Bilateral collaborations on space weather: Recent results

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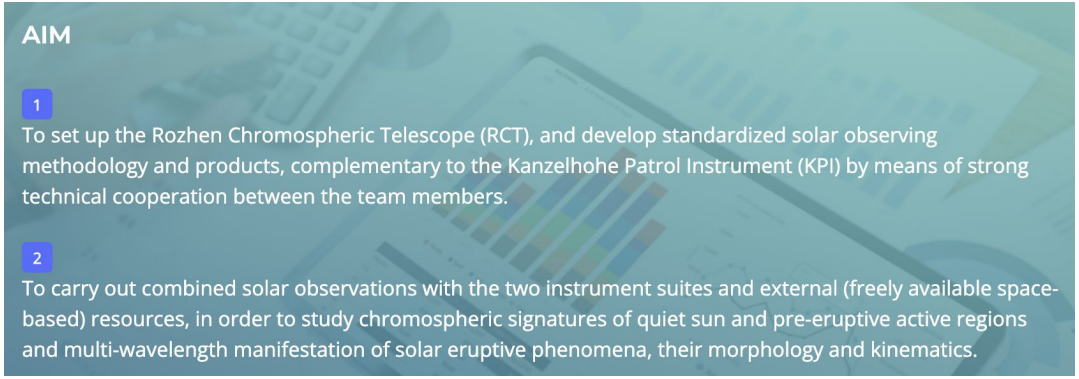
I. Bulgarian-Austrian project

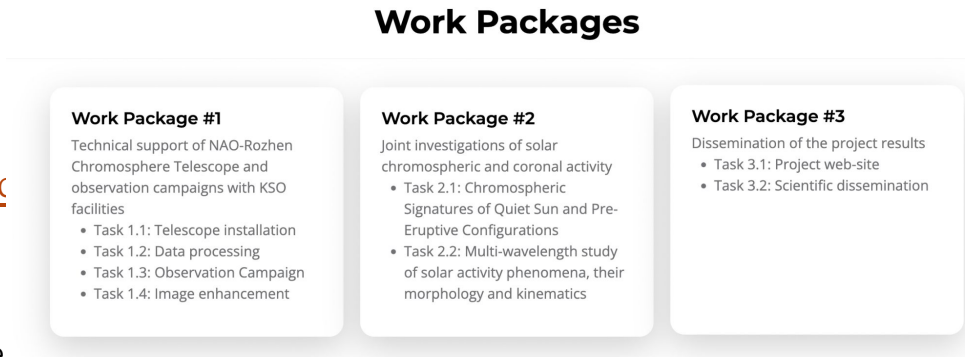
Title: Joint Observations and Investigations Solar Chromospheric and Coronal Activity (2023-2025)

Bg-PI: R. Miteva
At-PI: W. Poetzi

T2.1: Parameter study of geoeffective active regions (completed, 2024)
https://doi.org/10.3390/atmos15080930
T2.2: Confined M-class flares in solar cycles 23&24 (completed, 2025)
https://astro.bas.bg/AIJ/issues/n43/RMiteva.pd

In progress (WP1):
T1.1, T1.3: Solar observations
T1.2, T1.4: Machine learning, automatic feature recognition





https://astro.bas.bg/project-sun/

I. Bulgarian-Austrian project

T2.1:

