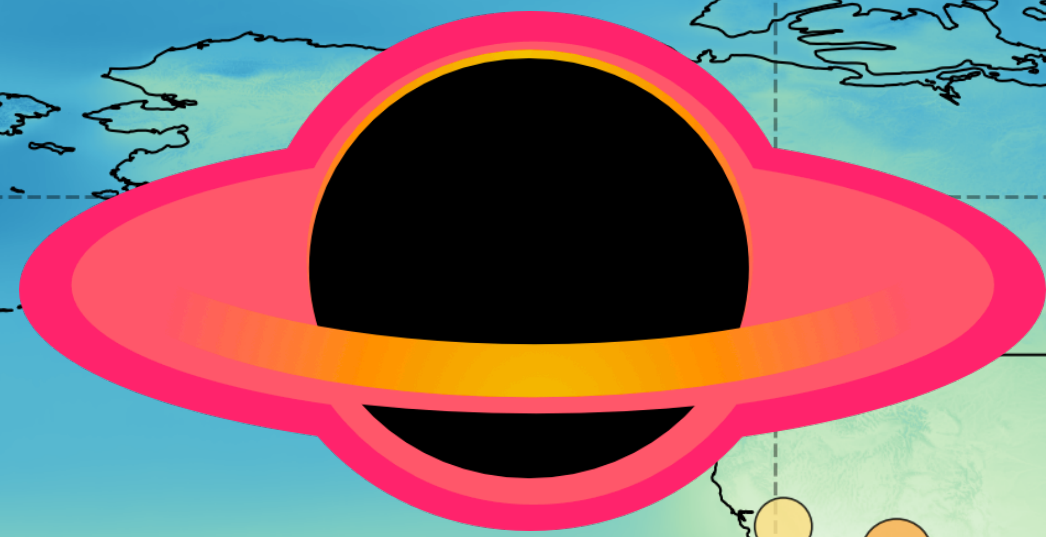


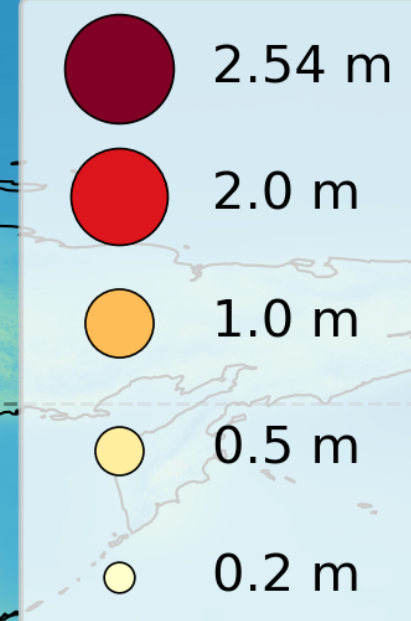


BHTOM

SIT BACK AND RELAX

- THE ROBOTS ARE DOING YOUR ASTRONOMY JOB FOR YOU

Łukasz Wyrzykowski
(pron. Woo-cash Vi-zhi-kov-ski)



Astronomical Observatory,
University of Warsaw, Poland



European Astronomical
Society of Small Telescopes



National Centre for Nuclear
Research, Warsaw, Poland



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EASST.EU

AstroColibri Workshop

20-24 October 2025



LW@ASTROUW.EDU.PL

TEAM



Warsaw University Astronomical Observatory



National Centre for Nuclear Research - Astrophysics Division



Mauritz Wicker
(PhD student)



Joysakar Majumdar
(PhD student)



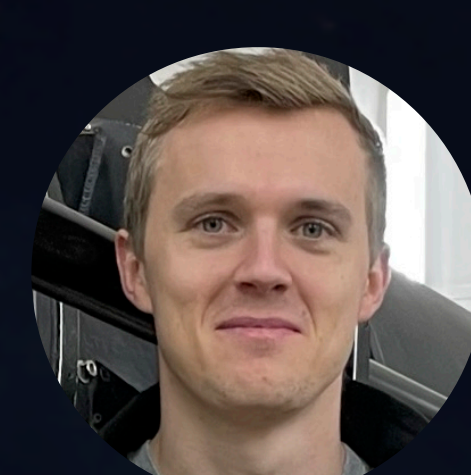
Krzysztof Kotysz
(staff)



Łukasz Wyrzykowski
(staff)



Przemek Mikołajczyk
(staff)



Fraser Gillan
(postdoc)



Priscila Pessi
(postdoc)

Students, former students



Kris A. Rybicki
(postdoc)



Katarzyna Kruszyńska
(postdoc)



Nada Ihanec
(PhD student)



Uliana Pylypenko
(PhD student)



Zofia Kaczmarek
(PhD student)

collaborators



Marius Maskoliūnas
and his group



Andreja Gomboc
and her group



Paweł Zieliński
(staff)

Former contributors: Maia Jahłońska, Piotr Trzcionkowski, Kacper Raciborski, Algita Stankeviciute, Kornel Howil, Mariusz Gromadzki, Milena Ratajczak, Monika Sitek

///AkondLab.

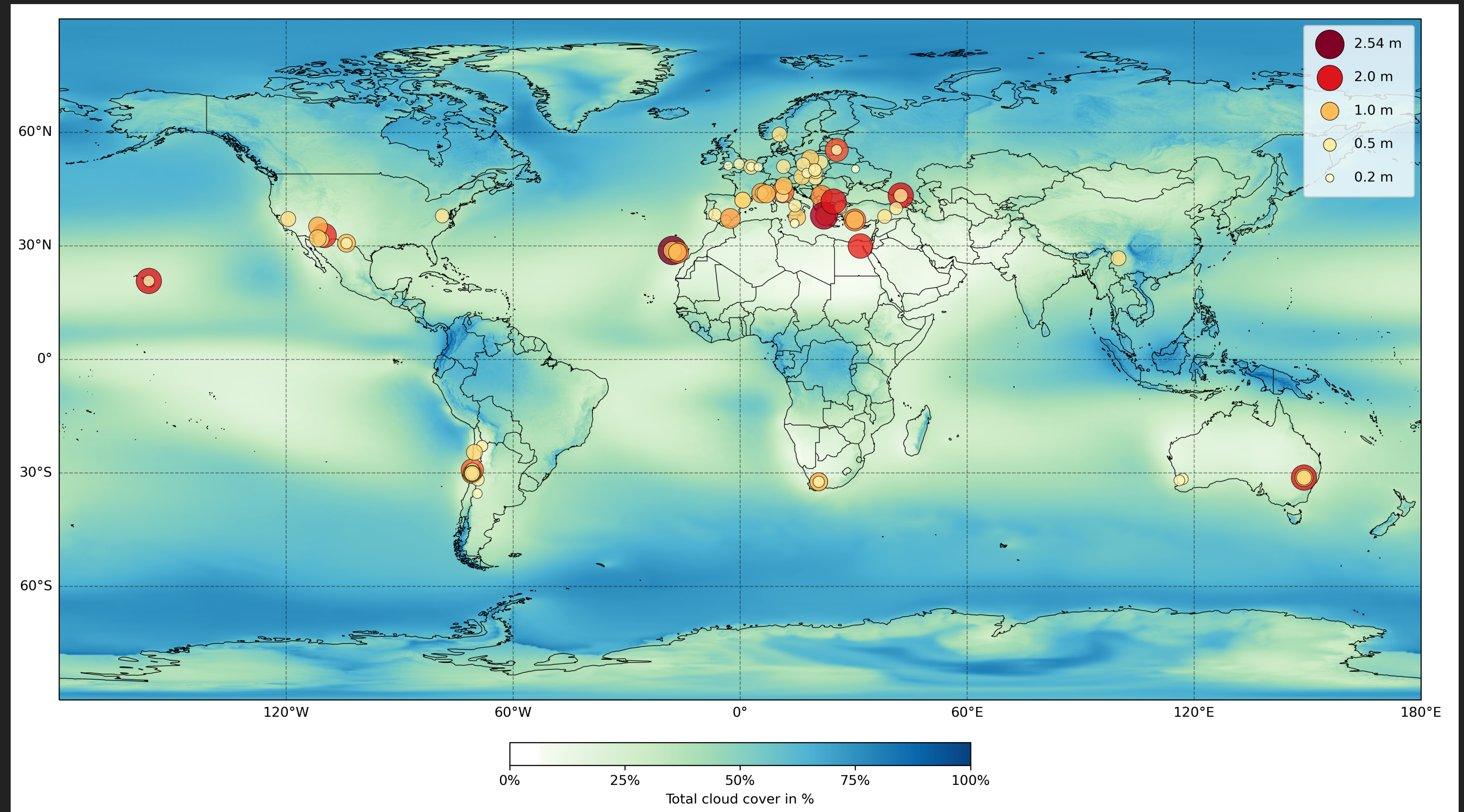
Funding



BHTOM TELESCOPE NETWORK

▶ since 2013, built for Gaia Alerts

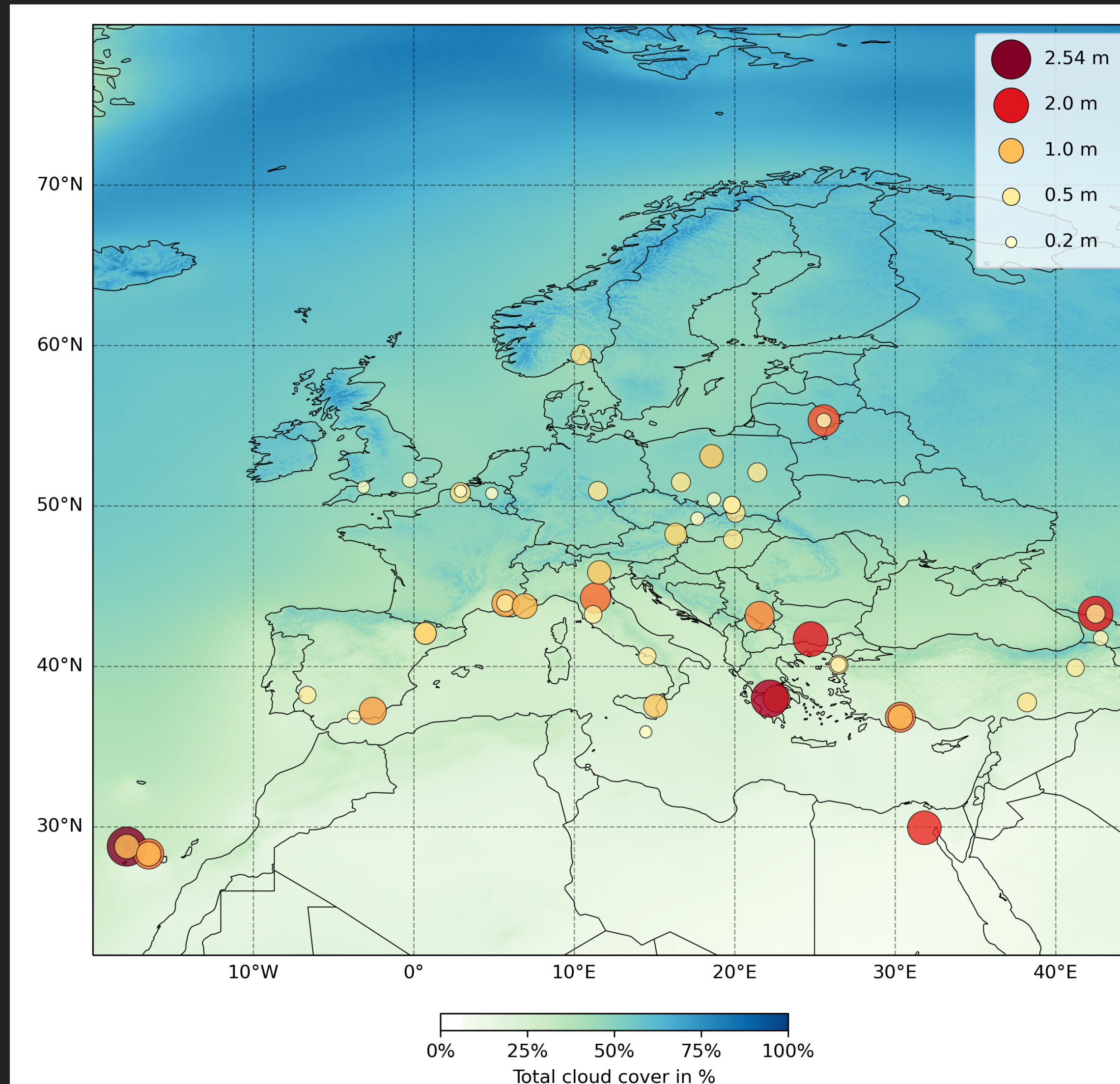
- ~150 telescopes
- sizes 0.05 - 2.5 m
- manual
- robotic
- with good weather
- with poor weather
- volunteering
- via proposals
- ▶ your telescope?



BHTOM TELESCOPE NETWORK

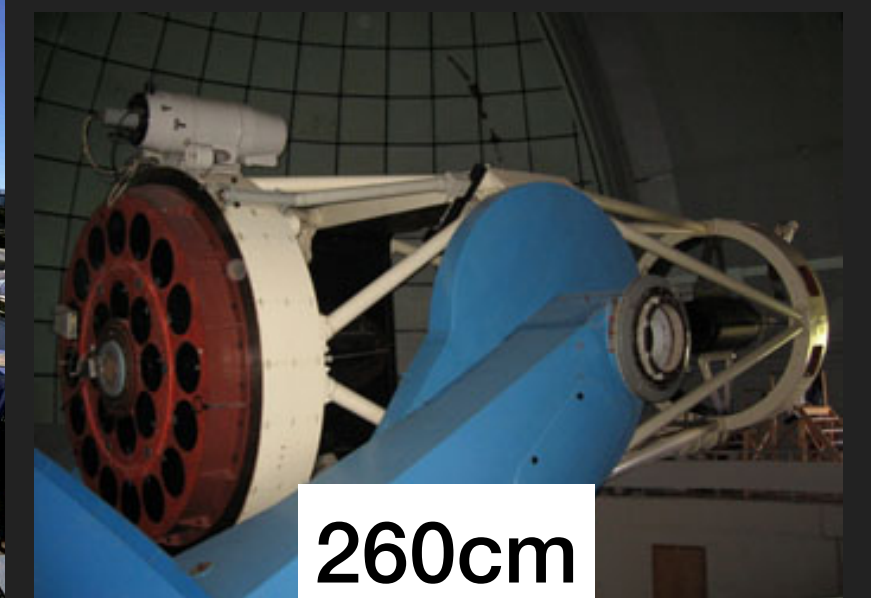
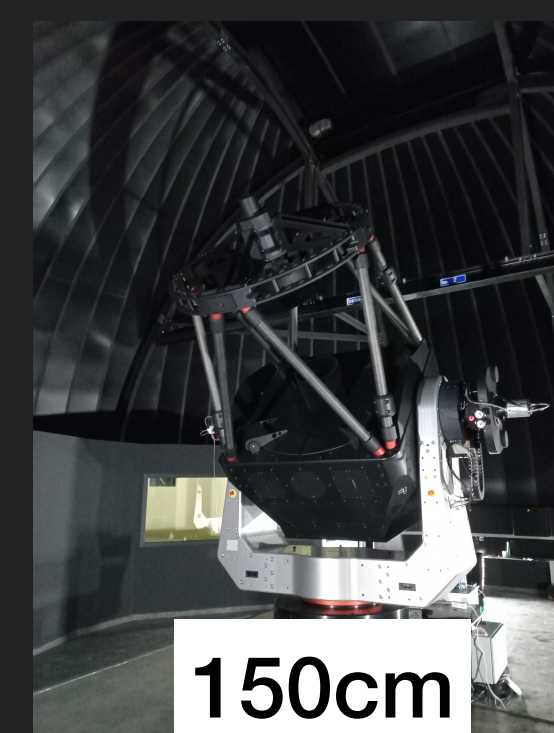
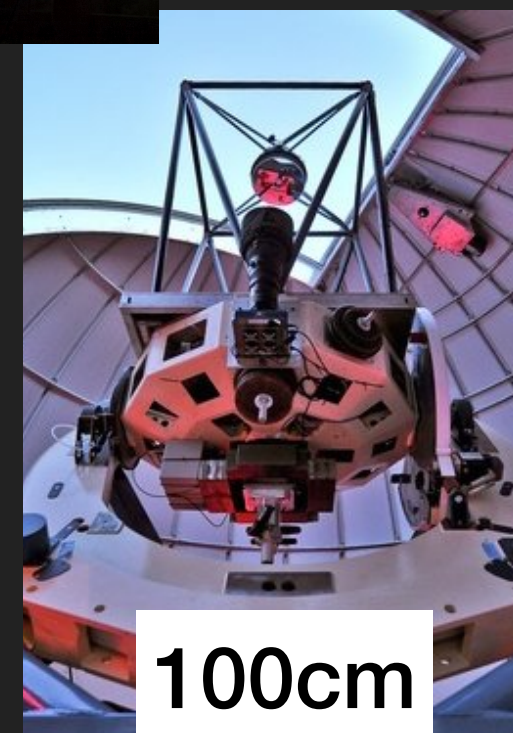
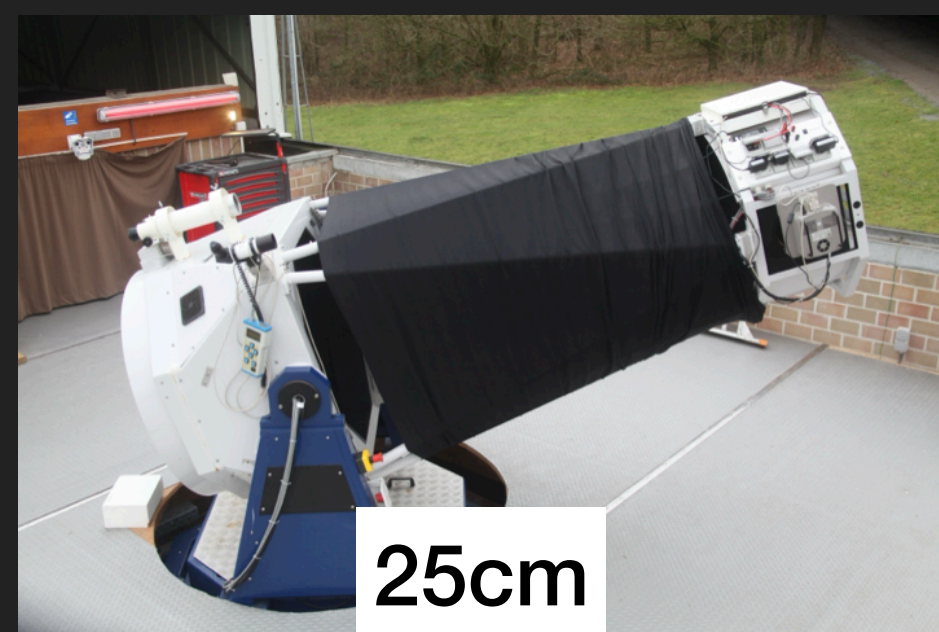
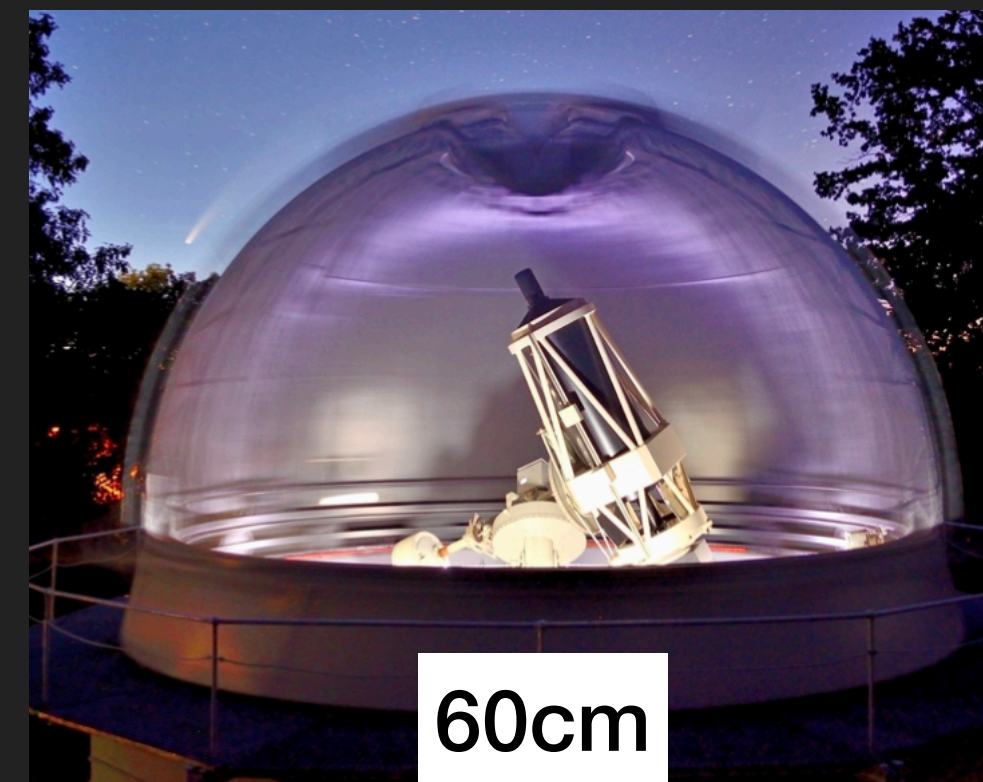
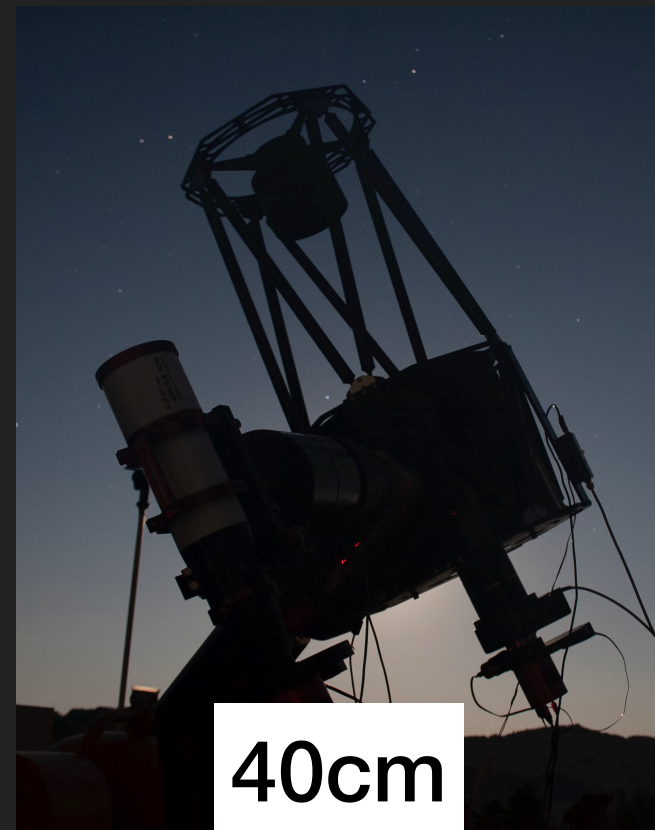
▶ since 2013, built for Gaia Alerts

- ~150 telescopes
- sizes 0.05 - 2.5 m
- manual
- robotic
- with good weather
- with poor weather
- volunteering
- via proposals
- ▶ your telescope?



