that. The cycle count between 2001 and 2006 was unclear and we couldn't determine the supercycle uniquely. This object appears to be a relatively ordinary SU UMa-type dwarf nova with frequent outbursts.

E-section 3.83 CRTS J122221.6−311524

Although we have already reported the 2013 superoutburst and claimed the object to be a best candidate for a period bouncer (Kato et al. 2013b), we treat this object again since Neustroev et al. (2017) reported a spectroscopic orbital period of 109.80(7) min [0.07625(5) d]. Since we have a period of stage A superhumps [0.07721(1) d], we can now directly estimate the mass ratio. The value of ϵ^* for stage A superhumps is 0.0124(6), which corresponds to q=0.032(2). This value supersedes our previous constraint (Kato et al. 2013b) and the q value based on stage B superhumps with a large uncertainty (Neustroev et al. 2017). The value is sufficiently low to give strong

E-table 76. List of possible superoutbursts of CRTS J120052

Year	Month	Day	max*	mag†	Source
2001	2	14	51954	13.4V	ASAS-3
2006	5	21	53876	14.0V	ASAS-3
2007	6	2	54254	14.1V	ASAS-3
2007	12	22	54457	13.9V	ASAS-3
2008	6	7	54625	14.0C	CRTS, ASAS-3
2009	1	8	54840	13.7V	ASAS-3
2009	7	18	55031	13.9C	CRTS
2010	1	18	55215	13.8C	CRTS
2015	2	1	57055	13.6V	ASAS-SN
2016	3	14	57462	13.8V	ASAS-SN
2017	4	24	57867	13.7V	ASAS-SN

*JD−2400000.
†C means unfiltered CCD.

E-table 77. List of past outbursts of CRTS J162806

Year	Month	Day	max*	mag†	Source
2005	9	14	53628	15.3C	CRTS
2006	6	20	53907	16.0C	CRTS
2007	4	10	54201	14.1C	CRTS
2011	6	10	55723	14.2C	CRTS
2013	10	1	56567	14.1C	CRTS
2017	3	11	57823	14.6V	ASAS-SN

*JD−2400000.
†C means unfiltered CCD.

credence to the period-bouncer status.

E-section 3.84 CRTS J162806.2+065316

The object was detected as a transient (=CSS110611:162806+065316; hereafter CRTS J162806) by CRTS on 2011 June 11. The 2011 superoutburst was studied in Kato et al. (2013a). The 2017 superoutburst was detected by the ASAS-SN team at V=14.64 on 2017 March 11. Only one superhump was recorded: BJD 2457825.5805(9) (N=76).

Although this field has been monitored by the ASAS-SN team since 2012 April 1, no other secure outburst was recorded. The 2013 October outburst fell in the gap of the ASAS-SN observations. The three outbursts detected by CRTS since 2007 were likely superoutbursts (e-table 77). The intervals of known (likely) superoutbursts were 1522 d, 844 d and 1256 d. Considering the sparse past observations of CRTS, the frequency of outbursts in this system probably is not very low.

E-section 3.85 CRTS J214934.1−121908

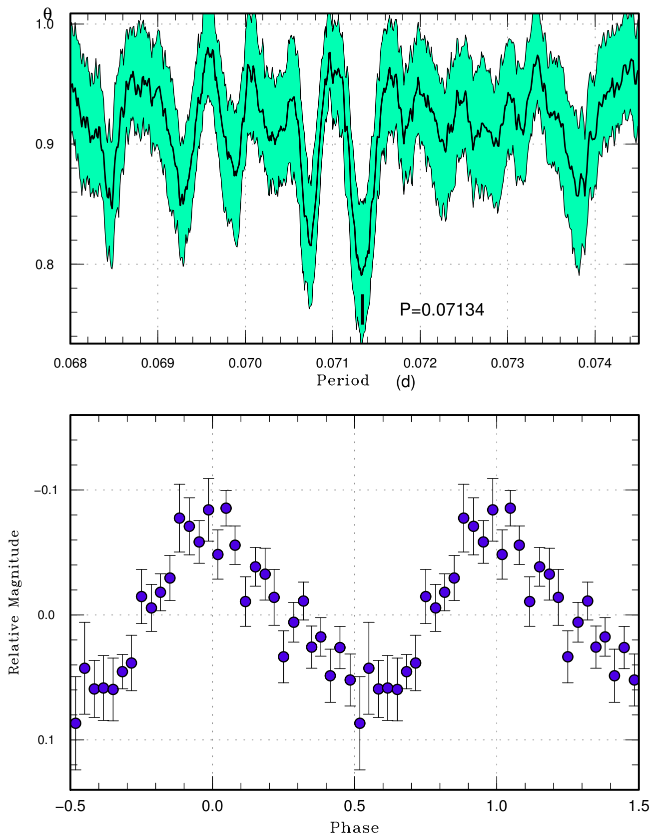
The object was detected as a transient (=CSS120922:214934−121908; hereafter CRTS J214934) by CRTS on 2012 September 22. The SU UMa-type nature was confirmed by single-night observations in Kato et al. (2014b).

The 2017 superoutburst was detected by the ASAS-SN team at V=15.69 on 2017 October 8. Subsequent observations detected superhumps (vsnet-alert 21511; e-figure 85). The times of superhump maxima are listed in e-table 78. Although observations were insufficient, the data suggest stage B-C transition. The period of stage B superhumps given in the table should refer to a lower limit since stage B likely ended before E=64.

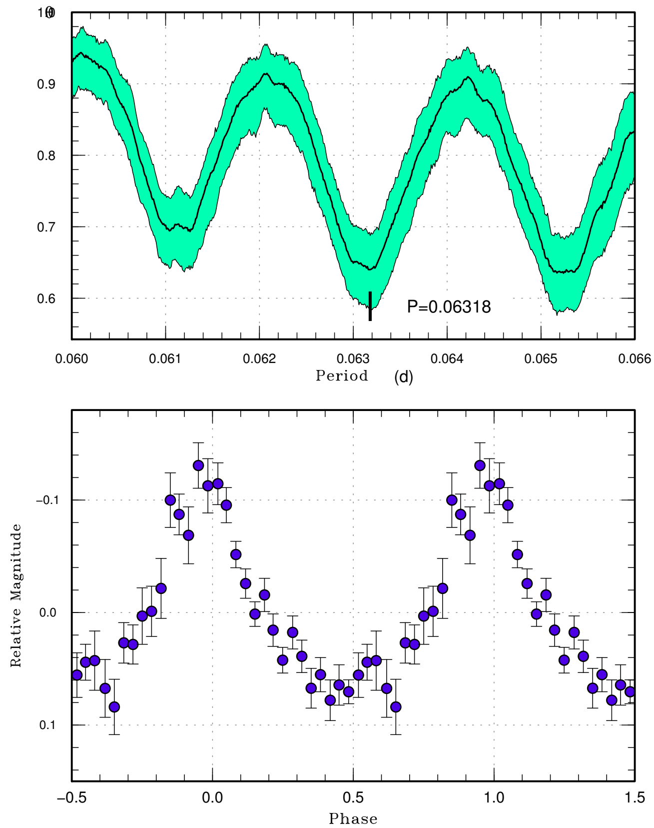
We listed superoutbursts in the ASAS-SN data in e-table 79. The interval between the 2012 superoutburst and the 2013 one was 284 d. The interval between the 2013 and 2014 superoutbursts was 332 d. Assuming that there were four supercycles between 2014 and 2017, the supercycle was estimated to be 308(3) d.

E-section 3.86 CRTS J223235.4+304105

The object was detected as a transient (=CSS081107:223235+304105; hereafter CRTS J223235) by CRTS on 2008 November 7 (Drake et al. 2014). The 2017 outburst was detected by the ASAS-SN team (the name ASASSN-17nw was assigned) at V=17.7 on 2017 October 18 and was announced after the object brightened to V=15.9 on 2017 October 19. Subsequent observations detected superhumps (vsnet-alert 21551, 21553; e-figure 86). The times of superhump maxima are listed in e-table 80.



E-figure 85. Superhumps in CRTS J214934 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 86. Superhumps in CRTS J223235 (2017). (Upper): PDM analysis. The alias was selected by $O-C$ analysis. (Lower): Phase-averaged profile.

E-table 78. Superhump maxima of CRTS J214934 (2017)

E	max*	error	$O-C$†	N‡
0	58036.9845	0.0019	−0.0020	63
1	58037.0564	0.0015	−0.0015	69
64	58041.5593	0.0035	0.0040	16
65	58041.6313	0.0030	0.0045	27
92	58043.5531	0.0033	−0.0011	16
93	58043.6280	0.0019	0.0024	28
106	58044.5494	0.0033	−0.0043	15
107	58044.6231	0.0095	−0.0019	20

*BJD−2400000.
†Against max $= 2458036.9865 + 0.071388E$.
‡Number of points used to determine the maximum.

E-table 79. List of superoutbursts of CRTS J214934 in the ASAS-SN data

Year	Month	Day	max*	V mag
2013	7	3	56477	15.7
2014	5	31	56809	15.4
2017	10	7	58034	15.6

*JD−2400000.

E-table 80. Superhump maxima of CRTS J223235 (2017)

E	max*	error	$O-C$†	N‡
0	58054.5328	0.0017	0.0004	47
28	58056.2899	0.0011	−0.0063	44
29	58056.3626	0.0017	0.0034	72
30	58056.4225	0.0017	0.0003	73
31	58056.4874	0.0011	0.0022	107
32	58056.5483	0.0015	0.0001	60

*BJD−2400000.
†Against max $= 2458054.5324 + 0.062994E$.
‡Number of points used to determine the maximum.

E-table 81. List of superoutbursts of CTCV J1940 in the ASAS-SN data

Year	Month	Day	max*	V mag
2015	11	3	57330	13.0
2016	5	28	57537	13.9
2016	10	25	57687	13.3
2017	4	7	57851	13.5
2017	8	29	57995	13.4†

*JD−2400000.

†Visually detected 2 d earlier.

E-table 82. Superhump maxima of CTCV J1940 (2017)

E	max*	error	$O-C$†	N‡
0	57994.6257	0.0016	−0.0029	19
13	57995.6269	0.0017	0.0016	18
26	57996.6239	0.0016	0.0019	24
39	57997.6202	0.0020	0.0016	25
52	57998.6136	0.0019	−0.0017	27
65	57999.6099	0.0012	−0.0021	18
66	57999.6912	0.0018	0.0025	20
78	58000.6071	0.0026	−0.0016	25
79	58000.6860	0.0029	0.0006	19

*BJD−2400000.

†Against max = 2457994.6286 + 0.076668E.

‡Number of points used to determine the maximum.

