Monitoring of transient phenomena at the Terskol Observatory

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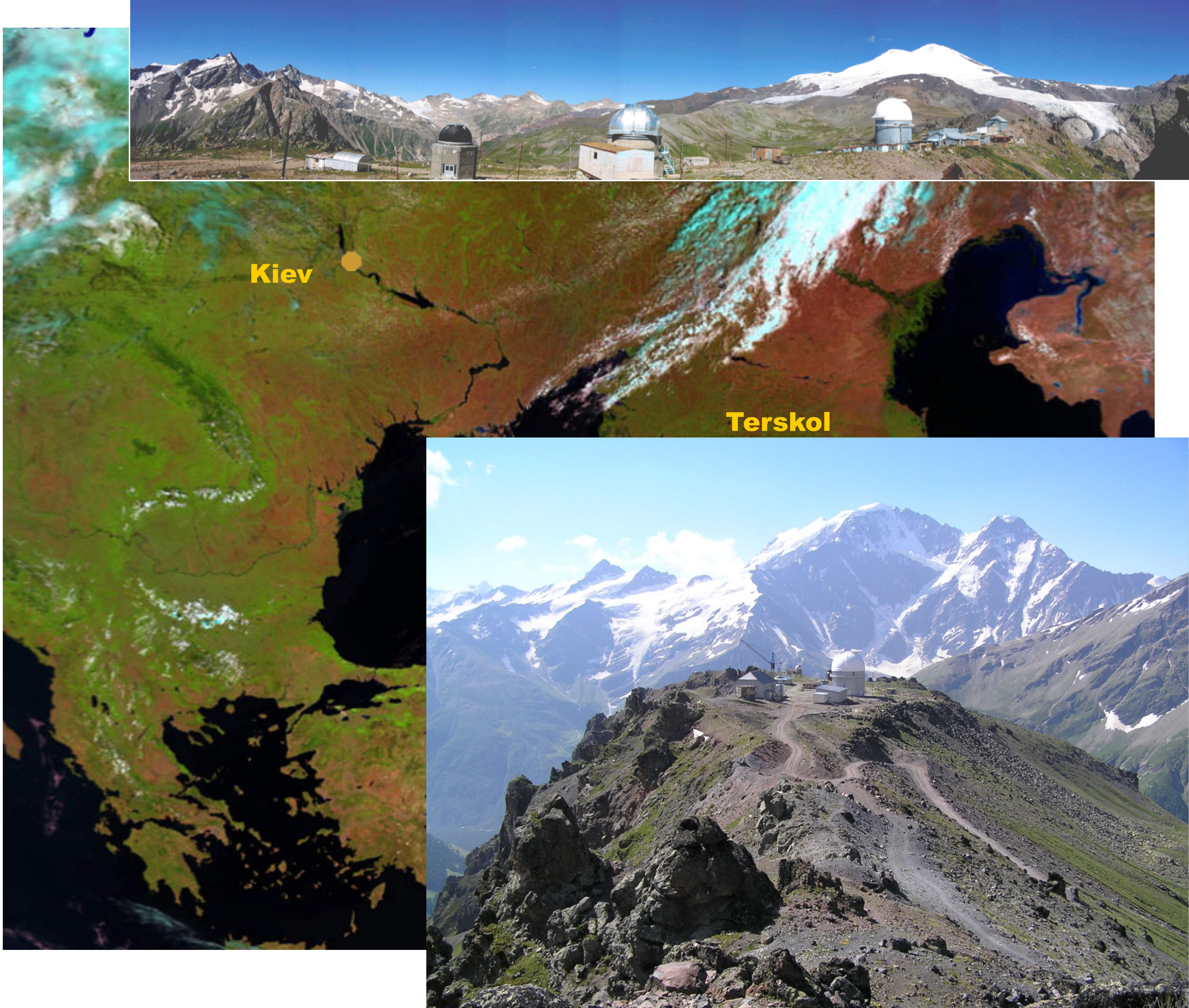

Kiev
Terskol

FACILITIES & INSTRUMENTATION

- 2-m Ritchey-Chretien-Coude telescope
- Large solar telescope ACU-26
- Zeiss-600 telescope
- Small telescopes (11” and 14”)

- High-resolution Echelle spectrograph
- Multimode spectrometer
- High-speed two-channel photometer
- Several specified photometers and CCDs
- Low-resolution spectrograph

Location:

Terskol Peak in the Northern Caucasus
(43°16’29”N, 42°30’03”E, 3120 m asl)

Main mirror
d=2m, f= 5.6m

Ritchey-Chretien system

equivalent focal length: 16 m
field of view: 108’

Coude system

equivalent focal length: 72 m
field of view: 5’

High-resolution Echelle spectrograph
Multimode spectrometer
High-speed two-channel photometer
Several specified photometers and CCDs

CCD Camera FLI PL4301
Field of view: 11x11 arcmin

The photometric complex of the 2-m telescope includes a two-channel high-speed photometer with cooled photo-multipliers, UBVRI filters and a CCD guiding system. This complex has a precise timing and synchronization system based on the GPS smart antenna Acutime-2000. The accuracy of the timing and synchronization is better than l ms.

Large solar telescope ACU-26

Zeiss-600 telescope

Small telescopes

Meade LX 200 GPS 14"

Focal length 3550 mm

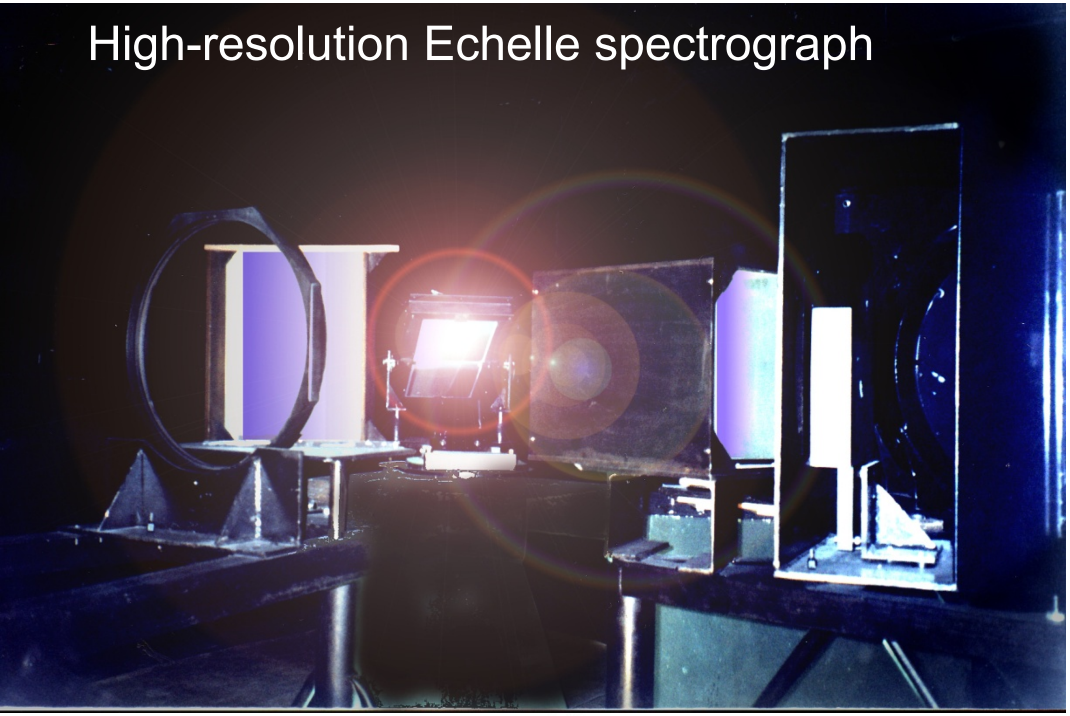
Celestron NexStar GPS 11"