WHAT ARE THE SMALL TELESCOPES?

- professional - old (some very old!) & new, built in best astronomical sites in the world
- amateur - modern, growing in numbers, in backyard, shed and in Chile, Spain
- schools - modern, in big cities
- outreach facilities - modern, in big cities



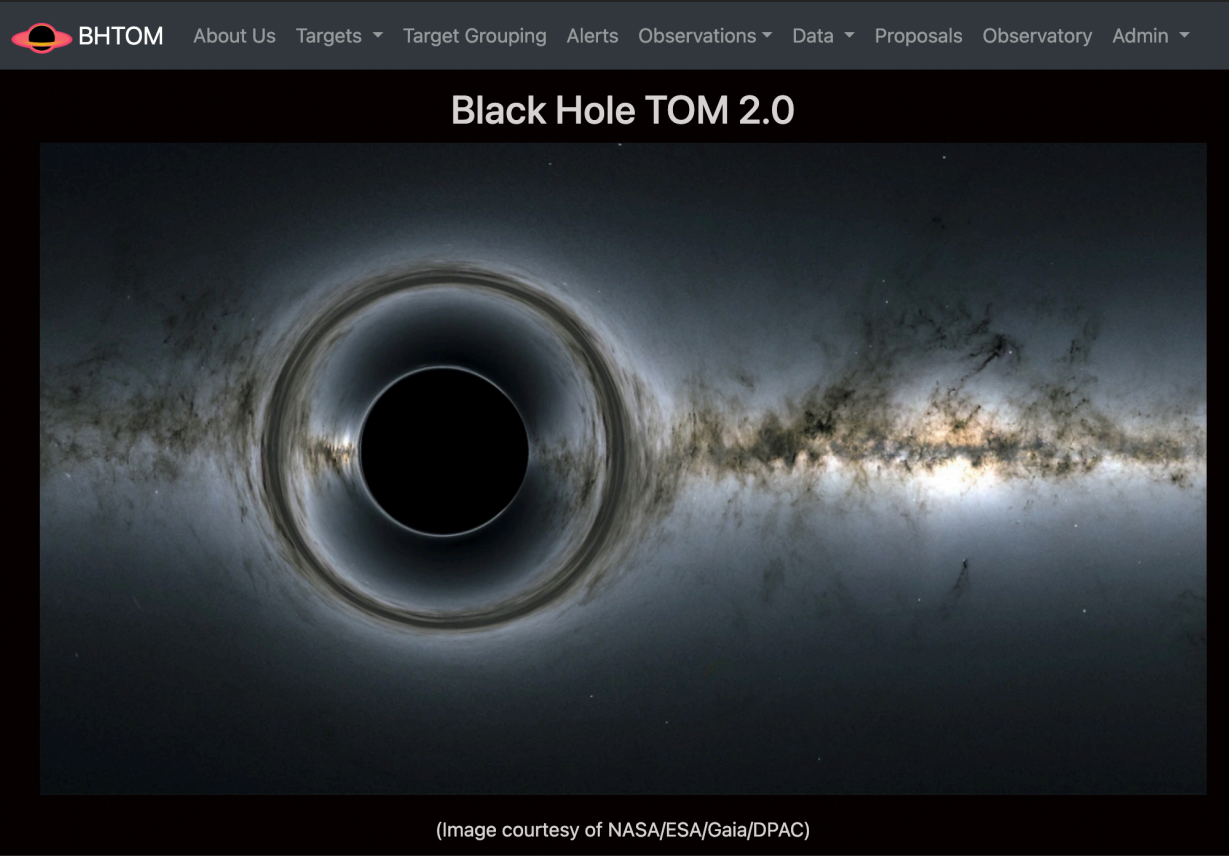


BLACK HOLE TARGET AND OBSERVATION MANAGER (BHTOM)

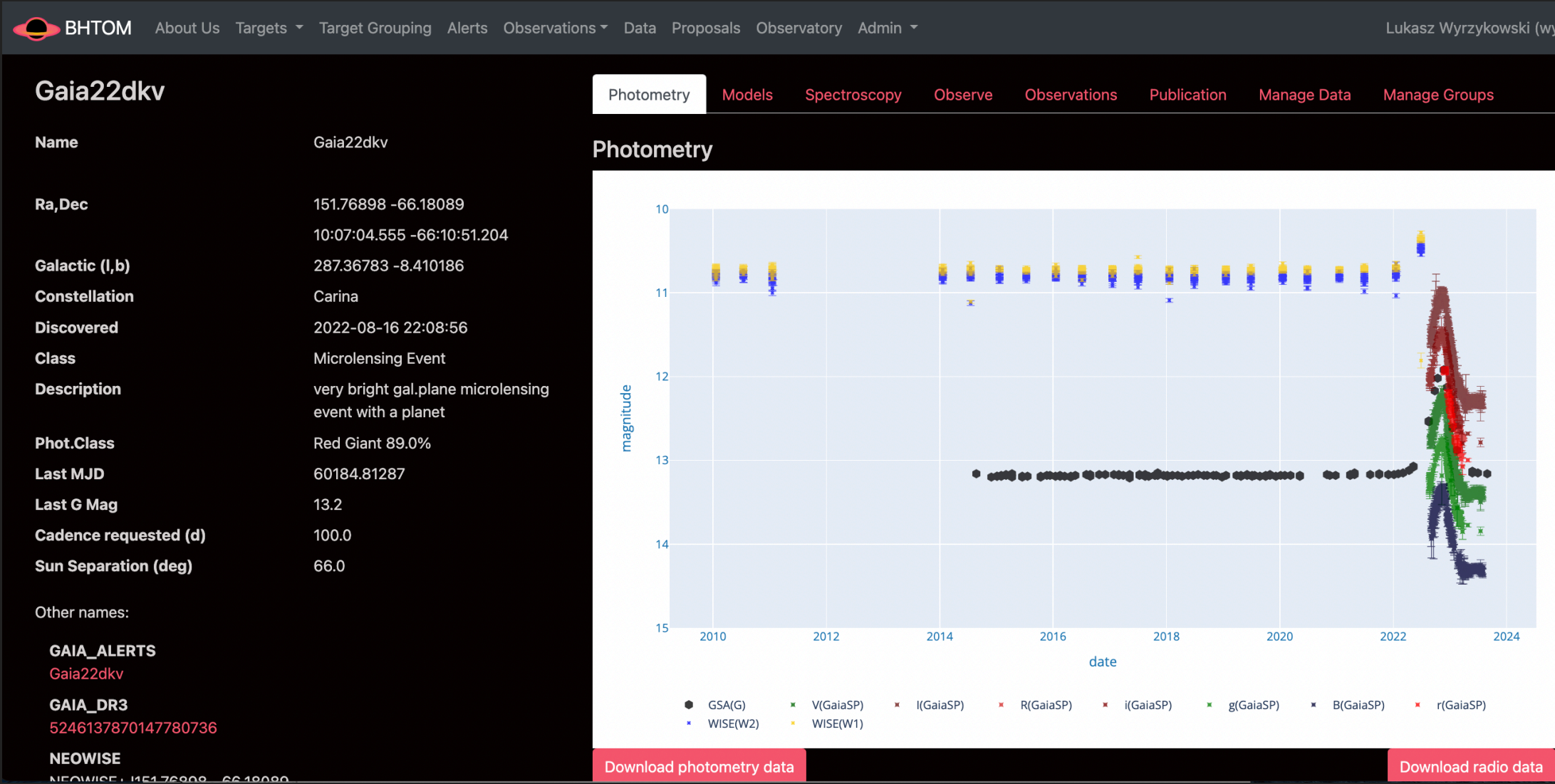
- ▶ web tool for coordination for time-domain observation
- ▶ automated observation requests
- ▶ processing of raw images from heterogenous units
- ▶ automated standardisation
- ▶ archival multi-wavelength time-domain photometry
- ▶ open for new users, new telescopes, new targets!



///AkondLab.



☐	Names	RA	Dec	Nobs	Last Gmag	Last Filter	Importance	Created	Priority	Sun	Class
☐	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
☐	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
☐	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
☐	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