E-section 3.87 CTCV J1940−4724

This object (hereafter CTCV J1940) was detected as a CV by Calán-Tololo Survey (Augusteijn et al. 2010). Augusteijn et al. (2010) obtained an orbital period of 0.0809(30) d using a set of 18 spectroscopic observations taken over a baseline of 0.11 d. Since the period suggested an SU UMa-type dwarf nova, a systematic search for outbursts was conducted (cf. vsnet-alert 21188). Although the outburst detected on 2017 July 1 turned out to be a normal outburst, a precursor outburst (2017 August 19–20) and an apparent superoutburst starting on 2017 August 27 were visually detected by R. Stubbings (vsnet-alert 21370). Subsequent observations detected superhumps (vsnet-alert 21378). The resultant data, however, were not ideally spaced and there remained an ambiguity in choosing the alias. Although the PDM analysis favored a period of 0.07124(8) d, an $O-C$ analysis gave a systematic trend and preferred 0.07667(7) d. We adopted the latter, which is also marginally consistent with the approximate orbital period by Augusteijn et al. (2010) in estimating cycle counts in e-table 82.

We listed superoutbursts in the ASAS-SN data in e-table 81. The data suggest a supercycle of 168(6) d. This supercycle is also consistent with the ASAS-3 data, which detected several long outbursts though they were not as well sampled as in the ASAS-SN data.

E-section 3.88 DDE 51

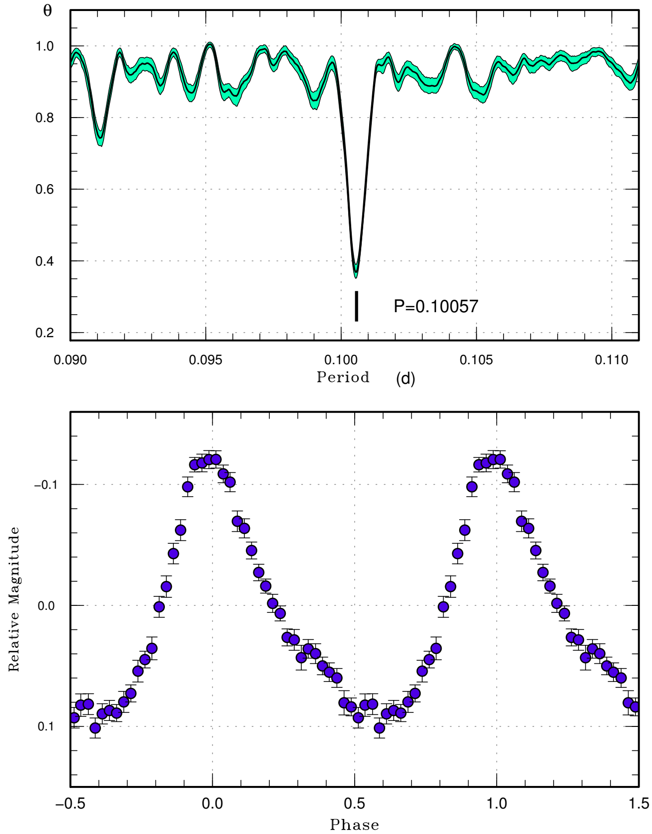
DDE 51 was discovered as a dwarf nova by D. Denisenko.[11] Denisenko monitored this object and found an outburst at an unfiltered CCD magnitude of 16.52 on 2017 September 28 (vsnet-alert 21475). The object further brightened and reached an unfiltered CCD magnitude of 15.58 on 2017 September 30. The initial superhump detection was made by Oleg Milantiev (vsnet-alert 21489). Further observations clarified that this object is an SU UMa-type in the period gap by detecting long-period superhumps (vsnet-alert 21490, 21491, 21493; e-figure 87). The times of superhump maxima are listed in e-table 83. It is apparent that there was a stage transition between E=12 and E=30. Considering the similarity with the SU UMa-type dwarf novae in the period gap V1006 Cyg and MN Dra (Kato et al. 2016c), we consider that superhumps for $E \leq 12$ were stage A superhumps despite large superhump amplitudes (see also a discussion in subsection E-section 3.81). Determination of the orbital period will be a crucial test for this interpretation.

Among outbursts recorded by the ASAS-SN team (e-table 84), only the 2017 September–October one appears to be a superoutburst. Observations are not yet sufficient to determine the supercycle.

E-section 3.89 MASTER OT J132501.00+431846.1

Although this object has not been identified as an SU UMa-type dwarf nova, we include it due to its special characteristics. This object (hereafter MASTER J132501) was detected as a transient at an unfiltered CCD magnitude of 15.4 on 2017 June 5 (Balanutsa et al. 2017). The object was initially proposed to be a large-amplitude WZ Sge-type dwarf nova. There were, however, no early superhumps (vsnet-alert 21107). Based on this negative detection and further brightening, Denisenko (2017) suggested this object to be a likely supernova in NGC 5145. Although we had observations on three nights between 2017 June 7 and 11, no periodic signal was detected. The object, however, faded quickly (vsnet-alert 21130), which appears to be inconsistent with the supernova classification. Although the object was again suspected to be a dwarf nova, the behavior is unusual (fading at a rate of $\sim$0.5 mag d^{-1}, which suggests an SS Cyg-type dwarf

[11] <http://scan.sai.msu.ru/~denis/VarDDE.html>.



E-figure 87. Superhumps in DDE 51 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 83. Superhump maxima of DDE 51 (2017)

E	max*	error	$O-C$†	N‡
0	58028.4266	0.0005	−0.0099	112
1	58028.5285	0.0021	−0.0085	50
9	58029.3409	0.0008	−0.0002	81
10	58029.4476	0.0014	0.0059	46
11	58029.5420	0.0005	−0.0001	100
12	58029.6449	0.0009	0.0022	45
30	58031.4572	0.0007	0.0052	87
49	58033.3685	0.0013	0.0066	106
50	58033.4669	0.0010	0.0044	93
57	58034.1696	0.0005	0.0035	180
70	58035.4750	0.0004	0.0022	92
71	58035.5733	0.0005	−0.0001	96
76	58036.0759	0.0005	−0.0001	148
77	58036.1743	0.0007	−0.0022	164
108	58039.2839	0.0005	−0.0087	85

*BJD−2400000.

†Against max = 2458028.4365 + 0.100520E.

‡Number of points used to determine the maximum.

E-table 84. List of outbursts of DDE 51 in the ASAS-SN data

Year	Month	Day	max*	V mag
2016	5	12	57521	16.5
2016	10	26	57688	16.0
2017	6	16	57921	15.8
2017	9	29	58026	15.2

*JD−2400000.

nova, while the amplitude exceeds 8 mag). No spectroscopic observation was reported. This object probably would require future deep observations to clarify the nature.

E-section 3.90 MASTER OT J174305.70+231107.8

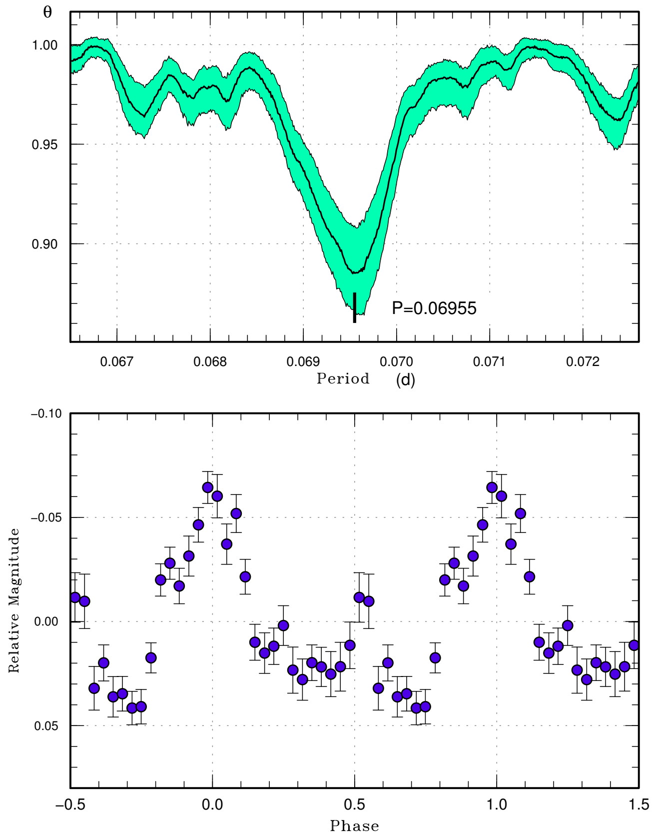
This object (hereafter MASTER J174305) is a transient detected at an unfiltered CCD magnitude of 15.6 on 2012 April 5 (Balanutsa et al. 2012). Although 2012 observations established the SU UMa-type classification, only two superhumps were recorded (Kato et al. 2013a).

The 2017 superoutburst was recorded by the ASAS-SN team (cf. vsnet-alert 21024). Superhumps were detected (vsnet-alert 21034, 21043; e-figure 88). The times of superhump maxima are listed in e-table 85. Although stages B and C were apparently recorded, the determined periods were not precise due to the limited quality of the data. The mean superhump period with the PDM method [0.06955(3) d], however, is sufficiently reliable.

The field of this object has been monitored since 2012 March 17 by the ASAS-SN team and the coverage has been particularly good since 2012 September. The object has been regularly caught in outbursts and they are listed in e-table 86. All these outbursts were superoutburst as judged from outburst durations. In additions to them, there were single-night outburst detections at an unfiltered CCD magnitude of 17.3 on 2015 October 6 (E. Muyllaert) and V=16.84 (multiple detections on a single night, ASAS-SN). These outbursts were likely normal outbursts. The recorded superoutbursts were well expressed by a supercycle of 208(1) d. These data suggest that MASTER J174305 is a relatively ordinary SU UMa-type dwarf nova with rather frequent superoutbursts.

E-section 3.91 MASTER OT J192757.03+404042.8

This object (hereafter MASTER J192757) is a transient detected at an unfiltered CCD magnitude of 15.2 on 2014 February 13 (Balanutsa et al. 2014a). The 2017 superoutburst was detected at V=14.36 on 2017 April 4 by the ASAS-SN team. The ASAS-SN data recorded V=13.83 on



E-figure 88. Superhumps in MASTER J174305 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 85. Superhump maxima of MASTER J174305 (2017)

E	max*	error	$O-C$†	N‡
0	57891.5471	0.0014	−0.0025	58
7	57892.0348	0.0006	−0.0022	129
12	57892.3855	0.0010	0.0002	75
13	57892.4563	0.0009	0.0014	75
14	57892.5261	0.0007	0.0015	32
27	57893.4328	0.0009	0.0028	113
28	57893.5019	0.0007	0.0023	112
29	57893.5715	0.0010	0.0022	71
38	57894.1926	0.0011	−0.0035	122
39	57894.2665	0.0026	0.0007	94
41	57894.4039	0.0028	−0.0011	75
42	57894.4744	0.0018	−0.0003	77
43	57894.5439	0.0015	−0.0004	76
44	57894.6130	0.0056	−0.0010	42

*BJD−2400000.
†Against max = 2457891.5495 + 0.069647E.
‡Number of points used to determine the maximum.