F 2800 mm D/F 1:10

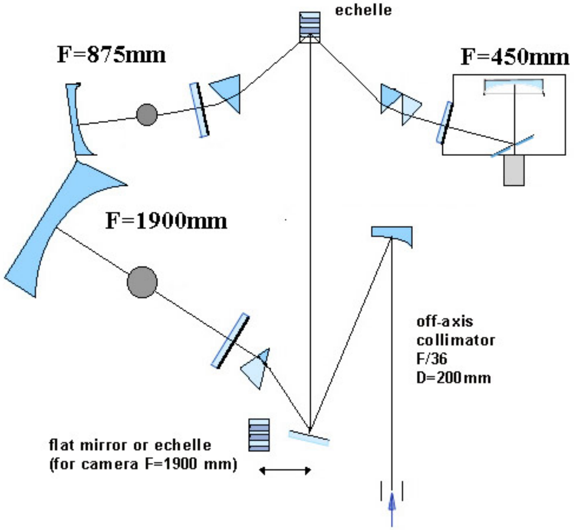
On-going science projects

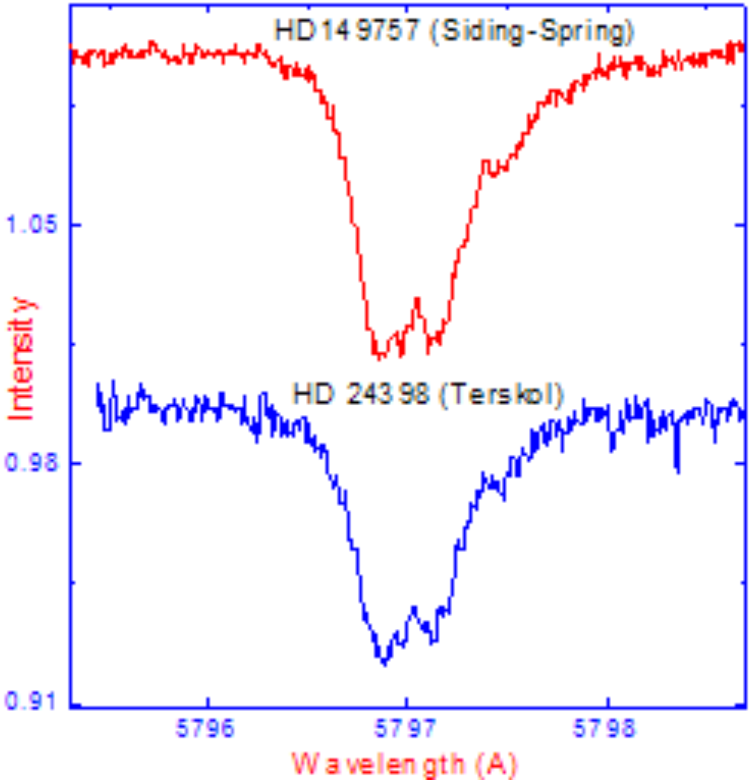
- Follow-up astrometry, photometry, and spectroscopy of Solar System small bodies
- Search for optical afterglow of gamma ray bursts
- High-resolution spectroscopy of interstellar clouds
- Photometry of white dwarfs within the Whole Earth Telescope project (the WET collaboration)
- Follow-up photometry of CVs, SNs …
- Astrometry of Gaia and newly detected asteroids

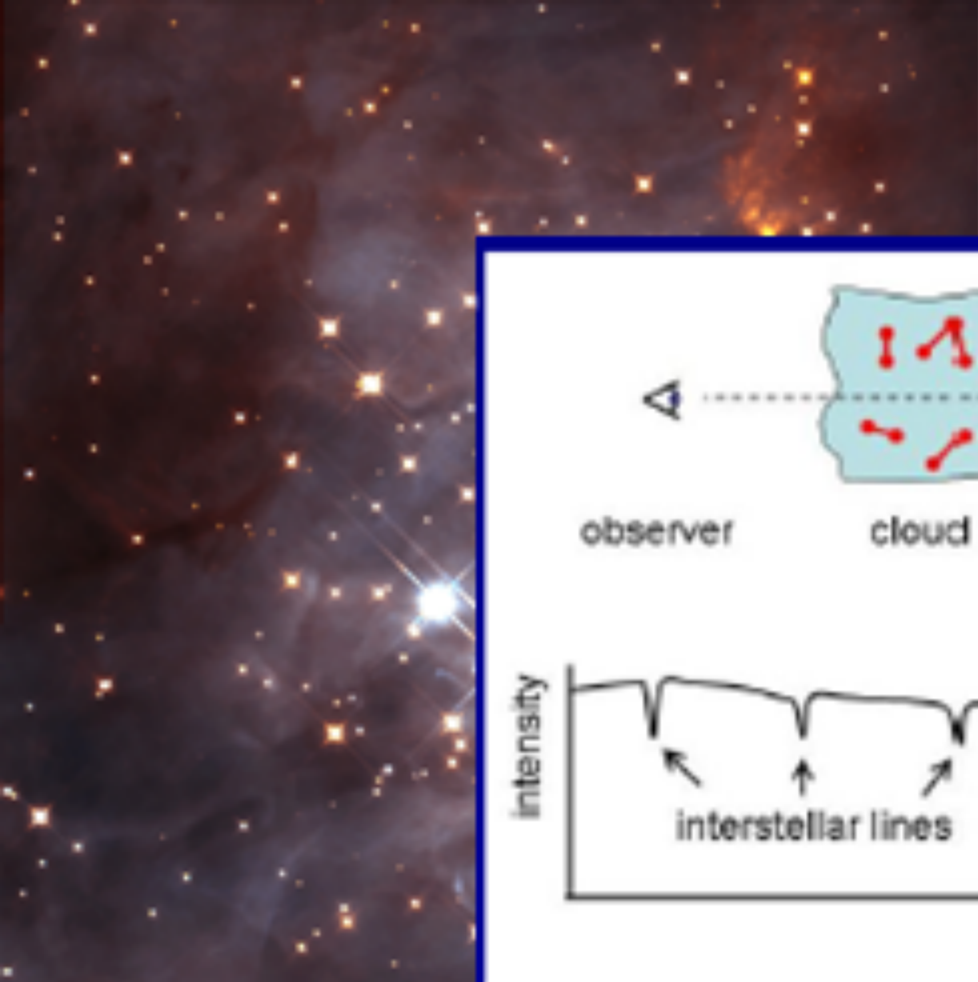
Study of diffuse interstellar clouds

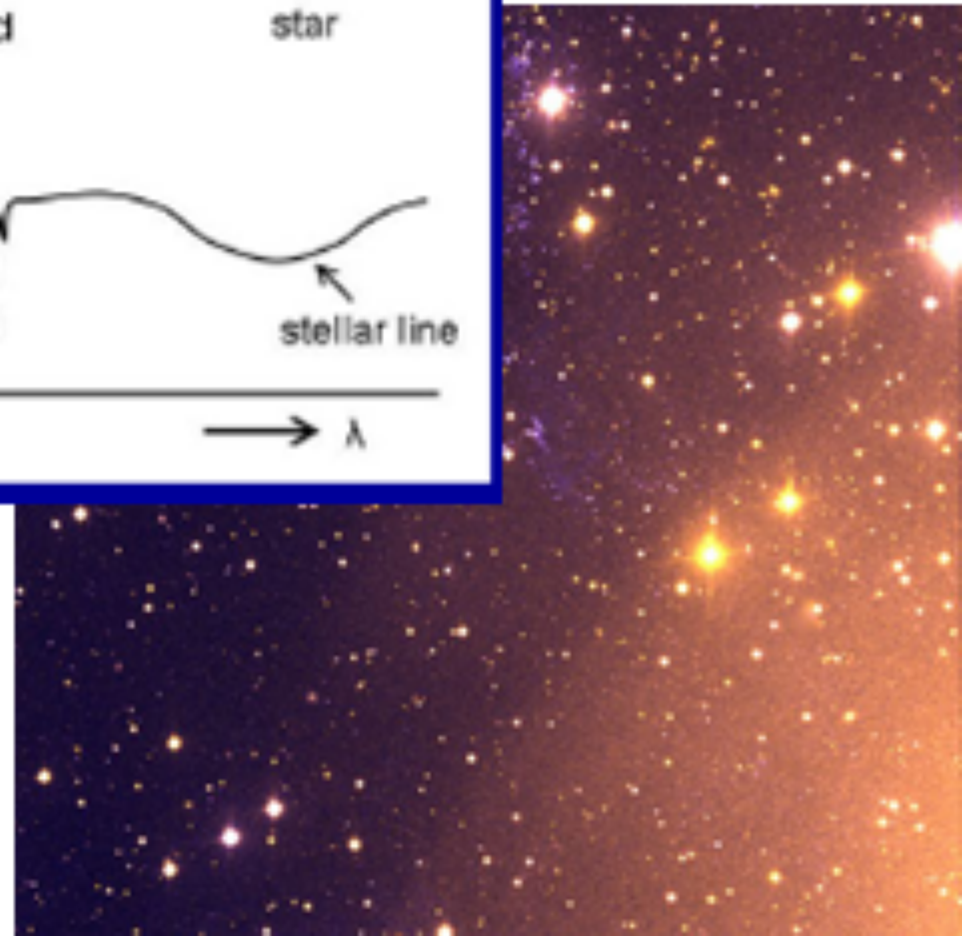


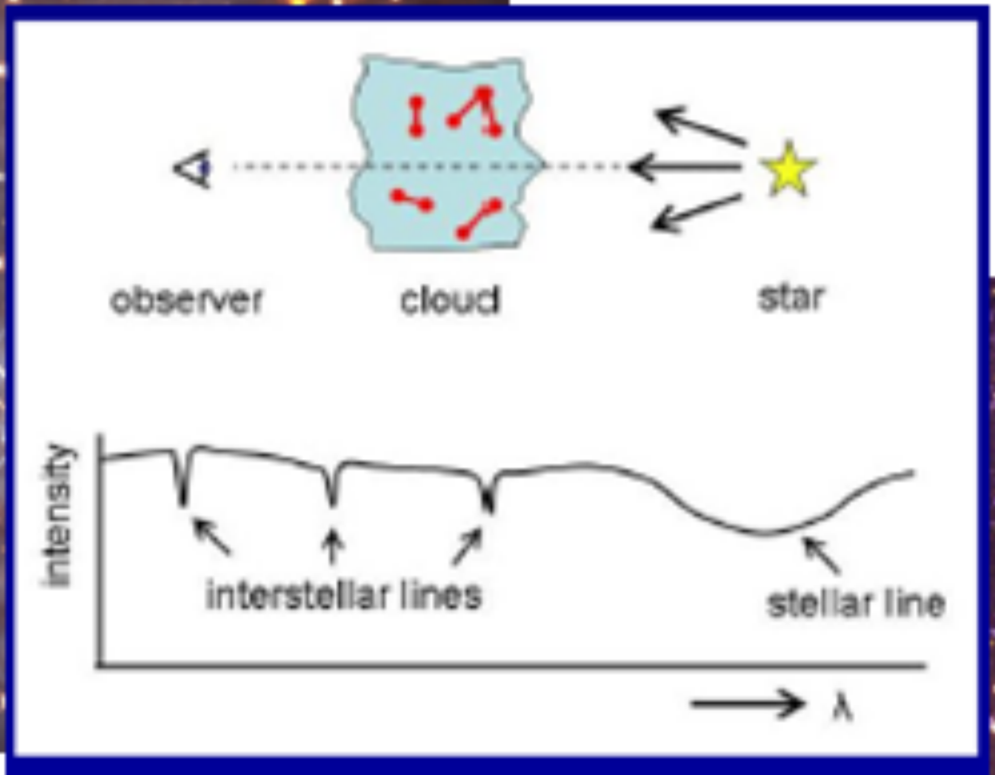
Collaborator:
Prof. Jacek Krelowski
Torun Centre for Astronomy of Nicolaus Copernicus University, Poland