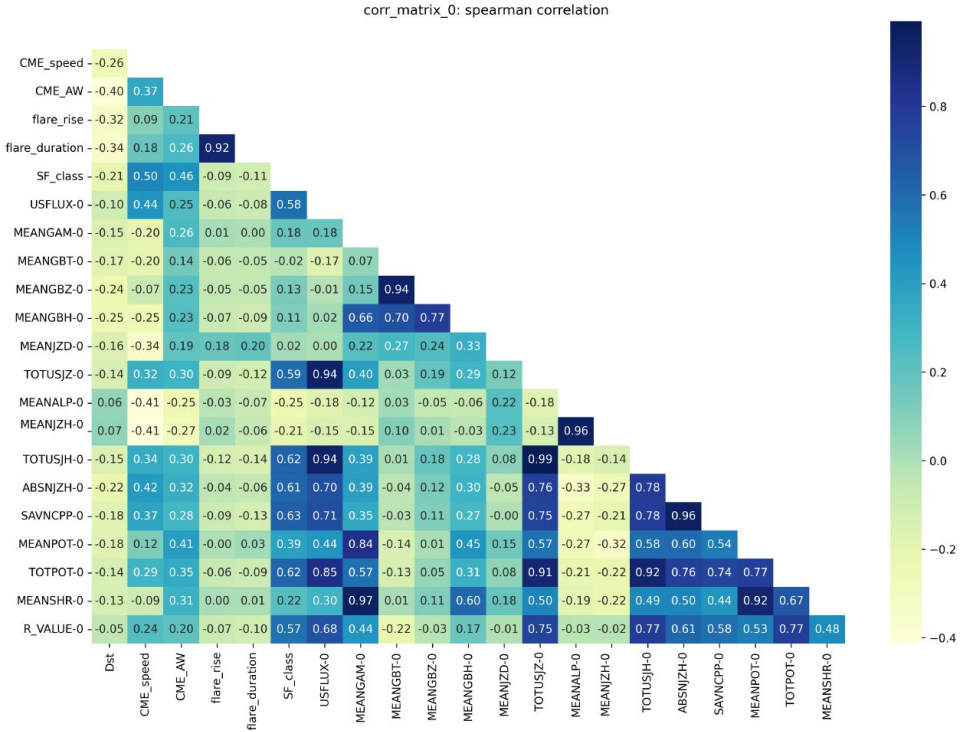


Figure 2. Spearman correlation coefficients between the SW and SHARP parameters.

atmosphere

MDPI

Article

Parameter Study of Geoeffective Active Regions

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Abstract: Geomagnetic storms (GSs) are major disturbances in the terrestrial atmosphere caused by the reconnection process between the incoming plasma ejecta in the solar wind and the planetary magnetosphere. The strongest GSs can lead to auroral displays even at lower latitudes, and cause both satellite and ground-based infrastructure malfunctions. The early recognition of geoeffective events based on specific features on the solar photosphere is crucial for the development of early warning systems. In this study, we explore 16 magnetic field parameters provided by the Space-weather HMI Active Region Patch (SHARP) database from the SDO/HMI instrument. The analysis includes 64 active regions that produced strong GS during solar cycle (SC) 24 and the ongoing SC25. We present the statistical results between the SHARP and solar parameters, in terms of Pearson and Spearman correlation coefficients, and discuss their space weather potential.

Keywords: active regions; geomagnetic storms; photospheric magnetic fields; solar flares; coronal mass ejections; statistical analysis

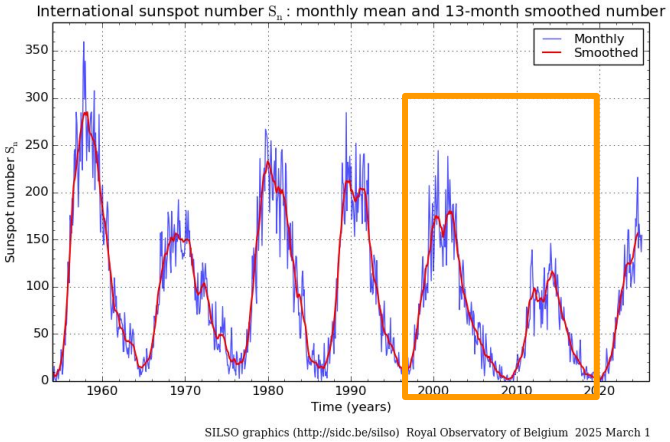
(Selected) SHARP parameters seem to be more promising for exploring the (photospheric) link to SFs and/or CMEs, not to GSs.

I. Bulgarian-Austrian project

T2.2:

- M-class: GOES soft X-ray (1-8 A) flux, 10^-5 to 10^-4 W/m^2
  https://www.swpc.noaa.gov/products/goes-x-ray-flux
- Confined: no associated (parent) coronal mass ejection (no magnetized plasma eruptions) & no particle events
- Time coverage: 1997-2009 & 2010-2019
  https://www.sidc.be/SILSO/monthlyssnplot
- Event sample: ~990
- Analyses: timings, location, sunspot type, radio burst (II & III type) associations

(e-poster)



Confined vs. eruptive M-class flares in solar cycles 23 and 24

Rositsa Miteva[1] and Werner Pötzi[2]
[1] Institute of Astronomy and National Astronomical Observatory - Bulgarian Academy of Sciences, 1784 Sofia, Bulgaria
[2] Institute of Physics, Kanzelhöhe Observatory for Solar and Environmental Research, University of Graz, 8010 Graz, Austria
rmiteva@nao-rozhen.org
(Submitted on 09.04.2025; Accepted on 25.04.2025)

