

# Software and data processing activities of the ICCUB Technological Unit

Jordi Portell i de Mora  
Deputy technical director

**ICCUB Winter Meeting**

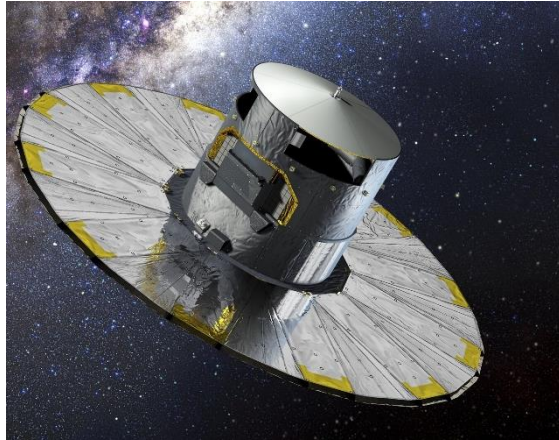
Institute of Cosmos Sciences  
Universitat de Barcelona

Barcelona  
7 February 2024



# Projects overview

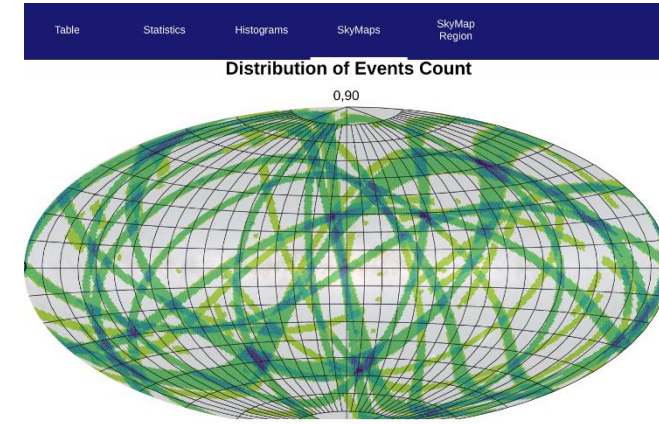
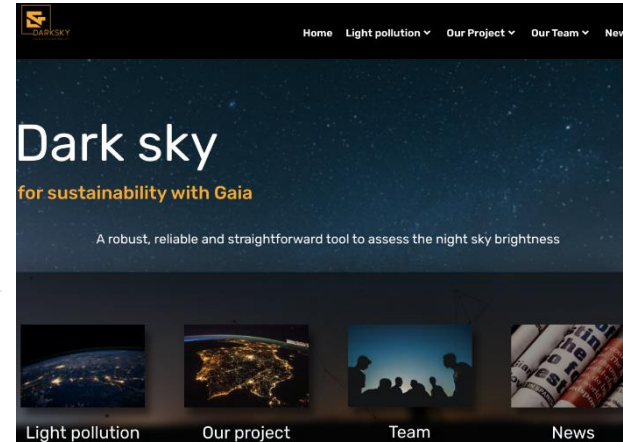
**Gaia**



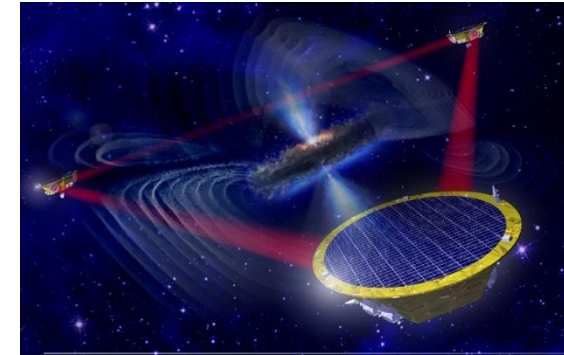
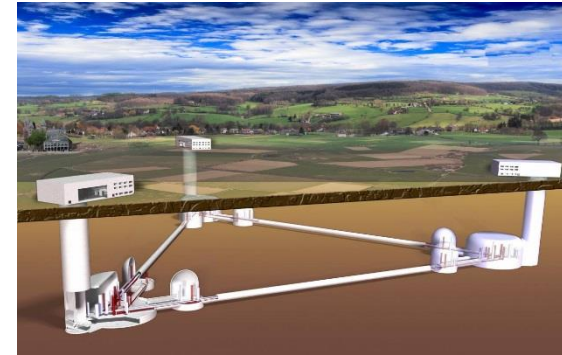
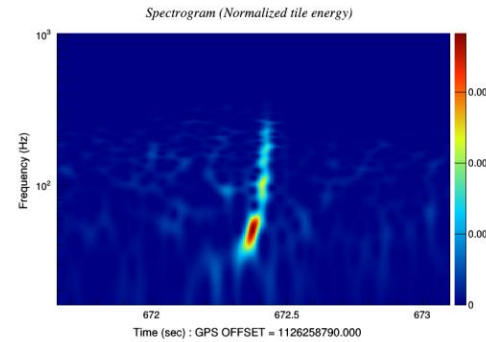
**OCRE** Open Clouds for Research Environments