observer
cloud
star
intensity
interstellar lines
stellar line
λ

Highlights

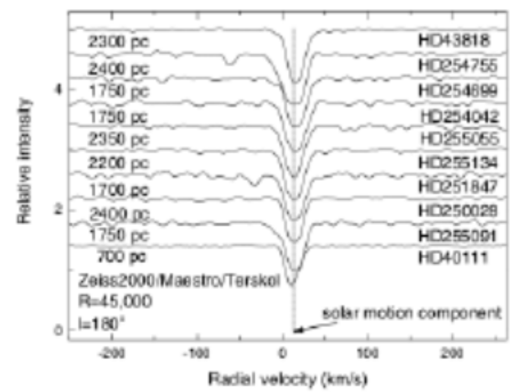
- An atlas of diffuse interstellar bands together with tables with measurements of their parameters: central wavelengths, full widths at half-maximum and equivalent widths was elaborated. For this goal the spectra of ten reddened, early-type stars have been selected. The spectra are of high resolution, ˜100 000, and reasonable signal-to-noise ratio, S/N > 300; they cover a wide spectral range 3500-10 000 Å and show a lack of evident Doppler splitting in the interstellar K I line. The measurement technique has allowed a homogeneous set of data to be achieved. As a result, the identity of 336 DIBs from previous surveys has been confirmed and 21 new bands have been found.

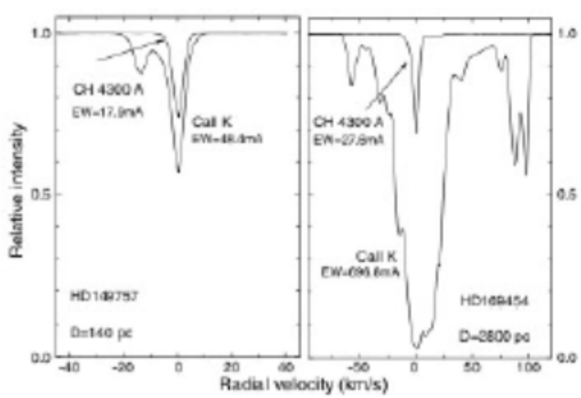
Ref: Bondar A. (2012) – MNRAS, Vol.423, 1, pp. 725-734

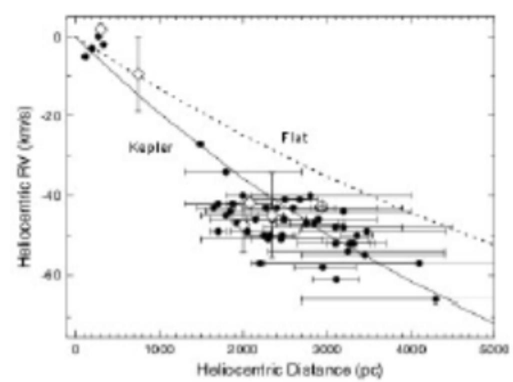
- The results of our distance and radial velocity measurements from Ca II lines, being more precise than any others and thus best representing the kinematics of the Galaxy thin gaseous disk, clearly argue in favor of Keplerian rotation of the latter => no evidence for dark matter (!?)

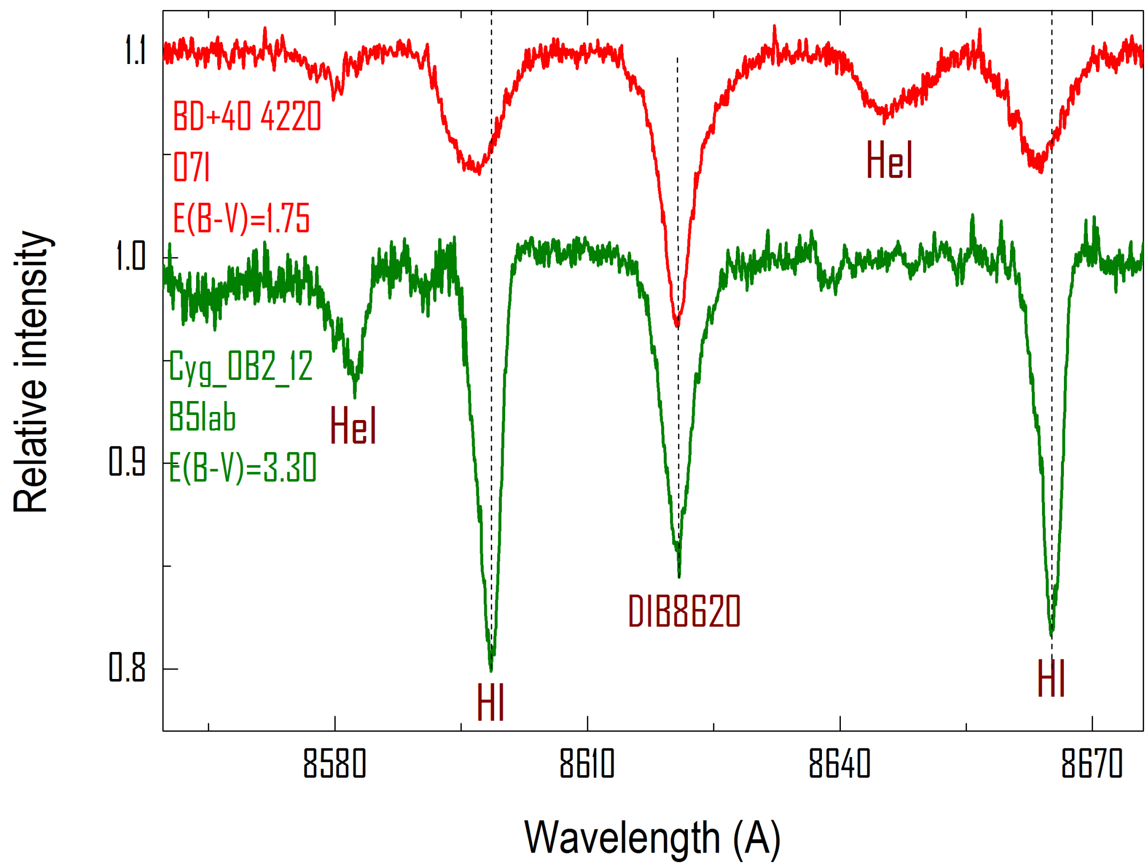
Ref: Galazutdinov, G.; Strobel, A.; Musaev, F. A.; Bondar, A.; Krełowski, J. (2015) – PASP, Vol. 127, 948, pp.126-142

- H I clouds have uncertain linear sizes
- Molecular clouds don't coincide with OB stars spatially
- OB stars have uncertain calibrated Mv
- Interstellar Ca II clouds are evenly distributed in the Galactic plane, K and H of Ca II lines are strong and not or slightly saturated, their intensities correlate well with distance.
- Single assumption: circular motion of the Ca II clouds









The 8620 A DIB is the only one available to the GAIA Radial Velocity Spectrometer. As seen in the plot for HD190603 the feature is clearly seen in the Terskol spectrum. This proves that the Terskol spectrograph is capable to cover with its observations the spectral range of the GAIA RVS and to detect the same spectral features. However, the Maestro spectrograph of the Terskol Observatory may cover a much broader spectra range, including most of known diffuse bands as well as atomic and molecular interstellar features. We can thus establish relations between 8620 and other DIBs and also between 8620 and molecular features, in particular the nearby C2 Phillips (2,0) band situated just out of the RVS range.

The resolution of the Maestro spectrograph ranges from 45,000 up to almost 500,000 but, naturally, we expect to use the lowest resolution to reach as many faint stars as possible.

Zeiss-600

F/D   1/12.9
focal length 7750 mm

field of view 10.9 x 10.9 arcmin
limiting magnitude 21.2

SBIG STL-1001 CCD camera
(1024x1024) 24x24microns

Astrometry of asteroids and comets

- In 2003-2015, positions of more than 250 objects were detected.
- An accuracy on average is about 0.2-0.3 arcseconds.
- Precise astrometric data have been continuously reported to the Minor Planet Center (MPC).

