Annual report on observational results of the Astronomical Observatory at Kolonica Saddle

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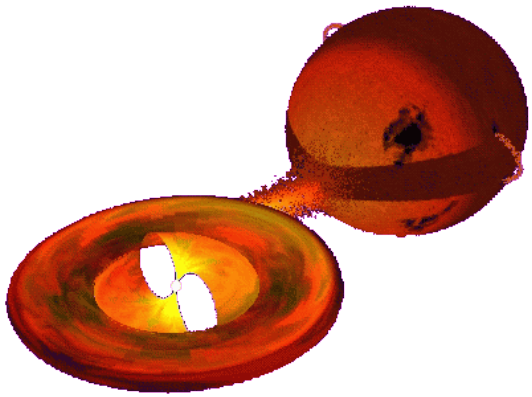
Intermediate polars - Standard model



- Cataclysmic system - white dwarf, red dwarf
- Asynchronous rotation - orbital and spin
- Magnetic field of the WD - truncated accretion disk
- Magnetically channeled accretion to the magnetic poles

The general model for intermediate polars is a red dwarf filling its Roche lobe, and a white dwarf, the magnetic field of which is strong enough to disrupt accretion disk completely or at least in its internal parts. The white dwarf rotates much more faster than the orbital motion.

Intermediate polars campaign

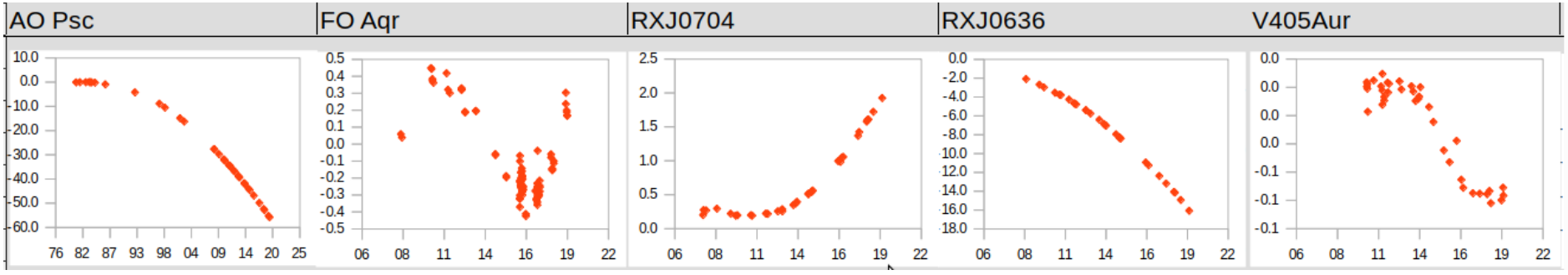
The goal of the campaign is the monitoring of selected intermediate polars for spin period changes. More detailed data analysis is done by prof. Andronov team including data from Hlohovec, Baja, Korea, Crimea and USA. The campaign is a part of Inter- longitude Astronomy project, Andronov et al. 2003.

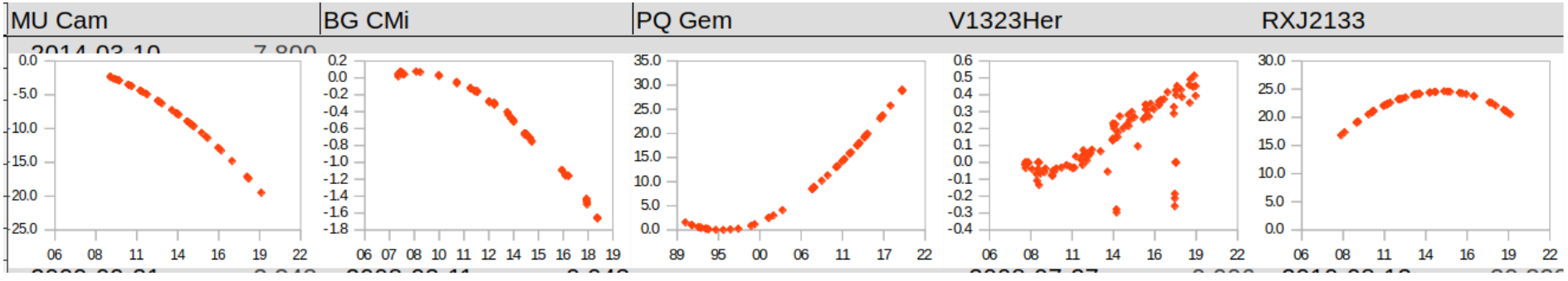
8 *Odessa Astronomical Publications*, vol. 23 (2010)

"INTER-LONGITUDE ASTRONOMY" (ILA) PROJECT:
CURRENT HIGHLIGHTS AND PERSPECTIVES.
I. MAGNETIC VS. NON-MAGNETIC
INTERACTING BINARY STARS

I.L. Andronov[1,2], K.A. Antoniuk[2], A.V. Baklanov[2], V.V. Breus[1,3], V. Burwitz[4], L.L. Chinarova[3], D. Chochol[5], P.A. Dubovsky[6], W. Han[7], T. Hegedus[8], A. Henden[9], L. Hric[5], Chun-Hwey Kim[10], Yonggi Kim[10,11], S.V. Kolesnikov[3], I. Kudzej[6], A. Liakos[12], P.G. Niarchos[12], A. Oksanen[13], L. Patkos[14], K. Petrik[15], N.V. Pit'[2], N.M. Shakhovskoy[2], N.A. Virnina[1], J. Yoon[10], S. Zola[16,17]

