

Small telescopes for big science

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[HTTP://SLACK.BHTOM.SPACE/](http://SLACK.BHTOM.SPACE/)
[HTTP://BHTOM.SPACE](http://BHTOM.SPACE)



LW
@ASTROUW.EDU.PL

TEAM

<https://gaia.astrow.edu.pl>



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Funding:



BHTOM TEAM



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///AkondLab.

Former contributors: Maja Jabłońska, Piotr Trzcionkowski, Kacper Raciborski



Funding:



HORIZON 2020

OPTICON-RADIONET PILOT GRANT

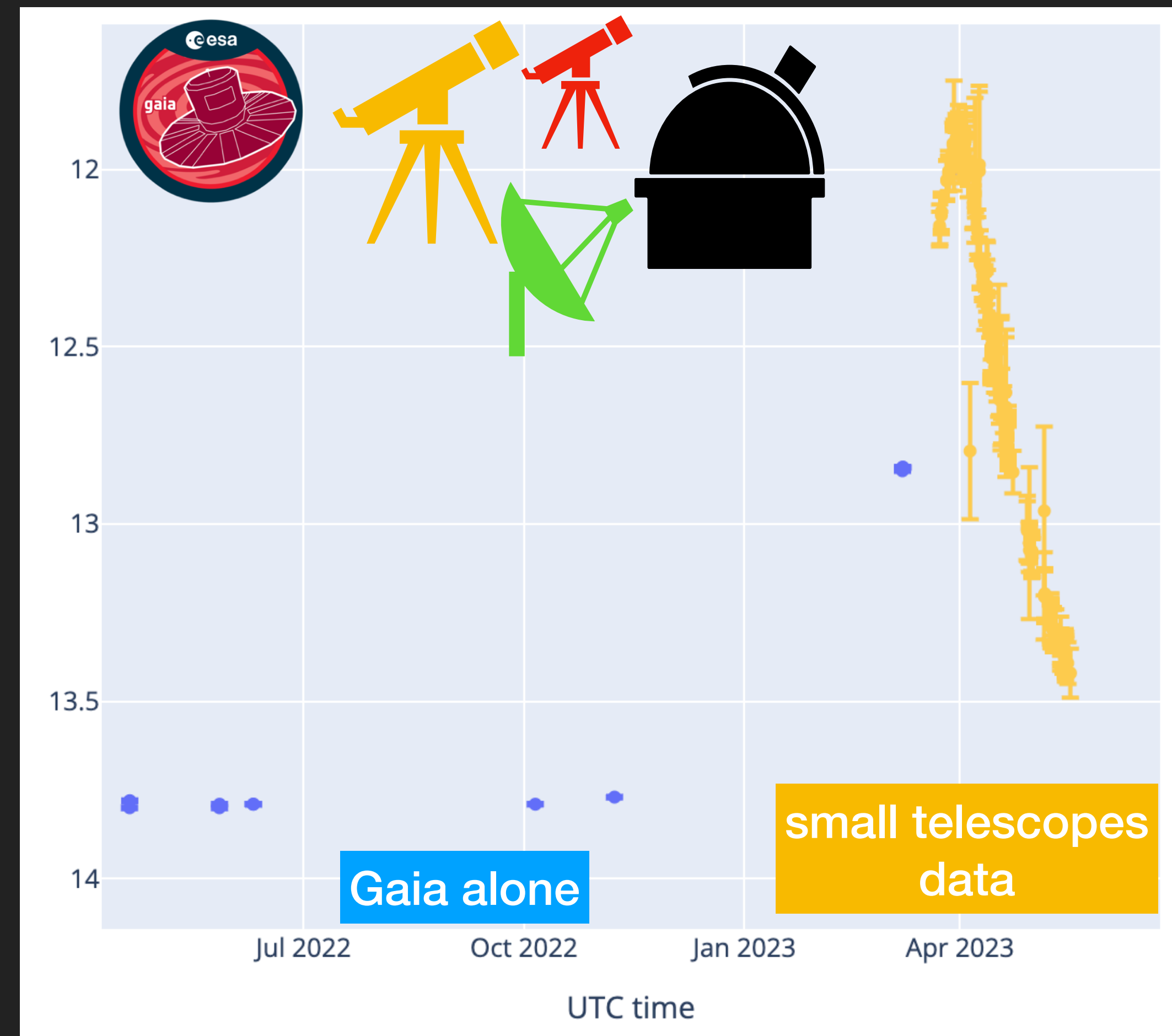
<https://www.orp-h2020.eu/>

- ▶ 15 M€ from EC H2020 for 2021-2025.02
- ▶ transnational access to optical and radio telescopes and excellence centres (VLTi)
- ▶ training via schools and workshops
- ▶ improvement of observing services and data access
- ▶ harmonisation of observing requests and proposal tools
- ▶ virtual access to facilities via coordinated hubs in time-domain



SMALL TELESCOPE FOR BIG SCIENCE

- ▶ part of OPTICON since 2013
- ▶ there are hundreds of small telescopes (0.3-2m) around the world
- ▶ owned by universities, research institutes, outreach institutions, private
- ▶ easy and cheap to buy, but hard to operate and use efficiently
- ▶ about 100 small telescopes have donated their observing time to our system for time-domain observations, primarily for Gaia microlensing events
- ▶ BHTOM system started in 2020 based on LCO's TOM Toolkit



BHTOM TELESCOPE NETWORK

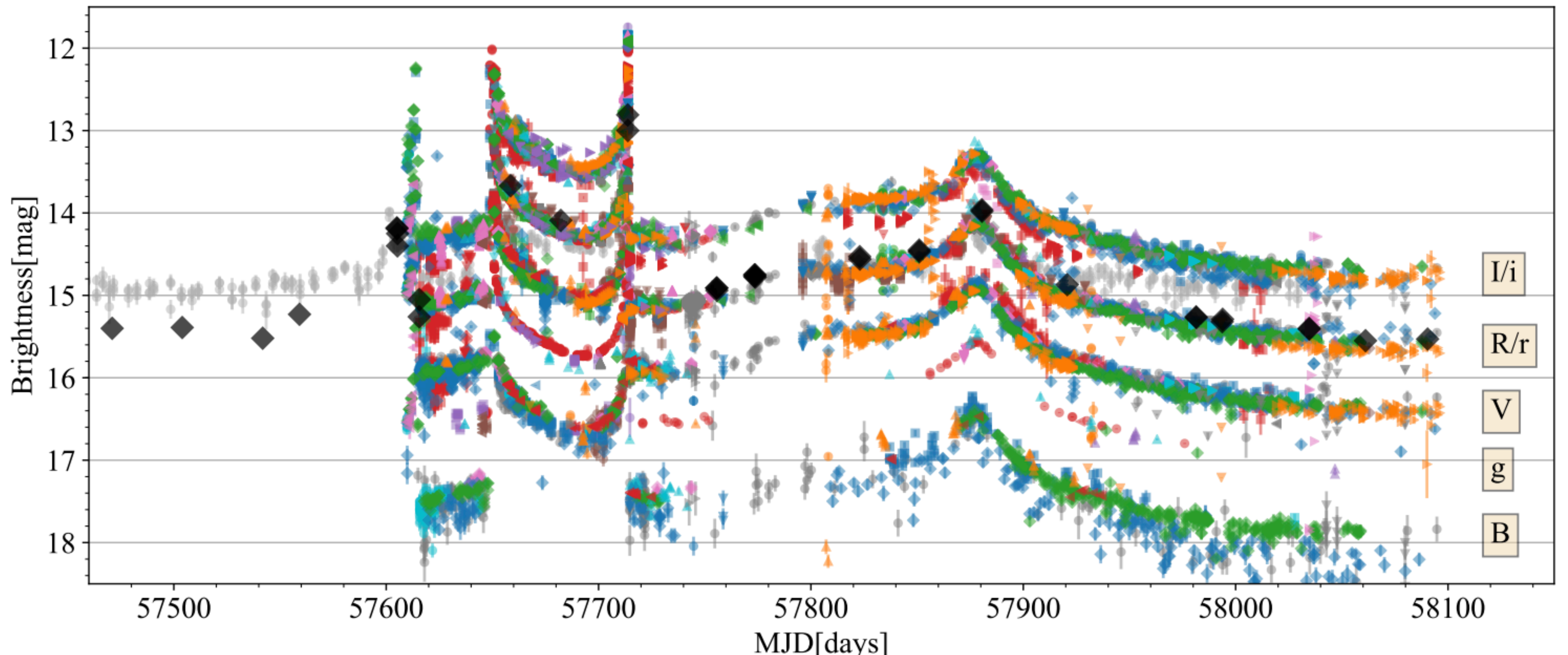
▶ since 2013, built for Gaia Alerts



UP TO 1.0 m (53) 1.0-2.0 m (21) 2.0+ m (5) 80 OPTICAL | 3 INFRARED

BHTOM TELESCOPE NETWORK

▶ since 2013, built for Gaia Alerts



UP TO 1.0 m (53) 1.0-2.0 m (21) 2.0+ m (5) 80 OPTICAL | 3 INFRARED



This is our telescope :)



Ostrowik 60-cm telescope founded in 1973



This is our
telescope :)



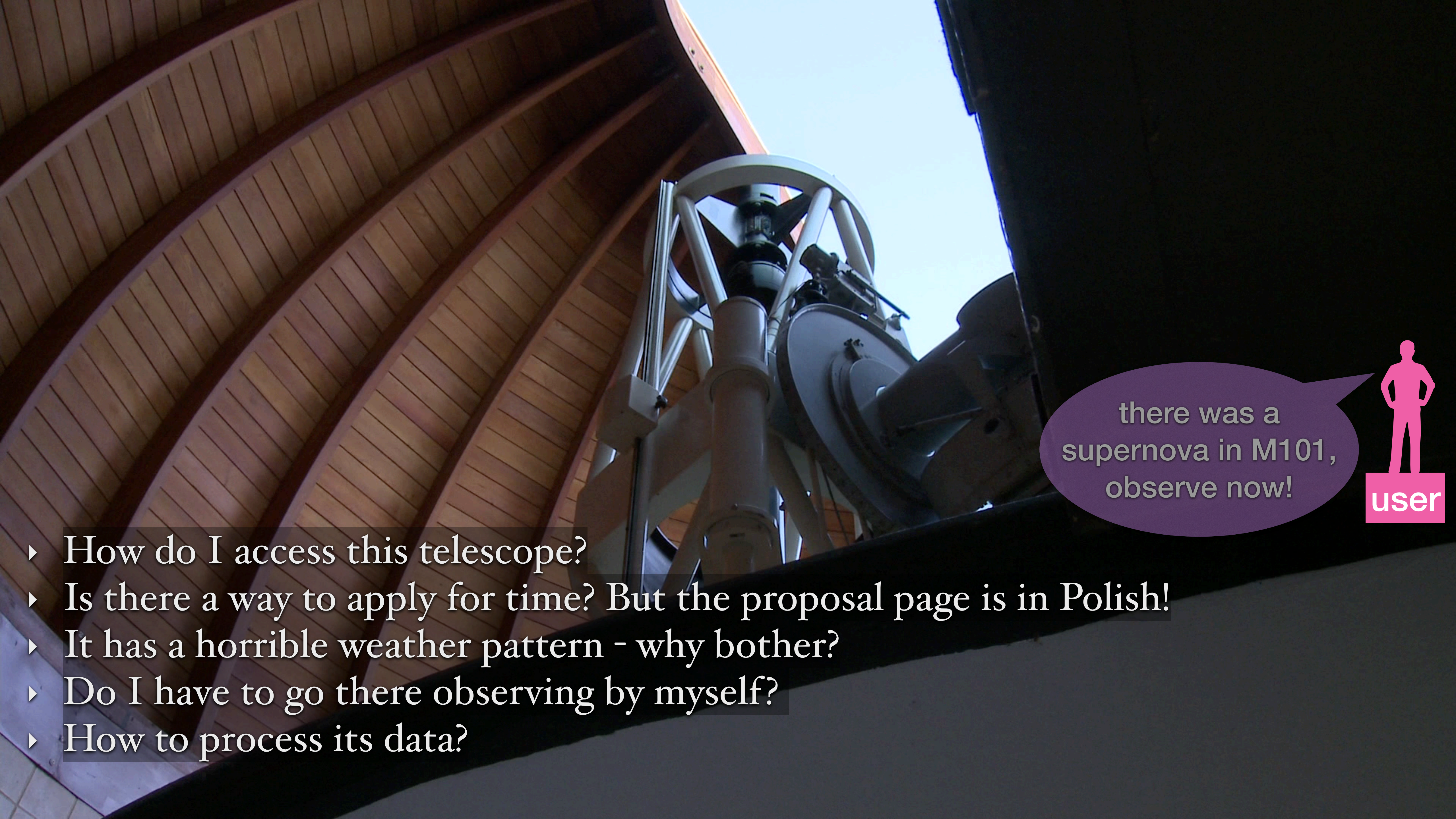
- ▶ What can I use my telescope for?
- ▶ I only have 30 clear nights a year... Let's close it and sell the forest...
- ▶ I can go observing any time but don't know what to observe
- ▶ I can process its data in an automated fashion
- ▶ My students use the telescope for their training but they lack ideas what to observe
- ▶ I need to justify the existence of the telescope with publications

Ostrowik 60-cm telescope founded in 1973



there was a
supernova in M101,
observe now!