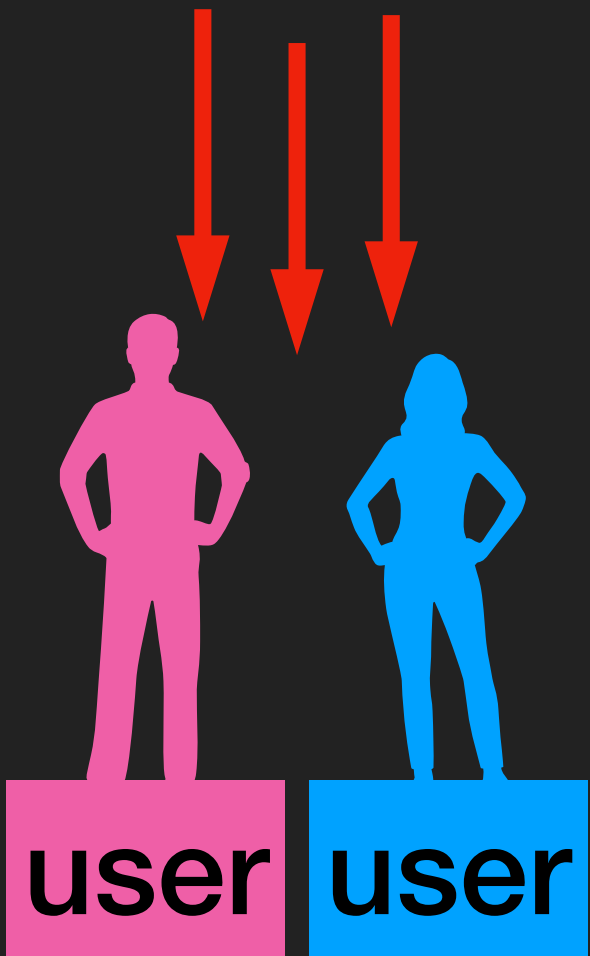


Surveys

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

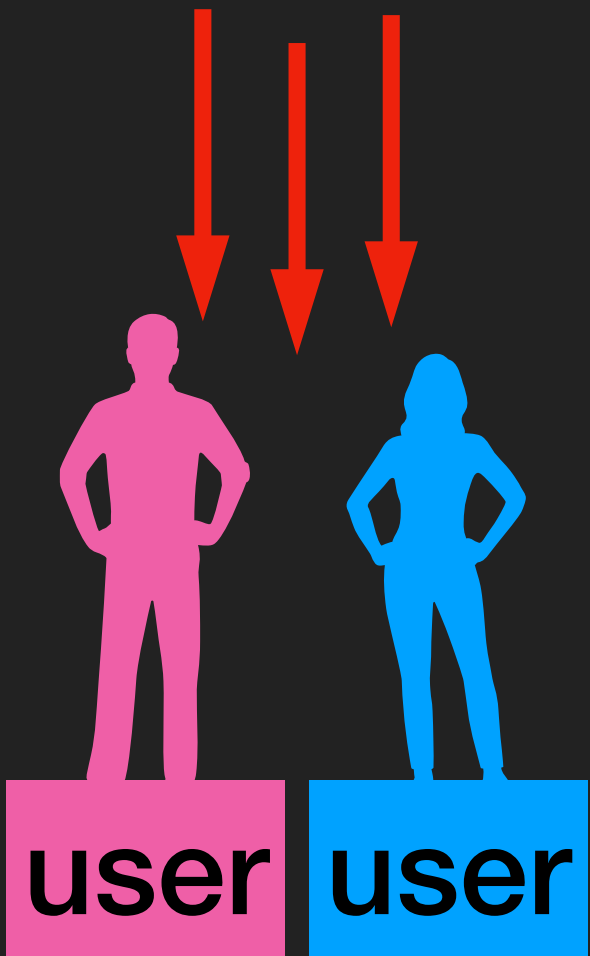


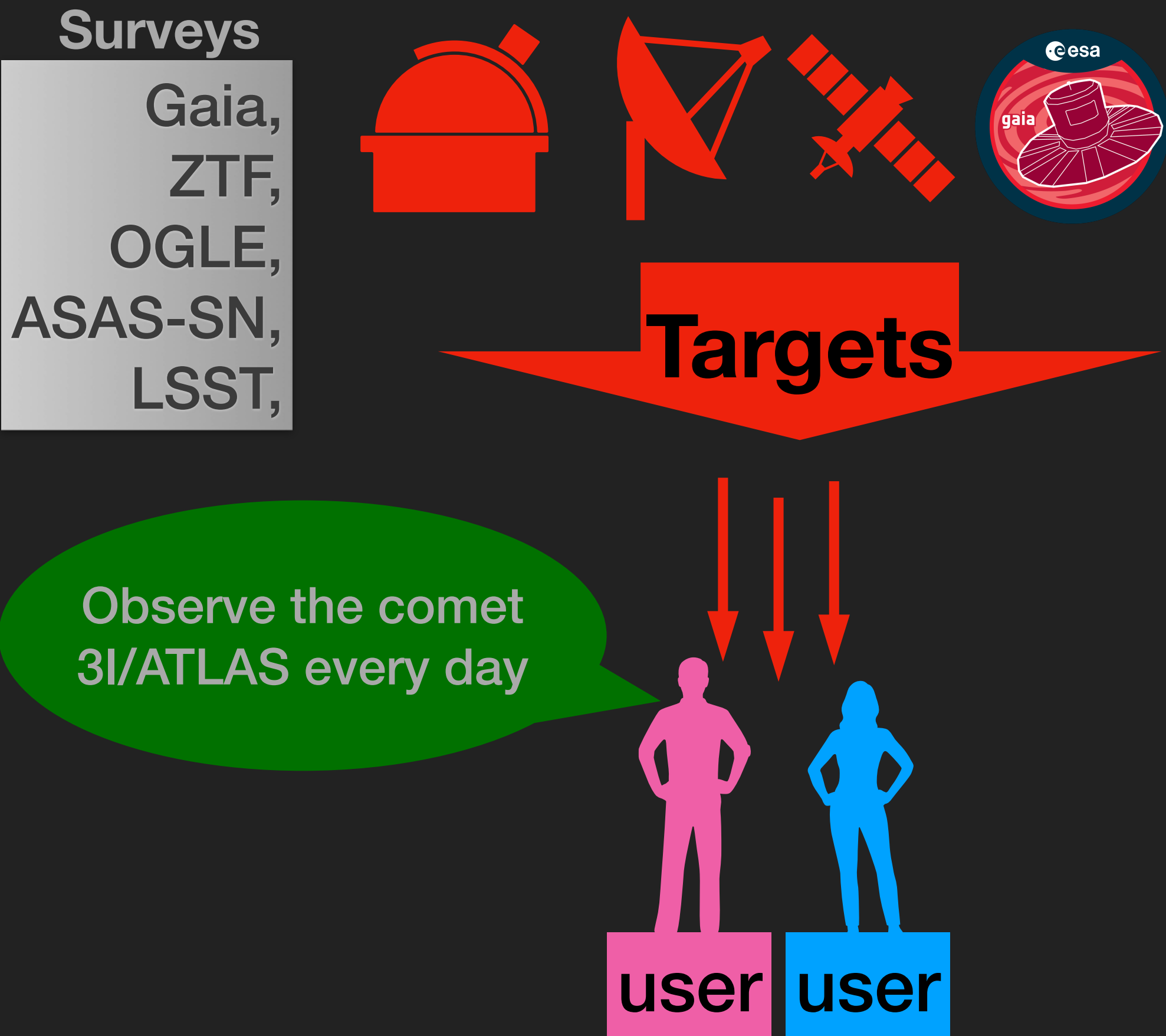
Targets

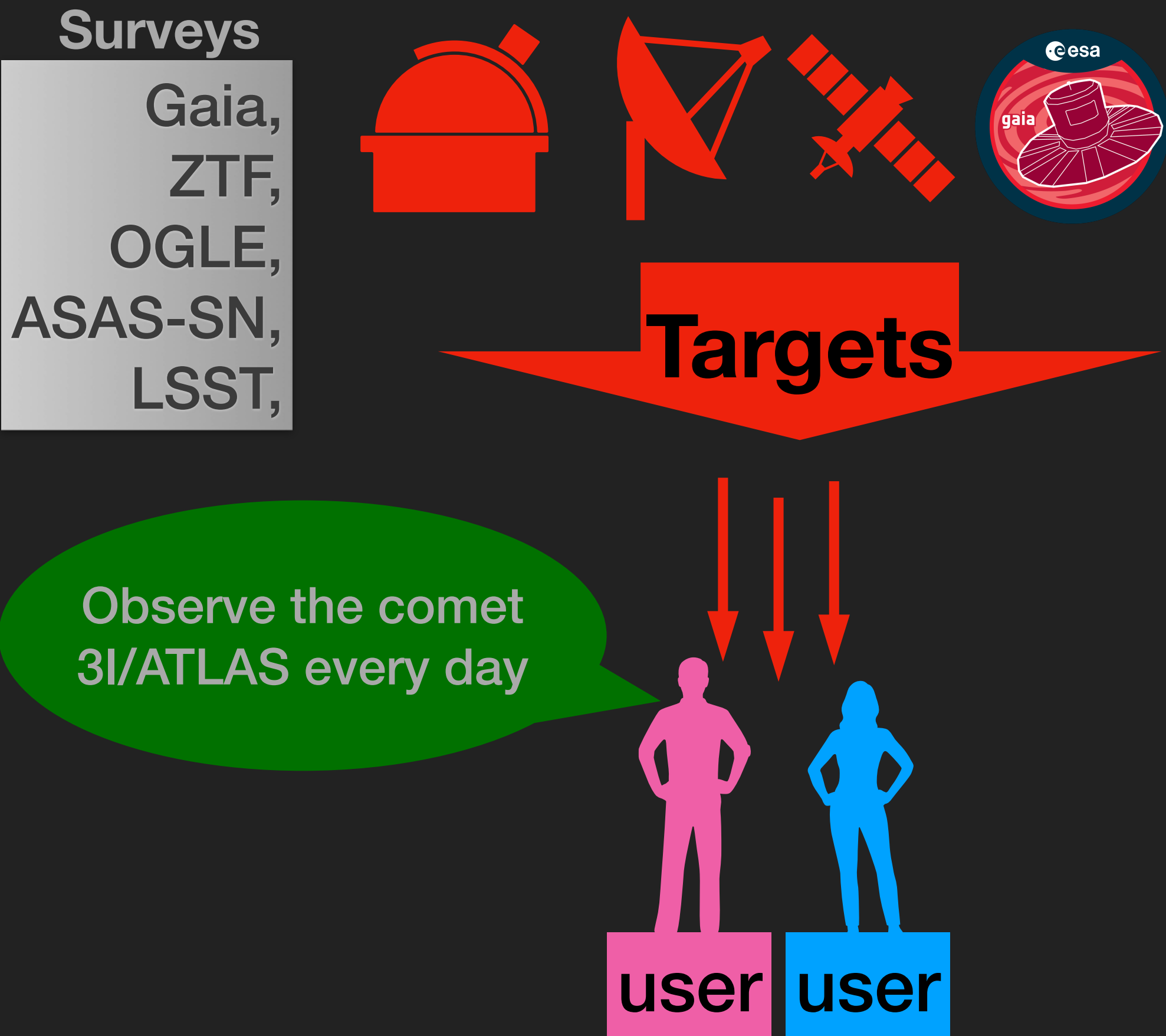


Surveys

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





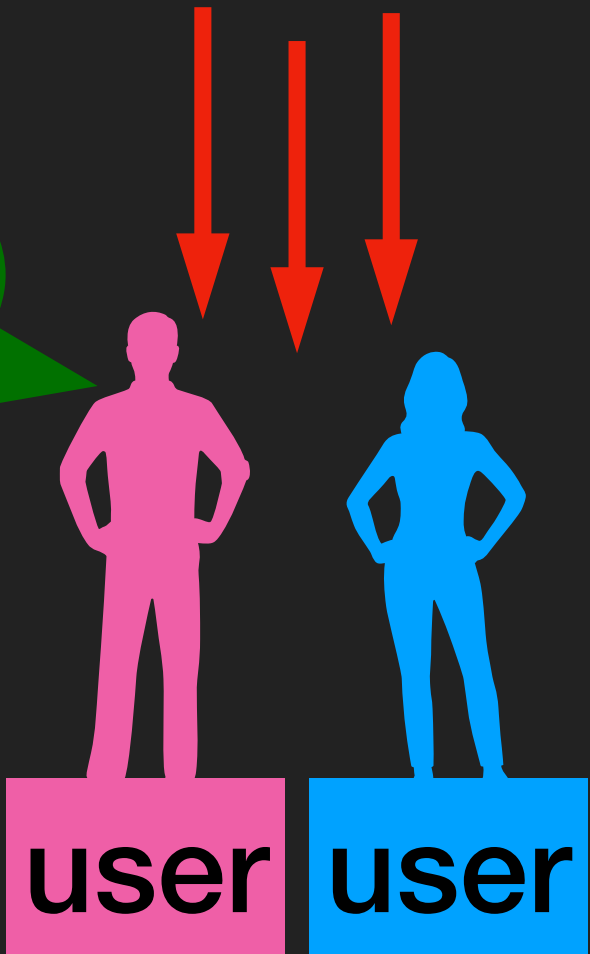


Surveys
Gaia,
ZTF,
OGLE,
ASAS-SN,
LSST,



Targets

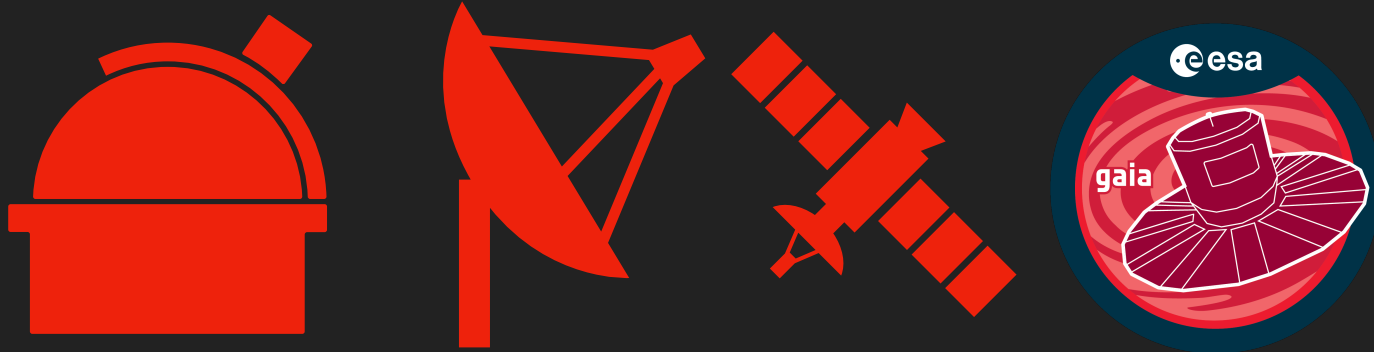
Observe the comet
3I/ATLAS every day



Observing
requests

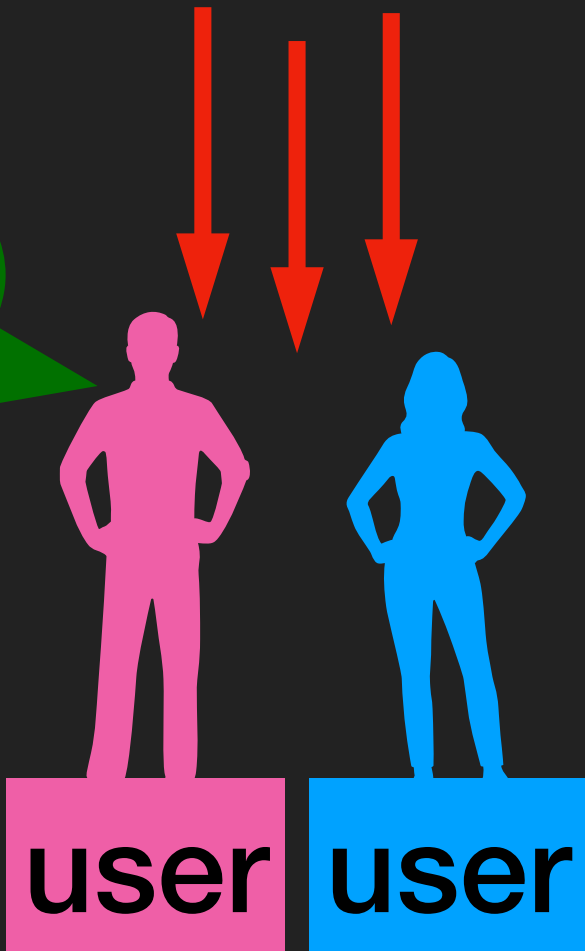


Surveys
Gaia,
ZTF,
OGLE,
ASAS-SN,
LSST,



Targets

Observe the comet
3I/ATLAS every day



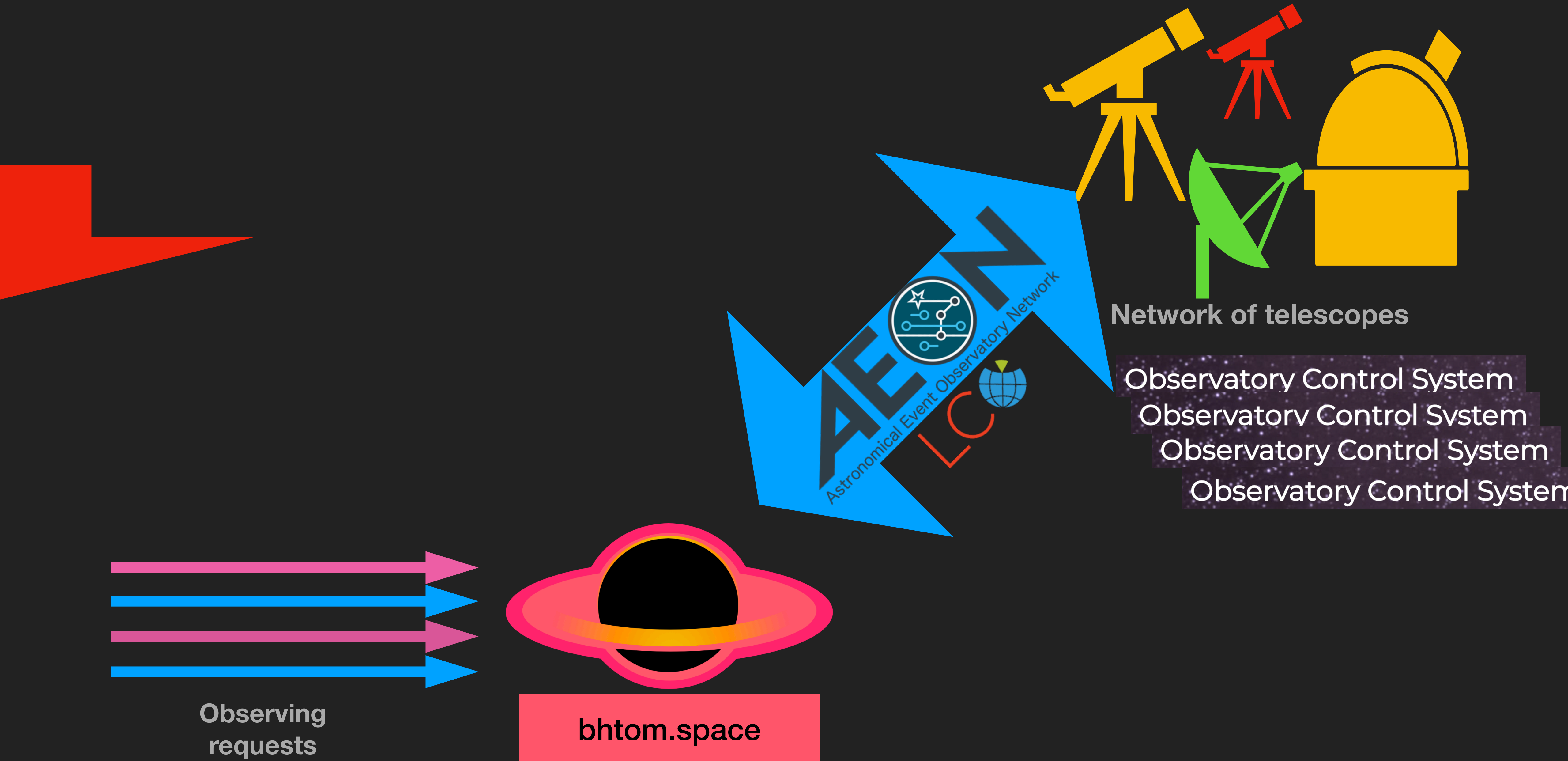
Observing
requests



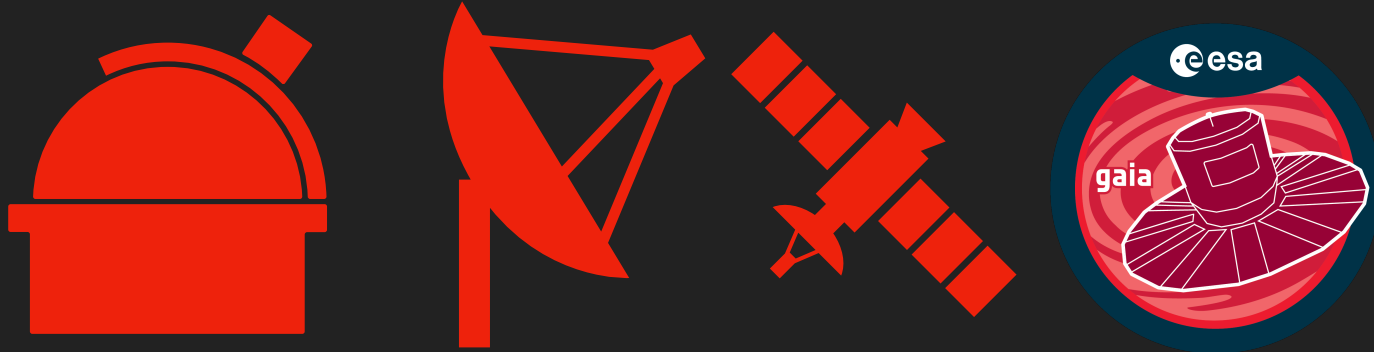
DATA



Network of telescopes

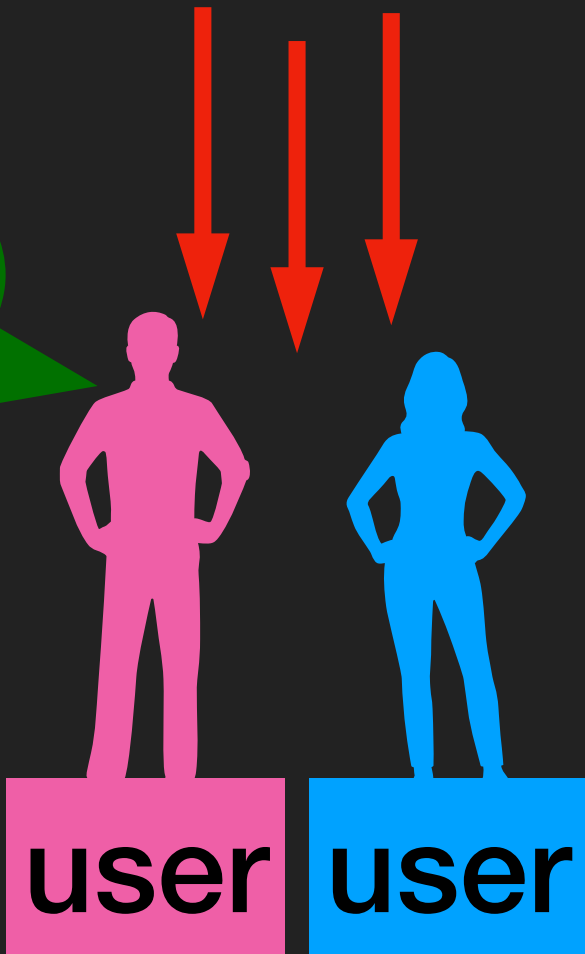


Surveys
Gaia,
ZTF,
OGLE,
ASAS-SN,
LSST,

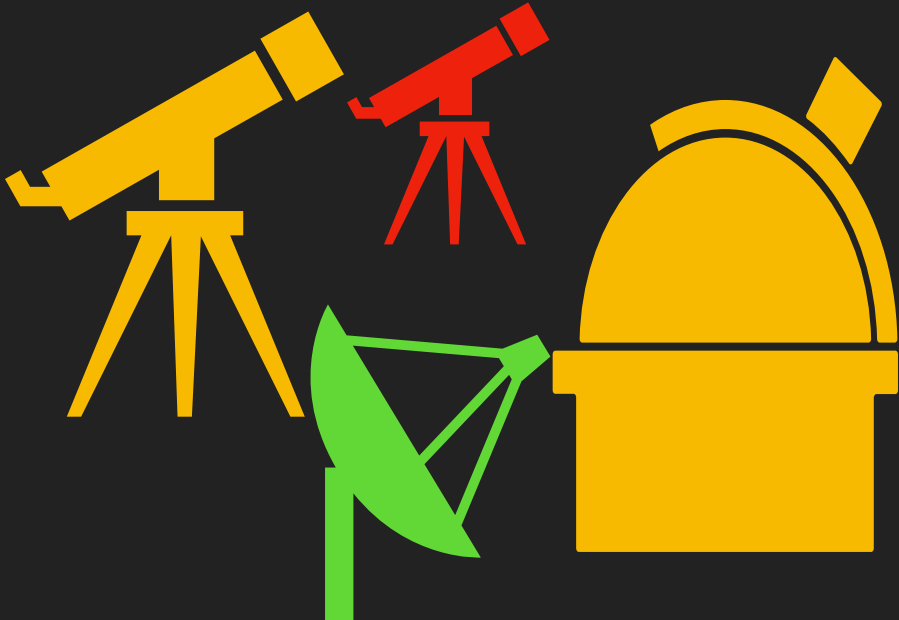


Targets

Observe the comet
3I/ATLAS every day



Observing
requests



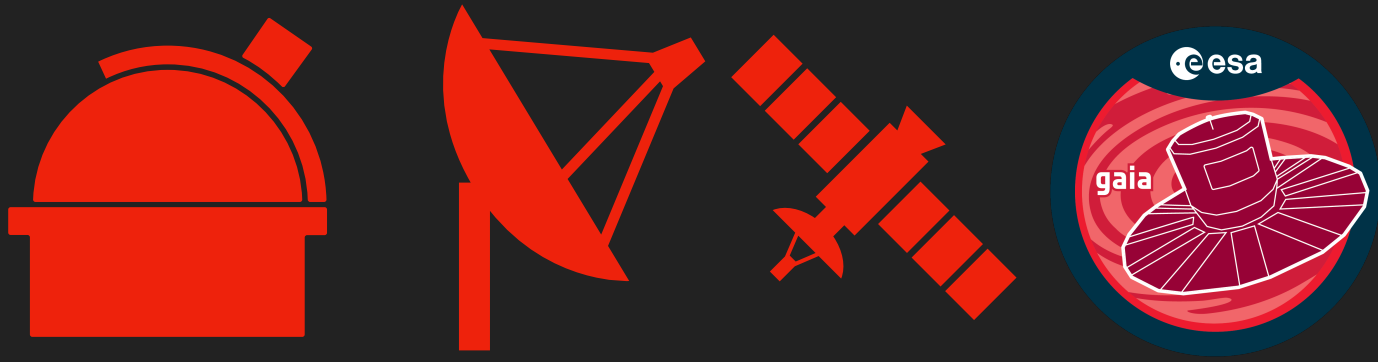
Network of telescopes



Archives

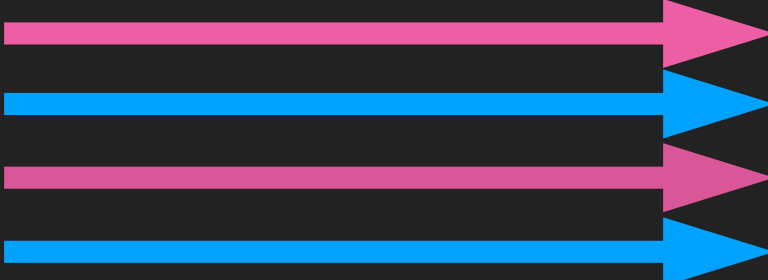
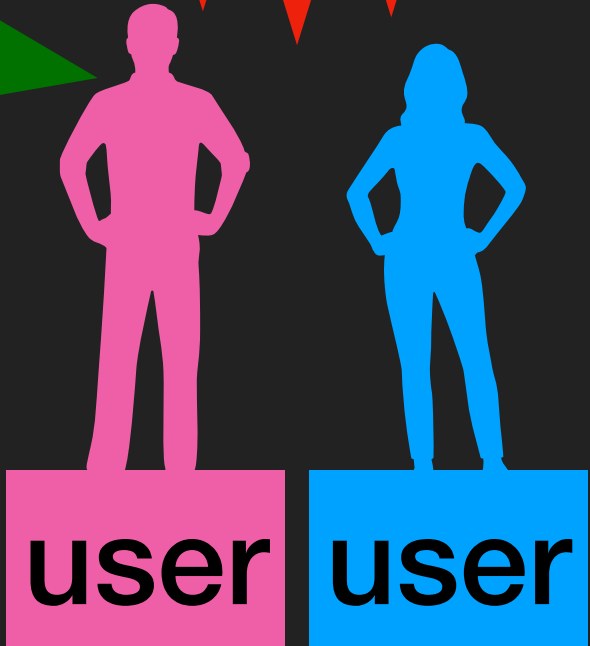
- Atlas
- ZTF
- CRTS
- OGLE
- Gaia
- SDSS
- DASCH

