



Gaia: an overview on a cornerstone mission

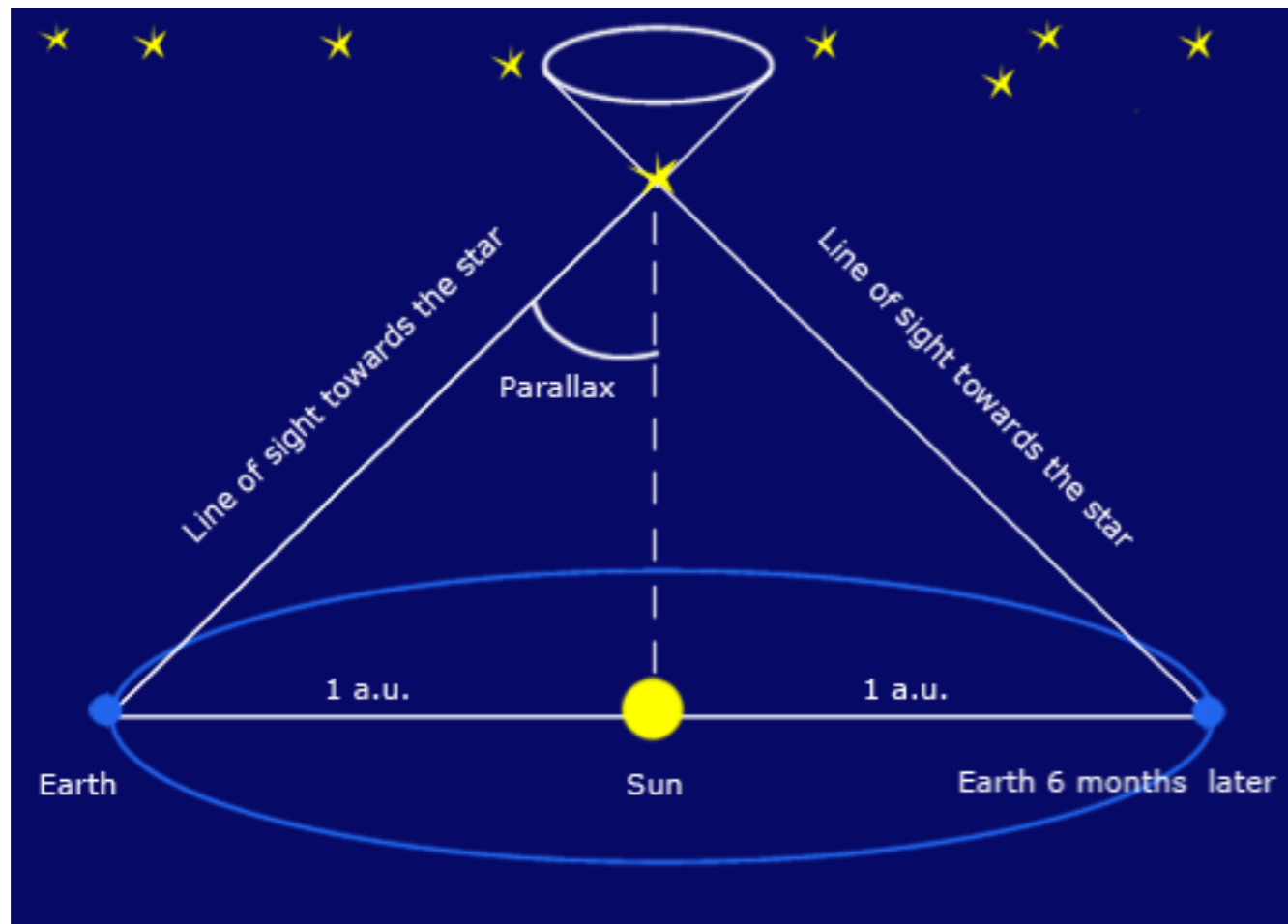
Giorgia Busso
(IoA, Cambridge)

Open University Colloquium, Milton Keynes Oct. 12 2016

Outline

- Gaia Mission and Status
- Gaia in UK: Photometric Processing
- Gaia in UK: Science Alerts
- Gaia Data Release 1
- Gaia Archive

Astrometric Mission: positions and proper motions

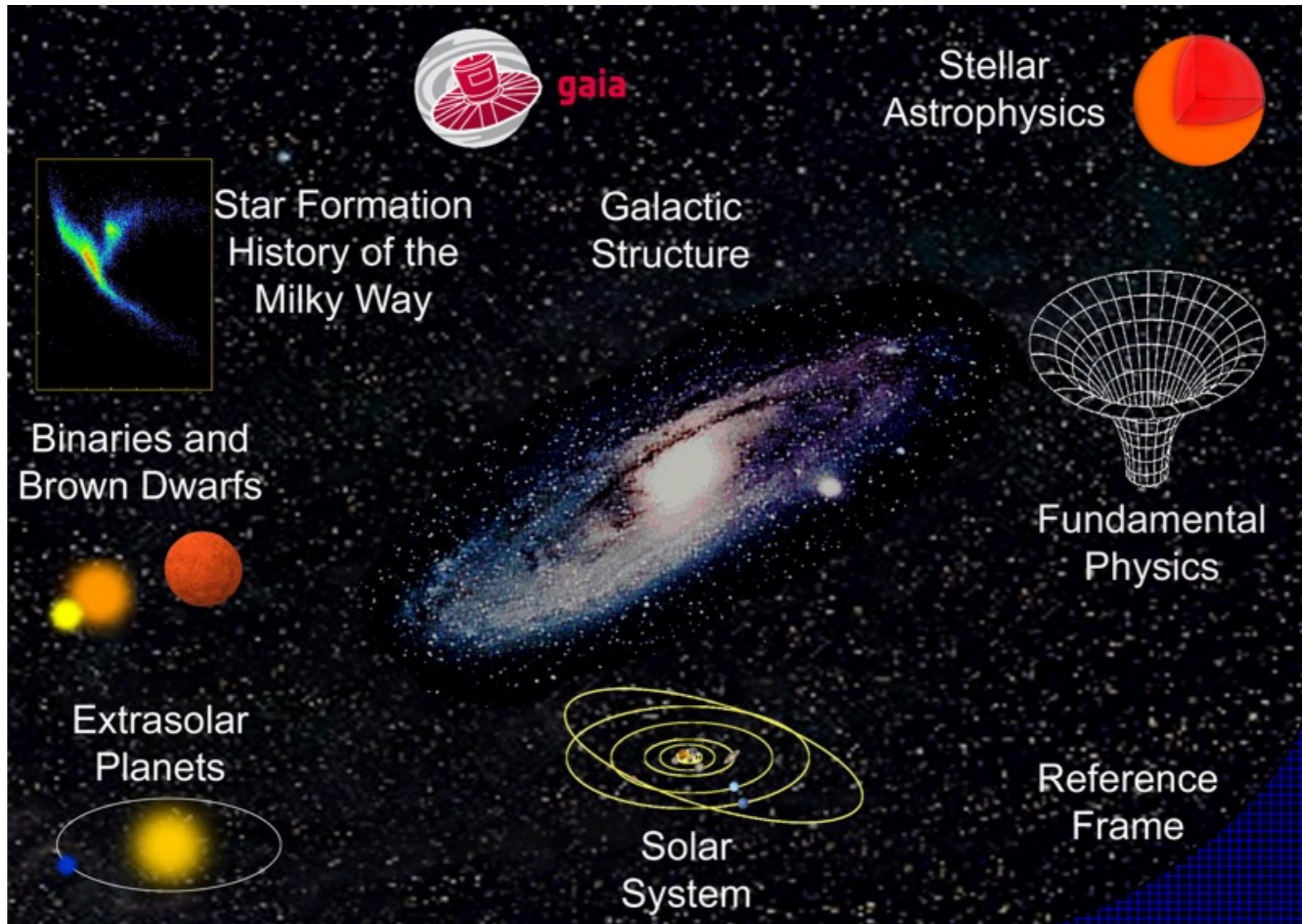


3D map of the Milky Way

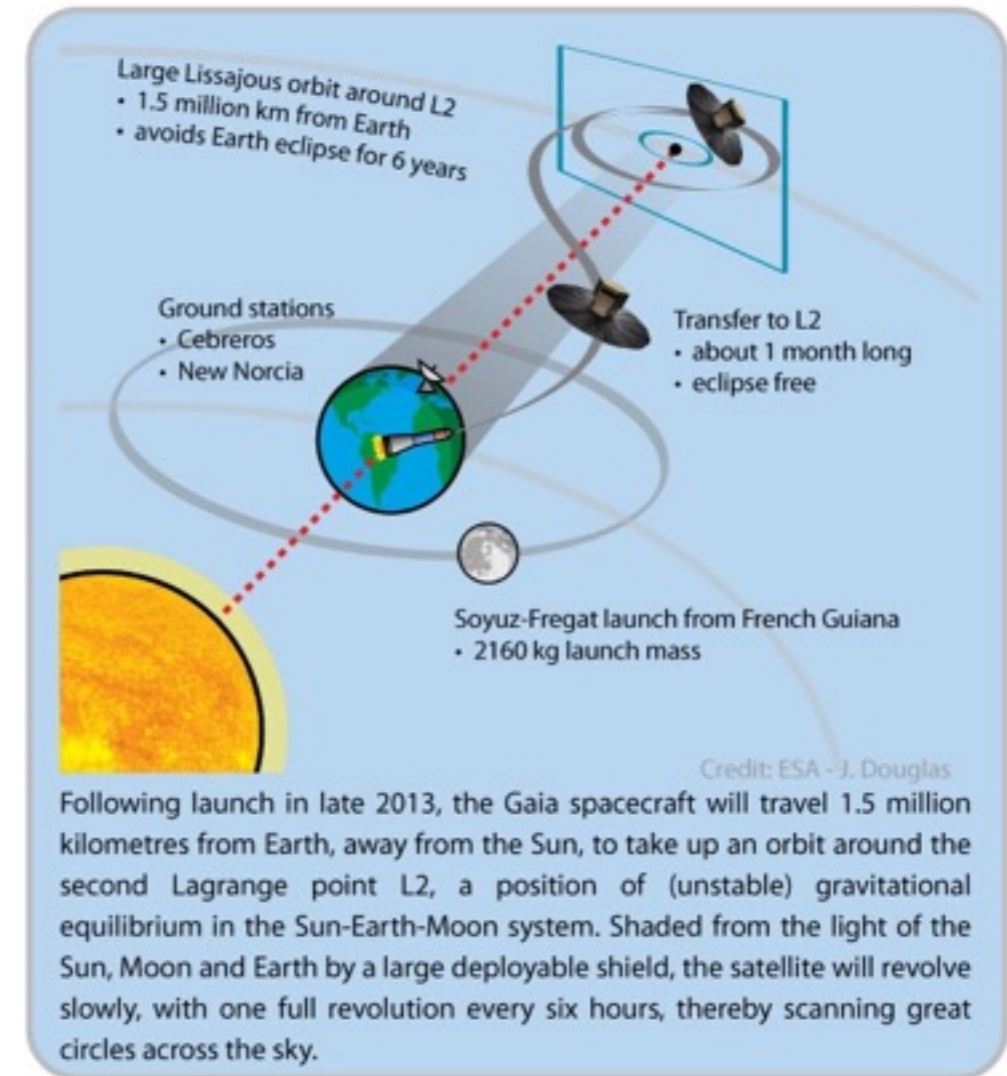
photometers -> colors
 spectrograph -> radial velocities

Gaia: Complete, Faint, Accurate

	Hipparcos	Gaia
Magnitude limit	12 mag	20 mag
Completeness	7.3 – 9.0 mag	20 mag
Bright limit	0 mag	3 mag
Number of objects	120,000	47 million to $G = 15$ mag
		360 million to $G = 18$ mag
		1192 million to $G = 20$ mag
Effective distance limit	1 kpc	50 kpc
Quasars	1 (3C 273)	500,000
Galaxies	None	1,000,000
Accuracy	1 milliarcsec	7 μ arcsec at $G = 10$ mag
		26 μ arcsec at $G = 15$ mag
		600 μ arcsec at $G = 20$ mag
Photometry	2-colour (B and V)	Low-res. spectra to $G = 20$ mag
Radial velocity	None	15 km s ⁻¹ to $G_{RVS} = 16$ mag
Observing	Pre-selected	Complete and unbiased



- Comprehensive luminosity calibration, for example:
 - * distances to 1% for ~11 million stars to 2.5 kpc
 - * distances to 10% for ~150 million stars to 25 kpc
 - * rare stellar types and rapid evolutionary phases in large numbers
 - * parallax calibration of all distance indicators (e.g., Cepheids and RR Lyrae to LMC/SMC)
- Physical properties, for example:
 - ◆ clean Hertzsprung–Russell diagrams throughout the Galaxy
 - ◆ Solar-neighbourhood mass and luminosity function, e.g., white dwarfs (~400,000) and brown dwarfs (~500)
 - ◆ initial mass and luminosity functions in star-forming regions
 - ◆ luminosity function for pre-main-sequence stars
 - ◆ detection and dating of all spectral types and Galactic populations
 - ◆ detection and characterisation of variability for all spectral types



- ESA-only mission
- Launch: 19 December 2013
- Launcher: Soyuz–Fregat from French Guiana
- Orbit: L2 Lissajous orbit
- Ground stations: Cebreros, New Norcia + Malargüe
- Lifetime: 5 years (1 year potential extension)

Gaia: the instrument



~3m

~10m

Payload and Telescope

Two SiC primary mirrors
 $1.45 \times 0.50 \text{ m}^2$ at 106.5°

Rotation axis (6h)

Basic-Angle-Monitoring (BAM) system

SiC torus (optical bench)

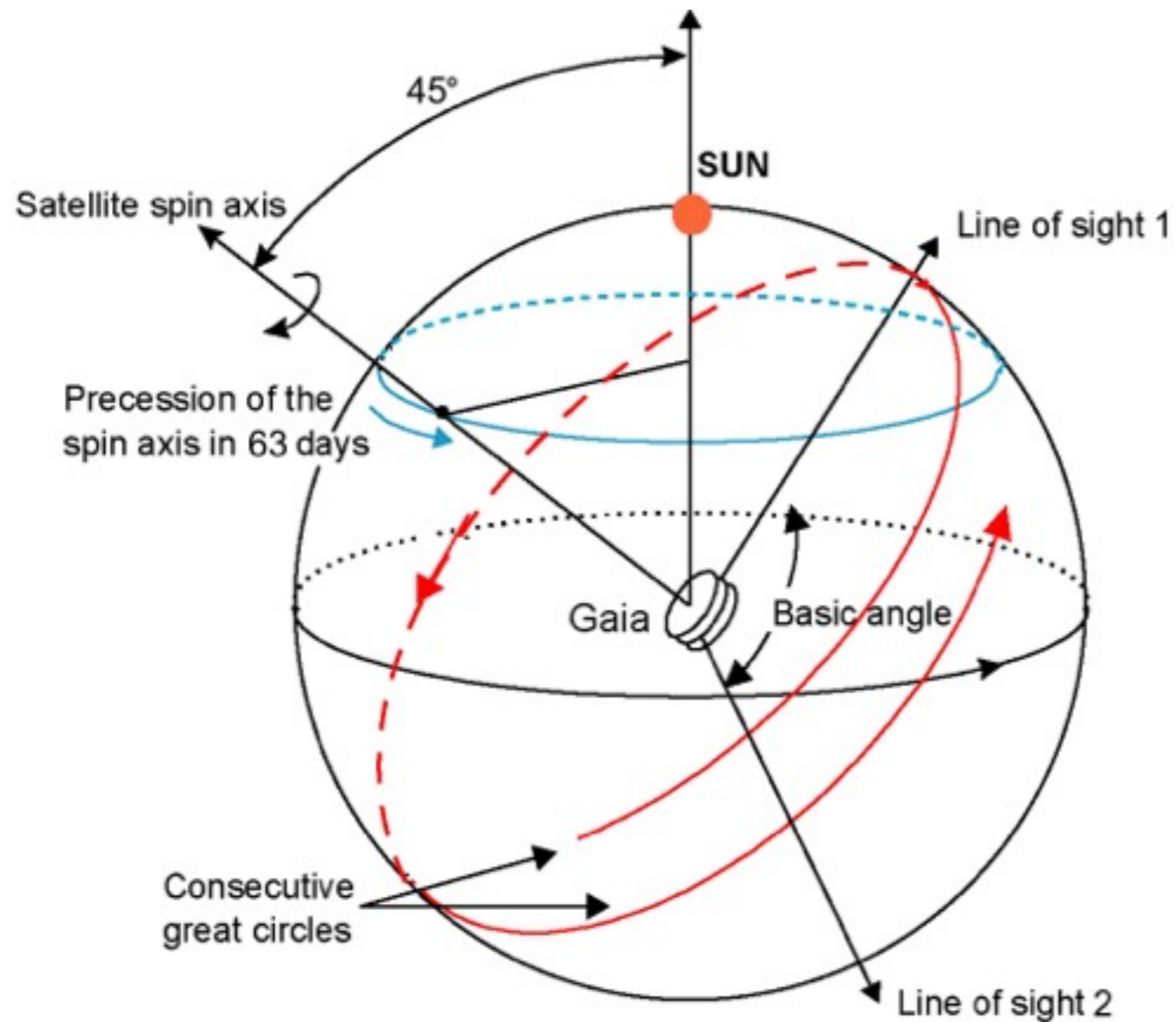
Combined Focal-Plane Assembly (FPA) with 106 CCD detectors

Superposition of two Fields of View (FoV)

Radial-Velocity Spectrometer (RVS)

Figure courtesy EADS-Astrium

Scanning Law

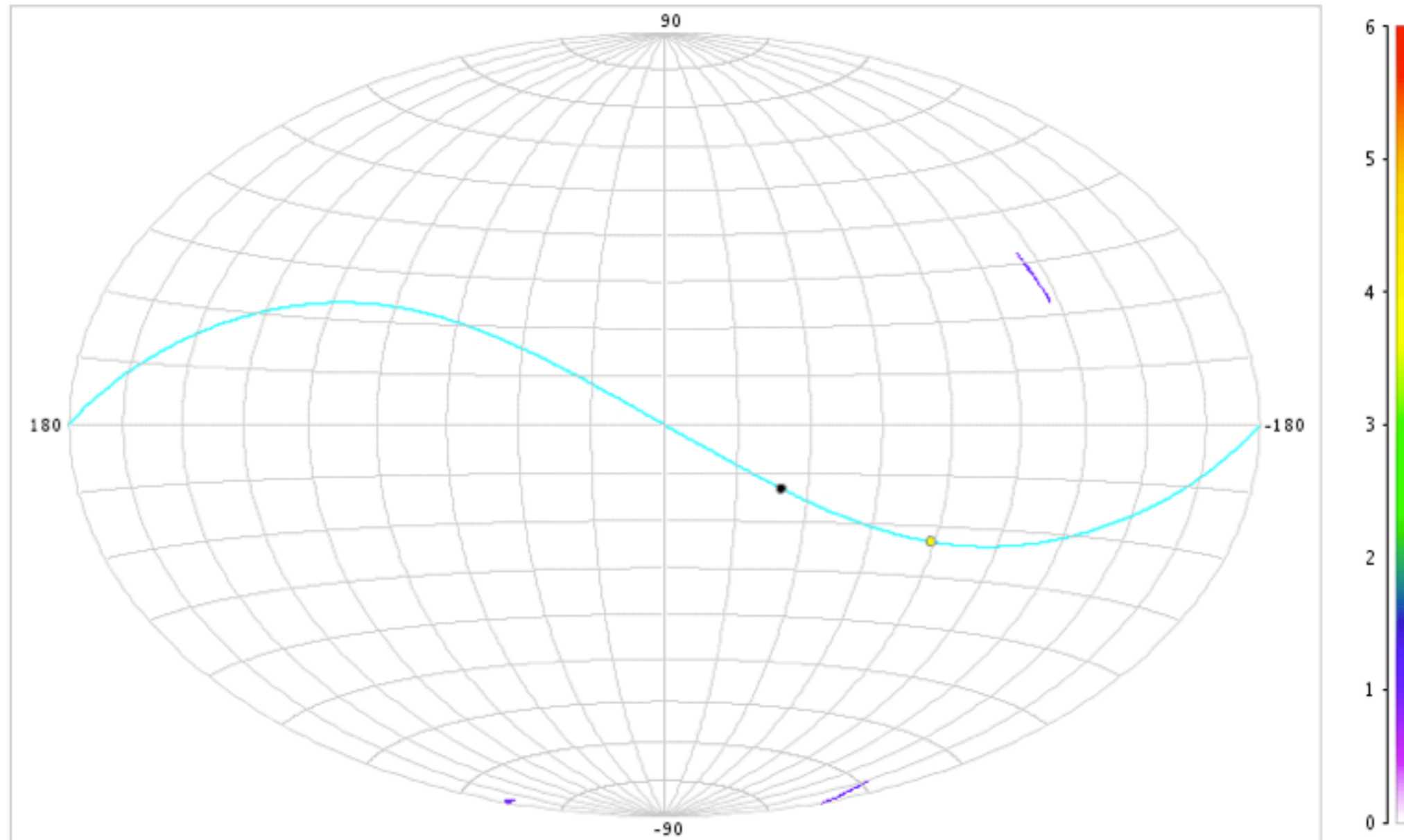


Spin axis 45° to Sun
 Scan rate: 60 arcsec s⁻¹
 Spin period: 6 hours

In average every source is
 observed ~80 times

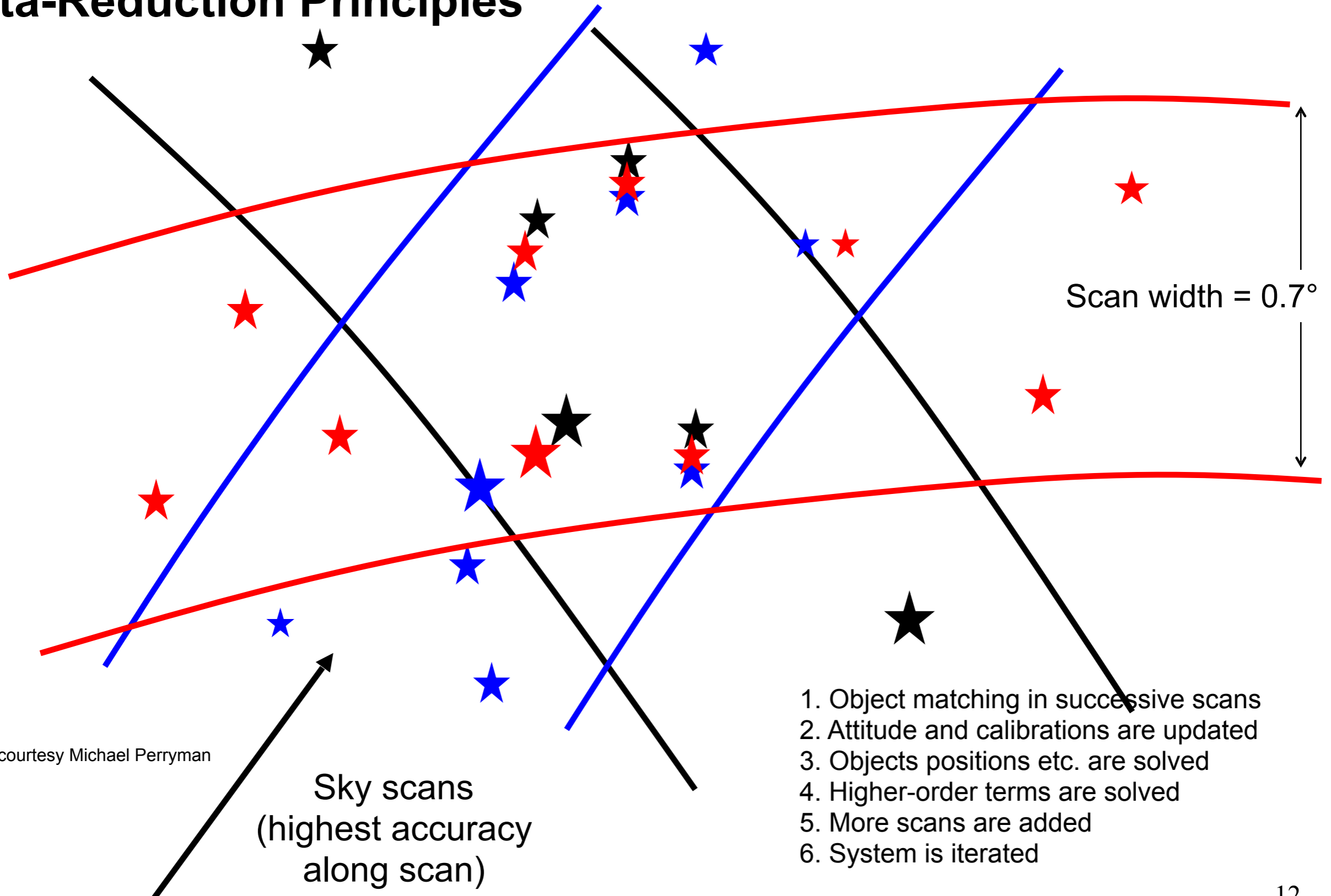
Scanning Law

NSL field transits in ICRS after: 0 years 000 days 00 hr 10 min



http://www.cosmos.esa.int/documents/29201/304590/Gaia_scanLaw_movie.mov/024d4a49-e0d5-4d47-8f80-c1a32ead6a46