Abstract. This report presents a quantitative comparison between confined, eruptive and all (2177) M-class solar flares (SFs) over the last two solar cycles (SC) and separately in SC 23 and 24. The properties of the SFs, related radio bursts and the parent sunspots (Hale type and total area) are examined. The differences are presented and discussed in the framework of space weather.
Key words: solar flares: solar cycle: sunspot type

Bulgarian Astronomical Journal 43, 2025

II. Bulgarian-Serbian project

Title: Active Events On The Sun. Catalogs Of Proton Events And Electron Signatures In X-Ray, UV And Radio diapason...
(2023-2025)

Bg-PI: M. Dechev
Rs-PI: Z. Simic

Preliminary results: statistics of proton fluence (15 MeV): published

Publ. Astron. Obs. Belgrade No. 107 (2025), 29 - 36 *Invited Lecture*
http://doi.org/10.69646/14sbac04p

SOHO/ERNE PROTON FLUENCE IN SOLAR CYCLES 23 AND 24

R. MITEVA[1], S. W. SAMWEL[2] and M. DECHEV[1]
[1]*Institute of Astronomy and National Astronomical Observatory (IANAO), Bulgarian Academy of Sciences, 1784 Sofia, Bulgaria*
E–mail: rmiteva@nao-rozhen.org
[2]*National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Cairo 11421, Egypt*

Abstract. The focus of this study is on solar proton events detected by the SOHO/ERNE instrument during solar cycles (SC) 23 and 24. We select the output produced by the first channel of the high energy detector or at about 15 MeV. This report presents the distributions of the onset-to-peak proton fluences, in terms of their strength, location of their solar origin and mutual correlations, well as the SC trends.

II. Bulgarian-Serbian project

https://catalogs.astro.bas.bg/

Proton events

The catalog lists the proton events from the SOHO/ERNE instrument presented separately in solar cycle (SC) 23 (1996-2008) and SC24 (2009-2017). In contrast to other catalogs available elsewhere, this catalog utilizes the highest temporal resolution as provided, namely 1 min.

Results from the final SEP catalog are available here:

Miteva et al. Atmosphere (2024)

Preliminary results from the catalog are published here:

Miteva et al. SES-Proceedings (2023)

Miteva et al., Bulgarian Astronomical Journal, Vol. 33, pp. 99-108 (2020)

Miteva & Tsvetkov *AIP Conf. Proc.* 2075, 090014 (2019)

Miteva & Danov WS-Proceedings (2019)

Miteva SES-Proceedings (2017)

Work in progress:

Proton fluences in 10 energy channels over solar cycles 23 & 24 (correlations)
>600 events

III. Bulgarian-Egyptian project

Title: On space weather effects at near Earth environment - from remote observations and in situ particle forecasting to impacts on satellites (finished, 2022-2024)

Bg-PI: R. Miteva
Eg-PI: S. W. Samwel

Objectives:
(1) SEP events
(2) Solar observations
(3) Impact on satellites
(*) Geomagnetic storms

BG team members with contribution:
K. Kozarev, M. Nedal

Conference participations:
Oral: 6
Posters: 4

Publications:
(*) Universe 2023, 9(4), 179 (15pp.)
https://doi.org/10.3390/universe9040179
(*) Astron. Soc. "Rudjer Bošković" No 25, 2023, 125-135
https://astro.bas.bg/conf_proc/book_XIIIBSAC.pdf
(*) Atmosphere, 2023, 14(12)
https://doi.org/10.3390/atmos14121744
(3) Astronomy, 2023, 2(3), 165-179
https://doi.org/10.3390/astronomy2030012
(1) Proceedings SES 2023, 67-70
http://space.bas.bg/SES/archive/SES%202023_DOKLADI/PROCEEDINGS%20SES%202023.pdf