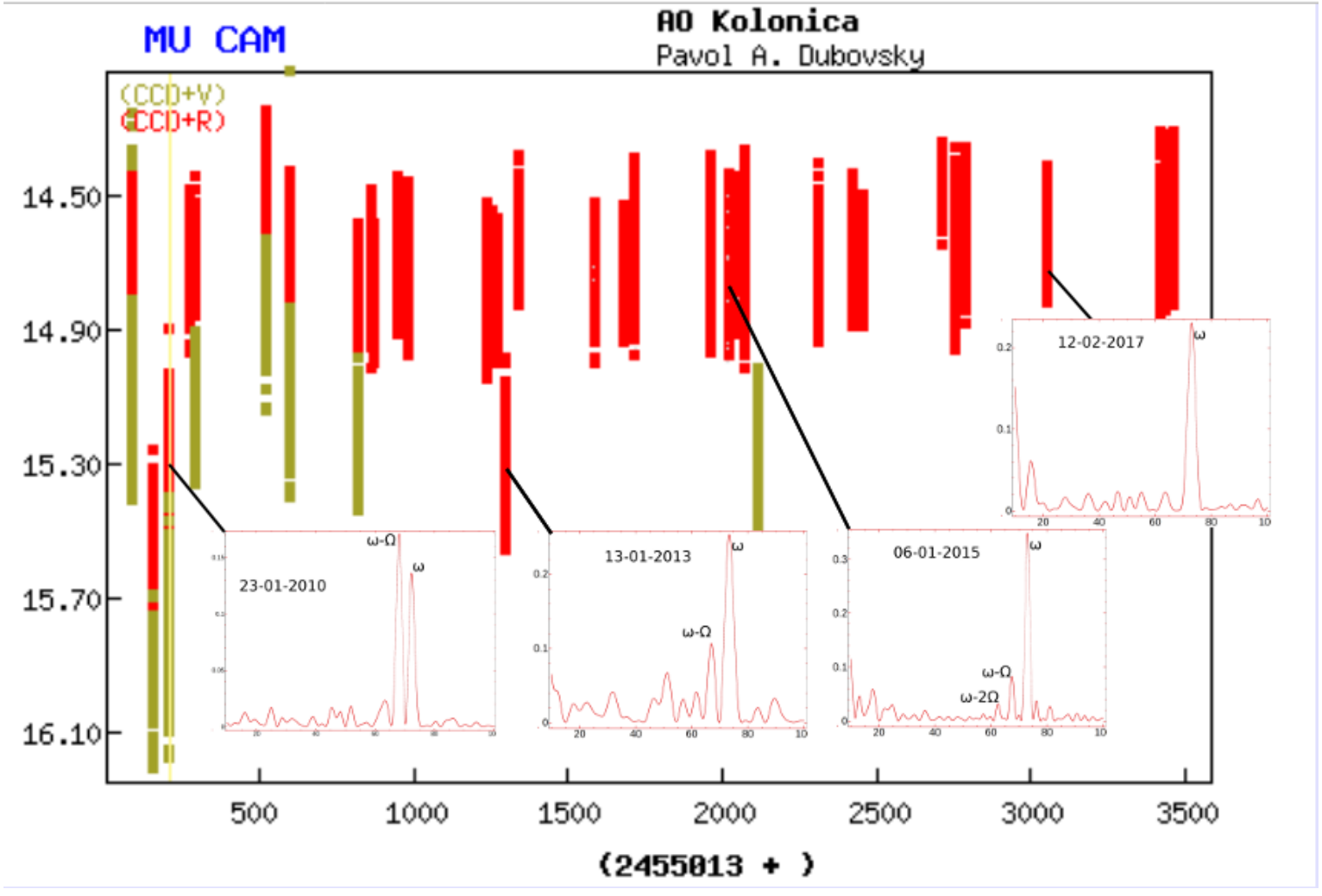
Gallery of solved O-C





Note the peculiar behavior of FO Aqr and V 1323 Her during their faint states. Change in mass tranfer rate $\rightarrow$ change between disc-fed and stream-fed accretion.

MU Cam - Orbital sidebands in the periodic signal produced by intermediate polar



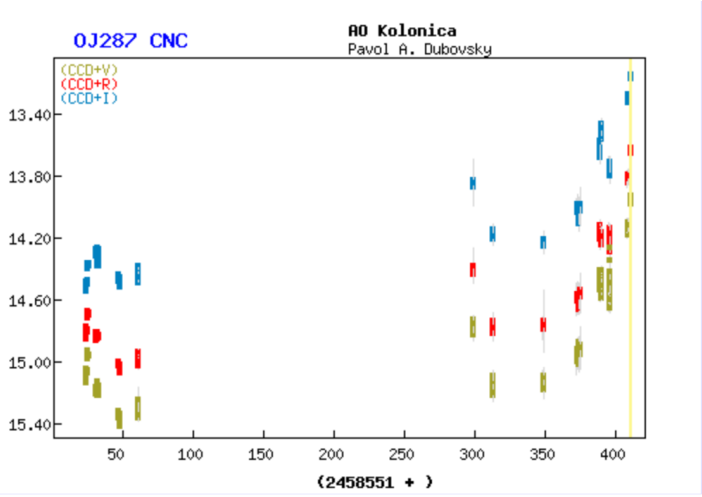
Active galactic nuclei

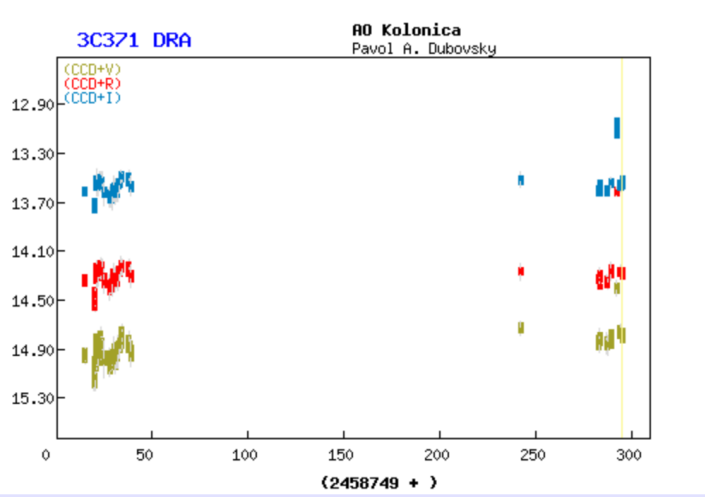
Participation in the radio - optical search for short term variability, i.e. Intro Day Variability and Inter day Variability (IDV)