Data-Reduction Principles



Foçal Plane

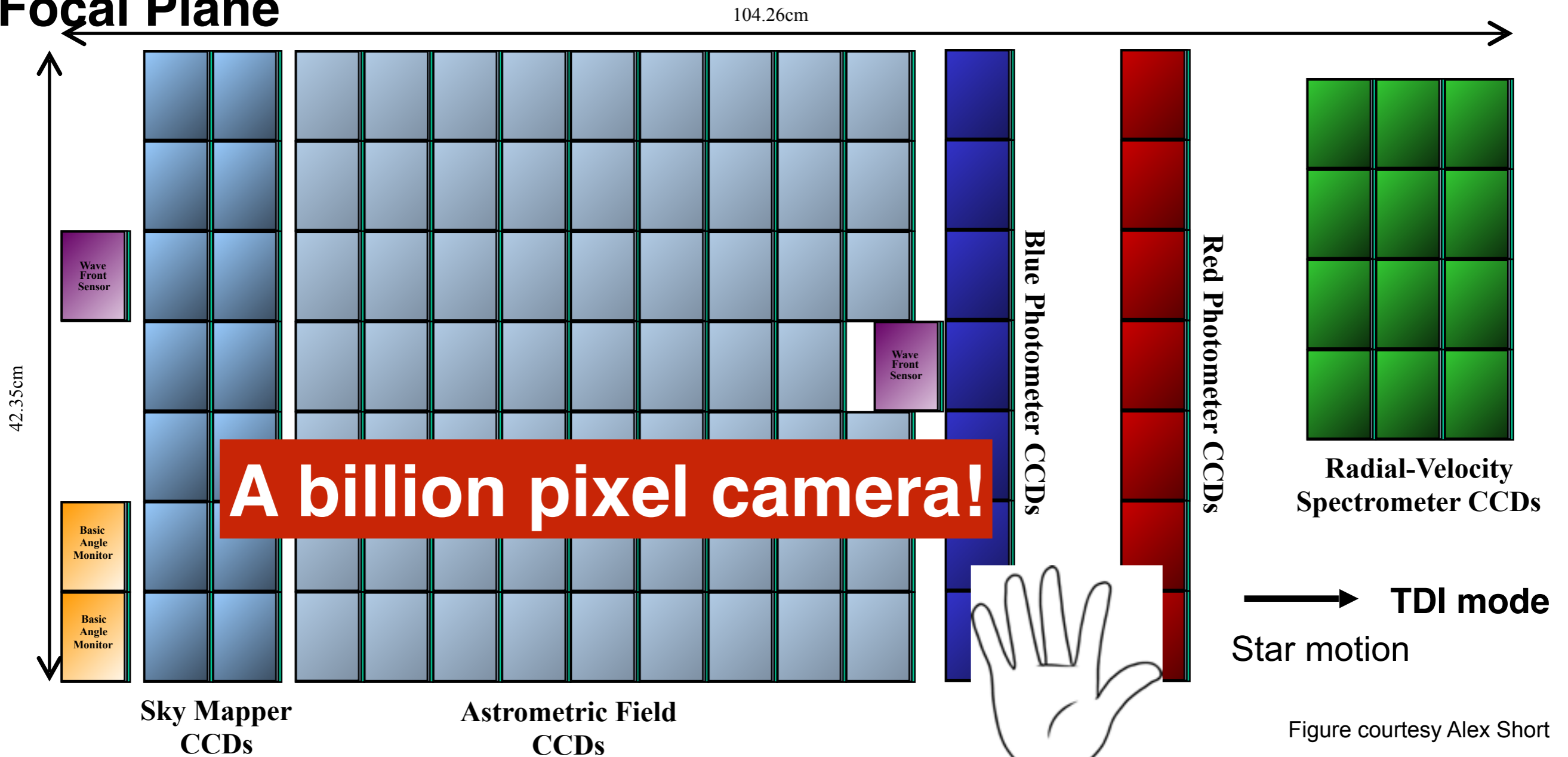


Figure courtesy Alex Short

Total field:

- active area: 0.75 deg²
- CCDs: 14 + 62 + 14 + 12 (+ 4)
- 4500 x 1966 pixels (TDI)
- pixel size = 10 μm x 30 μm
= 59 mas x 177 mas

Sky mapper:

- detects all objects to G=20 mag
- rejects cosmic-ray events
- field-of-view discrimination

Astrometry:

- total detection noise ~ 4 e⁻

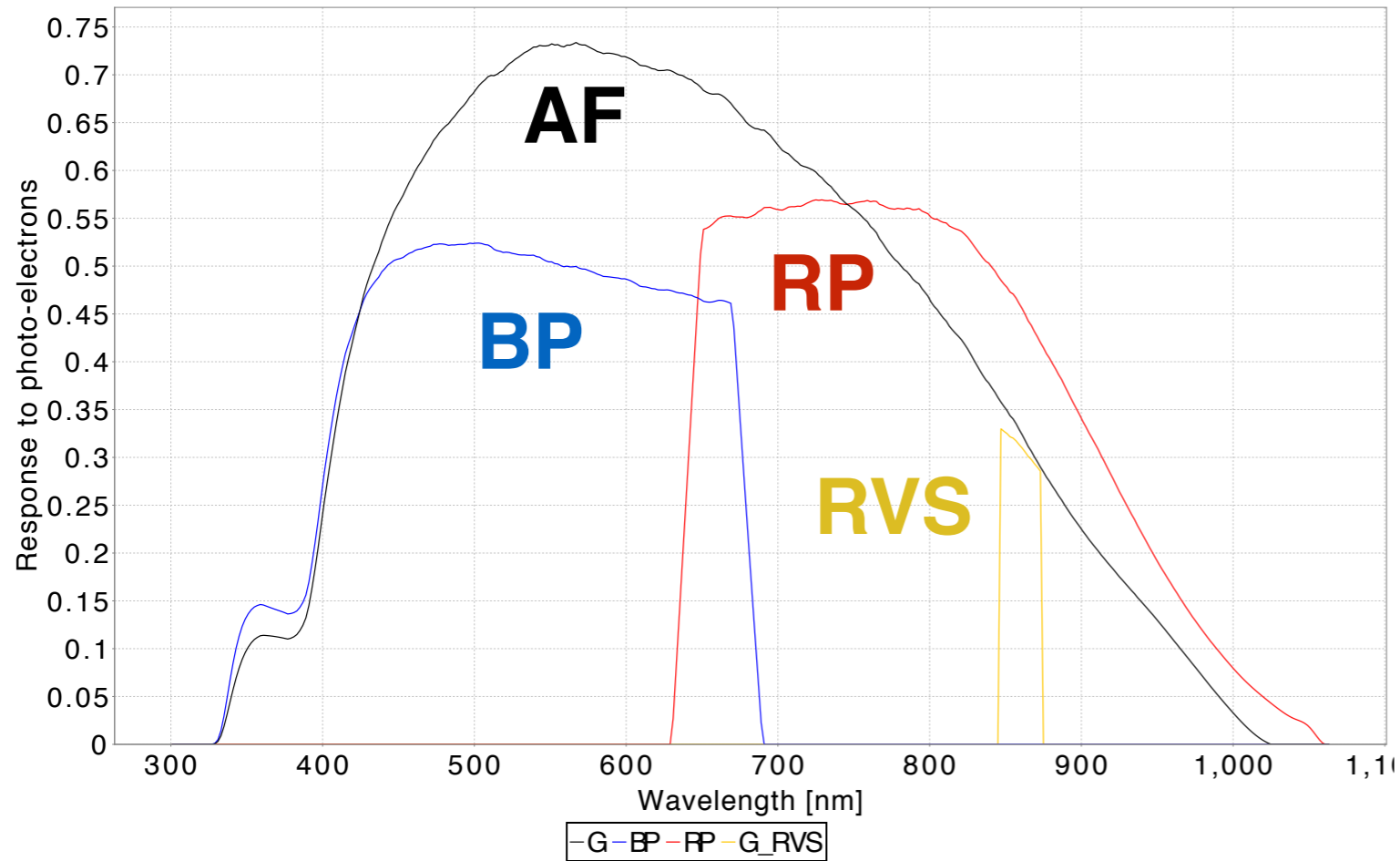
Photometry:

- spectro-photometer
- blue and red CCDs

Spectroscopy:

- high-resolution spectra
- red CCDs

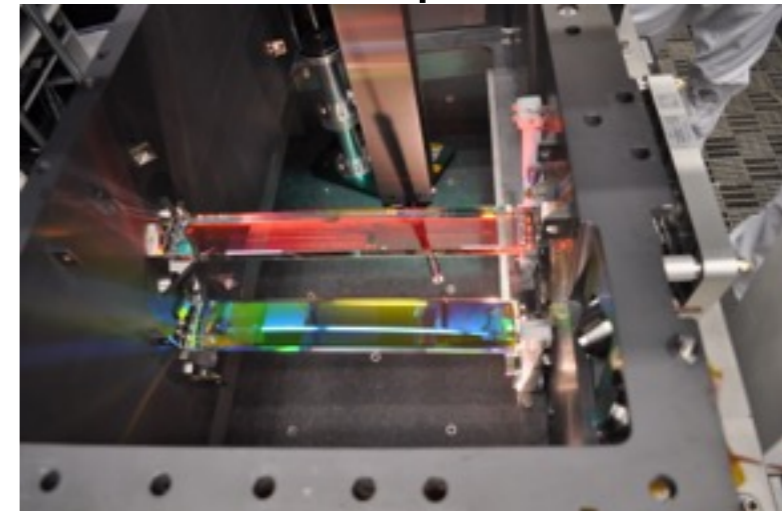
Passbands



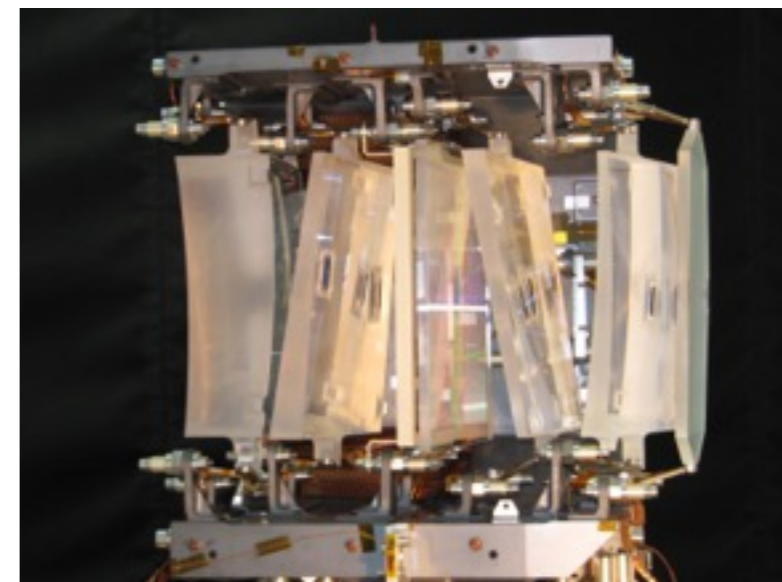
Blue photometer:
330 - 680 nm

Red photometer:
640 - 1050 nm

BP-RP prisms

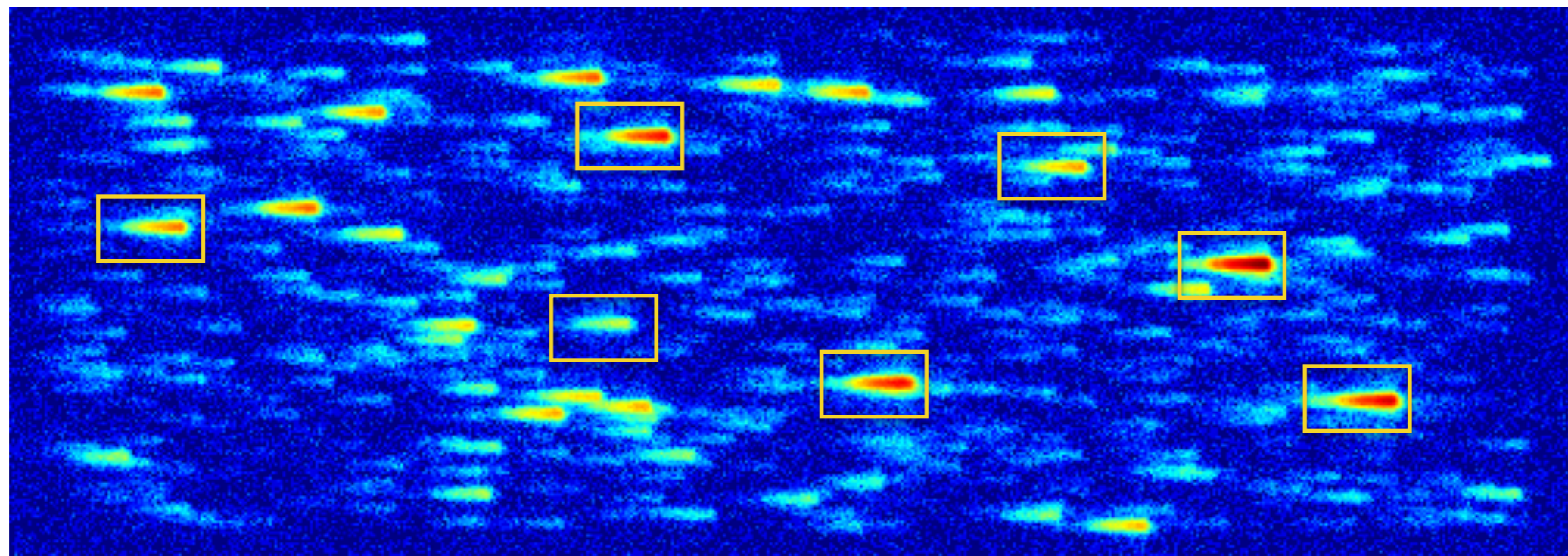


low resolution



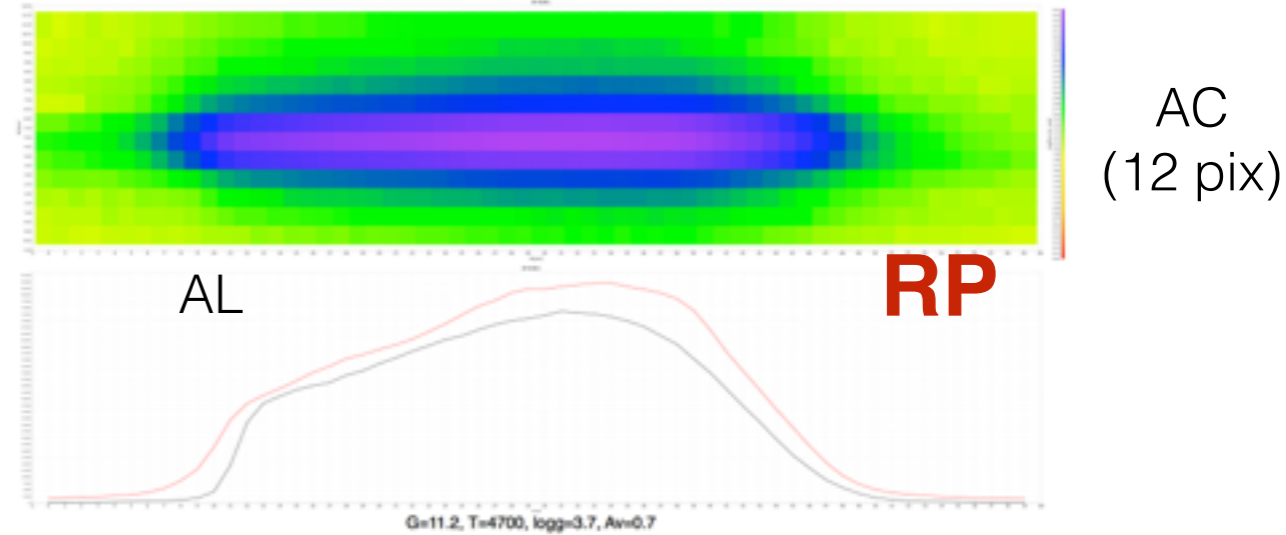
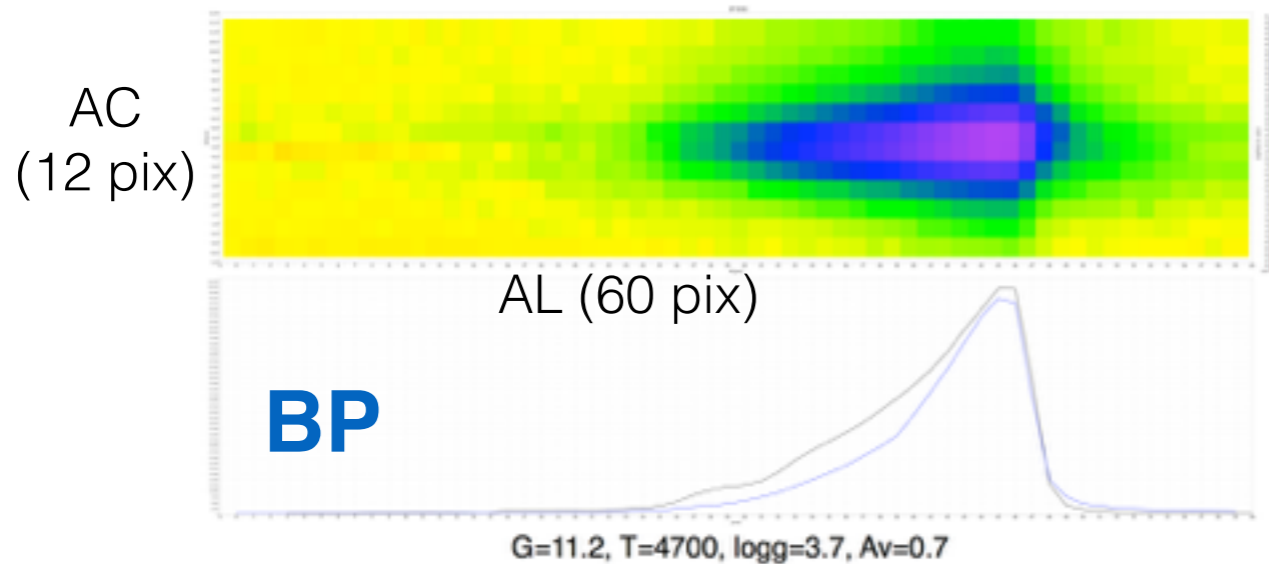
$\lambda/\Delta\lambda \sim 11500$

Window strategy

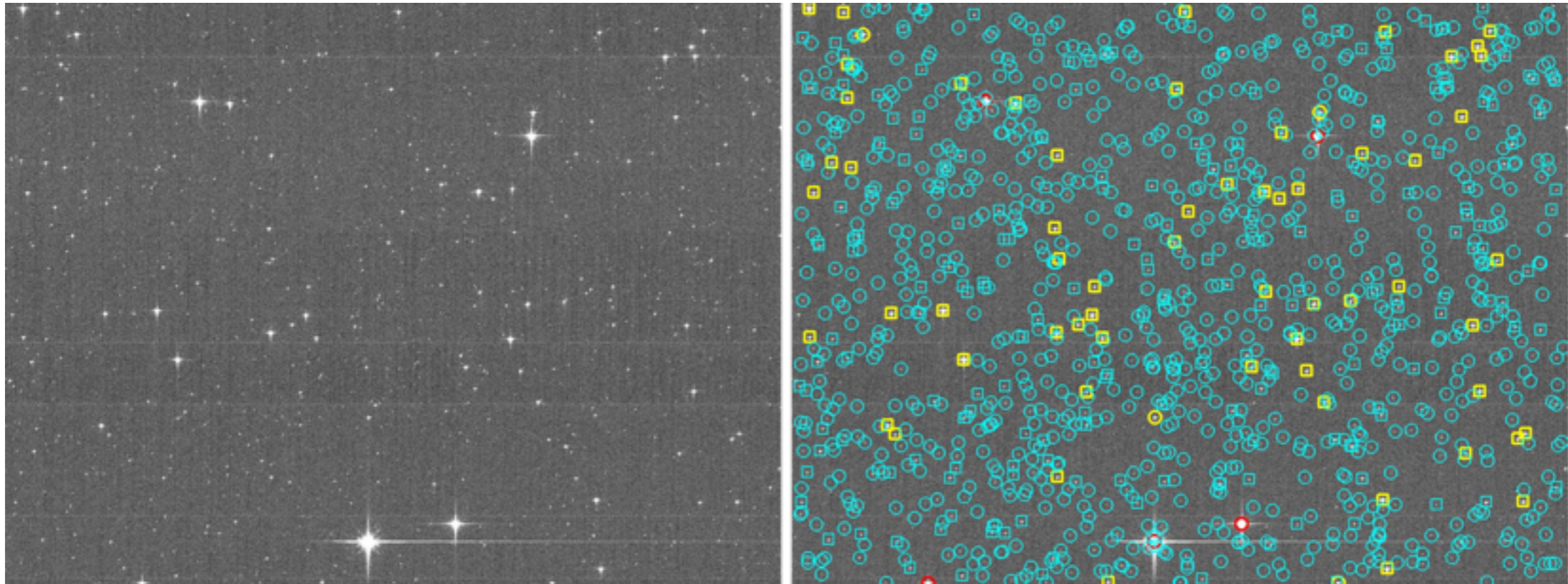





Along scan →

↑ Across scan



Source detection

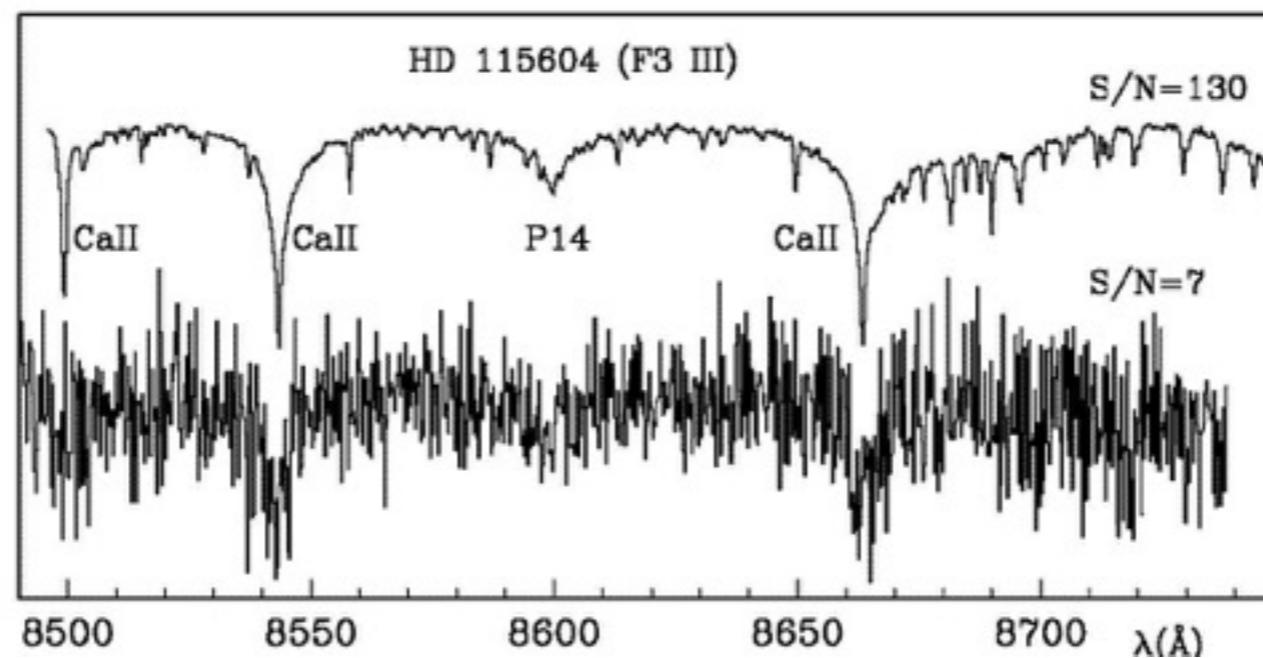


-  $G < 13$; 2D window
-  $13 < G < 16$; 1D window
-  $16 < G < 20$; 1D window

Radial Velocity Spectrograph

847-874 nm

$\lambda/\Delta\lambda \sim 11500$

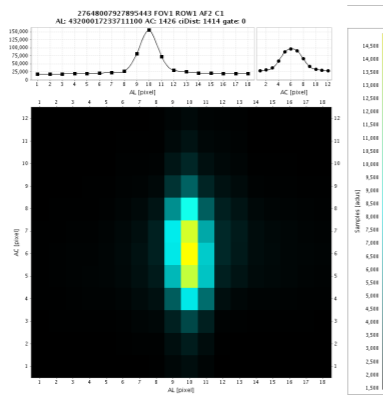


Figures courtesy David Katz

RVS spectra of F3 giant ($V = 16$ mag)
 S/N = 7 (single measurement)
 S/N = 130 (summed over mission)

Data Processing Center IoA

Astrometric Field

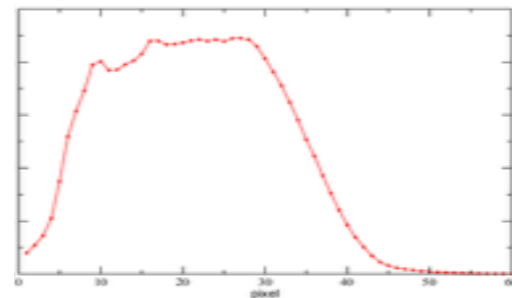


**Initial Data Treatment /
Intermediate Data Update
Image Parameter
Determination**

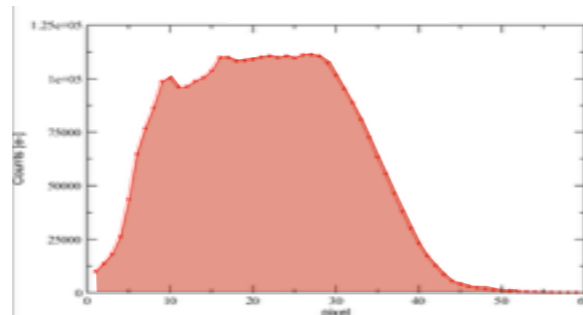
**bias and background correction
LSF/PSF fit**

**centroid & G-band flux
per CCD transit**

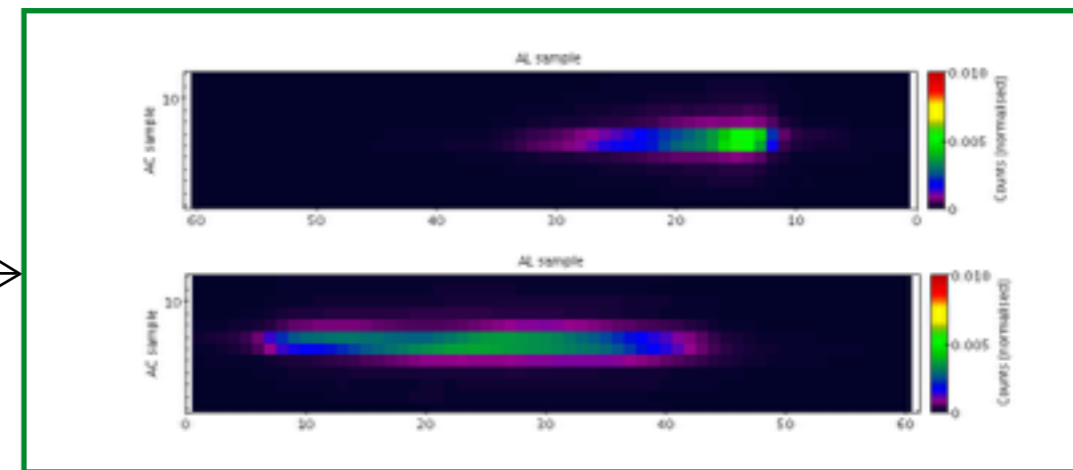
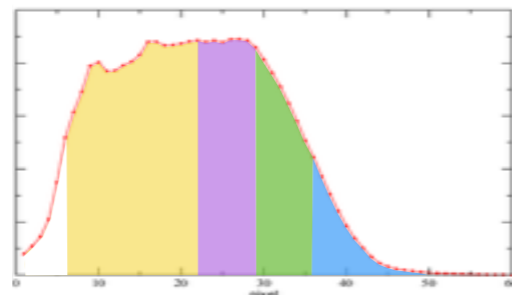
**BP and RP low-
resolution spectra**



**integrated
BP and RP flux**



**spectral shape
coefficients (SSCs)**



**PhotPipe
bias and background correction
dispersion function**

Internal Calibration

large number of sources
no external reference data



External Calibration

smaller number of sources
(~200 SPSS)
calibrate the average instrument to the
external reference system



