

# Gaia Alerts and the Serbian-Bulgarian mini-network telescopes during 2020

---

G. Damljanović<sup>1</sup>, M. Stojanović<sup>1</sup>

<sup>1</sup>Astronomical Observatory, Belgrade, Serbia

E-mail: [gdamljanovic@aob.rs](mailto:gdamljanovic@aob.rs)

**11th OPTICON Gaia Science Alerts Workshop**  
**18-22 January 2021**



# Introduction

---

❖ Gaia mission is scanning full sky to create 3D map of our Galaxy. The ESA space mission: the satellite was launched in December 2013, with the first observations in mid-2014, and the first alerts after that. Goal: astrometry and photometry for  $>1$  billion sources (down to 21 mag in Gaia G-band), spectroscopy for about 150 million objects (down to 16 mag).

Gaia EDR3 (3 December 2020)  $\sim 1.8$  billion sources.

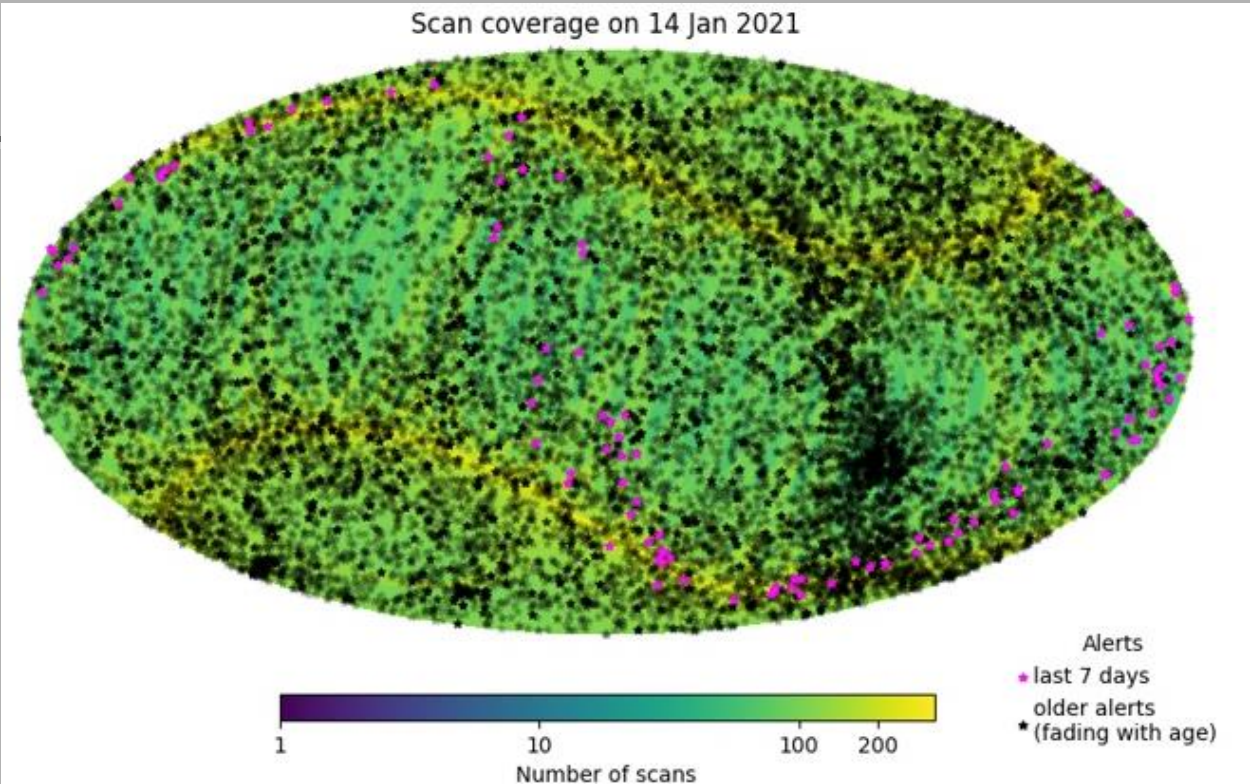
❖ Optical Gaia Celestial Reference Frame (Gaia CRF) - in the future (it is based on QSOs). Link Gaia CRF-ICRF, via QSOs visible in optical and radio domains.