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



Targets

Observe the comet
3I/ATLAS every day



Observing
requests



bhtom.space

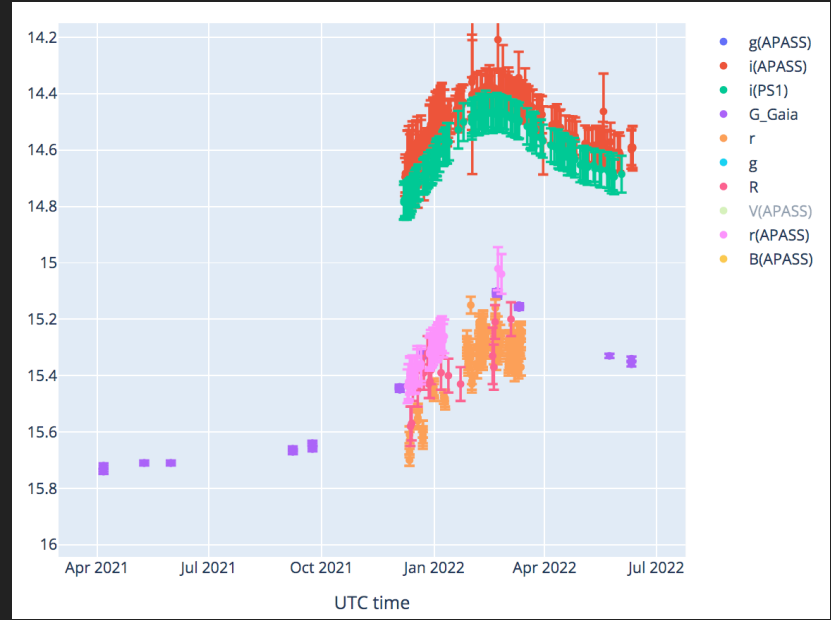
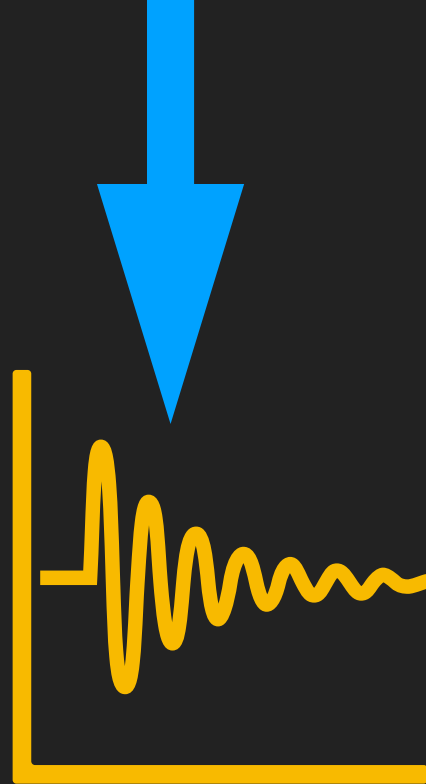


Network of telescopes

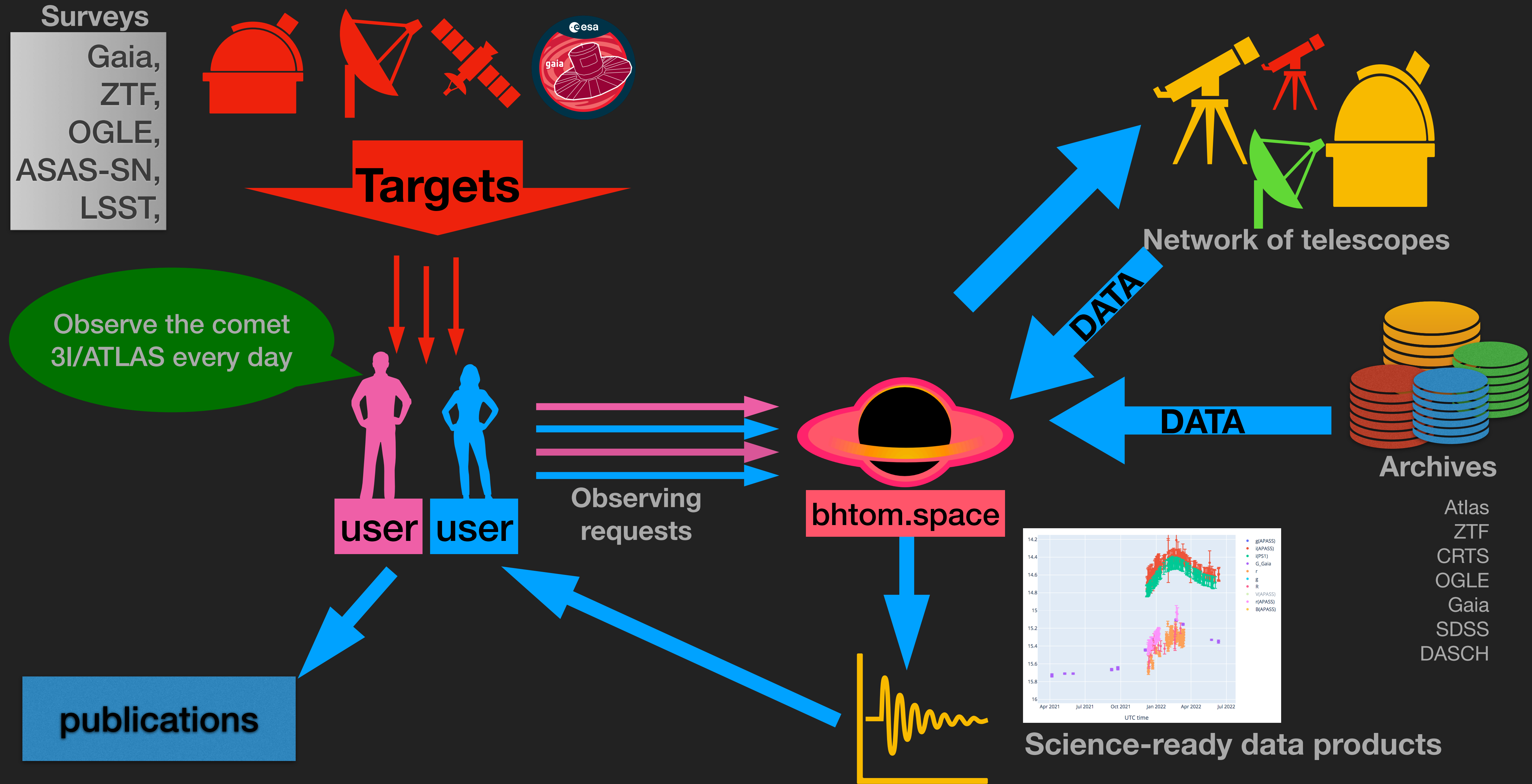


Archives

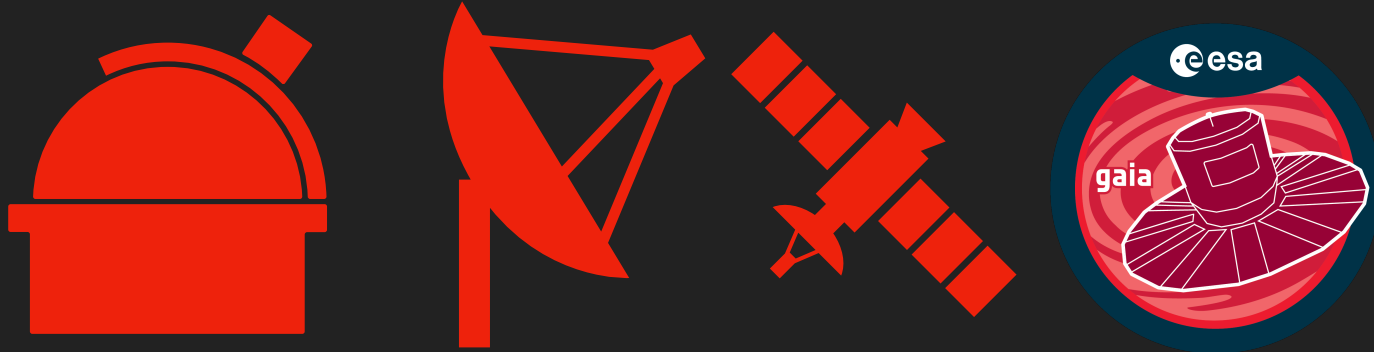
Atlas
ZTF
CRTS
OGLE
Gaia
SDSS
DASCH



Science-ready data products

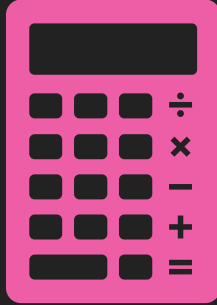


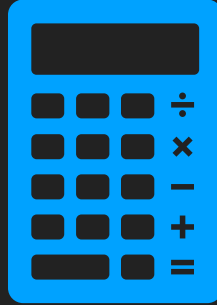
Surveys
Gaia,
ZTF,
OGLE,
ASAS-SN,
LSST,



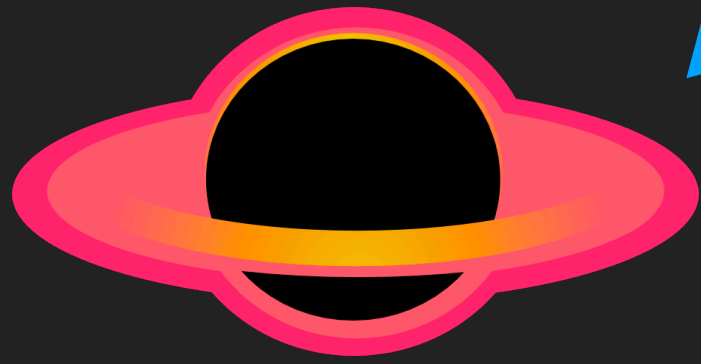
Targets

Observe the comet
3I/ATLAS every day

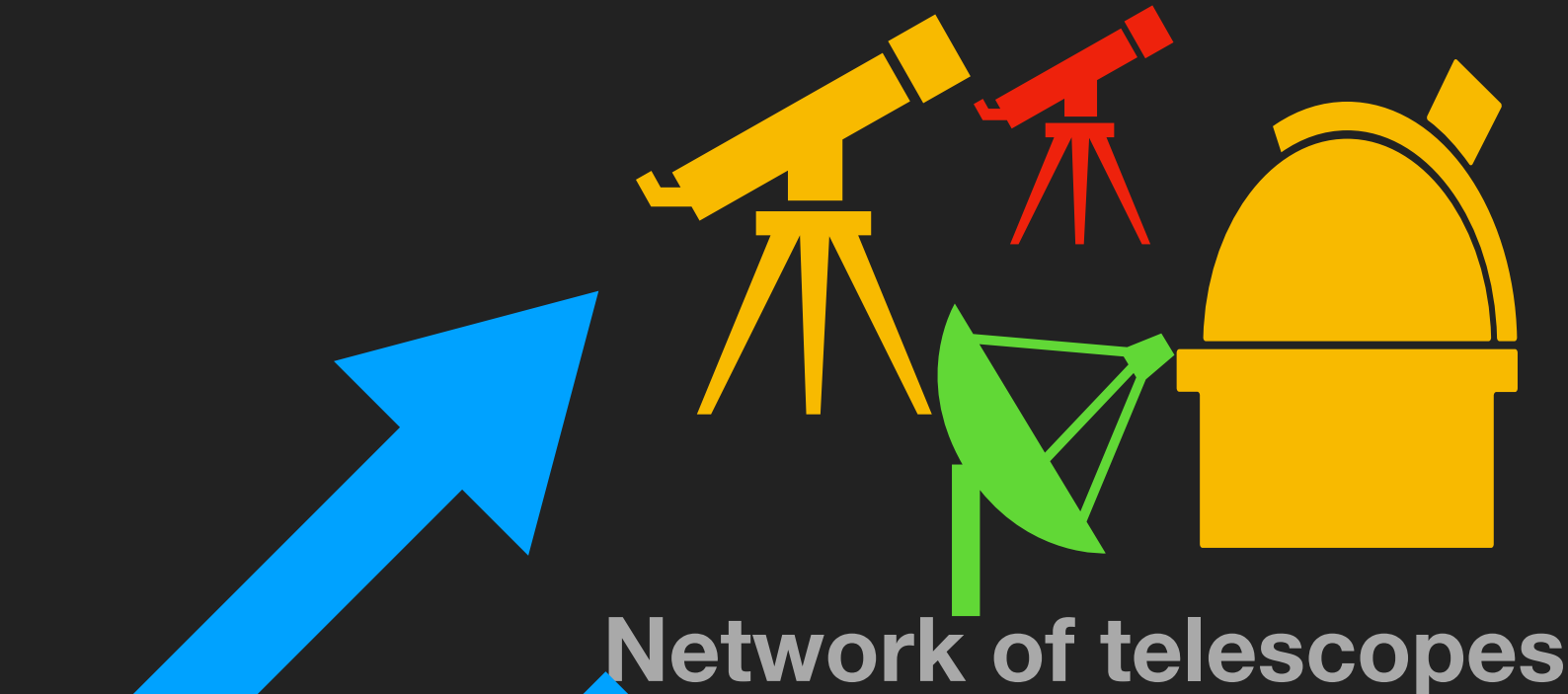

bot


bot

Observing
requests


bhtom.space

publications

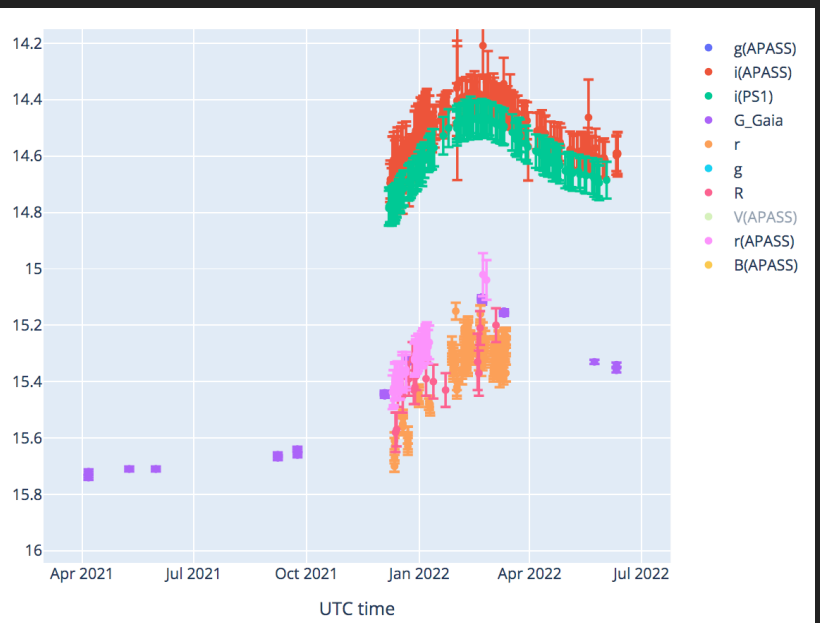
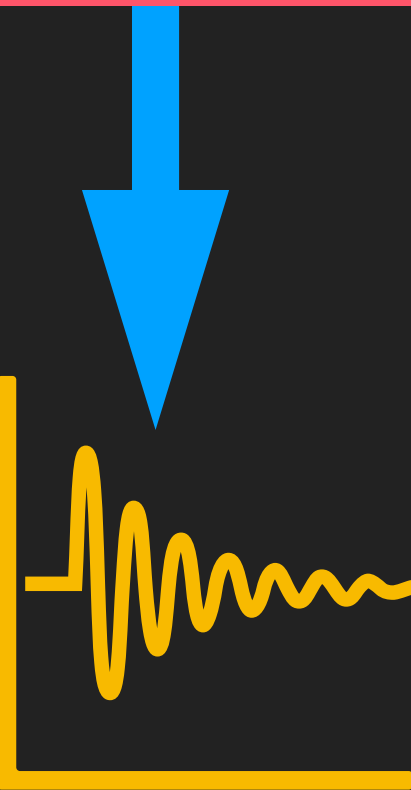


DATA

DATA



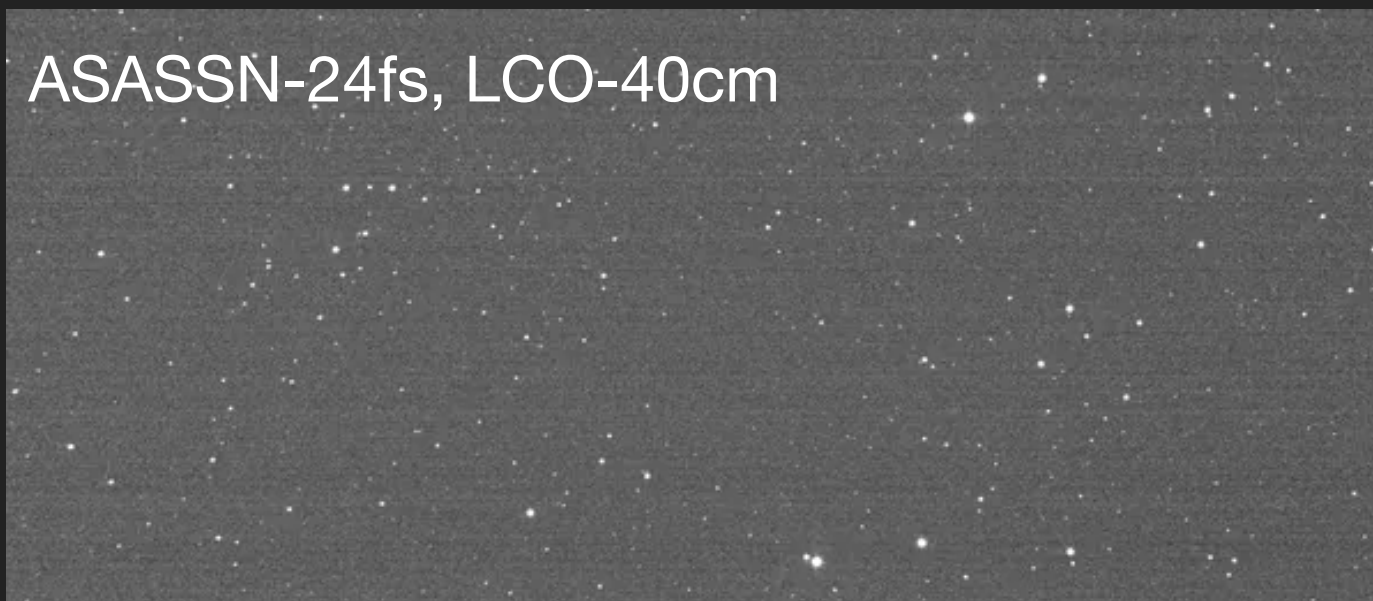
Atlas
ZTF
CRTS
OGLE
Gaia
SDSS
DASCH



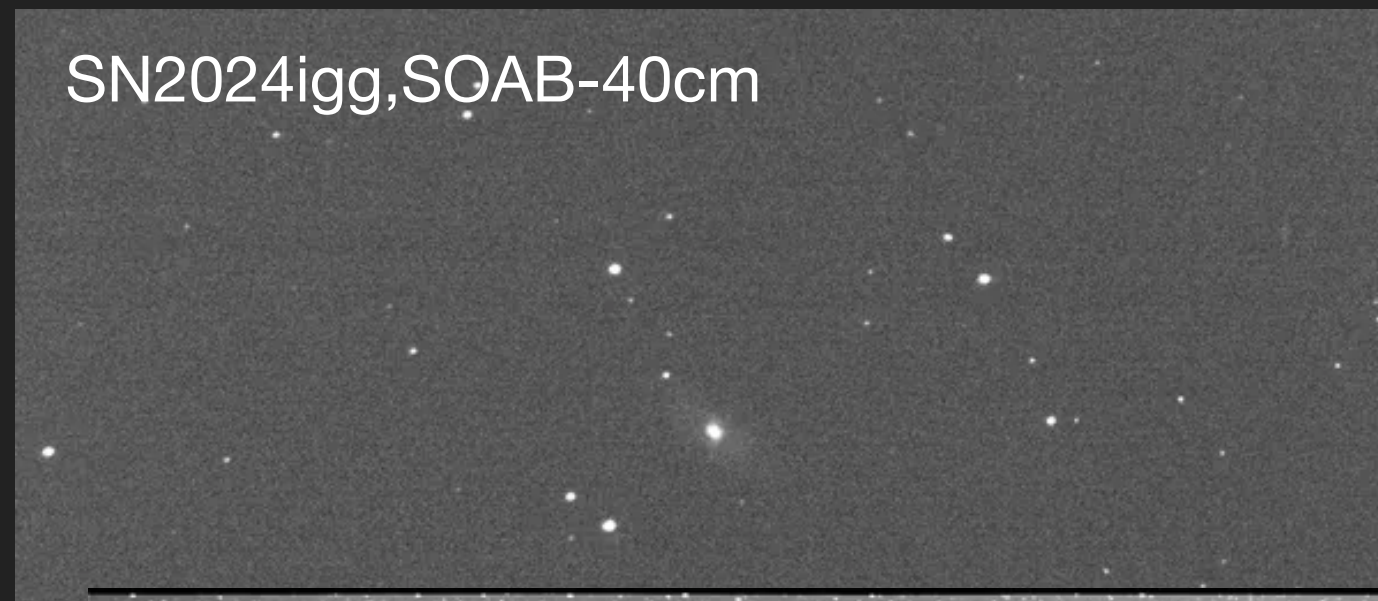
Science-ready data products

BHTOM – FROM IMAGE REQUEST TO SCIENCE-READY LIGHT CURVES

- ▶ fully automated data processing - PSF/Aper photometry - uniformly for all 150+ telescopes
- ▶ standardisation of observations from any filter to Gaia Synthetic Photometry
- ▶ downloadable and science-ready - for registered users