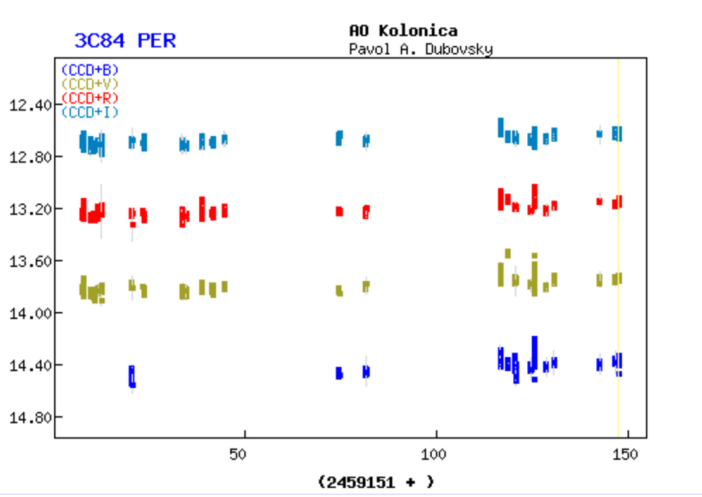
Ventspils International Radio Astronomy Centre, Latvia
Astronomical Observatory, Odessa National University, Ukraine
Odessa observatory URAN-4 Radio-astronomical Institutes NAS Ukraine

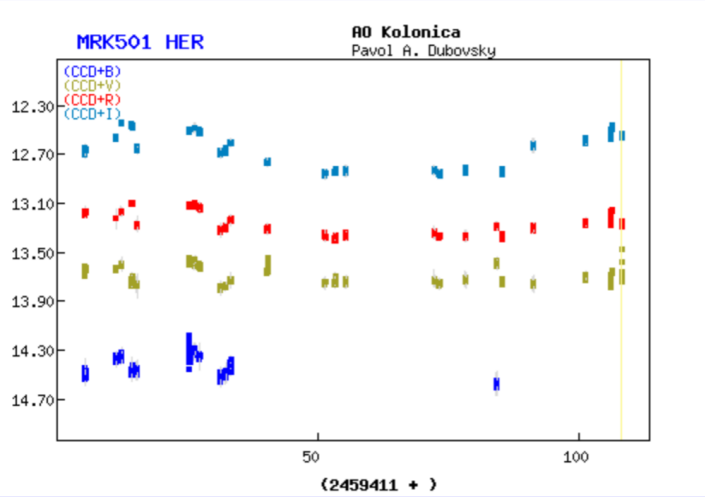
Designation	**Type**	**Nobs**	**filters, exposure**
OJ 287 (Cnc)	BLLAC	18	VRI 120s
3C 371 (Dra)	BLLAC	23	V120S RI90S
3C 84 (Per)	AGN	24	B180 V180 R60s I30s
Mrk 501 (Her)	BLLAC	24	V180s RI120s

Active galactic nuclei - Light curves observed at AO Kolonica

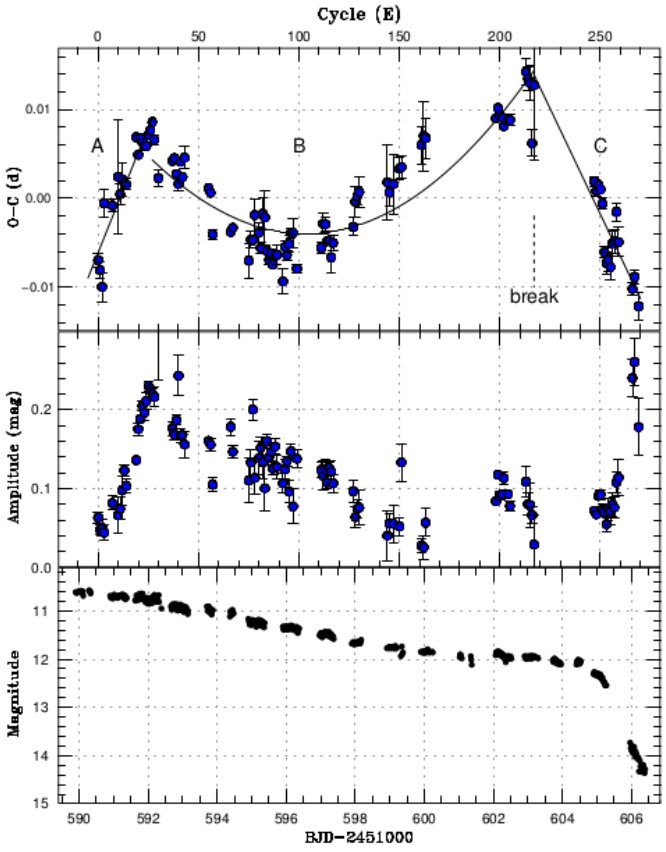








Superhumps in cataclysmic variables



SW UMa superoutburst 2000

VSNET campaign conducted by T. Kato. Evolution of accretion discs investigated by photometric observations of superhump period variations ($\dot{P}$). Most fruitful program. Serie of "Pdot" papers.

Kato et al. (2009) introduced superhump stages: initial growing stage (A) with a long period, fully developed stage with a systematically varying period (B) and later stage C with a shorter period.

Mass ratio from A stage of superhumps

The mass ratio q can be determined from the superhumps excess ϵ^* - Kato, Osaki (2013)