❖ “Serbian-Bulgarian mini-network telescopes” have been established in 2013.



# Gaia Alerts

❖ 14 945 Gaia Alerts, from all over the sky during September 2014 – today.



Year	Number of alerts
2021 (updated 15.01.)	180
2020	4002
2019	3915
2018	2729
2017	2322
2016	1522
2015	168
30.08.2014. – 31.12.2014.	103



# Mini-network (3 sites, 6 telescopes):

---

Astronomical Station  
Vidojevica (**ASV**)  
– Astronomical  
Observatory Belgrade  
(AOB, Serbia)

---

Rozhen National  
Astronomical  
Observatory (**NAO**)  
– Bulgarian Academy of  
Sciences (BAS, Bulgaria)

---

Belogradchik  
Astronomical  
Observatory (AO,  
Bulgaria)

---

Telescopes  
“Milankovic” 1.4 m  
(since mid-2016),  
“Nedeljkovic” 60 cm

Telescopes  
2 m and 60 cm,  
50/70 cm Schmidt-  
camera

Telescope 60cm

❖ Plus telescope 1.31m of Aryabhata Research Institute of observational sciences (ARIES, Manora Peak, Nainital, India)

❖ Johnson UBV and Cousins Rclc filters

❖ The SASA-BAS joint research project  
“Gaia Celestial Reference Frame (CRF) and  
fast variable astronomical objects”

2020-2022 (G.Damljanović and R. Bachev)



# Instruments – Telescopes & Cameras

---

1. **60 cm Cassegrain (ASV: long=21.5°, lat=43.1°, alt=1140m)**  
CCD Apogee Alta U42 (E47), SBIG ST-10 XME, FLI PL230;
2. **1.4 m Ritchey-Chrétien (ASV: 21.6, 43.1, 1150m)**  
Nasmyth, Cassegrain, CCD Apogee Alta U42, Andor iKon-L;
3. **2 m Ritchey-Chrétien (Rozhen NAO: 24.7°, 41.7°, 1730m)**  
CCD VersArray 1300B, Andor iKon-L;
4. **60 cm Cassegrain (Rozhen NAO: 24.7°, 41.7°, 1760m)**  
CCD FLI PL09000;
5. **50/70 cm Schmidt-camera (Rozhen NAO: 24.7°, 41.7°, 1760m)**  
CCD FLI-New PL16803;
6. **60 cm Cassegrain**  
(Belogradchik AO: 22.7°, 43.6°, 650m)  
CCD FLI PL09000.



# ASV (Serbia)

1.4 m telescope  
since mid-2016



40 cm MEADE telescope  
since 2021



# Instruments – Telescopes & Cameras

Telescope D/F [m]	Camera	Chip size [pixel]	Pixel size [μm]	Scale [arc sec/pixel]	Field of View [arc min]
1.4/11.42 ASV	Apogee Alta U42	2048 x 2048	13.5 x 13.5	0.243	8.3 x 8.3
	Andor iKon-L	2048 x 2048	13.5 x 13.5	0.24	8.3 x 8.3
2/15.774 Rozhen	VersArray 1300B	1340 x 1300	20 x 20	0.261	5.6 x 5.6
	Andor iKon-L	2048 x 2048	13.5 x 13.5	0.176	6.0 x 6.0
0.6/6 ASV	Apogee Alta U42	2048 x 2048	13.5 x 13.5	0.465	15.8 x 15.8
	SBIG ST10 XME	2184 x 1472	6.8 x 6.8	0.23	8.4 x 5.7
0.6/7.5 Rozhen	FLI PL09000	3056 x 3056	12 x 12	0.33	16.8 x 16.8
0.6/7.5 Belogradchik	FLI PL09000	3056 x 3056	12 x 12	0.33	16.8 x 16.8
0.5/0.7/1.72 Rozhen	FLI PL16803	4096 x 4096	9 x 9	1.08	73.7 x 73.7

# NAO Rozhen telescopes

---



Schmidt-camera 50/70cm



60cm



# Belogradchik Observatory - 60 cm telescope

---



# Results 2020

---

Few papers are published using our data of Gaia alerts:

❖ *Full orbital solution for the binary system in the northern Galactic disc microlensing event Gaia16aye*

Ł. Wyrzykowski et al., A&A, 633, A98 (2020)

❖ *Gaia 18dvy: A New FUor in the Cygnus OB3 Association*

E. Szegedi-Elek et al., ApJ, 899:130 (2020)

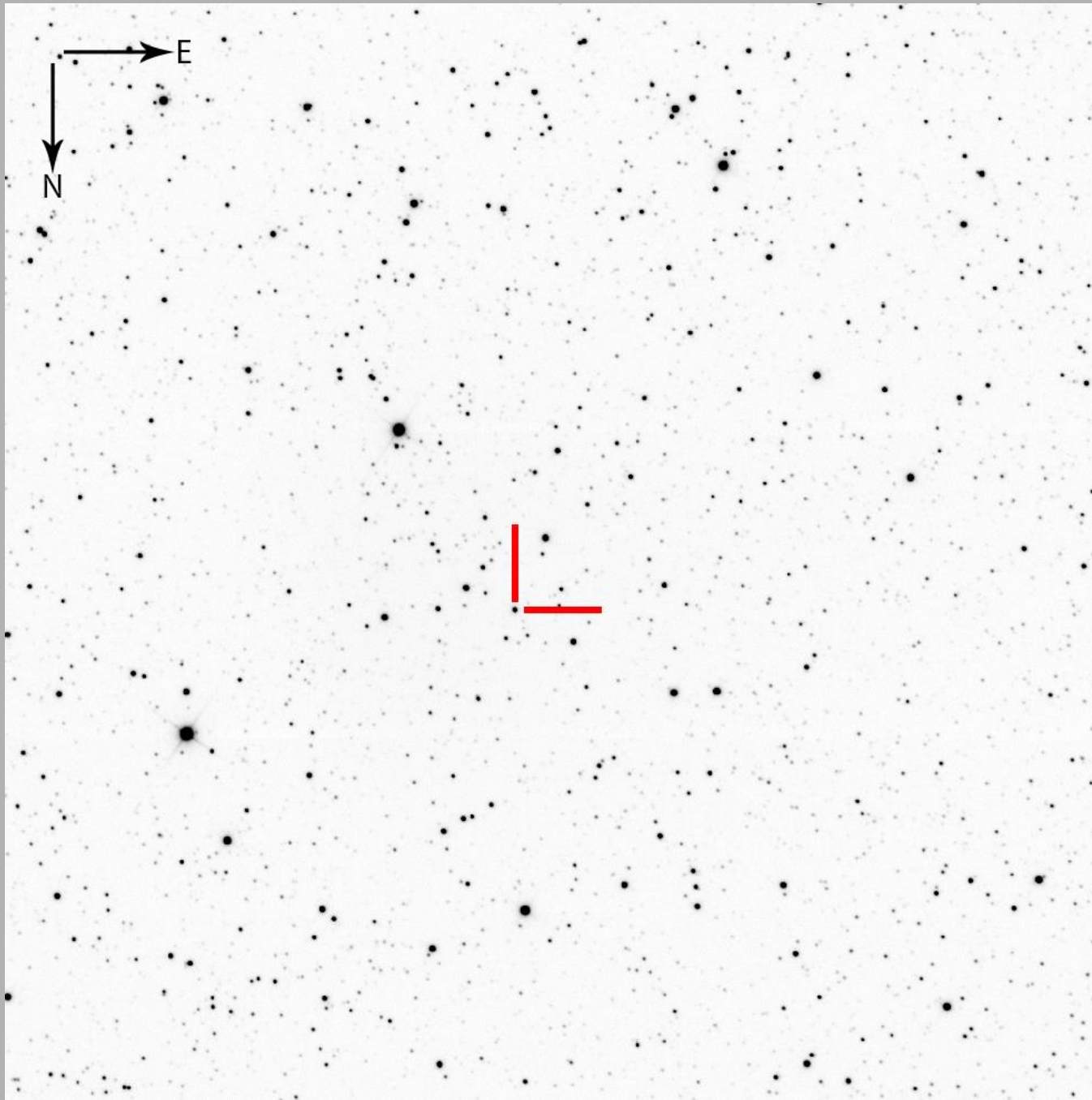
❖ *Comparison of photometric results between the Serbian and Bulgarian telescopes and activities in line with Gaia Alerts (Gaia-FUN-TO)*