- 
- ▶ How do I access this telescope?
 - ▶ Is there a way to apply for time? But the proposal page is in Polish!
 - ▶ It has a horrible weather pattern - why bother?
 - ▶ Do I have to go there observing by myself?
 - ▶ How to process its data?

there was a
supernova in M101,
observe now!



user

MICROLENSING EVENTS DISCOVERED BY GAIA DATA 2014-2018

please
observe Gaia20fnr
event for 1 year



user



MICROLENSING EVENTS DISCOVERED BY GAIA DATA 2014-2018

please
observe Gaia20fnr
event for 1 year

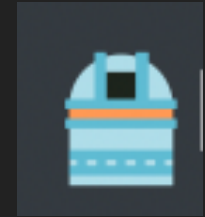


user



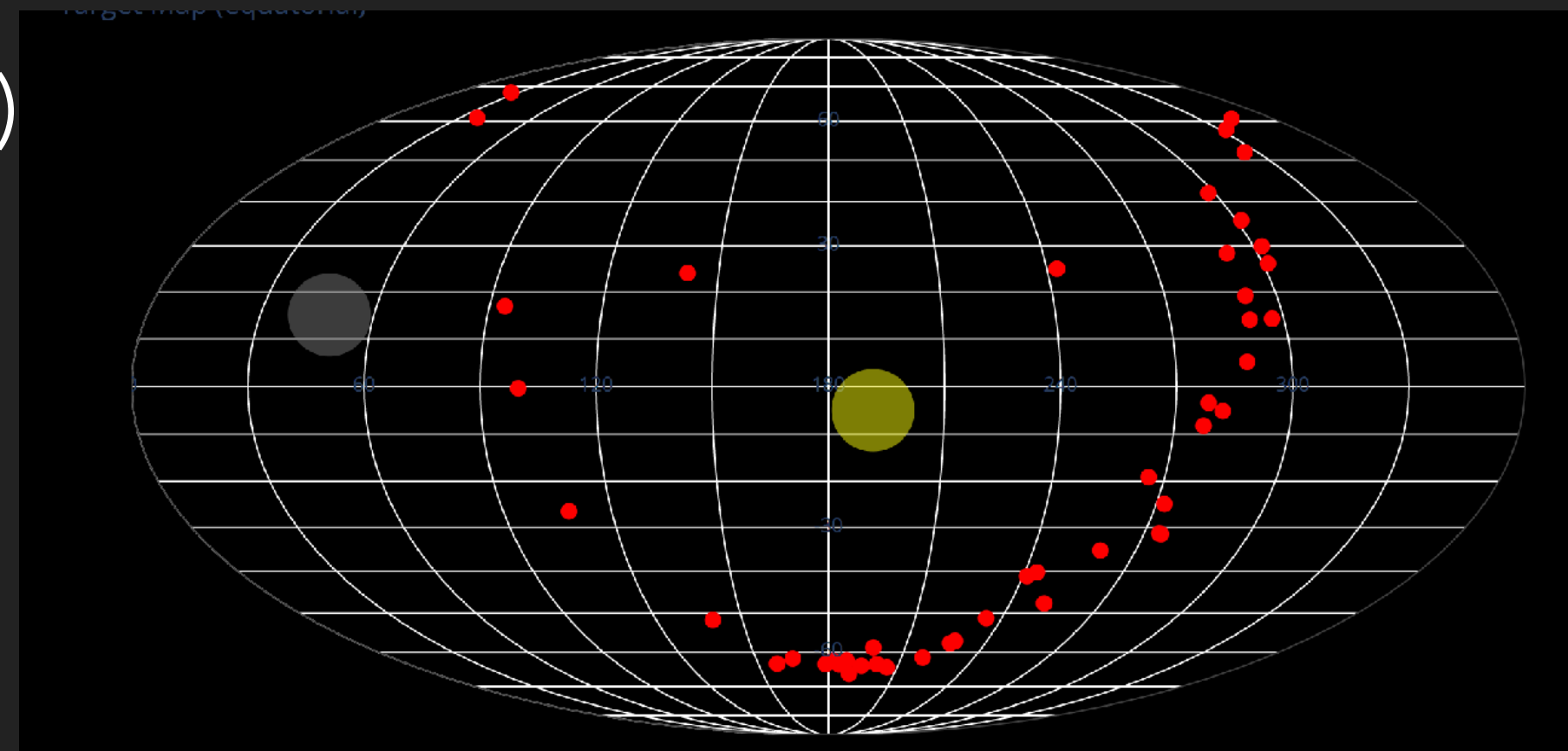
- ▶ I need a long-term multi-wavelength time-domain data for my target
- ▶ I don't have access to any Southern telescopes.
- ▶ No one is going to give me observing time for one target for 1 year!
- ▶ I don't have time to process thousands of images from different telescopes!
- ▶ I am going to write a paper on this target

BHTOM V.1 (2021-2023)



<https://bhtom.space>

- ▶ coordination of long-term monitoring of targets
- ▶ processing of raw images (PSF photometry)
- ▶ automated standardisation (to GaiaSP)
- ▶ automated observation requests



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Event	Name/Aliases	RA	Dec	Number of Observations	Last Gaia [mag]	Target Importance	Time from last obs [days]	Required Cadence [days]	Observing Priority	Sun distance [deg]
■	Gaia18cbf	241.1619	-41.10483	3164	20.13	10.0	29.9	1.0	299.1	64
■	Gaia20azc	242.75086	25.00718	444	20.83	5.0	54.1	1.0	270.6	62
■	Gaia20bof	184.61816	-63.49726	10852	15.7	8.0	13.9	0.5	223.0	61
■	Gaia19dak	302.36516	29.93588	3316	18.98	9.0	24.3	1.0	219.1	115
■	Gaia20cek	343.03385	60.66898	3333	12.46	10.0	16.1	1.0	160.6	119
■	Gaia20bgu	205.559	-64.31565	92	16.57	9.0	11.9	1.0	107.4	64
■	Gaia19cnm	227.93683	-57.0571	5396	18.03	10.0	9.4	1.0	94.3	65

Gaia20azc

Update Delete List Fits

Names: Gaia20azc
 Target Type: SIDEREAL
 Right Ascension: 242.75086
 Declination: 25.00718
 Epoch: 2000.0

gala_alert_name: Gaia20azc
 calib_server_name: ivor//Gaia20azc
 ztf_alert_name: ZTF18abjndpj
 galadr2_id: rapidly changing blazar/quasar
 tweet: False
 jdlastobs: 2459073.7281134
 maglast: 20.83
 priority: 5.0
 dicoverry_date: 1.0
 cadence: 1.0
 Sun_separation: 62.112924142328666

Photometry Spectroscopy Upload Observe Observations Data

Photometry Check for new data



BHTOM V.2 FROM OCTOBER 2023

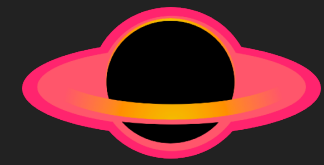


<https://bhtom.space>

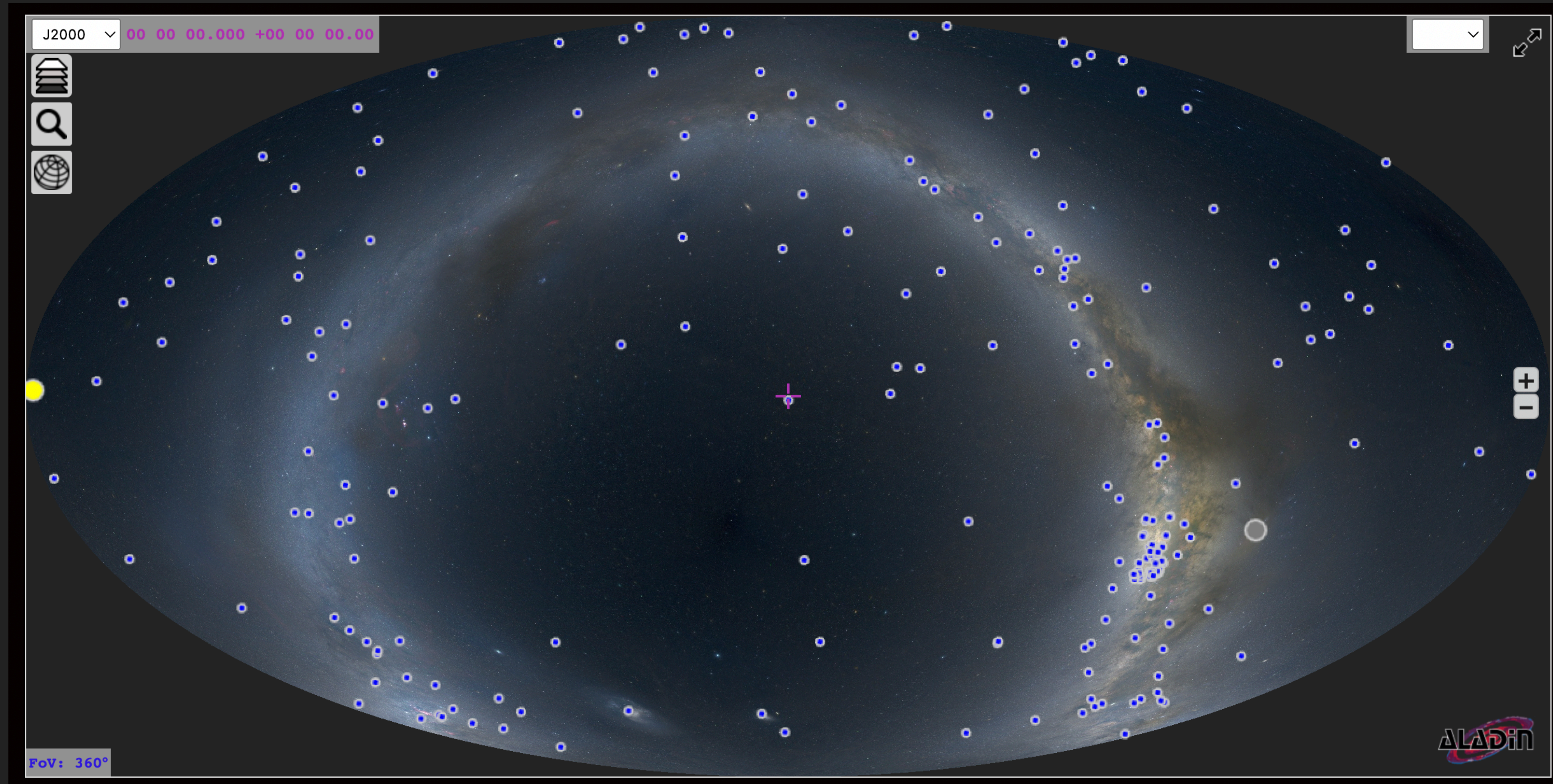
- ▶ re-designed to work faster (docker, kafka)
- ▶ access to the vast number of archives
- ▶ facilitates preparing publications (AI-assisted)
- ▶ customizable for users, private filters, targets



///AkondLab.



<https://bhtom.space>



BHTOM – PRIORITIZATION OF TARGETS



Any time-domain target can be added! Transients, variable stars, etc.

<input type="checkbox"/>	Names	RA	Dec	Nobs	Last Gmag	Last Filter	Importance	Created	Priority	Sun	Class
<input type="checkbox"/>	Gaia18acq	22:05:42.324	+03:39:17.064	982	20.2	Gaia/r	9.99	2023-09-18 10:09:17	799.0	155	long_period_variable
<input type="checkbox"/>	Gaia22bpl	10:38:42.425	-61:15:49.680	903	12.7	Gaia/r	9.99	2023-09-18 10:09:48	208.6	64	microlensing_event
<input type="checkbox"/>	Gaia22awa	19:04:51.962	-08:34:00.660	1602	15.0	Gaia/r	9.99	2023-09-17 21:09:11	770.1	111	microlensing_event
<input type="checkbox"/>	ZTF19abflrit	18:24:23.314	-24:36:42.053	842	15.2	Gaia/r	0.0	2023-09-19 11:09:02	0.0	100	long_period_variable

Targets from:

- Gaia Alerts
- OGLE EWS
- TNS
- ANTARES
- Simbad
- NED
- JPL Horizons

BHTOM – ARCHIVES



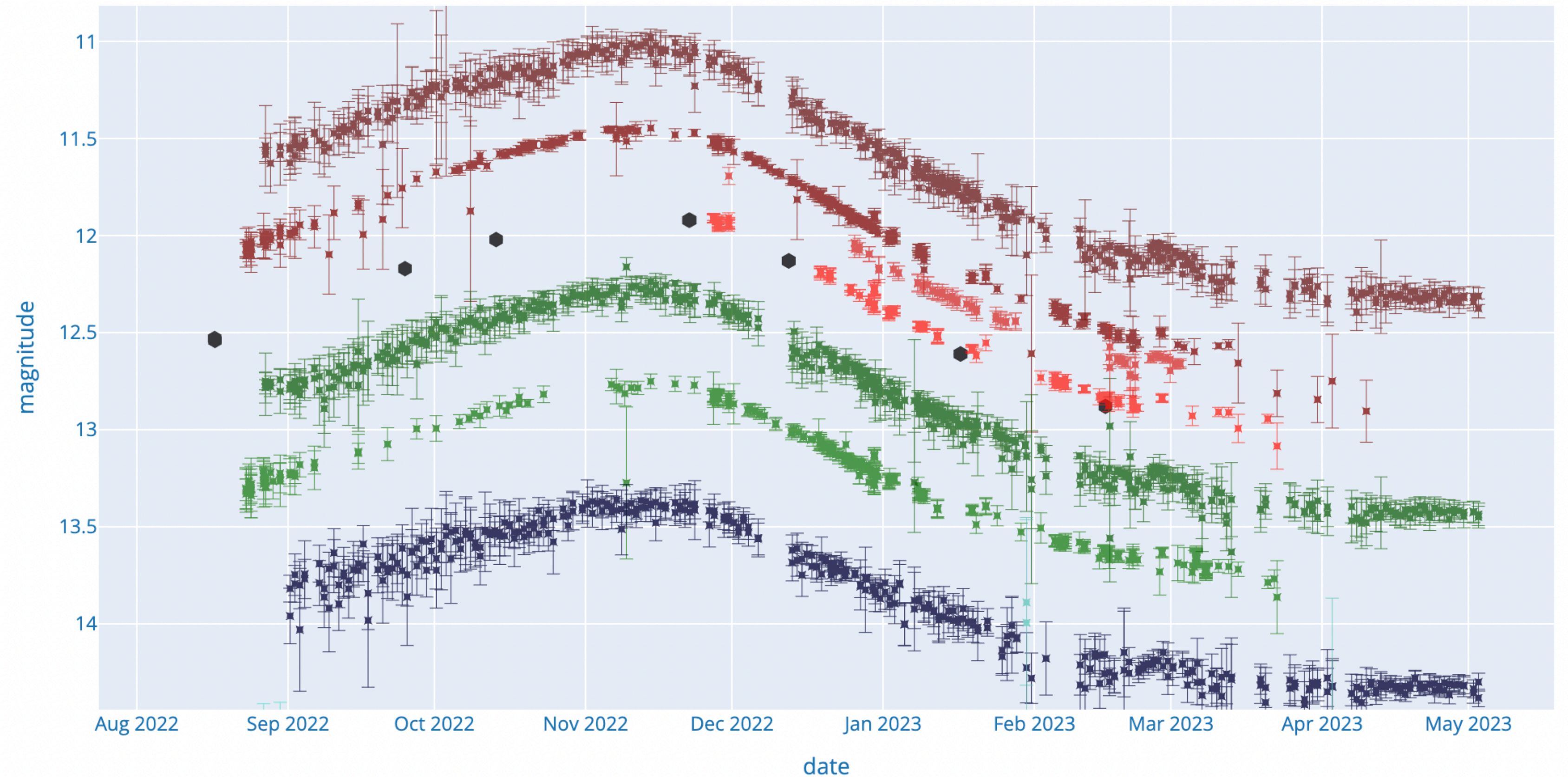
- ▶ automated harvesting archival time-domain data
- ▶ only public
- ▶ ZTF
- ▶ NEOWISE+ALLWISE
- ▶ LINEAR, CRTS
- ▶ Gaia DR3
- ▶ Gaia Alerts
- ▶ SDSS, PS1, DECAPS
- ▶ ATLAS almost there
- ▶ OGLE EWS almost there
- ▶ KMT NET almost there
- ▶ DASH - Harvard photographic plates TBA



BHTOM – FITS PROCESSING

- ▶ CCDPhot - the engine
- ▶ combination of SExtractor Daophot and Scamp
- ▶ manual set-up per instrument
- ▶ automated processing, 99% successful
- ▶ slow (minutes)
- ▶ upload can be scripted