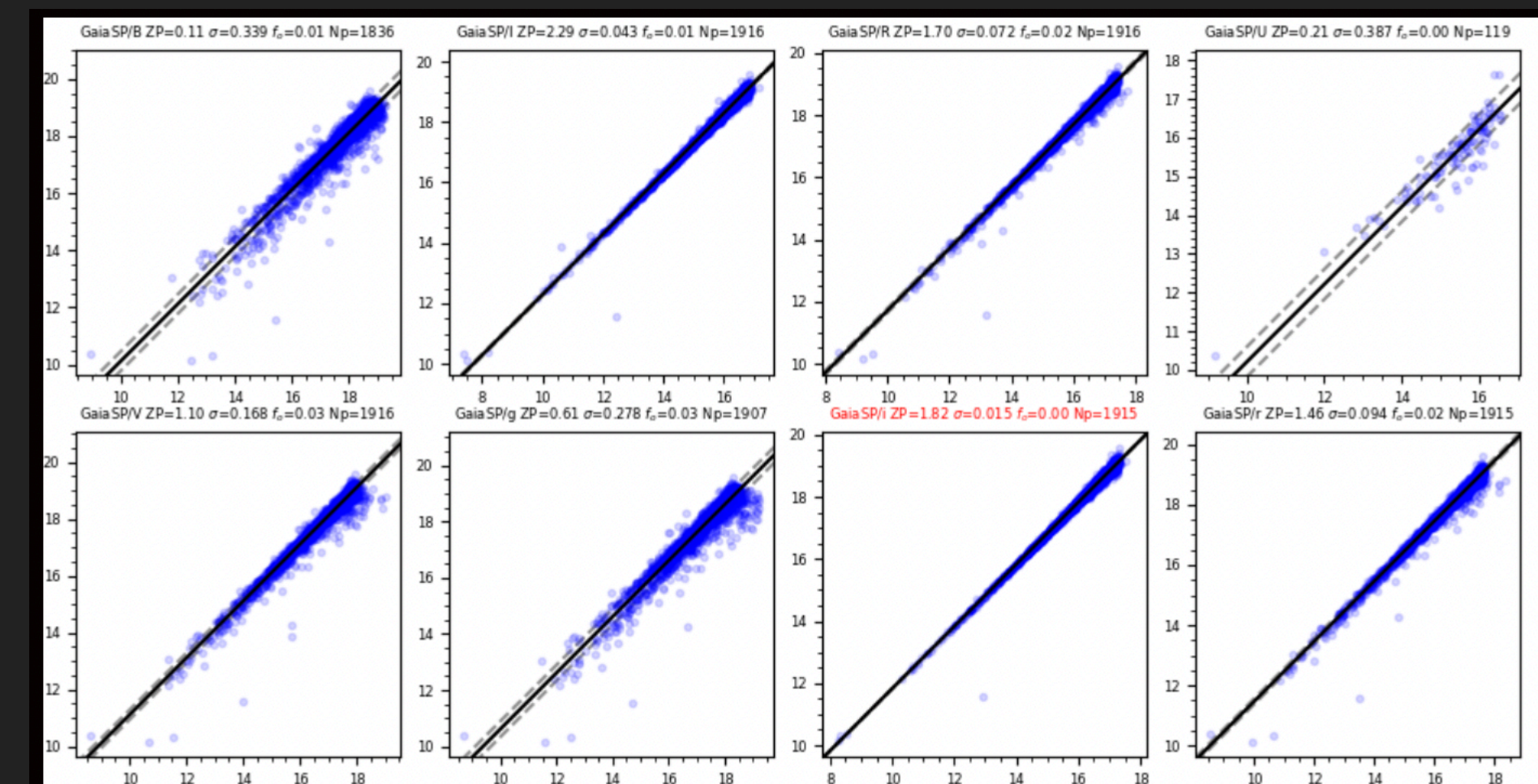
SN2024igg, SOAB-40cm



SN2024ggi, GoChile-40cm



Gaia24amo, LCO-1m

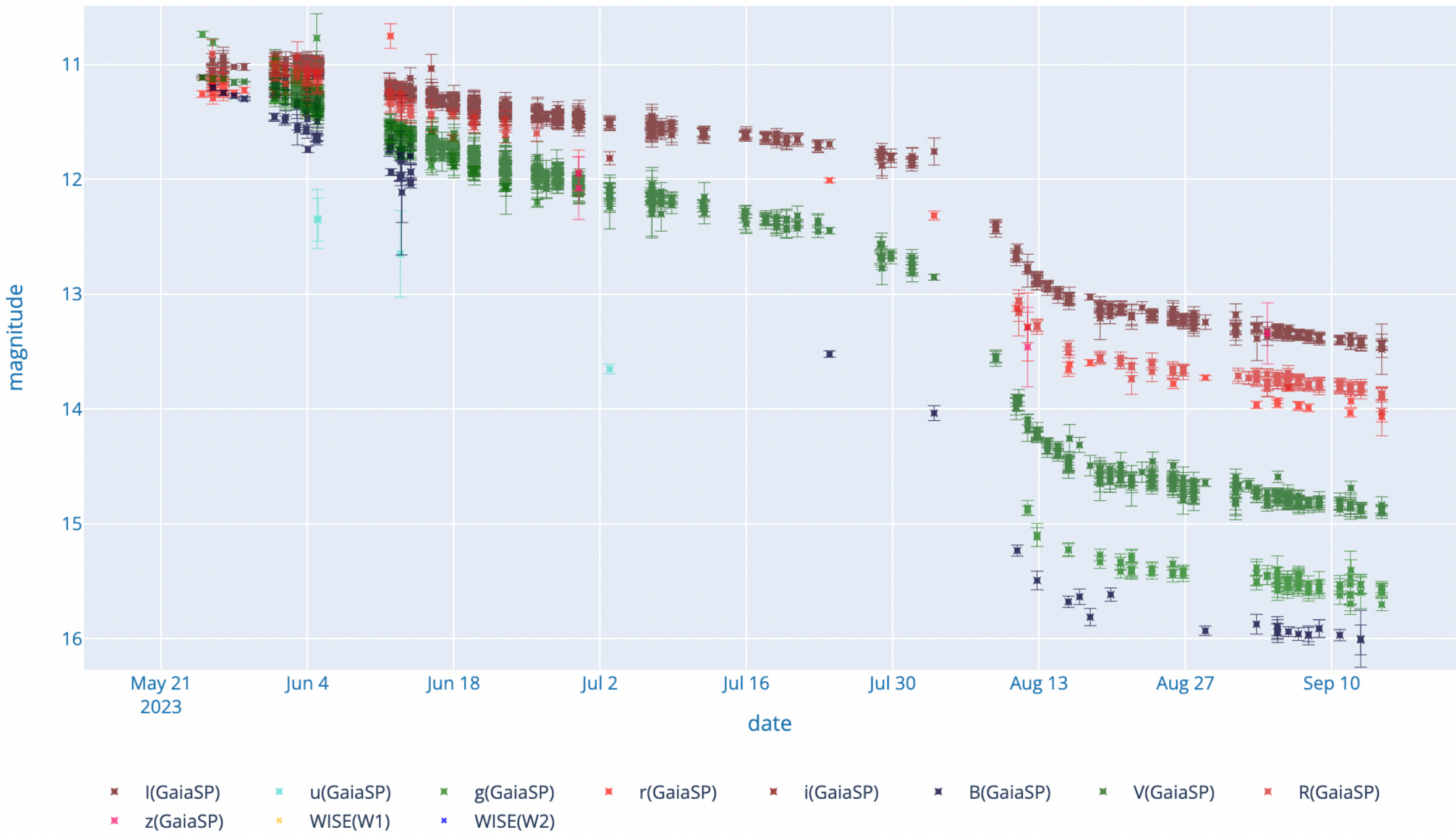


Automated detection of filter
and zero-point fit to Gaia Synthetic Photometry

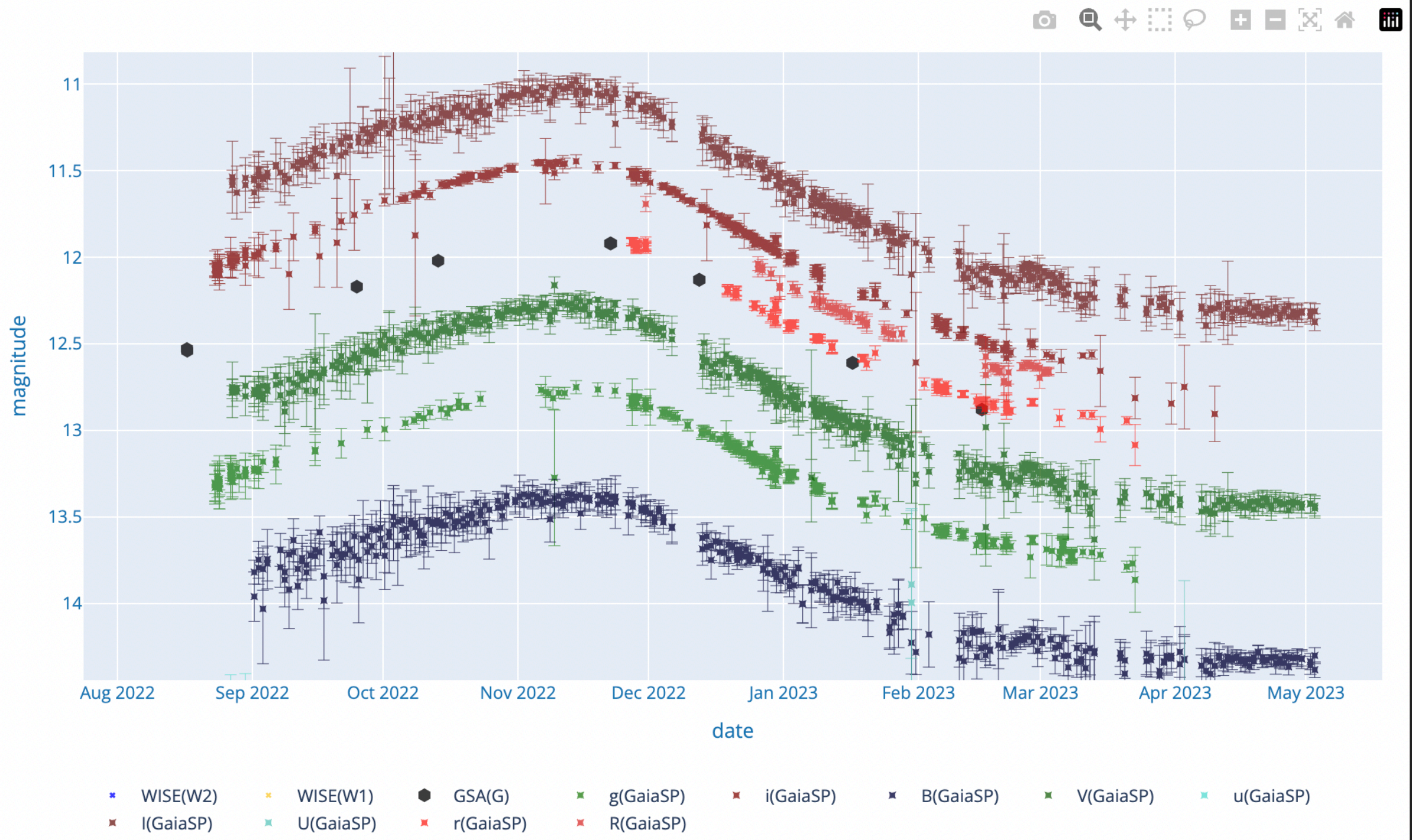
BHTOM – FROM IMAGE REQUEST TO SCIENCE-READY LIGHT CURVES

- ▶ fully automated data processing - PSF/Aper photometry - uniformly for all 150+ telescopes
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SN2023ixf

