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

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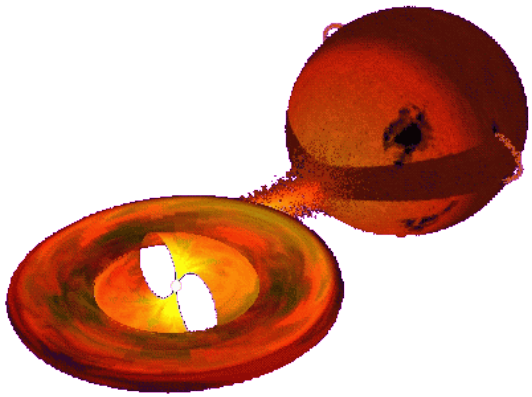
# Content

# 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

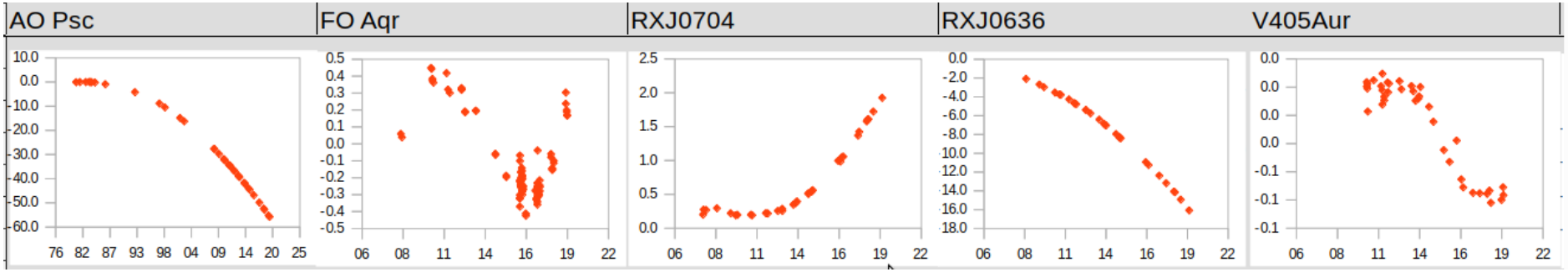
The goal of the campaign is the monitoring of selected intermediate polars for spin period changes. More detailed data analysis is done by prof. Andronov team including data from Hlohovec, Baja, Korea, Crimea and USA. The campaign is a part of Inter- longitude Astronomy project, Andronov et al. 2003.

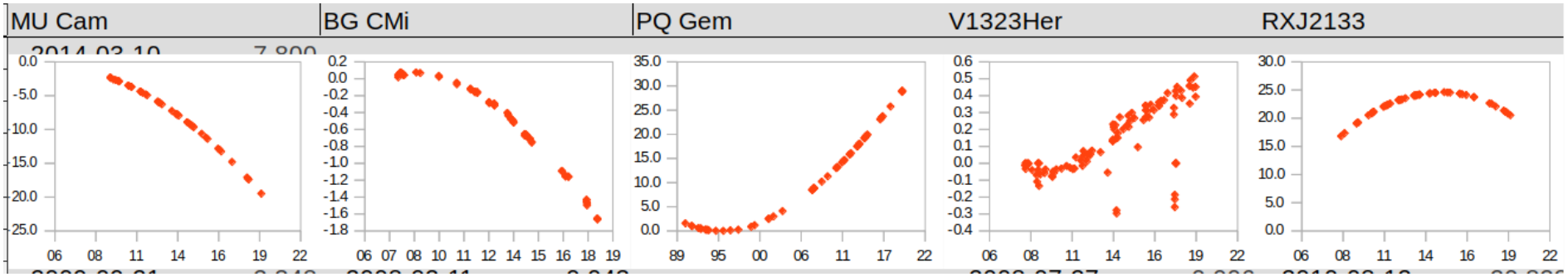
8 *Odessa Astronomical Publications*, vol. 23 (2010)

"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]