Gaia22dkv -planetary microlensing event



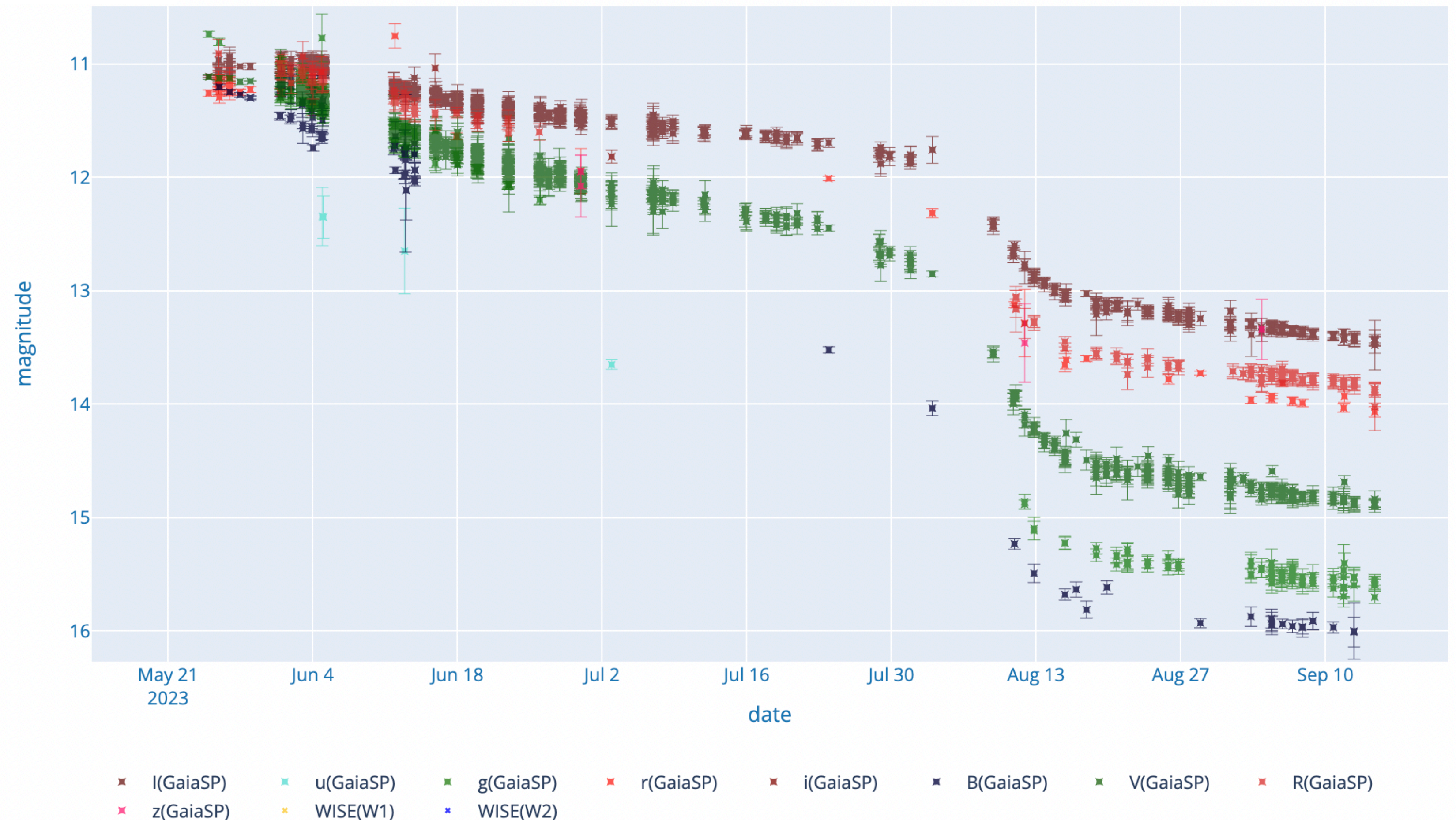
★ WISE(W2) ★ WISE(W1) ● GSA(G) ★ g(GaiaSP) ★ i(GaiaSP) ★ B(GaiaSP) ★ V(GaiaSP) ★ u(GaiaSP)
★ l(GaiaSP) ★ U(GaiaSP) ★ r(GaiaSP) ★ R(GaiaSP)

BHTOM – STANDARDISATION



- ▶ instrumental data from users or from CCDPhot
- ▶ automated standardisation to Gaia Synthetic Photometry
- ▶ formerly run as: Cambridge Photometric Calibration Server (CPCS, Zielinski+ 2019)

SN2023ixf



BHTOM – MODELS



- ▶ automated models for data
- ▶ interactive selection of data
- ▶ standard microlensing
- ▶ parallax microlensing
- ▶ planned:
peak detection
TDE

Microensing parallax model for Gaia21azb

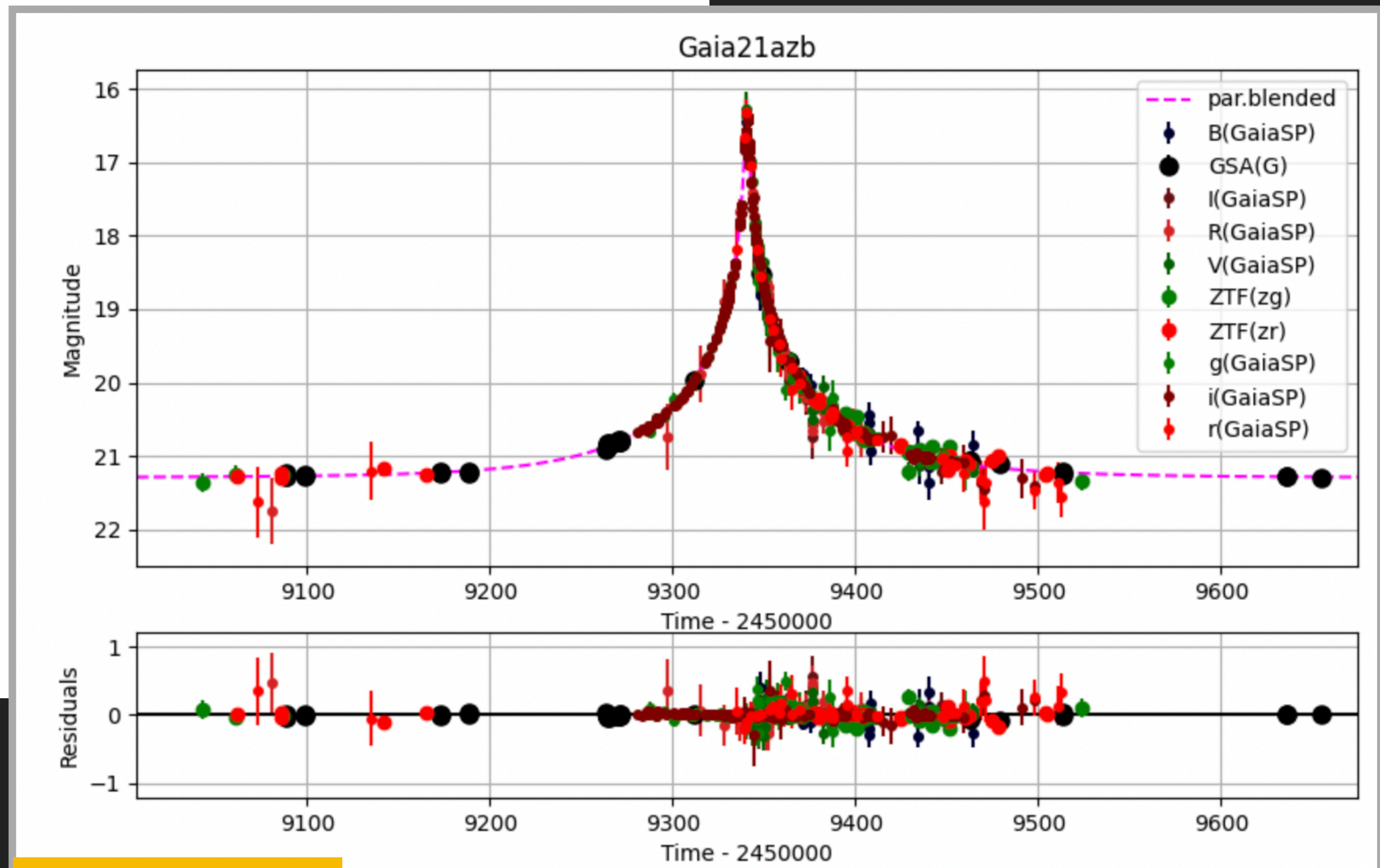
Gravitational microlensing model with parallax using MulensModel (Poleski&Yee 2018)

Fit initial values:

t0: u0: tE: piEN: piEE: logu0: fixblending:
auto_init:

Available filters and number of datapoints:

-
- ASASSN(V) 57
 - ASASSN(g) 1172
 - B(GaiaSP) 39
 - GSA(G) 158
 - I(GaiaSP) 66
 - PS1(g) 1
 - PS1(i) 1
 - PS1(r) 1
 - PS1(z) 1
 - R(GaiaSP) 82
 - V(GaiaSP) 68
 - ZTF(zg) 31
 - ZTF(zr) 38
 - g(GaiaSP) 140
 - i(GaiaSP) 592
 - r(GaiaSP) 41
 - u(GaiaSP) 1
 - z(GaiaSP) 6
 - WISE(W1) 31
 - WISE(W2) 25



ASV data here

BHTOM – API



<https://bhtom.space>

- all functionalities of BHTOM available programmatically!
- upload (fits, dat, spec)
- target list and filtering
- data download
- standardisation results

BHTOM2 API Documentation [↗](#)

Introduction [↗](#)

This is a simple guide for BHTOM's REST API. It lets you use BHTOM webpage features in your own programs. You can get a list of targets, add observations, download data and more. Let's get started!

Remember! To use API you should get your own TOKEN first!

1. AUTHORIZATION API: [/api/token-auth/](#) [↗](#)

Description [↗](#)

The `token-auth` API provides a method for users to obtain an authentication token by submitting their `username` and `password`. Once you have acquired this token, it allows you to access and utilize all other available APIs.

Endpoint [↗](#)

- Method: POST
- URL: `/api/token-auth/`

docs.bhtom.space

BHTOM – PUBLICATION



Photometry Models Spectroscopy Observe Observations **Publication** Manage Data Manage Groups

Generate LaTeX target description

Photometry Stats

Facility	Filters	Number	Min MJD	Max MJD
ALLWISE	WISE(W1), WISE(W2)	41	55369.64	55556.85
CRTS	CRTS(CL)	284	53479.24	56476.45
Gaia Alerts	GSA(G), G(GAIA_ALERTS)	270	56882.22	59948.55
NEOWISE	WISE(W1), WISE(W2)	461	56656.33	59739.5
PS1	PS1(g), PS1(r), PS1(i), PS1(z)	4	55727.28	56137.46
ZTF	ZTF(zg), ZTF(zr), ZTF(zi)	353	58203.3	60064.27

Download photometry stats as LaTeX table

Gaia Archive parameters

Parameter	GDR2	GDR3
parallax [mas]	-0.748±0.48	-0.469±0.4
PM RA [mas/yr]	-0.664±1.144	-0.113±0.502
PM Dec [mas/yr]	-0.186±0.546	0.012±0.349
RUWE / AEN [mas]	1.021 / 0.716	1.026 / 0.85
Dist_med_geo [kpc]	-	3.392

Generate LaTeX description for Gaia21fkl

ChatGPT-generated title:

"Puppis-Powered: Unlocking the Mysteries of Gaia21fkl's Black Hole Candidate!"

Copy/paste to your paper

Prompt used for the title

Suggest a catchy title about a black hole candidate found with microlensing named Gaia21fkl, found in the constellation Puppis.

ChatGPT-generated LaTeX target description:

Gaia21fkl was discovered by \textit{Gaia} Science Alerts (GSA) on 2021-12-03 18:50 (MJD = 59551.78491) and was made available on the GSA website \footnote{\href{http://gsaweb.ast.cam.ac.uk/alerts/alert/Gaia21fkl/}{http://gsaweb.ast.cam.ac.uk/alerts/alert/Gaia21fkl/}}. Transient name server designations for this event are Gaia21fkl (GAIA_ALERTS) 5712117323266396544 (GAIA_DR3) NEOWISE+J116.61824_-21.87556 (NEOWISE) CRTS+J116.61824_-21.87556 (CRTS) PS1_81741166182359645 (PS1). It has equatorial coordinates RA, Dec(J2000.0)= 07:46:28.378, -21:52:32.016 and galactic coordinates $l, b = 238.551541, 1.520389$ in the constellation Puppis. A finding chart with the event's

Copy/paste to your paper

Prompt used

Rephrase and keep LaTeX: \quad Gaia21fkl({tns} according to the IAU transient name server) Gaia21fkl was discovered by \textit{Gaia} Science Alerts (GSA) on 2021-12-03 18:50 (MJD = 59551.78491) and was posted on the GSA website \footnote{\href{http://gsaweb.ast.cam.ac.uk/alerts/alert/Gaia21fkl/}{http://gsaweb.ast.cam.ac.uk/alerts/alert/Gaia21fkl/}}. Other surveys' names include: Gaia21fkl(GAIA_ALERTS) 5712117323266396544(GAIA_DR3) NEOWISE+J116.61824_-21.87556(NEOWISE) CRTS+J116.61824_-21.87556(CRTS) PS1_81741166182359645(PS1) . The event was located at equatorial coordinates RA, Dec(J2000.0)= 07:46:28.378, -21:52:32.016 and galactic coordinates $l, b = 238.551541, 1.520389$ in constellation Puppis. The finding chart with the



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Advance Access publication 2022 July 12
<https://doi.org/10.1093/mnras/stac1915>

Photometric and spectroscopic study of the burst-like brightening of two Gaia-alerted young stellar objects

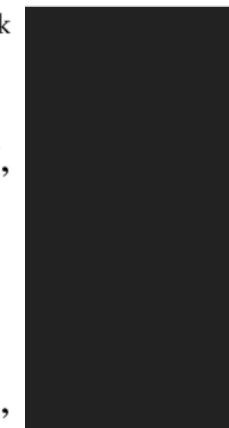
Zsófia Nagy^{1,2*}, Péter Ábrahám^{1,2,3}, Ágnes Kóspál^{1,2,3,4}, Sunkyung Park^{1,2}, Michał Siwak^{1,2}, Fernando Cruz-Sáenz de Miera^{1,2}, Eleonora Fiorellino^{1,2,5}, David García-Álvarez^{6,7}, Zsófia Marianna Szabó^{1,2,8,9}, Simone Antonucci⁵, Teresa Giannini⁵, Alessio Giunta¹⁰, Levente Kriskov Mária Kun^{1,2}, Gábor Marton^{1,2}, Attila Moór^{1,2}, Brunella Nisini⁵, Andras Pál^{1,2,3}, László Szaba Paweł Zieliński¹¹ and Łukasz Wyrzykowski¹²

THE ASTROPHYSICAL JOURNAL, 899:130 (8pp), 2020 August 20
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Gaia 18dvy: A New FUor in the Cygnus OB3 Association

E. Szegedi-Elek¹, P. Ábrahám^{1,2}, Ł. Wyrzykowski³, M. Kun¹, Á. Kóspál^{1,2,4}, L. Chen¹, G. Marton^{1,2}, A. Moór^{1,2}, C. Kiss^{1,2}, A. Pál^{1,2,5}, L. Szabados¹, J. Varga^{1,6}, E. Varga-Verebélyi¹, C. Andreas⁷, E. Bachelet⁸, R. Bischoff⁷, A. Bódi^{1,9}, E. Breedt¹⁰, U. Burgaz^{11,12}, T. Butterley¹³, J. M. Carrasco¹⁴, V. Čepas¹⁵, G. Damljanić¹⁶, I. Gezer³, V. Godunova¹⁷, M. Gromadzki³, A. Gurgul³, L. Hardy¹⁸, F. Hildebrandt⁷, S. Hoffmann⁷, M. Hundertmark¹⁹, N. Ihanec³, R. Janulis¹⁵, Cs. Kalup¹, Z. Kaczmarek³, R. Könyves-Tóth¹, M. Krezinger¹, K. Kruszyńska³, S. Littlefair¹⁸, M. Maskoliūnas¹⁵, L. Mészáros¹, P. Mikołajczyk²⁰, M. Mugrauer⁷, H. Netzel²¹, A. Ordasi¹, E. Pakštienė¹⁵, K. A. Rybicki³, K. Sármeczky¹, B. Seli¹, A. Simon²², K. Šiškauskaitė¹⁵, Á. Sódor¹, K. V. Sokolovsky^{23,24,25}, R. Szakáts¹, L. Tomasella²⁶, Y. Tsapras¹⁹, K. Vida^{1,2}, J. Zdanavičius¹⁵, M. Zieliński³, P. Z