NEODyS-2

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B18 ▸ OBSERVATIONS AND RESIDUALS

Parallax info

Obs & residuals

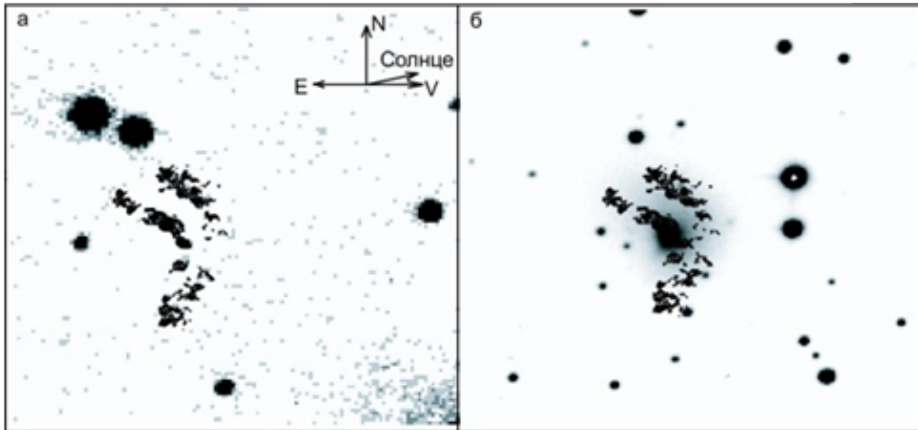
B18-Terskol

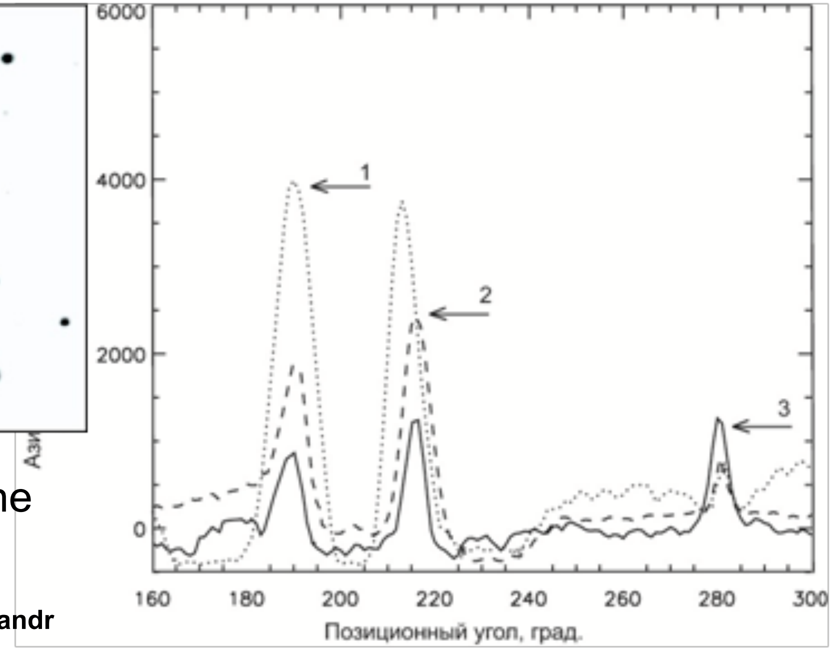
Detections | Residuals | Detections & Residuals

[1-200] [201-400] [401-600] [601-800] [801-1000] [1001-1200] [1201-1400] [1401-1480]

Designation	T	Tech	N	Date		Right Ascension						Declination						Apparent Magnitude			Star Catalog	Site code	χ	Used A	Used M
				yr-mo-day	precision	hr:min:sec	precision	rms	F	bias	residual	deg min sec	precision	rms	F	bias	residual	mag/col	rms	residual					
2003RB	O	C		2015-08-21.00510	1.000E-05	23:15:44.360	1.500E-01	0.660	F	0.000	-0.114	+25° 39' 31.10"	1.000E-01	0.590	F	0.000	-0.047	14.0 V	0.70	-0.02	q	B18	0.19	Yes	Yes
2003RB	O	C		2015-08-21.00536	1.000E-05	23:15:44.540	1.500E-01	0.660	F	0.000	0.059	+25° 39' 35.50"	1.000E-01	0.590	F	0.000	0.125	14.0 V	0.70	-0.02	q	B18	0.23	Yes	Yes
2003RB	O	C		2015-08-21.00563	1.000E-05	23:15:44.720	1.500E-01	0.660	F	0.000	0.144	+25° 39' 40.00"	1.000E-01	0.590	F	0.000	0.234	14.1 V	0.70	0.08	q	B18	0.45	Yes	Yes
2003RB	O	C		2015-08-21.03834	1.000E-05	23:16:05.890	1.500E-01	0.660	F	0.000	0.241	+25° 48' 31.10"	1.000E-01	0.590	F	0.000	0.398	14.0 V	0.70	-0.03	q	B18	0.77	Yes	Yes
2003RB	O	C		2015-08-21.03861	1.000E-05	23:16:06.050	1.500E-01	0.660	F	0.000	0.028	+25° 48' 35.20"	1.000E-01	0.590	F	0.000	0.123	14.0 V	0.70	-0.03	q	B18	0.21	Yes	Yes
2003RB	O	C		2015-08-21.03887	1.000E-05	23:16:06.210	1.500E-01	0.660	F	0.000	-0.098	+25° 48' 39.40"	1.000E-01	0.590	F	0.000	0.110	14.0 V	0.70	-0.03	q	B18	0.24	Yes	Yes
2003RB	O	C		2015-08-21.03914	1.000E-05	23:16:06.400	1.500E-01	0.660	F	0.000	0.094	+25° 48' 43.80"	1.000E-01	0.590	F	0.000	0.136	14.0 V	0.70	-0.03	q	B18	0.27	Yes	Yes
2015RH2	O	C		2015-09-07.94753	1.000E-05	23:18:45.920	1.500E-01	1.500	F	0.000	0.113	+03° 57' 07.30"	1.000E-01	1.500	F	0.000	0.203	18.9 R	0.70	-0.08	v	B18	0.16	Yes	Yes
2015RH2	O	C		2015-09-07.95076	1.000E-05	23:18:45.410	1.500E-01	1.500	F	0.000	0.094	+03° 57' 11.50"	1.000E-01	1.500	F	0.000	0.273	18.9 R	0.70	-0.08	v	B18	0.19	Yes	Yes
2015RH2	O	C		2015-09-07.95615	1.000E-05	23:18:44.560	1.500E-01	1.500	F	0.000	0.069	+03° 57' 18.20"	1.000E-01	1.500	F	0.000	0.083	18.9 R	0.70	-0.08	v	B18	0.08	Yes	Yes
2015RH2	O	C		2015-09-07.95830	1.000E-05	23:18:44.220	1.500E-01	1.500	F	0.000	0.042	+03° 57' 21.10"	1.000E-01	1.500	F	0.000	0.235	18.8 R	0.70	-0.18	v	B18	0.16	Yes	Yes
2015RH2	O	C		2015-09-07.95938	1.000E-05	23:18:44.050	1.500E-01	1.500	F	0.000	0.039	+03° 57' 22.60"	1.000E-01	1.500	F	0.000	0.355	19.0 R	0.70	0.02	v	B18	0.24	Yes	Yes
2015RT83	O	C	K	2015-09-16.06299	1.000E-05	00:47:13.860	1.500E-01	0.660	F	0.000	0.078	+35° 27' 22.90"	1.000E-01	0.590	F	0.000	0.009	19.9 R	0.70	0.18	q	B18	0.12	Yes	Yes
2015RT83	O	C	K	2015-09-16.06516	1.000E-05	00:47:13.760	1.500E-01	0.660	F	0.000	-0.002	+35° 27' 27.50"	1.000E-01	0.590	F	0.000	0.061	20.4 R	0.70	0.68	q	B18	0.10	Yes	Yes
2015RT83	O	C	K	2015-09-16.06735	1.000E-05	00:47:13.670	1.500E-01	0.660	F	0.000	0.048	+35° 27' 32.10"	1.000E-01	0.590	F	0.000	0.072	20.0 R	0.70	0.28	q	B18	0.15	Yes	Yes
2015RT83	O	C	K	2015-09-16.06954	1.000E-05	00:47:13.590	1.500E-01	0.660	F	0.000	0.219	+35° 27' 36.70"	1.000E-01	0.590	F	0.000	0.084	19.9 R	0.70	0.18	q	B18	0.37	Yes	Yes
2015SS	O	C		2015-09-18.72113	1.000E-05	23:52:36.040	1.500E-01	0.660	F	0.000	-0.364	+09° 09' 44.00"	1.000E-01	0.590	F	0.000	0.065	18.9 R	0.70	-0.21	t	B18	0.57	Yes	Yes
2015SS	O	C		2015-09-18.72277	1.000E-05	23:52:36.020	1.500E-01	0.660	F	0.000	-0.303	+09° 09' 37.70"	1.000E-01	0.590	F	0.000	0.258	19.1 R	0.70	-0.01	t	B18	0.64	Yes	Yes