Google Cloud

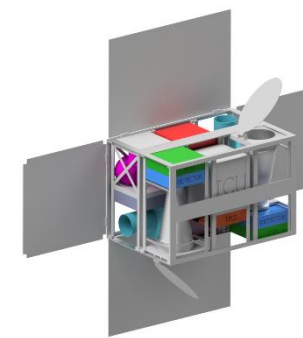
Compute Engine



**GW**



**Future missions and NewSpace**



C35atP v1 engineering model with OBC (bottom) and OBDH (top)

# Team overview

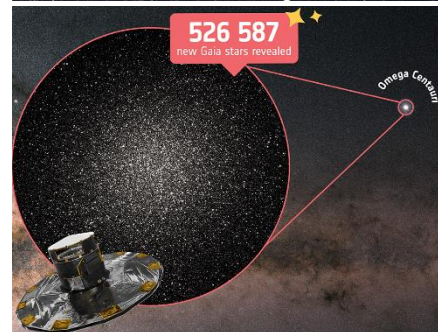
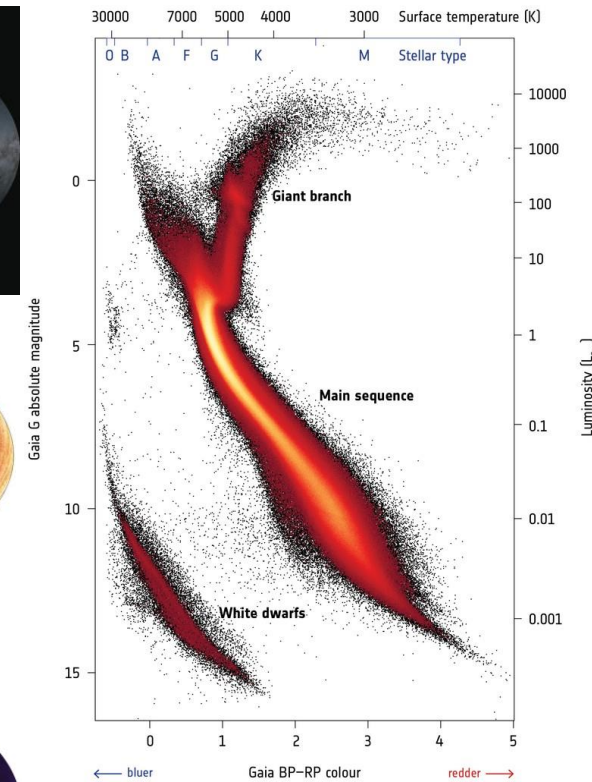
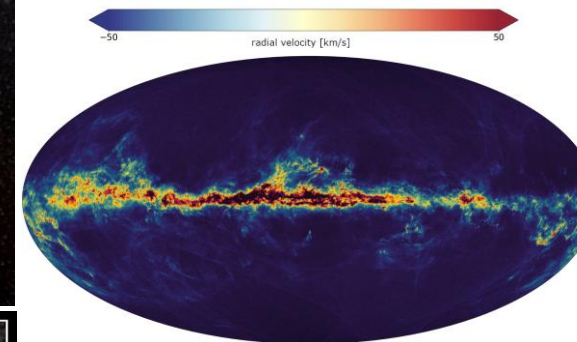
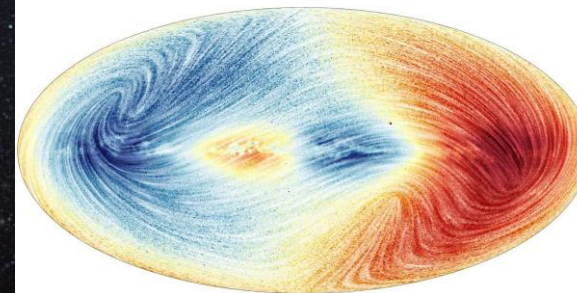
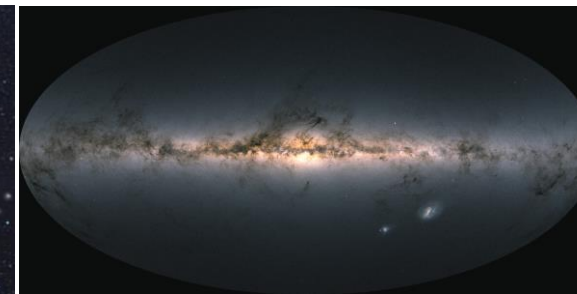
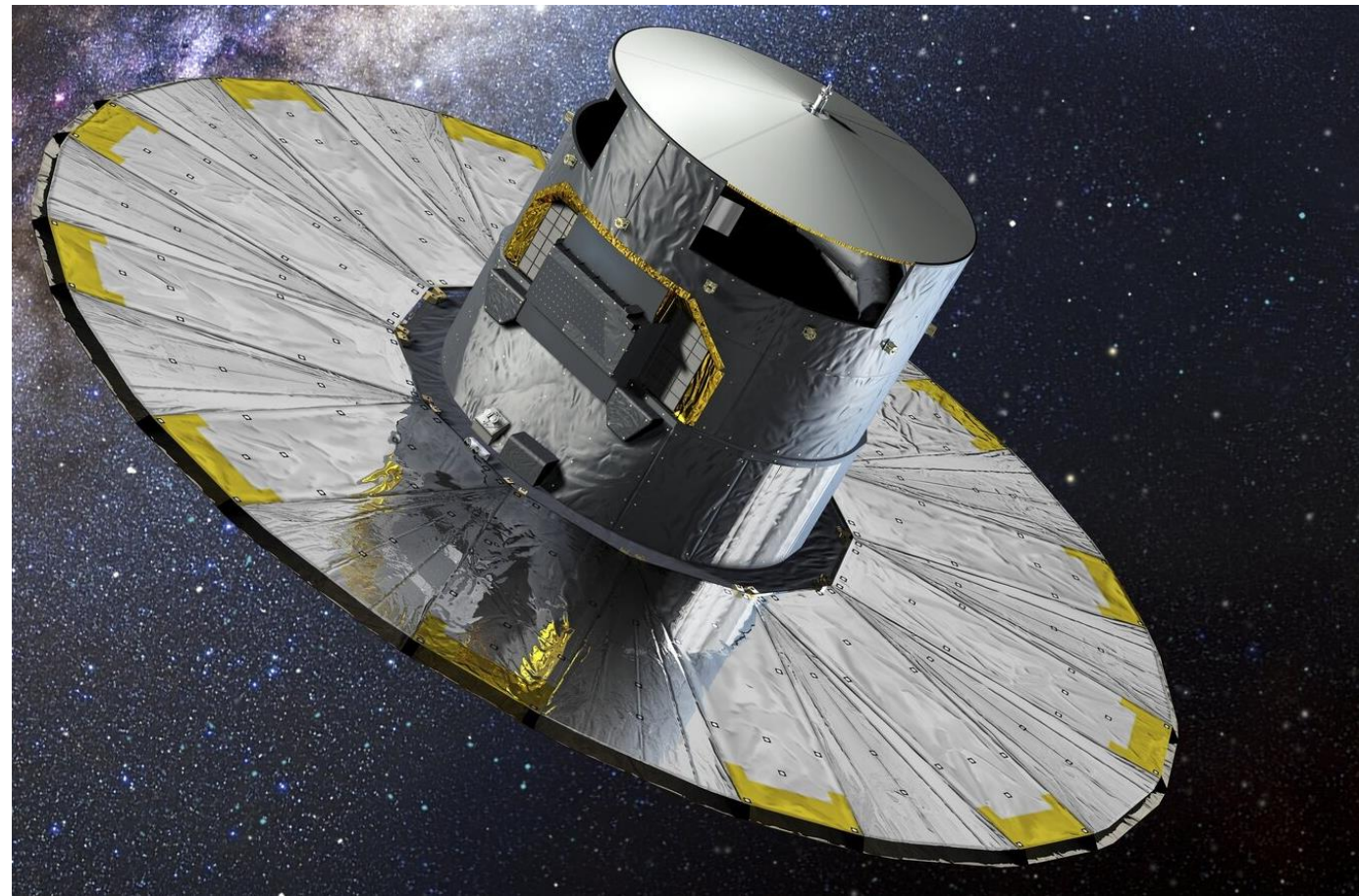
- Core team of TU / Software & Data:
  - 15 people at PCB – Torre D, 4<sup>th</sup> floor
- Involved in ~13 projects!
- Funding:
  - National grants:  
Gaia, Gaia4Sust, B2CATS, Virgo
  - Plan Complementario:  
Gaia, PLATO, Virgo, ET, LISA,  
nanosatellites/PhotSat, future missions
  - ESA: Gaia
  - European programs: Cloud
- **MANY THANKS** to ICCUB Secretariat for the HUGE support on bureaucracy
  - Also to FQA/ICCUB IT Support!