E-table 86. Superoutbursts of MASTER J174305 in the ASAS-SN data

Year	Month	Day	max*	V-mag
2012	4	2	56020	16.03
2012	10	30	56231	15.66
2013	5	27	56440	15.91
2014	8	14	56884	16.16
2015	2	15	57069	15.98
2015	9	5	57271	16.14
2016	4	9	57488	16.09
2017	5	14	57888	16.08

*JD−2400000.

E-table 87. Superhump maxima of MASTER J192757 (2017)

E	max*	error	$O-C$†	N‡
0	57849.5593	0.0003	−0.0014	80
1	57849.6437	0.0008	0.0015	30
12	57850.5382	0.0004	−0.0001	85

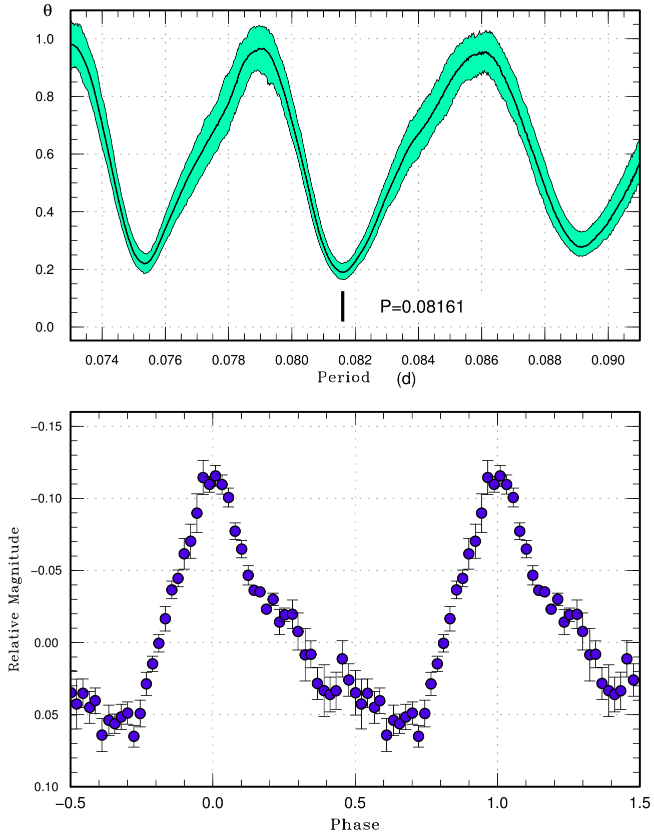
*BJD−2400000.
†Against max = 24849.5607 + 0.081471E.
‡Number of points used to determine the maximum.

2017 April 1. Subsequent observations detected superhumps (vsnet-alert 20885; figure 89). The times of superhump maxima are listed in e-table 87. Although there remained some ambiguity in the one-day alias, the other aliases appear to be excluded by using the observations on the first night. The best superhump period by the PDM method was 0.08161(5) d.

There were two likely superoutbursts in the past ASAS-SN data: 2014 March 18 (V=13.8) and 2015 June 21 (V=14.1). Since the object is sufficiently bright, future observations will clarify more detailed development of superhumps and outburst statistics.

E-section 3.92 MASTER OT J200904.69+825153.6

This object (hereafter MASTER J200904) is a transient detected at an unfiltered CCD magnitude of 15.6 on 2014 March 10 (Balanutsa et al. 2014b). The 2017 outburst was detected by the ASAS-SN team at V=15.70 on 2017 June 2. The large outburst amplitude (Balanutsa et al. 2014b) suspected an SU UMa-type dwarf nova. Subsequent observations detected large-amplitude superhumps (vsnet-alert 21089, 21093; e-figure 90). The times of superhump maxima are listed in e-table 88.

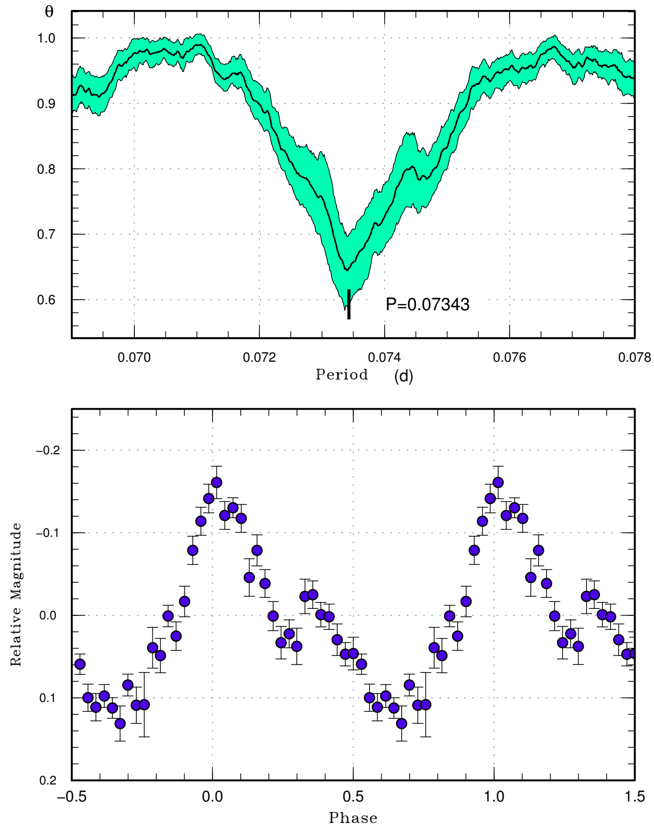


E-figure 89. Superhumps in MASTER J192757 (2017). (Upper): PDM analysis. The alias selection was based on the observations on the first night. (Lower): Phase-averaged profile.

E-table 88. Superhump maxima of MASTER J200904 (2017)

E	max*	error	$O-C$†	N‡
0	57909.0440	0.0038	−0.0025	46
1	57909.1194	0.0008	−0.0004	81
2	57909.1943	0.0007	0.0010	82
3	57909.2593	0.0030	−0.0074	32
4	57909.3378	0.0015	−0.0022	36
5	57909.4139	0.0010	0.0004	78
6	57909.4873	0.0007	0.0004	82
7	57909.5638	0.0009	0.0035	51
14	57910.0791	0.0018	0.0050	73
15	57910.1482	0.0017	0.0006	84
16	57910.2206	0.0014	−0.0004	75
19	57910.4455	0.0012	0.0043	70
20	57910.5157	0.0010	0.0010	70
55	57913.0799	0.0037	−0.0041	65
69	57914.1124	0.0029	0.0007	40

*BJD−2400000.
†Against max $= 2457909.0464 + 0.073409E$.
‡Number of points used to determine the maximum.



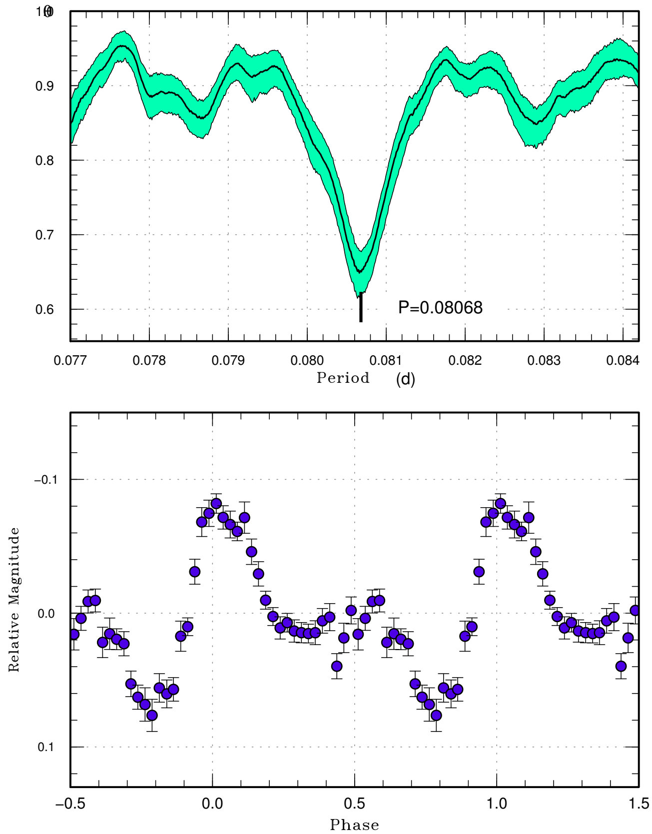
E-figure 90. Superhumps in MASTER J200904 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-section 3.93 MASTER OT J205110.36+044842.2

This object (hereafter MASTER J205110) was detected as a quasar or a dwarf nova at an unfiltered CCD magnitude of 15.0 on 2017 September 28 by the MASTER network (Shumkov et al. 2017). Two past outbursts (2001 June and 2002 August) were detected by D. Denisenko in past images and Denisenko suggested it to be an SU UMa-type dwarf nova based on the past outbursts, ROSAT identification and the SDSS colors (vsnet-alert 21483). Subsequent observations detected superhumps (vsnet-alert 21486, 21487, 21488; e-figure 91). The times of superhump maxima are listed in e-table 89.

E-section 3.94 MASTER OT J212624.16+253827.2

This object (hereafter MASTER J212624) was detected as a transient at an unfiltered CCD magnitude of 14.1 on 2013 June 26 by the MASTER network (Denisenko et al. 2013). The SU UMa-type nature was confirmed during the 2013 superoutburst. The object attracted attention since the superhump period indicates an SU UMa-type dwarf nova in the period gap see Kato et al. (2014b) and Kato et al.



E-figure 91. Superhumps in MASTER J205110 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

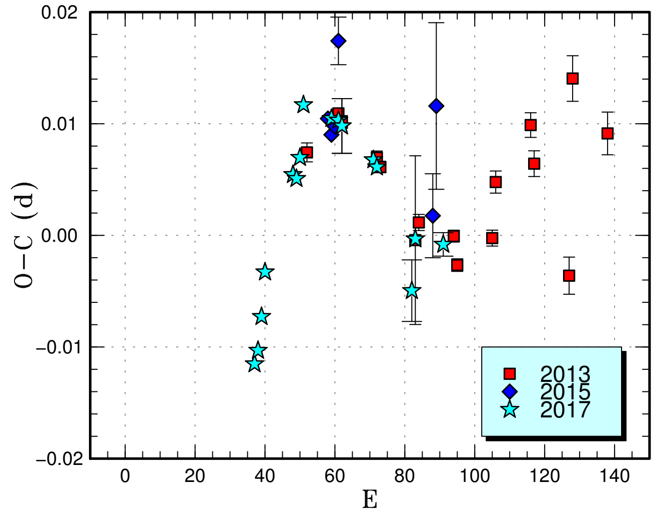
E-table 89. Superhump maxima of MASTER J205110 (2017)

E	max*	error	$O-C$†	N‡
0	58025.5946	0.0005	0.0029	262
1	58025.6720	0.0005	−0.0004	265
18	58027.0415	0.0014	−0.0030	132
19	58027.1245	0.0007	−0.0007	196
22	58027.3685	0.0015	0.0011	88
34	58028.3343	0.0015	−0.0015	79
59	58030.3552	0.0037	0.0016	85

*BJD−2400000.