CrossMark



Single lens mass measurement in the high magnification microlensing event Gaia19bld located in the Galactic Disk

K. A. Rybicki,^{1*} Ł. Wyrzykowski,¹ E. Bachelet,² A. Cassan,³ P. Zieliński,¹ A. Gould,^{4,5} S. Calchi Novati,⁶ J.C. Yee,⁷ Y.-H. Ryu,⁸ M. Gromadzki,¹ P. Mikołajczyk,⁹ N. Ihanec,¹ K. Kruszyńska,¹ F.-J. Hambsch,^{10,11} S. Zola,¹² S. J. Fossey,¹³ S. Awiphan,¹⁴ N. Nakharutai,¹⁵ F. Lewis,^{16,17} F. Olivares E.,¹⁸ S. Hodgkin,¹⁹ A. Delgado,¹⁹ E. Breedt,¹⁹ D. L. Harrison,^{19,20} M. van Leeuwen,¹⁹ G. Rixon,¹⁹ T. Wevers,¹⁹ A. Yoldas,¹⁹ A. Udalski,¹ M. K. Szymański,¹ I. Soszyński,¹ P. Pietrukowicz,¹ S. Kozłowski,¹ J. Skowron,¹ R. Poleski,¹ K. Ulaczyk,^{21,1} P. Mróz,^{1,22} P. Iwanek,¹ M. Wrona,¹ R.A. Street,² Y. Tsapras,²³ M. Hundertmark²⁴, Gaudi,⁵ C. Henderson,⁶ Y. Shvartzvald,²⁵ W. Zang Vanaverbeke¹⁶, R. W. Wilson²⁹, M. Zejmo²⁴, S. Zola²⁸,

AT2021uey: A planetary microlensing event outside the Galactic bulge

Ban, M.¹, Voloshyn, P.^{2,3}, Adomavičienė, R.⁴, Bachelet, E.^{5,6}, Bozza, V.^{7,8}, Brincat, S. M.⁹, Bruni, I.¹⁰, Burgaz, U.¹¹, Carrasco, J. M.¹², Cassan, A.⁵, Čepas, V.⁴, Dominik, M.¹³, Dubois, F.¹⁴, Figuera Jaimes, R.¹⁵, Fukui, A.^{16,17}, Galdies, C.^{18,19}, Garofalo, A.¹⁰, Hundertmark, M.²⁰, Kruszyńska, K.¹, Kulijanishvili, V.²¹, Kvernadze, T.²¹, Logie, L.¹⁴, Maskoliūnas, M.⁴, Mikołajczyk, P. J.^{1,22}, Mróz, P.¹, Narita, N.^{16,17,23}, Pakštienė, E.⁴, Peloton, J.³, Poleski, R.¹, Qvam, J. K. T.²⁴, Rau, S.¹⁴, Rota, P.^{7,8}, Rybicki, K. A.^{1,25}, Street, R. A.²⁶, Tsapras, Y.²⁰, Vanaverbeke, S.¹⁴, Wambsganss, J.²⁰, Wyrzykowski, Ł.¹, Zdanavičius, J.⁴, and Zieliński, P.²⁷

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

Łukasz Wyrzykowski^{1,2,3*}, P. Mróz¹, K. A. Rybicki¹, M. Gromadzki¹, Z. Kolaczynski^{4,5,7,9}, M. Zieliński¹, P. Zieliński¹, N. Britavskiy^{4,15}, A. Gomboc³⁵, K. Sokolovsky^{19,31,66}, S.T. Hodgkin⁶, L. Abe⁸⁹, G.F. Aldi^{20,80}, A. AlMannae^{62,100}, G. Altavilla^{72,7}, A. Al Qasbi^{62,100}, G.C. Anupama⁸, S. Awiphan⁹, E. Bachelet⁶³, V. Bakaj¹⁰, S. Baker¹⁰⁰, S. Bartlett⁵⁰, P. Bendjoya¹¹, K. Benson¹⁰⁰, I.F. Bikmacv^{76,87}, G. Birenbaum¹², N. Blagorodnova²⁴, S. Blanco-Cuaresma^{15,74}, S. Boeva¹⁶, A.Z. Bonanos¹⁹, V. Bozza^{20,80}, D.M. Bramich⁶², I. Bruni²⁵, R.A. Burenin^{84,85}, U. Burgaz²¹, T. Butterley²², H. E. Caines³⁴, D. B. Caton⁹³, S. Calchi Novati⁸³, J.M. Carrasco²³, A. Cassan²⁹, V. Čepas⁵⁶, M. Cropper¹⁰⁰, M. Chruślińska^{11,24}, G. Clementini²⁵, A. Clerici³⁵, D. Cont⁹¹, M. Conti²⁴⁸, S. Cross⁶³, F. Cusano²⁵, G. Damjanovic²⁶, A. Danersolas¹⁹, G. D'Agostini⁸¹, I. H. J. de Bruijne²⁷, M. Dennefeld²⁹, V. S. Dhillon^{30,4}, M. Dominik³¹, S. J. Fossey³⁴, A. I. anowicz^{11,36}, C. Han², B. rden¹⁰³, V. L. Hoete⁹⁵, K. I. Itoh⁴³, P. Iwanek¹, Khamitov^{44,76}, Y.Kilic³², J. G. Latev¹⁶, C.-H. Lee^{17,18}, J. Manser⁵², S. Mao⁵³, D. itjes¹⁰³, S. S. Melnikov^{76,87}, S. M. Natarov⁹⁰, H. laversa^{6,74}, A. Pandey⁹⁹, E. 96,197, J. K. T. Qvam⁹⁸, C. 89, G. Rixon⁶, D. Roberts⁴⁷, shappee⁶⁹, R. Schmid⁴¹, Y. es³⁴, B. van Soelen¹⁰³, Z. T. I. Szegedi¹⁰³, L. M. Tinjaca ambsganss^{11,42}, I. P. van der A. Zubareva^{73,3}, D. G. Zhukov⁷⁶, J.

Lens mass estimate in the Galactic disk extreme parallax microlensing event Gaia19dke

M. Maskoliūnas¹, Ł. Wyrzykowski², K. Howl², K. A. Rybicki², P. Zieliński³, Z. Kaczmarek⁴, K. Kruszyńska², M. Jabłońska², J. Zdanavičius¹, E. Pakštienė¹, V. Čepas¹, P. J. Mikołajczyk^{2,8}, R. Janulis¹, M. Gromadzki², N. Ihanec², R. Adomavičienė¹, K. Šiškauskaitė¹, M. Bronikowski^{2,7}, P. Sivak², A. Stankevičiūtė², M. Sitek², M. Ratajczak², U. Pylypenko², I. Gezer⁵, S. Awiphan⁹, E. Bachelet¹⁰, K. Bąkowska³, R. P. Boyle¹², V. Bozza^{32,33}, S. M. Brincat¹³, U. Burgaz¹¹, T. Butterley²⁹, J. M. Carrasco¹⁴, A. Cassan³⁸, F. Cusano¹⁵, G. Damljanić⁶, V. S. Dhillon²², M. Dominik³⁹, F. Dubois¹⁶, H. H. Esenoglu¹⁷, R. Figuera Jaimes³⁴, A. Fukui¹⁹, C. Galdies²⁰, A. Garofalo¹⁵, V. Godunova²¹, T. Güver^{17,18}, J. Heidt²², M. Hundertmark³⁶, I. Izviakova³, B. Joachimczyk³, M.K. Kamińska³⁹, K. Kamiński³⁹, S. Kaptan^{17,18}, T. Kvernadze²⁴, O. Kvaratskhelia²⁴, S. Littlefair²², O. Michniewicz²⁴, N. Nakhatutai³⁵, W. Ogłóżca⁴², J. M. Olszewska³⁹, M. Polińska³⁹, A. Popowicz²⁵, J. K. T. Qvam²⁶, M. Radziwonowicz², A. Słowikowska^{37,3}, A. Simon^{30,31}, E. Sonbas^{40,41}, M. Stojanovic⁶, Y. Tsapras³⁶, S. Vanaverbeke¹⁶, R. W. Wilson²⁹, M. Zejmo²⁴, S. Zola²⁸,

SN 2018zd: An Unusual Stellar Explosion as Part of the Diverse Type II Supernova Landscape

Jujia Zhang,^{1,2,3,4*} Xiaofeng Wang,^{5,6} József Vinkó^{7,8,9} Qian Zhai,^{1,2,3,4} Tianmeng Zhang,¹⁰ Alexei V. Filippenko,^{12,13} Thomas G. Brink,¹² WeiKang Zheng,¹² Łukasz Wyrzykowski,¹⁴ Przemysław Mikołajczyk,¹⁴ Fang Huang,¹⁵ Xinhan Zhang,⁵ Huijuan Wang,^{10,11} James A. Bódi,^{7,18} G. Csörnyei,^{7,8} O. Hanyecz,⁷ I. R. Könyves-Tóth,^{7,8} A. Ordasi,⁷ A. Pál,^{7,8} G. Zsidi^{7,8,19}

The Gaia alerted fading of the FUor-type star Gaia21elv

Zsófia Nagy,^{1,2*} Sunkyung Park,^{1,2} Péter Ábrahám,^{1,2,3} Ágnes Kóspál,^{1,2,3,4} Fernando Cruz-Sáenz de Miera,^{1,2} Mária Kun,^{1,2} Michał Siwak,^{1,2} Zsófia Marianna Szabó,^{1,2,5,6} Máté Szilágyi,^{1,2,3} Eleonora Fiorellino,⁷ Teresa Giannini,⁸ Jae-Joon Lee,⁹ Jeong-Eun Lee,¹⁰ Gábor Marton,^{1,2} László Szabados,^{1,2} Fabrizio Vitali,⁸ Jan Andrzejewski,¹¹ Mariusz Gromadzki,¹² Simon Hodgkin,¹³ Maja Jabłońska,¹² Rene A. Mendez,¹⁴ Jaroslav Merc,¹⁵ Olga Michniewicz,¹¹ Przemysław J. Mikołajczyk,^{12,16} Uliana Pylypenko,¹² Milena Ratajczak,¹² Łukasz Wyrzykowski,¹² Michal Zejmo,¹¹ Paweł Zieliński¹⁷

6 more submitted or in prep.

WORKSHOPS SINCE 2010



GAIA SCIENCE ALERTS WORKSHOP

Wednesday 29 June - Friday 1 July 2011, at the Institute of Astronomy, University of Cambridge

DETAILS AND REGISTRATION
<http://www.ast.cam.ac.uk/low/Research/GaiaAlerts>

GAIA SCIENCE ALERTS WORKSHOP

For more information e-mail: gsawg@ast.cam.ac.uk
 © 2011 Institute of Astronomy, Madingley Road, Cambridge CB3 0H4. Telephone: +44 (0)1223 337348



Gaia Science Alerts Verification and Follow-up Workshop
 Wednesday 29 June - Friday 1 July 2011, at the Institute of Astronomy, University of Cambridge

DETAILS AND REGISTRATION
<http://www.ast.cam.ac.uk/low/Research/GaiaAlerts>

For more information e-mail: gsawg@ast.cam.ac.uk
 © 2011 Institute of Astronomy, Madingley Road, Cambridge CB3 0H4. Telephone: +44 (0)1223 337348



GAIA SCIENCE ALERTS WORKSHOP
 BOLOGNA 6-7 SEPTEMBER 2012

Astronomical Observatory of Bologna

GAIA SCIENCE ALERTS WORKSHOP
 BOLOGNA 6-7 SEPTEMBER 2012

Registration deadline: 15 August. Contact: gsaw2012@unibo.it

Further details at: <http://www.ast.cam.ac.uk/low/wikis/gsaawg/wiki/index.php?title=Workshop2012main>



Gaia Science Alerts

Workshop Organising Committee:
 Łukasz Wyrzykowski
 Simon Hodgkin
 Gerry Gilmore
 Nicholas Walton
 Szymon Kozłowski
 Heather Campbell
 Morgan Fraser
 Nadejda Blagoderova



FIFTH GAIA SCIENCE ALERTS WORKSHOP
 UNIVERSITY OF WARSAW 9-12 SEPTEMBER 2014

DETAILS AND REGISTRATION: <http://www.astrow.edu.pl/gaiaawg2014>

Status of Gaia
 First Alerts and preliminary results from the Verification Phase | Gaia alerts follow-up campaigns | Science with Gaia transients: Supernovae, Microlensing, Novae, TDEs, CVs, YSOs | Current/planned multi-wavelength transient surveys and synergies

Workshop Organising Committee:
 Łukasz Wyrzykowski
 Simon Hodgkin
 Gerry Gilmore
 Nicholas Walton
 Szymon Kozłowski
 Heather Campbell
 Morgan Fraser
 Nadejda Blagoderova



Gaia Science Alerts Workshop 2015
 Liverpool John Moores University (UK)
 10-13 November 2015

- Follow-up observations
- Automated classification
- Gaia Alerts Publisher
- Science cases
- Robotic telescopes
- Outreach
- Transient surveys
- Hands-on sessions

Details: www.ast.cam.ac.uk/low/wikis/gsaawg/wiki/index.php/Workshop2015main
 Contact: gaiaalerts@liverpool.ac.uk



7th Gaia Science Alerts Workshop

7-9 December 2016 * SRON Utrecht NL

SRON
 Netherlands Institute for Space Research

Workshop Organising Committee:
 Łukasz Wyrzykowski (Warsaw)
 Milena Ratajczak (Warsaw)
 Simon Hodgkin (Cambridge)
 Charles Galdies (Malta)
 Stephen M. Brincaat (Malta)
 Gerry Gilmore (Cambridge)
 Nadejda Blagoderova (Utrecht)



8th OPTICON Gaia Science Alerts Workshop
 6-8 December 2017
 Warsaw, Poland

Details and registration: <https://tinyurl.com/gaiaaworkshop>

Workshop Organizing Committee:
 Łukasz Wyrzykowski
 Simon Hodgkin
 Krzysztof Rybicki
 Katarzyna Kruszyńska



The 9th OPTICON GAIA SCIENCE ALERTS WORKSHOP
 8-10 OCTOBER 2018
 Vipava, Slovenia

Workshop Organizing Committee:
 Łukasz Wyrzykowski
 Andreja Gomboc
 Simon Hodgkin
 Kasia Kruszyńska
 Nadejda Blagoderova
 Tanja Petrushevska
 Katja Brincat
 Aurora Clerid

Overview of the Gaia mission
 Overview of the Gaia Science Alerts
 Gaia Alerts highlights
 Gaia Alerts and DR2
 Machine-learning classification of transients
 New photometric calibration server
 Organizing the follow-up

DETAILS AND REGISTRATION
<https://tinyurl.com/gaiaalerts2018>



10th OPTICON Gaia Science Alerts Workshop
 Astronomical Observatory, University of Catania, Sicily, 18-20 December 2019

update on the Gaia mission
 update on the improvements in the Gaia Alerts
 Gaia Alerts highlights and results
 Gaia Alerts and results
 synergies with radio, X-ray and high energy
 new members of the telescope network
 new photometric calibration server
 organization of the follow-up
 future plans

Workshop Organizing Committee:
 Łukasz Wyrzykowski (Warsaw)
 Giuseppe Leto (INAF)
 Simon Hodgkin (Cambridge)
 Kasia Kruszyńska (Warsaw)
 Nadejda Blagoderova (INAF-OACT)
 Giancarlo Bellazzini (INAF-OACT)