	Gaia	Cloud	Gaia4Sust	B2CATS	Virgo	ET	LISA	PLATO	Nanosats	PhotSat	GaiaNIR	Euclid	Jasmine
Pablo Barneo					X	x	o						
Sergi Bartolomé	X	x	x	o									
Javier Castañeda	X	x		x		o	x			x	o		o
Ignasi de José				X									
Claus Fabricius	X										x		o
Aniol Garcia	X												
Victor Gregori	X												
Pradeep Jasal					X	X							
Albert Masip	X	x								x		o	
Jordi Portell	X	x	.	.	o	.	o	X	o	o	.		
Julien Poyatos								X		o			
Georgy Skorobogatov						X	X						
Francesc Sunyol										X			
Ferran Torra	X	.									.	.	
Èlia Villar	X												

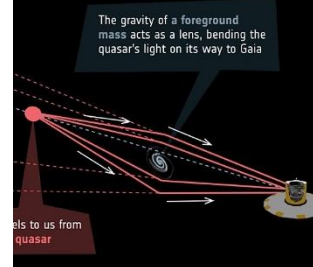
Scale (from more to less involvement): [X] [x] [o] [-]



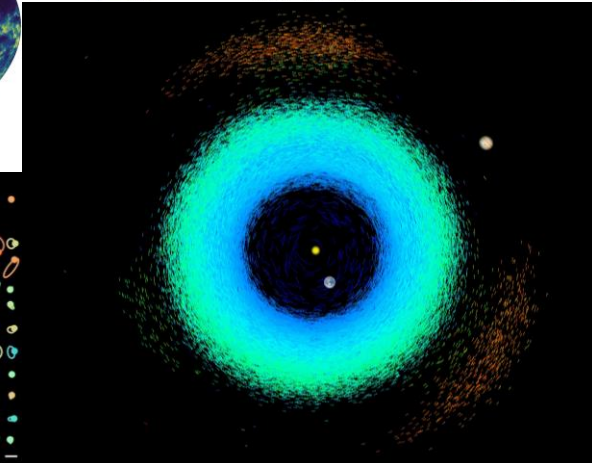
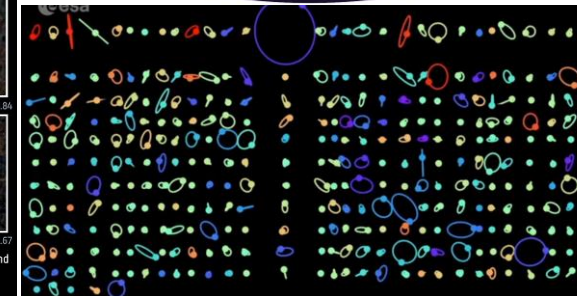
# Gaia



the distant Universe on the hunt for gravitational lenses: some of our biggest questions about the cosmos.



Lensed systems as seen by the Dark Energy Spectroscopic Instrument (DESI) and PanSTARRS (bottom right) and identified in Gaia's Data Release 3 (DR3).