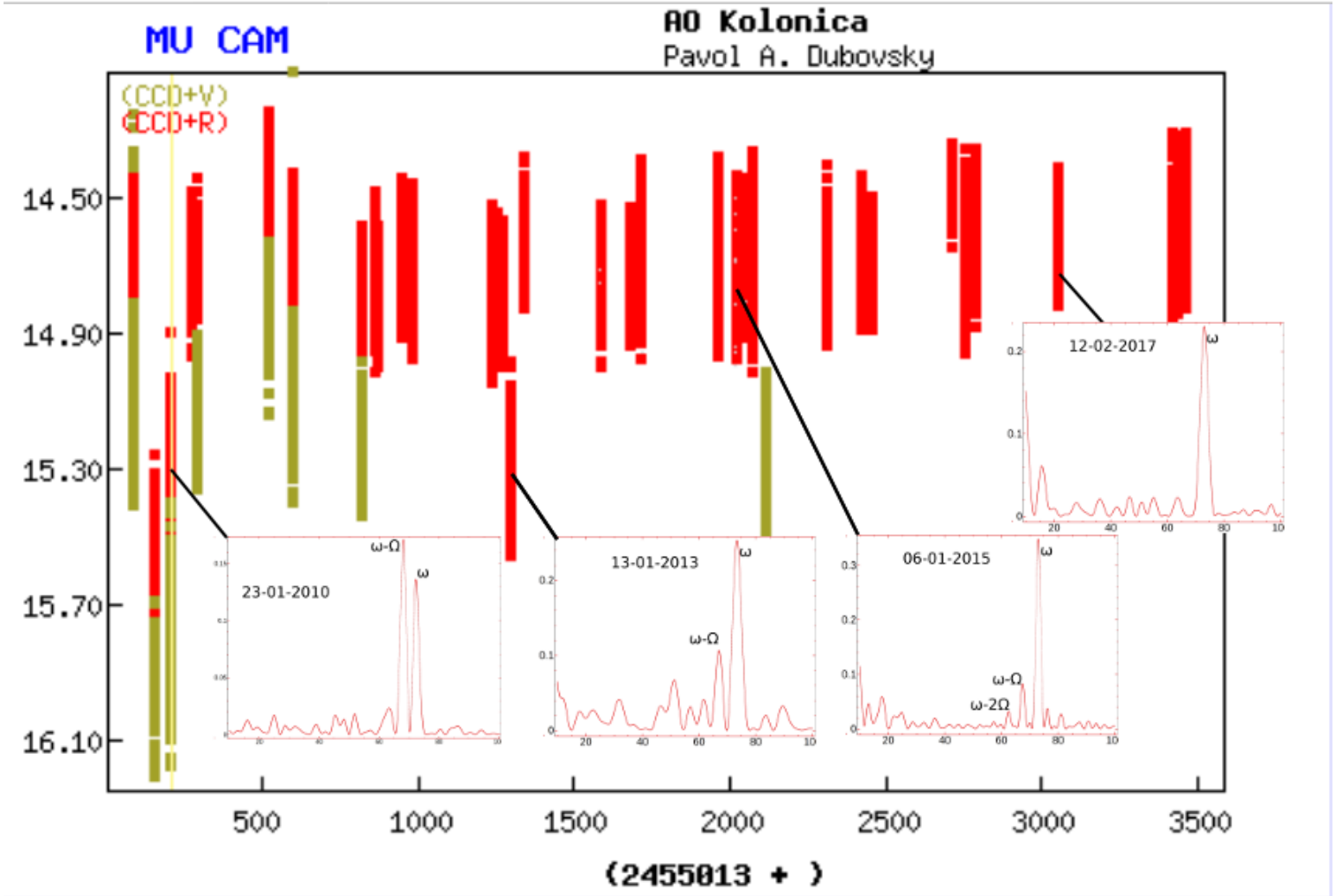
# Gallery of solved O-C




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

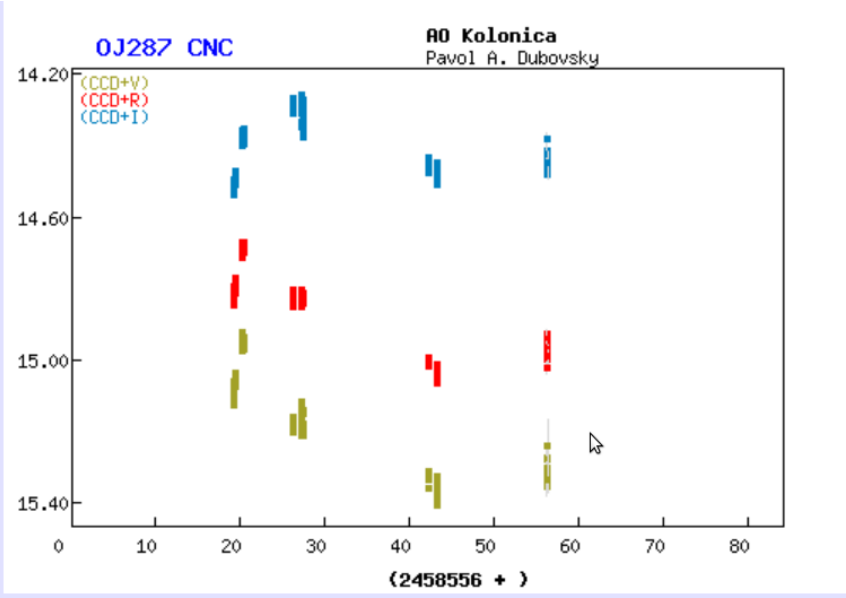
Participation in the radio - optical search for short term variability, i.e. Intro Day Variability and Inter day Variability (IDV)

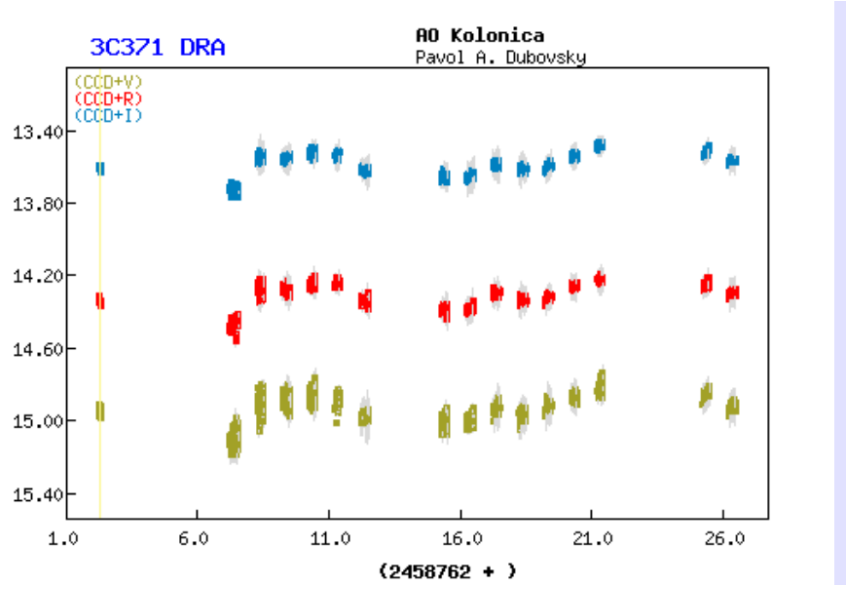
Ventspils International Radio Astronomy Centre, Latvia
Astronomical Observatory, Odessa National University, Ukraine
Odessa observatory URAN-4 Radio-astronomical Institutes NAS Ukraine

| **Designation** | **Type** | **N** | **filters, exposure** |
|---|---|---|---|
| OJ 287 (Cnc) | BLLAC | 7 | VRI 120s |
| 3C 371 (Dra) | BLLAC | 16 | VRI, 90s |
| 3C 273 (Vir) | AGN | 0 | |
| 3C 454.3 (Peg) | AGN | 0 | |

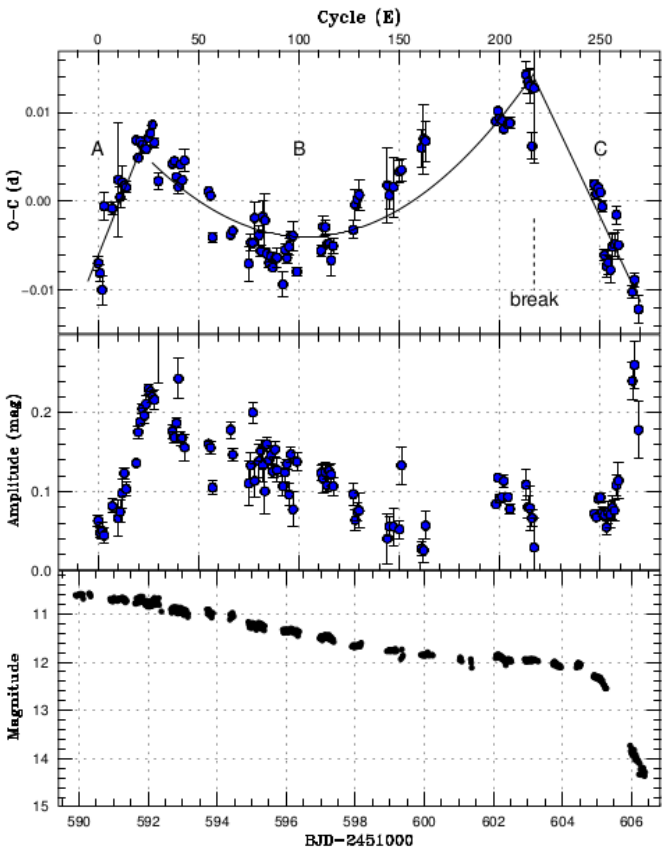
# Active galactic nuclei

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 $\epsilon^*$ - 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 inicial phase.