The calibration principles

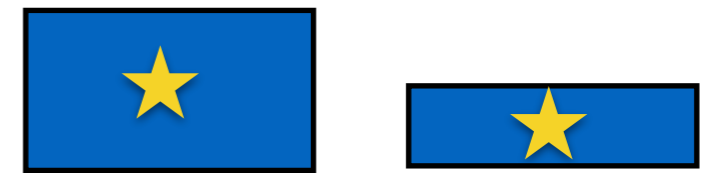
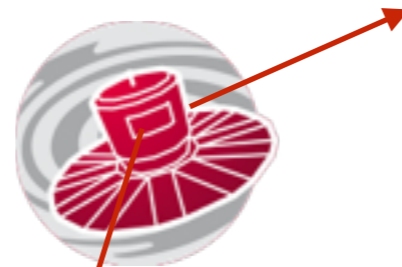
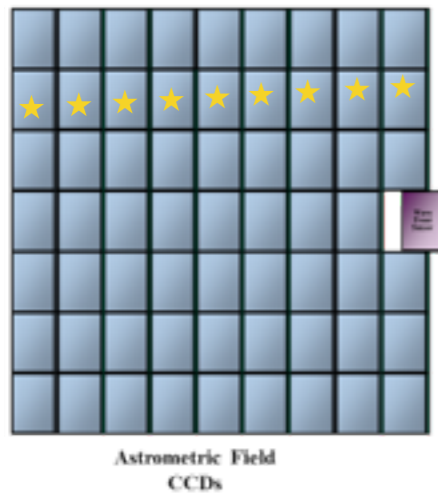
Internal Calibration

bring all observations to the same average instrument

different CCDs

different FoVs

different observations



window size



2D

1D

Link Calibration

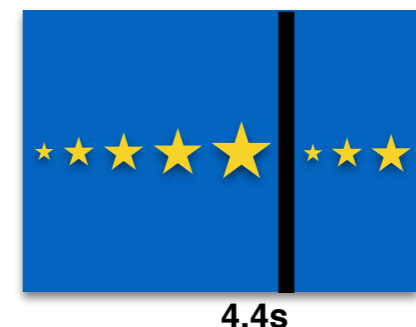
Large-Scale

CCD, FoV, Gate, WinClass
Short time scale (1d)

Small-Scale

group of 4 pixel columns, Gate, WinClass
Long time scale (months)

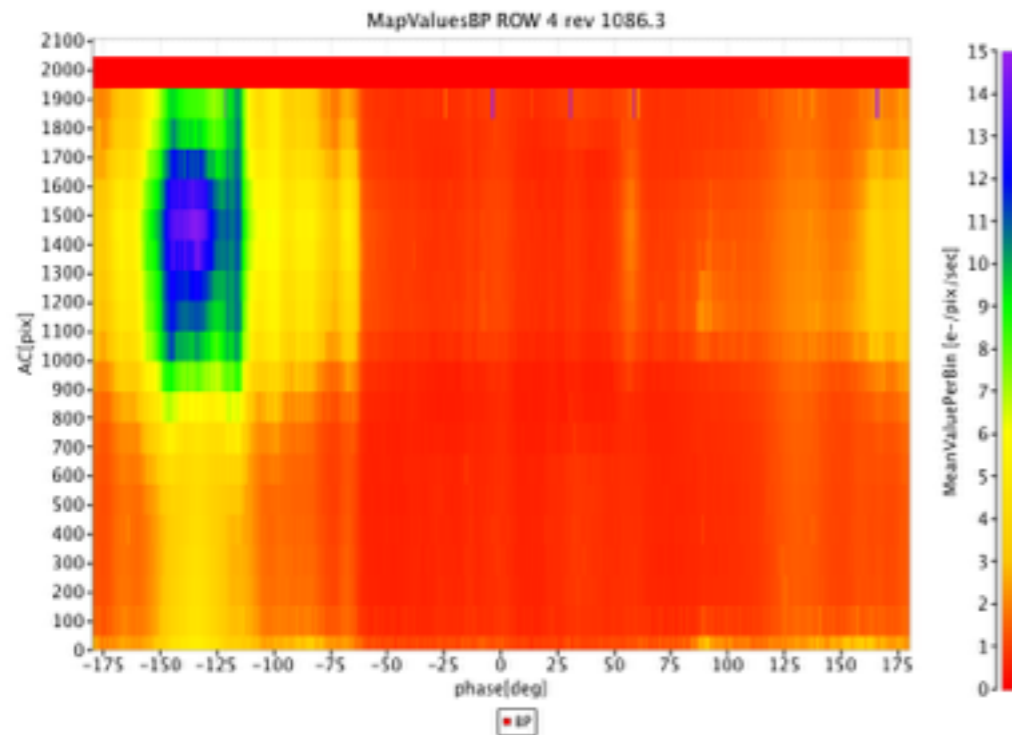
Calibration Unit



different exposure time (gates)

The problems

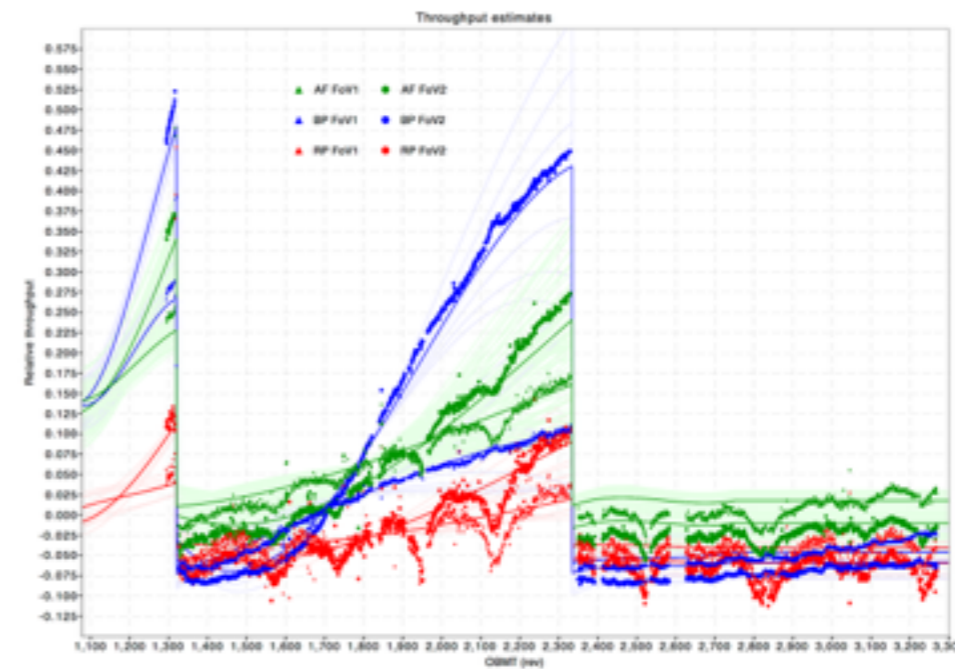
Stray light



solved adapting
the software



Contamination



solved with
decontamination campaigns

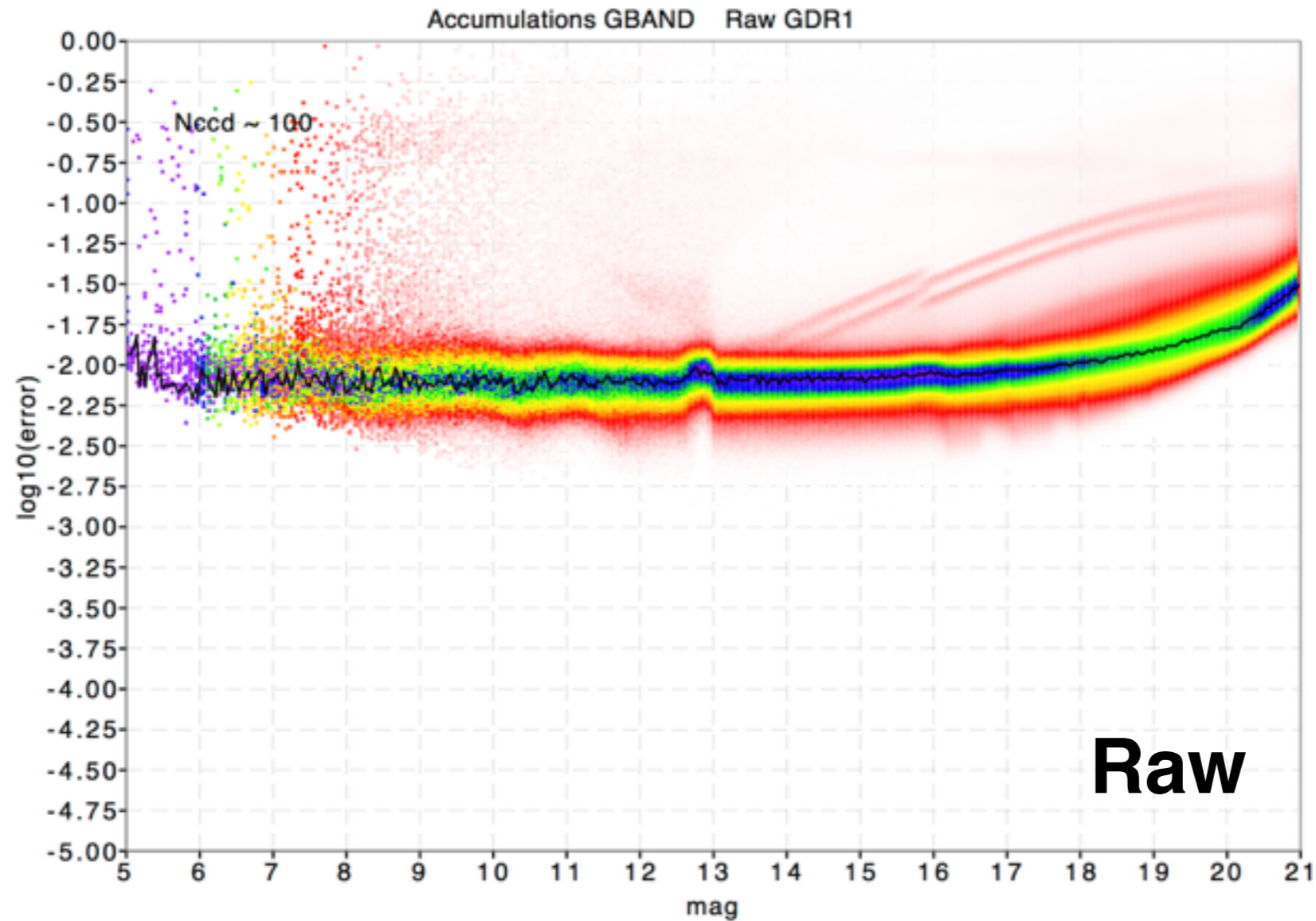
and adapting
the software

(Time-Link Calibration)



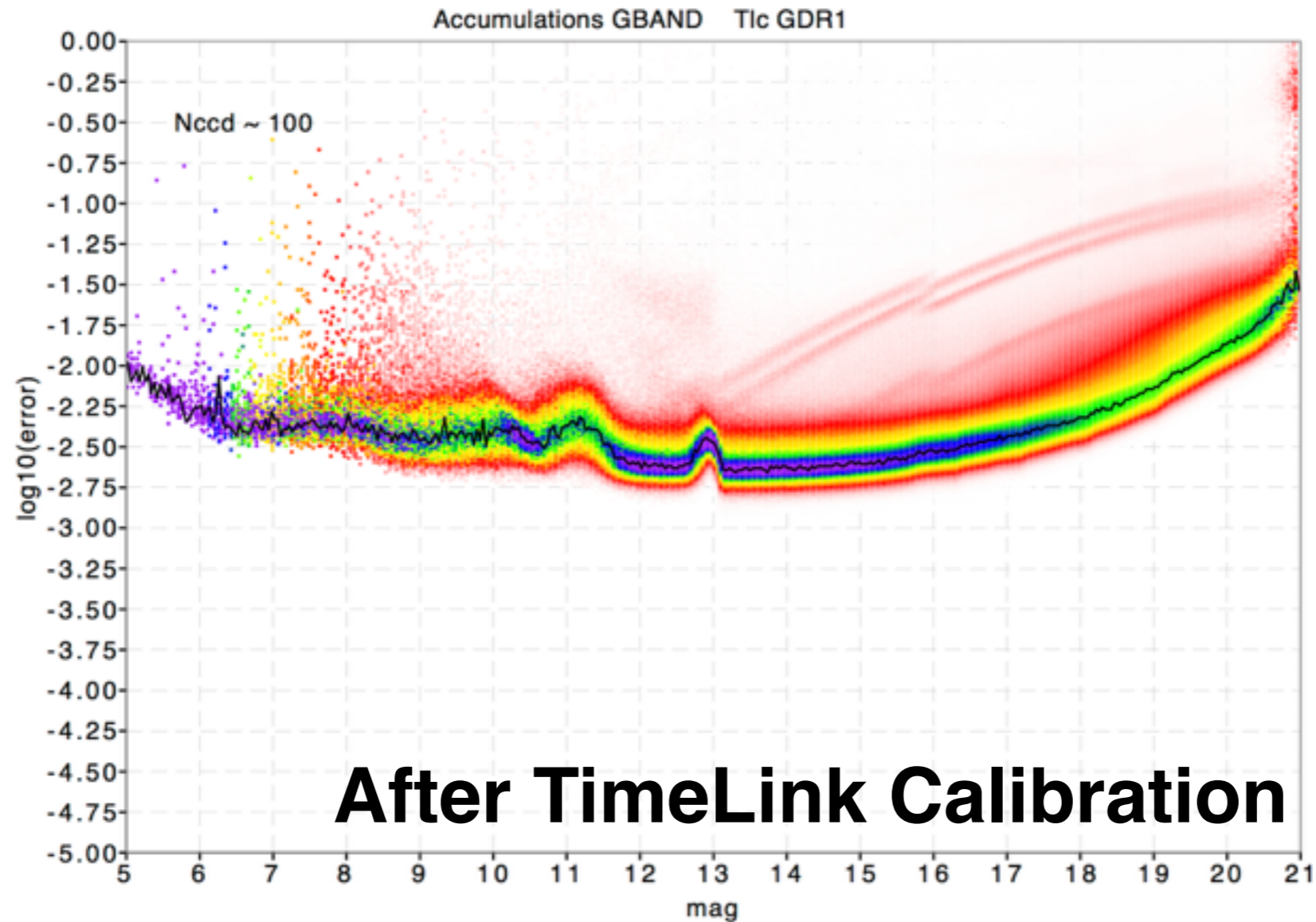
The results

Errors during different steps



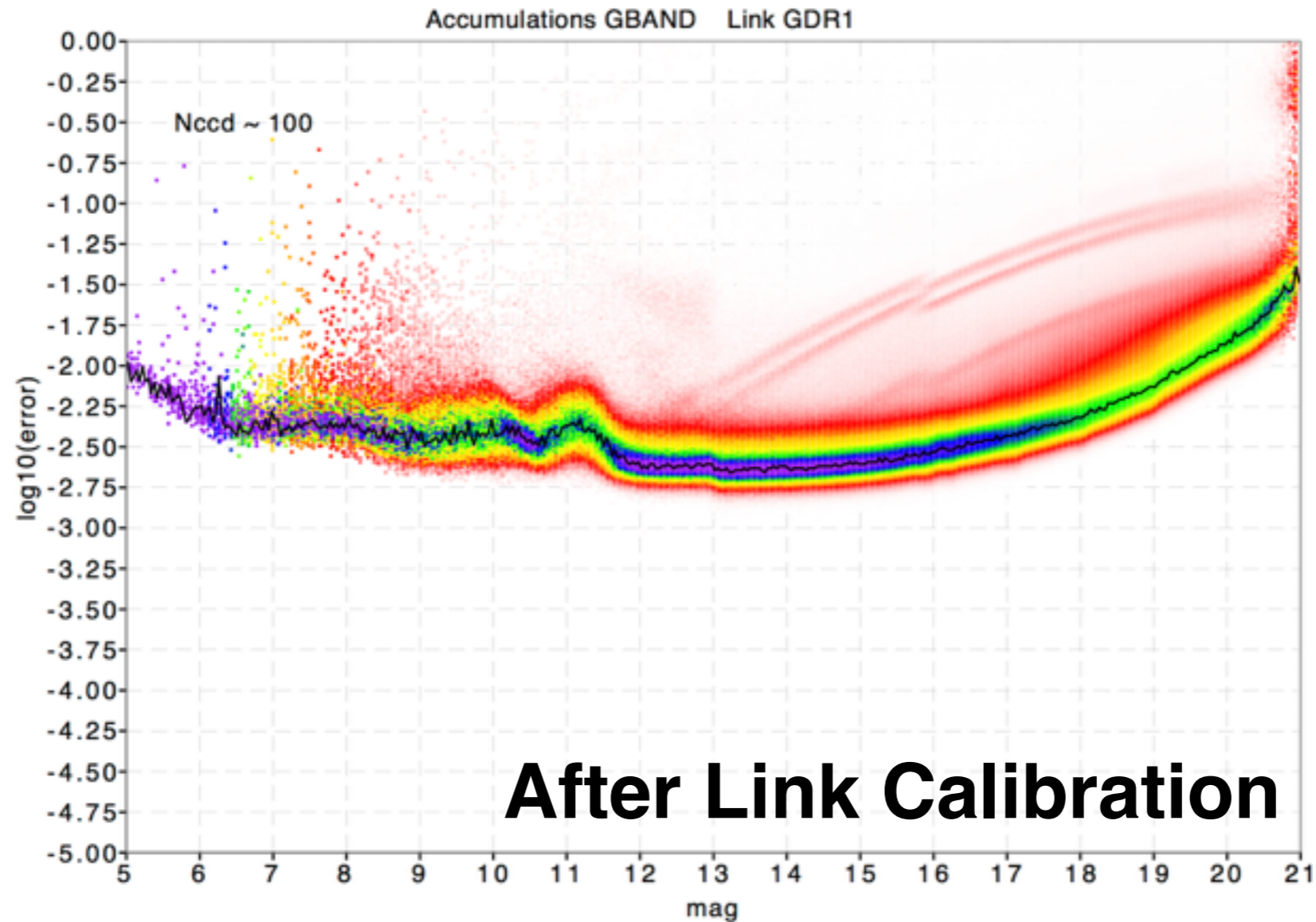
The results

Errors during different steps



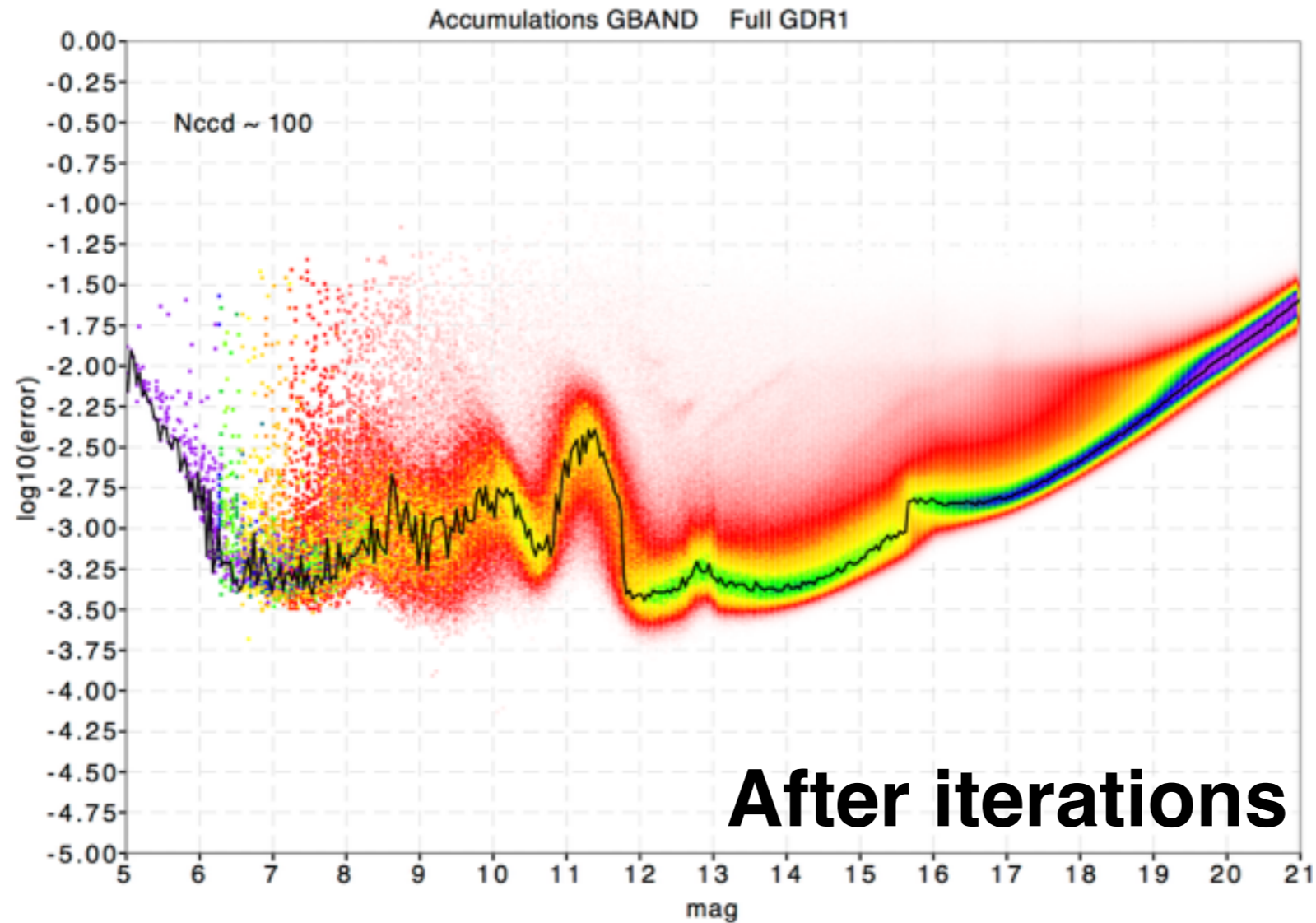
The results

Errors during different steps



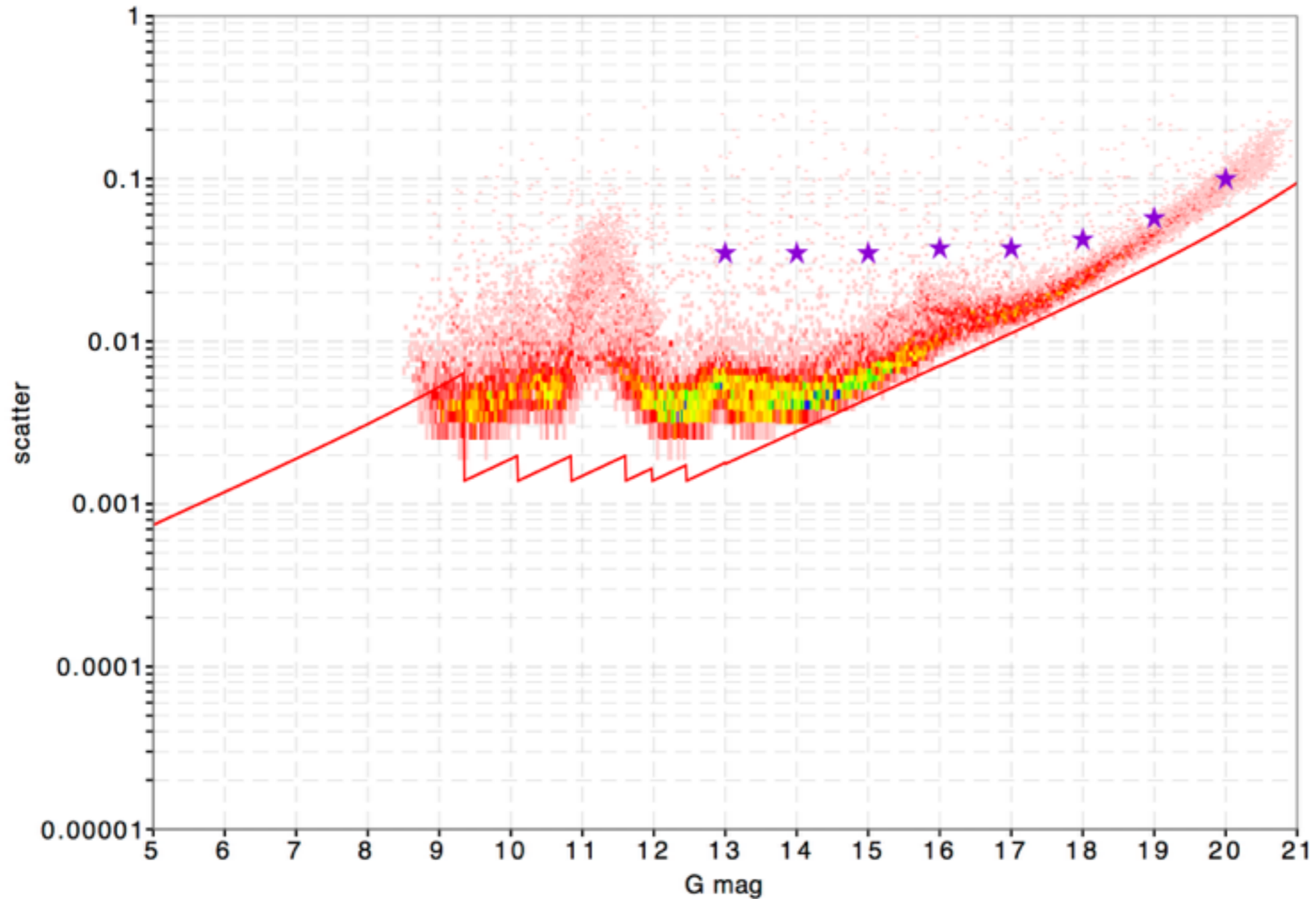
The results

Errors during different steps



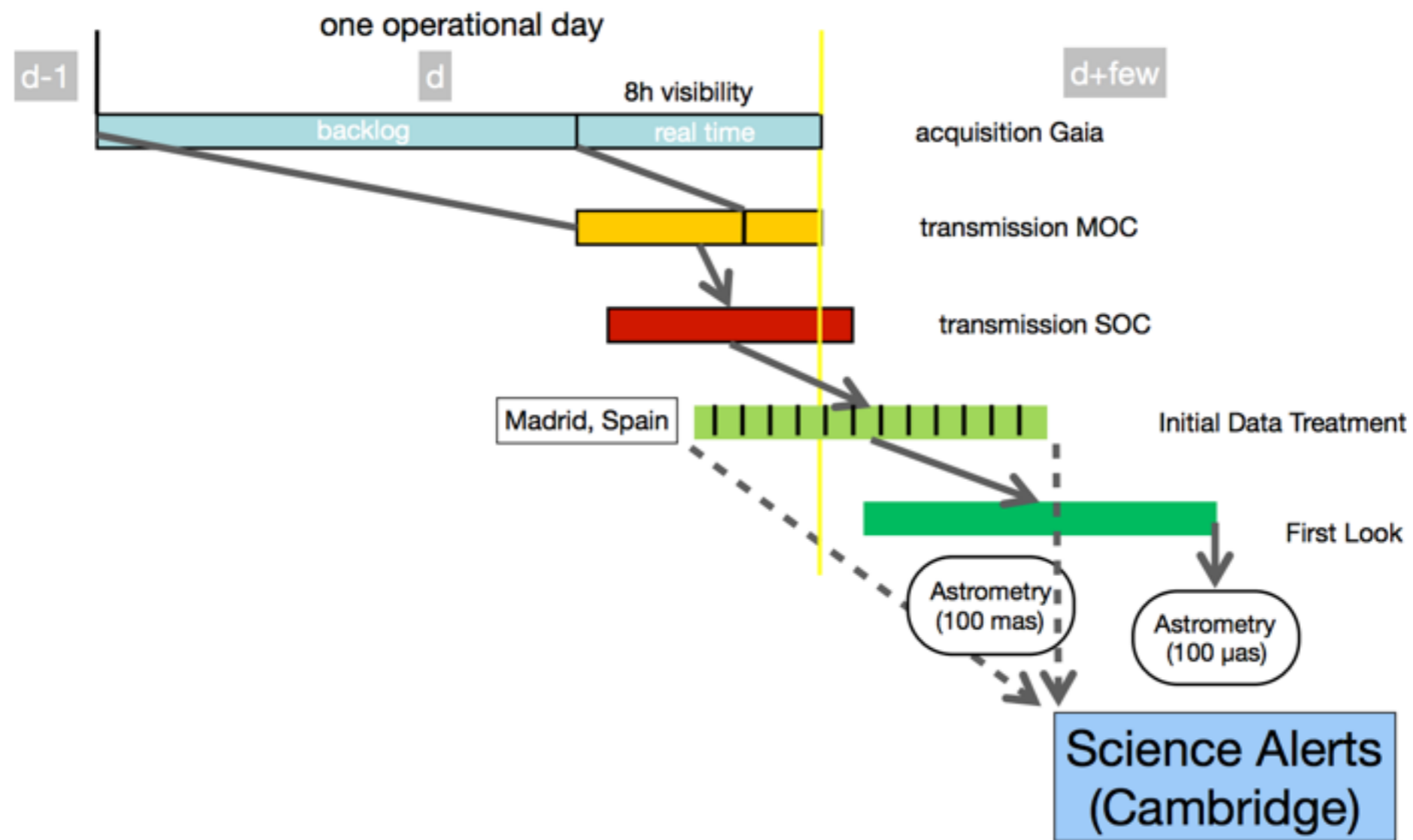
The results

Observed scatter



Science Alerts

Timeline for Data Flow



Science Alerts

<http://gsaweb.ast.cam.ac.uk/alerts/home>

The screenshot shows the 'All-Sky Gaia Alerts' web interface. At the top, there is a navigation bar with links: Gaia Alerts, Alerts Index, All-Sky, Alerts Search, Surveys-ATels, Tools, About, Related Sites, and a Log in button. The main heading is 'All-Sky Gaia Alerts' with 'Restart' and 'Export Image' buttons. The central feature is a circular map of the sky filled with blue 'x' markers representing alerts. The map is titled 'GAL: 43.8718215 +1.9160948'. To the right of the map is a control panel with several sections: 'Display Gaia alerts:' with checkboxes for 'All Alerts' (checked) and 'Alerts from Today' (checked); 'Change survey image:' with a dropdown menu set to 'Meinger colored'; 'Click on an alert on the map to see the details' with a checkbox; a list of fields to display: Name, RA-Dec, G Mag, Date, and Class; 'Go to Gaia alert:' with a text input 'Lc.Gaia16aaa' and a 'Go!' button; 'Go to object or position:' with a text input 'Object name/position' and a 'Go!' button; 'After search, objects displayed in 0.5° from:' with checkboxes for 'NED' (checked) and 'SIMBAD' (checked); and finally, checkboxes for 'HEALPix Grid' and 'Reticle'.