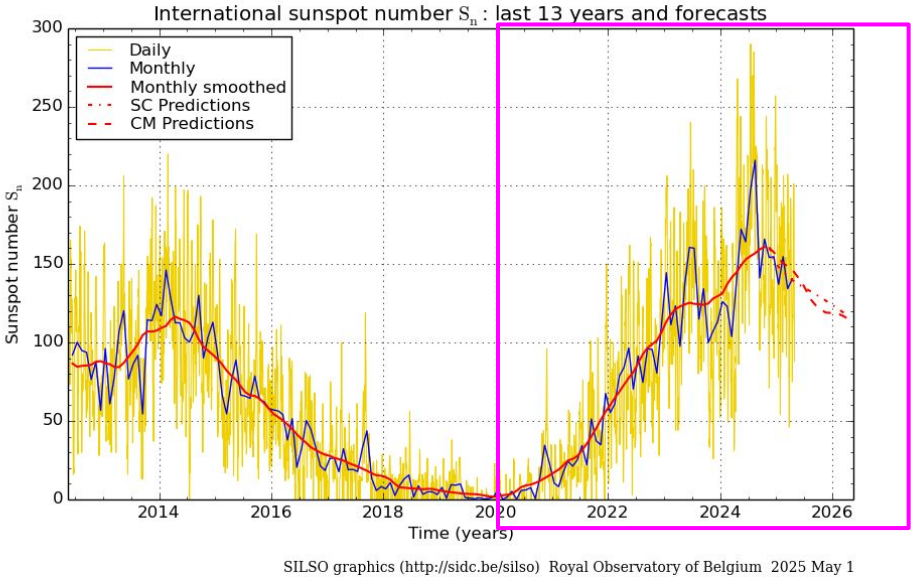
III. Bulgarian-Egyptian project

Title: **Solar activity and space weather effects during solar cycle 25**
(proposed, 2025-2027)

Bg-PI: R. Miteva
Eg-PI: S. W. Samwel

Objectives:
(1) SEP modeling and effects on satellites
(2) Geomagnetic storms
(3) Solar and IP drivers of space weather

BG-team:
K. Kozarev
M. Dechev
A. Epifanov



New project:
Geomagnetic storm effects on satellites

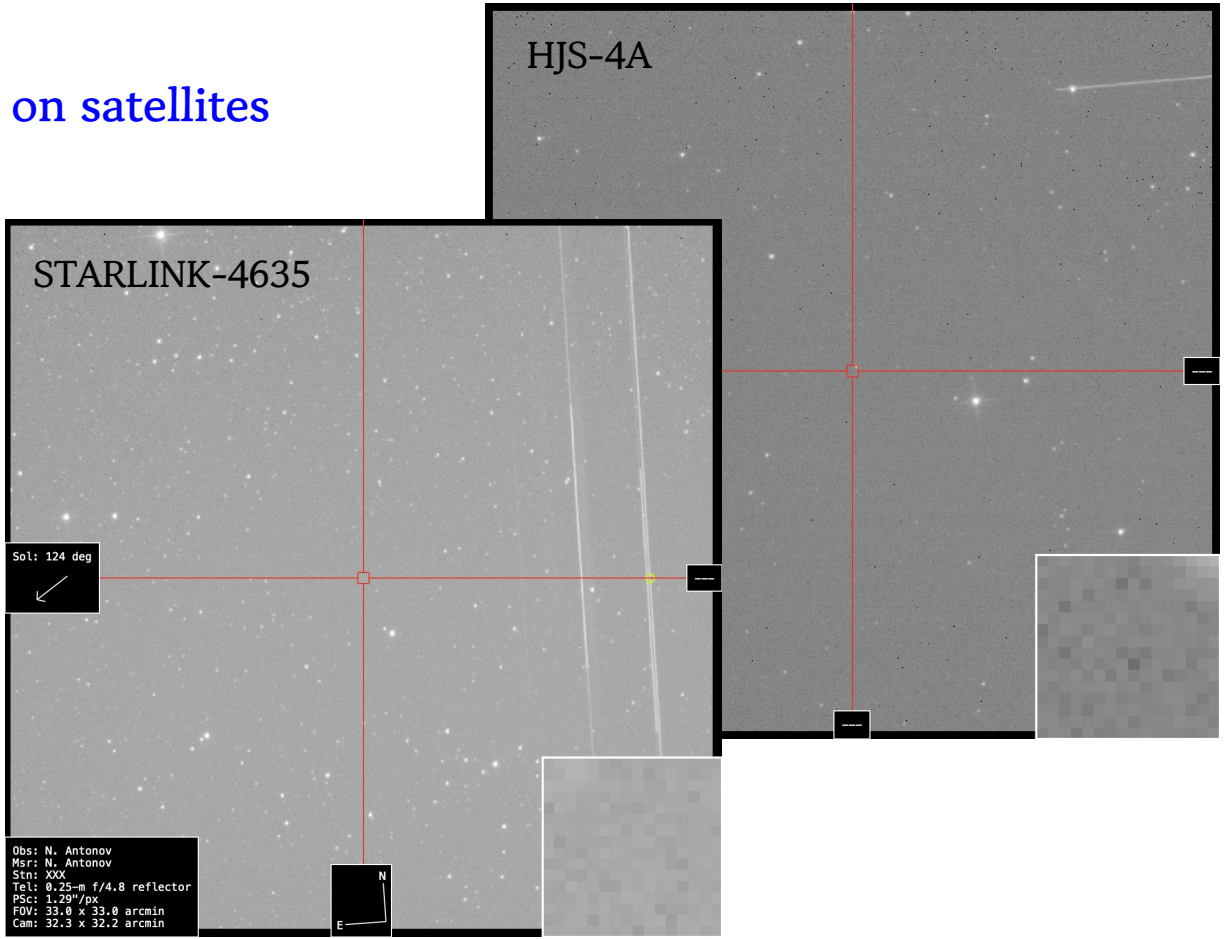
Data (Nikola Antonov):