# Observations made in Kolonica during 2019

Targets observed in superoutburst with superhumps detected

| **Designation** | **Type** | **N** | **Comment** |
|---|---|---|---|
| TCP J05515391+6504346 | UGWZ | 11 | |
| ASASSN-18ey | LMXB/XN | 36 | rebrightenning |
| TCP J05390410+4748030 | UGWZ | 6 | |
| RZ Sge | UGSU | 4 | |
| AL Com | UGWZ | 7 | q=0.083 |
| V844 Her | UGSU | 6 | |
| SU UMa | UGSU | 9 | |
| EQ Lyn | UGWZ+ZZ | 11 | only ordinary sh |

N = number of time series acquired in Kolonica

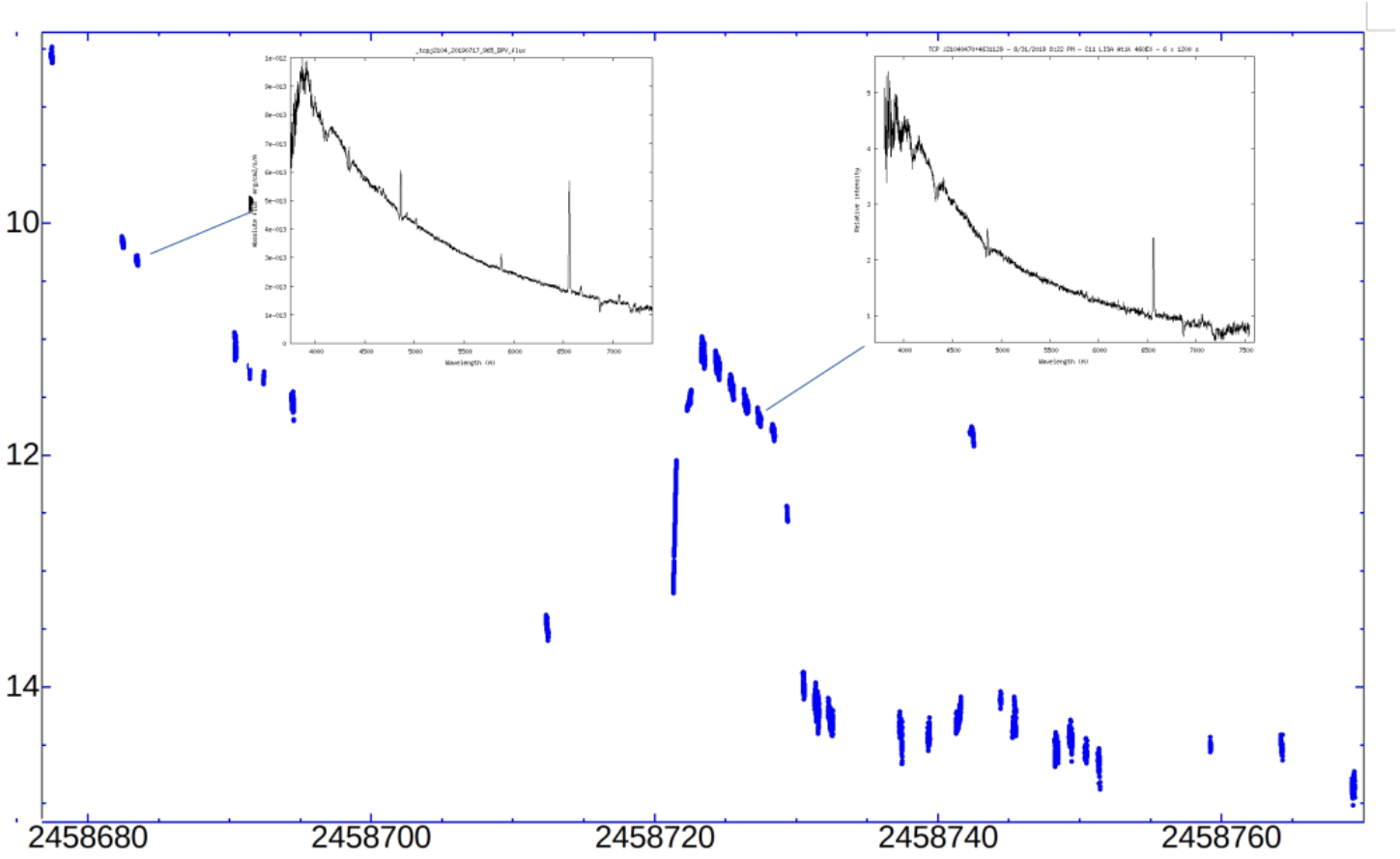
# Observations made in Kolonica during 2019

| **Designation** | **Type** | **N** | **Comment** |
|---|---|---|---|
| ASASSN-19pe | UGWZ? | 6 | |
| V507 Cyg | UGZ/IW And | 7 | |
| OT J162717.0+040559 | UGWZ+E | 2 | |
| KX Aql | UGWZ | 4 | UGSU type |
| SS UMi | UGSU | 3 | |
| ASASSN-19sk | UGSU | 6 | |
| TCP J20225930+5239030 | UGWZ | 3 | |
| EI Psc | UGSU | 7 | precursor |