$$q = -0.0016 + 2.60\epsilon^* + 3.33(\epsilon^*)^2 + 79(\epsilon^*)^3$$

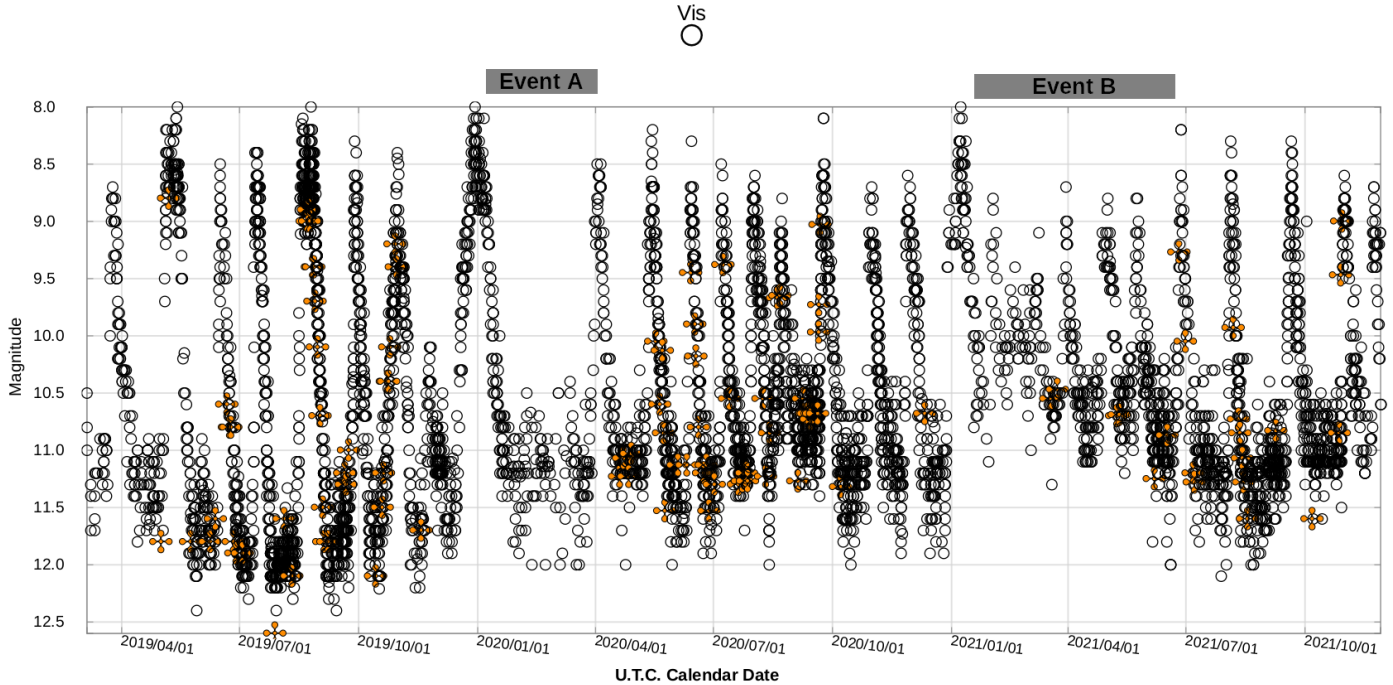
This is because stage A superhumps reflect the dynamical precession rate at the 3:1 resonance radius.

Observing superhumps during stage A is very important althought the amplitude is low and the noise in the data is annoying.

Thanks to the vsnet-alert system many superoutbursts were indeed catched in the initial phase.

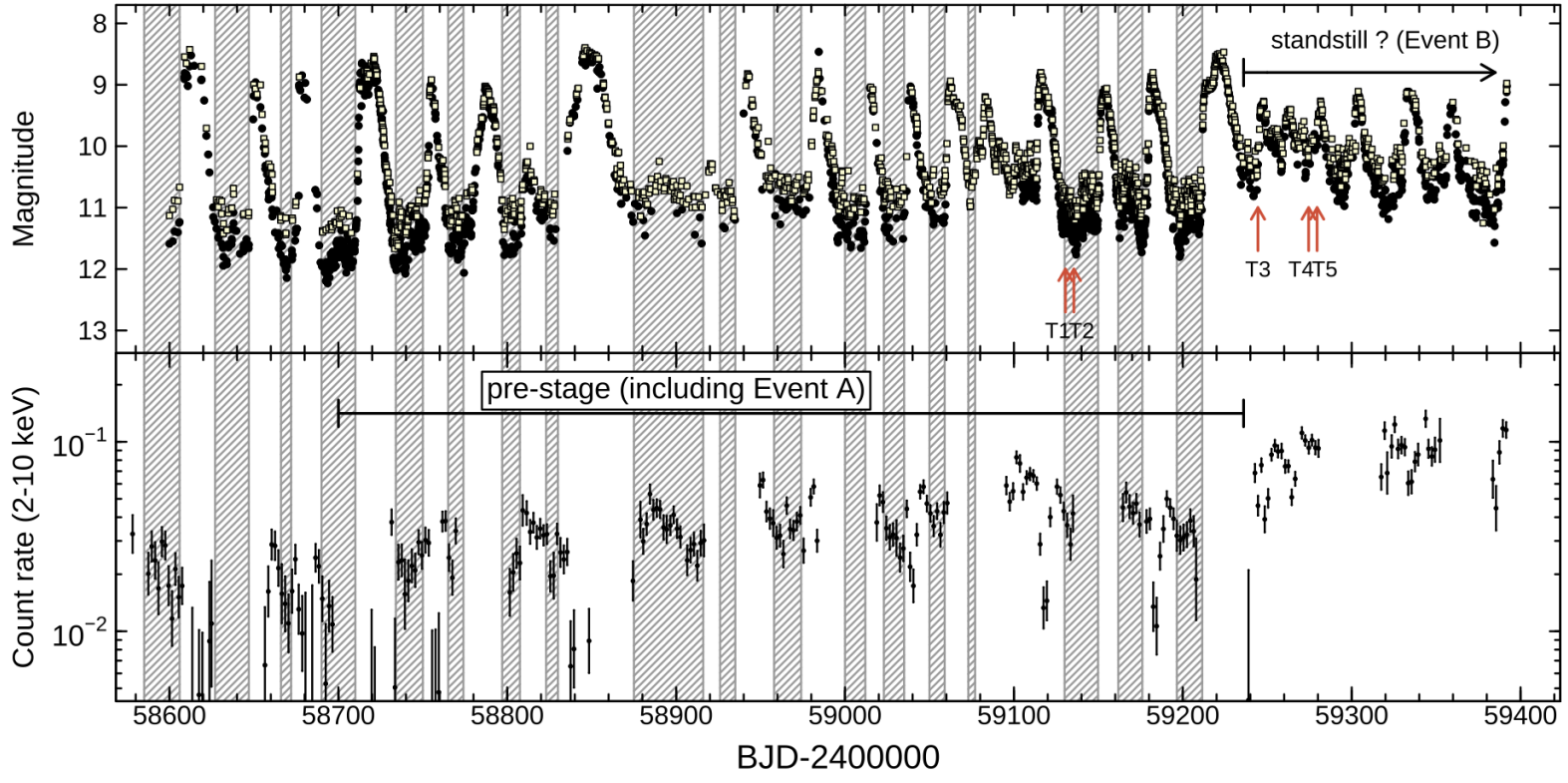
Anomalous event in 2021 in the dwarf nova SS Cygni

One of the most intensively observed variable stars. Prototype of long orbital period dwarf novae. And there is still space for surprise. The anomalous behavior started already in 2019. The outbursts became irregular, quiescence brighter. The optical irregularities are accompanied by increased flux in X rays. This was the reason for international observing campaign leaded by Dr. Mariko Kimura (RIKEN, Japan).