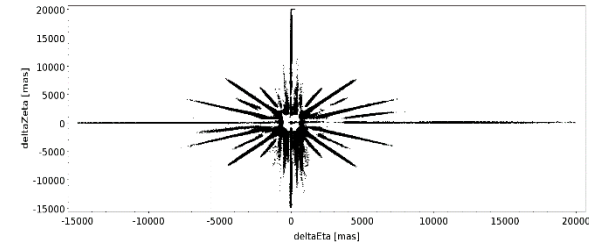


# Gaia: Data processing, validation and visualization

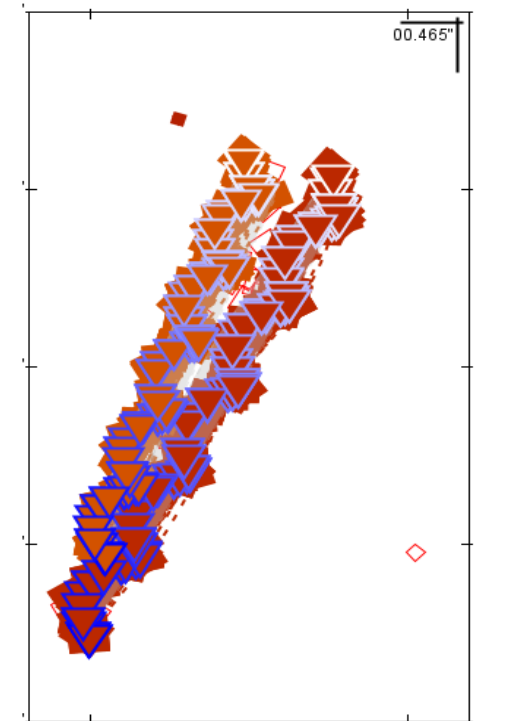


Most activities within the frame of the **Gaia DPAC (Data Processing and Analysis Consortium)**:

- CU3 (**Core Processing**), IDU (**Intermediate Data Updating**), Cross-Matching
  - Development and integration of algorithms: calibrations, image parameters, spurious detections...
  - Improvement of very bright stars astrometry
  - Recently: on-ground detection and resolution of **close star pairs**
  - Identification and modelling of **resolved binary stars**  
--> improve catalogue resolution and completeness (**DR4-DR5**): clusters, binaries, dense areas...
- DPCB (**Data Processing Centre of Barcelona**)
  - **Operational runs** at BSC (**MareNostrum**):  
Latest full runs: on **5.5 years** of mission data (**DR4**), up to **154E9 observations** processed, more than **280 TB** generated...
  - Now processing **~9 years** of mission data (towards **DR5**)
  - **Official backup** of the full MainDB and raw TM Archive



Obs: 338, GMag: 9.61+-1.02 [8.83, 17.27]  
Src: 3, GMag: 11.94+-4.57 [9.10, 17.22]



*Contributors:*  
*J. Castañeda, F. Torra, C. Fabricius,  
E. Villar, S. Bartolomé, M. Bernet,  
J. Portell et al.*