G. Damjanovic et al., Bulgarian Astronomical Journal, Vol. 32, p. 108 (2020)



# Gaia16aye (R-filter, Exp.=30s), November 1<sup>st</sup> 2016, 1.4m ASV/CCD Apogee Alta U42

---



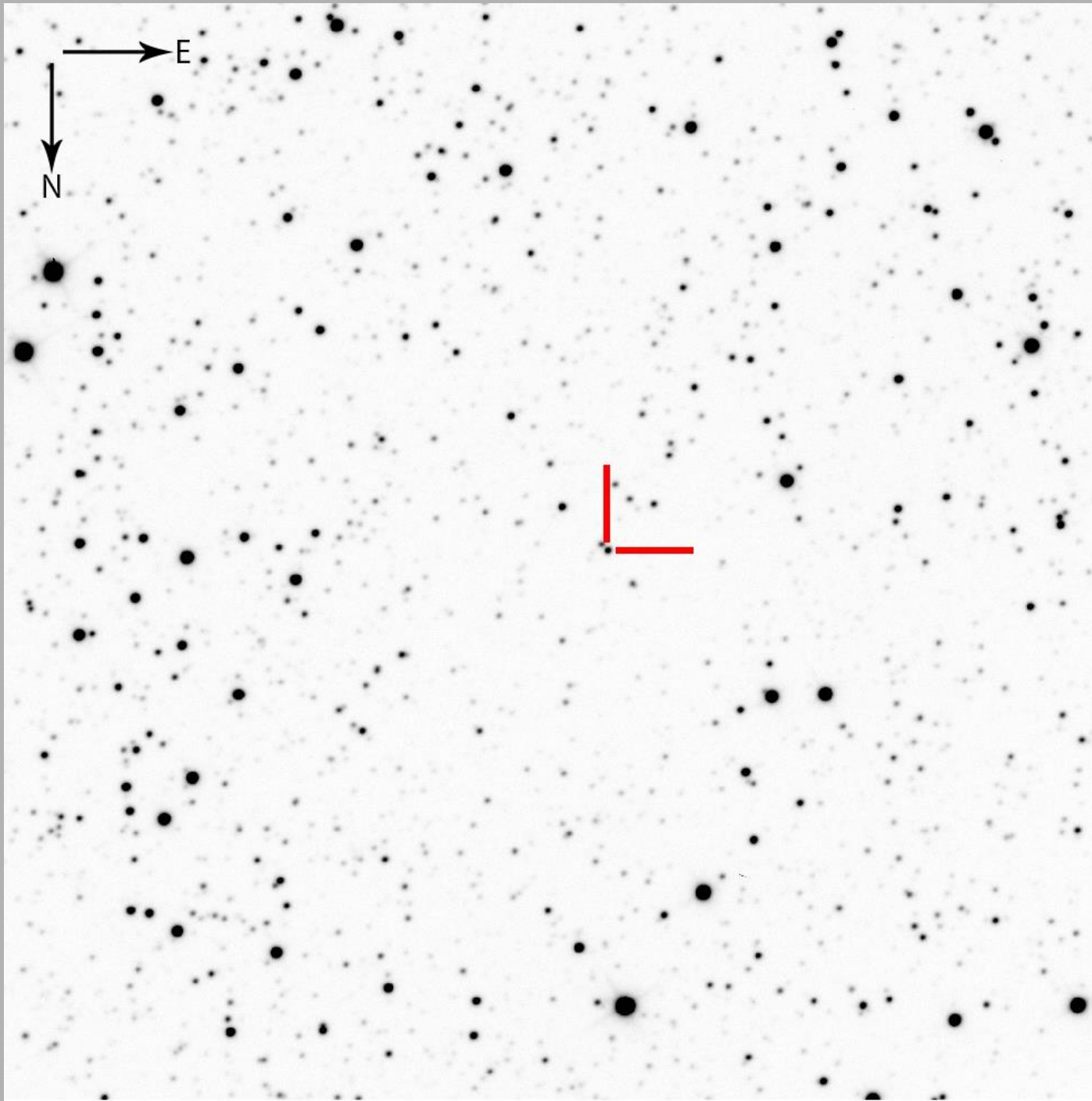
# Gaia16aye

---

- ❖ Observations were done by Serbia-Bulgaria-India cooperation for 2.5 years (from mid-2016 to the end of 2018):
  - 1.4 m (261 epochs, points) and 60 cm ASV (109 points) telescopes,
  - 2 m Rozhen (63 points) and 50/70 cm Schmidt-camera (48 points),
  - 1.31 m ARIES in India (23 points).
- ❖ Gaia16aye was published on Gaia Science Alerts webpage on 9 Aug 2016. There were 7 members in our team: S.Boeva and G.Latev from Bulgaria, G.Damljanovic, O.Vince and M.D.Jovanovic from Serbia, A.Gupta and A.Pandey from India.
- ❖ That object is the binary microlensing rare event, and it was found towards the Galactic spiral arms.



# Gaia18dvy (R-filter, Exp.=120s), March 12<sup>th</sup> 2019, 1.4m ASV/Andor iKon-L



# Gaia 18dvy – observations

Szegedi-Elek et al. (2020)

