

SANU-BAN project GAIA ASTROMETRY AND FAST VARIABLE ASTRONOMICAL OBJECTS (from 2023 to 2025)



G. Damljanovic¹, R. Bachev², M. D. Jovanovic¹, M. Stojanovic¹, S. Boeva², G. Latev² and Z. Simic¹

¹ Astronomical Observatory, Belgrade, Serbia

² Institute of Astronomy and NAO Rozhen, Bulgarian Academy of Sciences, Sofia, Bulgaria

E-mail: **gdamljanovic@aob.rs**

ABSTRACT. At the end of 2025 we finished our SANU-BAN bilateral joint research project “Gaia astrometry and fast variable astronomical objects” (for the period from 2023 to 2025, G.Damljanovic - Serbian side, R.Bachev - Bulgarian side) as a part of the cooperation between the Serbian Academy of Sciences and Arts and the Bulgarian Academy of Sciences.

Also, it is in line with our local cooperation the “Serbian-Bulgarian mini-network telescopes” (which we established at 2013); there are 8 instruments: 5 in Bulgaria (at Rozhen and Belogradchik sites) and 3 in Serbia (at Astronomical Station Vidojevica – ASV site).

We observed 15 Gaia Alerts objects during 2025: AT2021aeuk (1 time), AT2024kwu (1), TCrB (20), ZTF18aarippg (2), SN2015ap (1), Gaia22dwj (1), Gaia23crp (4), Gaia24acn (5), Gaia24aup (8), Gaia24azc (4), Gaia23cer (6), Gaia24bux (1), Gaia24bnd (1), Gaia24axc (1) and Gaia23axx (1). Also, we did some obejsts in line with the international Whole Earth Blazar Telescope (WEBT) project: 0235+164, 0735+178, 0716+164, 1553+113, 1641+399, 1652+398, 1807+698, 2200+420, 2230+114, 2251+158, 2344+514, etc. Some results of our activities are presented, here.

Introduction

We did few main activities in line with the SANU-BAN project “Gaia astrometry and fast variable astronomical objects” (2023-2025): to observe the Gaia Alerts (or Black Hole Target Observation Manager - BHTOM) objects, the Whole Earth Blazar Telescope - WEBT objects and investigations regarding Gaia astrometry.

1. The European Space Agency (ESA) is behind two satellite missions for modern astrometry: Hipparcos (during the last century) and Global Astrometric Interferometer for Astrophysics - GAIA (at the beginning of the 21st century. The Gaia Follow Up Network for Transients Objects (Gaia-FUN-TO) or Gaia Alerts is a part of Gaia mission.

2. The WEBT is international project and network of about 100 telescopes for monitoring of blazars (as active galactic nucleus - AGN) in optical, near infra-red and radio domains in order to build the light curves of the observed objects; Torino Observ.

3. In the last data release (Gaia DR3), the Gaia mission provides precise astrometry for about 1.8 billion sources. The Gaia CRF3 celestial reference frame is based on about 1.6 million extragalactic sources (mostly quasars - QSOs) . The Gaia DR3 was made available for public on June 13th, 2022. The Gaia uses astrometric observations of optical counterparts of sources from the radio catalogue International Celestial Reference Frame (ICRF) to adjust its reference frame. From 2013 we conducted optical photometric observations in the V and R bands for 47 AGNs to investigate their brightness variability; it was in line with the PhD thesis by Dr. Miljana D. Jovanovic (she finished her PhD in 2025). During July 2025, G.Damljanovic was in the Paris Observ.

SANU-BAN project (2023-2025)

There are few our joint research projects about the SANU-BAN cooperation until now: “Observations of ICRF radio-sources visible in optical domain” (period 2014-2016), “Study of ICRF radio-sources and fast variable astronomical objects” (2017-2019), “Gaia Celestial Reference Frame (CRF) and fast variable astronomical objects” (2020-2022); the actual one is “Astrometric and astrophysical research of variable astronomical objects” (2026-2028, head – Dr. G. Damljanovic).

About the period 2023-2025, the colleagues from Bulgarian side were: Dr. Rumen Bachev, Svetlana Boeva, Dr. Georgi Latev, Dr. Yanko Nikolov, Stefan Stefanov and Miroslav Moyseev. The colleagues from Serbian side were: Dr. Goran Damljanovic, Dr. Zorica Cvetkovic, Dr. Rade Pavlovic, Dr. Milan Stojanovic, Miljana D.Jovanovic and Dr. Zoran Simic.