https://astro.iaps.institute

Meshtitsa observatory
database: since 2023

Event selection:

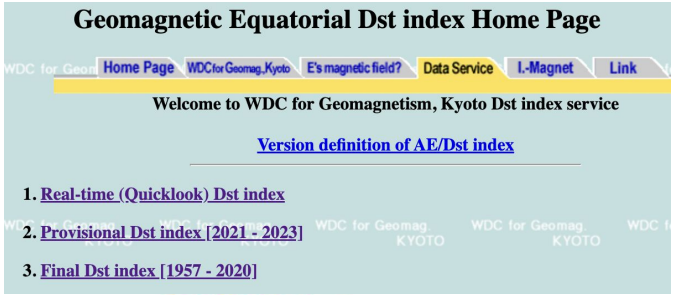
- June 2024 - January 2025
- >500 individual streaks

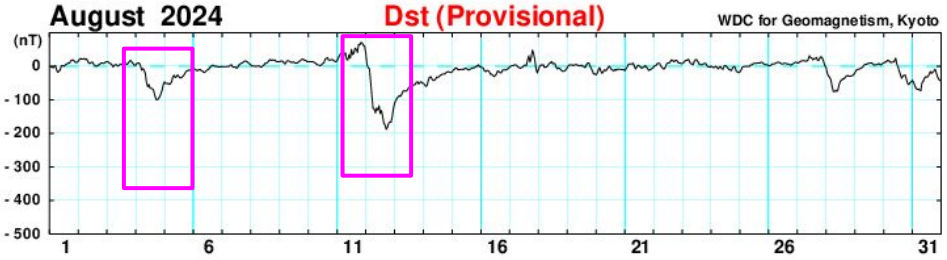


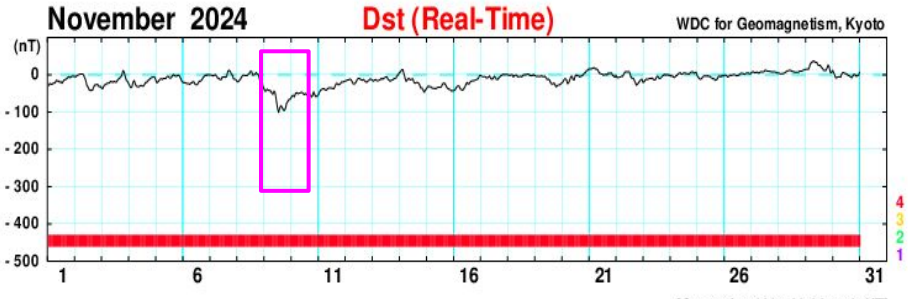
Geomagnetic storms (GSs)