2015 - Institute of Astronomy, University of Cambridge, UK

Science Alerts

<http://gsaweb.ast.cam.ac.uk/alerts/home>

Gaia16blj

Details Follow-up



RA - DEC
323.85616 21.32013
21:35:25.48 21:19:12.47

Alerting date
2016-10-03 23:33:57

Julian date
2457665.48

Alerting magnitude
18.95

Historic magnitude
None

Historic StdDev
None

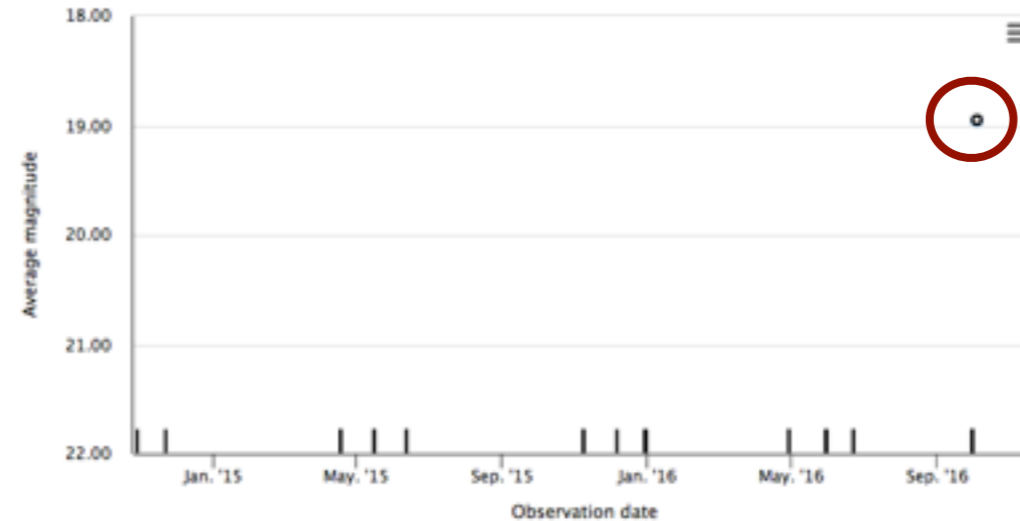
Class
SN Ia

Publication date
Oct. 5, 2016, 2:25 p.m.

Other surveys detections
None

Comments
confirmed SN Ia aka SN2016fmb

ATels
9472 9478

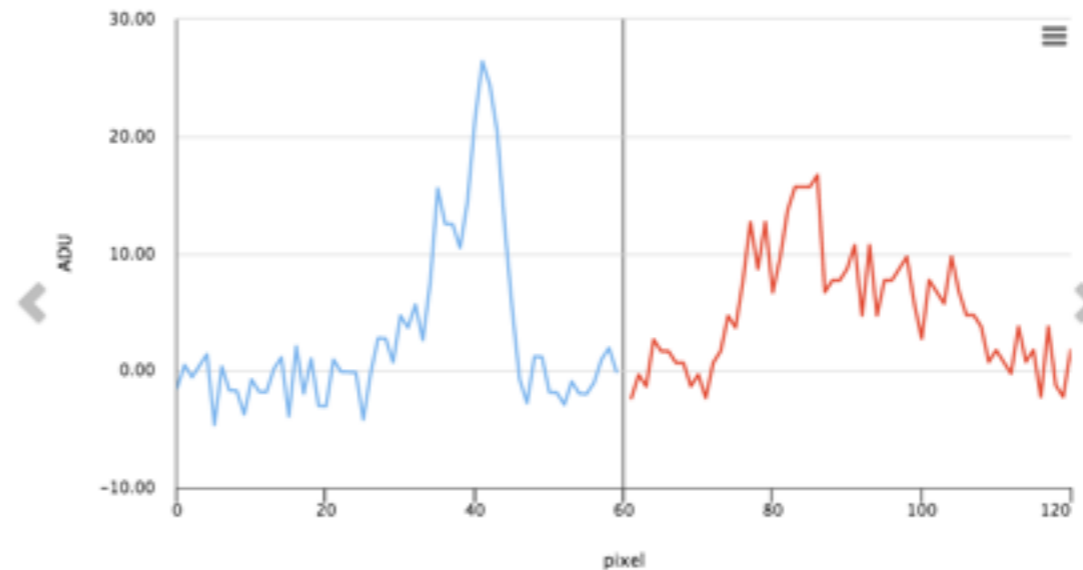


Detections Alert Scans

Get lightcurve data

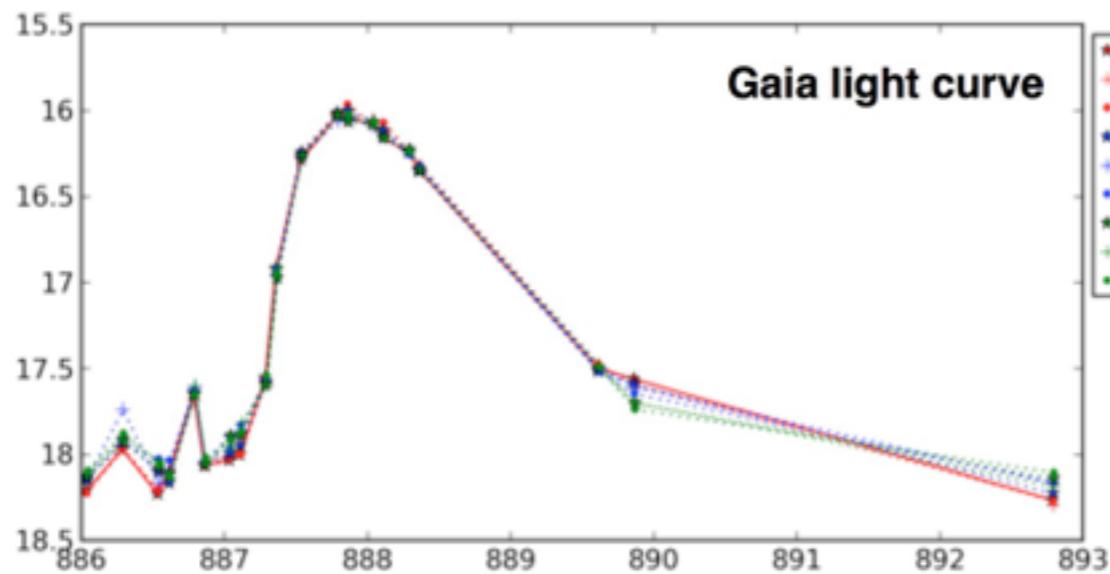
Click and scroll down and select one row in the table below to display the corresponding spectrum.

Date	JD	Average Mag.
2016-10-03 23:33:57	2457665.48	18.95
2016-10-04 01:20:31	2457665.56	18.96
2016-10-04 05:34:10	2457665.73	18.96

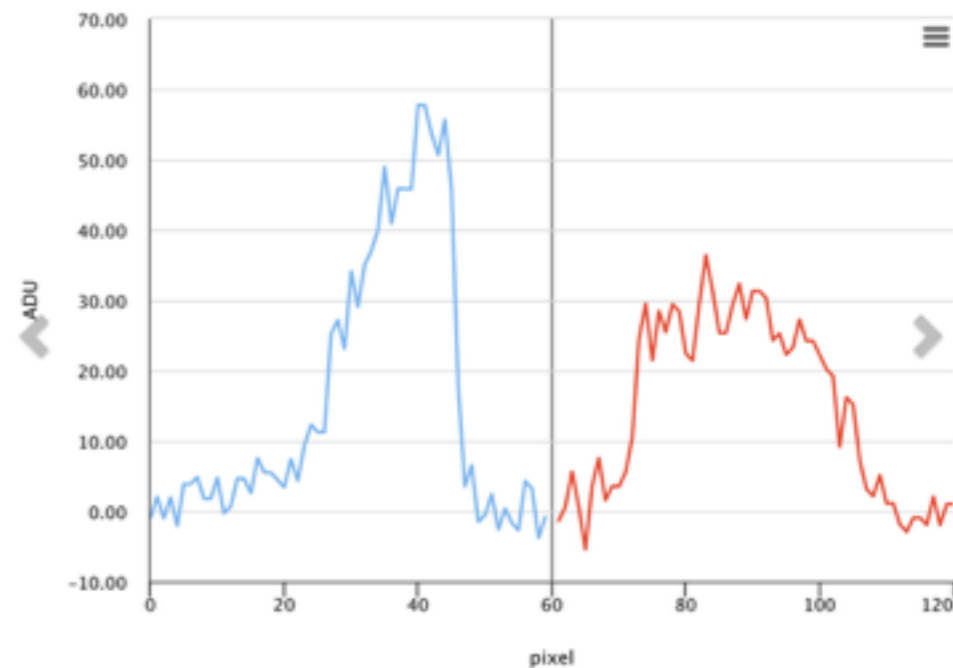


Science Alerts: First Science Discovery Publication

Gaia14aae identified as a transient by the Gaia Science Alerts project and independently by ASAS-SN (Shappee et al.) and during two separate outbursts.



Gaia light curve

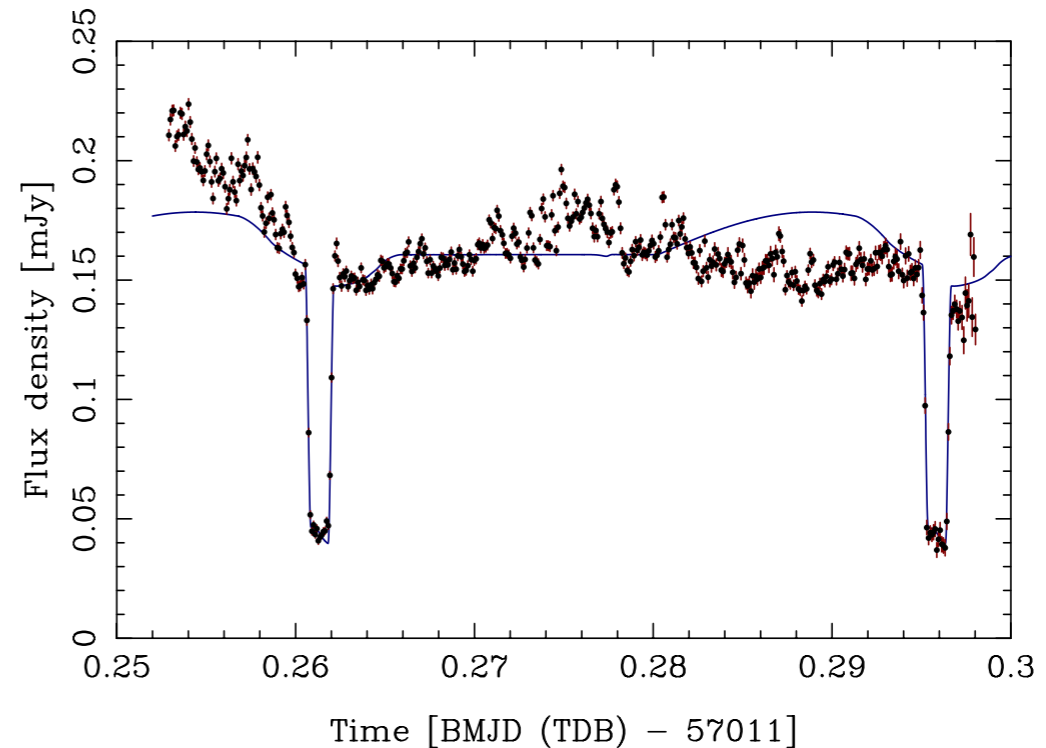
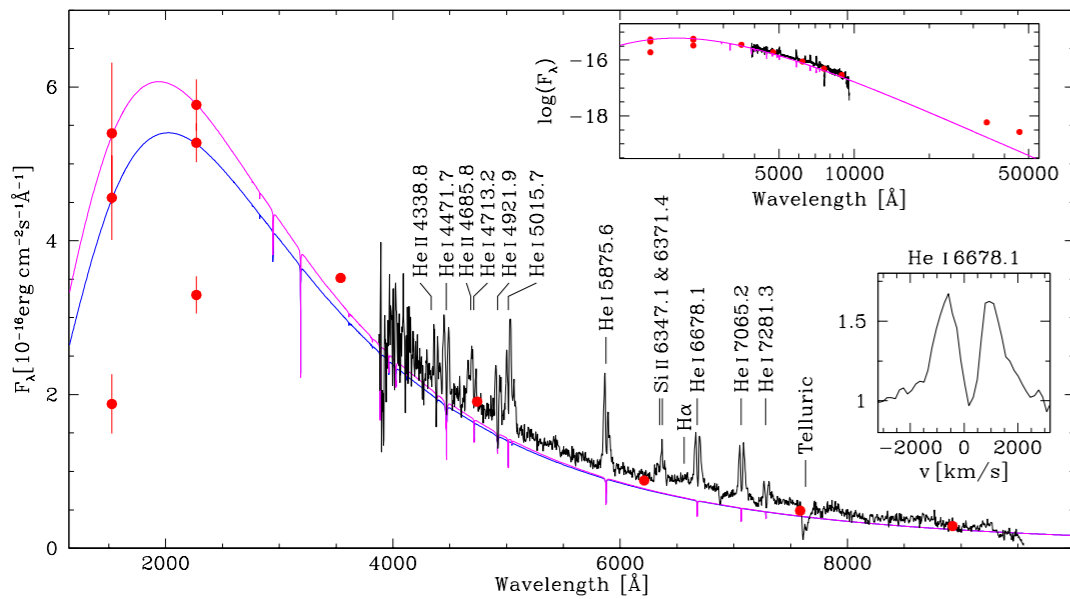


BP + RP

Images courtesy of H. Campbell

Science Alerts: First Science Discovery Publication

Spectroscopic and photometric follow-up and comparison with previous survey



The historical GALEX, SDSS and WISE photometry

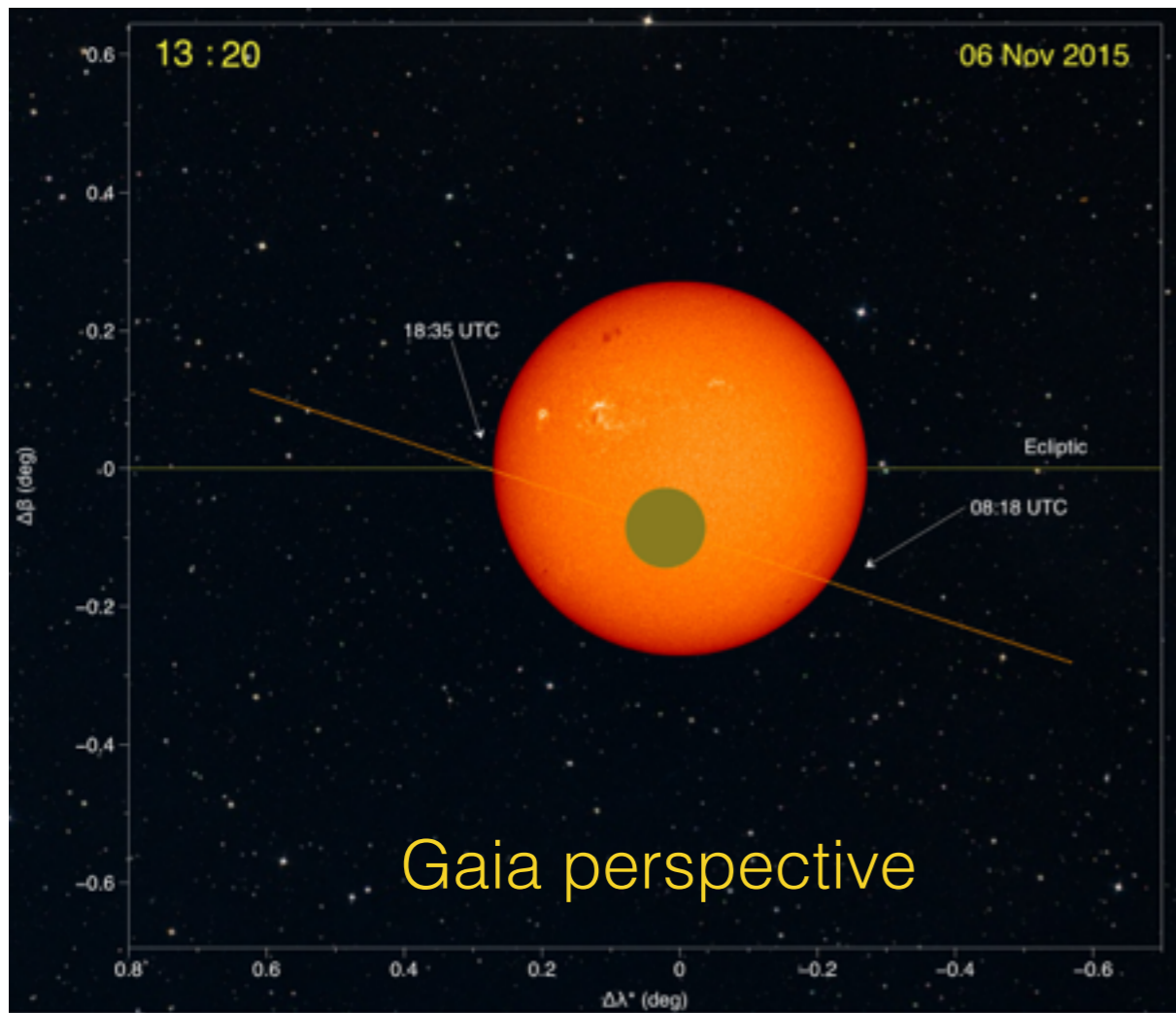
WHT spectrum: double-peaked He emission and an absence of H lines.

AM CVn WD accreting He from low mass degenerate companion
Third observed so far and first with total eclipse

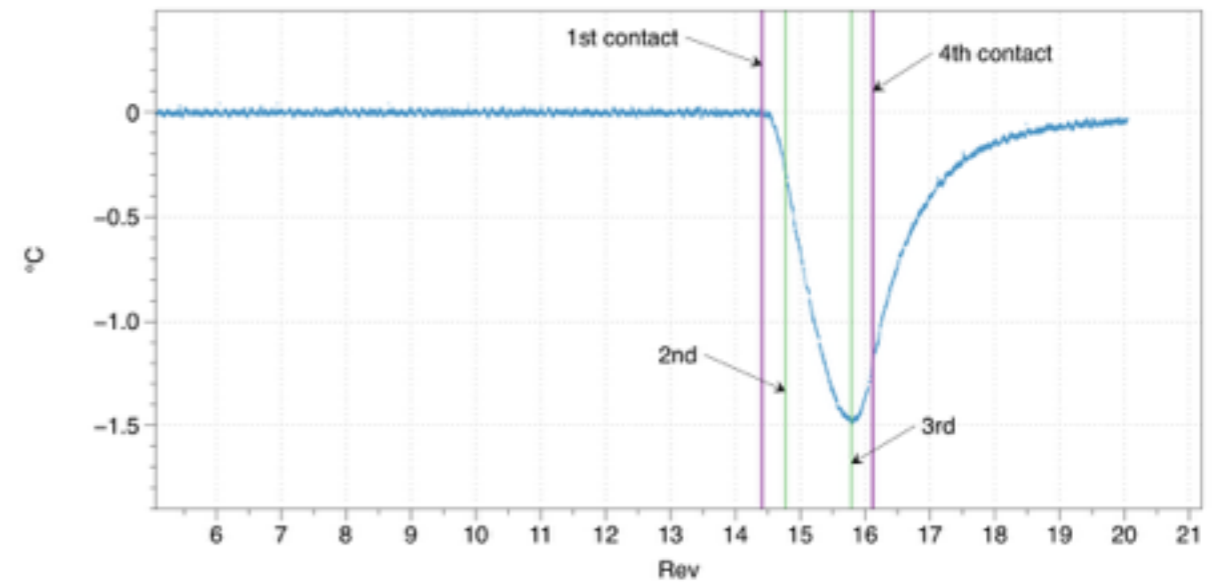
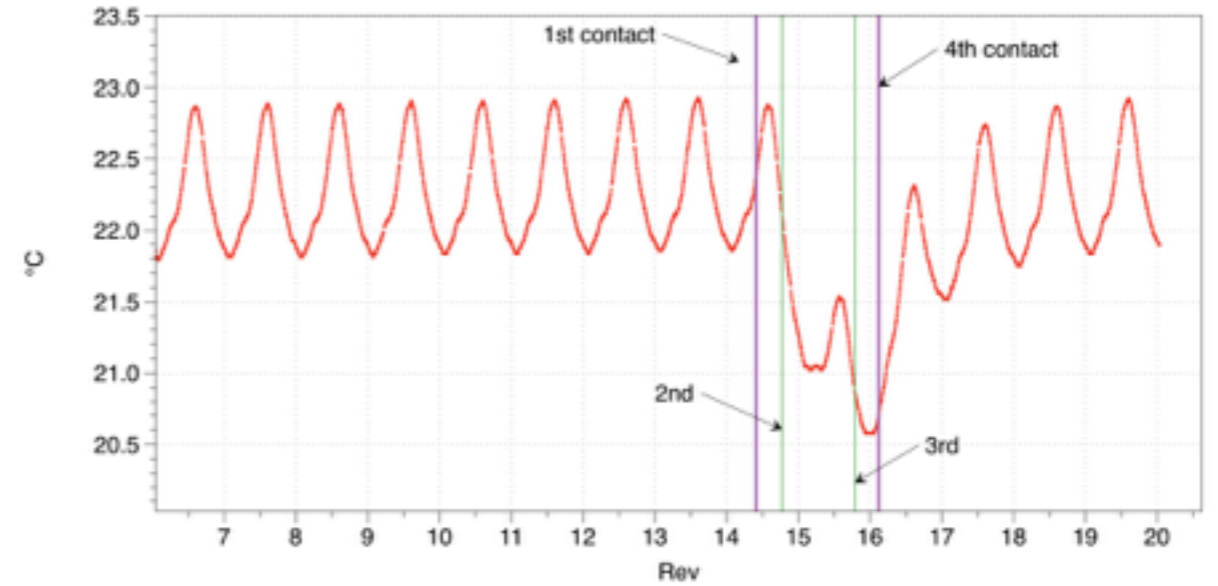
Campbell, H.C. et al. MNRAS 452, 1060

Images courtesy of H. Campbell

Lunar Transit



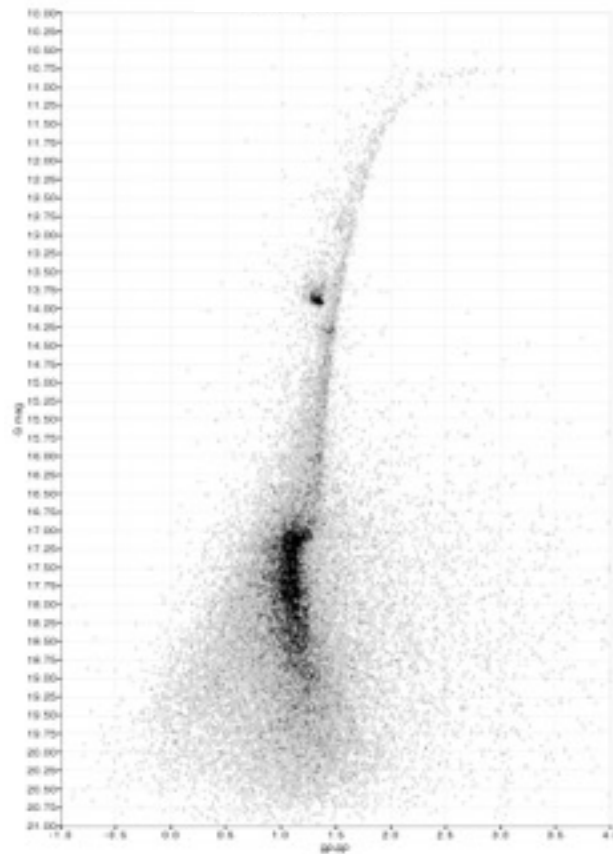
Images Courtesy of F. Mignard and J.Hernandez