We observed 15 Gaia Alerts objects during 2025: AT2021aeuk (1 time), AT2024kwu (1), TCrB (20), ZTF18aarippg (2), SN2015ap (1), Gaia22dwj (1), Gaia23crp (4), Gaia24acn (5), Gaia24aup (8), Gaia24azc (4), Gaia23cer (6), Gaia24bux (1), Gaia24bnd (1), Gaia24axc (1) and Gaia23axx (1). Also, we did some WEBT objects: 0235+164, 0735+178, 0716+714, 1553+113, 1641+399, 1652+398, 1807+698, 2200+420, 2230+114, 2251+158, 2344+514, etc.



Fig 1. Dome of ASV 1.4 m telescope.



Fig 2. Dome of 2 m telescope, NAO Rozhen, Bulgaria.

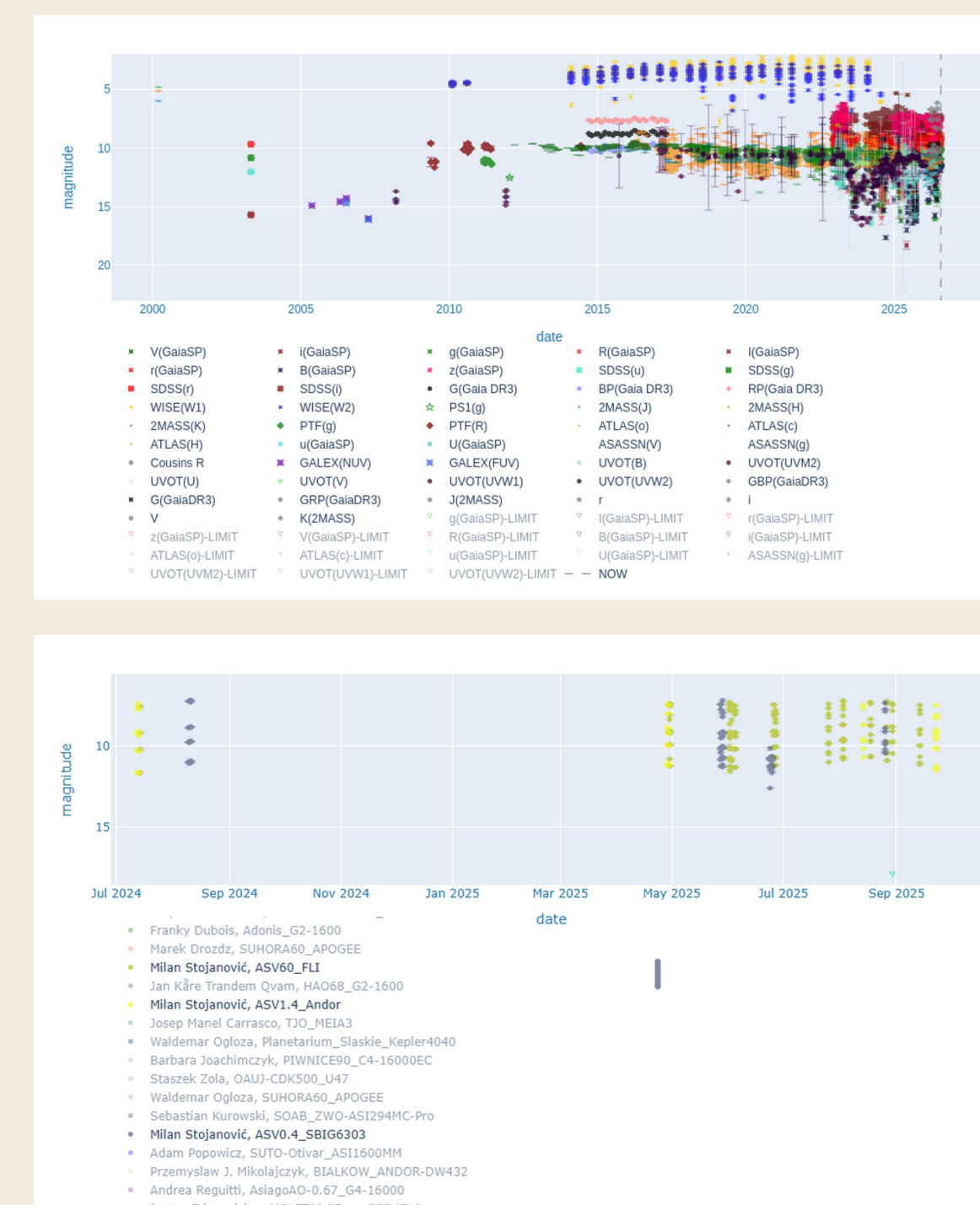


Fig 3. Light curve of TCrB object: all observations (upper part) and our observations (lower part).



Fig 4. Gaia Alerts object TCrB (T Coronae Borealis, recurrent nova predicted to explode 2024/2025): R-band, 60 cm ASV telescope with CCD FLI PL230, FOV=17.5x17.6, pixel scale is 0.512 per pixel..