More information and registration
<https://tinyurl.com/gsaaw10>



11th OPTICON Gaia Science Alerts Workshop
 from the comfort of our homes
 18-22 January 2021

update on Gaia mission
 Gaia Alerts highlights and results
 future of alerts and extension of Gaia
 improvements in Gaia Alerts
 new photometric calibration server
 synergies with radio, X-ray and high energy observations
 new members of the telescope network
 organization of the follow-up

Organizing Committee:
 Łukasz Wyrzykowski
 Simon Hodgkin
 Rob Beswick
 Marius Maskollunas
 Kasia Kruszyńska
 Nadejda Blagoderova
 Gerry Gilmore

DETAILS AND REGISTRATION:
<https://tinyurl.com/gsaaw2021>



12TH GAIA SCIENCE ALERTS WORKSHOP
 2021 NOV 8-12

FIRST ORP-TIME DOMAIN MEETING

UPDATES ON THE GAIA MISSION
 GAIA ALERTS UPDATES AND HIGHLIGHTS
 NEW PHOTOMETRIC CALIBRATION SERVER
 NEW MEMBERS OF THE TELESCOPE NETWORK
 SYNERGIES WITH RADIO WITHIN OPTICON-RADIONET PILOT GRANT

LOCATION
 Institute of Astrophysics-FORTH at the island of Crete, Greece
 on-line
<https://tinyurl.com/12GSAW2021>

REGISTER ONLINE
<https://tinyurl.com/12GSAW2021>

ORGANISING COMMITTEE:
 ŁUKASZ WYRZYKOWSKI (WARSAW)
 YASSIÖ ÇARMAÇIÖR (FORTH)
 SIMON HODGKIN (CAMBRIDGE)
 ROB BESWICK (MANCHESTER)
 KASIA KRUSZYŃSKA (WARSAW)
 GERRY GILMORE (CAMBRIDGE)
 DERYL SILLMORE (CAMBRIDGE)
 MARIUS MASKOLLUNAS (VILNIUS)



13th ORP and Gaia Science Alerts Workshop
 4-7 October 2022
 Pula, Sardinia

Workshop Organizing Committee:
 Łukasz Wyrzykowski (Warsaw)
 Milena Ratajczak (Warsaw)
 Simon Hodgkin (Cambridge)
 Paolo Bortolin (Cambridge)
 Rob Beswick (Manchester)
 Gerry Gilmore (Cambridge)
 Maja Jablonka (Warsaw)
 Marius Maskollunas (Vilnius)

<https://bit.ly/gaiaalerts2022>



14th Gaia Science Alerts and ORP Time-Domain Workshop
 Valletta, Malta
 2-5 October 2023
<https://bit.ly/gaiaalerts2023>

Gaia mission and Alerts BHTOM follow-up system highlights and results synergies with radio telescope network organization opportunities

Workshop Organizing Committee:
 Łukasz Wyrzykowski (Warsaw)
 Milena Ratajczak (Warsaw)
 Simon Hodgkin (Cambridge)
 Charles Galdies (Malta)
 Stephen M. Brincaat (Malta)
 Gerry Gilmore (Cambridge)
 Nadejda Blagoderova (Utrecht)

NAGRANIA ARCHIWALNE: [HTTP://WWW.AST.CAM.AC.UK/LOW/WIKIS/GSAAWG/WIKI](http://www.ast.cam.ac.uk/low/wikis/gsaawg/wiki)

Łukasz Wyrzykowski

14th Gaia Science Alerts and ORP Time-Domain Workshop

Valletta, Malta
2-5 October 2023

<https://bit.ly/gaiaalerts2023>

Gaia mission and Alerts
BHTOM follow-up system
highlights and results
synergies with radio
telescope new
organization
opportunities

Workshop Organizing Committee:
Łukasz Wyrzykowski (Warsaw)

<https://bit.ly/gaiaalerts2023>



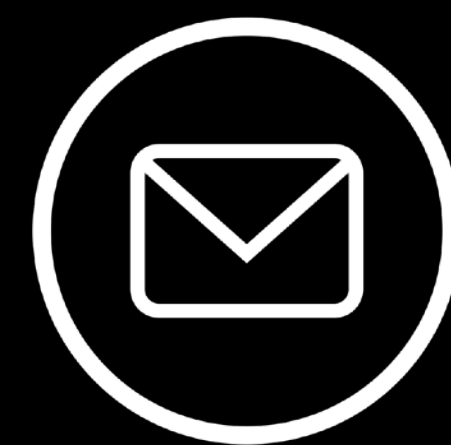
BHTOM.SPACE
BH-TOM.ASTROLABS.PL



SLACK.
BHTOM.SPACE



BHTOM@
ASTROUW.EDU.PL



LW@
ASTROUW.EDU.PL



A 3D rendered satellite component, possibly a camera or sensor, is shown against a starry space background. The component is a dark, cylindrical structure with a flat top and a flat base. On top of the cylinder is a black circle, and on either side of this circle are two bright blue lens flares. The entire assembly is mounted on a larger, flat, circular base. The text "extra slides" is overlaid in white on the front of the cylinder.

extra slides

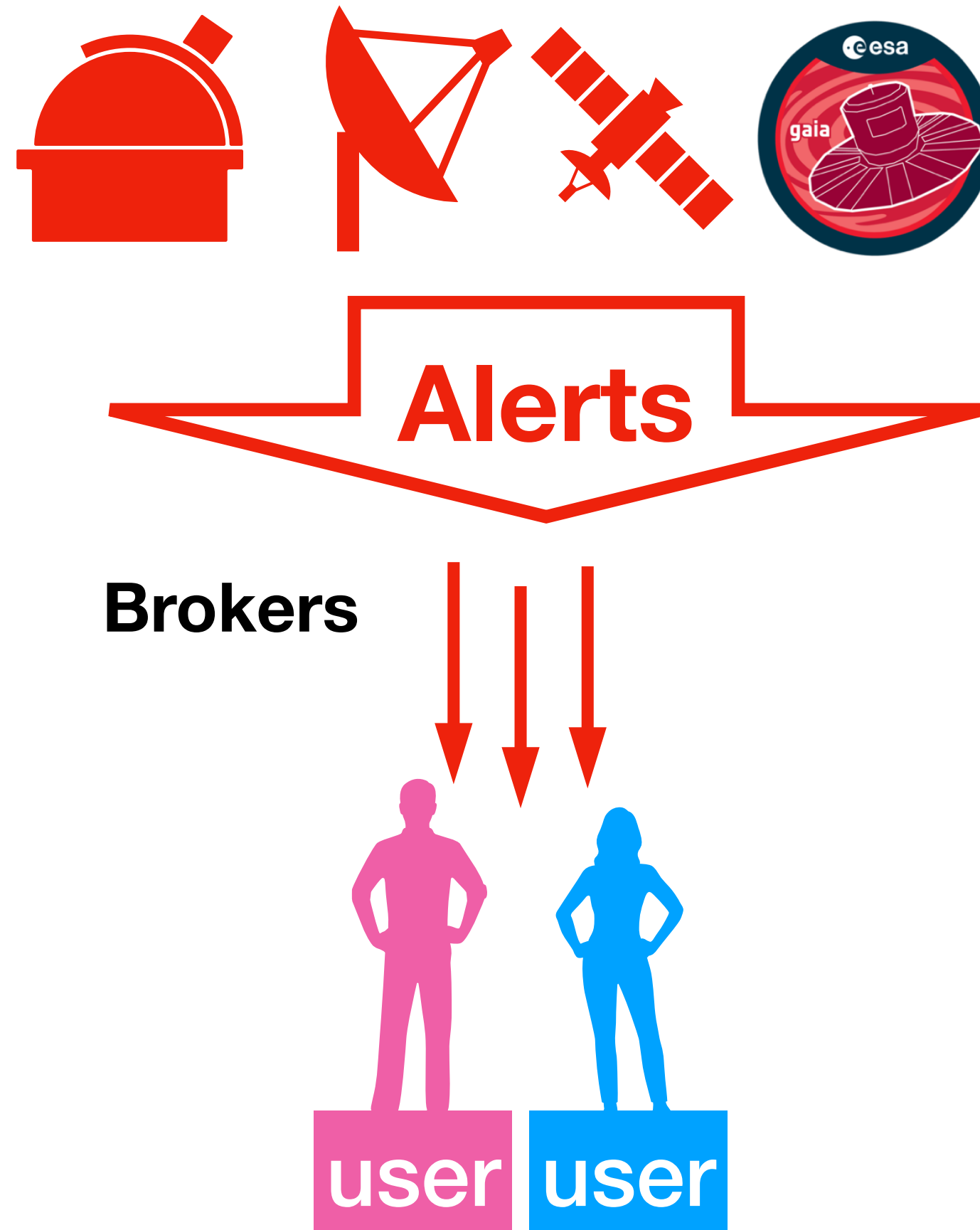
Surveys

Gaia,
ZTF,
OGLE,
ASAS-SN,
LSST,
...



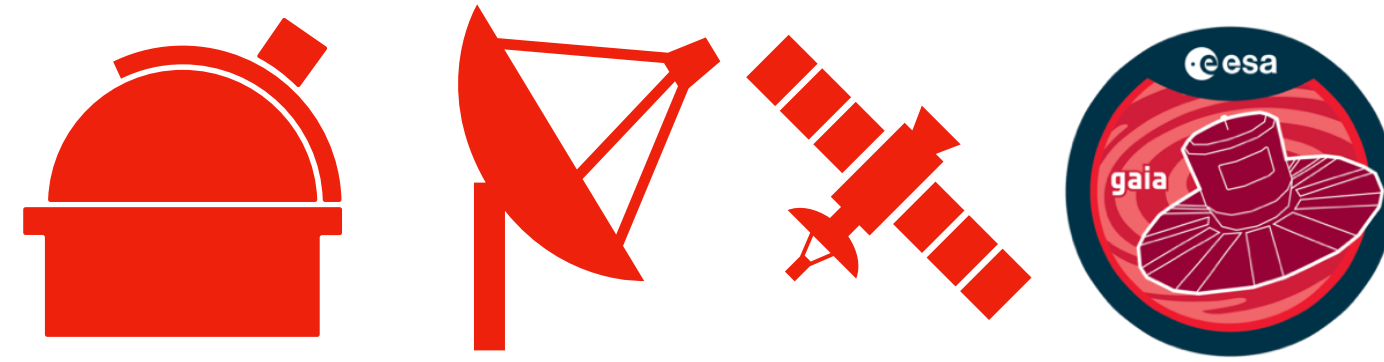
Surveys

Gaia,
ZTF,
OGLE,
ASAS-SN,
LSST,
...



Surveys

Gaia,
ZTF,
OGLE,
ASAS-SN,
LSST,
...

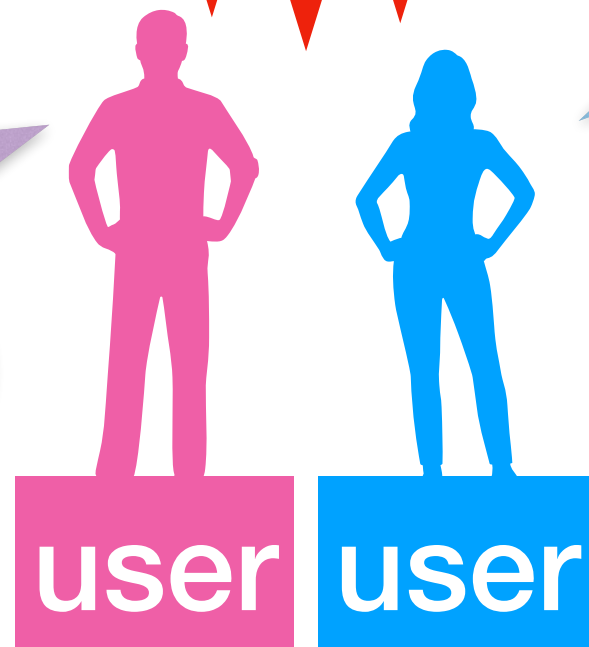


Alerts

Brokers

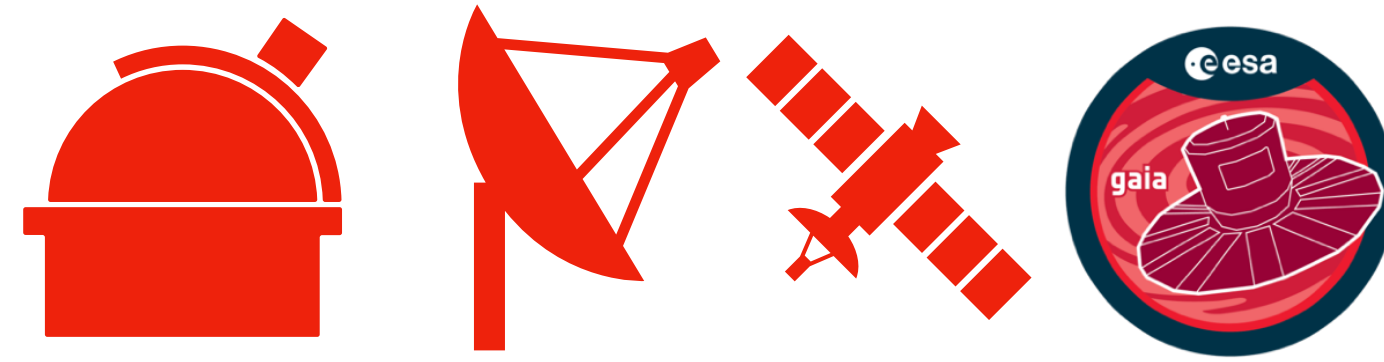
please
observe Gaia20fnr
event for 1 year

there was a
supernova in M81,
observe now!



Surveys

Gaia,
ZTF,
OGLE,
ASAS-SN,
LSST,
...

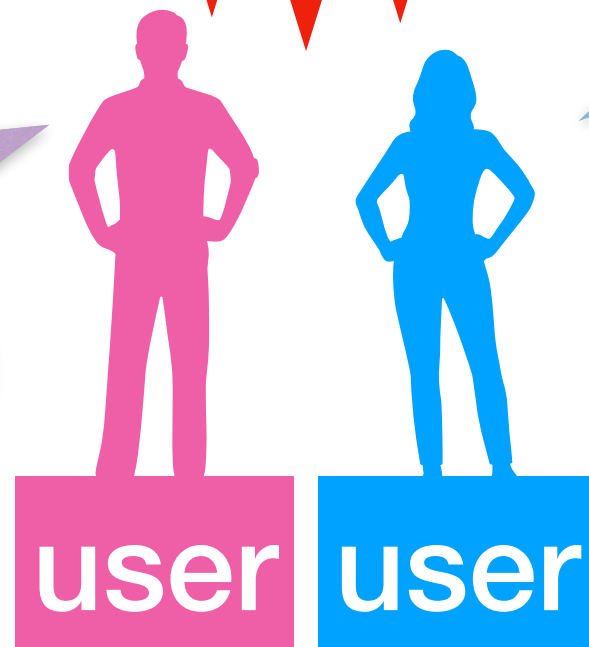


Alerts

Brokers

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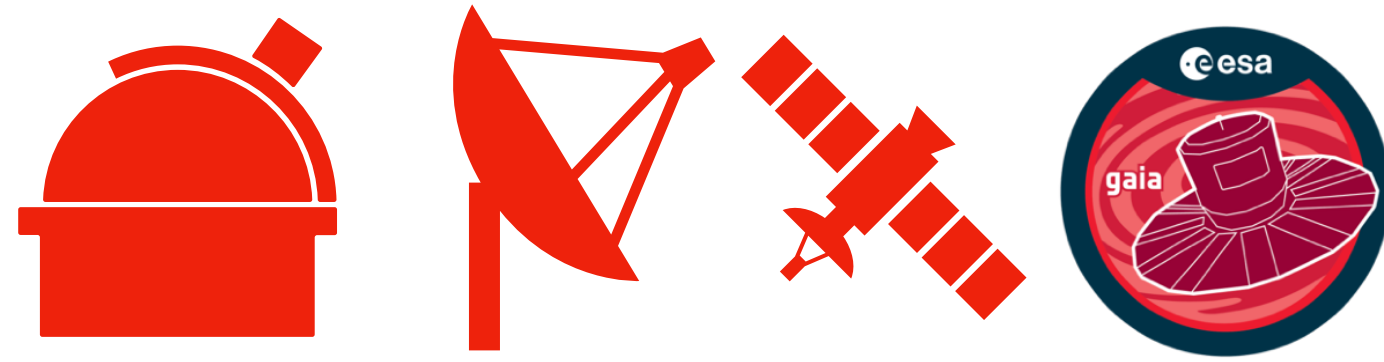


Observing
requests

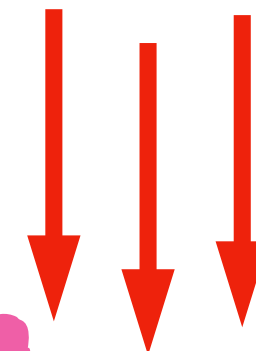
**bhtom.
space**

Surveys

Gaia,
ZTF,
OGLE,
ASAS-SN,
LSST,
...