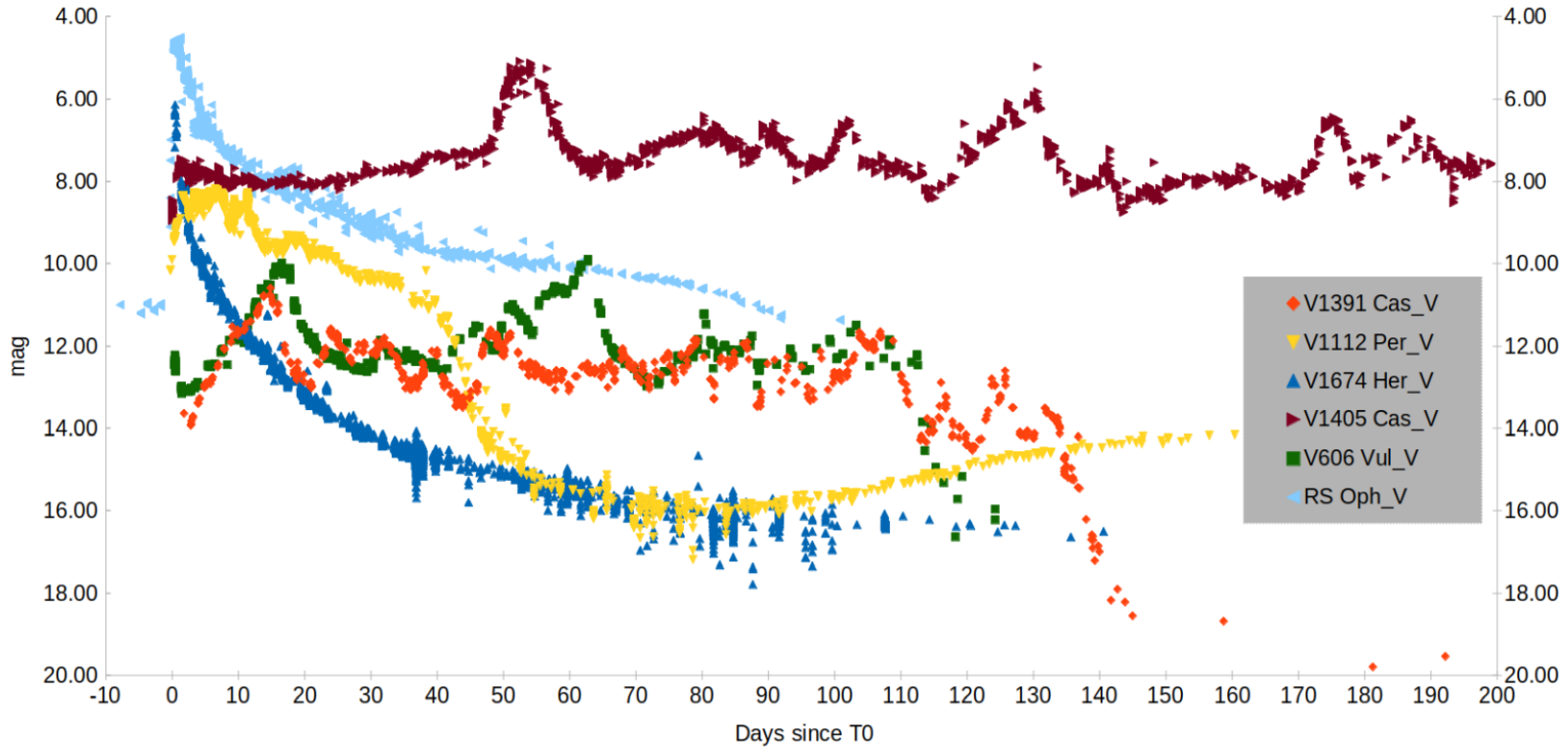
Anomalous event in 2021 in the dwarf nova SS Cygni

Kimura et al. 2021 suggested that anomalous phenomenon was caused by an enhancement of accretion disk viscosity in the cool state.



6 novae well observable from the northern hemisphere

All events where studied intensively both photometrically and spectroscopically. First results already presented on the Bezovec conference.



Special case - V1674 Her, fastest nova and intermediate polar

Spin period found in ZTF data

Surprisingly we have detected the Pspin = 0.00580d just 23 days after the nova exposion.