N = number of time series acquired in Kolonica

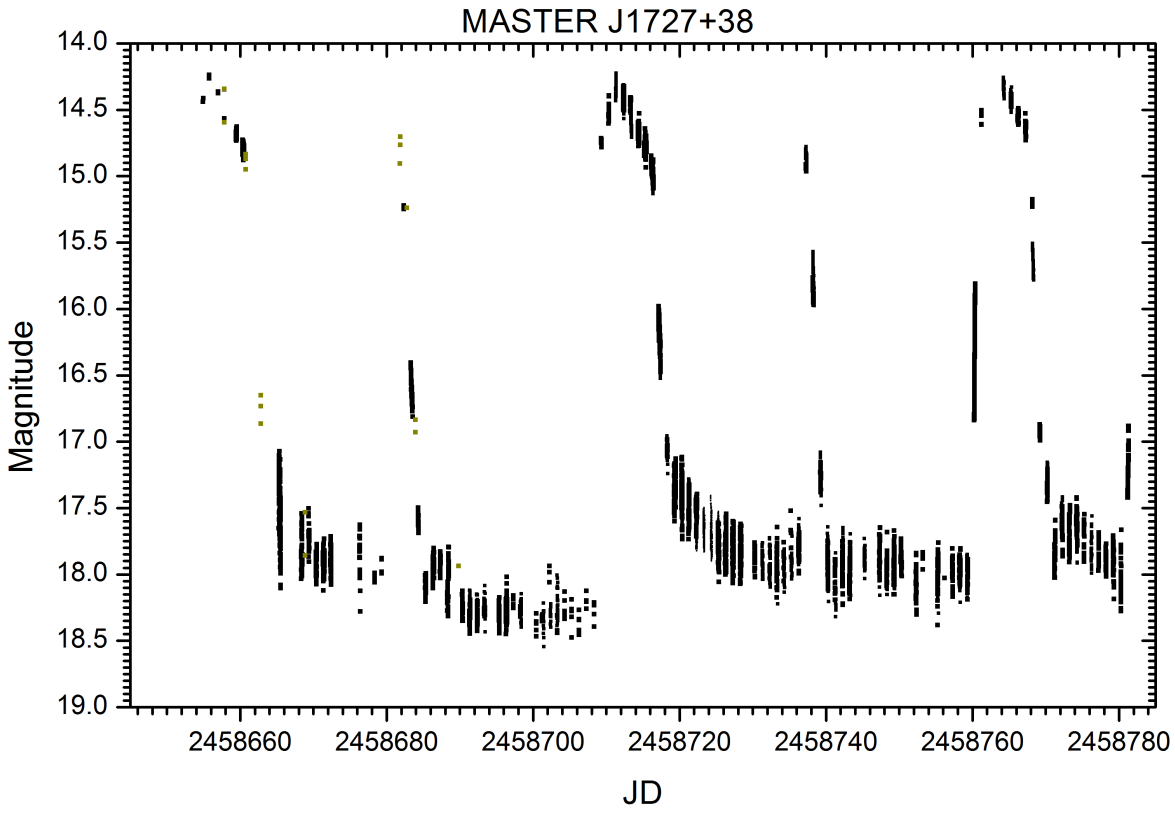
# Targets of special interest - TCP J21040470+4631129

Bright UGWZ star with 4 rebrigtennings and 2nd superoutburst - type E according Kato, 2015. 52 time series, 7 low resolution spectra



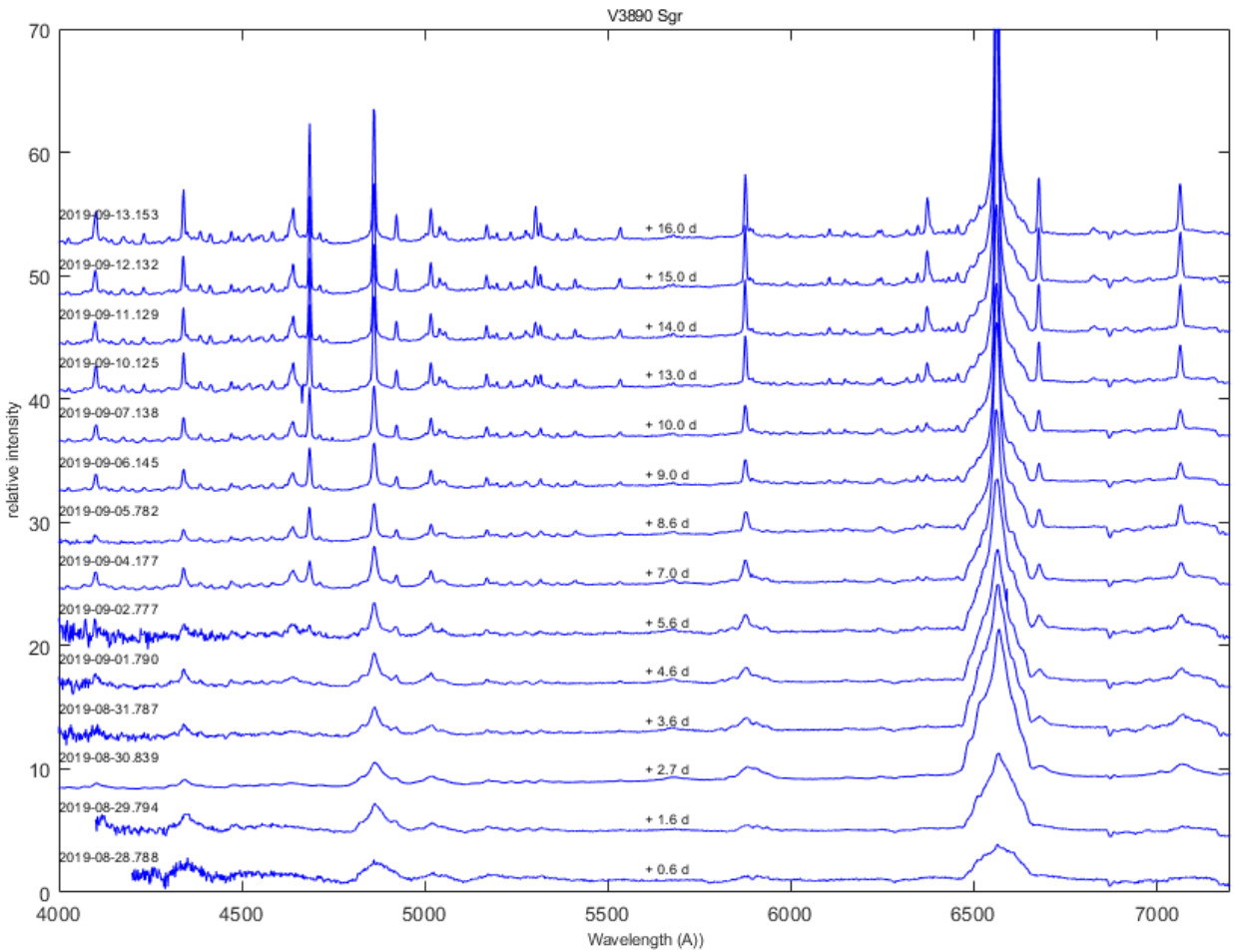
# MASTER OT J172758.09+380021.5

UGSU/EI PSc - short supercycle, positive and negative superhumps. 21 time series, multicolor