†Against max = 2458025.5917 + 0.080710E.

‡Number of points used to determine the maximum.



E-figure 92. Comparison of $O-C$ diagrams of MASTER J212624 between different superoutbursts. A period of 0.09135 d was used to draw this figure. Approximate cycle counts (E) after the start of the superoutburst were used. Since the start of the 2013 superoutburst was not well constrained, we shifted the $O-C$ diagram to best fit the best-recorded 2017 one.

(2016b) for more information.

The 2017 superoutburst was detected by the ASAS-SN team at V=14.90 on 2017 August 25. The object further brightened to V=14.2 in 0.85 d. The initial observations on 2017 August 26–27 did not show large-amplitude superhumps. They became apparent on the next night and grew further (vsnet-alert 21374, 21377). This was the first time in this object growing superhumps were recorded. The times of superhump maxima are listed in e-table 90. Stage A was impressively long. In determining periods, we neglected $32 \le E \le 35$, which were likely a transition phase between stages A and B. A comparison of the $O-C$ diagrams suggests that we observed stage A and early half of stage B (e-figure 92. We if could have continued observations, we could have detected a strongly positive $P_{\rm dot}$ as in the 2013 superoutburst.

This object adds a new example of long developing time of superhumps in long-$P_{\rm orb}$ systems (see subsection E-section 3.81).

This object showed relatively regular superoutburst (e-table 91). The supercycle was 345(9) d.

E-section 3.95 OT J182142.8+212154

This object (hereafter OT J182142) was discovered by K. Itagaki at an unfiltered CCD magnitude of 14.9 on 2010 April 24 (vsnet-alert 11952). Subsequent observations confirmed the SU UMa-type classification (Kato et al. 2010).

The 2017 superoutburst was detected by the ASAS-SN

E-table 90. Superhump maxima of MASTER J212624 (2017)

E	max*	error	$O-C$†	N‡
0	57992.3487	0.0036	−0.0338	93
2	57992.5291	0.0040	−0.0377	62
21	57994.3239	0.0003	0.0068	128
22	57994.4164	0.0002	0.0072	355
23	57994.5108	0.0002	0.0094	323
24	57994.6061	0.0004	0.0127	148
32	57995.3457	0.0002	0.0152	224
33	57995.4367	0.0002	0.0141	332
34	57995.5299	0.0002	0.0152	299
35	57995.6260	0.0006	0.0191	54
43	57996.3555	0.0008	0.0117	74
45	57996.5381	0.0002	0.0100	236
46	57996.6289	0.0024	0.0087	43
46	57996.6289	0.0024	0.0087	43
55	57997.4480	0.0002	−0.0013	309
56	57997.5387	0.0003	−0.0027	227
66	57998.4412	0.0028	−0.0215	65
67	57998.5371	0.0008	−0.0176	131
75	57999.2675	0.0011	−0.0243	97

*BJD−2400000.
†Against max = 2457992.3825 + 0.092123E.
‡Number of points used to determine the maximum.

E-table 91. List of superoutbursts of MASTER J212624 in the ASAS-SN data

Year	Month	Day	max*	V mag
2013	11	16	56613	14.9
2014	9	10	56911	14.5
2015	8	26	57261	14.2
2016	7	31	57601	14.4
2017	8	25	57991	14.2

*JD−2400000.

team at V=14.82 on 2017 May 31. Subsequent observations confirmed superhumps (vsnet-alert 21083, 21099). The times of superhump maxima are listed in e-table 92.

The object faded by 1.4 mag between 2017 June 3 and 5, and it was likely the termination of the superoutburst. It was likely that the superoutburst was not detected sufficiently early and there was a chance that we only observed stage C superhumps (this may have been also the case for the 2010 observations).

This field has been covered by the ASAS-SN team since 2014 March 18. There was only one previous outburst (type unknown) in the record at V=15.8 on 2016 February 15.

E-table 92. Superhump maxima of OT J182142 (2017)

E	max*	error	$O-C$†	N‡
0	57907.1707	0.0090	−0.0067	30
1	57907.2600	0.0010	0.0005	79
2	57907.3477	0.0016	0.0060	37
13	57908.2475	0.0026	0.0023	45
15	57908.4107	0.0007	0.0012	44
16	57908.4888	0.0008	−0.0028	40
39	57910.3813	0.0016	0.0004	44
40	57910.4622	0.0026	−0.0008	41

*BJD−2400000.
†Against max = 2457907.1774 + 0.082140E.
‡Number of points used to determine the maximum.

E-section 3.96 OT J204222.3+271211

This object (PNV J20422233+2712111, hereafter OT J204222) is a transient discovered independently by H. Nishimura, T. Kojima and Kaneko at an unfiltered CCD magnitude of 11.1 on 2017 April 13.[12] The object was immediately suspected to be a dwarf nova, not a classical nova as originally suspected, by the presence of a faint blue object in SDSS and a GALEX ultraviolet object. The large outburst amplitude (nearly 9 mag) suggested a WZ Sge-type dwarf nova (vsnet-alert 20915, see also <https://www.aavso.org/pnv-j204222332712111-new-transient-111-mag-vulpecula>).

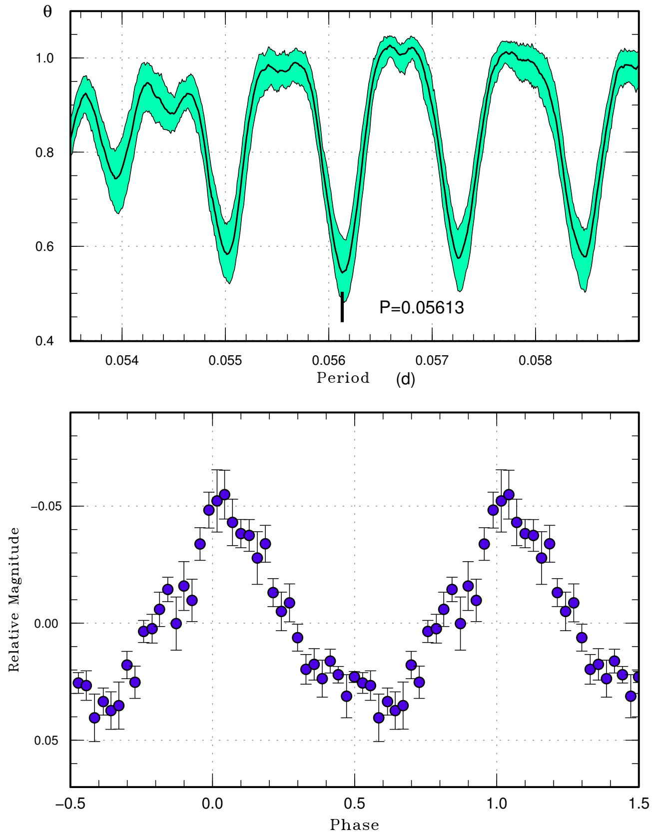
Despite the large outburst amplitude, observations of this object were rather sparse in the early morning and expected early superhumps were not detected. The object was found to show ordinary superhumps on 2017 April 22 (vsnet-alert 20941, 20959; e-figure 93). A retrospective examination suggested that growing superhumps were probably already present on 2017 April 18 (vsnet-alert 20960), only 5 d after the outburst detection. The times of superhump maxima are listed in e-table 93. Due to the lack of observations, the period of stage A was not determined and $P_{\rm dot}$ for stage B superhumps was not well determined (it may be almost zero considering the large uncertainty).

In the ASAS-SN data, the object was detected at V=12.2 on 2017 April 15 but was still in quiescence or still very faint on 2017 April 9. The waiting time of the emergence of superhumps was thus shorter than 9 d.

E-section 3.97 PNV J20205397+2508145

This object (hereafter PNV J202053) was detected as a transient by T. Kojima at an unfiltered CCD magnitude of

[12]<http://www.cbat.eps.harvard.edu/unconf/followups/J20422233+2712111.html>



E-figure 93. Superhumps in OT J204222 (2017). (Upper): PDM analysis. The data between BJD 2457865 and 2457872 were used. The alias selection was based on a long run on 2017 April 25. (Lower): Phase-averaged profile.

E-table 93. Superhump maxima of OT J204222 (2017)

E	max*	error	$O-C$†	N‡
0	57861.8675	0.0010	−0.0046	417
65	57865.5307	0.0015	0.0058	61
66	57865.5821	0.0003	0.0010	102
119	57868.5587	0.0003	−0.0009	81
120	57868.6163	0.0005	0.0006	47
156	57870.6483	0.0015	0.0095	25
165	57871.1388	0.0029	−0.0058	25
166	57871.1956	0.0006	−0.0052	61
167	57871.2567	0.0012	−0.0004	16

*BJD−2400000.

†Against max = 2457861.8721 + 0.056197E.

‡Number of points used to determine the maximum.

12.3 on 2017 September 12.[13] The outburst was recorded in the ASAS-SN data at V=12.9 on 2017 September 13. The object was not in outburst on 2017 September 8. A blue quiescent counterpart with g=20.41 was identified by Brian Skiff and astrometry by Andrea Mantero (cf. vsnet-alert 21424, 21426). Subsequent photometry detected early superhumps (vsnet-alert 21427, 21431, 21436; e-figure 94) and the object was identified as a WZ Sge-type dwarf nova. The object started to show ordinary superhumps (e-figure 95) on 2017 September 19 (see vsnet-alert 21455, 21460 and analysis in this subsection). The times of maxima of ordinary superhumps are listed in e-table 94. Stages A and B were very clearly recorded and there was possibly a transition to stage C during the final decline from the superoutburst plateau (e-figure 96).

The period of early superhump by the PDM method was 0.056509(5) d (e-figure 94). The value of ϵ^* for stage A superhumps was 0.0329(11), which corresponds to q=0.090(3). This value appears to be typical for a WZ Sge-type dwarf nova. There was no post-superoutburst rebrightening.

E-section 3.98 SDSS J152857.86+034911.7

This object (hereafter SDSS J152857) was selected as a CV during the course of the SDSS (Szkody et al. 2003). Some outbursts were recorded (Williams et al. 2010; Drake et al. 2014). No secure orbital variations were detected by Woudt et al. (2012) and it was concluded that the object has a very long orbital period or it is of low inclination. Kato et al. (2012b) estimated an orbital period of 0.082(3) d from SDSS colors. The 2017 outburst was detected by the ASAS-SN team at V=15.62 on 2017 May 16. Observations on 2017 May 21–22 detected superhumps (vsnet-alert 21056; e-figure 97; e-table 95).

E-section 3.99 SDSS J153015.04+094946.3

This object (hereafter SDSS J153015) was originally selected as a CV by the SDSS (Szkody et al. 2009). The SU UMa-type nature was confirmed during the 2017 March superoutburst (Kato et al. 2017a). The supercycle was estimated to be very short [84.7(1.2) d].

The 2017 June superoutburst was detected by the ASAS-SN team at V=15.86 on 2017 June 13. Subsequent observations detected superhumps (vsnet-alert 21121). The times of superhump maxima are listed in e-table 96.