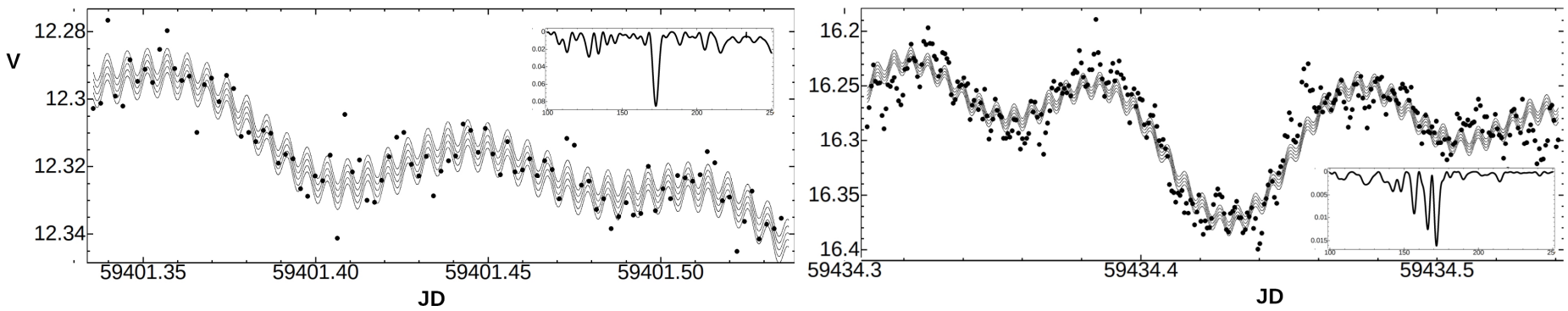
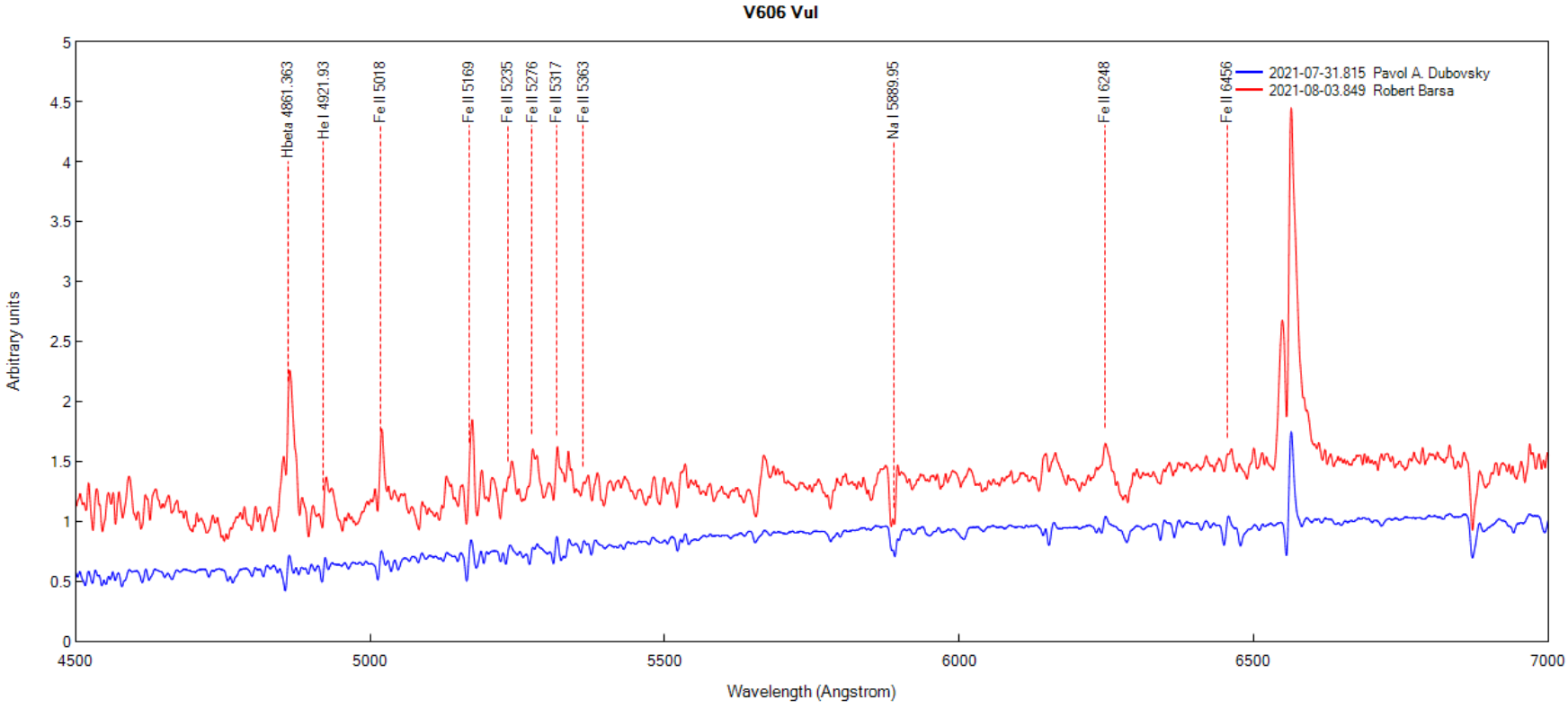


Figure: Fast photometry of V1674 Her. Left: multi sinusoidal fit of the data from July 5, 2021 in V band with periodogram (small panel) showing the peak at the spin frequency. Right: data from August 7, 2021. Sideband frequencies $\omega - \Omega$ and $\omega - 2\Omega$.