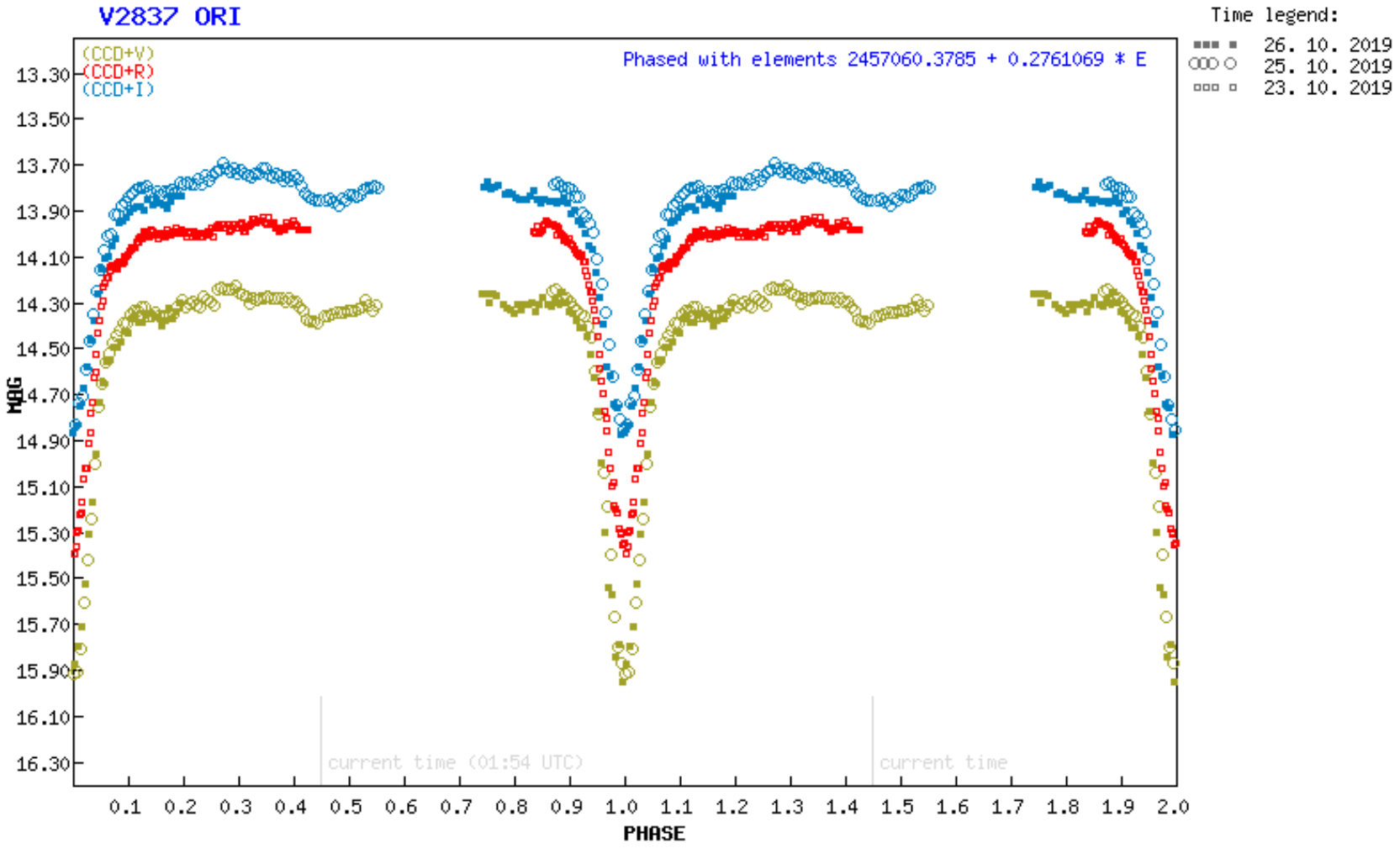


# V3890 Sgr - Third erruption of recurrent nova

## Declination -24. 14 low resolution spectra

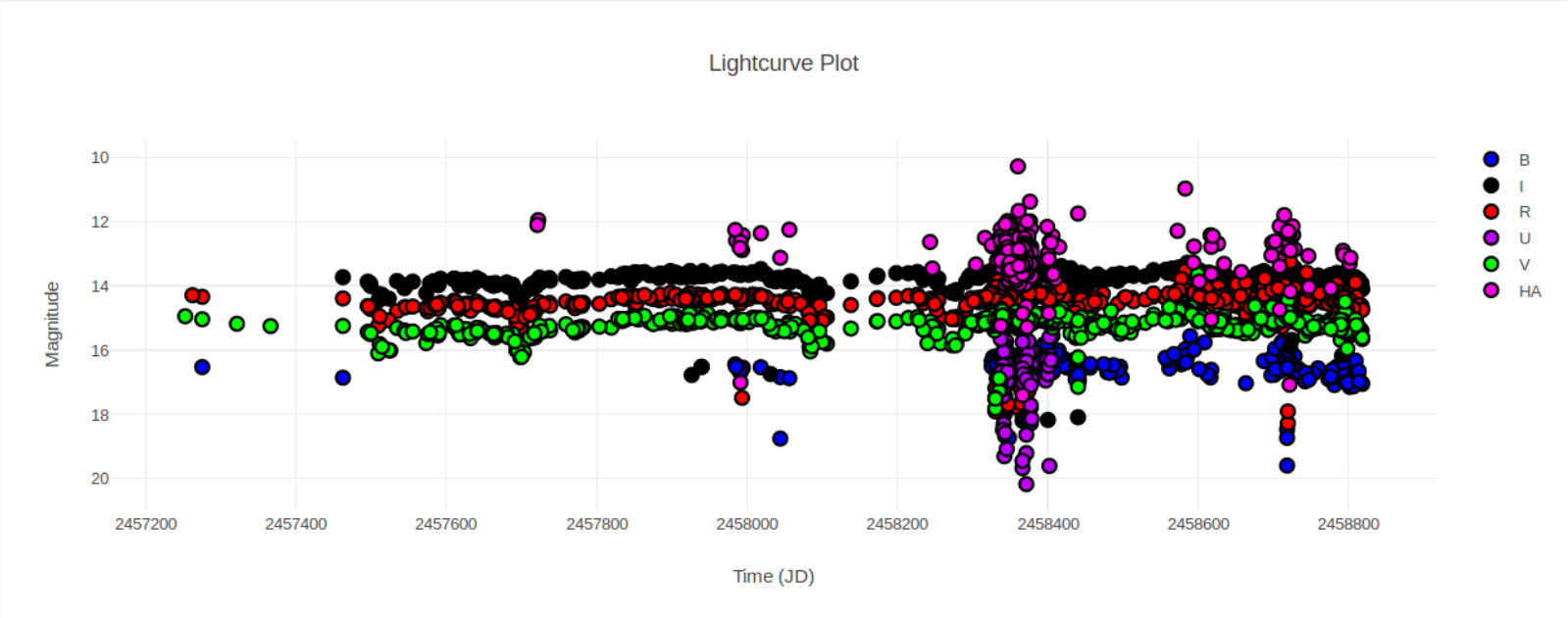


# V2837 Ori - The only known deeply eclipsing IW And



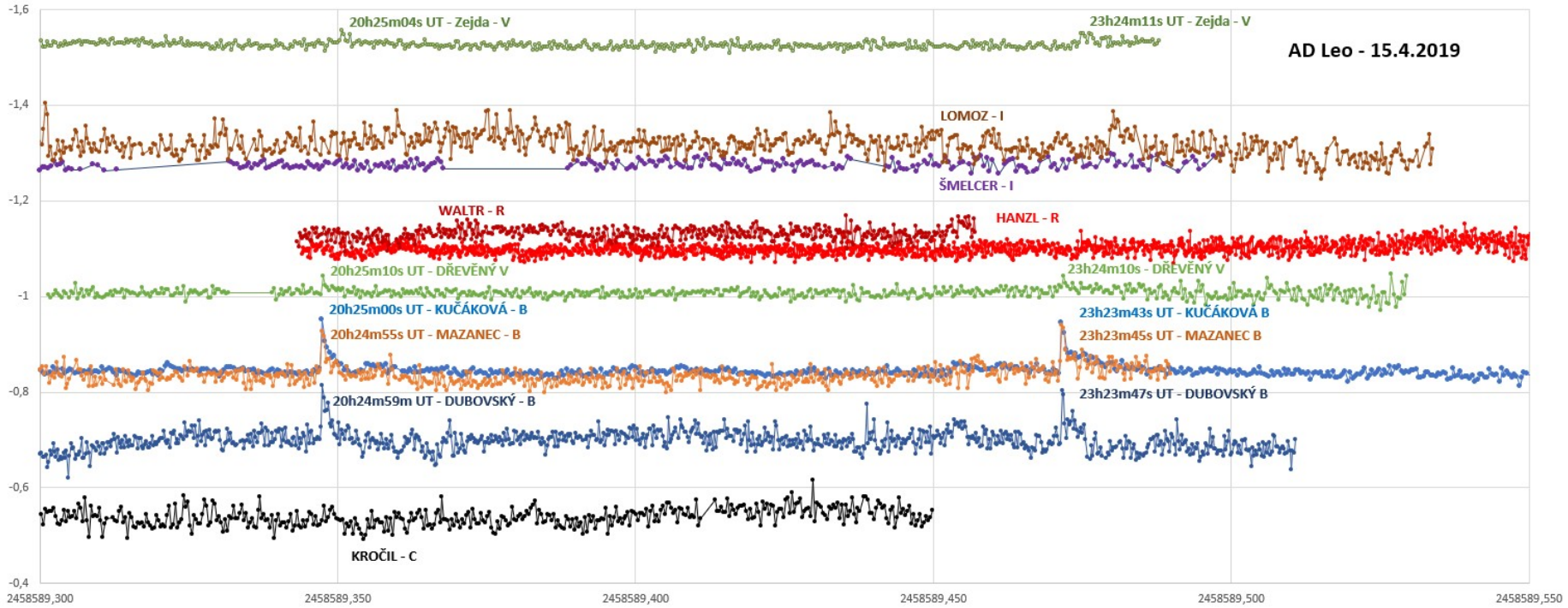
# Young stellar objects - V1491 Cyg and 2MASS J21383981+5708470

**54 nightly means in BVRcIc** photometry observations were performed in Kolonica as our participation in the campaign of HOYS-CAPS Project (Hunting Outbursting Young Stars with the Centre of Astrophysics and Planetary Sciences) managed by Prof. Dirk Froebrich from University of Kent.



# Flares on red dwarfs - AD Leo

Campaign managed by L. Smelcer VSS Czech Astronomical Society. Photometry and spectroscopy on 2m Ondrejov telescope. At AO Kolonica: 3 time series in B filter, 5 flares, 52 low resolution spectra



# 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 2019

**65** times of minima were collected of 32 different objects

Totals from 2006 to 2019

**1465** times of minima of 108 different objects

# Visual estimates of variable stars

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