[13] <http://www.cbat.eps.harvard.edu/unconf/followups/J20205397+2508145.html>.

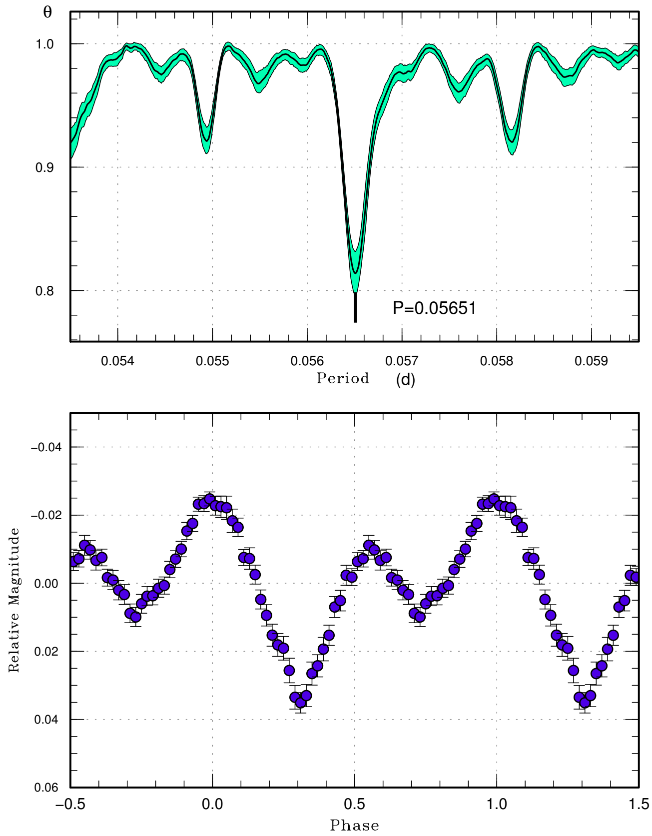
E-table 94. Superhump maxima of PNV J202053 (2017)

E	max*	error	$O-C$†	N‡	E	max*	error	$O-C$†	N‡
0	58016.2541	0.0005	−0.0280	114	111	58022.6571	0.0002	0.0001	226
1	58016.3131	0.0005	−0.0265	119	112	58022.7139	0.0002	−0.0005	180
2	58016.3642	0.0016	−0.0328	72	113	58022.7706	0.0002	−0.0013	164
3	58016.4221	0.0013	−0.0323	74	114	58022.8302	0.0004	0.0009	50
18	58017.3023	0.0008	−0.0136	121	118	58023.0612	0.0018	0.0022	48
19	58017.3617	0.0012	−0.0116	129	119	58023.1131	0.0017	−0.0034	63
33	58018.1731	0.0031	−0.0043	51	127	58023.5714	0.0026	−0.0046	24
35	58018.3057	0.0042	0.0134	25	128	58023.6304	0.0003	−0.0029	60
36	58018.3520	0.0003	0.0023	138	129	58023.6875	0.0004	−0.0033	58
37	58018.4103	0.0003	0.0032	147	130	58023.7455	0.0004	−0.0027	52
38	58018.4711	0.0006	0.0066	88	139	58024.2650	0.0013	−0.0001	62
39	58018.5281	0.0004	0.0062	74	140	58024.3183	0.0003	−0.0043	117
41	58018.6450	0.0002	0.0082	74	141	58024.3755	0.0004	−0.0044	113
42	58018.7022	0.0002	0.0080	156	142	58024.4342	0.0023	−0.0032	72
43	58018.7611	0.0003	0.0095	154	145	58024.6040	0.0011	−0.0057	34
44	58018.8236	0.0007	0.0145	34	146	58024.6625	0.0005	−0.0046	60
53	58019.3379	0.0001	0.0119	290	147	58024.7193	0.0004	−0.0052	61
54	58019.3947	0.0001	0.0113	245	157	58025.2942	0.0002	−0.0046	116
55	58019.4509	0.0002	0.0101	154	158	58025.3501	0.0004	−0.0062	117
56	58019.5055	0.0033	0.0072	31	159	58025.4096	0.0006	−0.0041	71
59	58019.6799	0.0002	0.0093	90	161	58025.5231	0.0020	−0.0055	52
60	58019.7373	0.0002	0.0093	89	162	58025.5831	0.0006	−0.0029	60
61	58019.7945	0.0002	0.0090	77	163	58025.6371	0.0006	−0.0064	59
64	58019.9653	0.0012	0.0076	24	170	58026.0419	0.0030	−0.0036	51
69	58020.2501	0.0063	0.0052	18	171	58026.0952	0.0031	−0.0077	52
70	58020.3080	0.0007	0.0056	78	172	58026.1582	0.0037	−0.0021	67
71	58020.3649	0.0010	0.0051	146	186	58026.9613	0.0010	−0.0031	51
72	58020.4225	0.0005	0.0053	73	187	58027.0187	0.0015	−0.0031	56
73	58020.4794	0.0004	0.0048	73	188	58027.0754	0.0014	−0.0039	55
74	58020.5385	0.0006	0.0064	59	189	58027.1315	0.0020	−0.0052	56
76	58020.6520	0.0002	0.0051	150	196	58027.5351	0.0010	−0.0036	47
77	58020.7096	0.0002	0.0053	158	197	58027.5944	0.0006	−0.0018	56
78	58020.7660	0.0002	0.0043	160	198	58027.6487	0.0007	−0.0049	60
79	58020.8226	0.0004	0.0034	51	199	58027.7075	0.0008	−0.0035	60
87	58021.2844	0.0006	0.0057	128	200	58027.7661	0.0024	−0.0023	37
88	58021.3399	0.0005	0.0038	314	227	58029.3157	0.0036	−0.0034	32
89	58021.3970	0.0007	0.0035	298	229	58029.4351	0.0017	0.0012	48
90	58021.4548	0.0005	0.0039	167	230	58029.5082	0.0124	0.0168	36
91	58021.5106	0.0003	0.0022	111	231	58029.5570	0.0026	0.0082	58
93	58021.6342	0.0007	0.0109	39	232	58029.6118	0.0016	0.0055	58
94	58021.6830	0.0003	0.0023	57	233	58029.6615	0.0018	−0.0022	36
95	58021.7395	0.0003	0.0014	60	246	58030.4194	0.0031	0.0092	128
96	58021.7987	0.0002	0.0032	53	248	58030.5280	0.0011	0.0028	46
97	58021.8557	0.0010	0.0028	37	249	58030.5850	0.0017	0.0025	60
105	58022.3177	0.0012	0.0053	54	250	58030.6388	0.0011	−0.0012	55
109	58022.5451	0.0023	0.0029	29	261	58031.2644	0.0084	−0.0074	11
110	58022.5997	0.0002	0.0001	71	263	58031.3750	0.0019	−0.0116	39

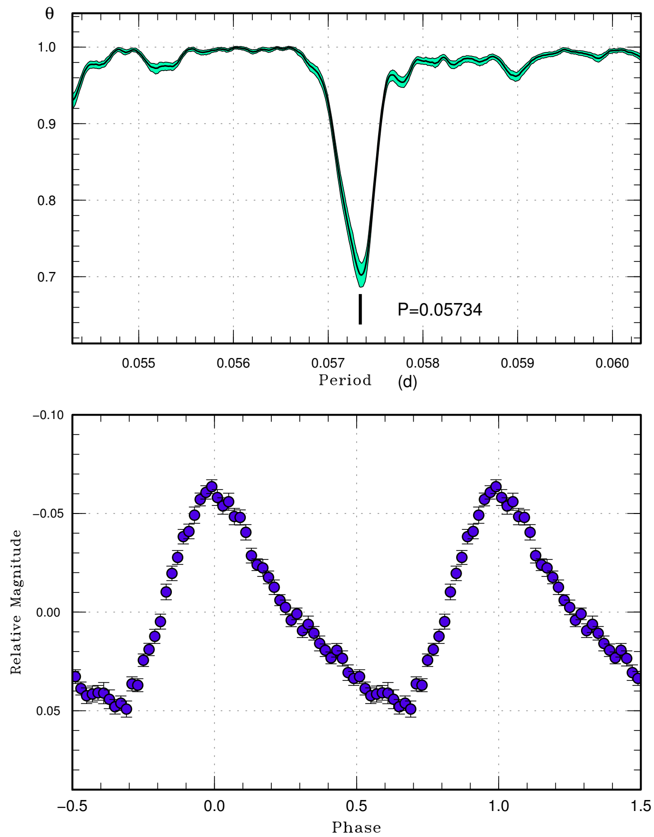
*BJD−2400000.

†Against max $= 2458016.2821 + 0.057432E$.

‡Number of points used to determine the maximum.



E-figure 94. Early superhumps in PNV J202053 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 95. Ordinary superhumps in PNV J202053 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-table 95. Superhump maxima of SDSS J152857 (2017)

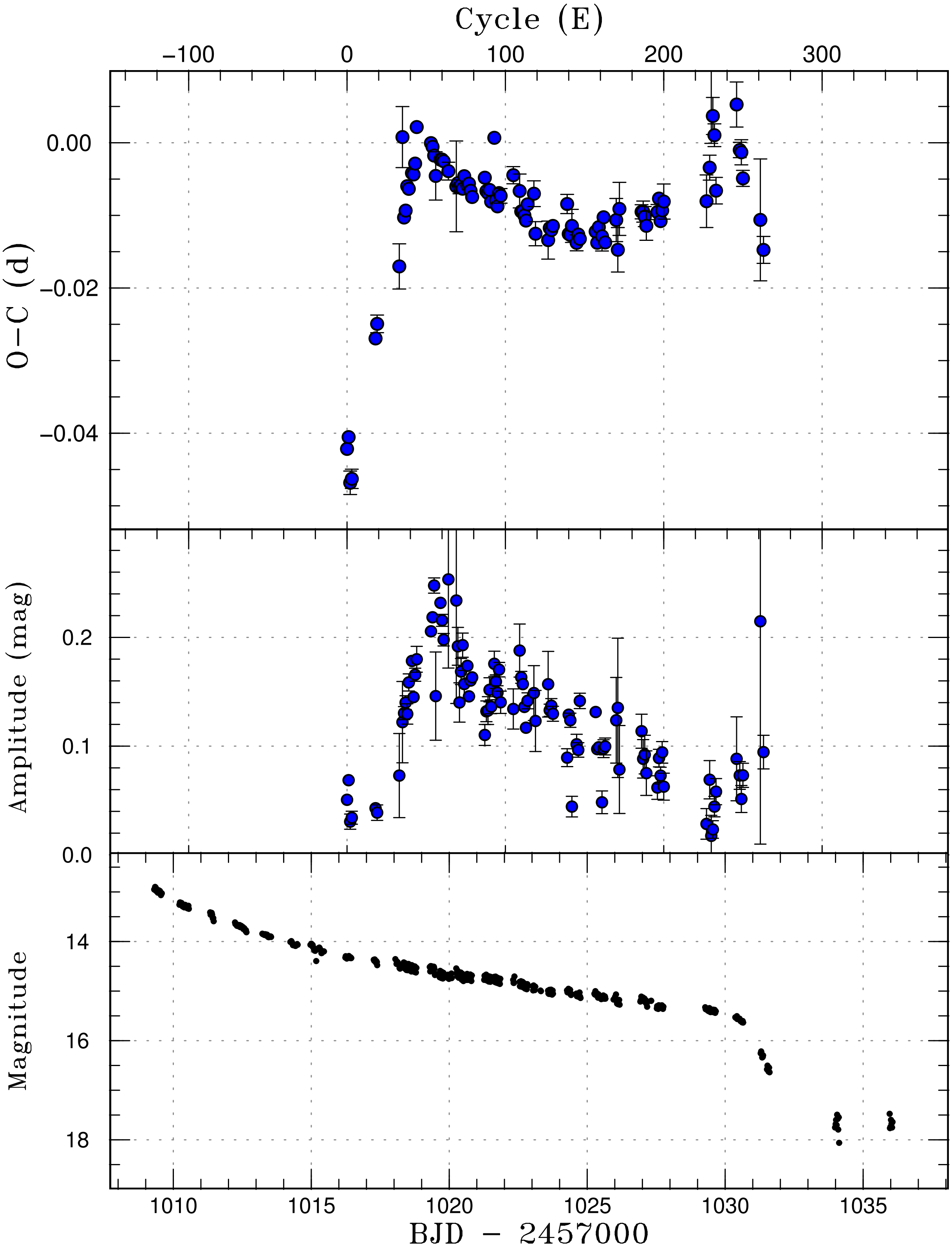
E	max*	error	$O-C$†	N‡
0	57895.3966	0.0011	0.0003	41
1	57895.4598	0.0011	0.0000	38
2	57895.5223	0.0007	−0.0008	64
3	57895.5871	0.0028	0.0005	25