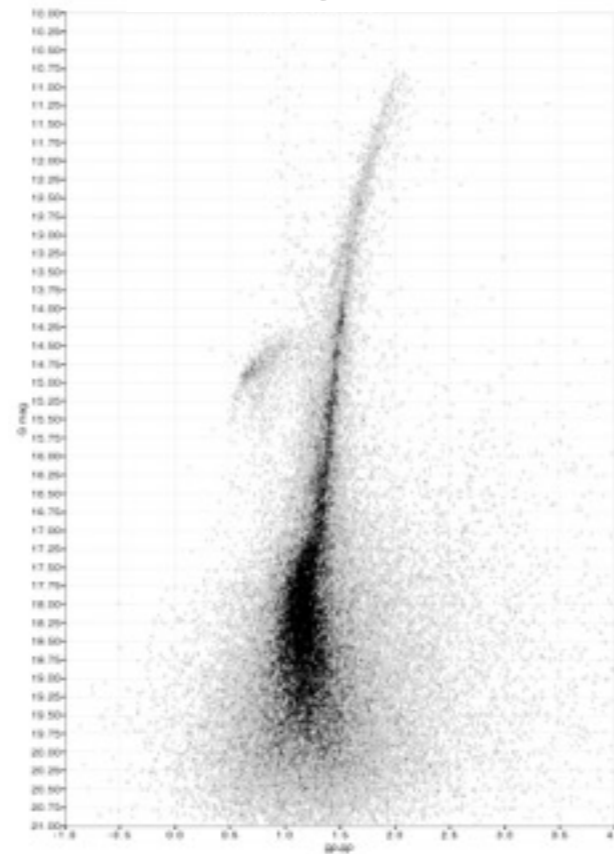
The results

Picture of the week

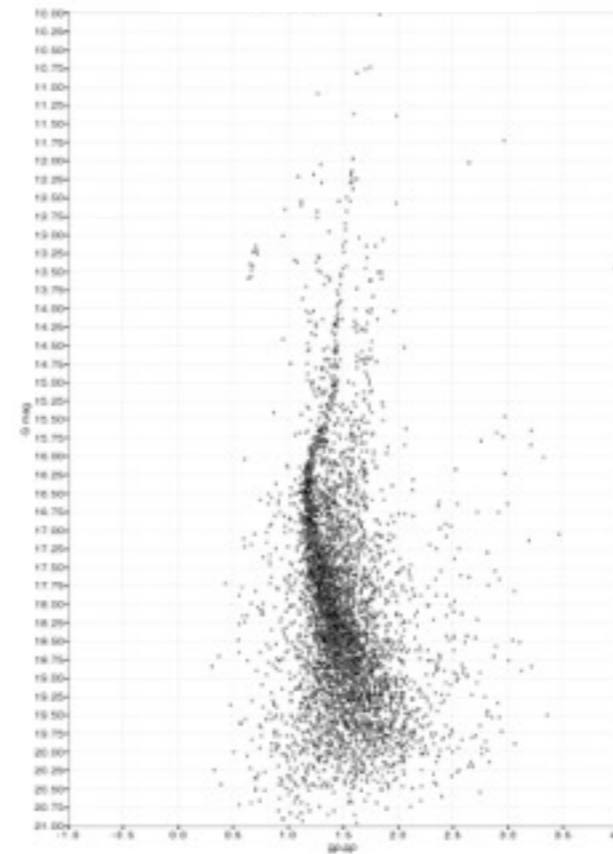
47 Tuc



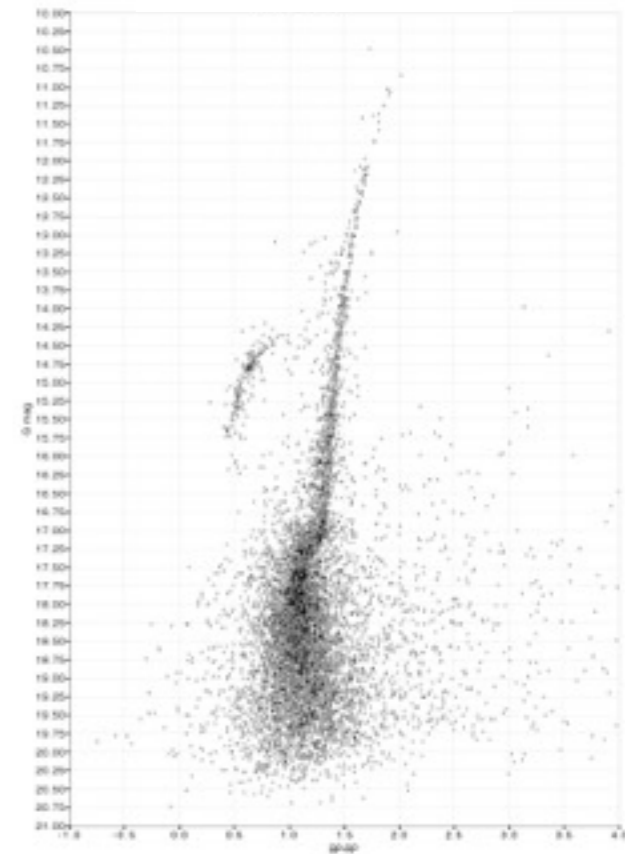
Omega Cen

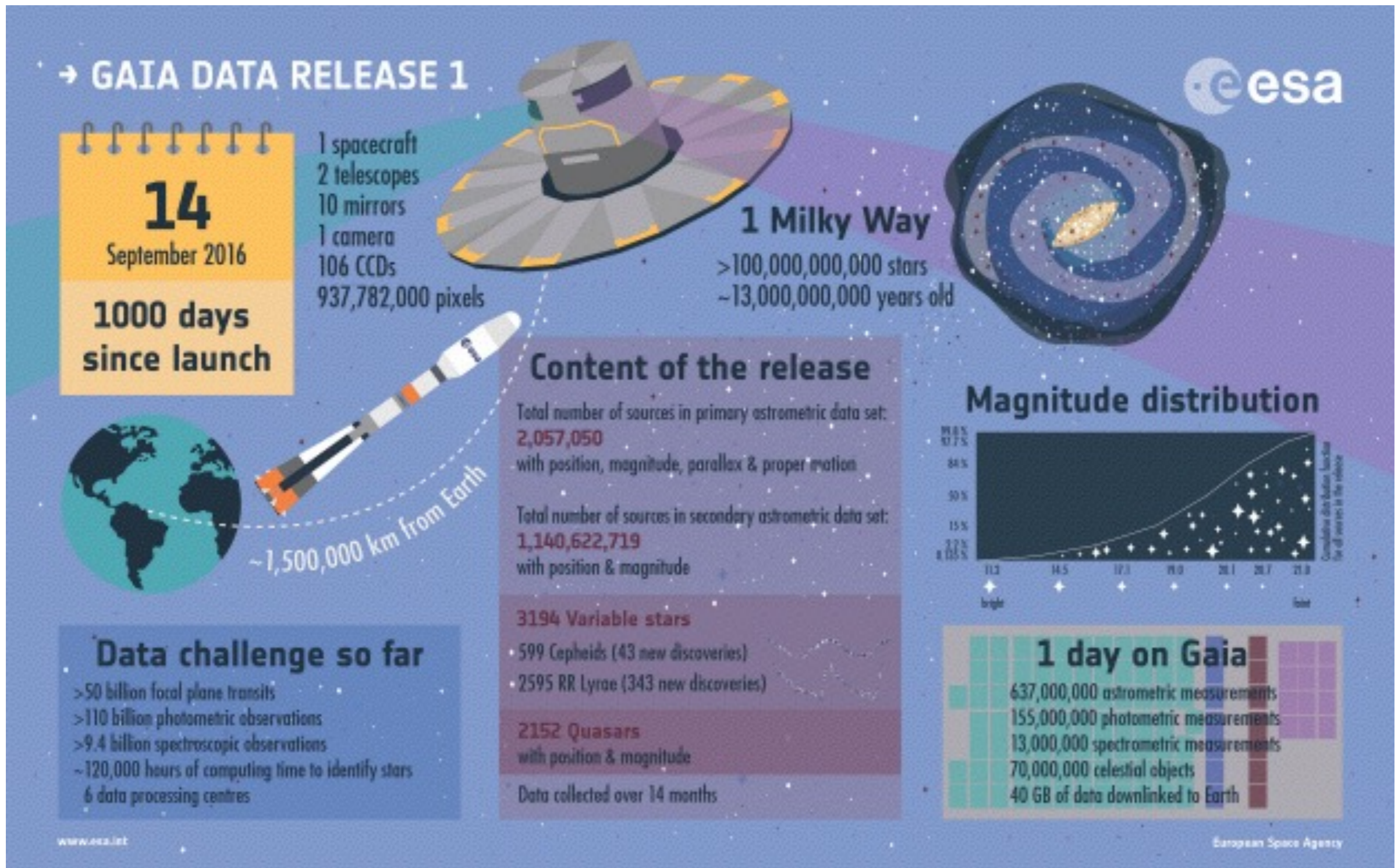


NGC 6397



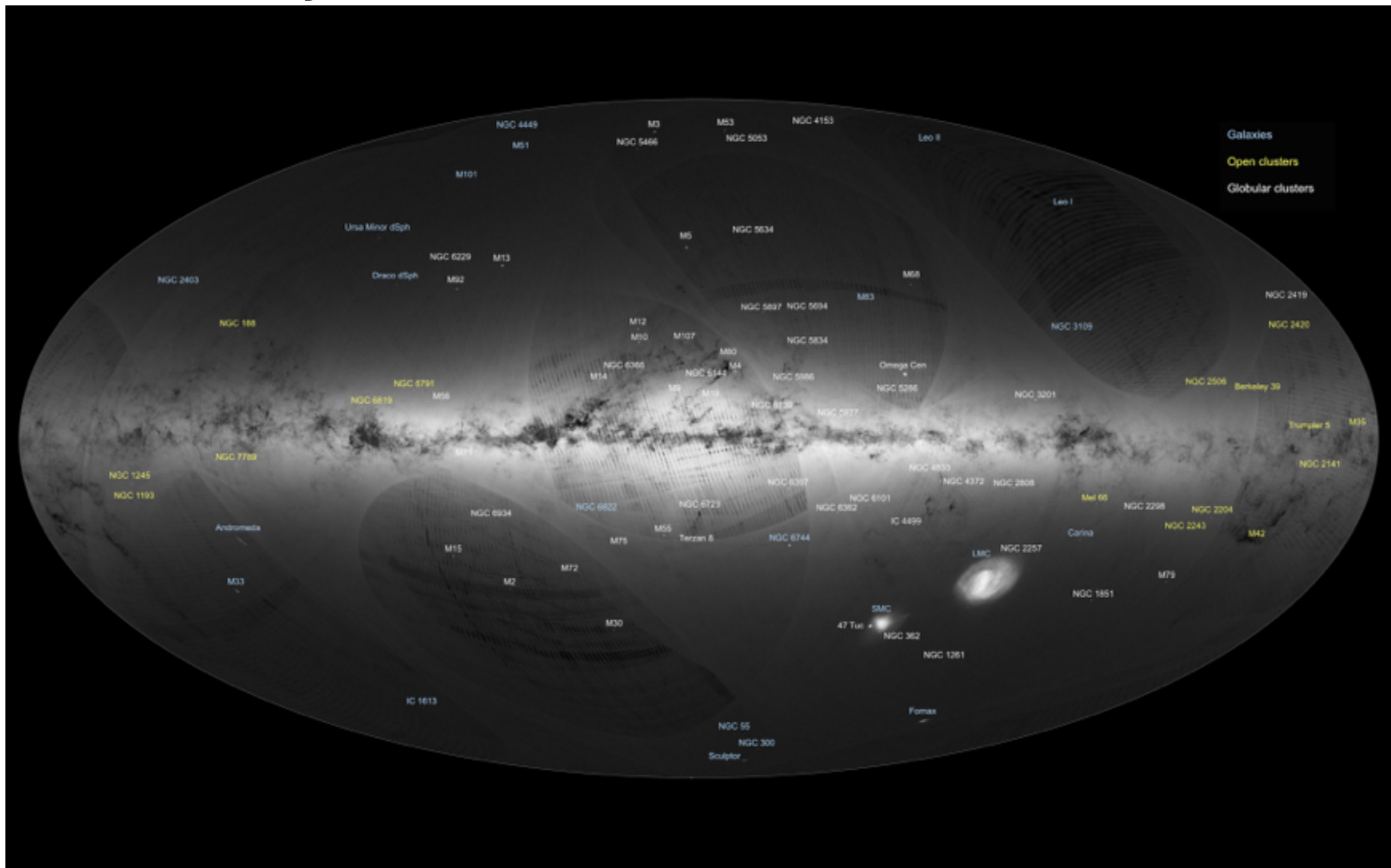
NGC 6809





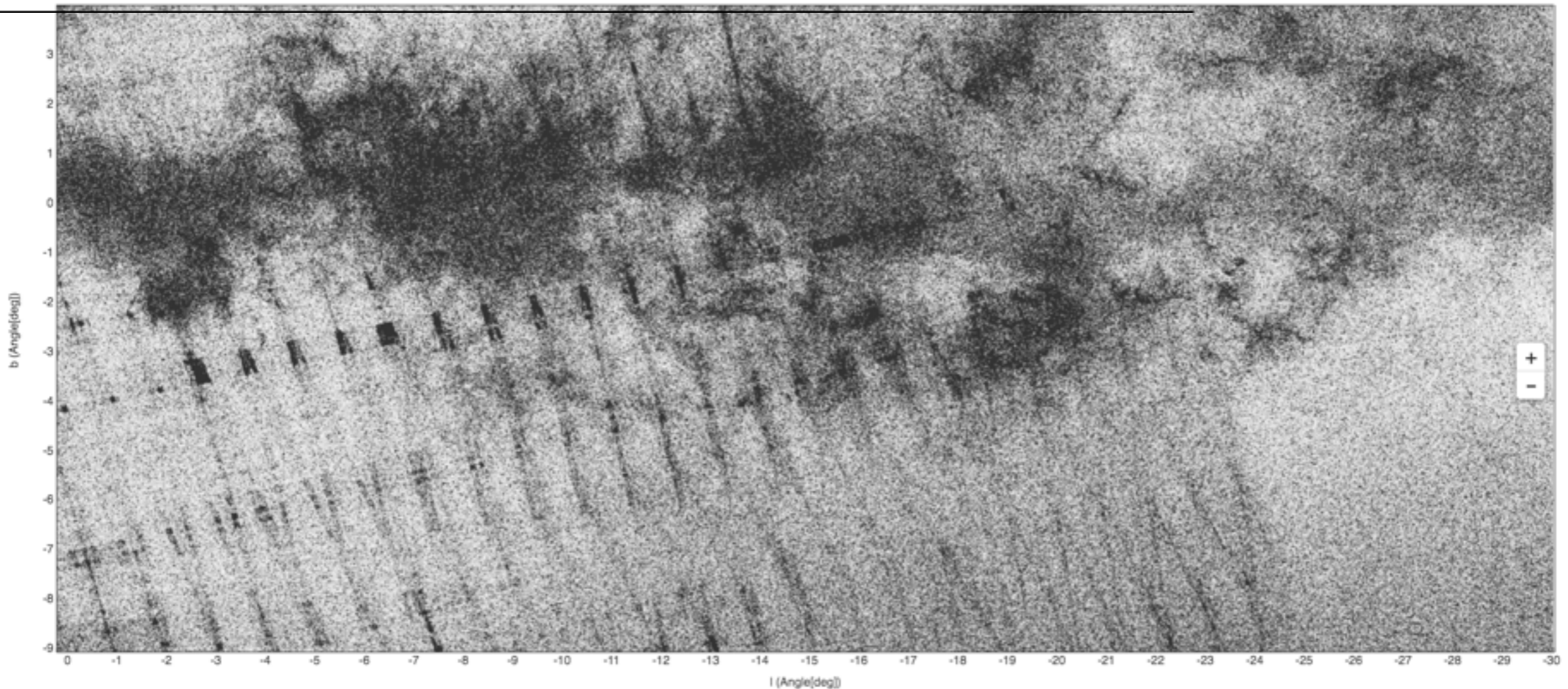
Data between 25 July 2014 and 16 September 2015.

The Gaia Sky



http://www.esa.int/spaceinimages/Images/2016/09/Gaia_s_first_sky_map_annotated

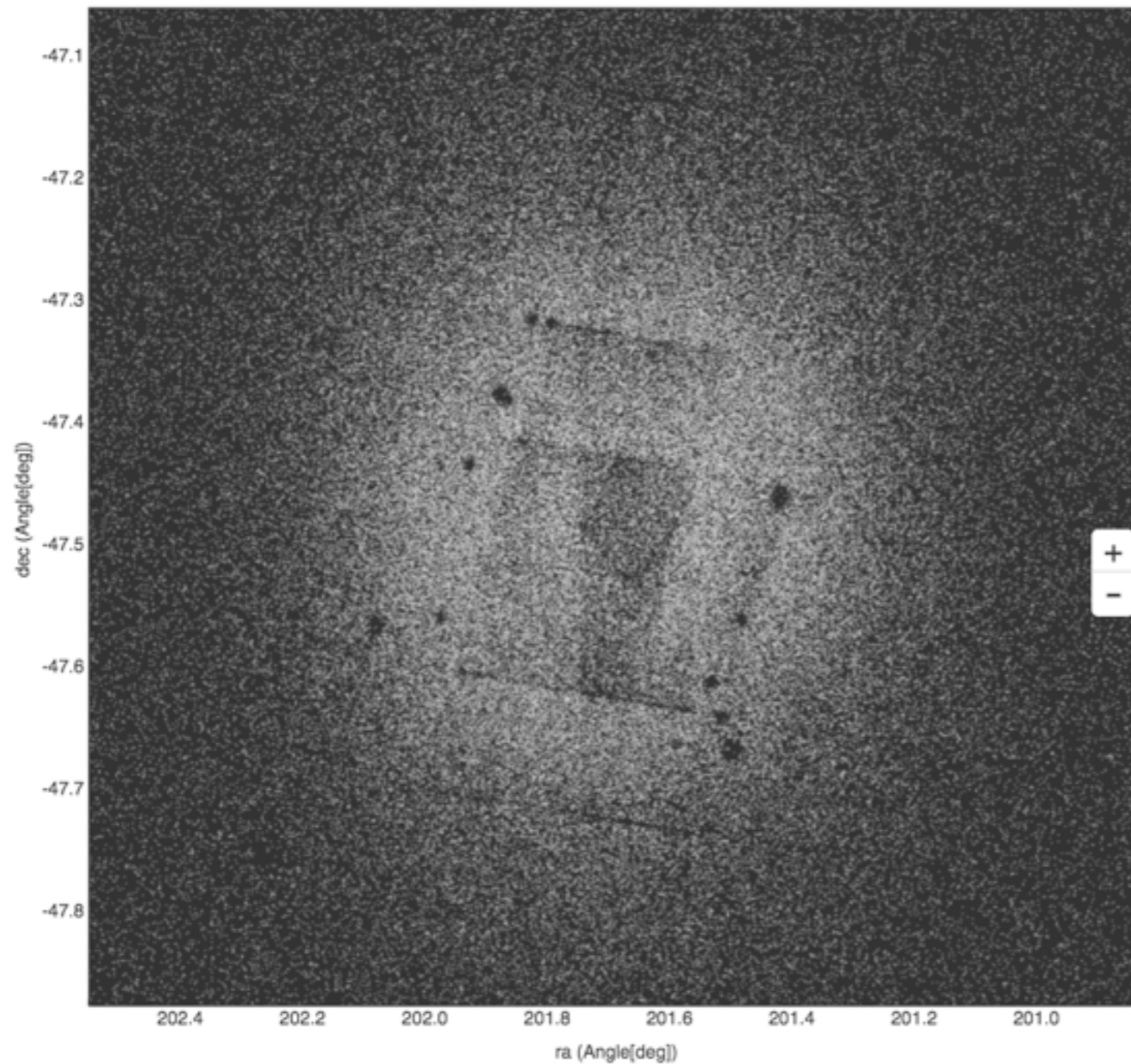
The Gaia Sky... zooming in



Scanning pattern is visible

- dense regions
- areas with poor scanning law coverage
- filtering on number of observations

The Gaia Sky... zooming in



OmegaCen
saturation effects
in dense core

Astrometry

Primary data set: **positions, parallaxes, mean proper motions**

for $\sim 2 \times 10^6$ stars in T-GAS

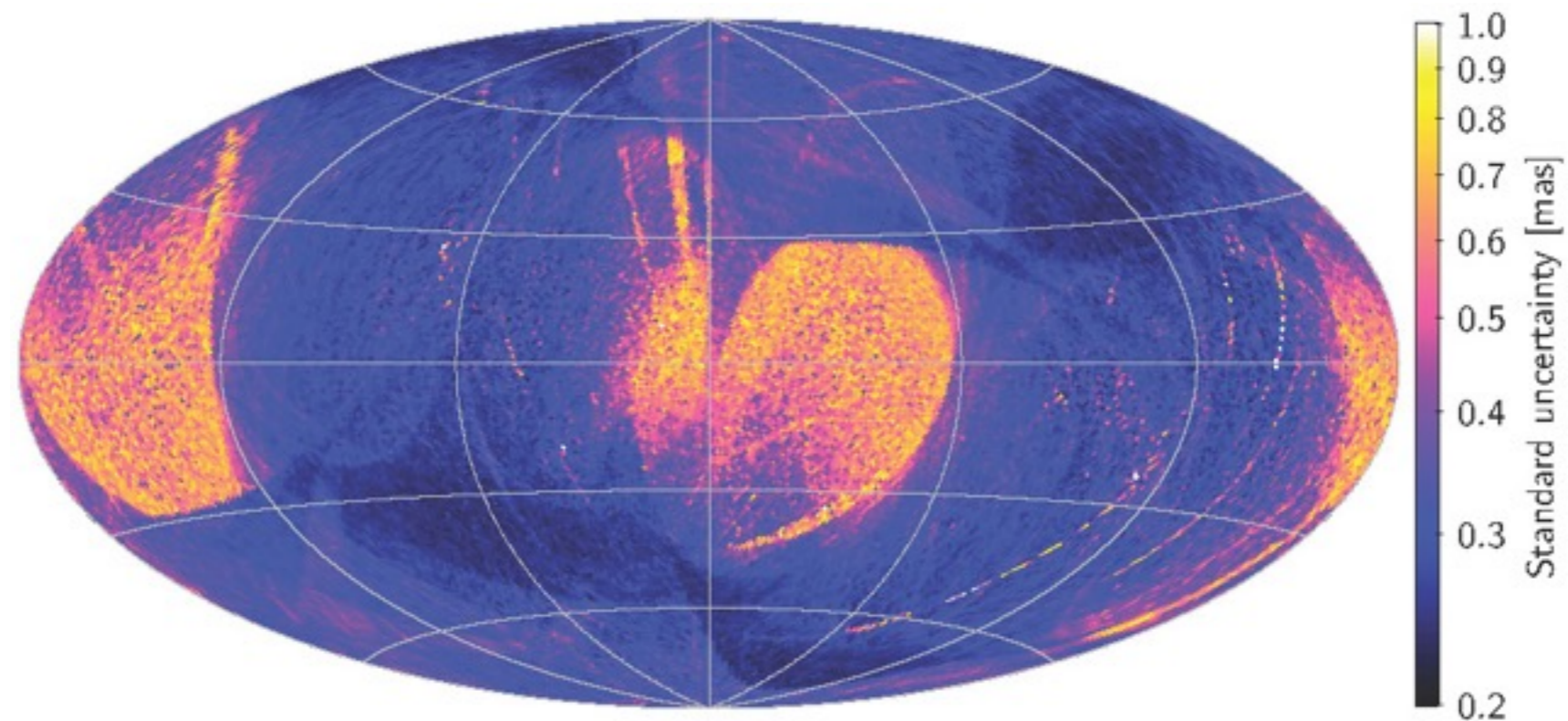
$\sigma \sim 0.3$ mas for the positions

$\sigma \sim 1$ mas yr for the proper motions. Only Hipparcos ($\sim 9 \times 10^5$) 0.06 mas yr $^{-1}$

$\sigma \sim 0.3$ mas for the parallaxes

Secondary data set: **positions** for more than 1×10^9 sources.