Total **1400** estimates made with dobson Meade Starlight 405/1830, dobson Chermelin 300/1500 and double binocular 25x100 + 12x60 in 2019. Total **69690** visual estimates by DPV made in the period 1998 - 2019.

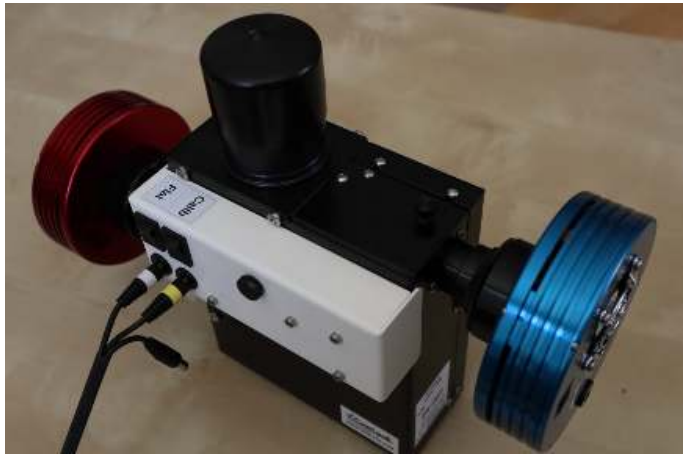
## Monitoring of cataclysmic variables

LL Lyr, V1113 Cyg, VW CrB, V503 Cyg and RZ Sge superoutburts detected visualy

## Long period variables

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

# The beginnig of spectroscopy at AO Kolonica Saddle



Low resolution spectrograph LISA purchased from the Polish NCN grant 2015/18/A/ST9/00578 was installed on C11 telescope in 2018. Observing program:

- Spectral classification of Be stars
- Novae and dwarf novae accesible with the given instrument i.e. brighter than 12 mag
- Symbiotic stars

Up to now **316** spectra collected

# Interacting binaries - Key for the Understanding of the Universe

### The project dedicated to close binaries investigation

All previously mentioned observations were done in the frame of the APVV grant 15-0458.

### Co-ordinating organization

Slovak Academy of Sciences, Astronomical Institute

### Principal investigator

RNDr. Augustín Skopal, DrSc.