*BJD−2400000.
†Against max = 2457895.3963 + 0.063404E.
‡Number of points used to determine the maximum.

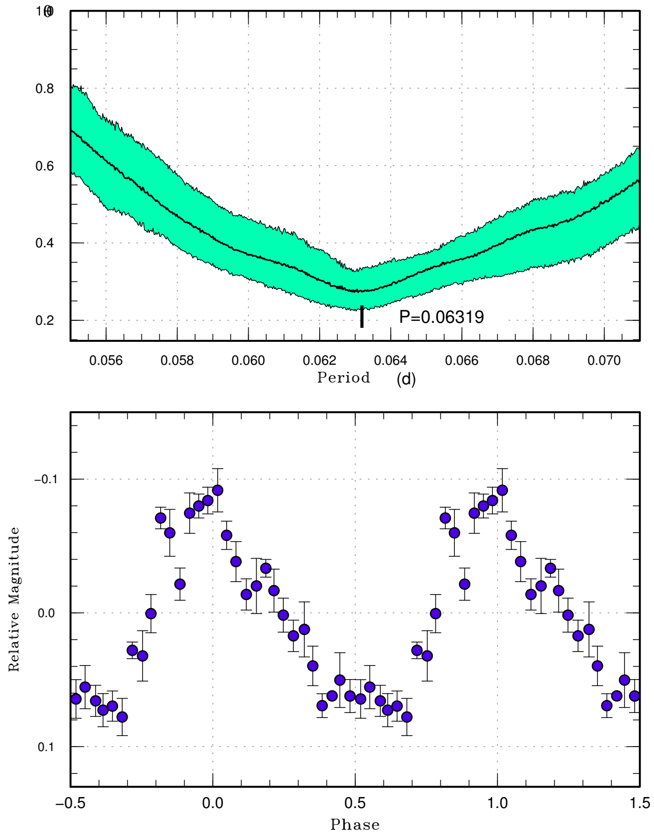
E-table 96. Superhump maxima of SDSS J153015 (2017b)

E	max*	error	$O-C$†	N‡
0	57919.0487	0.0013	0.0011	86
1	57919.1257	0.0020	0.0029	83
4	57919.3495	0.0017	0.0008	67
5	57919.4249	0.0008	0.0009	86
13	57920.0182	0.0031	−0.0083	63
18	57920.4043	0.0011	0.0012	88
26	57921.0077	0.0013	0.0021	83
27	57921.0717	0.0022	−0.0092	83
31	57921.3873	0.0016	0.0052	25
32	57921.4608	0.0040	0.0034	27

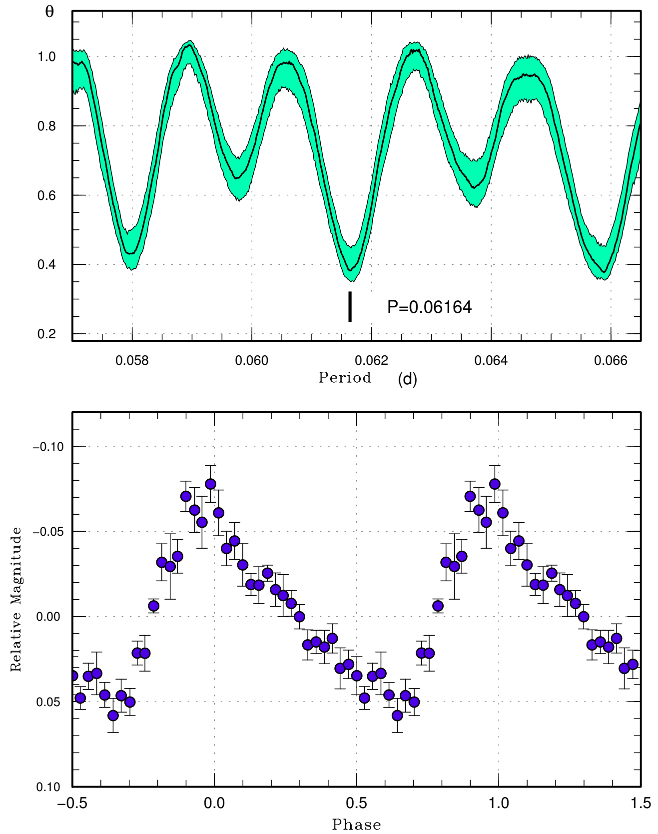
*BJD−2400000.
†Against max = 2457919.0475 + 0.075310E.
‡Number of points used to determine the maximum.



E-figure 96. $O-C$ diagram of superhumps in PNV J202053 (2017). (Upper:) $O-C$ diagram. We used a period of 0.05739 d for calculating the $O-C$ residuals. (Middle:) Amplitudes of superhumps. (Lower:) Light curve. The data were binned to 0.019 d.



E-figure 97. Superhumps in SDSS J152857 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 98. Superhumps in SDSS J204817 (2009). (Upper): PDM analysis. (Lower): Phase-averaged profile.

E-section 3.100 SDSS J204817.85−061044.8

This object (hereafter SDSS J204817) is a CV selected during the course of the SDSS (Szkody et al. 2003). The object was identified as an SU UMa-type dwarf nova during the 2009 superoutburst. Woudt and Warner (2010) observed the object in quiescence and obtained an orbital period of 0.060597(2) d. Kato et al. (2010) reported a superhump period of 0.06166(2) d based on the orbital period by Woudt and Warner (2010).

The 2017 superoutburst was detected by the ASAS-SN team at V=14.55 on 2017 May 30. Subsequent observations detected superhumps (vsnet-alert 21087). Although we obtained data on two nights, the data on the first night was of less quality and the apparent hump was not expressed by the 2009 period, we only used the data on the second night. The times of superhump maxima are listed in e-table 97. The quality of the data during the 2017 superoutburst was poorer and we could not give meaningful constraint on the superhump period. We instead provide an updated period analysis of the 2009 data using a modern (LOWESS) detrending method. The updated result favors the alias corresponding to the orbital period (e-figure 98).

E-table 97. Superhump maxima of SDSS J204817 (2017)

E	max*	error	$O-C^{\dagger}$	$N^{\ddagger}$
0	57908.4832	0.0100	0.0006	20
1	57908.5505	0.0013	−0.0011	30
2	57908.6212	0.0031	0.0006	12

*BJD−2400000.

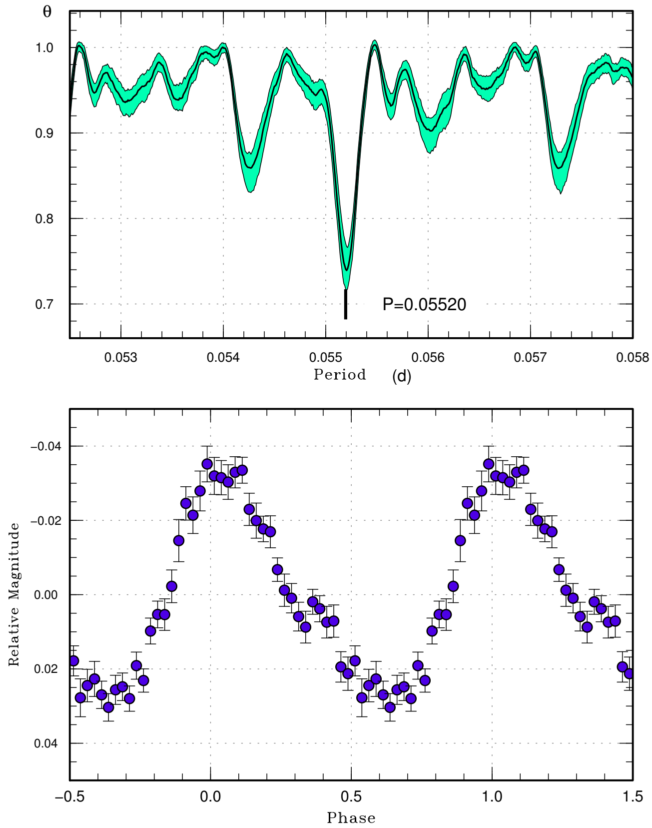
†Against max = 2457908.4826 + 0.069017E.

‡Number of points used to determine the maximum.