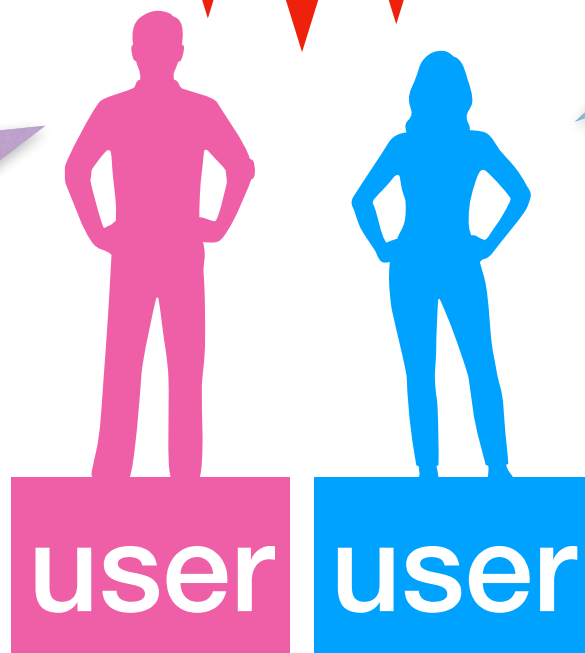


Brokers

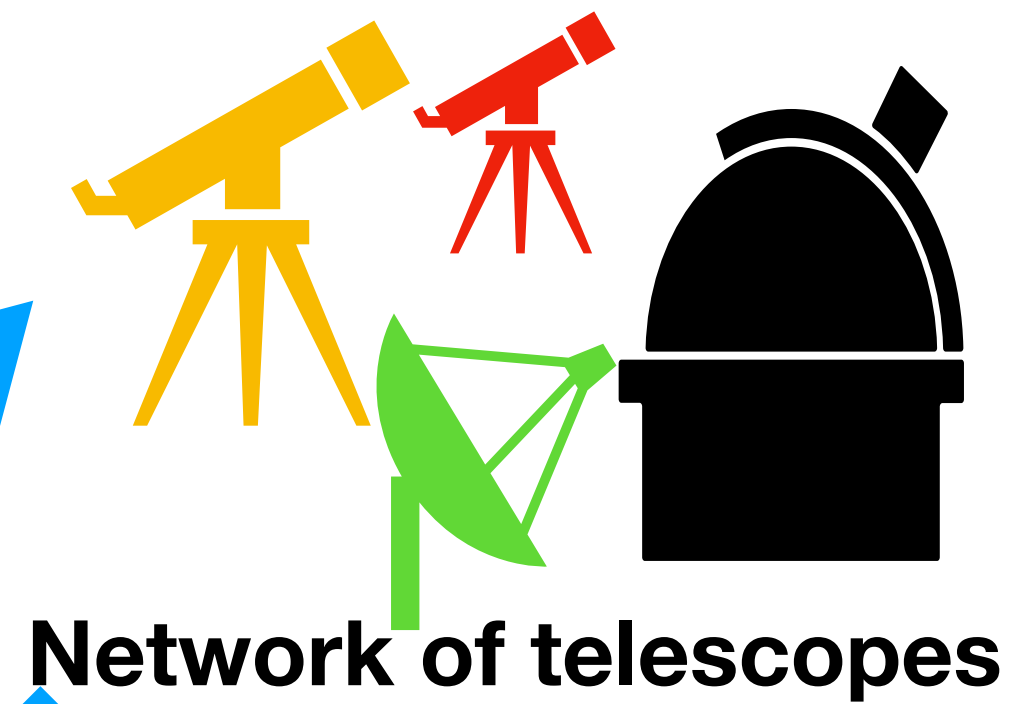
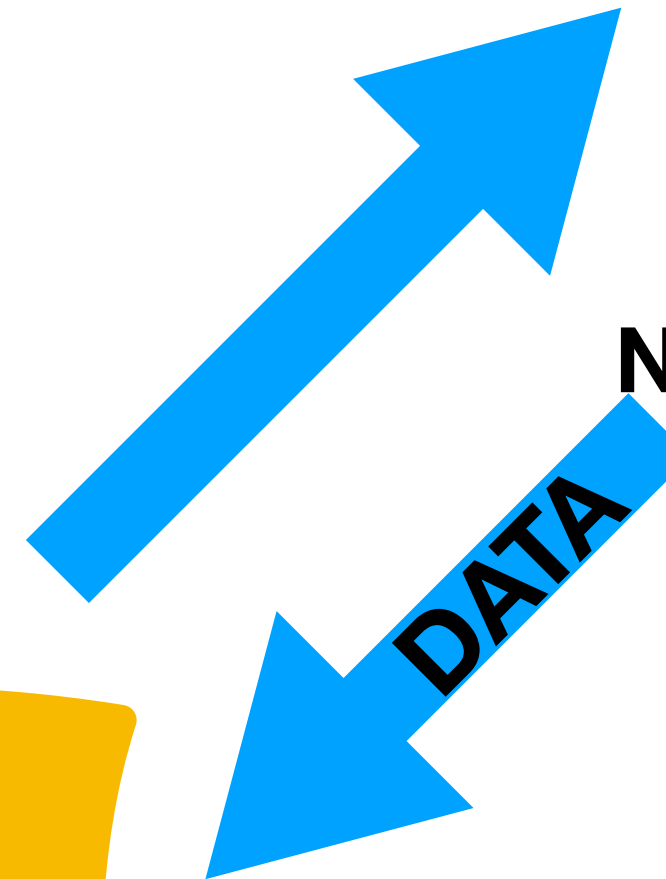


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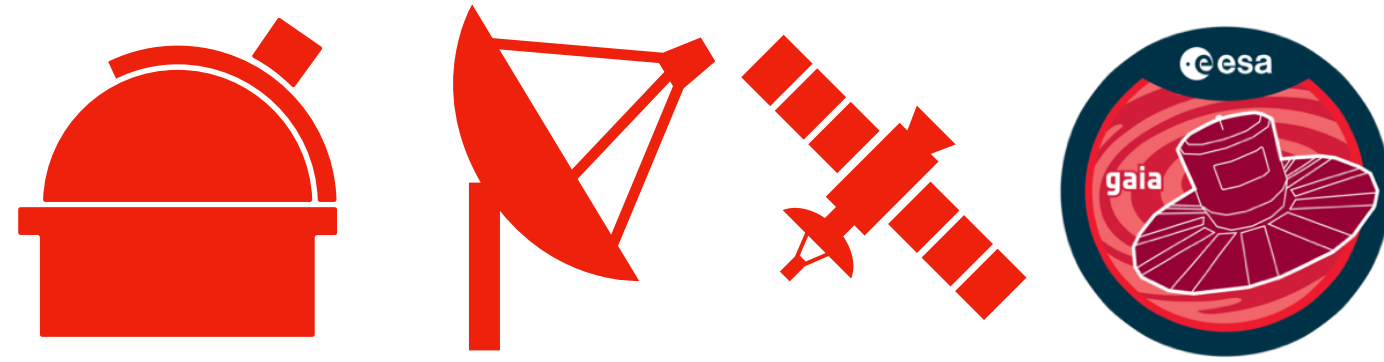


**Observing
requests**



Surveys

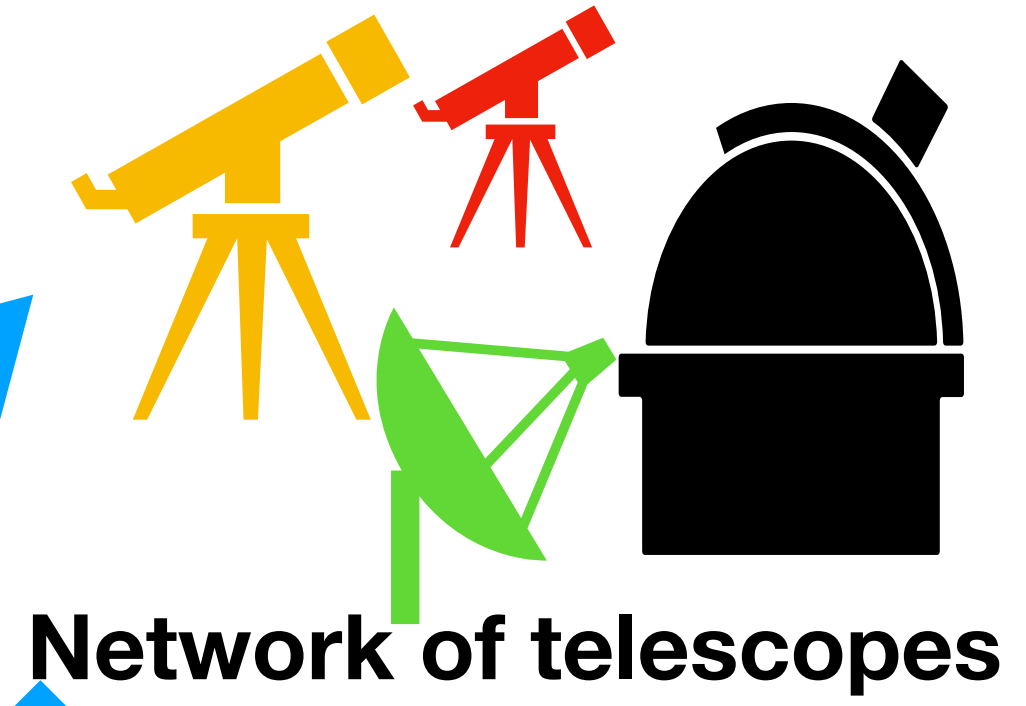
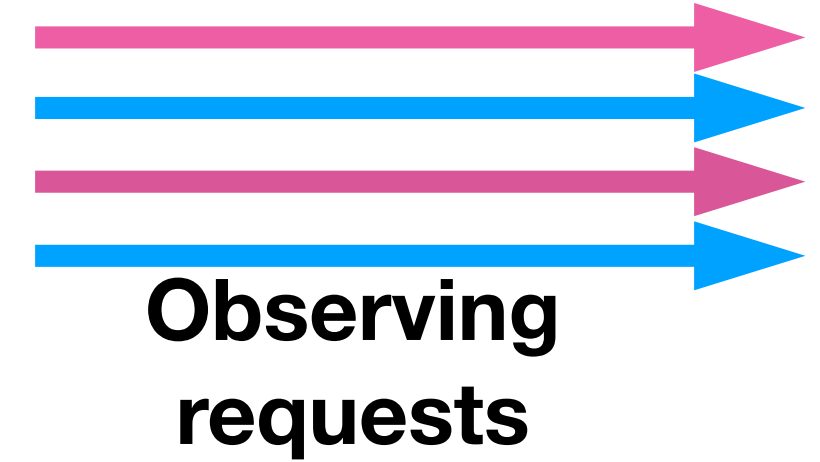
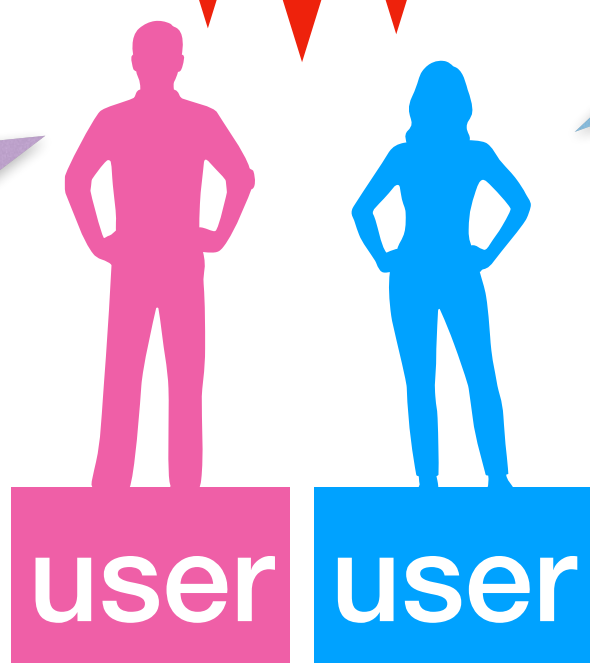
Gaia,
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OGLE,
ASAS-SN,
LSST,
...



Brokers

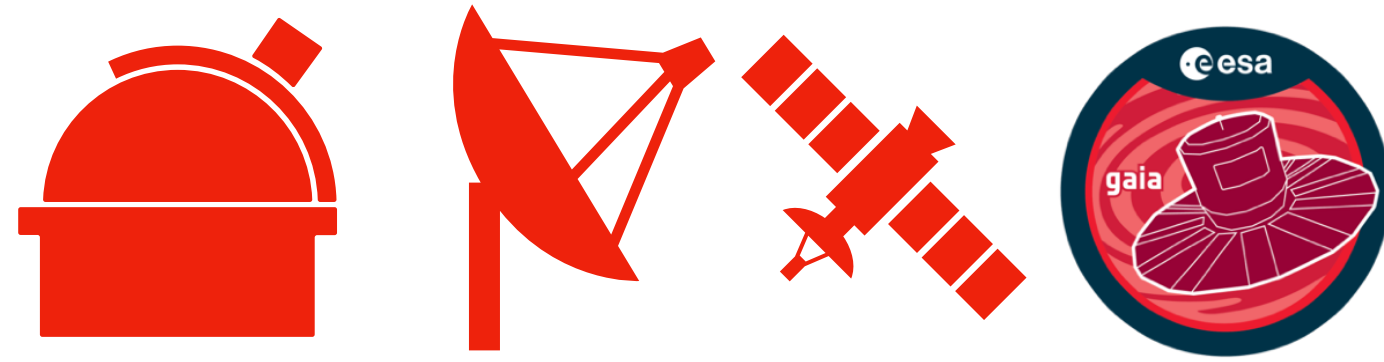
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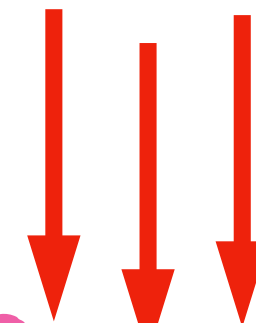


Surveys

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OGLE,
ASAS-SN,
LSST,
...