Observations of comets at large heliocentric distances





Determination of the rotational period of the comet 29P/Schwassmann-Wachmann

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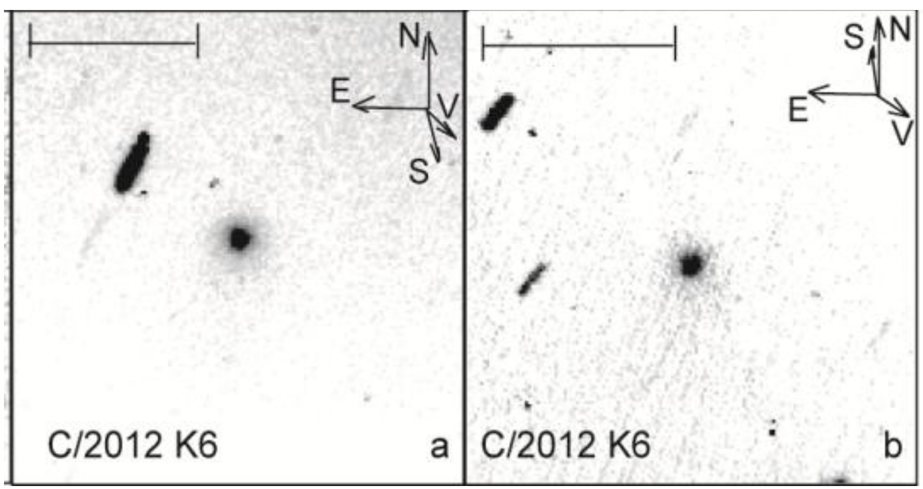


Zeiss-600; filter R

The positions of comet C/2012 K6 (McNaught) on 2014, Feb 13 and 23, respectively.

Here are shown celestial north (N), east (E), the motion (V), and sunward directions (S).

The scale bar represents 5x105 km perpendicular to the line of sight.

© A. Ivanova, Luboš Neslušan, Zuzana Seman Krišandová, Ján Svoreň, Pavlo Korsun, Viktor Afanasiev,Volodymyr Reshetnyk, Maxim Andreev (2015) – Icarus, 258, 28-36

Observations of NEAs

Astrometry (down to V~21.5 mag)
Photometry (down to V~18 mag) and
Spectrophotometry (down to V~14.5 mag)

Scientific programmes on studies of near-Earth asteroids (NEAs) have been run at Terskol since 2010, whereas astrometric and photometric observations of asteroids started here as far back as the early 2000s. Extremely high emphasis is placed on follow-up observations of potentially hazardous asteroids (PHAs).

Selection of targets

As for the objects to be observed preeminently, the following selection criteria are applied:

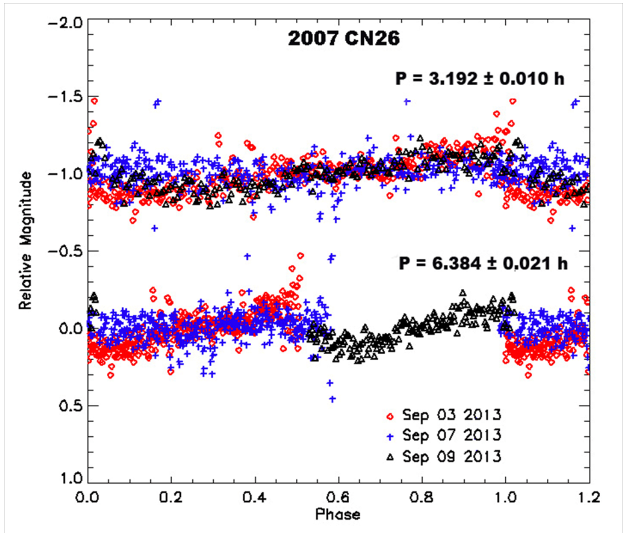
recently discovered NEAs of visual magnitudes V down to about 21.5m,

- potentially hazardous asteroids with absolute magnitudes H > 20m, which have unknown or poorly-defined physical characteristics and which come within 20 lunar distances,

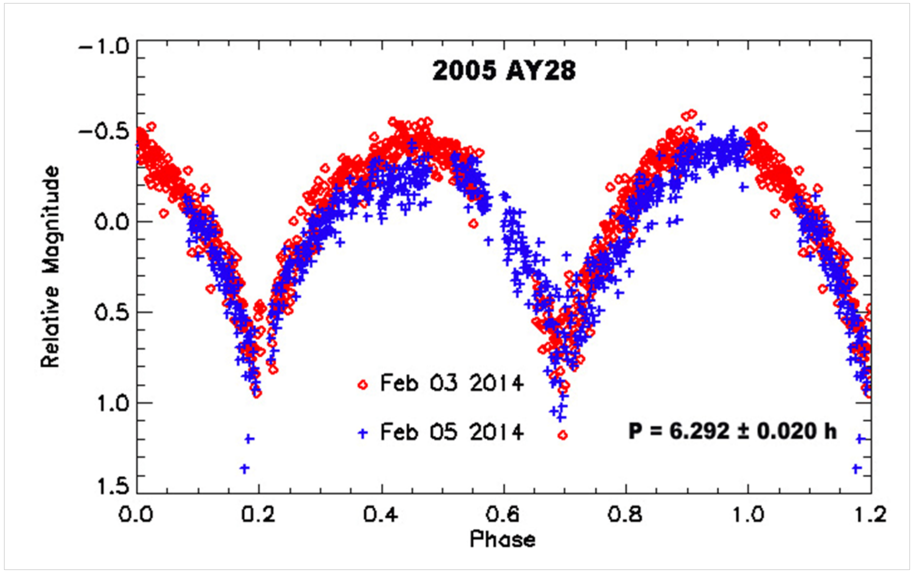
- targets of opportunity (risk lists, GBOT's list, etc).

Photometry of asteroids

- High-accuracy photometry of asteroids has been used to study their rotation properties. In 2013-2015, complete light curves were obtained for a number of PHAs.
- Photometric observations of asteroids have been conducted with the Zeiss-600 telescope, with individual exposure times of 10-30 s. In order to enhance the signal-to-noise ratio, most CCD images have been taken in “white light”.
- To determine the rotation periods of the observed PHAs, we use methods based on Lomb normalized periodogram, or phase dispersion minimization (PDM) or Hotelling's T-squared statistic. Comparison of the results obtained showed that the PDM technique and a modified version of the Hotelling test are most appropriate for this purpose.



Composite light curves of 2007 CN26.
Two possible rotation period solutions are plotted (each is shifted along the Y-axis).

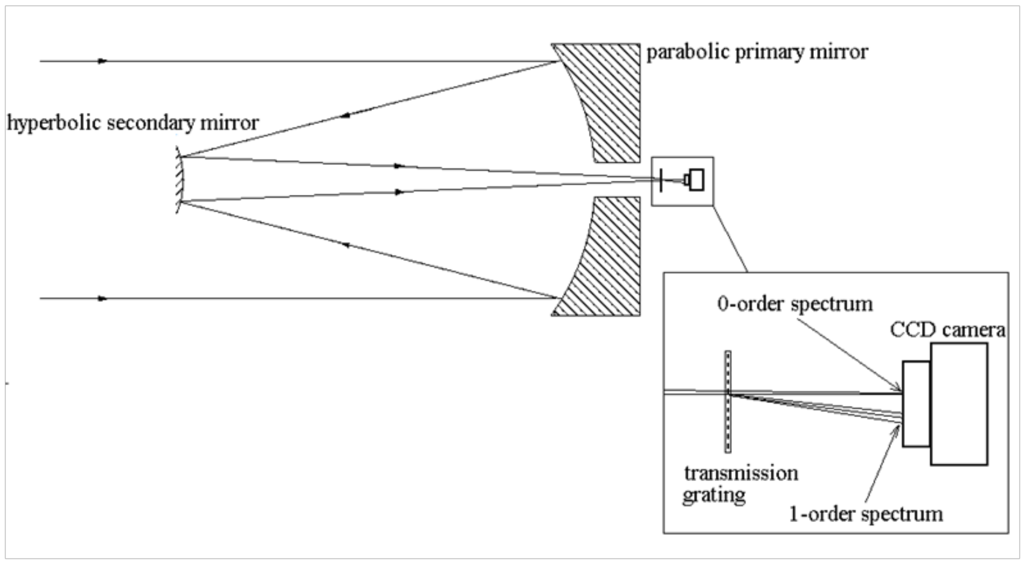


Composite light curves of 2007 CN26.
A best-fit period of 6.292 ± 0.020 h was found using the PDM technique.

Low-resolution spectroscopy

Spectra of asteroids have been obtained by using a low-resolution imaging spectrograph attached to the Zeiss-600 telescope

Objects were observed down to V magnitude of 14.5, with individual exposure times of 10-30 s; their spectra were recorded over the wavelength range from 300 to 900 nm.