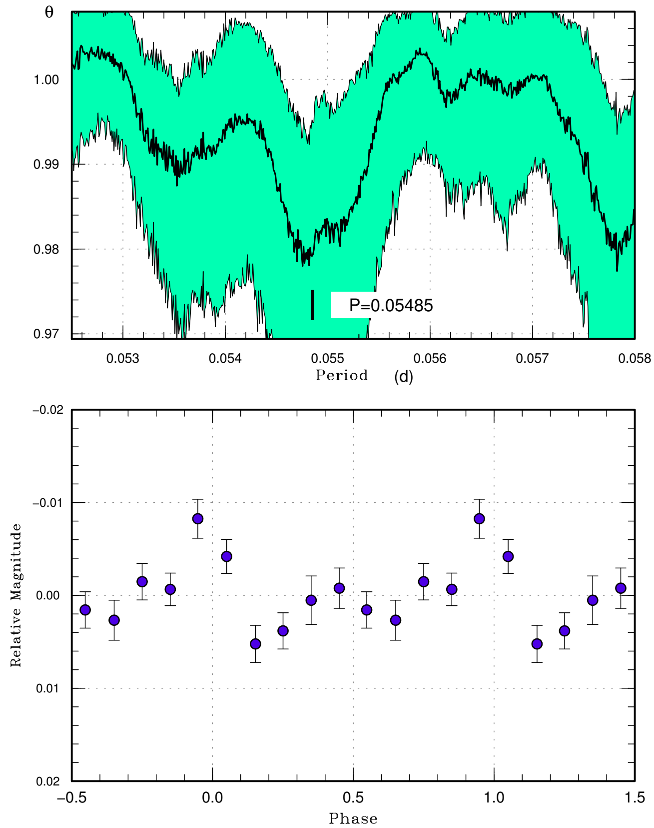
In the ASAS-SN data, there was a superoutburst (maximum V=14.9 on 2015 October 19) preceded by a precursor outburst on 2015 October 15 (V=15.3). The behavior appears to be typical for an SU UMa-type dwarf nova.

E-section 3.101 TCP J00332502−3518565

This object (hereafter TCP J003325) was discovered by Shigehisa Fujikawa at an unfiltered CCD magnitude of



E-figure 99. Ordinary superhumps in TCP J003325 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.



E-figure 100. Possible early superhumps in TCP J003325 (2017). (Upper): PDM analysis. (Lower): Phase-averaged profile.

12.8–13.3 on 2017 August 5.[14] The object was suspected to be a WZ Sge-type dwarf nova (vsnet-alert 21320). There was a 2003 outburst in the ASAS-3 data (D. Denisenko, vsnet-alert 21321). The object was also recorded by the ASAS-SN team at V=14.7 (rising) in 2017 August 5 and V=12.7 on 2017 August 7. Well-developed superhumps were observed since 2017 August 18 (vsnet-alert 21357; e-figure 99). The times of superhump maxima are listed in e-table 98. We retrospectively identified that ordinary superhumps emerged on 2017 August 13 ($0 \le E \le 2$) based on the flattening of the outburst light curve and low superhump amplitudes. Although these superhumps were presumably stage A, we could not determine the period due to a 4-d gap in the observation after 2017 August 13. There were possible very low-amplitude early superhumps (e-figure 100) with a period of 0.05484(16) d.

The relatively early (8 d after the outburst rise) appearance and the presence of the 2003 outburst suggests that this object is not an extreme WZ Sge-type dwarf nova.

[14]<http://www.cbat.eps.harvard.edu/unconf/followups/J00332502-3518565.html>.

E-table 98. Superhump maxima of TCP J003325 (2017)

E	max*	error	$O-C$†	N‡
0	57979.4129	0.0018	−0.0003	127
1	57979.4705	0.0023	0.0022	126
2	57979.5338	0.0023	0.0103	127
91	57984.4321	0.0002	−0.0016	127
92	57984.4871	0.0002	−0.0019	124
109	57985.4236	0.0002	−0.0032	127
110	57985.4787	0.0003	−0.0033	98
163	57988.4006	0.0004	−0.0054	107
165	57988.5114	0.0003	−0.0050	127
166	57988.5648	0.0002	−0.0068	123
220	57991.5505	0.0009	−0.0003	127
222	57991.6606	0.0007	−0.0006	109
255	57993.4897	0.0016	0.0080	127
256	57993.5447	0.0013	0.0078	127

*BJD−2400000.
†Against max = 2457979.4132 + 0.055171E.
‡Number of points used to determine the maximum.

E-section 3.102 TCP J20100517+1303006

This object (hereafter TCP J201005) was discovered as a transient at an unfiltered CCD magnitude of 12.6 on 2017 June 19 by Tadashi Kojima.[15] There is an ROSAT X-ray source 1RXS J201006.4+130259 (vsnet-alert 21146) and the object was considered to be a dwarf nova. Although initial observations suggested the presence of early superhumps (vsnet-alert 21149, 21153), The object was later found to be an ordinary SU UMa-type dwarf nova (vsnet-alert 21156; the initial claim of early superhumps was due to the relatively strong secondary maximum of superhumps; e-figure 101). The object entered the rapidly fading stage on 2017 June 28 (vsnet-alert 21174).

The times of superhump maxima during the superoutburst and early post-superoutburst phase are listed in e-table 99. Although there were observations on BJD 2457931, the hump profile became complex with strong secondary humps and it was difficult to measure superhump maxima. The $O-C$ values for post-superoutburst maxima are strongly negative, indicating that they were traditional late superhumps ($\sim$0.5 phase jump around the termination of the superoutburst). The superhump stage was unknown. Since the profile was already doubly humped at the time of initial observations (see also e-figure 101), the observations were not early enough to detect typical stage B superhumps The observed superhumps may have been already stage C ones.

The object was recorded to undergo frequent outbursts (cf. vsnet-alert 21192, 21197, 21203) and they were once confused as rebrightenings. They were shown to be normal outbursts occurring every 5–10 d (vsnet-alert 21235). Superoutbursts recorded in the ASAS-SN data are summarized in e-table 100. The coverage by the ASAS-SN observations of this field was not good enough as in other objects and true maxima were not necessarily detected. The data, however, were sufficient to estimate the supercycle of 103.5(1.3) d. The short supercycle suggests a high mass-transfer rate and it is consistent with the appearance of traditional late superhumps.

E-table 99. Superhump maxima of TCP J201005 (2017)

E	max*	error	$O-C$†	N‡
0	57927.3706	0.0096	−0.0061	42
1	57927.4535	0.0010	−0.0039	180
2	57927.5285	0.0018	−0.0095	123
9	57928.0947	0.0039	−0.0078	48
10	57928.1808	0.0008	−0.0023	76
11	57928.2610	0.0012	−0.0028	59
13	57928.4230	0.0003	−0.0021	276
14	57928.5024	0.0004	−0.0034	304
15	57928.5929	0.0011	0.0065	41
17	57928.7515	0.0008	0.0038	87
18	57928.8280	0.0005	−0.0003	110
19	57928.9089	0.0007	−0.0001	57
26	57929.4755	0.0011	0.0020	42
30	57929.7951	0.0015	−0.0010	44
31	57929.8812	0.0007	0.0045	142
38	57930.4484	0.0007	0.0071	189
39	57930.5309	0.0011	0.0090	169
40	57930.6122	0.0016	0.0096	77
42	57930.7740	0.0011	0.0102	185
43	57930.8514	0.0009	0.0069	188
44	57930.9385	0.0014	0.0134	80
67	57932.7677	0.0020	−0.0123	28
68	57932.8509	0.0018	−0.0097	22
79	57933.7416	0.0024	−0.0061	25
80	57933.8229	0.0023	−0.0055	23

*BJD−2400000.
†Against max = 2457927.3767 + 0.080646E.
‡Number of points used to determine the maximum.

E-table 100. List of superoutbursts of TCP J201005 in the ASAS-SN data

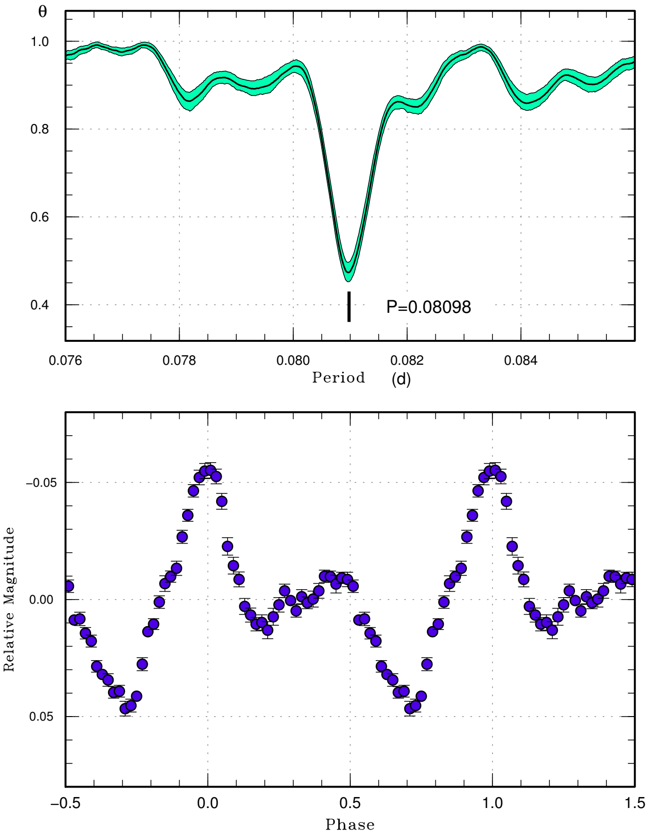
Year	Month	Day	max*	V mag
2015	6	10	57184	13.4†
2015	9	24	57290	13.7‡
2016	4	10	57489	13.5
2016	7	23	57593	13.7
2016	11	14	57707	13.8

*JD−2400000.
†Following a precursor outburst.
‡Only late phase was recorded.

References

Alksnis, A., & Zharova, A. V. 2000, IBVS, 4909
Antipin, S. V. 1996, IBVS, 4343
Antipin, S. V., & Pavlenko, E. P. 2002, A&A, 391, 565
Augusteijn, T., Tappert, C., Dall, T., & Maza, J. 2010, MNRAS, 405, 621
Aviles, A., et al. 2010, ApJ, 711, 389
Balanutsa, P., Denisenko, D., Gorbovskoy, E., & Lipunov, V. 2013, Perem. Zvezdy, submitted (arXiv/1307.7396)
Balanutsa, P., et al. 2014a, Astron. Telegram, 6024

[15] <http://www.cbat.eps.harvard.edu/unconf/followups/J20100517+1303006.html>.



E-figure 101. Superhumps in TCP J201005 (2017). (Upper): PDM analysis. The data before BJD 2457931 were used. (Lower): Phase-averaged profile.