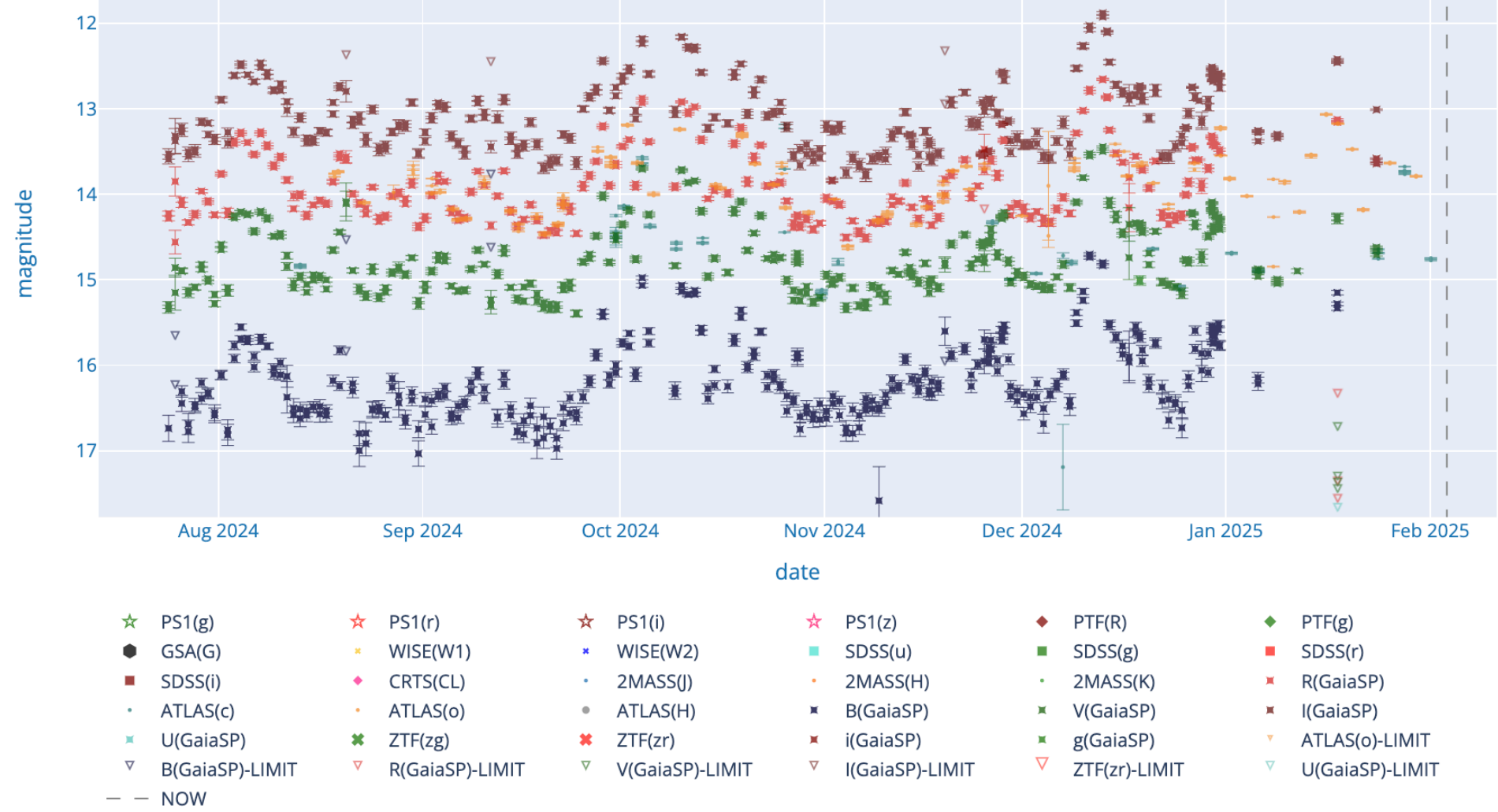


Gaia22dkv -planetary microlensing event

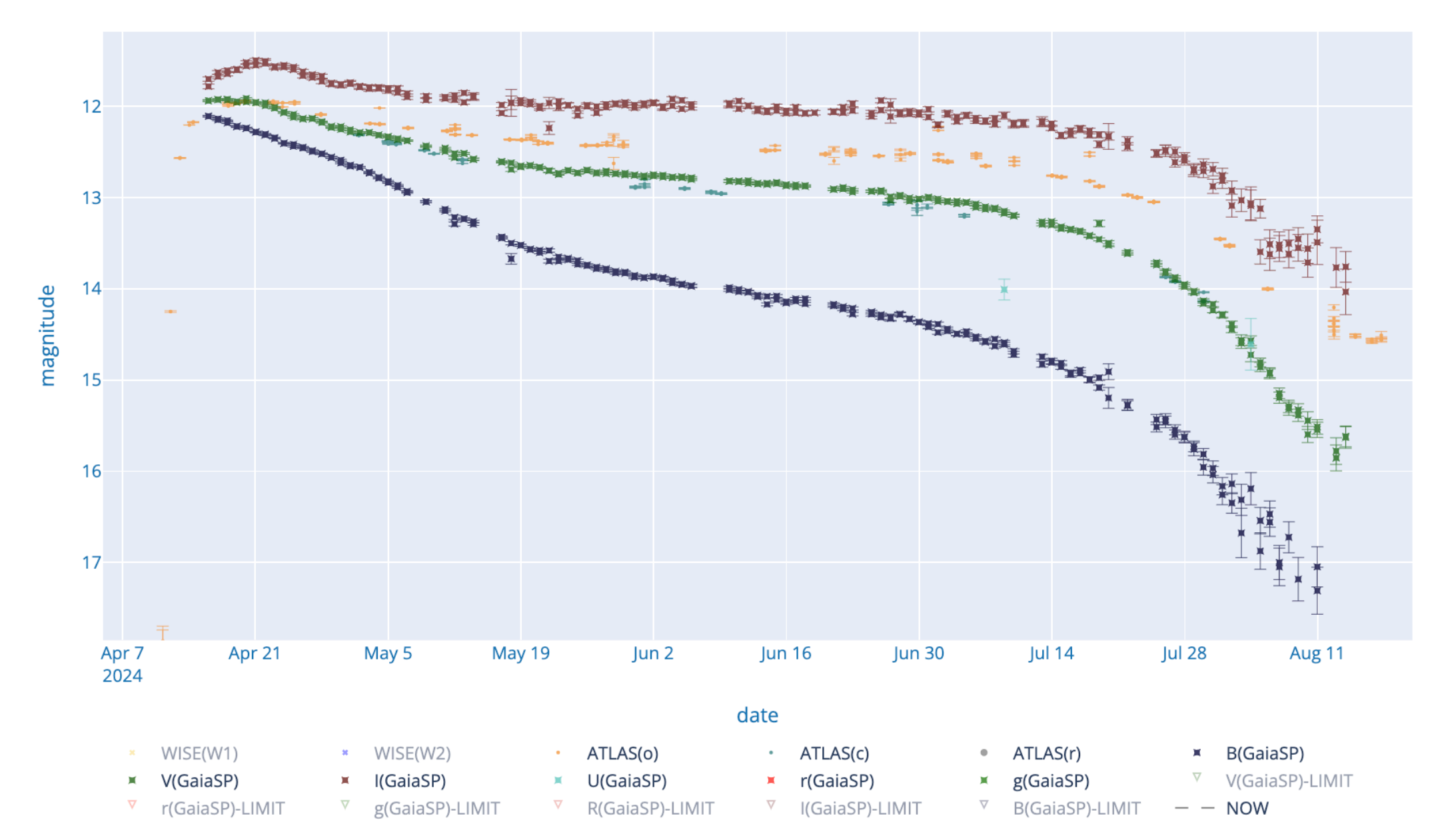


BHTOM – SCIENCE CASES

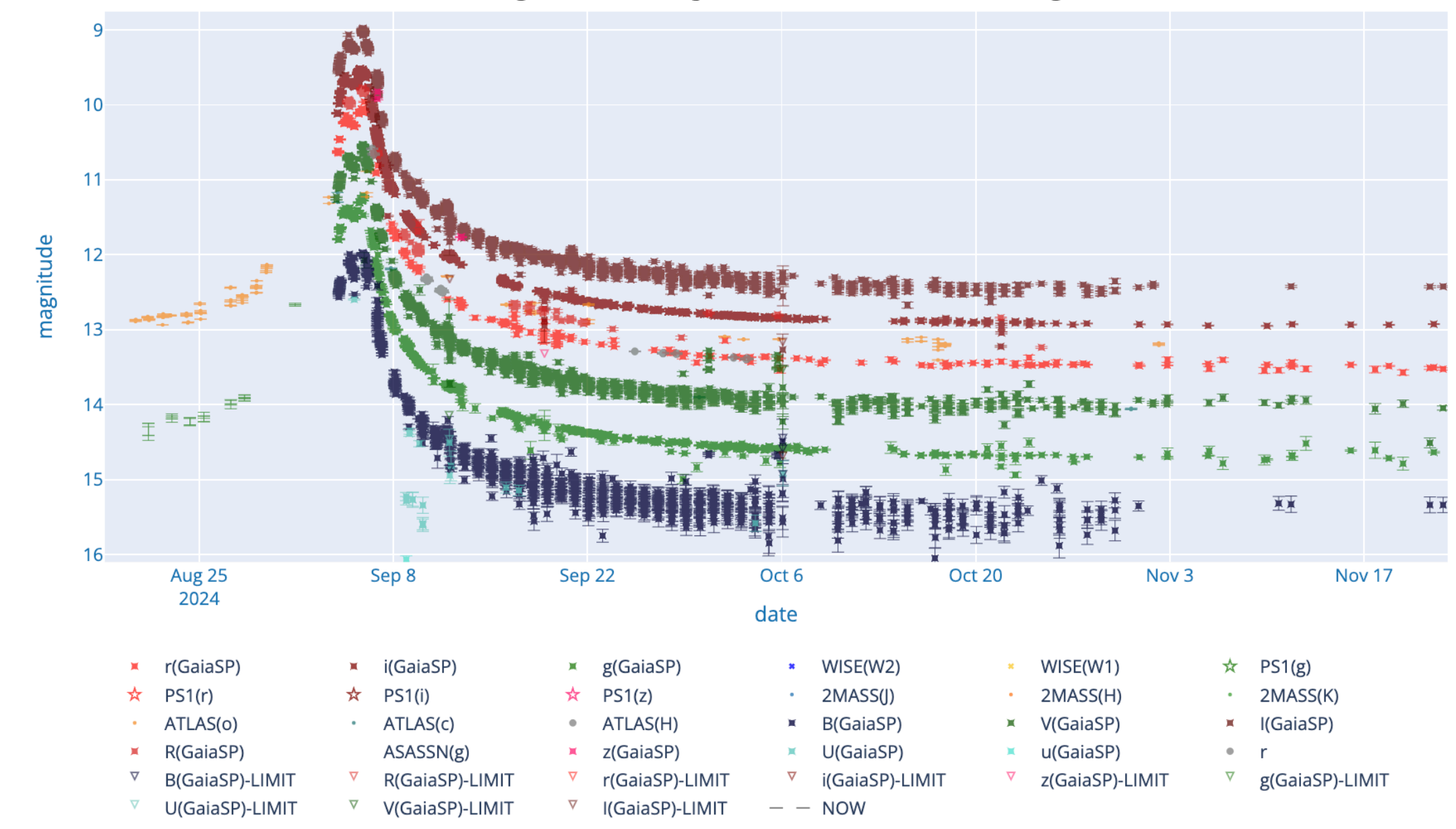
TT Ori - eruptive variable



SN2024ggi

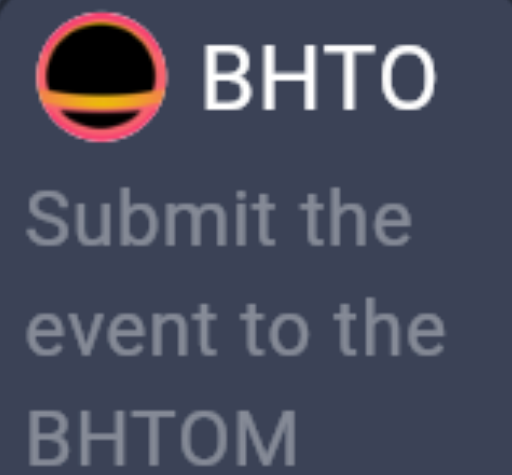


ASASSN-24fs - long binary microlensing event



BHTOM – PROGRAMABLE ACCES (API)

- ▶ All functionalities of BHTOM are accessible via API
- ▶ Scripting the data flow to/from telescopes, observing requests, images upload for processing
- ▶ Astro-COLIBRI connected already!
- ▶ We provide ready scripts for: data download, data upload, target selection



BHTOM2 API Documentation

DATA DOWNLOAD API

Here we present end-points how to download the photometry and radio data from BHTOM.

Please contact us if you plan to use the data in a publication. By downloading the data from BHTOM you agree to follow our data policy and to use this acknowledgment:

The data was obtained via [BHTOM] (<https://bhtom.space>), which has received funding from the European Union's Horizon 

For more information about acknowledgement and data policy please visit <https://about.bhtom.space>

1. Photometry download

With this API one can download all photometric observations (magnitudes) in semi-color separated form. The columns of the output are the following:

MJD;Magnitude;Error;Facility;Filter;Observer

Request

- **Method:** POST
- **URL:** `/targets/download-photometry/`

BHTOM – PROGRAMABLE ACCES (API)

- ▶ Example of BHTOM API in PRISM system for amateur observers (Savalle et al. 2025)

<https://www.prism-astro.com/>

PRISM - Version Avancée fonctionnalités_vo21 64 bits 11.4.34.40

Fichier Edition Carte du ciel Visualisation Traitements Addition-Recalage Imagerie Couleur Analyse Spectrographie Observatoire Outils Configuration Fenêtres Aide

Requete BHTOM

Recevoir Envoyer Gérer Gen Jeton Site BHTOM Fermer Help

Objet

RA (*Dec) 0 Dec (*Dec) -90

Min 0 Max +360

Importance 0 Dist. Soleil 70

Filtrage par classification

- Galaxy
- LBV
- LPV
- M-dwarf flare
- Microlensing Event**
- Nova
- Peculiar Supernova
- QSO

Filtrage par Groupe

- 0 importance
- 2021 EA/WD search project: Ga
- AGNs
- AISV survey
- ASV
- AvinashFlashers
- BeXB
- BHTOM_tests
- C2PU_Targets
- candidates for lensed QSO from

Liste Filtrée de BHTOM

N°	Objet	Nom. alt.	Arcmin	Magn.	Type	ALPHA 2000	DELTA 2000
1	Gaia18ajz	Microlensir	19.9	110.0		18h30m14.460s	-08°13'12.76"
2	Gaia19dke	Microlensir	15.5	116.0		19h25m58.682s	+28°24'24.70"
3	Gaia23cri	Microlensir	20.0	125.0		19h54m45.569s	+20°54'20.02"
4	Gaia23bor	Microlensir	15.6	95.0		17h25m00.130s	-39°54'25.24"
5	Gaia23cqh	Microlensir	19.1	117.0		19h08m36.578s	+11°08'30.55"
6	Gaia22dkv	Microlensir	13.0	72.0		10h07m04.555s	-66°10'51.20"
7	Gaia23cki	Microlensir	19.2	101.0		17h55m13.032s	-33°35'31.70"
8	Gaia23air	Microlensir	17.8	85.0		06h02m24.631s	-44°28'11.96"
9	Gaia23cnu	Microlensir	15.9	116.0		18h56m25.440s	-18°04'50.88"
10	Gaia21azb	Microlensir	18.5	121.0		19h22m33.350s	+06°31'07.90"
11	Gaia21dnp	Microlensir	19.9	123.0		21h25m29.890s	+46°25'08.83"
12	GaiaDR3-ULEN	Microlensir	15.8	103.0		18h01m09.168s	-32°33'27.72"

Enlever Monter Editer Descendre Ajouter Carte sur Infos Transit Pointer

☒ Afficher ces objets dans les cartes du ciel ☐ Afficher le numéro de la liste à côté de l'objet ☐ Enlever le nom de l'objet à l'affichage

Objets: 21 Temps sidéral local : 03h35m29s Temps TU: 11/09/2025 04:04:23

Le ciel EQ.2000-1-1, Zoom=1, Alpha= 22h29m20s Delta= +16°37'50" 11/09/2025 04:03:00 TU [Window1.mapsky] Observatoire de Paris [France]

W N S E Z

Zenith

Pôle Nord

Gaia23cqh

Gaia21dnp

Gaia19dke

Gaia23cri

Gaia23cnu

Gaia18ajz

Gaia19eca

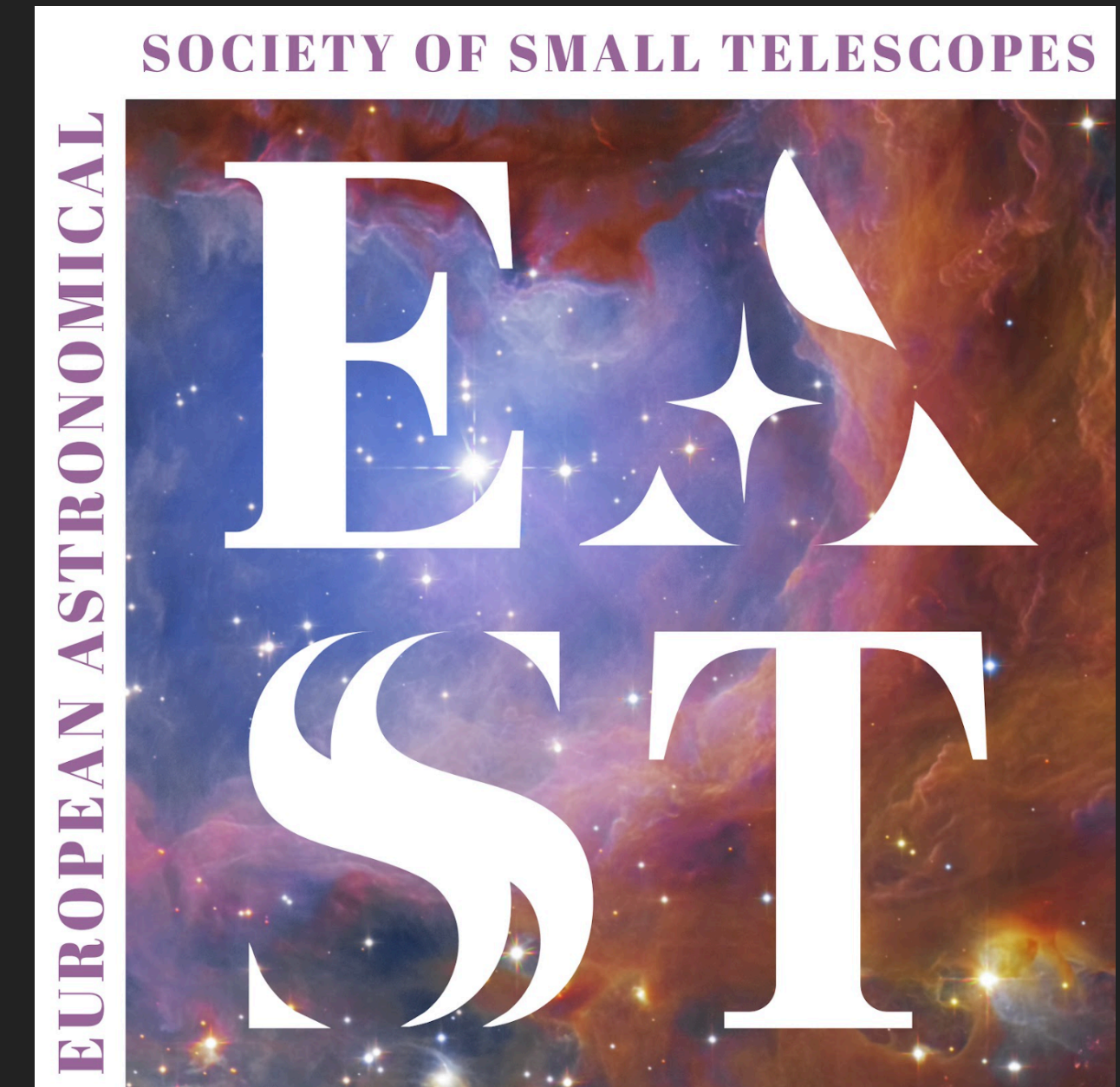
Mode carte Azimutal, Azimutal fixe, Date/heure PC temps réel EQ. J20

Hub non requis/défini

EUROPEAN ASTRONOMICAL SOCIETY OF SMALL TELESCOPES (EASST)

<https://easst.eu>

- ▶ Advancing Citizen Science with the use of small telescopes
(with BHTOM as the core tool)
- ▶ Training in observing and BHTOM
- ▶ Coordinating data exchange between professionals and amateurs
- ▶ Expanding the telescope network for science, outreach and space industry
- ▶ Enhancing telescope technology
- ▶ Protecting dark skies
- ▶ We seek new partners!



Funded on Valentines Day 2025

Ambassadors

AMBASSADORS OF THE EASST



Emilio Molinari -
Italy



Nicholas
Rattenbury - New
Zealand



Pedro Humire -
South America



Süleyman Fişek -
Türkiye

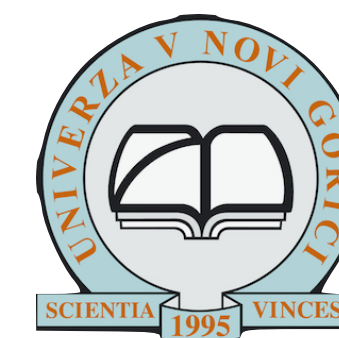


Edita Stonkute -
Lithuania



Stephane Basa —
France

Science partners



thank you!