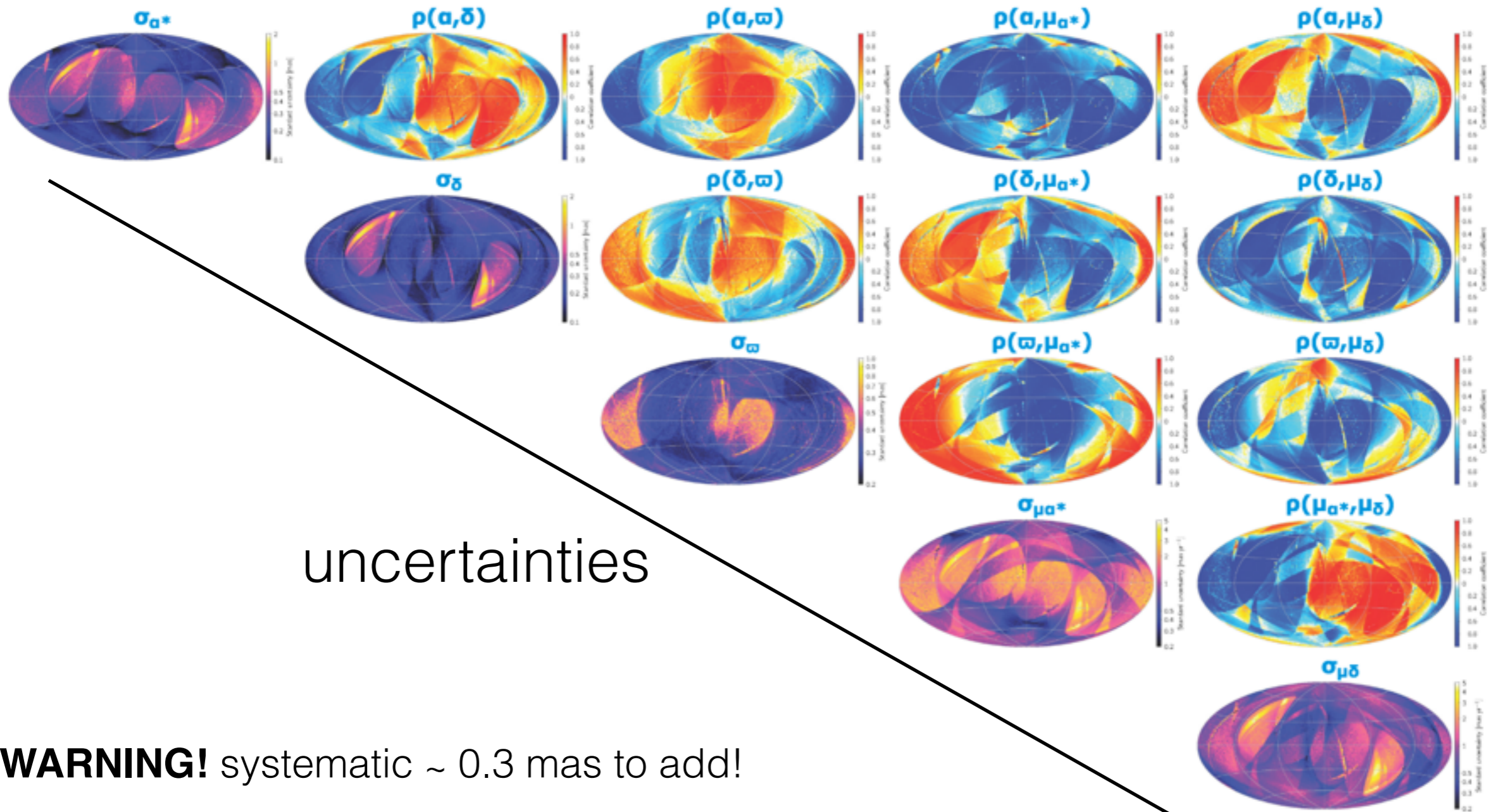
$\sigma \sim 10$ mas



parallax uncertainty

Astrometry: more statistics

correlations

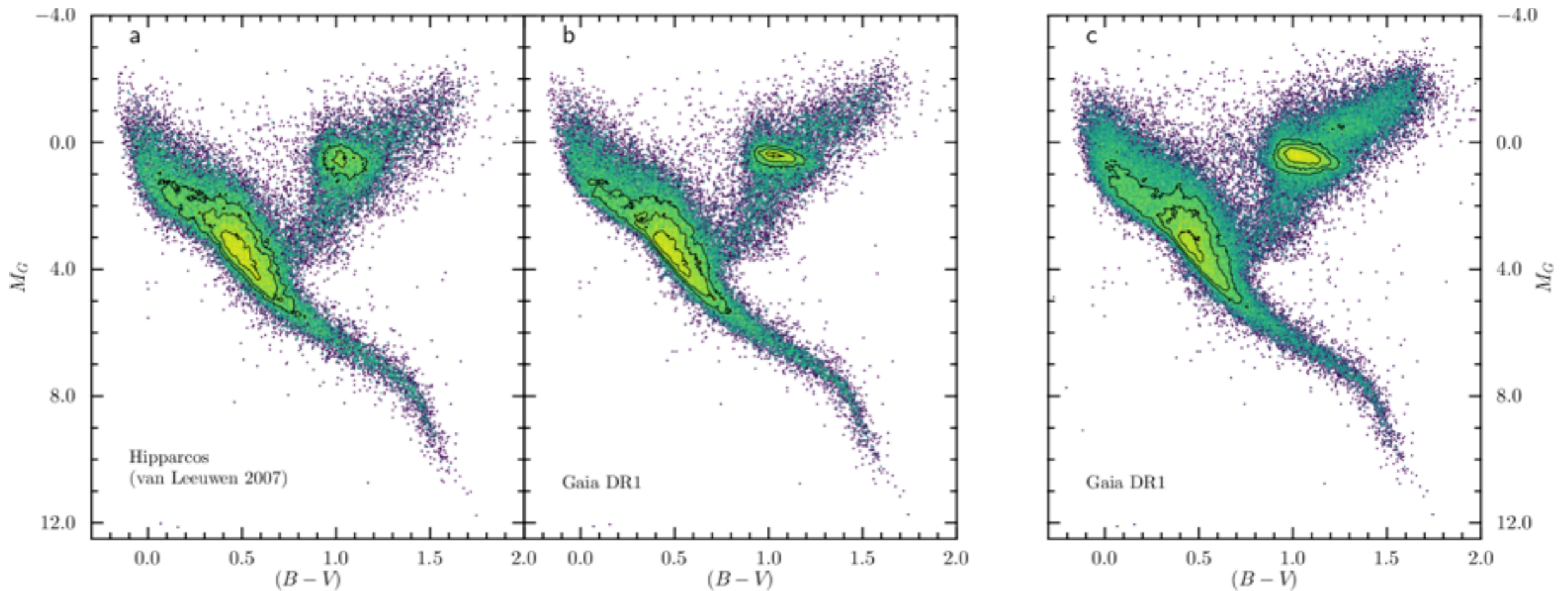


uncertainties

WARNING! systematic ~ 0.3 mas to add!

Astrometry Comparison with Hipparcos

B-V from Hipparcos
G from Gaia



Selected on parallaxes and magnitude on both catalogues

$$(\omega/\sigma)_{\text{Gaia}} \geq 5$$

$$\sigma_G < 0.05$$

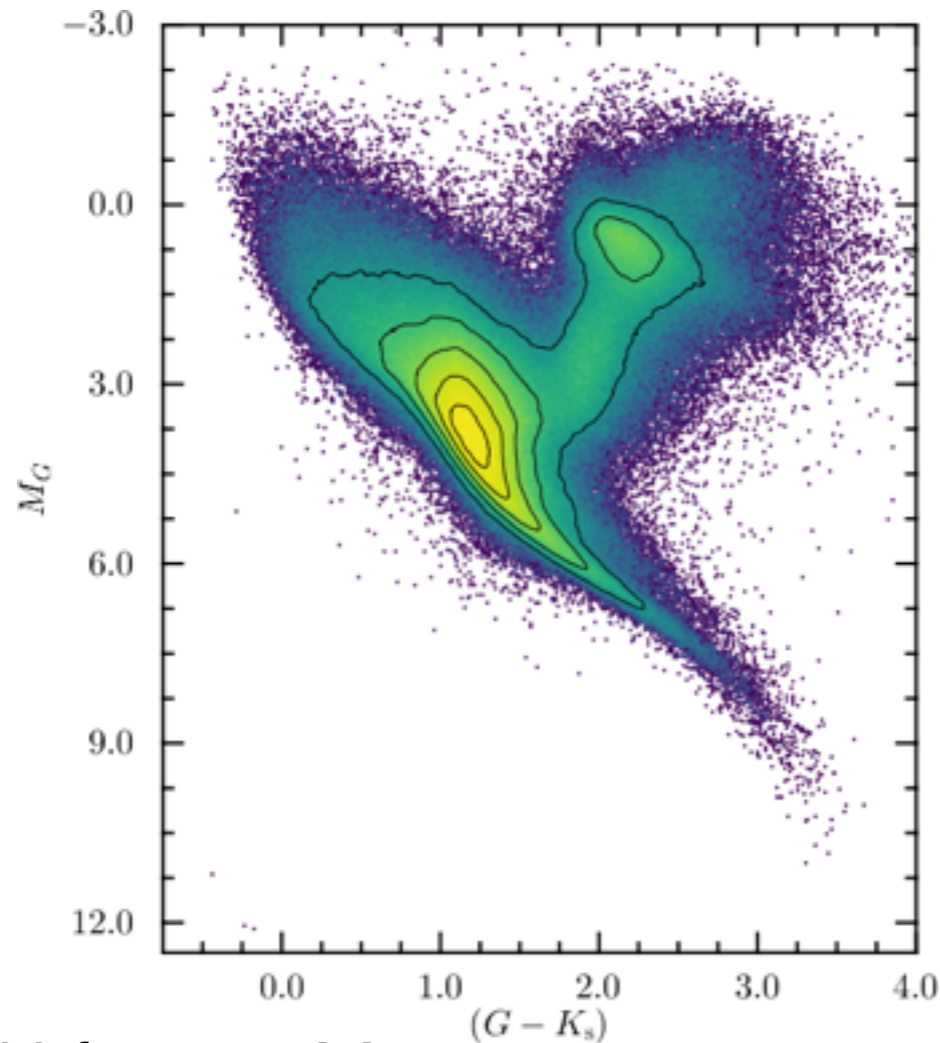
$$(\omega/\sigma)_{\text{Hipparcos}} \geq 5$$

$$\sigma_{B-V} < 0.05$$

Same selection in magnitude, but only selected in Gaia parallaxes

Photometry

All GDR1



K from 2-Mass

G from Gaia

10%, 30%, 50%, 70%, and 90%

mean Gaia G-band magnitudes

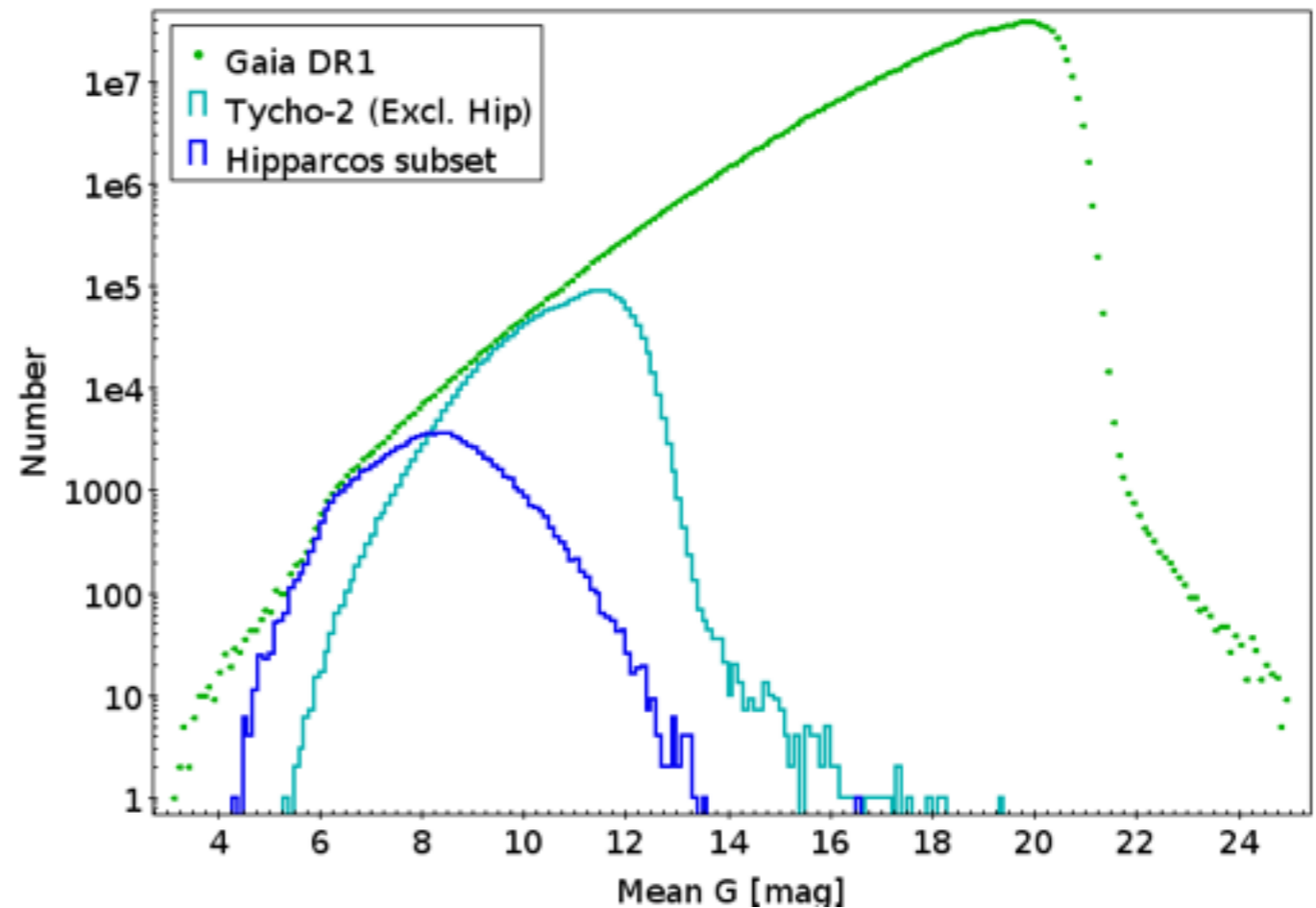
for **all** the sources contained in Gaia DR1.

$G_{\text{max}} = 3.2$,

99.7% with $11.2 \leq G \leq 21$.

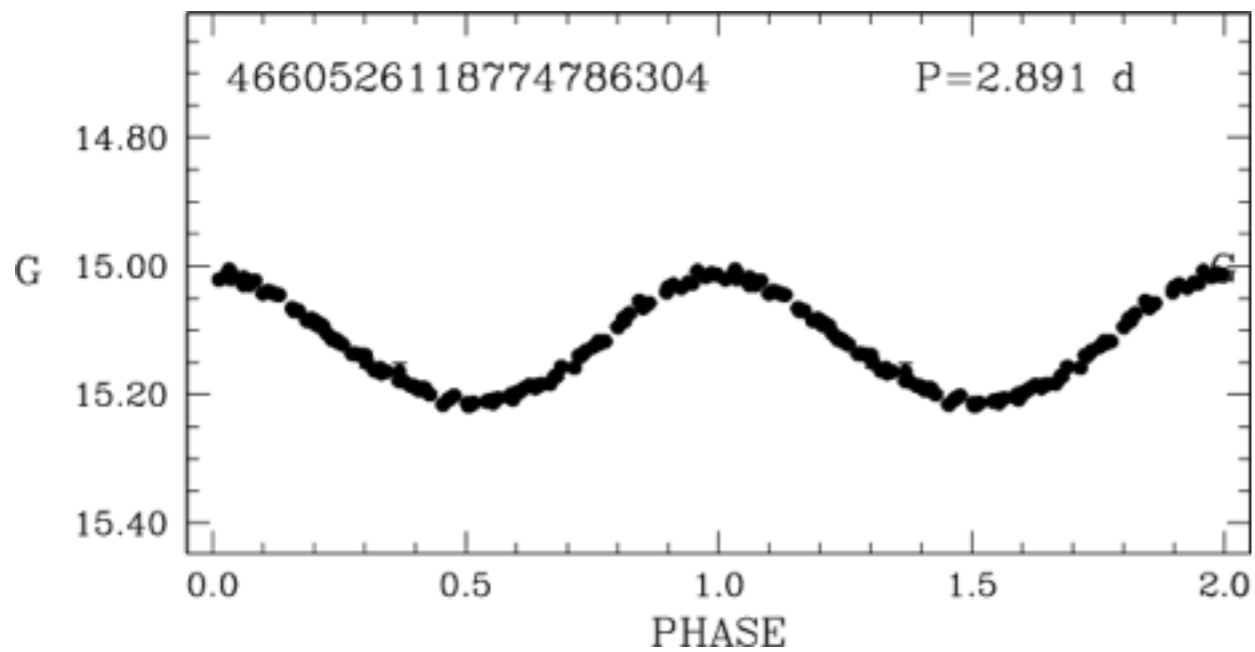
$\sigma \sim 0.1$ for $G > 13$

$\sigma \sim 0.03$ at $G \sim 21$

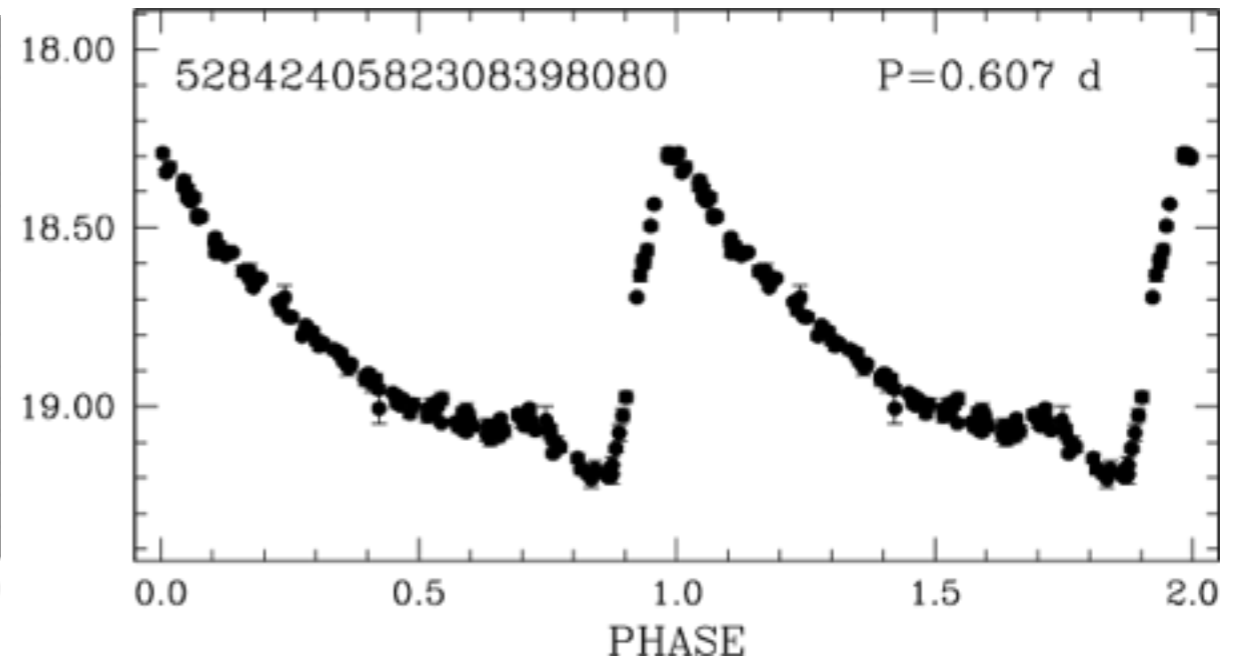


Variables

G-band light curves and characteristics for 599 Cepheid (43 new) and 2595 RR-Lyrae (343 new) observed during the EPSL



Cepheid

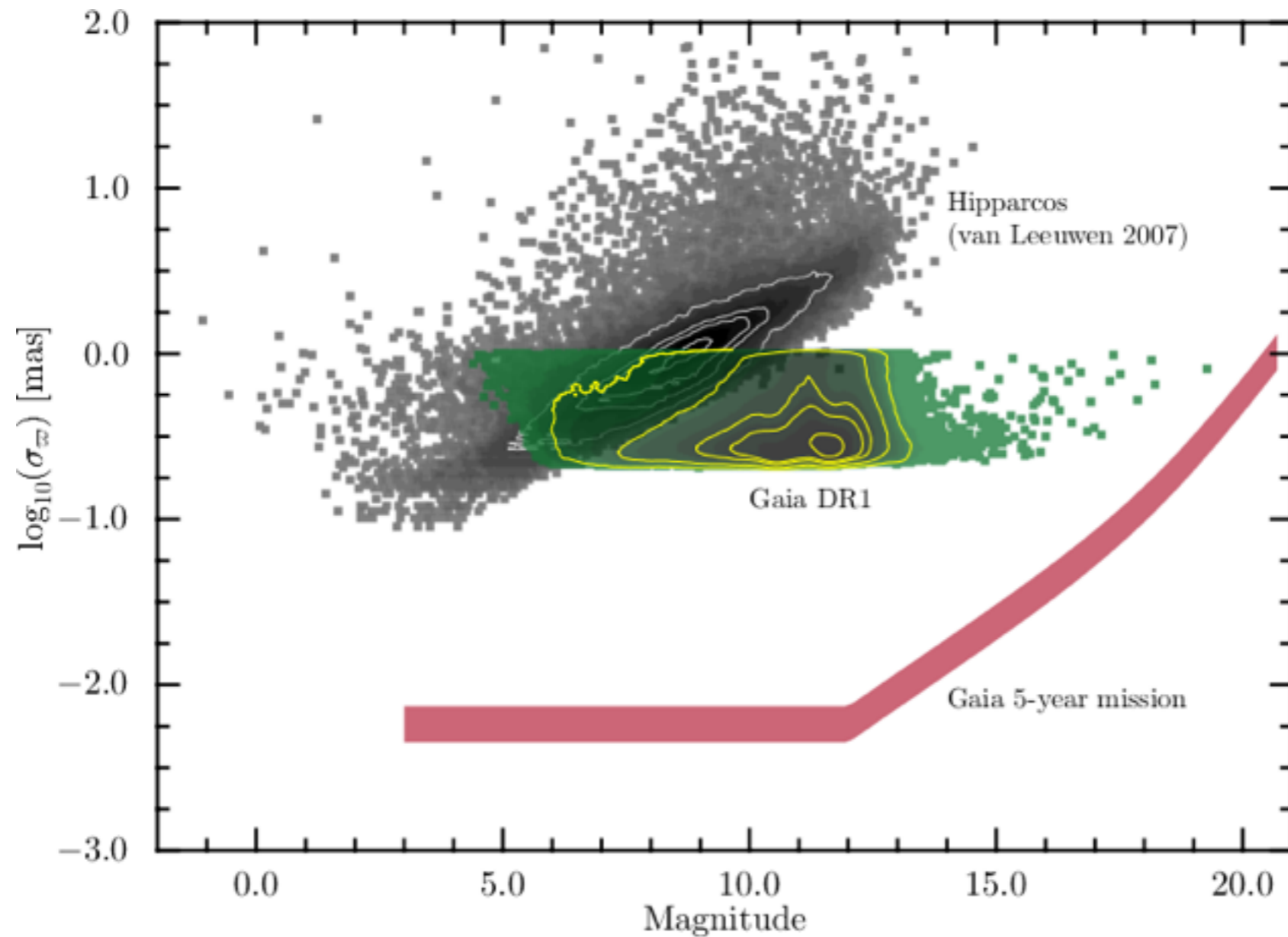


RRab

Known problems :(

- **Accurate PSF modeling**
- **Photometric Calibration not yet accurated**
- **Source modelling:** All sources were treated as single stars without taking their radial velocity into account (binaries?)
- **Basic Angle Periodic Variation:** $\sim 1 \mu\text{as}$, ok for GDR1 accuracy, will be better calibrated in future releases in the astrometric solution
- **Correlated astrometric parameters:** especially in certain region of the sky, will improve in future releases
- **Colour dependent** and **Spatially correlated systematics:** caused by incomplete model of the attitude $\rightarrow 0.3 \text{ mas}$ in the parallaxes

Astrometry: comparison with Hipparcos



The gory details

The Gaia mission, Gaia Collaboration, Prusti, T., de Bruijne, J.H.J., et al., 2016a (arXiv 1609.04153)

Gaia Data Release 1: Summary of the astrometric, photometric, and survey properties, Gaia Collaboration, Brown, A.G.A., Vallenari, A., et al., 2016b (arXiv 1609.04153),

Gaia Data Release 1: Astrometry: one billion positions, two million proper motions and parallaxes, Lindegren et al. (arXiv 1609.04303)

Gaia Data Release 1: The photometric data, van Leeuwen et al,

Gaia Data Release 1: Data validation: procedures, statistics and conclusions, Arenou et al.

Gaia Data Release 1: The variability processing & analysis and its application to the south ecliptic pole region, Eyer et al.

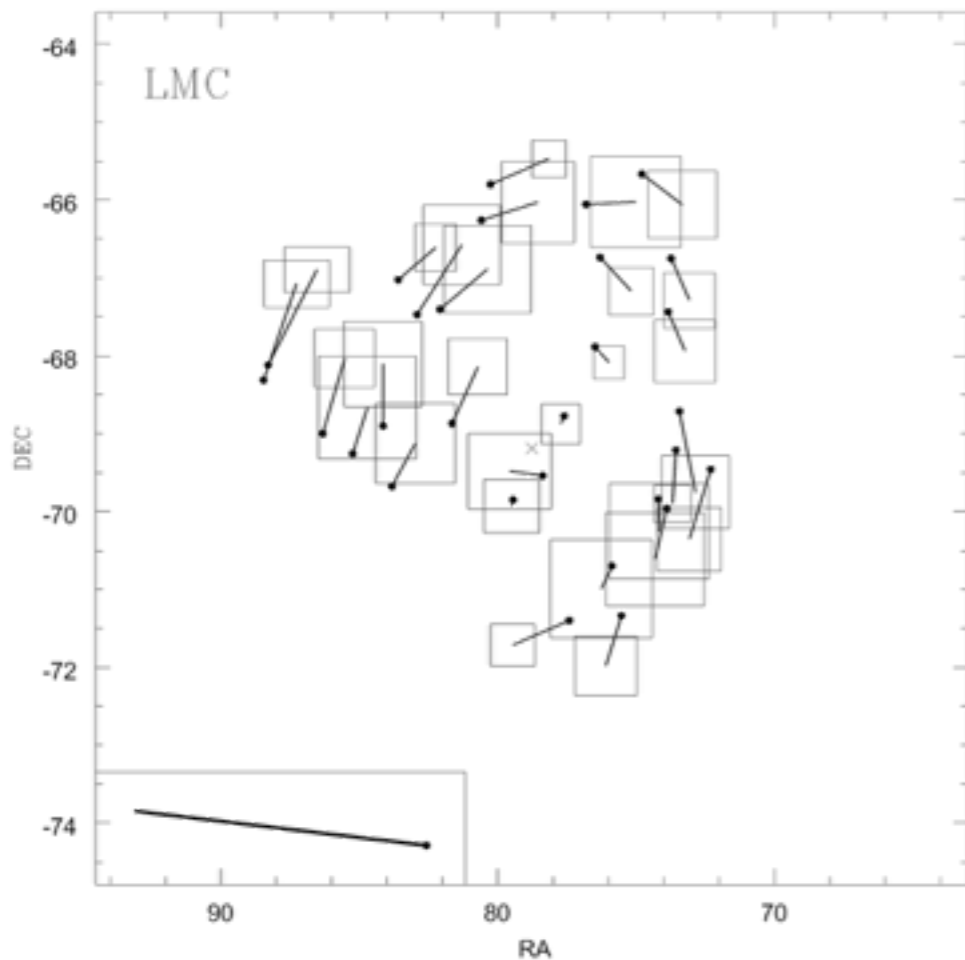
Gaia Data Release 1: The Cepheid & RR Lyrae star pipeline and its application to the south ecliptic pole region, Clementini et al. (arXiv 1609.04269)

Gaia Data Release 1: Open cluster distances, Gaia Collaboration et al.

and more...

The fastest paper!

First Gaia Local Group Dynamics: Magellanic Clouds Proper Motion and Rotation, **arXiv 1609.04395**, Roeland P. van der Marel, Johannes Sahlmann



Gaia proper motions have similar accuracy agree to within the uncertainties with existing HST measurements.

The TGAS LMC proper-motion field clearly shows the clockwise rotation of the disk.

Gaia-DR2 : Q4 2017

- full astrometric solution (positions, parallaxes, and proper motions) for 90% of the sky (single sources)
- integrated BP/RP photometry, with appropriate standard errors, for sources with verified astrophysical parameter
- mean radial velocities for objects showing no radial-velocity variation and for which an adequate synthetic template could be selected

under the assumption that this can be done for 90% of the bright stars on the sky!

Data Releases Scenario

Gaia-DR3 : 2018 (TBD) :

- Orbital solutions + radial velocity and five-parameter astrometric solutions for binaries with $P > 2$ months
- Object classification and astrophysical parameters + BP/RP spectra and/or RVS spectra they are based on, for well-behaved objects (non variable)
- Mean Radial velocity for non variable objects

Gaia-DR4 : Summer 2019 (TBD):

- variable epoch spectra
- Solar System Objects
- Non single stars

Gaia-DR final : Summer 2022 (TBD): everything!