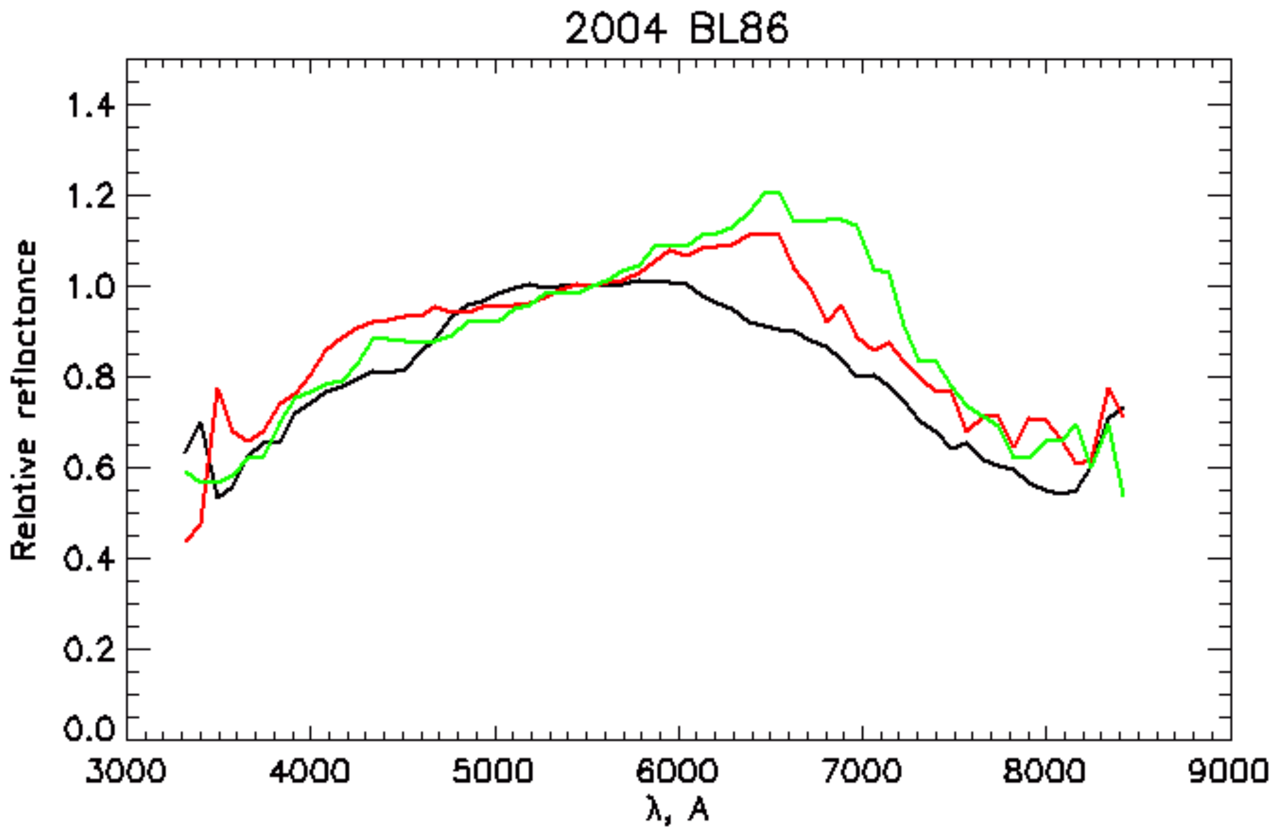
. Optical layout of a slitless spectrograph mounted on the Cassegrain reflector.

A **slitless spectrograph for observing transient events with small telescopes**
Zhilyaev B.E., Sergeev O.V., Andreev M.V., Godunova V.G., Reshetnyk V.M., Tarady V.K.
// Ground-based & Airborne Instrumentation for Astronomy IV at the SPIE Astronomical Telescopes + Instrumentation 2012 Meeting (Amsterdam, 1-6 July 2012). – eds. I.S.McLean, S.R.Ramsay, H.Takami - Proc. of SPIE Vol. 8446, 84468I (11 p.) doi: 10.1117/12.925730

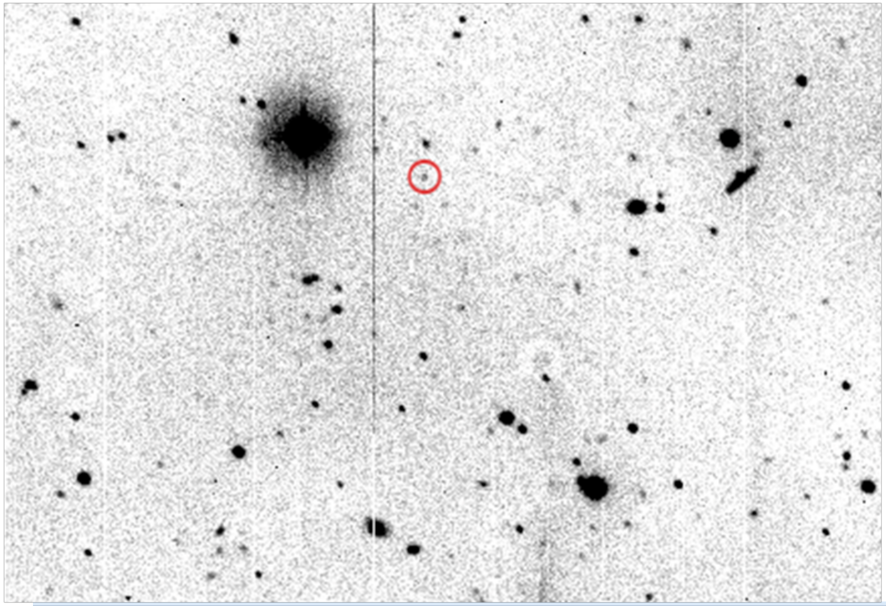
2004 BL86

We have carried out low-resolution spectral observations of this PHA on January 27-28, 2015. This asteroid (~0.5 km in diameter) came within 0.008 AU (3.1 lunar distances) to the Earth on January 26, 2015.

Figure shows the preliminary results obtained from series of CCD images.The relative reflectance spectrum calculated allowed us to place this asteroid in the V-class.



Astrometry of Gaia and asteroids



Gaia is fainter than 21 R; moreover, full Moon does not allow one to detect this object.

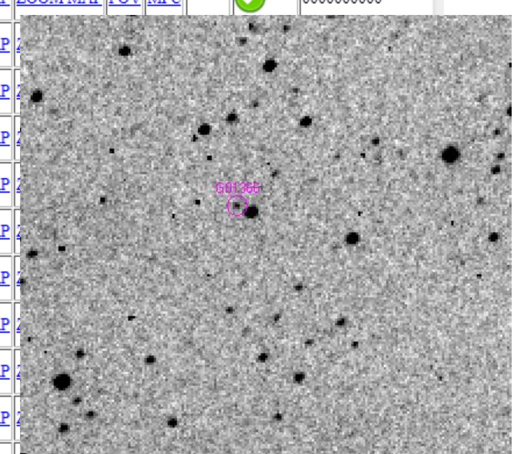
In 2015, we start to observe asteroids discovered within the Gaia project. Objects have been selected from the list of recently discovered asteroids prepared by the Gbot team *(gbot.obspm.fr/pub/ASTEROIDS/mostrecent.php)*.

Asteroids have been observed down to V magnitude of 21m, with individual exposure times of 60-180 seconds.

There is a problem which concerns the processing of asteroid observations, because orbits of newly detected asteroids is not yet known to great precision. In fact, only observations that are close in time to those aquired with VST can be easily linked together, as the asteroid displacement relative to its background will be small.

If the observations are performed over longer time spans (two days and more), it is difficult or even impossible to detect and identify these objects.

GBOT AST NAME	STATUS	MPC NAME	DATE(UTC)	RA(hh mm ss.s)	DEC(dd mmnbspss.ss)	MAG(R)	d[RAcosDEC]/dt("/min)	d[DEC]/dt("/min)	Det. Nb.	TRAIL MAP(CCD)	GLOBAL MAP	ZOOM MAP	FoV	MPC	TYPE	SUBMIT	IMAGE FLAGS
AST_20151031_CCD1_11	new	G02528	2015 11 01.13996	03 12 25.07	+18 48 44.5	19.4	-0.7356079	0.0976534	5	TRAIL MAP(1)	GLOBAL MAP	ZOOM MAP	FOV	MPC		✓	00000
AST_20151031_CCD2_12	new	G02529	2015 11 01.13996	03 12 42.21	+18 42 39.0	20.5	-0.4935554	-0.1828544	10	TRAIL MAP(2)	GLOBAL MAP	ZOOM MAP	FOV	MPC		✓	0000000000
AST_20151031_CCD2_13	new	G02530	2015 11 01.13996	03 12 50.41	+18 45 17.8	20.3	-0.5622914	-0.0253413	10	TRAIL MAP(2)	GLOBAL MAP	ZOOM MAP	FOV	MPC		✓	0000000000
AST_20151031_CCD2_14	new	G02531	2015 11 01.13996	03 12 42.13	+18 41 17.0	19.7	-0.5277379	-0.1607235	10	TRAIL MAP(2)	GLOBAL MAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AST_20151031_CCD2_15	new	G02532	2015 11 01.13996	03 12 54.64	+18 46 11.3	20.7	-0.6423381	-0.1084491	10	TRAIL MAP(2)	GLOBAL MAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AST_20151031_CCD2_16	new	G02533	2015 11 01.13875	03 12 55.11	+18 35 42.7	21.4	-0.5356912	-0.0887455	7	TRAIL MAP(2)	GLOBAL MAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AST_20151031_CCD11_12	new	G02534	2015 11 01.13996	03 13 19.86	+19 09 01.4	21.1	-0.5441000	-0.1992635	10	TRAIL MAP(11)	GLOBAL MAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AST_20151031_CCD11_13	new	G02535	2015 11 01.13996	03 13 39.13	+19 17 38.6	20.6	-0.5518354	-0.1667760	9	TRAIL MAP(11)	GLOBAL MAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AST_20151031_CCD14_12	new	G02536	2015 11 01.13996	03 13 08.37	+19 33 09.7	20.8	-0.5776573	-0.0309153	10	TRAIL MAP(14)	GLOBAL MAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AST_20151031_CCD20_11	new	G02537	2015 11 01.13996	03 16 08.88	+18 46 57.5	20.3	-0.5380488	-0.2031342	10	TRAIL MAP(20)	GLOBAL MAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AST_20151031_CCD21_12	new	G02538	2015 11 01.13996	03 14 26.60	+18 55 16.8	20.5	-0.5451306	-0.0466461	10	TRAIL MAP(21)	GLOBAL MAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AST_20151031_CCD22_11	new	G02539	2015 11 01.13996	03 14 53.42	+19 01 01.7	20.5	-0.5270800	-0.1963428	10	TRAIL MAP(22)	GLOBAL MAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			2015 11														