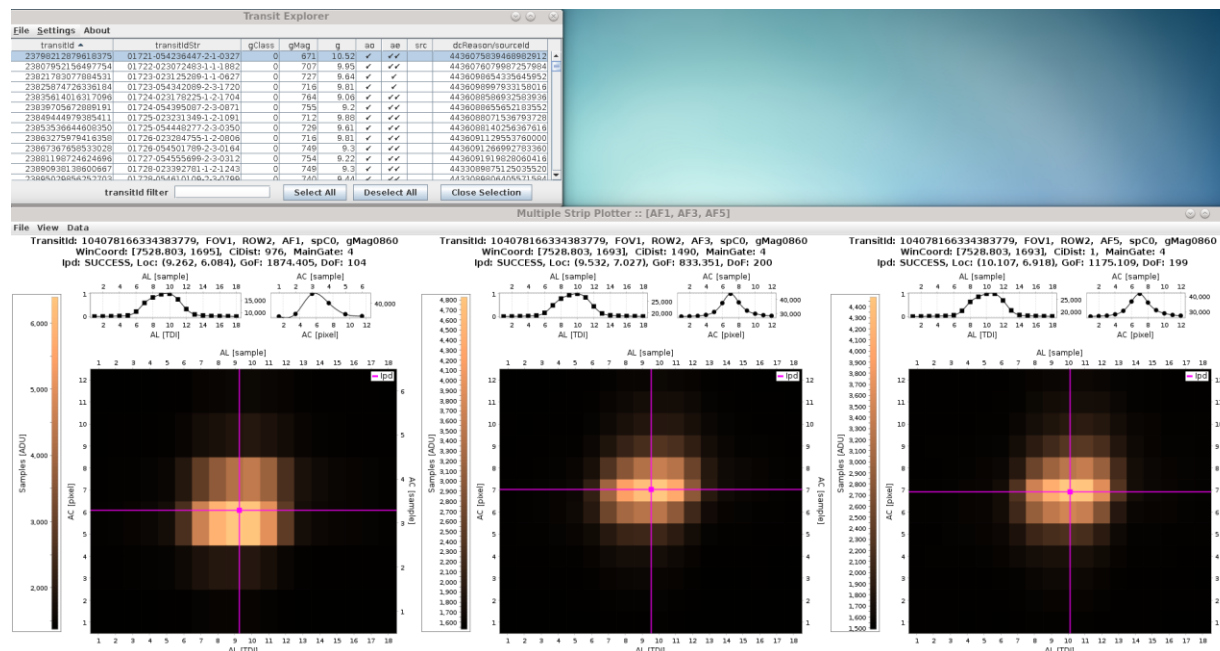
# Gaia: Data processing, validation and visualization



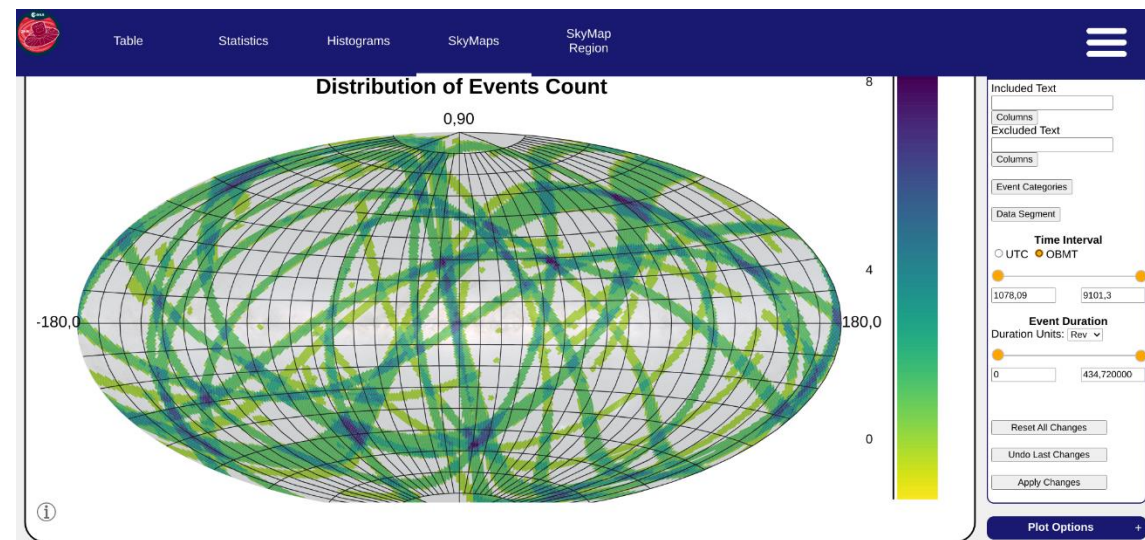
Most activities within the frame of the **Gaia DPAC (Data Processing and Analysis Consortium)**:

- **DPCB (Data Processing Centre of Barcelona), Data visualization tools**

- **Catalog Explorer**, to visualize the “scene” (observations and their match to sources) and run cross-matching tests
- **Transit Explorer**, to visualize the observations
- **Event Explorer**, to examine the spacecraft and mission events