Low resolution spectroscopy of novae

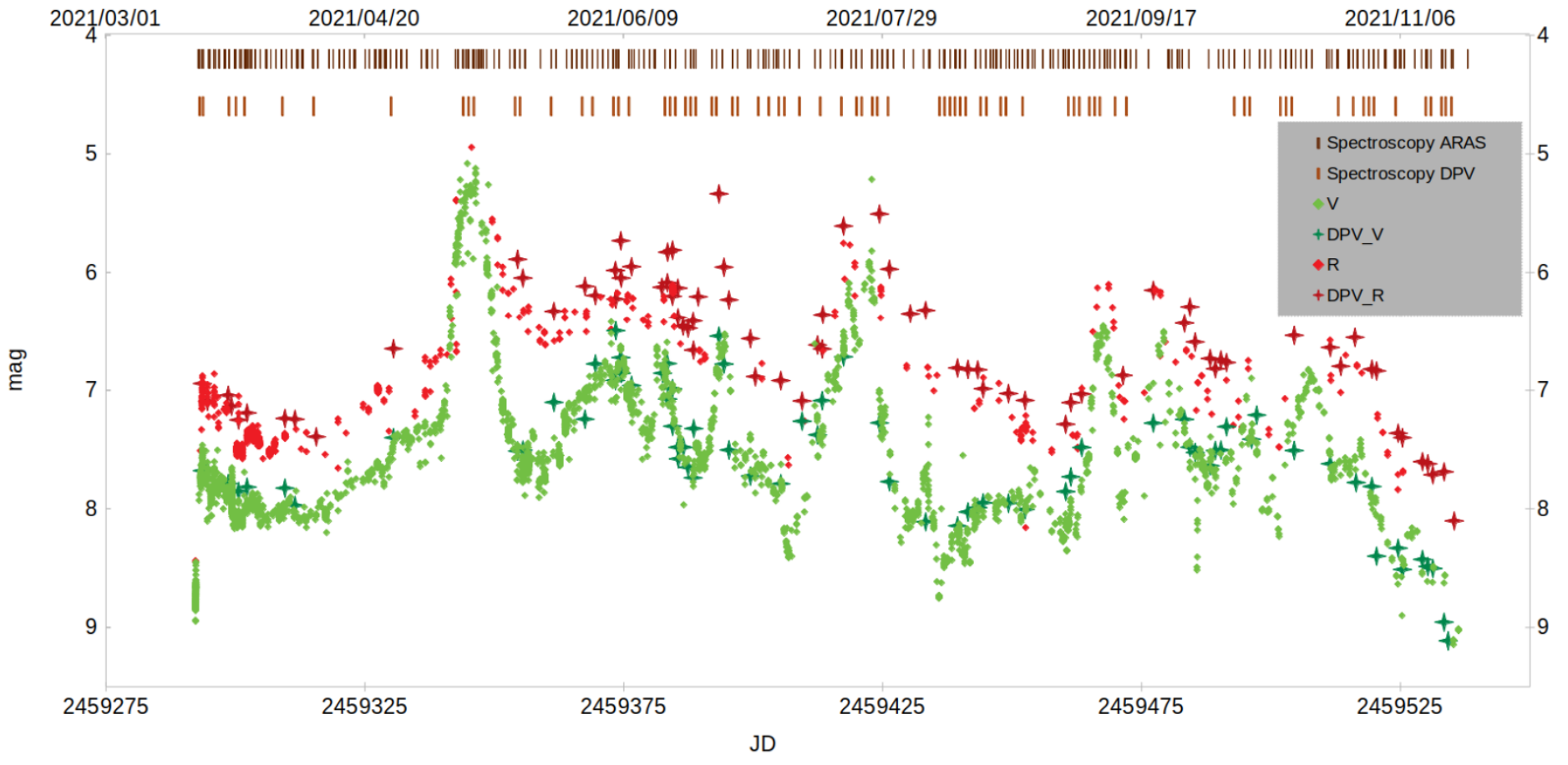
V606 Vul example

Spectra obtained during the Variable astrocamp held at AO on Kolonica Saddle showing transition from He/N type to FeII type nova.



V1405 Cas - slow nova with oscillations

Photometric and spectrospic coverage



Times of minima of selected eclipsing binaries

Long term campaign conducted by Pribulla, Vaňko and Parimucha.
Regular publication after sufficient data is accumulated

Times of minima in 2020 and 2021

56 times of minima were collected of 24 different objects

Totals from 2006 to 2019

1521 times of minima of 108 different objects

Visual estimates of variable stars

Only one observer - Pavol A. Dubovský (**DPV**)

Total 5216 estimates made with dobson Meade Starlight 405/1830, dobson Chermelin 300/1500, double binocular 25x100 + 12x60 and Dobson 200/1400 in 2020 and 2021. Total **73402** visual estimates by DPV made in the period 1998 - 2021.

Monitoring of cataclysmic variables

Long period variables

Symbiotic and Semiregular variables. Long term light curve is step by step constructed for **73** targets.

Projects

Interacting binaries - Key for the Understanding of the Universe, APVV grant 15-0458

Period 2016 - 2020. Co-ordinating organization: Slovak Academy of Sciences, Astronomical Institute. Principal investigator: RNDr. Augustín Skopal, DrSc.

From Interacting Binaries to Exoplanets, APVV grant 20-0148

Period 2021 - 2025. Co-ordinating organization: Slovak Academy of Sciences, Astronomical Institute. Principal investigator: RNDr. Theodor Pribulla, CSc.

Papers published with Vihorlat Observatory co-authors in 2020

Žák, J.; et al. (2019)

Photometric and spectroscopic investigation of nine Cepheids in the Cassiopeia constellation

CoSka 49, 503.

Breus, V.; et al. (2020)

On the spin and orbital variability of the intermediate polars

AANv 1, 191B.

Kato, T.; et al. (2020)

Survey of period variations of superhumps in SU UMa-type dwarf novae. X. The tenth year (2017)

PASJ 72, 14.

Papers published with Vihorlat Observatory co-authors in 2020

Sukharev, A., et al. (2020)

Study of Rapid Variability of the Blazar OJ 287 in the Radio and Optical Ranges

Ap 63, 32S.

Parimucha, Š.; et al. (2020)

About the dependency of the spin maxima on orbital phase in the intermediate polar MU Cam

CoSka 50, 618P.

Evitts, J. J.; et al. (2020)

A survey for variable young stars with small telescopes: II - mapping a protoplanetary disc with stable structures at 0.15 au

MNRAS 493, 184E.

Papers published with Vihorlat Observatory co-authors in 2020

Skopal, A., et al. (2020)

The path to Z And-type outbursts: The case of V426 Sagittae (HBHA 1704-05)

A&A 636A, 77S.

Tampo, Y.; et al. (2020)

First detection of two superoutbursts during the rebrightening phase of a WZ Sge-type dwarf nova: TCP J21040470+4631129

PASJ 72, 49T.

Sukharev, A.; et al. (2020)

Program and Results of Investigations Rapid Variability of the BL Lac Object 3C 371 in Radio and Optical Ranges

Galax 8, 69S.

Papers published with Vihorlat Observatory co-authors in 2021

Breus, V., et al. (2020)

On the spin period variability in intermediate polars

OEJV 208, 11B.

Dubovsky, P. A.; et al. (2021)

Spectroscopic Confirmation of the Active Dwarf Nature of 2MASS J07363415+6538548

RNAAS 5, 11D.

Kimura, M.; et al. (2021)

Multi-wavelength photometry during the 2018 superoutburst of the WZ Sge-type dwarf nova EG Cancri

PASJ 73, 1K.

Papers published with Vihorlat Observatory co-authors in 2021

Wakamatsu, Y., et al. (2021)

ASASSN-18aan: An eclipsing SU UMa-type cataclysmic variable with a 3.6-hr orbital period and a late G-type secondary star

PASJ tmp, 11W.