Acknowledgement

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (contract number 451-03-33/2026-03/200002). We gratefully acknowledge the observing grant support from the Institute of Astronomy and Rozhen NAO BAS through the bilateral joint research projects (2026-2028): “Astrometric and astrophysical research of variable astronomical objects” and “Optical flux stability of 47 Active Galactic Nuclei important for the link between the Gaia CRF and ICRF systems”. GD acknowledges the support through the project F-187 of the Serbian Academy of Sciences and Arts. GD and MDJ acknowledge the financial support by the European Commission through project BELISSIMA (BELgrade Initiative for Space Science, Instrumentation and Modelling in Astrophysics, call FP7-REGPOT-2010-5, contract No. 256772) which was used to procure the "Milanković" 1.40 m telescope with support from the Ministry of Education, Science and Technological Development of the Republic of Serbia.

References

2023 (7 papers)

- Abe, H., ..., Bachev, R., ..., Damljanovic, G., ..., Stojanovic, M., et al.: 2023, Multimessenger Characterization of Markarian 501 during Historically Low X-Ray and gamma-Ray Activity, ApJS, 266:37, 43pp.
- Dhiman, V., ..., Damljanovic, G., ..., Bachev, R., ..., Jovanovic, M.D., ..., Stojanovic, M., et al.: 2023, Multiband optical variability of the TeV blazar PG 1553+113 in 2019, MNRAS, 519, 2796-2811.
- Bachev, R., ..., Boeva, S., Damljanovic, G., Vince, O., Stojanovic, M., et al.: 2023, Intra-night optical flux and polarization variability of BL Lacertae during its 2020-2021 high state, MNRAS, 522, 3018-3035.
- Raiteri, C.M., ..., Bachev, R., ..., Damljanovic, G., ..., Jovanovic, M.D., ..., Stojanovic, M., et al.: 2023, Extreme photometric and polarimetric variability of blazar S4 0954+65 at its maximum optical and gamma-ray brightness levels, MNRAS, 526, 4502-4513.
- Jovanovic, M.D., Damljanovic, G., et al.: 2023, Multiband optical variability of a newly discovered 12 blazars sample from 2013-2019, MNRAS, 522, 767-791.
- Raiteri, C.M., ..., Bachev, R., ..., Damljanovic, G., ..., Jovanovic, M.D., ..., Stojanovic, M., et al.: 2023, The optical behaviour of the BL Lacertae at its maximum brightness levels: a blend of geometry and energetics, MNRAS, 522, 102-116.
- Damljanovic, G., Stojanovic, M., Bachev, R., Boeva, S.: 2023, GAIA ALERTS AND BULGARIAN-SERBIAN COOPERATION FROM 2014 TO 2022, The Proc. of the XIII Bulgarian-Serbian Astronomical Conference (October 3-7, 2022, Velingrad, Bulgaria), Publ. Astron. Soc. “Rudjer Boskovic”, 25, 43-51.

2024 (3 papers)

- Abe, H., ..., Bachev, R., Strigachev, A., Damljanovic, G., Vince, O., Jovanovic, M.D., Stojanovic, M., et al.: 2024, Multi-year characterisation of the broad-band emission from the intermittent extreme BL Lac 1ES 2344+514, A&A, 682, A114.
- Raiteri, C.M., ..., Bachev, R., ..., Damljanovic, G., ..., Jovanovic, M.D., ..., Stojanovic, M., et al.: 2024, A wiggling filamentary jet at the origin of the blazar multi-wavelength behaviour, A&A, 692, A48.
- Tripathi, T., ..., Bachev, R., ..., Damljanovic, G., et al.: 2024, Optical intraday variability of the blazar S5 0716+714, MNRAS, 527, 5220-5237.

2025 (3 papers)

- Damljanovic, G., Stojanovic, M., Jovanovic, M. D., Bachev, R., Boeva, S.: 2025, SERBIAN-BULGARIAN COOPERATION ABOUT GAIA ALERTS DURING 2023, the Proc. of the XIV Serbian-Bulgarian Astronomical Conference (23-27 September 2024, Vrnjacka Banja, Serbia), Publ. Astron. Obs. Belgrade No. 107, pp.57-62.
- Vince, O., ..., Damljanovic, G., Stojanovic, M., Jovanovic, M.D., ..., Bachev, R., et al.: 2025, Multiband optical variability on diverse timescales of the blazar Ton 599 from 2011 to 2023, A&A, 703, A159.
- Dogra, K., ..., Bachev, R., Damljanovic, G., ..., Jovanovic, M.D., ..., Stojanovic, M., et al.: 2025, Multiband Optical Variability of the Blazar 3C 454.3 on Diverse Timescales, ApJS, 276:1, 14pp.

21. SRPSKA ASTRONOMSKA KONFERENCIJA (21st Serbian Astronomical Conference)

5. - 8. oktobra 2026. godine, Beograd, Srbija