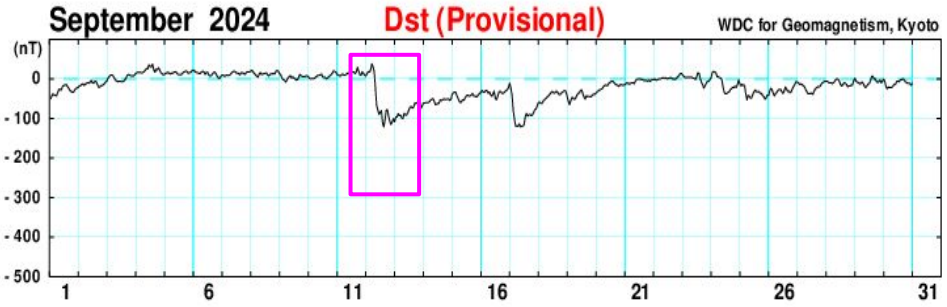
https://wdc.kugi.kyoto-u.ac.jp/dstdir/index.html

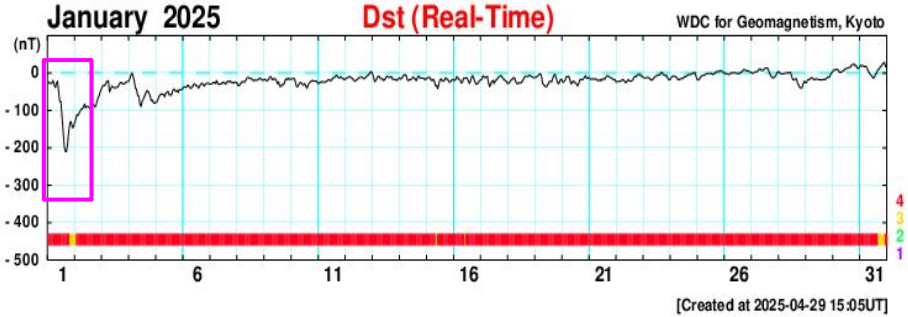
- only 5/12 GSs with streak data









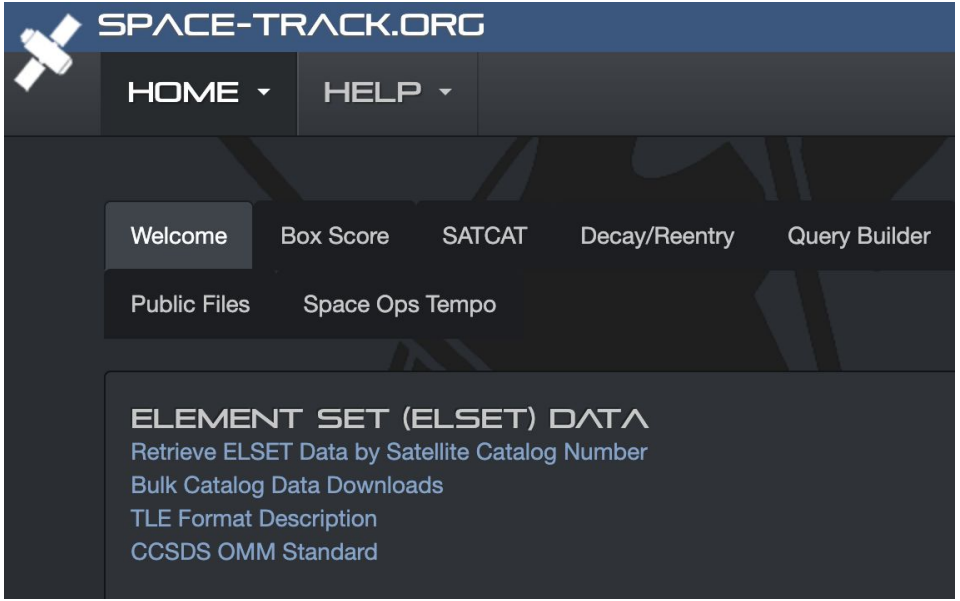


Phase I. Satellite identification (completed)