# Papers published with Vihorlat Observatory co-authors in 2019


Kudzej, I.; et al. (2019)
CoLiTecVS - A new tool for the automated reduction of photometric observations
*AN* 340, 68.

Parimucha, S.; et al. (2019)
CoLiTecVS - a new tool for an automated reduction of photometric observations
*CoSka* 49, 151.

Pavlenko, E.; et al. (2019)
ASASSN-18fk: A new WZ Sge-type dwarf nova with multiple rebrightenings and a new candidate for a superhumping intermediate polar
*CoSka* 49, 204.

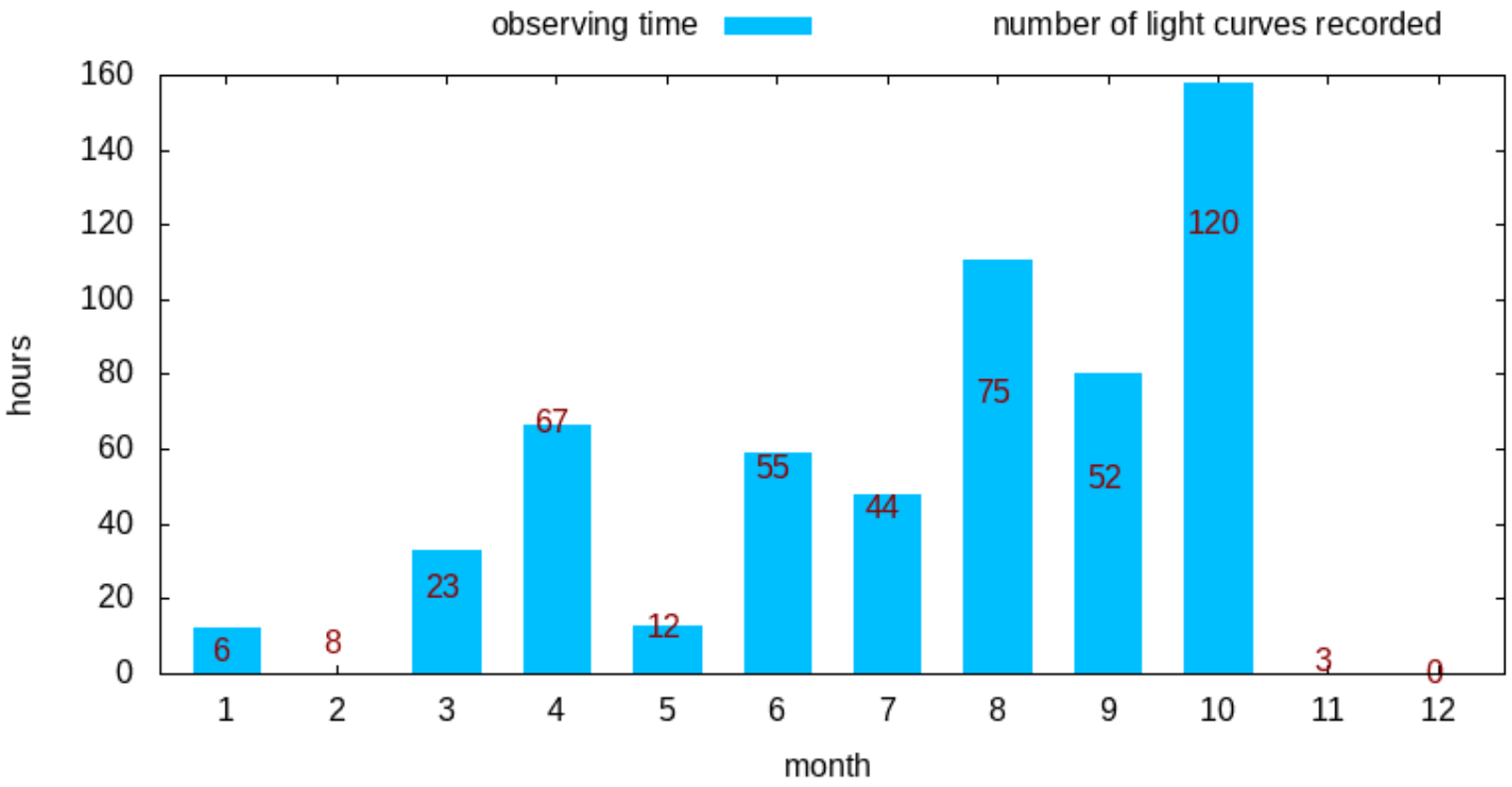
# Papers published with Vihorlat Observatory co-authors in 2019

Kato, T., et al. (2019)
Discovery of standstills in the SU UMa-type dwarf nova NY Serpentis
*PASJ* 71, 1.

Breus, V., V.; et al. (2019)
Variability of the Spin Periods of Intermediate Polars: Recent Results
*OEJV* 197, 8.