Follow-up of GRBs

TITLE: GCN CIRCULAR
NUMBER: 18558
SUBJECT: GRB 151027A: Mt. Terskol observatory optical observation
DATE: 15/11/04 10:08:22 GMT
FROM: Alexei Pozanenko at IKI, Moscow <apozanen@iki.rssi.ru>

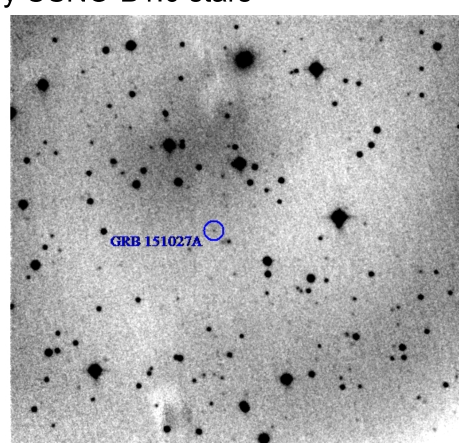
V. Kozlov (IC AMER, NASU), M. Andreev (Terskol Branch of INASAN), E.Mazaeva (IKI), A. Sergeev (Terskol Branch of INASAN), A. Volnova (IKI), A.Pozanenko (IKI) report on behalf of larger GRB follow-up collaboration:

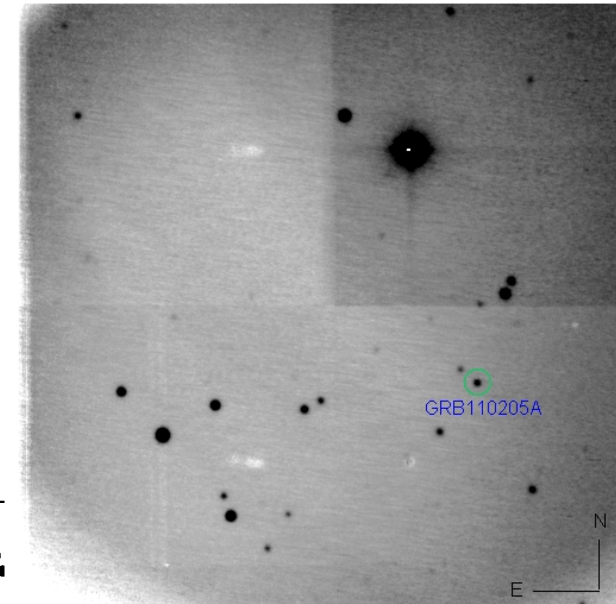
We observed the field of GRB 151027A (Maselli et al., GCN 18478) with Zeiss-600 telescope of Mt. Terskol observatory in R-filter starting on Oct.28 (UT) 21:23:11. We obtained several images in R-filter. The afterglow (Maselli et al., GCN 18478; Zheng and Filippenko, GCN 18479) is clearly
detected in a combined image. The photometry of the combined image is following

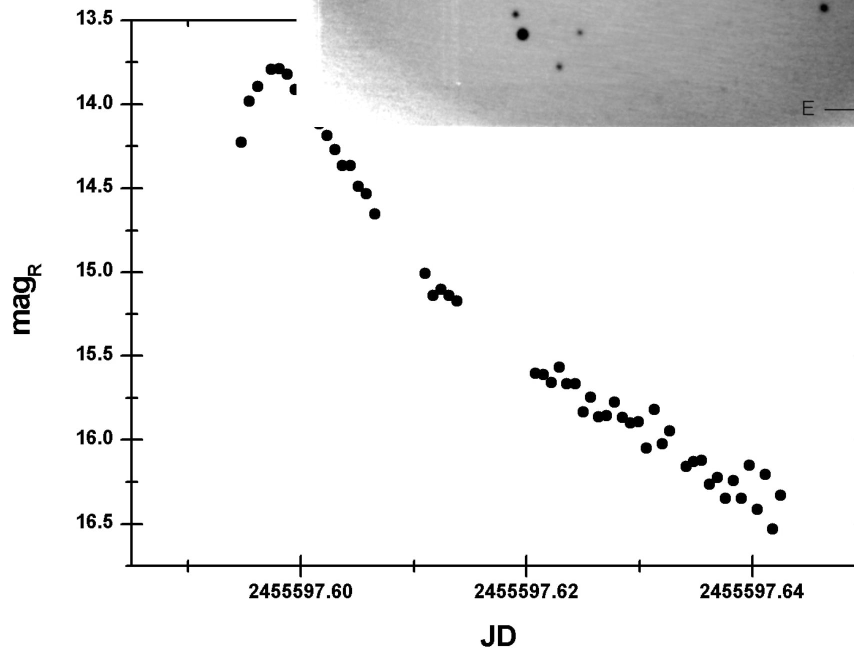
Date	UT start	t-T0 (mid, days)	Filter	Exp. (s)	OT	Err
2015-10-28	21:23:11	1.7431	R	25*120	19.56	0.12

The photometry is based on nearby USNO-B1.0 stars

USNO-B.1_id	R2
1513-0237223	16.66
1513-0237170	15.58
1513-0237251	16.81
1513-0237270	16.78



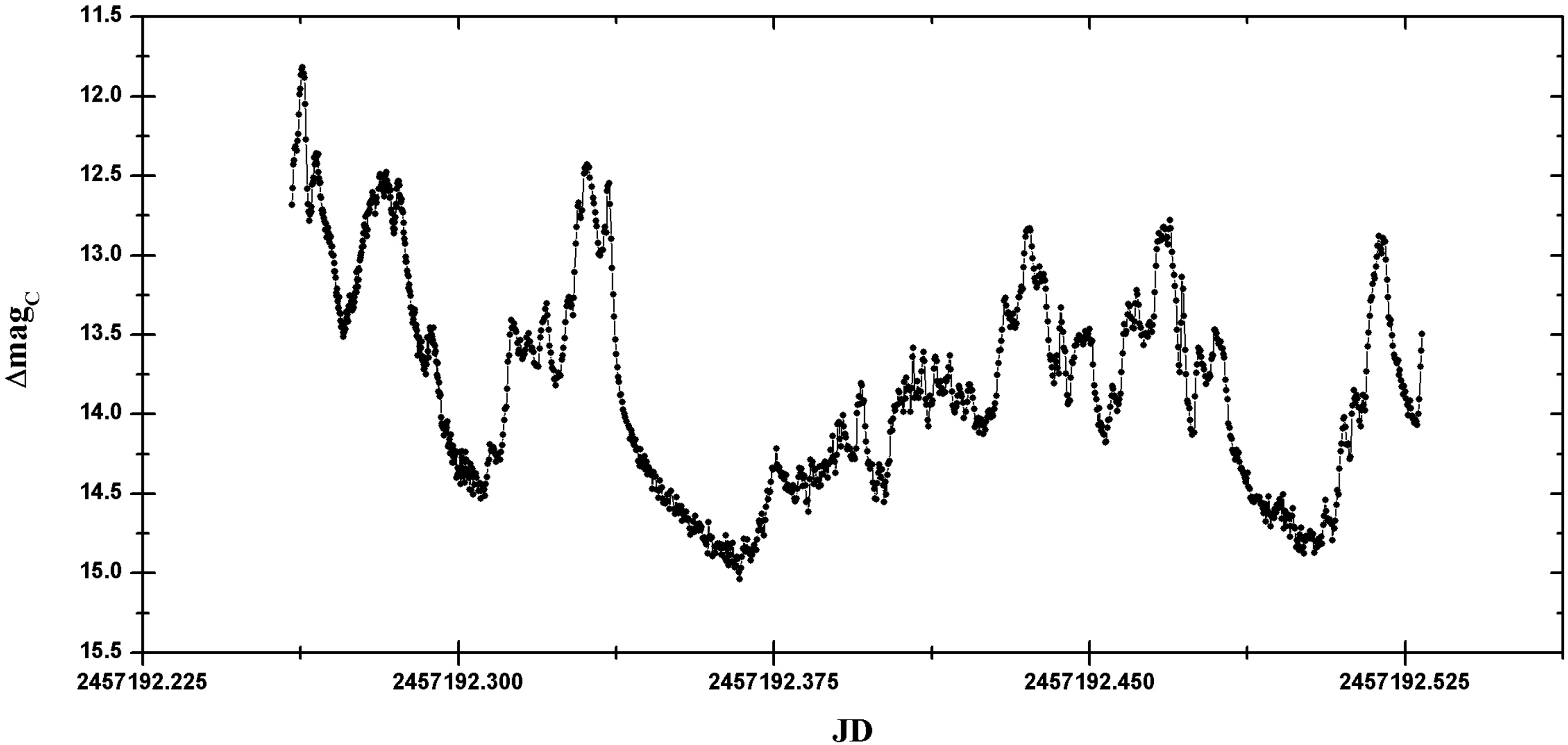




V404 Cygni

(X-ray transient containing a black hole of nine solar masses7 at a distance of 2.4 kpc)