- 19 observations during 5 GSs
- 12 confirmed satellites

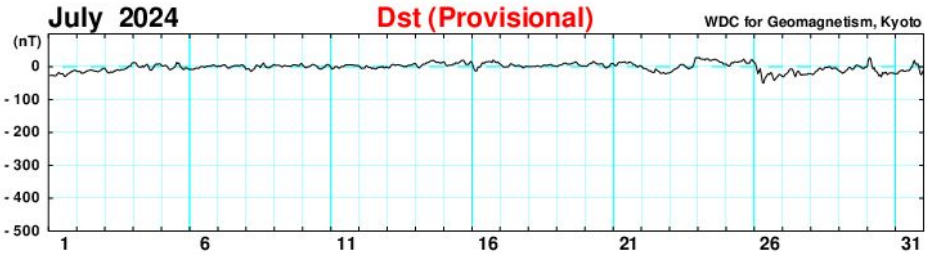
https://www.tycho-tracker.com/

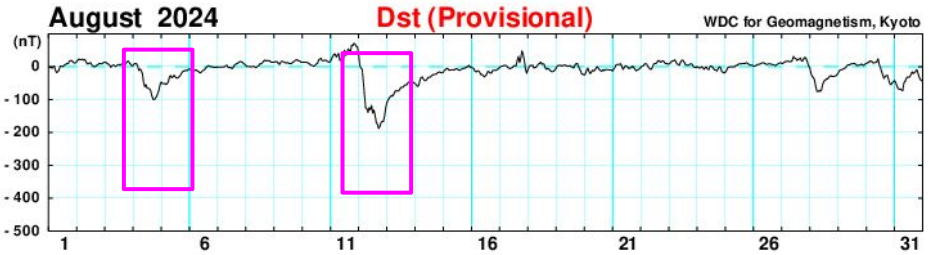
yyyy	mm	dd	FOV	ObjName
2024	8	4	T CrB	COSMOS 2251 DEB
2024	8	4	T CrB	STARLINK-2471
2024	8	4	T CrB	WILDFIRE 4
2024	8	4	V Nul	STARLINK-3899
2024	8	4	T CrB	STARLINK-31460
2024	8	12	BG Tri	HJS-4A
2024	8	12	BG Tri	COSMOS 1700 DEB
2024	8	12	BG Tri	STARLINK-3256
2024	8	12	BG Tri	COSMOS 839 DEB
2024	8	12	BG Tri	EKRAN 16
2024	8	12	BG Tri	STARLINK-1679
2024	8	12	BG Tri	STARLINK-5937
2024	8	12	BG Tri	STARLINK-5937
2024	8	12	BG Tri	DELTA 1 DEB
2024	9	12	BL Lac	Ofeq 16
2024	9	12	BL Lac	COSMOS 839 DEB
2024	11	9	KR Aur	SPACEBEE-174
2025	1	1	KR Aur	SL-16 DEB
2025	1	1	KR Aur	STARLINK-4635
				no match
				confirmed ID

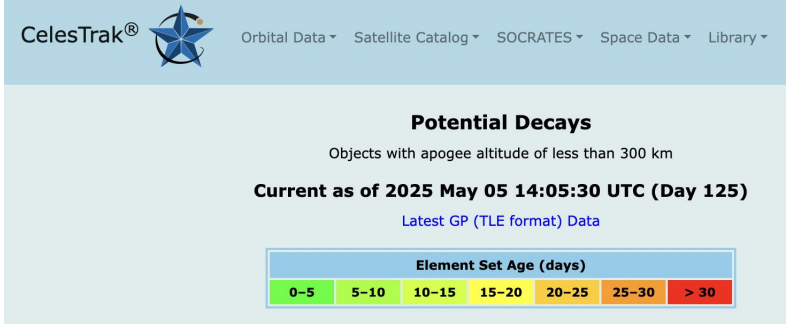


→ Two Line Element (TLE) sets (averaged orbital parameters)

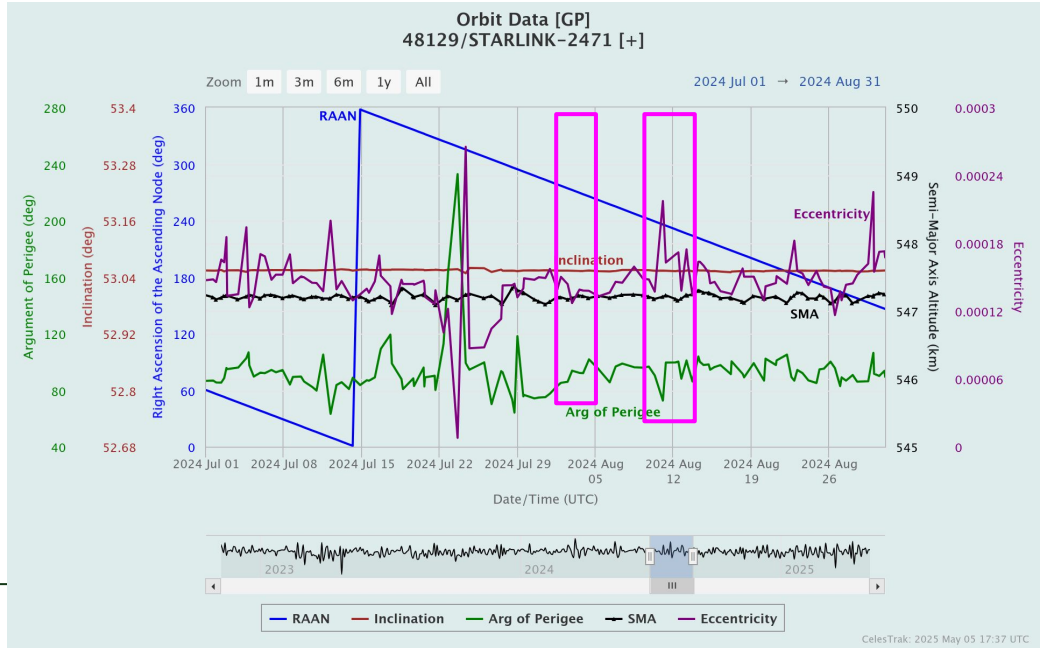
Phase II. Satellite orbital parameters (in progress)