Index	Event	System	Wavelength	OBMT	Description/Comments	Event length	Event length	Rev. interval	
7	ACCS NMNAP convergence	Spacecraft	06/09/2014 03:02	06/09/2014 03:13	1125.140	1125.170	From SC EAR, not in Transit	0:00:00 00:20	28.75
8	ACCS NMNAP convergence	Spacecraft	12/09/2014 06:00	12/09/2014 06:11	1149.950	1149.960	From SC EAR, not in Transit	0:00:00 00:20	28.40
9	ACCS NMNAP convergence	Spacecraft	13/09/2014 06:16	13/09/2014 06:26	1156.300	1156.300	From SC EAR, not in Transit	0:00:00 00:20	6.69
10	APR 1.1 switch-off (FSA)	SVM	17/08/2014 19:38	18/08/2014 09:38	1171.900	1178.240	SC EAR indicates end at 11	6:54:38 2	16.53
11	Breaker Keeping Maintenance	Spacecraft	21/08/2014 03:10	21/08/2014 04:19	1185.100	1188.300	All VFLUs in ZDMGMTATE state	0:30:18 1.8	6.02
12	ACCS NMNAP convergence	Spacecraft	21/08/2014 18:11	21/08/2014 18:24	1187.640	1187.700	From SC EAR, not in Transit	0:00:00 00:24	2.31
13	SCM 404 & MFS Offset Cl	Spacecraft	22/08/2014 03:10	22/08/2014 04:19	1189.100	1189.300	All VFLUs in ZDMGMTATE state	0:30:18 1.8	1.46
14	ACCS NMNAP convergence	Spacecraft	22/08/2014 08:27	22/08/2014 08:37	1190.040	1190.070	From SC EAR, not in Transit	0:00:00 00:20	0.69
15	12 of unassigned EPICs	Spacecraft	22/08/2014 11:58	22/08/2014 21:38	1192.620	1192.620	From GaiaCSPTransit_SC	0:00:00 00:00	0.56
16	CLUS start of Epoch	CLUS	22/08/2014 21:00	22/08/2014 21:00	1182.130	1182.130		0:00:00 00:00	1.51
17	Transition from LPSL to S	Spacecraft	22/08/2014 22:58	22/08/2014 22:58	1182.620	1192.620	From GaiaCSPTransit_SC	0:00:00 00:00	0.49
18	ACCS NMNAP convergence	Spacecraft	22/08/2014 18:45	22/08/2014 18:54	1182.750	1192.700	From SC EAR, not in Transit	0:00:00 00:21	8.12
19	VFLU autonomous switch-off	VFLU	28/08/2014 23:20	30/08/2014 09:29	1220.520	1220.740	VFLU passed in Startup, not	0:22:19 2.9	28.75
20	ACCS NMNAP convergence	Spacecraft	30/08/2014 13:42	30/08/2014 14:52	1222.920	1222.950	All VFLUs in ZDMGMTATE state	0:00:00 00:24	2.17
21	PRISM-17 trigger	VFLU	30/08/2014 21:00	30/08/2014 21:00	1224.120	1224.140	VFLU emergency in Standby	0:00:00 00:23	1.18
22	Calibration problems due to EPIC DM IOT FL	Spacecraft	02/09/2014 03:35	03/09/2014 04:35	1243.200	1275.380	EPICs/Calibration anomaly/d	42:39:26 30.30	9.09
23	Radio frequency problems in IOT	Spacecraft	04/09/2014 07:35	04/09/2014 08:35	1243.200	1243.240	Due to PDMU not finished	0:00:00 00:00	6.61
24	ACCS NMNAP convergence	Spacecraft	04/09/2014 07:17	04/09/2014 07:34	1241.840	1242.000	From SC EAR, not in Transit	0:00:00 00:21	7.50
25	Scum Barrot (causing spin)	Science	04/09/2014 17:33	04/09/2014 19:20	1243.500	1243.850	From FM: RADEC 026.78	6:29:14 4.4	0.02
26	Main tower (causing spin)	Science	05/09/2014 07:14	05/09/2014 07:14	1243.840	1243.840	From FM: RADEC 020.97	0:00:00 00:00	0.02
27	APR 2 autonomous switch	SVM	09/09/2014 03:39	09/09/2014 03:39	1261.130	1261.240	From JMS list	0:11:00 00:39	19.29
28	Transition from LPSL to S	Spacecraft	09/09/2014 04:27	09/09/2014 04:24	1261.300	1261.530	All VFLUs in ZDMGMTATE state	0:30:18 1.8	0.12