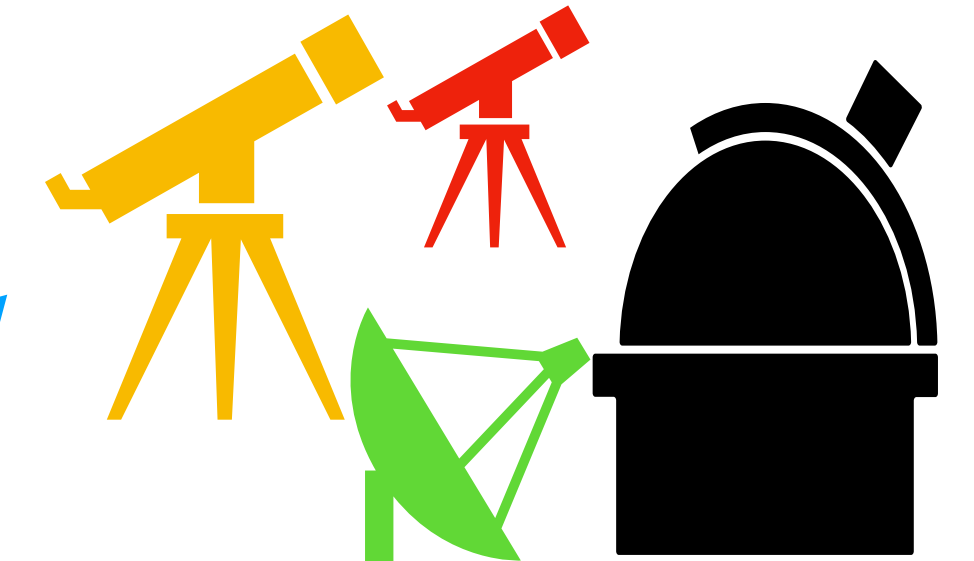
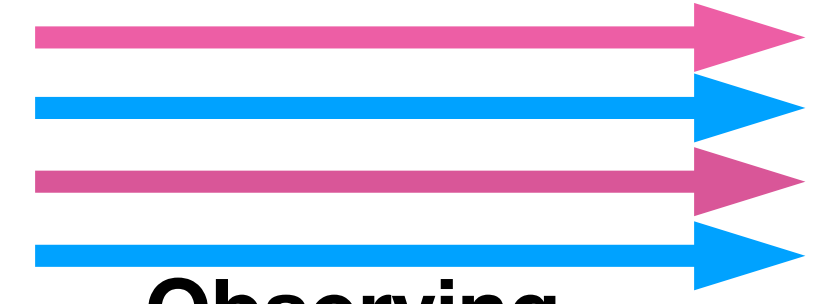
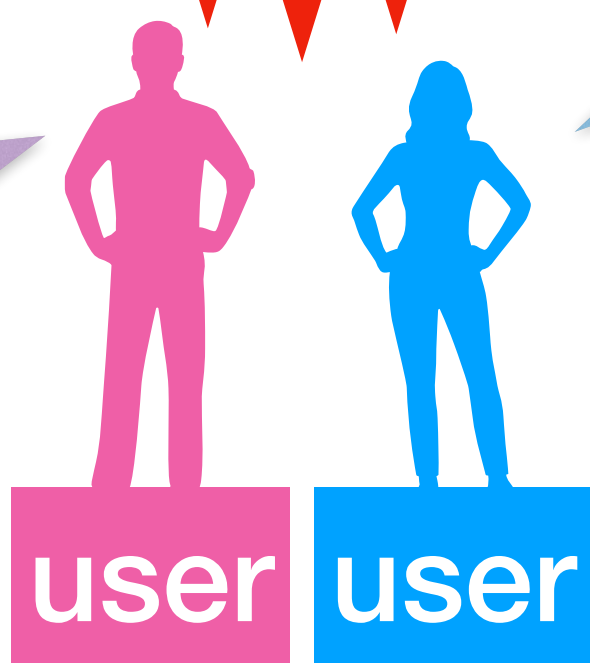


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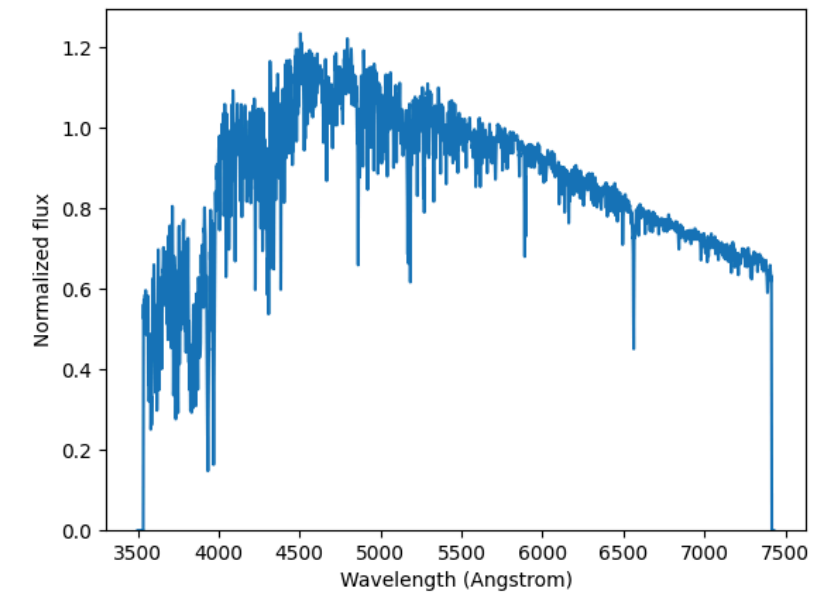
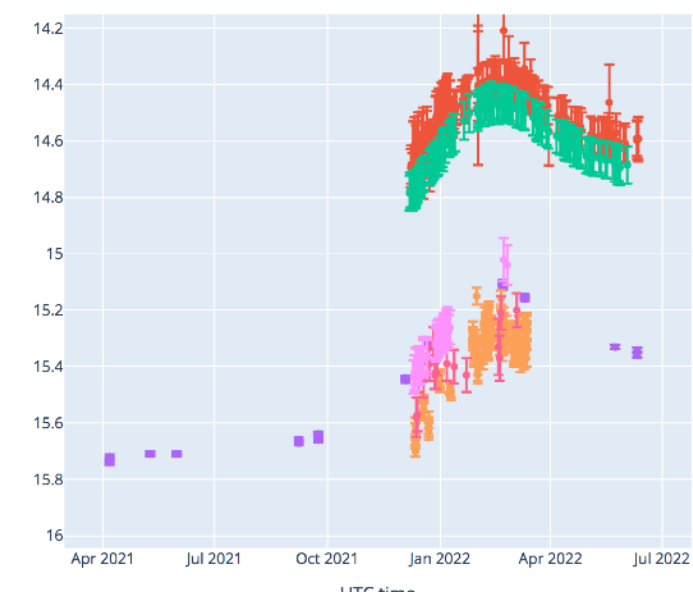
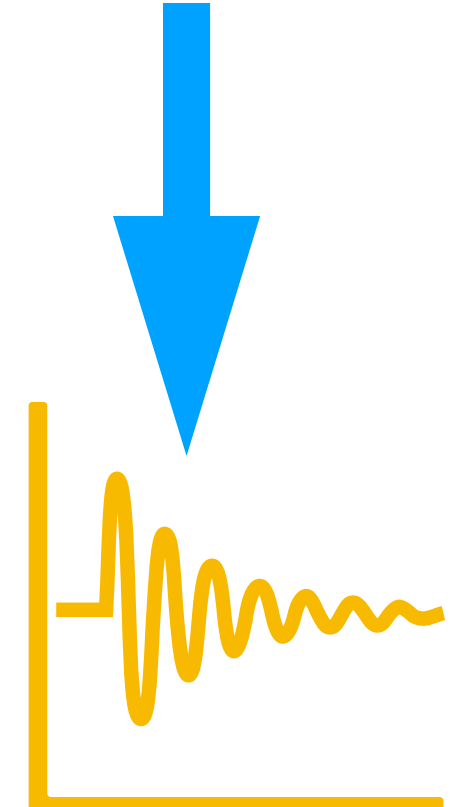
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observe now!



Network of telescopes



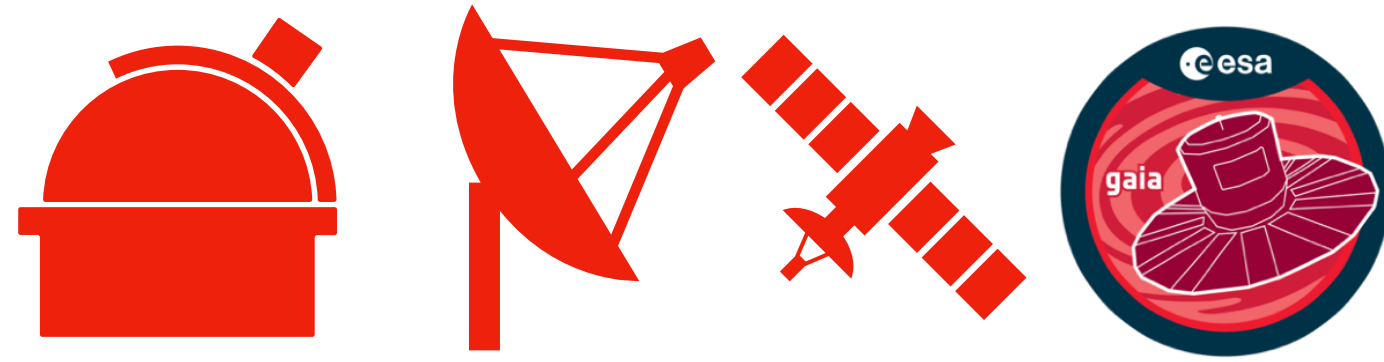
Archives



Science-ready data products

Surveys

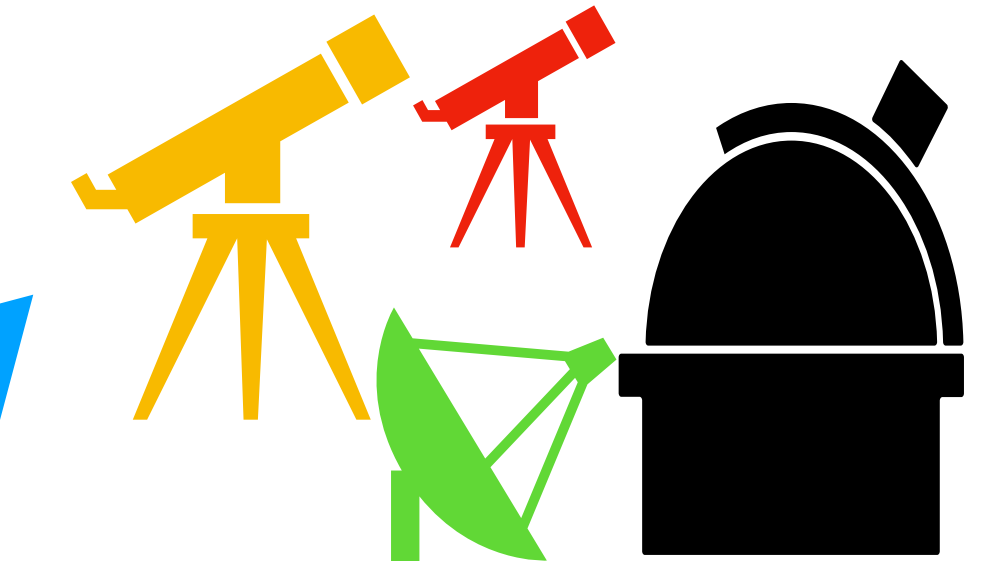
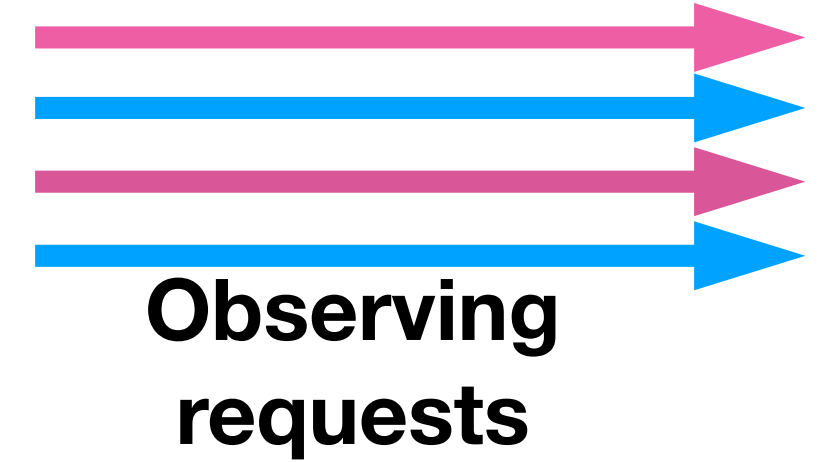
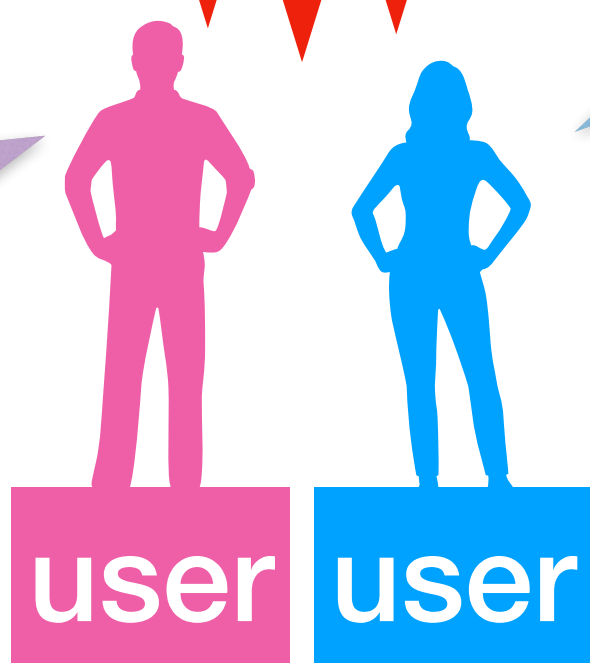
Gaia,
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OGLE,
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LSST,
...