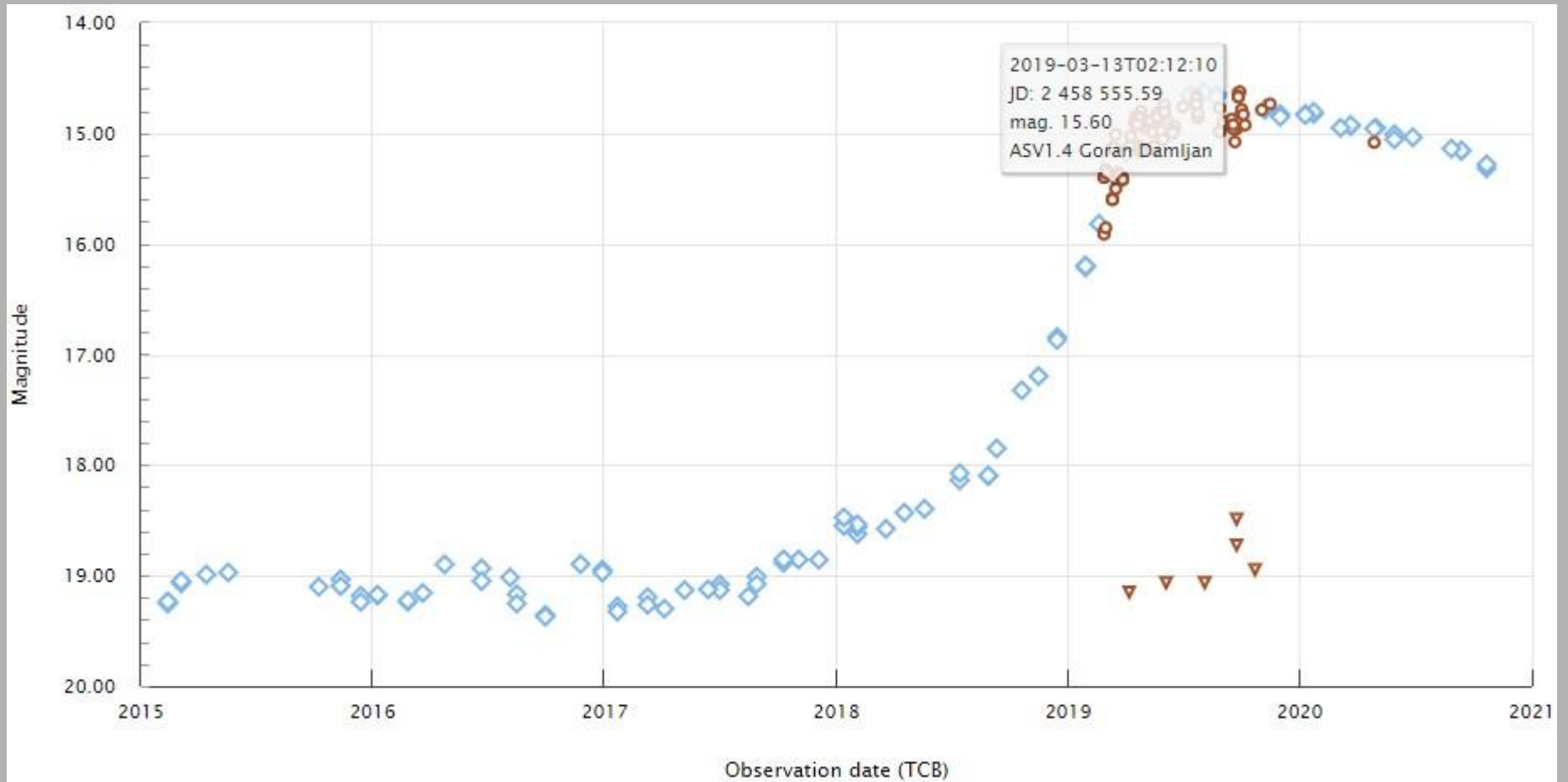
---

- ❖ Optical-infrared photometric and spectroscopic observations of Gaia 18dvy, located in the Cygnus, at a distance of 1.88 kpc.
- ❖ Gaia 18dvy was noted by the Gaia alerts system when its light curve exhibited a 4 mag rise in 2018–2019.
- ❖ Its optical and near-infrared spectroscopic characteristics in the outburst phase are consistent with those of FU Orionis-type young eruptive stars.
- ❖ A radiative transfer modeling of the circumstellar structure, indicates a disk with a mass of  $4 \times 10^{-3} M_{\text{sun}}$ .
- ❖ Known population of FUors is still very small, Audard et al. (2014) listed only 26 FUors...