Observations within the VSNET collaboration,



Light curve of ***V404 Cygni*** obtained at Terskol on June 18-19, 2015 (Zeiss-600)

ASASSN-15sc

Follow-up of CVs at the Lisnyky Observatory near Kiev (IAU code 585)

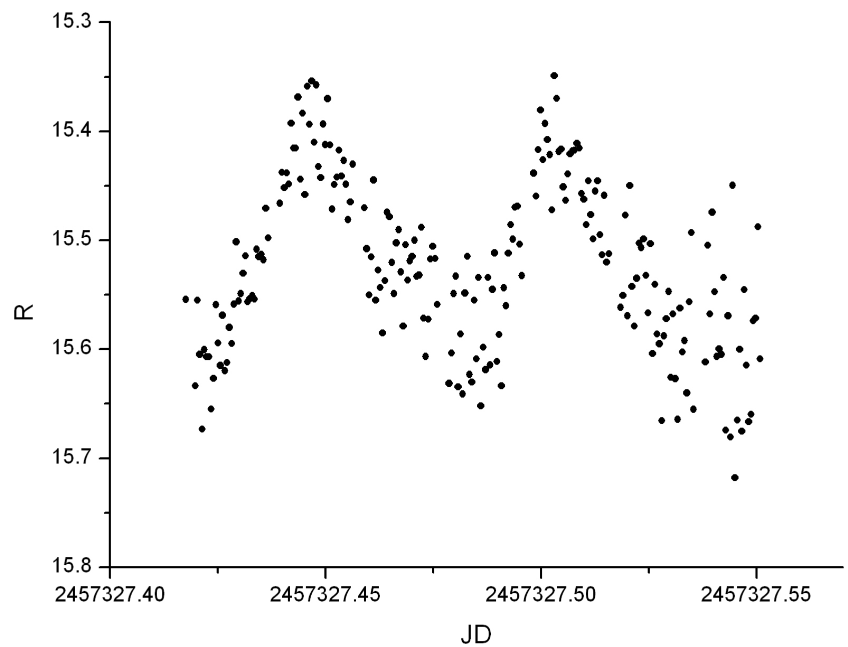
Telescope: AZT-8 (D~0.7-m f/4 reflector)
focal length: 2800 mm
field of view: 16' x 16'
limiting magnitude: ~ 19
CCD: PL47-10 FLI (1027È1056) 13x13 microns

From: Taichi Kato <tkato@kusastro.kyoto-u.ac.jp>
Date: 2015-11-06 10:08 GMT+03:00

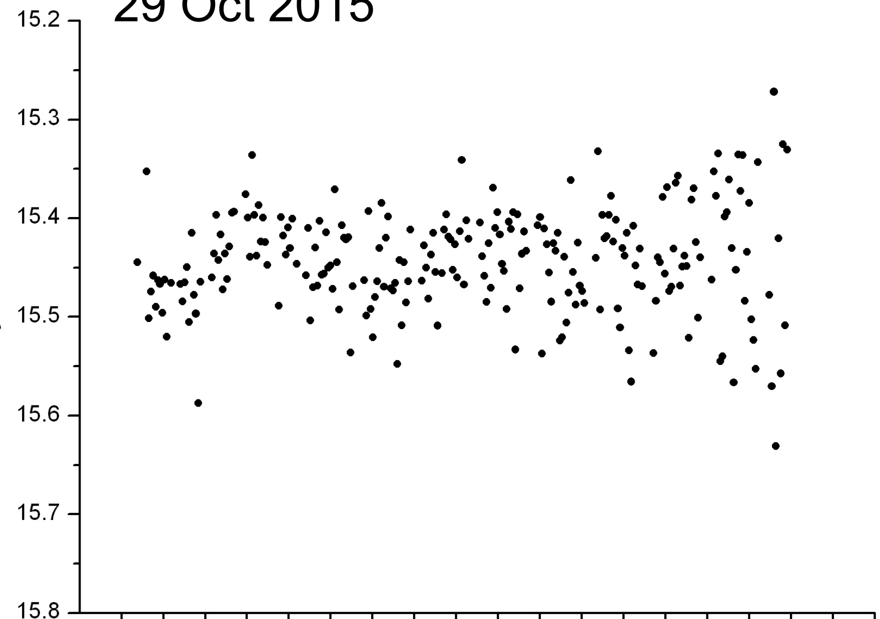
ASASSN-15sc: stage A superhumps

Andrei Simon (Lisnyky Observatory) has also reported observations on Oct. 30, 2015.
Using observations on Oct. 30-Nov. 1, we have been able to measure the period of stage A superhumps as 0.05867(5) d.

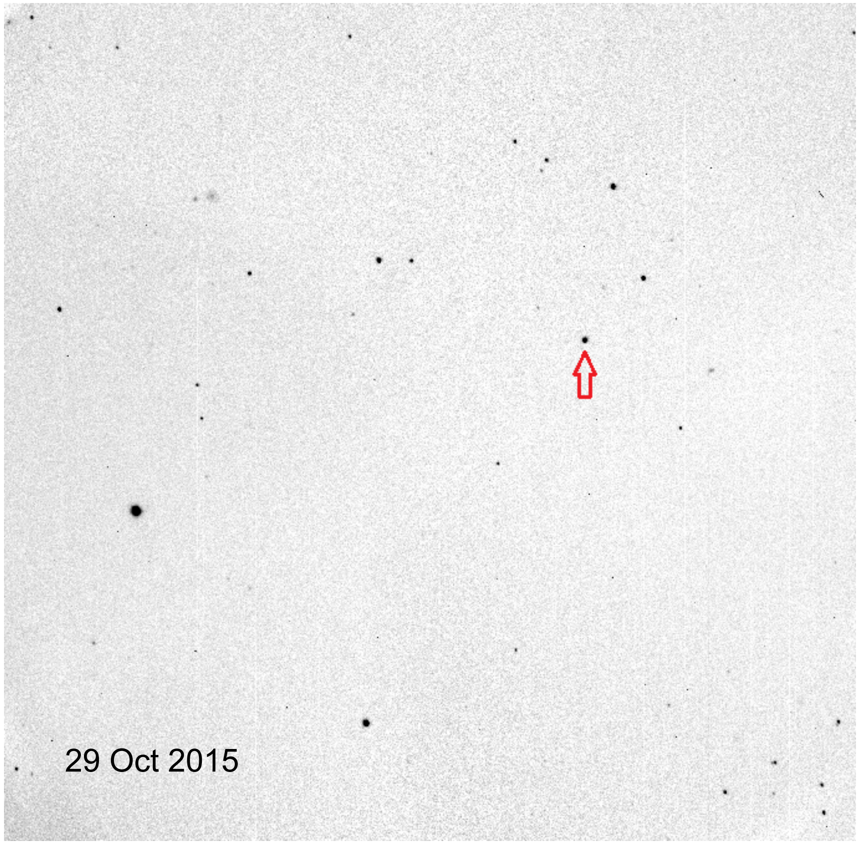
30 Oct 2015



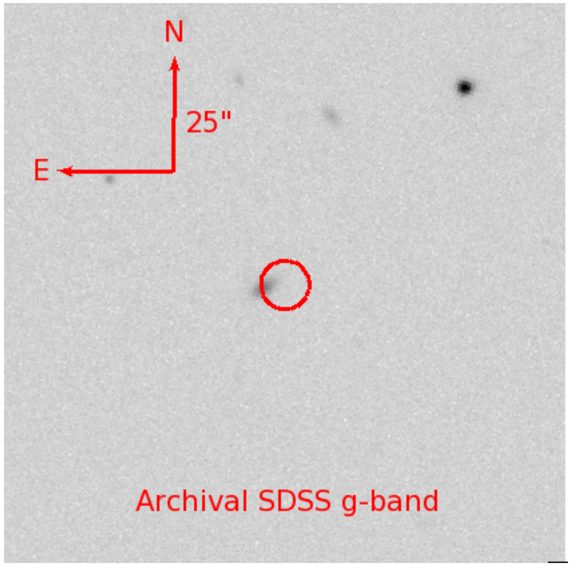
29 Oct 2015



ASASSN-15rw



Observations of this SN started at Terskol on 29 Oct 2015 .



Filter/Catalogue	APOP	NOMAD	URAT1	UCAC4
B	15.970	15.183	15.764	15.764
V	15.290	15.300	15.557	15.557
R	15.348	15.751	15.691	15.675


Dmitriy Chistoprudov | Nikolay Rykov