Where are the data:



<http://gea.esac.esa.int/archive>



<http://gaia.ari.uni-heidelberg.de/>



<http://cdsxmatch.u-strasbg.fr/xmatch>



<https://gaia.aip.de/>



<http://gaiaportal.asdc.asi.it/>

gaia archive

HOME SEARCH STATISTICS VISUALIZATION HELP DOCUMENTATION

Welcome to the Gaia Archive

Gaia is an ambitious mission to chart a three-dimensional map of our Galaxy, the Milky Way, in the process revealing the composition, formation and evolution of the Galaxy. Gaia will provide unprecedented positional and radial velocity measurements with the accuracies needed to produce a stereoscopic and kinematic census of about one billion stars in our Galaxy and throughout the Local Group. This amounts to about 1 per cent of the Galactic stellar population.

If you use public Gaia DR1 data in your paper, please take note of our guide on how to [acknowledge and cite Gaia DR1](#).

Top Features



Search

Query for Gaia sources using an ADQL (Astronomical Data Query Language) interface in an asynchronous mode (UWS).



Download

Direct download of Gaia data files.



Statistics

Show statistics of Gaia tables.

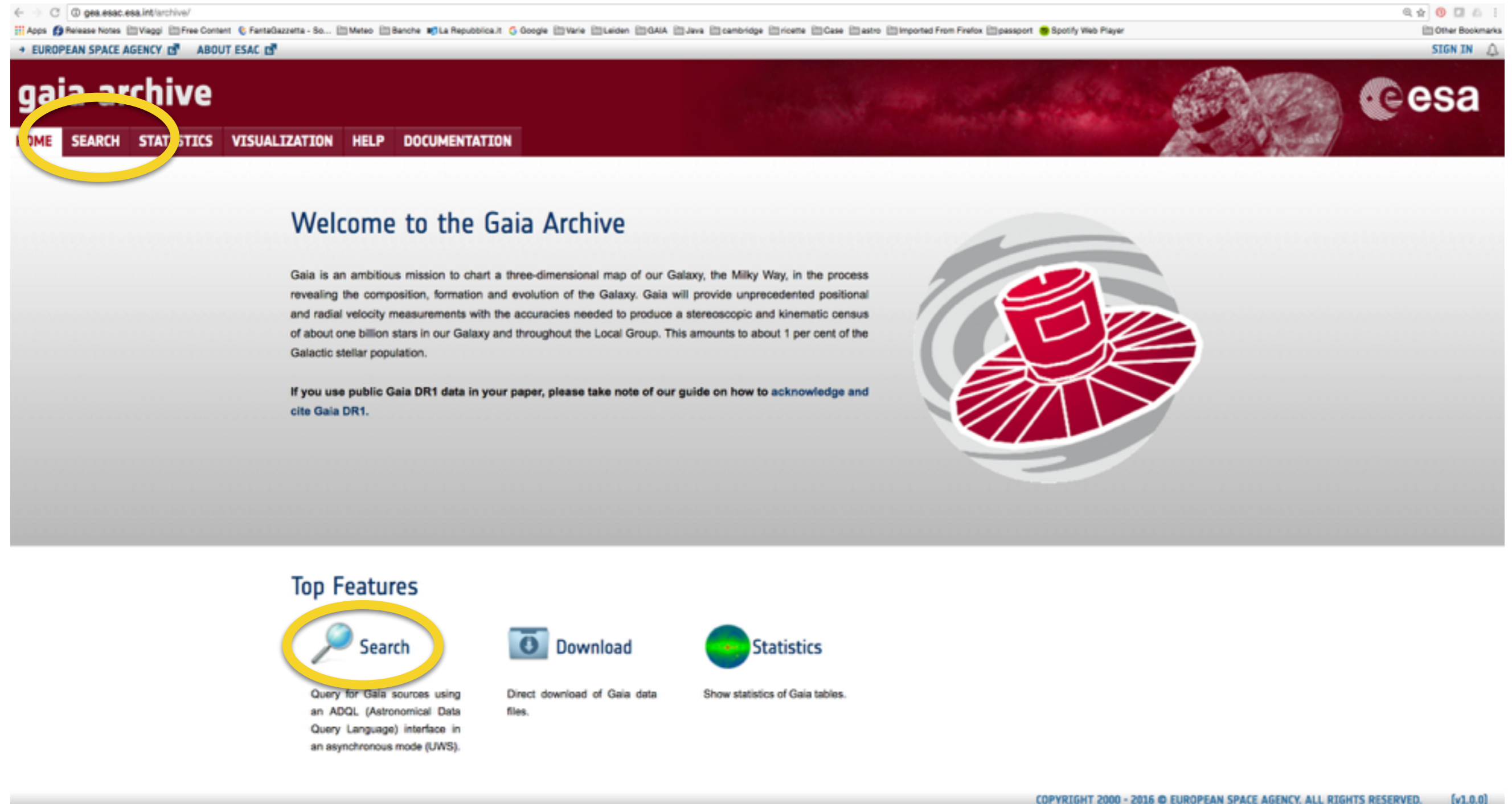
Download everything!

The screenshot shows the Gaia Archive website interface. At the top, there is a navigation bar with 'HOME', 'SEARCH', 'STATISTICS', 'VISUALIZATION', 'HELP', and 'DOCUMENTATION'. The main content area is titled 'Index of /Gaia/' and contains a directory listing:

../	
gaia_source/	08-Sep-2016 17:15
tgas_source/	08-Sep-2016 17:16

Below the directory listing, there is a 'Top Features' section with three icons: 'Search', 'Download', and 'Statistics'. The 'Download' icon is circled in yellow. The 'Download' feature description reads: 'Direct download of Gaia data files.' The 'Search' feature description reads: 'Query for Gaia sources using an ADQL (Astronomical Data Query Language) interface in an asynchronous mode (UWS).'

At the bottom of the page, there is a copyright notice: 'COPYRIGHT 2000 - 2016 © EUROPEAN SPACE AGENCY. ALL RIGHTS RESERVED. (v1.0.0)'



The screenshot shows the Gaia Archive website interface. At the top, there is a navigation bar with the following links: HOME, SEARCH, STATISTICS, VISUALIZATION, HELP, and DOCUMENTATION. The 'HOME' link is circled in yellow. Below the navigation bar, the main content area features a large heading 'Welcome to the Gaia Archive' and a paragraph describing the Gaia mission. To the right of the text is a stylized illustration of the Gaia satellite. Below the main content, there is a 'Top Features' section with three items: 'Search' (circled in yellow), 'Download', and 'Statistics'. The 'Search' feature is described as a query interface using ADQL. The 'Download' feature is described as direct download of data files. The 'Statistics' feature is described as showing statistics of data tables. At the bottom of the page, there is a copyright notice: 'COPYRIGHT 2000 - 2016 © EUROPEAN SPACE AGENCY. ALL RIGHTS RESERVED. [v1.0.0]'.

Simple Search

The screenshot shows the Gaia Archive website interface. At the top, there is a navigation bar with links for HOME, SEARCH, STATISTICS, VISUALIZATION, HELP, DOCUMENTATION, VOSPACE, and SHARE. The 'SEARCH' link is highlighted with a yellow circle. Below the navigation bar, there are three tabs: 'Simple Form', 'Advanced Form', and 'Query Results'. The 'Simple Form' tab is active. The search form includes a 'Position' section with radio buttons for 'Name' (selected) and 'Equatorial'. A 'Target in' section has radio buttons for 'Circle' (selected) and 'Box'. The 'Name' field contains 'hyades', and the 'Search in' dropdown is set to 'Simbad'. The 'Radius' is set to '10 arc sec'. Below the search form, there are sections for 'Extra conditions' and 'Display columns'. At the bottom, there are buttons for 'Reset Form', 'Show Query', and 'Submit Query'. The footer contains the text 'COPYRIGHT 2000 - 2016 © EUROPEAN SPACE AGENCY. ALL RIGHTS RESERVED. [v1.0.0]'.

Simple Search: input file

EUROPEAN SPACE AGENCY ABOUT ESAC Giorgia Busso (gbusso)

gaia archive

HOME SEARCH STATISTICS VISUALIZATION HELP DOCUMENTATION VOSPACE SHARE

Simple Form ADQL Form Query Results

Position **File**

Name
 Equatorial

Target in Circle Box

Select a file with Target Names No file chosen

galadr1.tgas_source

inputFile.txt	1	NGC	6388
	2	NGC	6441
	3	NGC	3202

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ADQL

gaia archive

HOME SEARCH STATISTICS VISUALIZATION HELP DOCUMENTATION VOSPACE SHARE

Simple Form **ADQL Form** Query Results

Job name:

Query examples

1

Reset Form Submit Query

Status	Job	Creation date	Num. rows	Size
✘	fullgdr1	23-Sep-2016, 18:33:45		0 KB
✓	firstsel	16-Sep-2016, 17:15:11	60	5 KB
✓	xmatch_firstsel_hipparcos	16-Sep-2016, 17:13:47		0 KB
✓	xmatch_firstsel_hipparcos_newreduction	16-Sep-2016, 16:50:59		0 KB
✓	firstsel	16-Sep-2016, 16:40:42	187744	16 MB
✓	1473954773003O	15-Sep-2016, 16:52:53	1	2 KB
✓	1473952796597O	15-Sep-2016, 16:19:56	2595	791 KB
✓	rriyae	15-Sep-2016, 14:57:35	187744	7 MB
✓	1473328732311O	08-Sep-2016, 10:58:52	130015	18 MB

1-20 of 44

Apply jobs filter Select all jobs Delete selected jobs

preloaded XM tables

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ADQL

<https://gaia.ac.uk/science/gaia-data-release-1/adql-cookbook>

<http://tapvizier.u-strasbg.fr/adql/help.html>

SELECT * **FROM** table_name

SELECT * **FROM** gaiadr1.gaia_source

SELECT * **FROM** gaiadr1.gaia_source **WHERE** phot_g_mean_mag < 10

brightstars

















The screenshot shows the Gaia ADQL query interface. At the top, there is a 'Job name:' input field and a 'Query examples' link. Below this is a text area containing the query: `1 SELECT * FROM gaiadr1.gaia_source WHERE phot_g_mean_mag < 10`. Below the query area are two buttons: 'Reset Form' and 'Submit Query'. Below the buttons is a table with the following columns: Status, Job, Creation date, Num. rows, and Size. The table contains five rows of job results. The first row has a status of '✓' and a job name of '14749092770340'. The second row has a status of '✗' and a job name of 'fullgdr1'. The third row has a status of '✓' and a job name of 'firstsel'. The fourth row has a status of '✓' and a job name of 'xmatch_firstsel_hipparcos'. The fifth row has a status of '✓' and a job name of 'xmatch_firstsel_hipparcos_newreduction'. There are also several icons in the rightmost column of the table.

Status	Job	Creation date	Num. rows	Size
✓	14749092770340	26-Sep-2016, 18:01:17	490015	128 MB
✗	fullgdr1	23-Sep-2016, 18:33:45	0 KB	
✓	firstsel	16-Sep-2016, 17:15:11	60	5 KB
✓	xmatch_firstsel_hipparcos	16-Sep-2016, 17:13:47	0 KB	
✓	xmatch_firstsel_hipparcos_newreduction	16-Sep-2016, 16:50:59	0 KB	

good

bad

















ADQL : query results

Job	▼ Creation date	Num. rows	Size	info
 14749092770340	26-Sep-2016, 18:01:17	490015	128 MB	      
 fullgdr1	23-Sep-2016, 18:33:45		0 KB	      

ADQL : query results

upload the table
on the archive



Job	Creation date	Num. rows	Size	
 14749092770340	26-Sep-2016, 18:01:17	490015	128 MB	      
 fullgdr1	23-Sep-2016, 18:33:45		0 KB	      



















download the table

ADQL : query results



send it
to Topcat



Job	Creation date	Num. rows	Size	
 14749092770340	26-Sep-2016, 18:01:17	490015	128 MB	      
 fullgdr1	23-Sep-2016, 18:33:45		0 KB	      



send it
to VOspace

ADQL : query results

gaia archive

HOME SEARCH STATISTICS VISUALIZATION HELP DOCUMENTATION VOSPACE SHARE

Simple Form ADQL Form Query Results

14749092770340 X

solution_id	source_id	random_index	ref_epoch	ra	ra_error	dec	dec_error
1635378410781933568	3704342291310623488	534069337	2015	193.8989092776972	1.1907661927999527	3.3972436062113993	1.13898744007903
1635378410781933568	5589311353427428096	341482726	2015	109.28560014186127	2.596384220886428	-37.09745047651609	3.44332378517024
1635378410781933568	329384512263823360	1104751764	2015	32.386693753639456	9.342913407306291	34.987129159781965	3.62454217932869
1635378410781933568	4629125166197136256	1020977432	2015	56.810529640189145	1.0646690352129475	-74.23848479469156	0.94785853538478
1635378410781933568	2968097043220615808	999688351	2015	82.06132082333338	0.7455106999497315	-20.759791133467935	0.91951071304680
1635378410781933568	2202629997292988928	224833179	2015	325.87694117487257	0.8501974726850964	58.78002891128556	0.86075771876503
1635378410781933568	2962546601148655488	793401152	2015	76.36537706401334	0.8598492653194981	-22.371346268225047	0.92735119769610
1635378410781933568	5786929086547274112	36495278	2015	211.33122211767343	1.600122906095055	-76.7968966538706	1.22020955416304
1635378410781933568	426558456578909056	749378401	2015	14.177423983107415	5.44391553002595	60.716724357505605	4.08715846223543
1635378410781933568	4473334470304897024	828121356	2015	265.8679594521625	2.075681012358508	4.567967792113831	2.07059623652664
1635378410781933568	2199493434211840512	439710857	2015	332.713762075799	1.355170104322635	58.20128624278751	1.39835043622160

1-20 of 2,000

Show query in ADQL form

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see
the result



see
the query



ADQL Search: input file

example: BHB stars

VizieR Service

Search Criteria

Preferences
 max: unlimited
 VOTable

Find catalogs among 14645 available

Clear Find...

Expand search

Catalog, author's name, word(s) from title, description, etc. e.g.: AGN, Veron, I/239, or bibcodes...

Search by Position across 16191 tables

Target Name (resolved by [Sesame](#)) or Position: J2000 Target dimension: 2 arcmin Go!

Radius Box size

Wavelength	Mission	Astronomy
Radio	AKARI	Abundances
IR	ANS	Ages
optical	ASCA	AGN
UV	BeppoSAX	Associations
EUV	CGRO	Atomic_Data
X-ray	Chandra	Binaries:cataclysmic
Gamma-ray	COBE	Binaries:eclipsing

Find Catalogs

Tools related to VizieR

- [Photometry viewer](#) : Plot photometry (sed) including all VizieR
- [TAP VizieR](#) : query VizieR using ADQL (a SQL extension dedicated for astronomy)
- [CDS cross-match service](#) : fast cross-identification between any 2 tables, including VizieR catalogues, SIMBAD

→ [Thanks for acknowledging the VizieR Service](#)
 → [Rules of usage of VizieR data](#)

© UDS/CNRS
 Contact

vizier_votable (2) vot Show All X

ADQL Search: input file

example: BHB stars

The screenshot shows the VizieR interface with a search for BHB stars. The 'ALL' checkbox is highlighted in yellow, and the 'Query selected Catalogs' button is also highlighted in yellow. A yellow box contains the text 'download vizier_votable.vot'.

Table Name	Description	Number of Stars	ReadMe+ftp
J/AJ/135/564	Photometry and spectroscopy of BHB candidates (Brown+, 2008)	2k	ReadMe+ftp
J/AJ/130/1097	BHB stars in Century Survey Galactic Halo Project (Brown+, 2005)	257	ReadMe+ftp
J/A+A/434/235	Abundances of BHB stars in NGC 1904 (Fabbian+, 2005)	493	ReadMe+ftp
J/A+A/522/A88	Photometric identification of BHB stars (Smith+, 2010)	297k	ReadMe+ftp
J/A+A/561/A142	Galactic extinction from SDSS BHB stars (Tian+, 2014)	9k	ReadMe+ftp
J/ApJ/731/119	BHB candidates in Sagittarius stream (Ruhland+, 2011)	70	ReadMe+ftp
J/MNRAS/422/2116	BHB stars in the Milky Way (Kinman+, 2009)	316	ReadMe+ftp
J/ApJ/738/79	SDSS-DR8 BHB stars in the Milky Way's halo (Xue+, 2011)	4k	ReadMe+ftp

ADQL Search: input file

gaia archive

HOME SEARCH STATISTICS VISUALIZATION HELP DOCUMENTATION VOSPACE SHARE

Simple Form **ADQL Form** Query Results

Job name:

Query examples

1

Reset Form Submit Query

Status	Job	Creation date	Num. rows	Size
✘	fullgdr1	23-Sep-2016, 18:33:45		0 KB
✓	firstsel	16-Sep-2016, 17:15:11	60	5 KB
✓	xmatch_firstsel_hipparcos	16-Sep-2016, 17:13:47		0 KB
✓	xmatch_firstsel_hipparcos_newreduction	16-Sep-2016, 16:50:59		0 KB
✓	firstsel	16-Sep-2016, 16:40:42	187744	16 MB

1-20 of 44

Apply jobs filter Select all jobs Delete selected jobs

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Cross Match example

BHB in Gaia DR1..

GAIA Table Editor

Column	UCD	utype	Flag	Indexed
bhb_oid			PK	<input checked="" type="checkbox"/>
_raj2000	pos.eq.ra		Ra	<input checked="" type="checkbox"/>
_dej2000	pos.eq.dec		Dec	<input checked="" type="checkbox"/>
chss	meta.id;meta.main			<input type="checkbox"/>
raj2000	pos.eq.ra;meta.main			<input type="checkbox"/>
dej2000	pos.eq.dec;meta.main			<input type="checkbox"/>
jmag	phot.mag;em.IR.J			<input type="checkbox"/>
j_h	phot.color;em.IR.J;em.IR			<input type="checkbox"/>
h_k	phot.color;em.IR.H;em.IF			<input type="checkbox"/>

Buttons: Cancel, Update

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Cross
Match
2 steps



GAIA Cross-Match

Table A

Table B

Output table name

Job name:

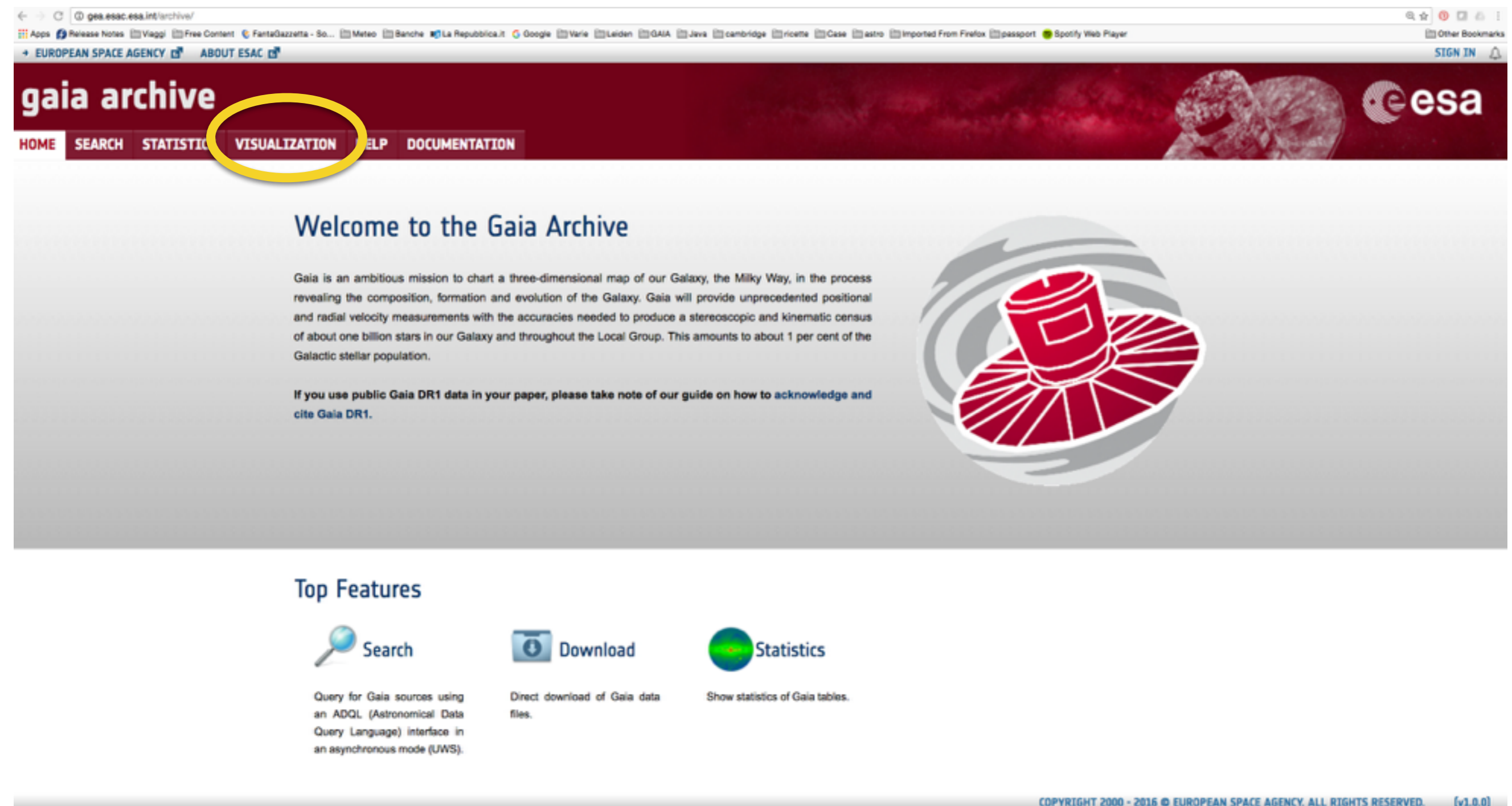
[Query examples](#)

```
1 SELECT c."dist", a."solution_id", a."source_id", a."random_index", a."ref_epoch", a."ra", a."ra_error", a."dec", a."dec_error",
a."parallax", a."parallax_error", a."pmra", a."pmra_error", a."pmdec", a."pmdec_error", a."ra_dec_corr", a."ra_parallax_corr",
a."ra_pmra_corr", a."ra_pmdec_corr", a."dec_parallax_corr", a."dec_pmra_corr", a."dec_pmdec_corr", a."parallax_pmra_corr",
a."parallax_pmdec_corr", a."pmra_pmdec_corr", a."astrometric_n_obs_al", a."astrometric_n_obs_ac", a."astrometric_n_good_obs_al",
a."astrometric_n_good_obs_ac", a."astrometric_n_bad_obs_al", a."astrometric_n_bad_obs_ac", a."astrometric_delta_q",
a."astrometric_excess_noise", a."astrometric_excess_noise_sig", a."astrometric_primary_flag", a."astrometric_relegation_factor",
a."astrometric_weight_al", a."astrometric_weight_ac", a."astrometric_priors_used", a."matched_observations",
a."duplicated_source", a."scan direction strength k1", a."scan direction strength k2", a."scan direction strength k3",
```

✓	<input type="checkbox"/>		gaia_bhb	26-Sep-2016, 23:08:18	2168	605 KB						
✓	<input type="checkbox"/>		xmatch_gaia_source_bhb	26-Sep-2016, 22:47:15		0 KB						

COPYRIGHT

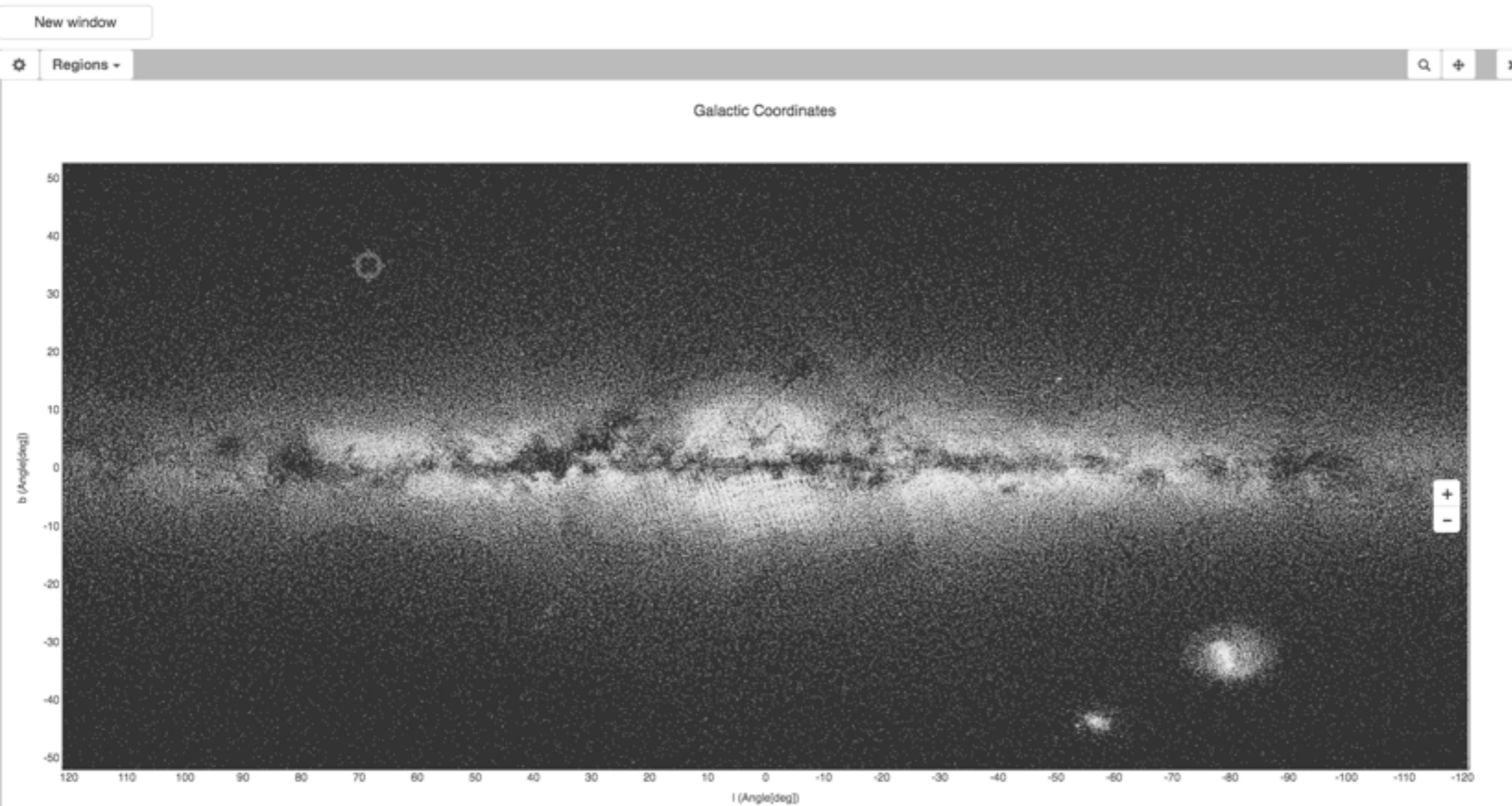
Visualisation



The screenshot shows the Gaia Archive website interface. The browser address bar displays 'ges.esac.esa.int/archive/'. The navigation menu includes 'HOME', 'SEARCH', 'STATISTICS', 'VISUALIZATION', 'HELP', and 'DOCUMENTATION'. The 'VISUALIZATION' menu item is highlighted with a yellow circle. Below the navigation bar, the main content area features a 'Welcome to the Gaia Archive' heading, a paragraph describing the mission, and a call to action regarding data citation. To the right is a large graphic of the Gaia spacecraft. Below this is a 'Top Features' section with three icons: 'Search' (magnifying glass), 'Download' (download icon), and 'Statistics' (globe). Each icon is accompanied by a brief description of the feature. At the bottom right, there is a copyright notice: 'COPYRIGHT 2000 - 2016 © EUROPEAN SPACE AGENCY. ALL RIGHTS RESERVED. [v1.0.0]'.