LW@ASTROUW.EDU.PL

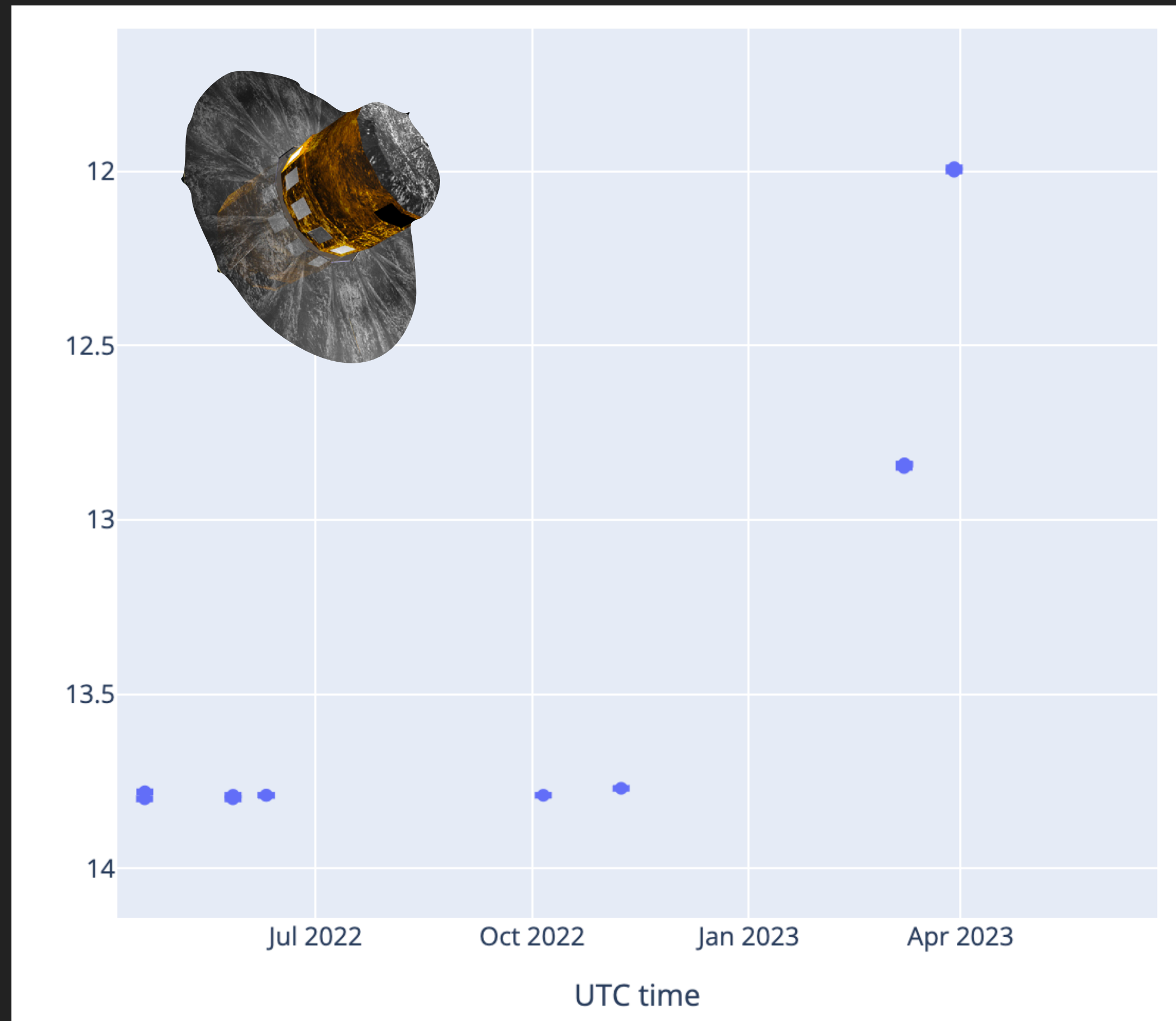


BHTOM.SPACE



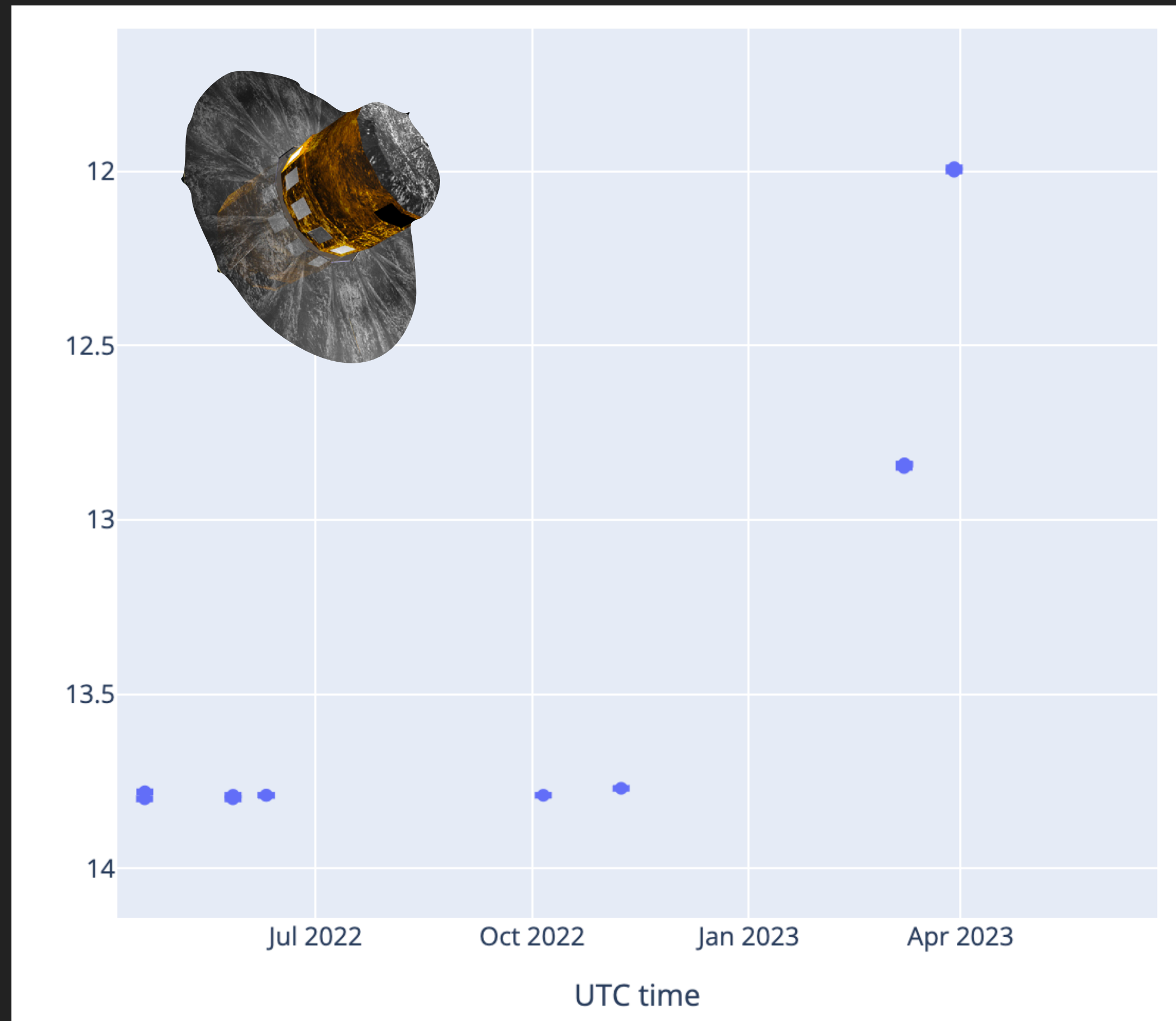
EASST.EU

GAIA23BAY ▶ Example alert from Gaia

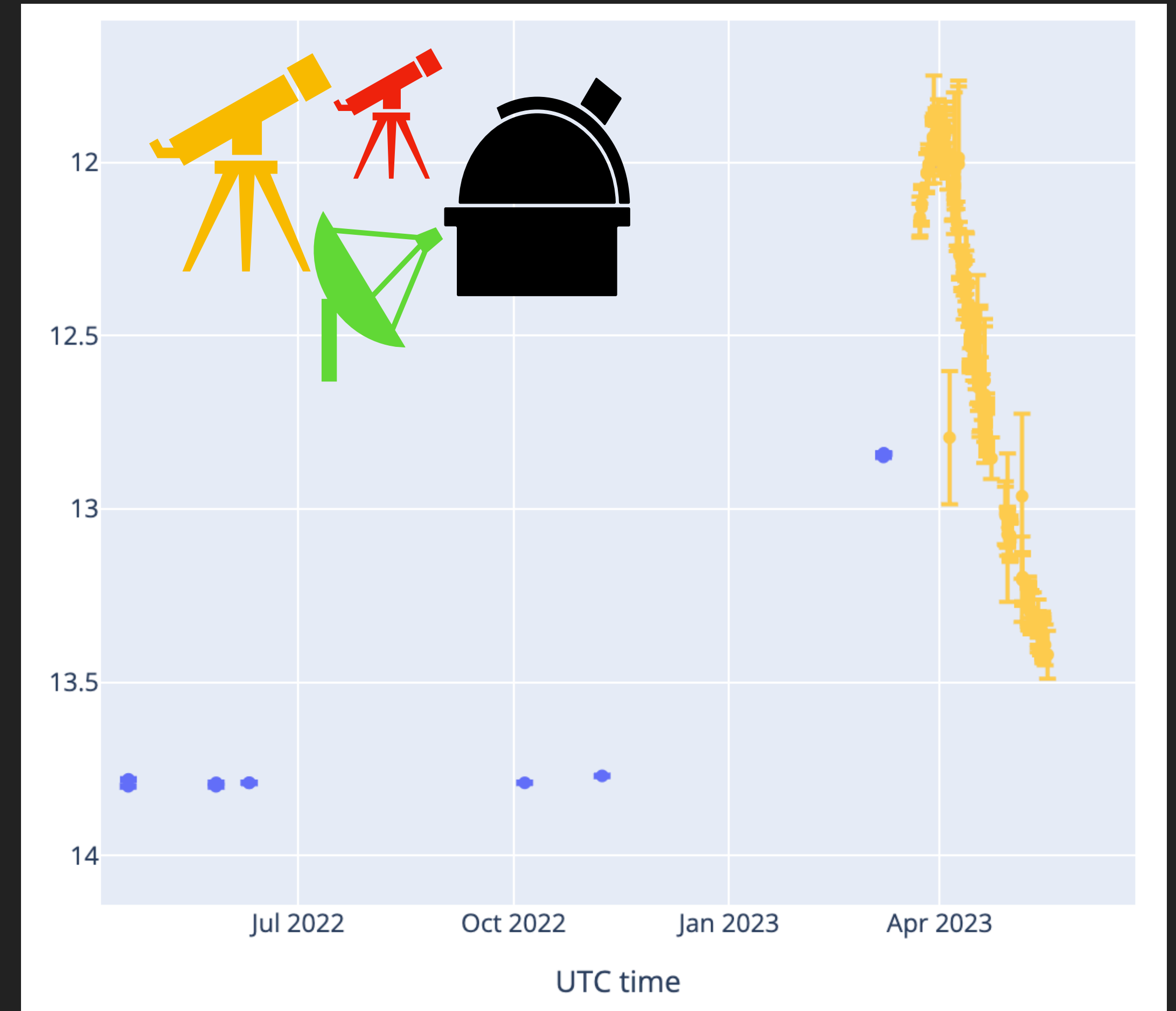


only Gaia

GAIA23BAY ▶ Example alert from Gaia

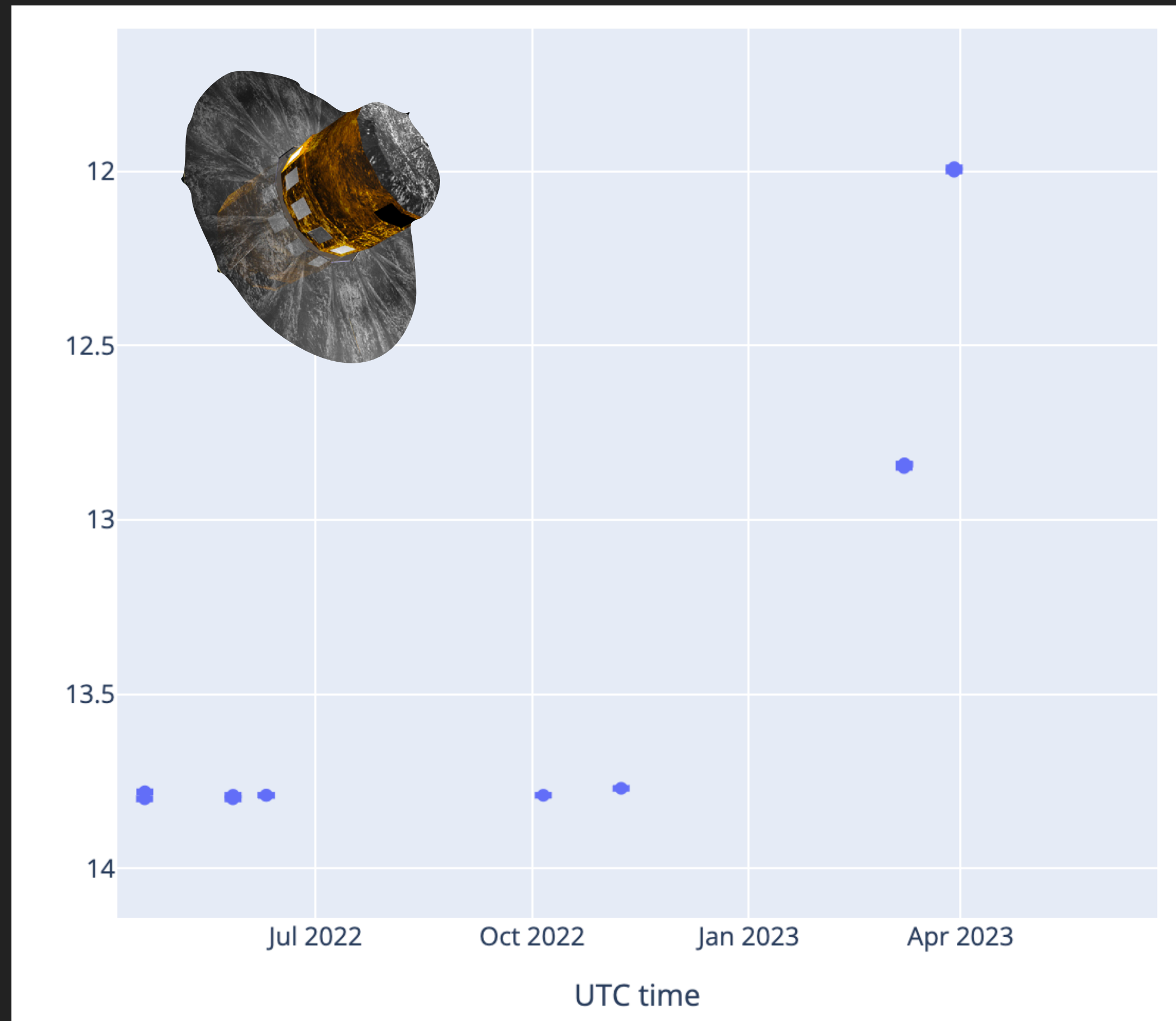


only Gaia

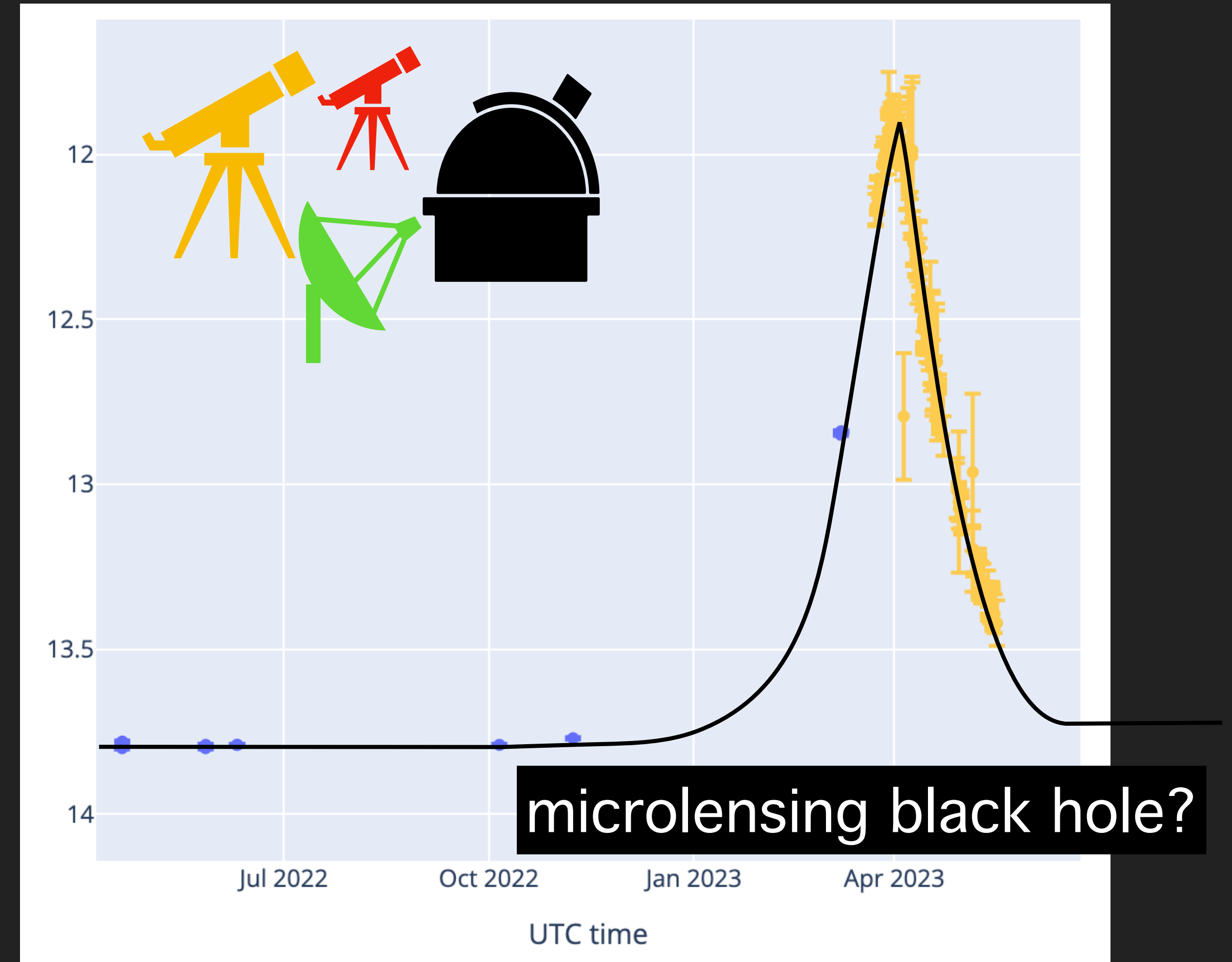


Gaia+small telescopes

GAIA23BAY ▶ Example alert from Gaia

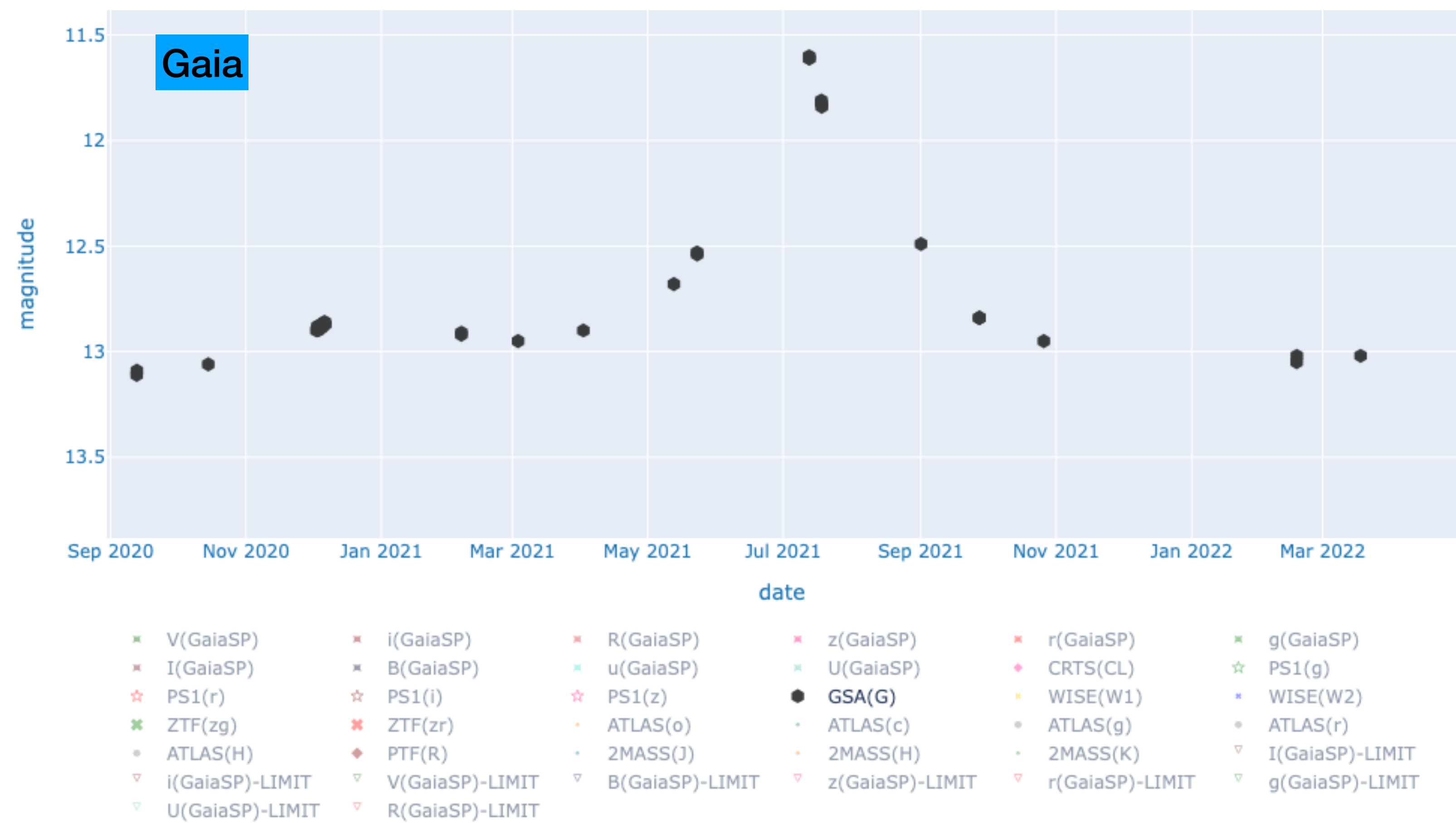


only Gaia

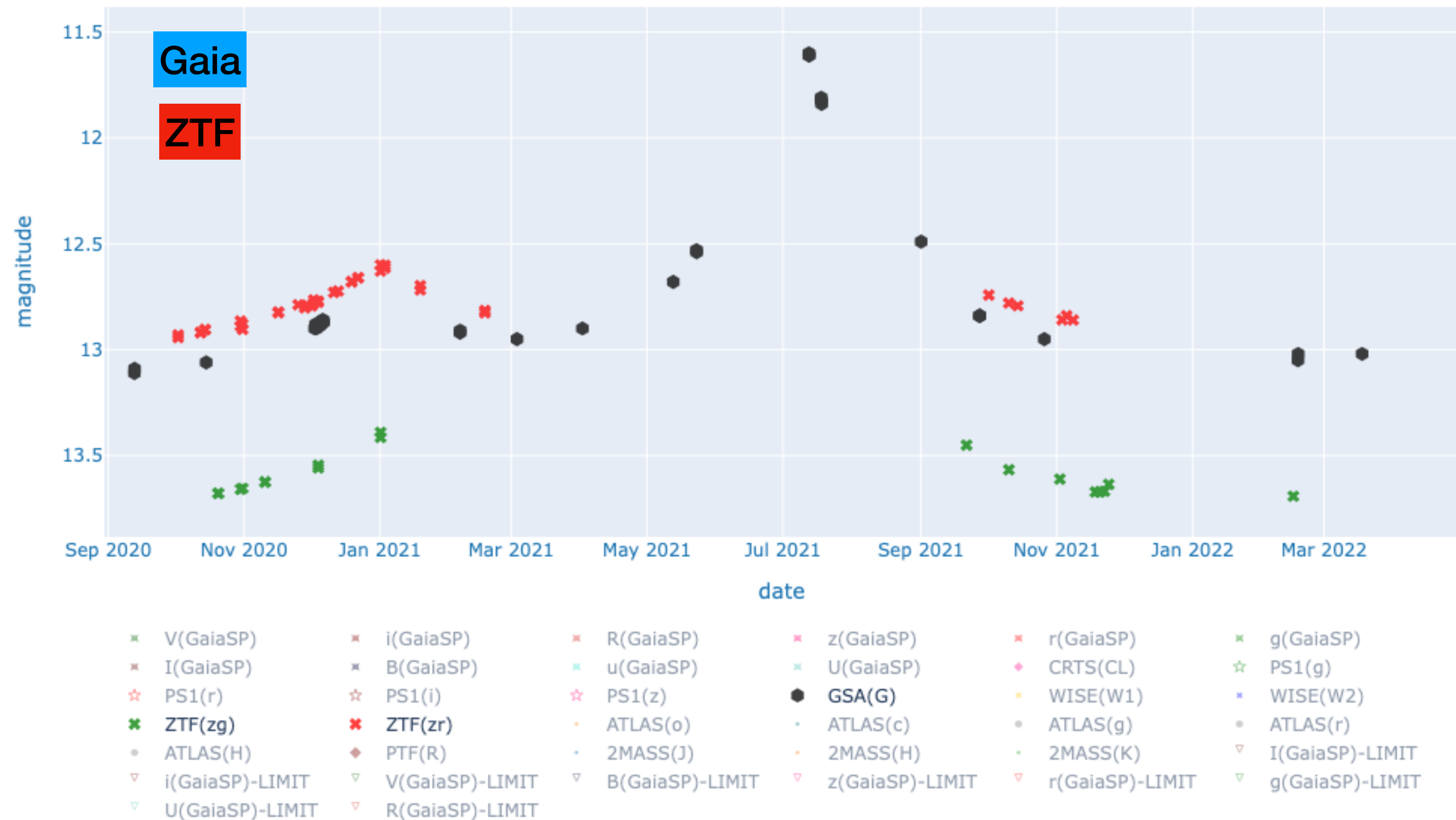


Gaia+small telescopes

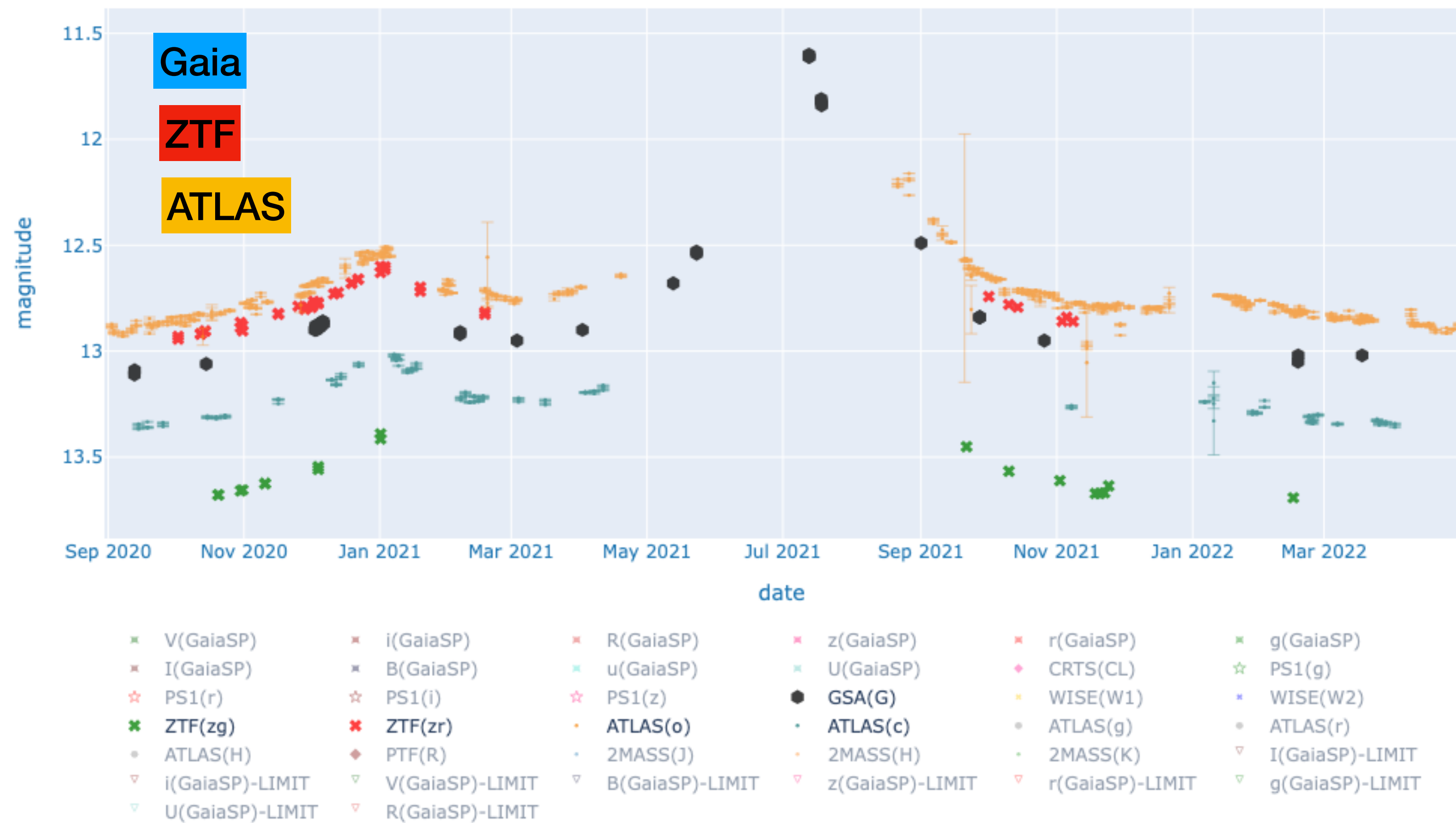
THE ROLE OF SMALL TELESCOPES



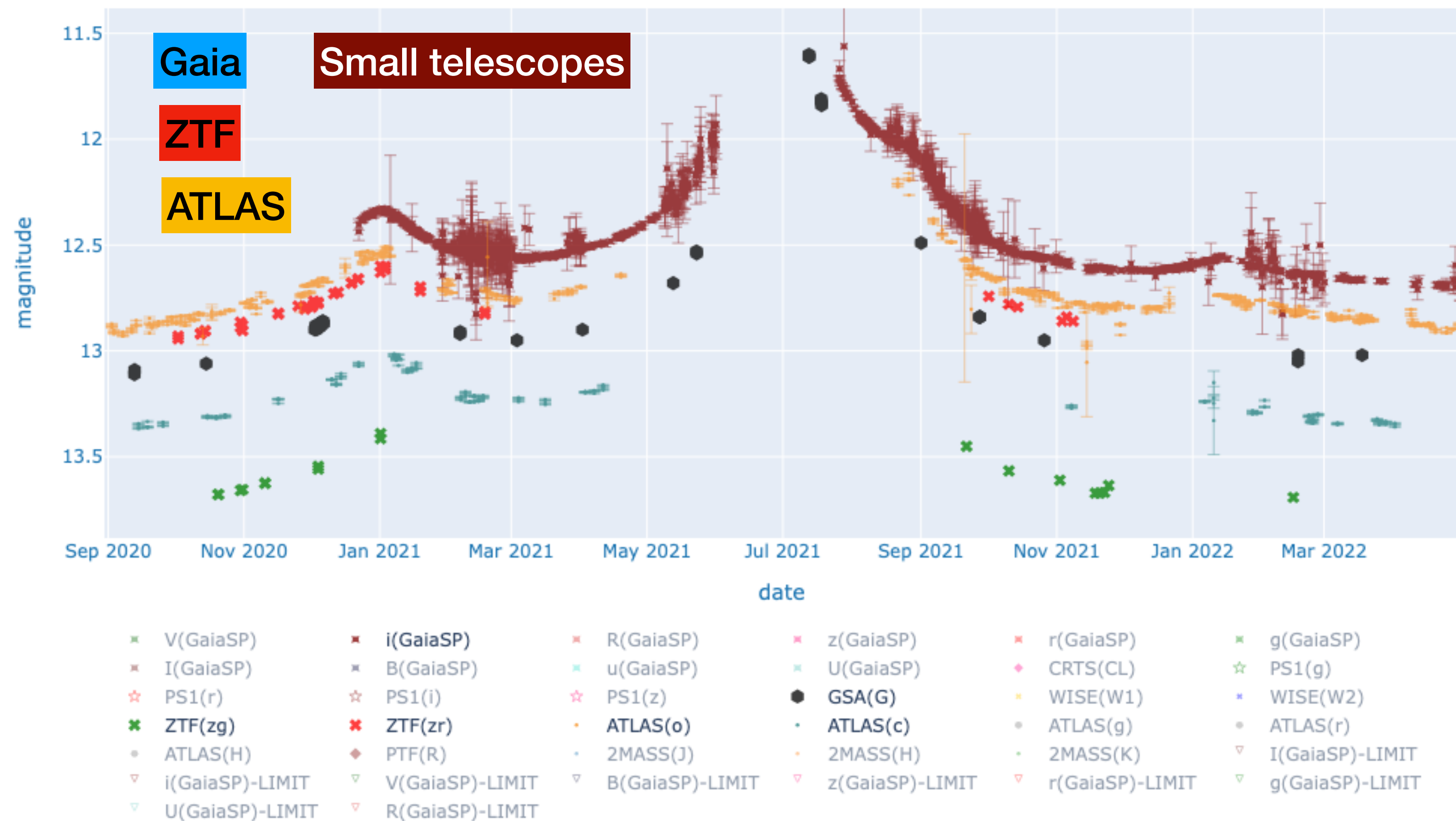
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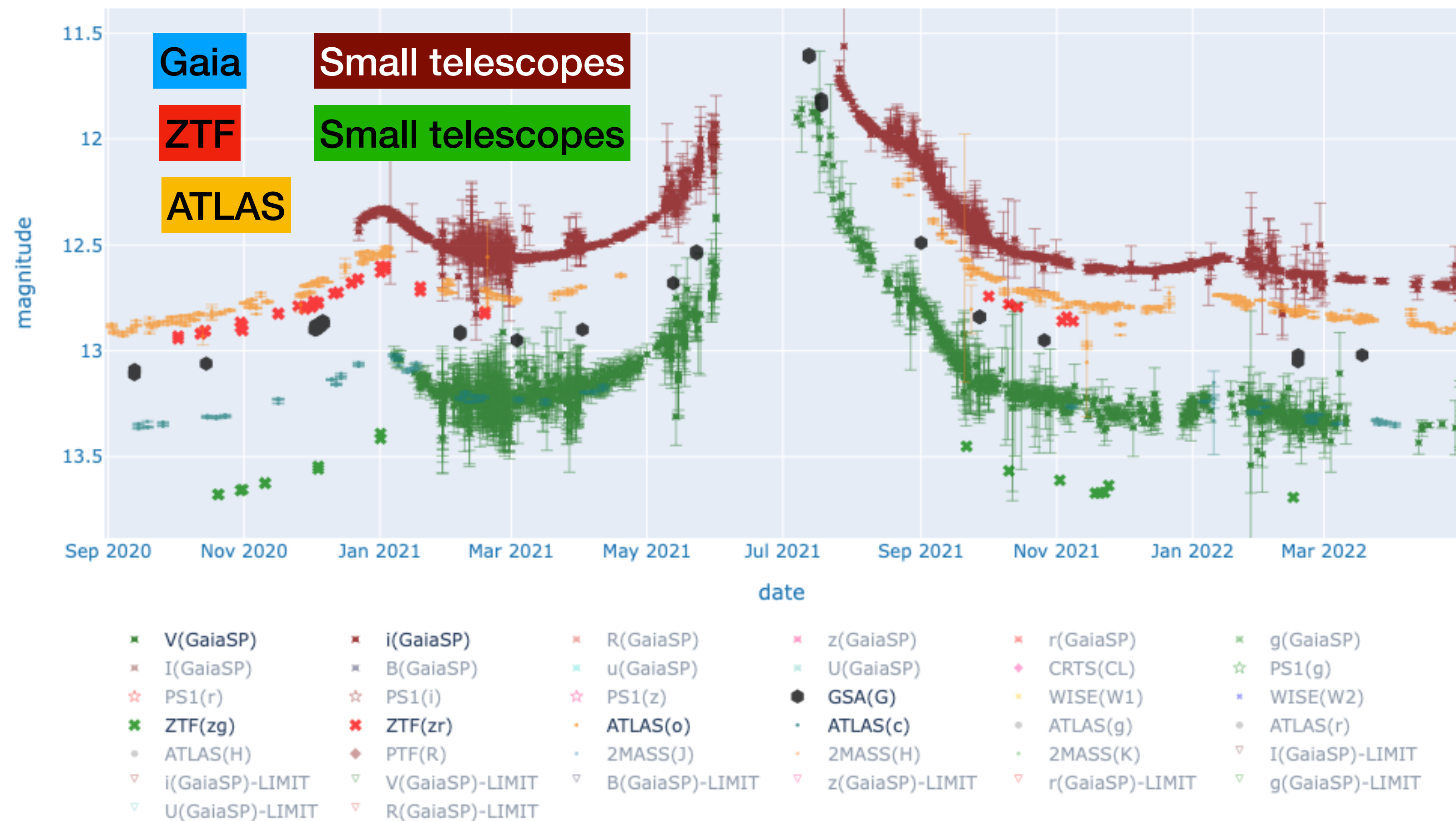
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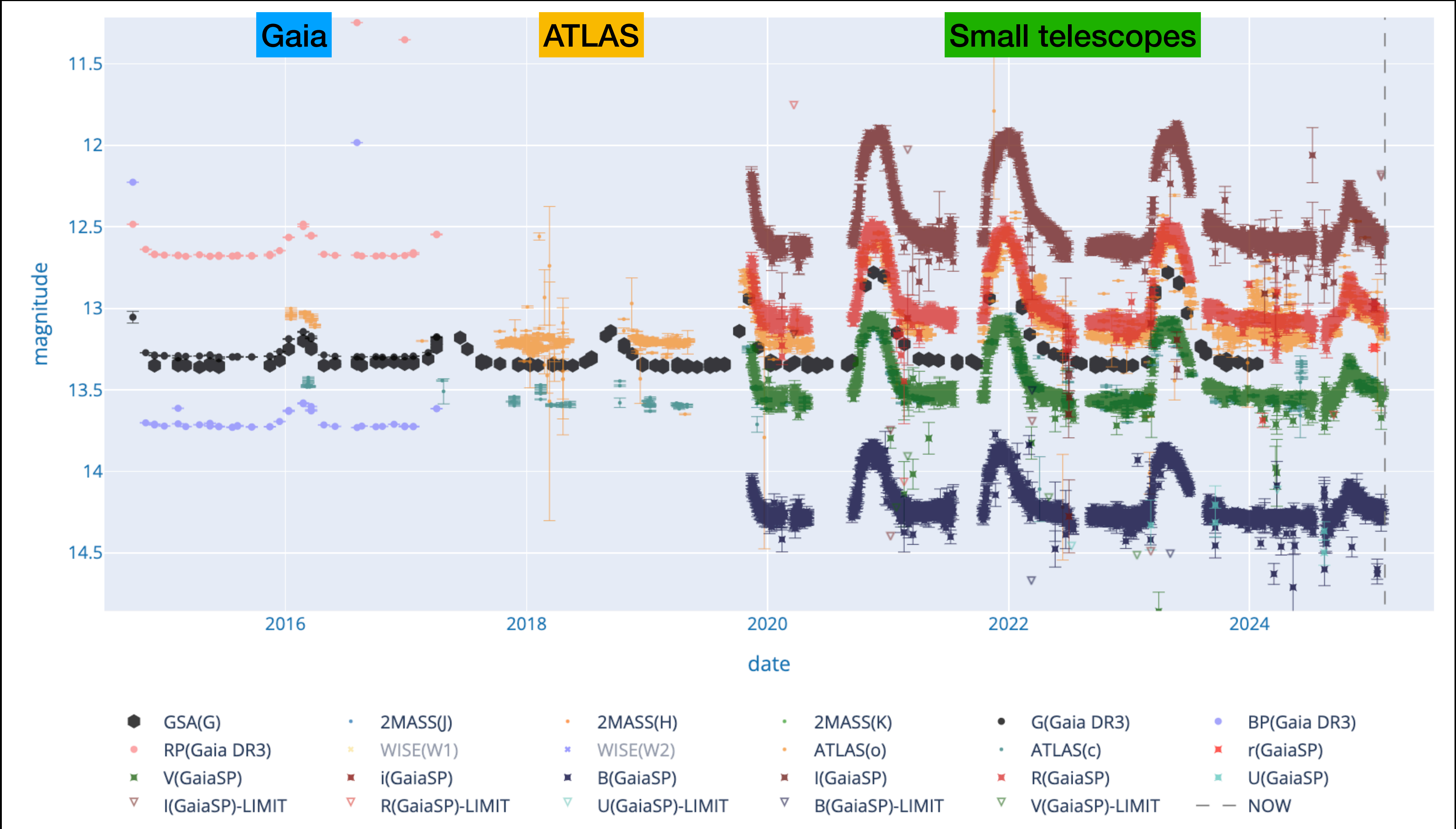
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Gaia20fnr 06:01:04.080 -18:58:03.720



Gaia19eyy 08:30:42.487 -41:33:42.516



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► All observers included!

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

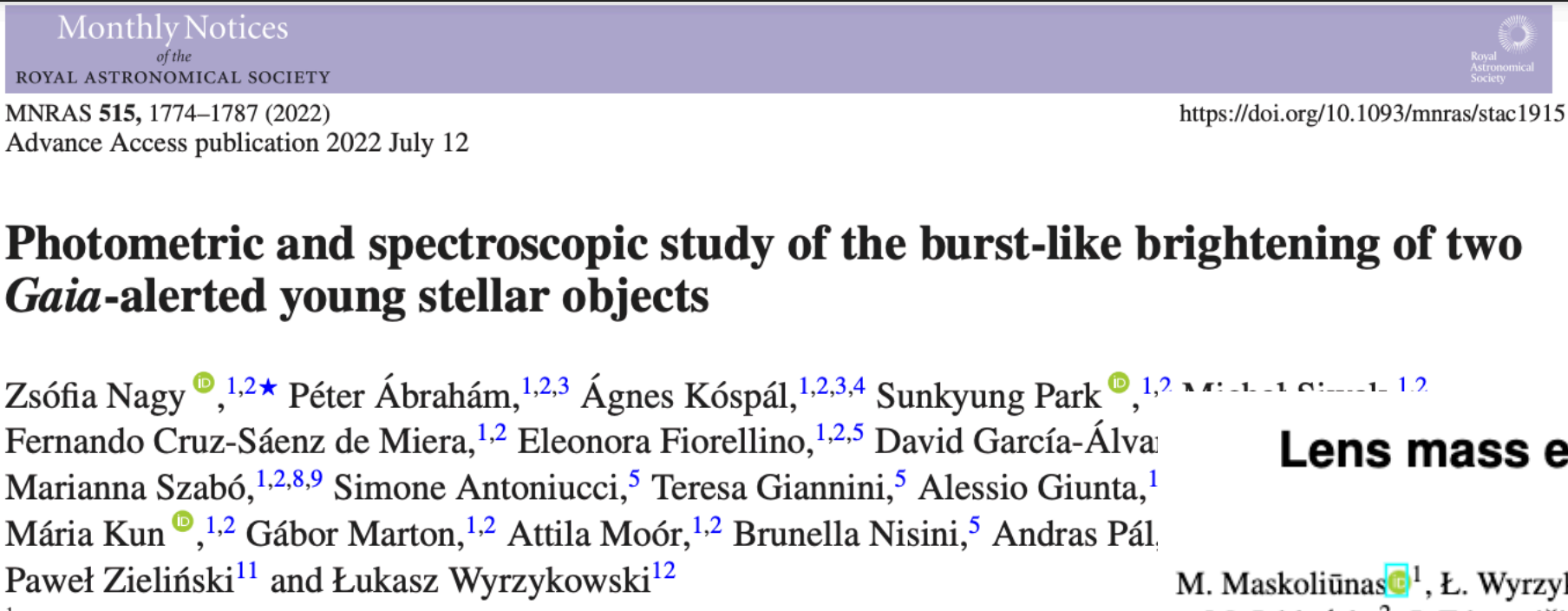
E. Szegedi-Elek¹ , P. Abraham^{1,2} , Ł. Wyrzykowski³ , M. Kun¹ , Á. Kóspál^{1,2,4} , L. Chen¹ , G. Marton^{1,2} , A. Moór^{1,2},
C. Kiss^{1,2} , A. Pál^{1,2,5} , L. Szabados¹ , J. Varga^{1,6} , E. Varga-Verebélyi¹ , C. Andreas⁷, E. Bachelet⁸ , R. Bischoff⁷,