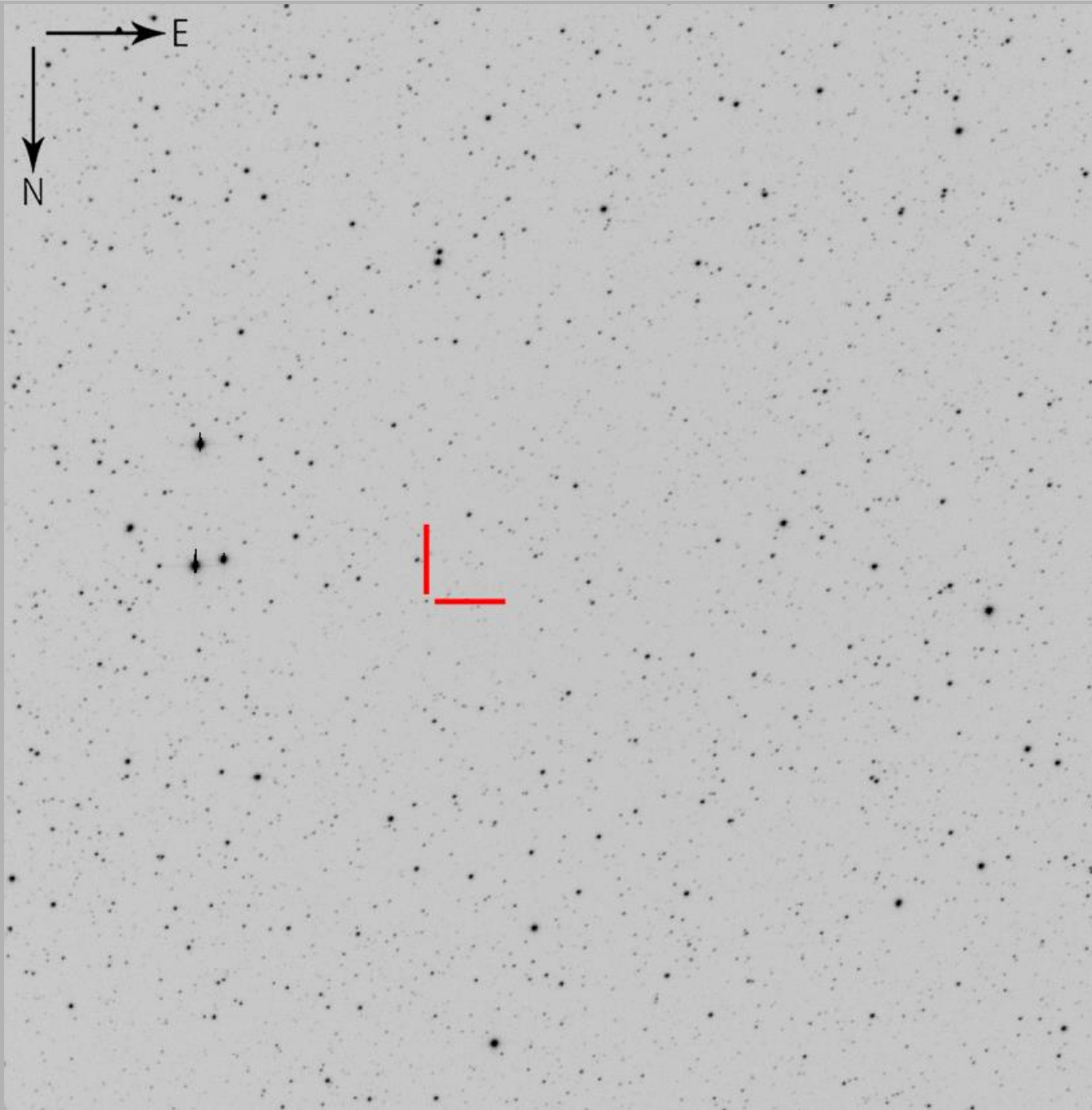


# Gaia 18dvy - observations

Szegedi-Elek et al. (2020)



# Gaia19dke (R-filter, Exp.=180s), December 20<sup>th</sup> 2020, 60cm ASV/CCD FLI PL230



# Gaia19dke

---

- ❖ This object was observed 4 times in 2019 and one time in 2018 by our telescopes:
  - at 12<sup>th</sup> and 19<sup>th</sup> November, 17<sup>th</sup> and 20<sup>th</sup> Decembar 2020 using the 60 cm ASV with CCD FLI PL230,
  - at 29<sup>th</sup> August 2019 using the 60 cm ASV with CCD FLI PL230.
- ❖ Gaia19dke was published on Gala Alerts August 8<sup>th</sup> 2019.



# Observed objects (11), 2020:

---

❖ 60 cm ASV (11 objects):

Gaia17dhv(1 epoch), Gaia19ftm(1), Gaia19frb(1), Gaia20dgq(2),  
Gaia20djf(1), Gaia20div(2), Gaia20dgd(1), Gaia20ehc(1), Gaia20egm(1),  
Gaia20ejl(1), Gaia19dke(4).

❖ 1.4 m ASV (1 object):

Gaia20dgd(1).

❖ 2m Rozhen: - .

❖ 50/70 cm Schmidt-camera at Rozhen: - .

❖ 60 cm Rozhen: - .

❖ 60 cm Belogradchik: - .



# Conclusions

---

- ❖ Gaia-FUN-TO: 11 objects were observed during 2020 (~90 in total for 2014-2020) using 6 telescopes, and BVRcIc filters.
- ❖ The seeing varies from 1."0 to 3."5 (mean ~1."2 at ASV, but there are some nights with 0."7 at Rozhen and ASV).
- ❖ During 2020 we recorded about 210 CCD images: about 200 using 60 cm ASV and about 10 using 1.4 m ASV (Serbia).
- ❖ ~ 2700 images - from October 2014 to the end of 2020.
- ❖ It is possible to observe the objects down to  $V \sim 20$  mag by using 2 m Rozhen or 1.4 m ASV (Exp.time. ~5min), or down to  $V \sim 19$  mag with smaller telescopes.
- ❖ The 1.4 m at ASV from mid-2016, new dome 2018, 40 cm MEADE, new CCD Andor iKon-L 936 (also, for 2 m Rozhen since April 2018), new EMCCD Andor iXon 897 for lucky imaging. Aluminization at 2 m Rozhen done in 2017.



---

*Thank you!*