Balanutsa, P., et al. 2012, Astron. Telegram, 4022

Balanutsa, P., et al. 2017, Astron. Telegram, 10470

Balanutsa, P., et al. 2014b, Astron. Telegram, 5974

Bąkowska, K., et al. 2017, A&A, 603, A72

Bąkowska, K., Olech, A., Pospieszyński, R., Martinelli, F., & Marciniak, A. 2014, Acta Astron., 64, 337

Boyd, D., et al. 2010, J. Br. Astron. Assoc., 120, 33

Cannon, A. J. 1925, Harvard Coll. Obs. Bull., 825, 1

Cartier, R., et al. 2017, Astron. Telegram, 10334

Cleveland, W. S. 1979, J. Amer. Statist. Assoc., 74, 829

Court, J. M. C., et al. 2019, MNRAS, 488, 4149

Davis, A. B., Shappee, B. J., Archer Shappee, B., & ASAS-SN 2015, American Astron. Soc. Meeting Abstracts, 225, #344.02

Davis, A. B., et al. 2014, Astron. Telegram, 6211

Denisenko, D. 2017, Astron. Telegram, 10480

Denisenko, D., et al. 2013, Astron. Telegram, 5111

Dillon, M., et al. 2008, MNRAS, 386, 1568

Drake, A. J., et al. 2009, ApJ, 696, 870

Drake, A. J., et al. 2014, MNRAS, 441, 1186

Erastova, L. K. 1973, Astron. Tsirk., 774, 5

Fernie, J. D. 1989, PASP, 101, 225

Gorbovskoy, E. S., et al. 2013, Astron. Rep., 57, 233

Green, R. F., Ferguson, D. H., Liebert, J., & Schmidt, M. 1982, PASP, 94, 560

Green, R. F., Schmidt, M., & Liebert, J. 1986, ApJS, 61, 305

Grubissich, C., & Rosino, L. 1958, Asiago Contr., 93, 1

Harvey, D., Skillman, D. R., Patterson, J., & Ringwald, F. A. 1995, PASP, 107, 551

Hellier, C. 2001, PASP, 113, 469

Henden, A. A., Munari, U., & Sumner, B. 2001, IBVS, 5140

Hoffmeister, C. 1949a, Erg. Astron. Nachr., 12, 12

Hoffmeister, C. 1949b, Erg. Astron. Nachr., 12, 1

Hoffmeister, C. 1957a, Mitteil. Veränderl. Sterne, 1, 245

Hoffmeister, C. 1957b, Mitteil. Veränderl. Sterne, 1, 245

Hoffmeister, C. 1963, Veröff. Sternw. Sonneberg, 6, 1

Hoffmeister, C. 1964, Astron. Nachr., 288, 49

Hoffmeister, C. 1967, Astron. Nachr., 290, 43

Imada, A., et al. 2017, PASJ, 69, 72

Isogai, Keisuke, Kato, Taichi, Monard, Berto, Hambsch, Franz-Josef, Myers, Gordon, Starr, Peter, Cook, Lewis M., & Nogami, Daisaku 2019, PASJ, 71, 48

Kapusta, A. B., & Thorstensen, J. R. 2006, PASP, 118, 1119

Kato, T. 2015, PASJ, 67, 108

Kato, T. 2019, PASJ, submitted

Kato, T., et al. 2016a, PASJ, 68, 49

Kato, T., et al. 2014a, PASJ, 66, 90

Kato, T., et al. 2015, PASJ, 67, 105

Kato, T., et al. 2013a, PASJ, 65, 23

Kato, T., et al. 2014b, PASJ, 66, 30

Kato, T., Hambsch, F.-J., Monard, B., Nelson, P., Stubbings, R., & Starr, P. 2019a, PASJ, in press (arXiv/1909.00910)

Kato, T., et al. 2016b, PASJ, 68, 65

Kato, T., et al. 2009, PASJ, 61, S395

Kato, T., Ishioka, R., & Uemura, M. 2002, PASJ, 54, 1029

Kato, T., et al. 2017a, PASJ, 69, 75

Kato, T., et al. 2012a, PASJ, 64, 21

Kato, T., Maehara, H., & Uemura, M. 2012b, PASJ, 64, 62

Kato, T., et al. 2010, PASJ, 62, 1525

Kato, T., Monard, B., Hambsch, F.-J., Kiyota, S., & Maehara, H. 2013b, PASJ, 65, L11

Kato, T., Nogami, D., Masuda, S., & Baba, H. 1998, PASP, 110, 1400

Kato, T., Nogami, D., Masuda, S., & Hirata, R. 1995, IBVS, 4193

Kato, T., & Osaki, Y. 2013, PASJ, 65, 115

Kato, T., et al. 2019b, PASJ, 71, L1

Kato, T., et al. 2016c, PASJ, 68, L4

Kato, T., Sekine, Y., & Hirata, R. 2001, PASJ, 53, 1191

Kato, T., Stubbings, R., Pearce, A., Dubovsky, P. A., Kiyota, S., Itoh, H., & Simonsen, M. 2001, IBVS, 5109

Kato, T., et al. 2017b, PASJ, 69, L4

Kato, T., Uemura, M., Ishioka, R., Nogami, D., Kunjaya, C., Baba, H., & Yamaoka, H. 2004, PASJ, 56, S1

Katysheva, N., Chochol, D., & Shugarov, S. 2014, Contr. of the Astron. Obs. Skalnaté Pleso, 43, 306

Khruslov, A. V. 2005, Perem. Zvezdy, Prilozh., 5, 4

Kimura, M., et al. 2016a, PASJ, 68, 55

Kimura, M., et al. 2018, PASJ, 70, 47

Kimura, M., et al. 2016b, PASJ, 68, L2

Kinnunen, T., & Skiff, B. A. 2000, IBVS, 4896

Littlefield, C., et al. 2013, AJ, 145, 145

Littlefield, C., Garnavich, P., Kennedy, M., Szkody, P., & Dai, Z. 2018, AJ, 155, 232

Liu, Wu., & Hu, J. Y. 2000, ApJS, 128, 387

Liu, Wu., Hu, J. Y., Zhu, X. H., & Li, Z. Y. 1999, ApJS, 122, 243
Luyten, W. J. 1938, Publ. of the Astron. Obs. Univ. of Minnesota, 6, 1
Marsh, T., Parsons, S., & Dhillon, V. 2017, Astron. Telegram, 10354
Mason, E., & Howell, S. 2003, A&A, 403, 699
McAllister, M., et al. 2019, MNRAS, 486, 5535
Mennickent, R. E., Matsumoto, K., & Arenas, J. 1999, A&A, 348, 466
Motch, C., Haberl, F., Guillout, P., Pakull, M., Reinsch, K., & Krautter, J. 1996, A&A, 307, 459
Mróz, P., et al. 2015, Acta Astron., 65, 313
Nakata, C., et al. 2013, PASJ, 65, 117
Namekata, K., et al. 2017, PASJ, 69, 2
Neustroev, V. V., et al. 2017, MNRAS, 467, 597
Neustroev, V. V., et al. 2018, A&A, 611, A13
Nogami, D., & Kato, T. 1995, IBVS, 4227, 1
Nogami, D., et al. 2003, A&A, 404, 1067
Novák, R. 1997, IBVS, 4489
Ohnishi, R., et al. 2019, PASJ, in press
Ohshima, T., et al. 2012, PASJ, 64, L3
Osaki, Y., & Kato, T. 2013a, PASJ, 65, 50
Osaki, Y., & Kato, T. 2013b, PASJ, 65, 95
Osminkin, E. Y. 1985, Perem. Zvezdy, 22, 261
Pala, A. F., et al. 2019, MNRAS, 483, 1080
Pala, A. F., Schmidtobreick, L., Tappert, C., Gänsicke, B. T., & Mehner, A. 2018, MNRAS, 481, 2523
Patterson, J., et al. 2005, PASP, 117, 1204
Patterson, J., et al. 2003, PASP, 115, 1308
Patterson, J., Thorstensen, J. R., & Knigge, C. 2008, PASP, 120, 510
Pavlenko, E., et al. 2019, Contr. of the Astron. Obs. Skalnaté Pleso, 49, 204
Pavlenko, E. P., Samsonov, D. A., Antonyuk, O. I., Andreev, M. V., Baklanov, A. V., & Sosnovskij, A. A. 2012, Astrophysics, 55, 494
Pojmański, G. 2002, Acta Astron., 52, 397
Prieto, J. L., et al. 2014, Astron. Telegram, 6688
Richter, G. A. 1969, Mitteil. Veränderl. Sterne, 5, 88
Ringwald, F. A. 1993, PhD thesis, Dartmouth Coll., Hanover, NH.
Rodríguez-Gil, P., Gänsicke, B. T., Hagen, H.-J., Marsh, T. R., Harlaftis, E. T., Kitsionas, S., & Engels, D. 2005, A&A, 431, 269
Romano, G. . 1978, IBVS, 1421
Rosino, L., & Pigatto, L. 1972a, IAU Circ., 2453
Rosino, L., & Pigatto, L. 1972b, IAU Circ., 2464
Sharov, A. S. 1991, Astron. Tsirk., 1550, 16
Sharov, A. S., & Alksnis, A. K. 1989, Soviet Astronomy Letters, 15, 382
Sharov, A. S., Goranskij, V. P., & Samus, N. N. 1992, IBVS, 3756
Shears, J., & Boyd, D. 2007, J. Br. Astron. Assoc., 117, 25
Shears, J., Brady, S., Foote, J., Starkey, D., & Vanmunster, T. 2008, J. Br. Astron. Assoc., 118, 288
Sheets, H. A., Thorstensen, J. R., Peters, C. J., Kapusta, A. B., & Taylor, C. J. 2007, PASP, 119, 494
Shumkov, V., et al. 2017, Astron. Telegram, 10790
Sklyanov, A. S., Pavlenko, E. P., Antonyuk, O. I., Antonyuk, K. A., Sosnovsky, A. A., Galeev, A. I., Pit', N. V., & Babina, Yu. V. 2016, Astrophys. Bull., 71, 293
Sklyanov, A. S., et al. 2018, Astrophysics, 61, 64
Stanek, K. Z., et al. 2013, Astron. Telegram, 5118
Stellingwerf, R. F. 1978, ApJ, 224, 953
Szkody, P., et al. 2009, AJ, 137, 4011
Szkody, P., et al. 2003, AJ, 126, 1499
Szkody, P., et al. 2006, AJ, 131, 973
Thorstensen, J. R., Fenton, W. H., Patterson, J. O., Kemp, J., Krajci, T., & Baraffe, I. 2002, ApJ, 567, L49
Thorstensen, J. R., Wade, R. A., & Oke, J. B. 1986, ApJ, 309, 721
Uemura, M., et al. 2002, PASJ, 54, L15
Waagen, E. O. 2017, AAVSO Alert Notice, 580
Wakamatsu, Y., et al. 2017, PASJ, 69, 89
Warner, B. 1995, Cataclysmic Variable Stars (Cambridge: Cambridge University Press)
Wenzel, W. 1989, IBVS, 3405
Williams, K. A., et al. 2010, AJ, 139, 2587
Wood, M. A., Still, M. D., Howell, S. B., Cannizzo, J. K., & Smale, A. P. 2011, ApJ, 741, 105
Woudt, P. A., & Warner, B. 2010, MNRAS, 403, 398
Woudt, P. A., Warner, B., de Budé, D., Macfarlane, S., Schurch, M. P. E., & Zietsman, E. 2012, MNRAS, 421, 2414
Wyrzykowski, L., Mroz, P., Udalski, A., Poleski, R., Kostrzewa-Rutkowska, Z., & OGLE-IV Team 2014, Astron. Telegram, 6690
Zemko, P., Kato, T., & Shugarov, S. 2013, PASJ, 65, 54
Zharikov, S. V., Tovmassian, G. H., Napiwotzki, R., Michel, R., & Neustroev, V. 2006, A&A, 449, 645
Zheng, W., et al. 2010, Cent. Bur. Electron. Telegrams, 2574
Zloczewski, K. 2004, IBVS, 5599