A. Bódi^{1,9} , E. Breedt¹⁰ , U. Burgaz^{11,12} , T. Butterley¹³ , J. M. Carrasco¹⁴, V. Čepas¹⁵, G. Damljjanovic¹⁶ , 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

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}

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



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. Damljjanovic⁶, 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. Ogłóza⁴² , 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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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. Zang²⁶

The Gaia alerted fading of the FUor-type star Gaia21elv

✉ Zsófia Nagy,^{1,2}★ Sunkyung 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

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

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Zieliński¹, N. Britavskiy^{4,5}, A. Gomboc³⁵, K. Sokolovsky^{19,3,66}, 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. Bakış¹⁰, S.
Baker¹⁰⁰, S. Bartlett⁵⁰, P. Bendjoya¹¹, K. Benson¹⁰⁰, I.F. Bikmaev^{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. Chruslińska^{11,24}, G. Clementini²⁵, A. Clerici³⁵, D. Conti⁹¹, M. Conti⁴⁸, S. Cross⁶³, F. Cusano²⁵, G.
Damljjanovic²⁶, A. Dapergolas¹⁹, G. D’Agó⁸¹, J. H. J. de Bruijne²⁷, M. Dennefeld²⁹, V. S. Dhillon^{30,4}, M. Dominik³¹,
J. Dziedzic¹, O. Erecc³², M. V. Eiselevich⁸⁶, H. Esenoglu³³, L. Eyer⁷⁴, R. Figuera 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. Han¹², B.
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