https://celestrak.org/



Acknowledgements

Interacademy bilateral project: Bulgaria-Serbia (in progress)
'*Active Events On The Sun. Catalogs Of Proton Events And Electron Signatures In X-Ray, UV And Radio diapason. Influence of Collisions on Optical Properties of Dense Hydrogen Plasma*' (2023-2025)
Bulgarian Academy of Sciences

Bilateral project: Bulgaria-Austria (extended)
https://astro.bas.bg/project-sun/
'Joint observations and investigations of solar chromospheric and coronal activity' (2023-2025)
Bulgarian National Science Foundation project No. KP-06-Austria/5 (14-08-2023) and Austria's Agency for Education and Internationalisation (OeAD) project No. BG 04/2023

Announcements

Bulgarian Astronomical Journal

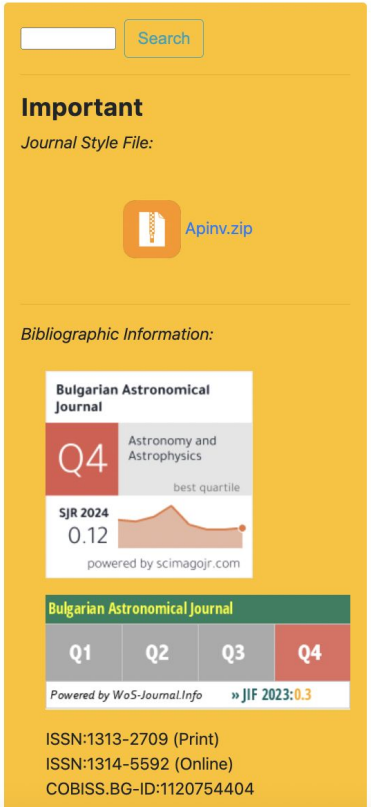
Institute of Astronomy
Bulgarian Academy of Sciences

Bulgarian Astronomical Journal (BAJ) publishes scientific articles in all fields of astronomy, astrophysics and interdisciplinary domains. It publishes scientific results of theoretical and observational research, as well as results of the design of astronomical instruments. The journal concerns the broad audience of professional astronomers, astrophysicists, and physicists.

Scientific papers of the following types are considered for publication: original papers (including catalogues, atlases, large data sets, etc.), reviews, conference presentations, lectures at scientific meetings, schools and seminars, as well as extended dissertation abstracts, conferences summaries, etc. Although BAJ may also publish conference proceedings as special volumes, in these volumes the journal will publish only the contributions that have successfully passed the peer review process. Submission is a representation that the manuscript has not been published elsewhere.

Each submitted for publication article is peer-reviewed. BAJ editors and referees work under the conditions of strict confidentiality. When a paper is accepted it is published in PDF-format on journal's website (see "Issues"). Such paper may be cited as "In print". When enough number of papers is collected, the current volume of BAJ is finalized, printed and distributed.

BAJ advantages: papers are rigorously refereed; there are no page charges; on line and printed versions are available; free on line access is available; the journal is indexed/abstracted by ADS, SCOPUS, Elsevier, Clarivate Analytics, Emerging Source Citation Index (ESCI) and other databases.



https://www.astro.bas.bg/AIJ/

Announcements

https://bulgarianspace.online/en/nafski2025/