Chochol, D.; et al. (2021)

Classical Nova Persei 2018 outburst from the dwarf nova V392 Per

gacv.workE 29C.

Shore, S. N.; et al. (2021)

V1405 Cas (= PNV J23244760+6111140) now displaying Fe II emission

ATel14577 1S.

Papers published with Vihorlat Observatory co-authors in 2021

Pavlenko, E., et al. (2021)

MASTER OT J172758.09+380021.5: a peculiar ER UMa-type dwarf nova, probably a missed nova in the recent past

CoSka 51, 138P.

Tampo, Y.; et al. (2021)

Spectroscopic and photometric observations of dwarf nova superoutbursts by the 3.8 m telescope Seimei and the Variable Star Network

PASJ 73, 753T.

Kato, T.; et al. (2021)

BO Ceti: Dwarf nova showing both IW And-type and SU UMa-Type features

PASJ tmp, 84K.

Papers published with Vihorlat Observatory co-authors in 2021

Kimura, M., et al. (2021)

On the nature of the anomalous event in 2021 in the dwarf nova SS Cygni and its multi-wavelength transition

PASJ tmp, 85K.

Shore, S. N.; et al. (2021)

ARAS Group spectroscopic monitoring of the latest outburst of RS Oph

ATel14868 1S.

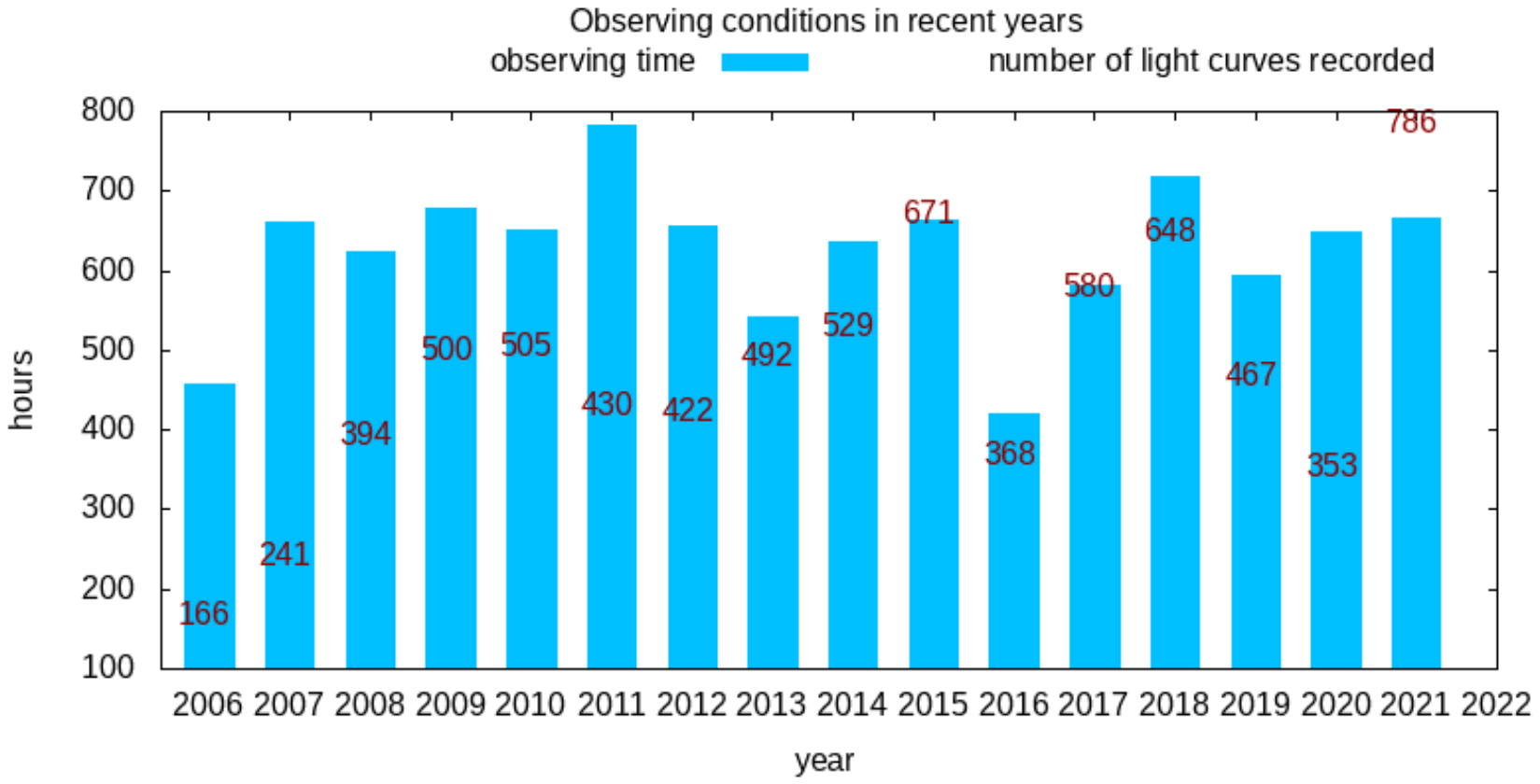
Froebrich, D.; et al. (2021)

A survey for variable young stars with small telescopes - IV. Rotation periods of YSOs in IC 5070

MNRAS 506, 5989F.

Observing statistics in recent years

Atmospheric conditions, activity and efficiency of the observatory



Observers and instruments

Pavol A. Dubovský and Tomáš Medulka as staff observers

VNT 1000/9000 + FLI1001E + B V Rc Ic Clear filters
C14 356/3910 + MII G2-1600 + B V Rc Ic Clear filters
C11 280/2800 + LISA spectrograph ATIK 460ex camera
Pupava 280/1500 + MII G2-1600 + B V Rc Ic Clear filters
M20 200/2000 + QHY9 without filters (private instrument)

Doc. Parimucha and his students from Šafárik University in Košice

ZIGA Planewave CDK20 508/3454 + MII G4-16000 + B V Rc Ic filters

Visual estimates of variable stars brightness

Pavol A. Dubovský with dobson Meade Starlight 405/1830 and double binocular 25x100 + 12x60

Thank you for your attention