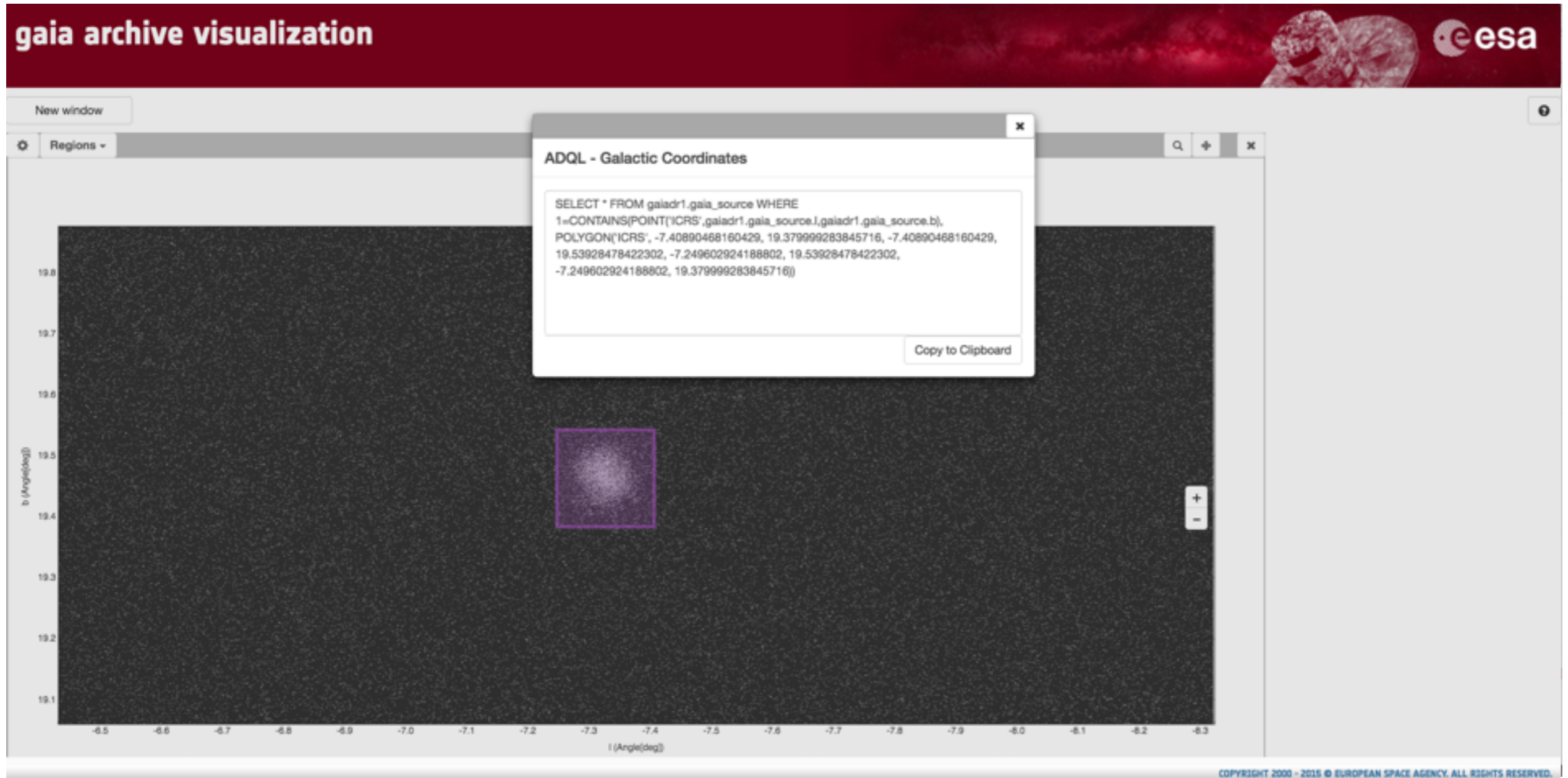
Visualisation

gaia archive visualization

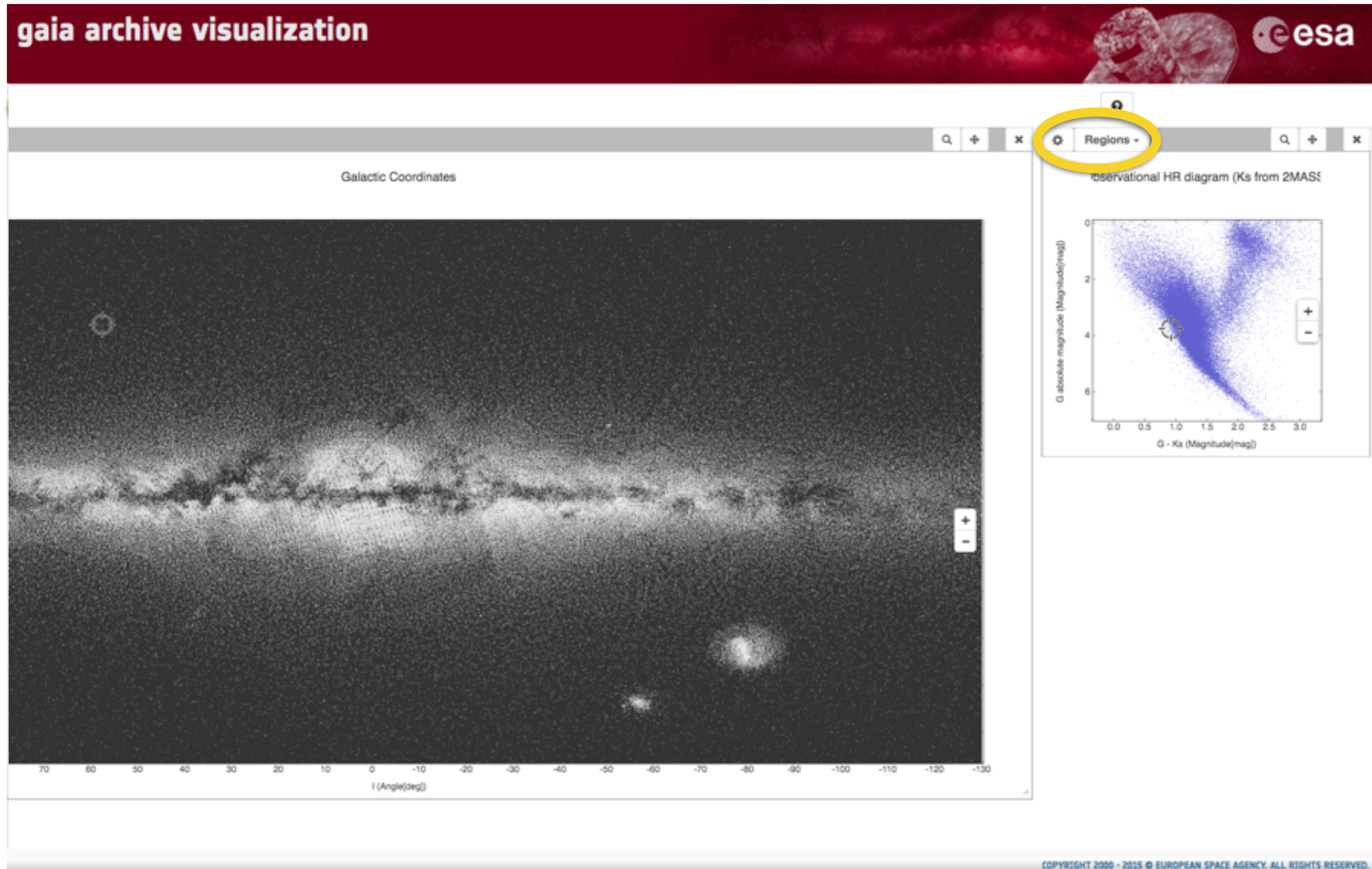


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Visualisation: selecting regions

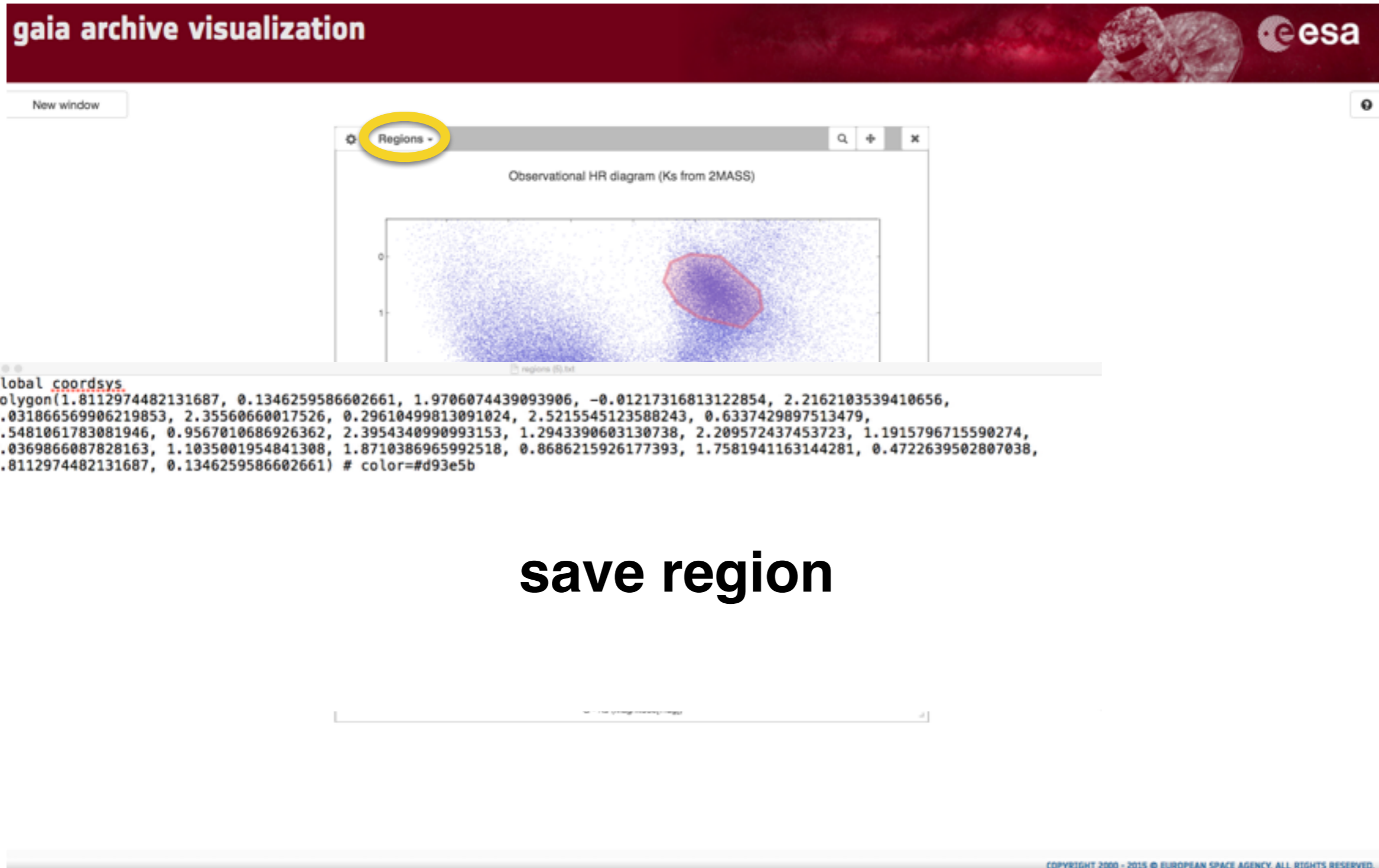


Visualisation: 2D plots



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Visualisation: 2D plots → select subsets

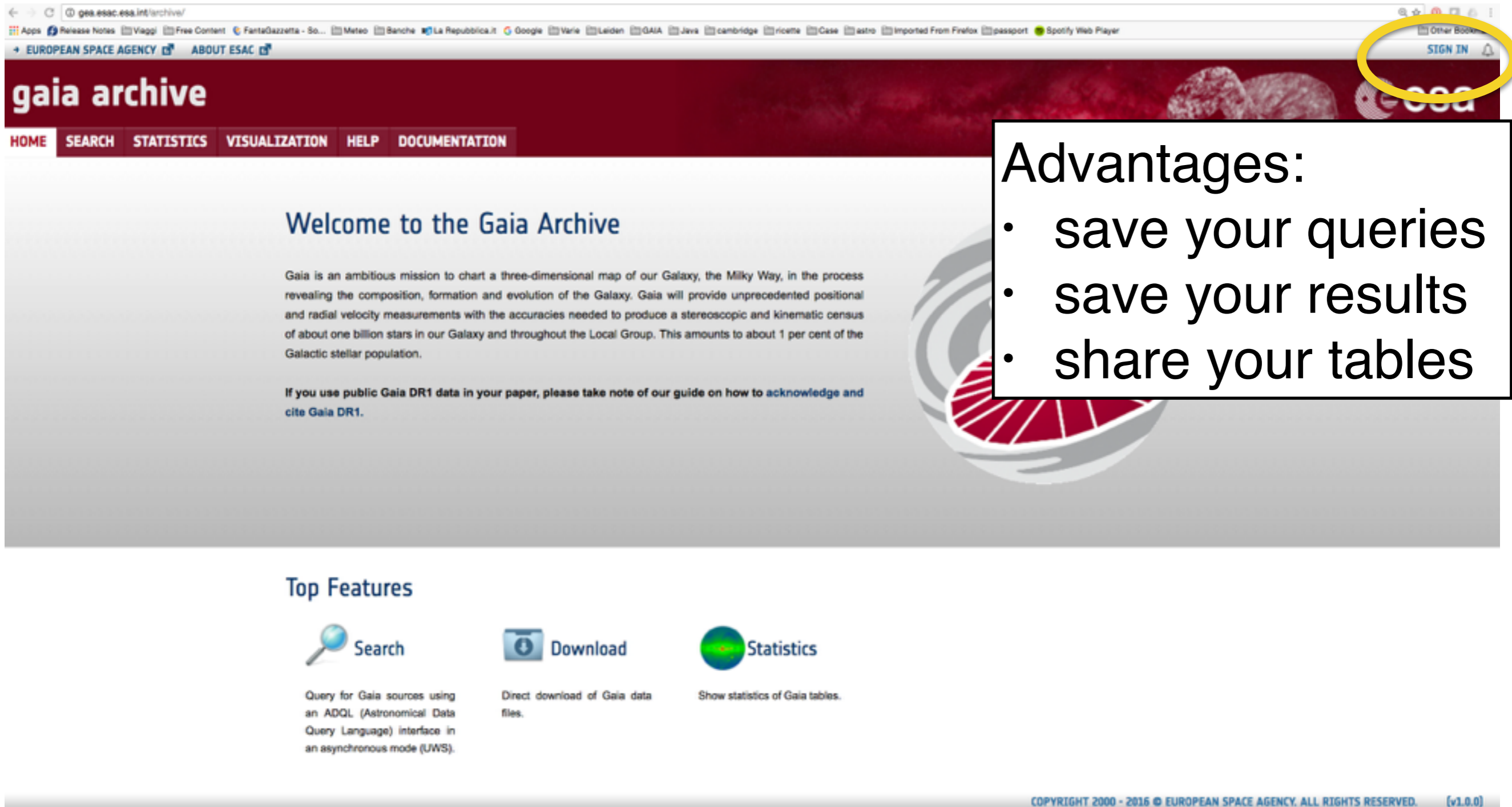


The screenshot shows the Gaia Archive visualization interface. At the top, there is a header with the text "gaia archive visualization" and the ESA logo. Below the header, there is a "New window" button. The main content area displays an "Observational HR diagram (Ks from 2MASS)" with a scatter plot of stars. A red polygon highlights a specific region of the plot. The "Regions" tab is selected and highlighted with a yellow circle. Below the plot, there is a text area containing the following code:

```
global coordsys
polygon(1.8112974482131687, 0.1346259586602661, 1.9706074439093906, -0.01217316813122854, 2.2162103539410656,
0.031866569906219853, 2.35560660017526, 0.29610499813091024, 2.5215545123588243, 0.6337429897513479,
2.5481061783081946, 0.9567010686926362, 2.3954340990993153, 1.2943390603130738, 2.209572437453723, 1.1915796715590274,
2.0369866087828163, 1.1035001954841308, 1.8710386965992518, 0.8686215926177393, 1.7581941163144281, 0.4722639502807038,
1.8112974482131687, 0.1346259586602661) # color=#d93e5b
```

save region

Sign In or not Sign In



The screenshot shows the Gaia Archive website interface. At the top right, a 'SIGN IN' button is circled in yellow. Below the navigation bar, the main content area features a 'Welcome to the Gaia Archive' section with a descriptive paragraph about the mission and a link to a guide on how to acknowledge and cite Gaia DR1 data. Below this, a 'Top Features' section highlights three key capabilities: Search, Download, and Statistics, each with a brief description of the feature.

Advantages:

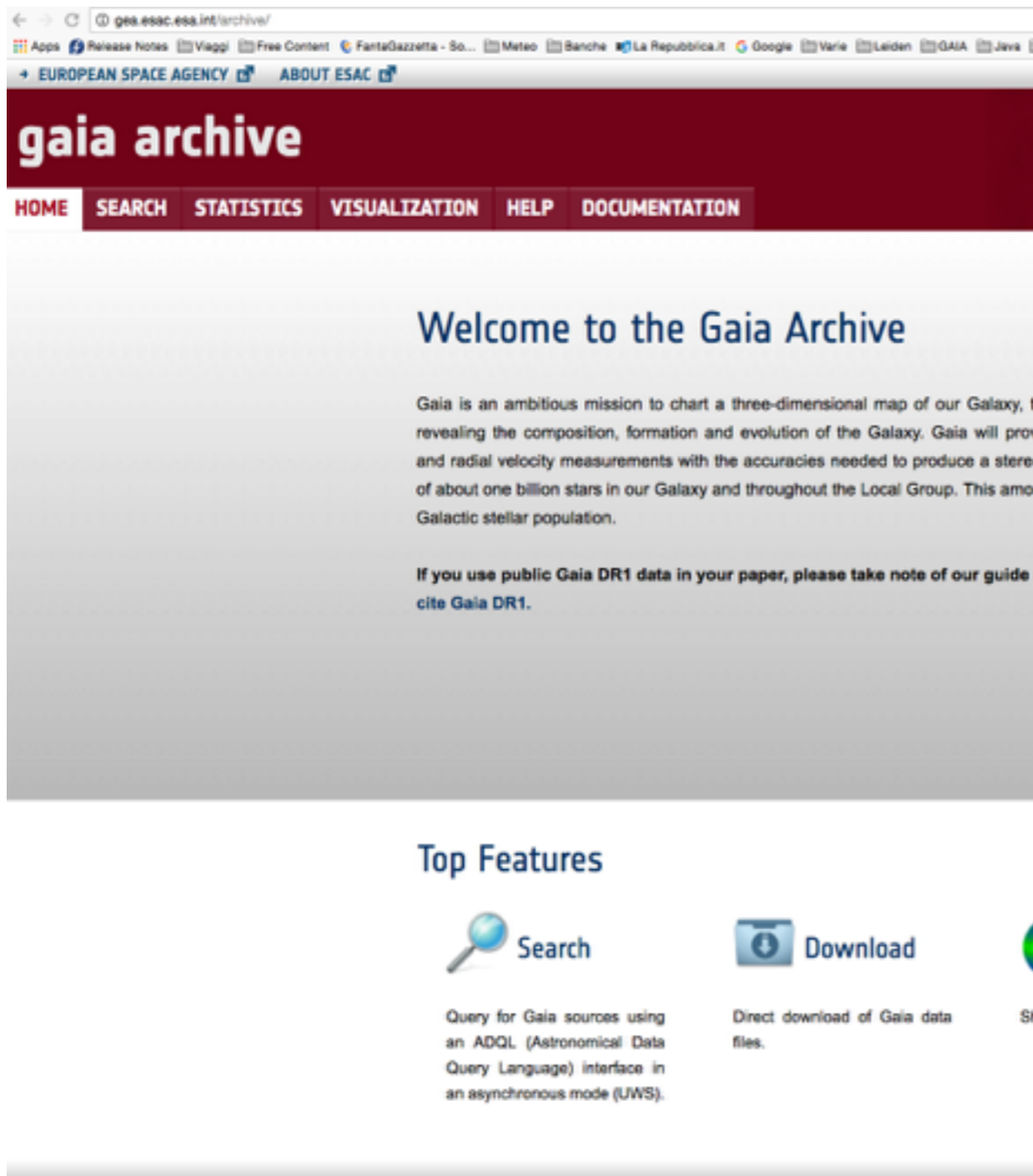
- save your queries
- save your results
- share your tables

Top Features

- Search**
Query for Gaia sources using an ADQL (Astronomical Data Query Language) interface in an asynchronous mode (UWS).
- Download**
Direct download of Gaia data files.
- Statistics**
Show statistics of Gaia tables.

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Sign In or not Sign In



ges.esac.esa.int/archive/

EUROPEAN SPACE AGENCY ABOUT ESAC

gaia archive

HOME SEARCH STATISTICS VISUALIZATION HELP DOCUMENTATION

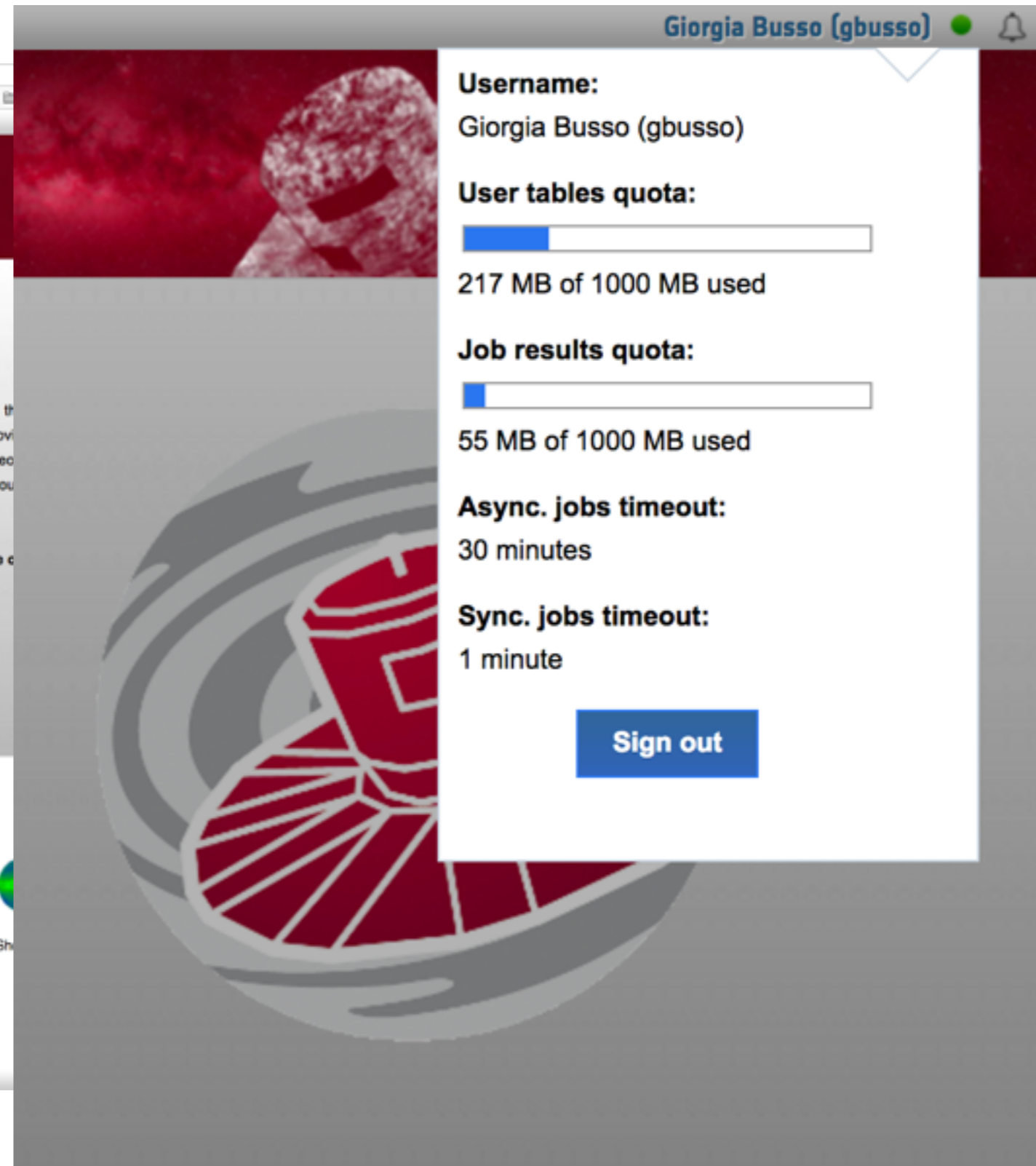
Welcome to the Gaia Archive

Gaia is an ambitious mission to chart a three-dimensional map of our Galaxy, revealing the composition, formation and evolution of the Galaxy. Gaia will provide astrometric, photometric and radial velocity measurements with the accuracies needed to produce a stereo map of about one billion stars in our Galaxy and throughout the Local Group. This amount of data will allow us to study the Galactic stellar population.

If you use public Gaia DR1 data in your paper, please take note of our guide on how to cite Gaia DR1.

Top Features

- Search**
Query for Gaia sources using an ADQL (Astronomical Data Query Language) interface in an asynchronous mode (UWS).
- Download**
Direct download of Gaia data files.



Giorgia Busso (gbusso)

Username:
Giorgia Busso (gbusso)

User tables quota:
217 MB of 1000 MB used


Job results quota:
55 MB of 1000 MB used

Async. jobs timeout:
30 minutes

Sync. jobs timeout:
1 minute

[Sign out](#)

Share your results

→ EUROPEAN SPACE AGENCY [ABOUT ESAC](#) Giorgia Busso (gbusso) ● 




gaia archive

HOME**SEARCH**STATISTICSVISUALIZATIONHELPDOCUMENTATIONVOSPACESHARE

Simple Form

ADQL Form

Query Results









- public.hipparcos_newreduction
- public.hubble_sc
- public.igsl_source
- public.igsl_source_catalog_ids
- public.tycho2
- User tables**
- user_gbusso.firstsel
- user_gbusso.gaiarrlyrae**
- user_gbusso.pleiades

Job name:

Query examples

1

 **Reset Form** **Submit Query**

  1-20 of 44  Select all jobs



go and get them!