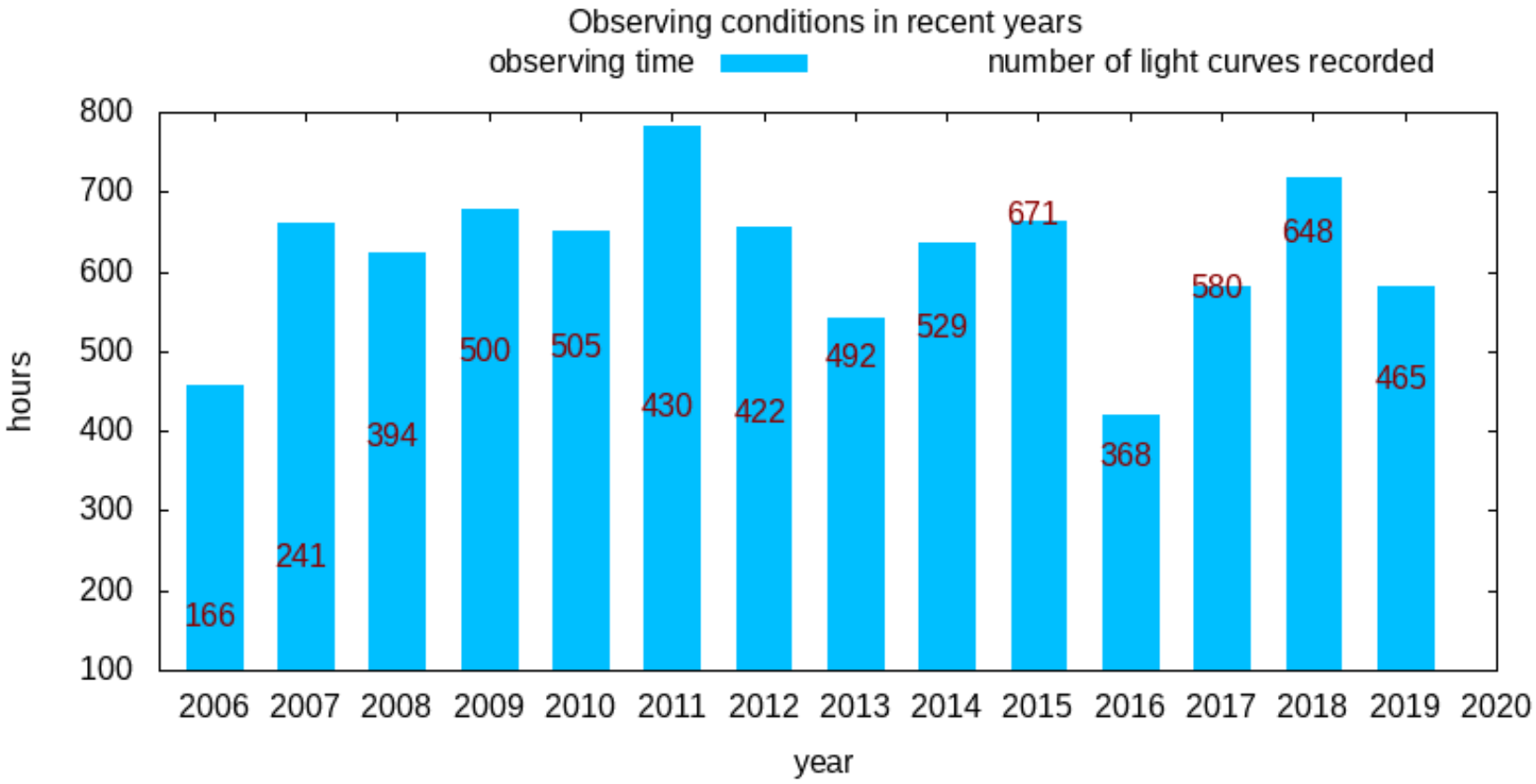
# Observing statistics in 2019

**Atmospheric conditions, activity and efficiency of the observatory**



# 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, Vitaly Breus SAIA grant

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)

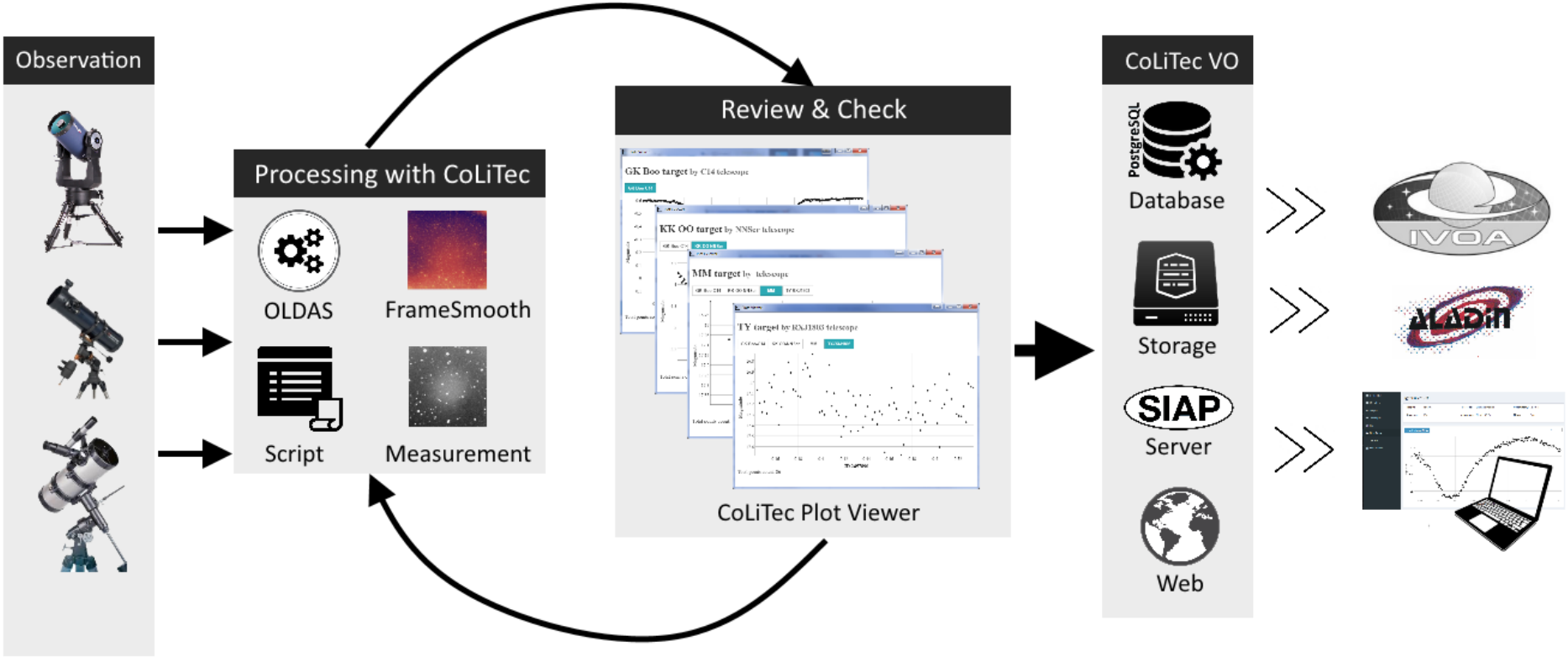
### Doc. Štefan Parimucha and his students from Šafárik University

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

### Amateur astronomers with his own equipment

Matúš Kamenec

# CoLiTecVS - new ways of data reduction




Fully automated process of data reduction developed by Ukrainian team leaded by Prof. Savanevych .

# CoLiTecVS capabilities

## Brightness equalization of the raw frames

Dark frame calibration
Flat field calibration - removes small artificial structures from the images
Background equalization using inverse median filtering - removes big structures

## Astrometry

Astrometry solution of the equalized frames
Selection of investigated star, main comparison and check stars (automated or manual option).
Creation of the task file with the coordinates of selected stars - software **Look Sky**

# CoLiTecVS capabilities

## Photometry

Instrumental magnitudes of selected stars
Assessment of the brightness of investigated star using the developed computational method
The user can optionally take instrumental magnitudes and perform the ensemble photometry with own resources (MCV)

## Plotting light curves

**PlotViewer** is the local tool of CoLiTecVS for light curves viewing.
The user can see the light curve creation on line during the observation.

Thank you for your attention