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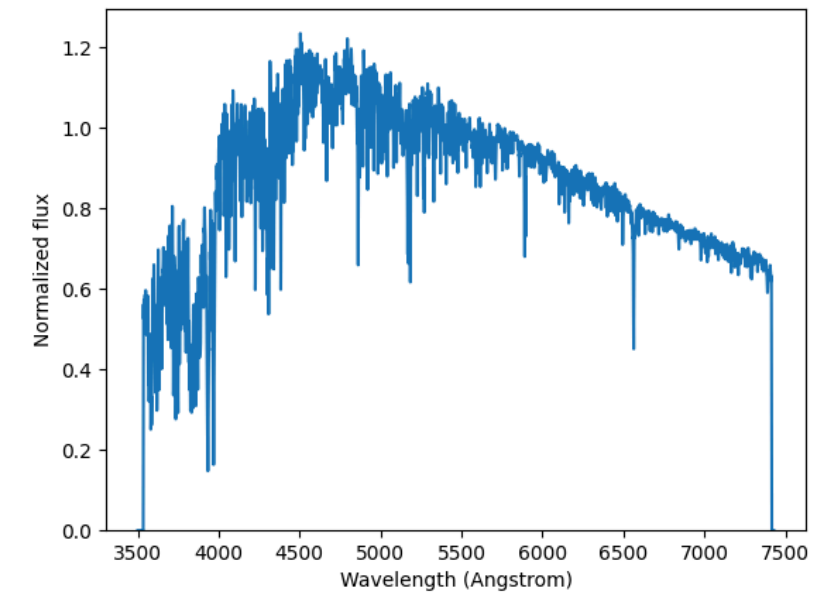
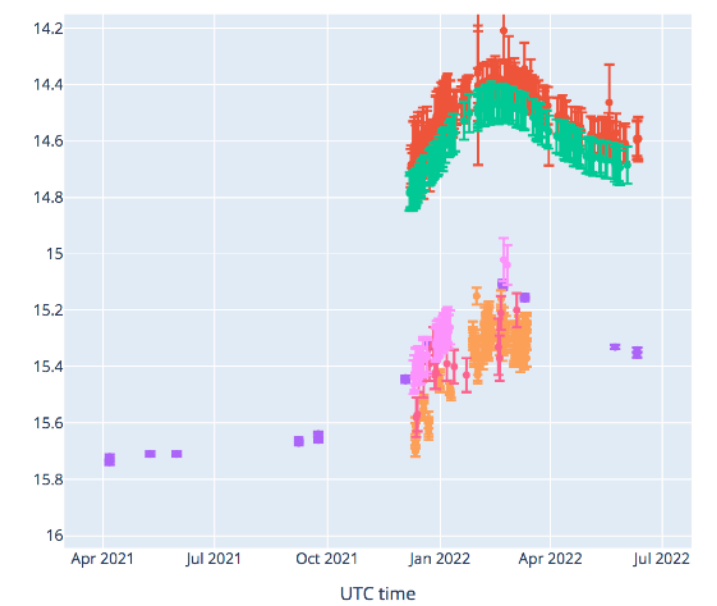
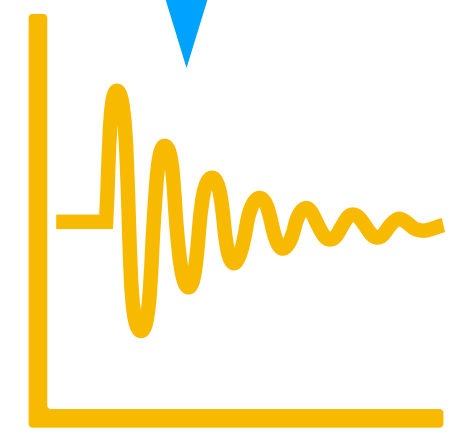


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THE ASTROPHYSICAL JOURNAL, 899:130 (8pp), 2020 August 20
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E. Szegedi-Elek¹, P. Abraham^{1,2}, Ł. Wyrzykowski³, M. Kun¹, Á. Kóspál^{1,2,4}, L. Chen¹, G. Marton^{1,2}, A. Moór^{1,2}, C. Kiss^{1,2}, A. Pál^{1,2,5}, L. Szabados¹, J. Varga^{1,6}, E. Varga-Verebélyi¹, C. Andreas⁷, E. Bachelet⁸, R. Bischoff⁷, A. Bódi^{1,9}, E. Breedt¹⁰, U. Burgaz^{11,12}, T. Butterley¹³, J. M. Carrasco¹⁴, V. Čepas¹⁵, G. Damjanovic¹⁶, I. Gezer³, V. Godunova¹⁷, M. Gromadzki³, A. Gurgul³, L. Hardy¹⁸, F. Hildebrandt⁷, S. Hoffmann⁷, M. Hundertmark¹⁹, N. Ihanec³, R. Janulis¹⁵, Cs. Kalup¹, Z. Kaczmarek³, R. Könyves-Tóth¹, M. Krezinger¹, K. Kruszyńska³, S. Littlefair¹⁸, M. Maskoliūnas¹⁵, L. Mészáros¹, P. Mikołajczyk²⁰, M. Mugrauer⁷, H. Netzel²¹, A. Ordasi¹, E. Pakštienė¹⁵, K. A. Rybicki³, K. Sárneczky¹, B. Seli¹, A. Simon²², K. Šiškauskaitė¹⁵, Á. Sódor¹, K. V. Sokolovsky^{23,24,25}, R. Szakáts¹, L. Tomasella²⁶, Y. Tsapras¹⁹, K. Vida^{1,2}, J. Zdanavičius¹⁵, M. Zieliński³, P. Z

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



SN 2018zd: An Unusual Stellar Explosion as Part of the Diverse Type II Supernova Landscape

Jujia Zhang^{1,2,3,4}, Xiaofeng Wang^{5,6}, József Vinkó^{7,8,9}, Qian Zhai^{1,2,3,4}, Tianmeng Zhang¹⁰, Alexei V. Filippenko^{12,13}, Thomas G. Brink¹², WeiKang Zheng¹², Łukasz Wyrzykowski¹⁴, Przemysław Mikołajczyk¹⁴, Fang Huang¹⁵, Xinhan Zhang⁵, Huijuan Wang^{10,11}, James A. Bódi^{7,18}, G. Csörnyei^{7,8}, O. Hanyecz⁷, I. R. Könyves-Tóth^{7,8}, A. Ordasi⁷, A. Pál^{7,8}, G. Zsidi^{7,8,19}

AT2021uey: A planetary microlensing event outside the Galactic bulge

Ban, M.¹, Voloshyn, P.^{2,3}, Adomavičienė, R.⁴, Bachelet, E.^{5,6}, Bozza, V.^{7,8}, Brincat, S. M.⁹, Bruni, I.¹⁰, Burgaz, U.¹¹, Carrasco, J. M.¹², Cassan, A.⁵, Čepas, V.⁴, Dominik, M.¹³, Dubois, F.¹⁴, Figuera Jaimés, R.¹⁵, Fukui, A.^{16,17}, Galdies, C.^{18,19}, Garofalo, A.¹⁰, Hundertmark, M.²⁰, Kruszyńska, K.¹, Kulijanishvili, V.²¹, Kvernadze, T.²¹, Logie, L.¹⁴, Maskoliūnas, M.⁴, Mikołajczyk, P. J.^{1,22}, Mróz, P.¹, Narita, N.^{16,17,23}, Pakštienė, E.⁴, Peloton, J.³, Poleski, R.¹, Qvam, J. K. T.²⁴, Rau, S.¹⁴, Rota, P.^{7,8}, Rybicki, K. A.^{1,25}, Street, R. A.²⁶, Tsapras, Y.²⁰, Vanaverbeke, S.¹⁴, Wambsganss, J.²⁰, Wyrzykowski, Ł.¹, Zdanavičius, J.⁴, and Zieliński, P.²⁷

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

Łukasz Wyrzykowski^{1,*,*}, P. Mróz¹, K. A. Rybicki¹, M. Gromadzki¹, Z. Kołaczekowski^{45,79}, M. Zieliński¹, P. Zieliński¹, N. Britavskiy^{4,15}, A. Gomboc³⁵, K. Sokolovsky^{19,31,66}, S.T. Hodgkin⁶, L. Abe⁸⁹, G.F. Aldi^{20,80}, A. AlMannaei^{62,100}, G. Altavilla^{72,7}, A. Al Qasim^{62,100}, G.C. Anupama⁸, S. Awiphan⁹, E. Bachelet⁶³, V. Bakis¹⁰, S. Baker¹⁰⁰, S. Bartlett⁵⁰, P. Bendjoya¹¹, K. Benson¹⁰⁰, I.F. Bikmaev^{76,87}, G. Birenbaum¹¹², N. Blagorodnova²⁴, S. Blanco-Cuaresma^{15,74}, S. Boeva¹⁶, A.Z. Bonanos¹⁹, V. Bozza^{20,80}, D.M. Bramich⁶², I. Bruni²⁵, R.A. Burenin^{84,85}, U. Burgaz²¹, T. Butterley²², H. E. Caines³⁴, D. B. Caton⁹³, S. Calchi Novati⁸³, J.M. Carrasco²³, A. Cassan²⁹, V. Čepas⁵⁶, M. Cropper¹⁰⁰, M. Chruslińska^{11,24}, G. Clementini²⁵, A. Clerici³⁵, D. Conti⁹¹, M. Conti⁴⁸, S. Cross⁶³, F. Cusano²⁵, G. Damjanovic²⁶, A. Dapergolas¹⁹, G. D'Agostini⁸¹, J. H. J. de Bruijne²⁷, M. Dennefeld²⁹, V. S. Dhillon^{30,4}, M. Dominik³¹, J. Dziedziuszko¹, O. Erceg³², M. V. Eiselevich⁸⁶, H. Esenoglu³³, L. Eyer⁷⁴, R. Figuera Jaimés^{31,53}, S. J. Fossey³⁴, A. I. Galeev^{76,87}, S. A. Grebenev⁸⁴, A. C. Gupta⁹⁹, A. G. Gutaev⁷⁶, N. Hallakoun¹¹², A. Hamanowicz^{11,36}, C. Han², B.

Lens mass estimate in the Galactic disk extreme parallax microlensing event Gaia19dke

M. Maskoliūnas¹, Ł. Wyrzykowski², K. Howl², K. A. Rybicki², P. Zieliński³, Z. Kaczmarek⁴, K. Kruszyńska², M. Jabłońska², J. Zdanavičius¹, E. Pakštienė¹, V. Čepas¹, P. J. Mikołajczyk^{2,8}, R. Janulis¹, M. Gromadzki², N. Ihanec², R. Adomavičienė¹, K. Šiškauskaitė¹, M. Bronikowski^{2,7}, P. Sivak², A. Stankevičiūtė², M. Sitek², M. Ratajczak², U. Pylypenko², I. Gezer⁵, S. Awiphan⁹, E. Bachelet¹⁰, K. Bąkowska³, R. P. Boyle¹², V. Bozza^{32,33}, S. M. Brincat¹³, U. Burgaz¹¹, T. Butterley²², J. M. Carrasco¹⁴, A. Cassan³⁸, F. Cusano¹⁵, G. Damjanovic⁶, V. S. Dhillon²², M. Dominik³⁹, F. Dubois¹⁷, H. H. Esenoglu¹⁷, R. Figuera Jaimés³⁴, A. Fukui¹⁹, C. Galdies²⁰, A. Garofalo¹⁵, V. Godunova²¹, T. Güver^{17,18}, J. Heidt²², M. Hundertmark³⁶, I. Izviakova³, B. Joachimczyk³, M.K. Kamińska³⁹, K. Kamiński³⁹, S. Kaptan^{17,18}, T. Kvernadze²⁴, O. Kvaratskhelia²⁴, S. Littlefair²², O. Michniewicz²⁴, N. Nakhatutai³⁵, W. Ogłóżka⁴², J. M. Olszewska³⁹, M. Polińska³⁹, A. Popowicz²⁵, J. K. T. Qvam²⁶, M. Radziwonowicz², A. Słowikowska^{37,3}, A. Simon^{30,31}, E. Sonbas^{40,41}, M. Stojanovic⁶, Y. Tsapras³⁶, S. Vanaverbeke¹⁶, R. W. Wilson²⁹, M. Zejmo²⁴, S. Zola²⁸,

Single lens mass measurement in the high magnification microlensing event Gaia19bld located in the Galactic Disk

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The Gaia alerted fading of the FUor-type star Gaia21elv

Zsófia Nagy,^{1,2,*} Sunkyoung Park,^{1,2} Péter Abraham,^{1,2,3} Ágnes Kóspál,^{1,2,3,4} Fernando Cruz-Sáenz de Miera,^{1,2} Mária Kun,^{1,2} Michał Siwak,^{1,2} Zsófia Marianna Szabó,^{1,2,5,6} Máté Szilágyi,^{1,2,3} Eleonora Fiorellino,⁷ Teresa Giannini,⁸ Jae-Joon Lee,⁹ Jeong-Eun Lee,¹⁰ Gábor Marton,^{1,2} László Szabados,^{1,2} Fabrizio Vitali,⁸ Jan Andrzejewski,¹¹ Mariusz Gromadzki,¹² Simon Hodgkin,¹³ Maja Jabłońska,¹² Rene A. Mendez,¹⁴ Jaroslav Merc,¹⁵ Olga Michniewicz,¹¹ Przemysław J. Mikołajczyk,^{12,16} Uliana Pylypenko,¹² Milena Ratajczak,¹² Łukasz Wyrzykowski,¹² Michał Zejmo,¹¹ Paweł Zieliński¹⁷

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

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 MNRAS 515, 1774–1787 (2022)
 Advance Access publication 2022 July 12
<https://doi.org/10.1093/mnras/stac1915>

Photometric and spectroscopic study of the burst-like brightening of two Gaia-alerted young stellar objects

Zsófia Nagy^{1,2*}, Péter Abraham^{1,2,3}, Ágnes Kóspál^{1,2,3,4}, Sunkyung Park^{1,2}, Michał Siwak^{1,2}, Fernando Cruz-Sáenz de Miera^{1,2}, Eleonora Fiorellino^{1,2,5}, David García-Álvarez^{6,7}, Zsófia Marianna Szabó^{1,2,8,9}, Simone Antonucci⁵, Teresa Giannini⁵, Alessio Giunta¹⁰, Levente Kriskov Mária Kun^{1,2}, Gábor Marton^{1,2}, Attila Moór^{1,2}, Brunella Nisini⁵, Andras Pál^{1,2,3}, László Szaba Paweł Zieliński¹¹ and Łukasz Wyrzykowski¹²



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

Łukasz Wyrzykowski^{1,11*}, P. Mróz¹¹, K. A. Rybicki¹¹, M. Gromadzki¹¹, Z. Kołaczekowski^{45,79,***}, M. Zieliński¹¹, P. Zieliński¹¹, N. Britavskiy^{41,5}, A. Gomboc³⁵, K. Sokolovsky^{19,31,66}, S.T. Hodgkin⁶, L. Abe⁸⁹, G.F. Aldi^{20,80}, A. AlMannai^{62,100}, G. Altavilla^{72,7}, A. Al Qasim^{62,100}, G.C. Anupama⁸, S. Awiphan⁹, E. Bachelet⁶³, V. Bakis¹⁰, S. Baker¹⁰⁰, S. Bartlett⁵⁰, P. Bendjoya¹¹, K. Benson¹⁰⁰, I.F. Bikmaev^{76,87}, G. Birenbaum¹², N. Blagorodnova²⁴, S. Blanco-Cuadros^{15,74}, S. Boeva¹⁶, A.Z. Bonanos¹⁹, V. Bozza^{20,80}, D.M. Bramich⁶², I. Bruni²⁵, R.A. Burenin^{84,85}, U. Burgaz²¹, T. Butterley²², H. E. Caines³⁴, D. B. Caton⁹³, S. Calchi Novati⁸³, J.M. Carrasco²³, A. Cassan²⁹, V. Čepas⁵⁶, M. Cropper¹⁰⁰, M. Chruslińska^{11,24}, G. Clementini²⁵, A. Clerici³⁵, D. Conti⁹¹, M. Conti⁴⁸, S. Cross⁶³, F. Cusano²⁵, G. Damjanovic²⁶, A. Dapergolas¹⁹, G. D'Agostini⁸¹, J. H. J. de Bruijne²⁷, M. Dennefeld²⁹, V. S. Dhillon^{30,4}, M. Dominik³¹, J. Dziedziuszko¹, O. Erceloni³², M. V. Eiselevich⁸⁶, H. Esenoglu³³, L. Eyerdal⁷⁴, R. Figueroa Jaimes^{31,53}, S. J. Fossey³⁴, A. I. Galeev^{76,87}, S. A. Grebenev⁸⁴, A. C. Gupta⁹⁹, A. G. Gutaev⁷⁶, N. Hallakoun¹², A. Hamanowicz^{11,36}, C. Han², B. ...

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