29	Star Star and Control Star	Science	12/09/2014 01:31	12/09/2014 02:49	1269.800	1276.120	Star AA-102 is for same star	2:30:42 4.8	7.27
30	VFLU AL Phasing table (AL VFLU)	Spacecraft	11/09/2014 04:58	11/09/2014 04:02	1289.900	1289.970	From GaiaCSPTransit_SC	0:00:00 00:21	1.16
31	Warna CCD	SCC IOT	15/09/2014 00:40	17/09/2014 17:50	1284.600	1294.000	Warm CCD causing spin	0:00:00 00:00	24.62
32	Detection of threshold violation	VFLU	15/09/2014 00:39	15/09/2014 00:37	1284.600	1284.700	EM detection threshold violation	0:00:00 00:00	0.02
33	AP 1 configuration parameter	VFLU	15/09/2014 00:40	15/09/2014 00:40	1284.740	1284.740	From JMS list	0:00:00 00:00	0.11
34	AP 2 autonomous switch	SVM	15/09/2014 00:39	15/09/2014 00:38	1284.600	1284.570	From JMS list	0:00:00 00:00	0.76
35	VFLU swap	VFLU VFLU	16/09/2014 00:30	16/09/2014 00:30	1282.840	1282.840	Short SERVICE mode for V	0:00:00 00:00	3.06
36	DRISK test start	SVM	16/09/2014 18:24	16/09/2014 18:24	1281.700	1291.700	From JMS list, probably not	0:00:00 00:00	3.06
37	MFS swap	VFLU VFLU	17/09/2014 00:30	17/09/2014 00:30	1282.840	1292.840	20 sec (VFLU) and 30 sec (	0:00:00 00:00	0.03
38	MFS piggyback movement	Spacecraft	17/09/2014 16:01	17/09/2014 16:01	1295.300	1295.300	From SC EAR, not in Transit	0:00:00 00:00	2.66
39	AP 1 configuration parameter	VFLU	18/09/2014 00:40	18/09/2014 00:40	1295.300	1295.300	From JMS list, filters unack	0:00:00 00:00	1.33
40	VFLU swap	VFLU VFLU	18/09/2014 00:30	18/09/2014 00:30	1295.300	1295.340	20 sec (VFLU) and 30 sec (	0:00:00 00:00	0.02
41	AP 2 configuration parameter	VFLU	18/09/2014 00:30	18/09/2014 00:30	1297.390	1297.390	From JMS list, probably not	0:00:00 00:00	2.75
42	DRISK test end	SVM	18/09/2014 18:22	18/09/2014 18:22	1299.950	1299.950	From JMS list, probably not	0:00:00 00:00	3.06
43	MFS swap	VFLU VFLU	18/09/2014 00:30	18/09/2014 00:30	1300.500	1300.540	Short SERVICE mode for V	0:00:00 00:00	0.04
44	MFS swap	VFLU VFLU	20/09/2014 00:30	20/09/2014 00:30	1304.400	1304.440	Short SERVICE mode for V	0:00:00 00:00	3.99
45	MFS piggyback movement	Spacecraft	20/09/2014 04:35	20/09/2014 04:35	1305.300	1305.300	From SC EAR, not in Transit	0:00:00 00:00	0.76
46	MFS swap	VFLU VFLU	21/09/2014 00:30	21/09/2014 00:30	1305.400	1305.440	Short SERVICE mode for V	0:00:00 00:00	3.24
47	AP 1 configuration parameter	VFLU	22/09/2014 00:40	22/09/2014 00:40	1312.800	1312.700	Activation of bonus fields	0:00:00 00:00	2.47
48	Time correlation (not general)	MCC SOC	22/09/2014 07:20	22/09/2014 08:22	1313.850	1314.020	From SC EAR, not in Transit	0:13:00 00:29	1.21
49	ACCS NMNAP convergence	Spacecraft	22/09/2014 21:00	22/09/2014 03:37	1314.400	1317.700	From SC EAR, not in Transit	0:00:00 00:00	2.47
50	CLUS start of Epoch	CLUS	23/09/2014 02:13	23/09/2014 02:13	1317.000	1317.000		0:00:00 00:00	0.51
51	Communication (FSA) CLUS	CLUS	23/09/2014 03:37	23/09/2014 03:37	1317.200	1317.200	20 sec (VFLU) and 30 sec (	0:00:00 00:00	7.26



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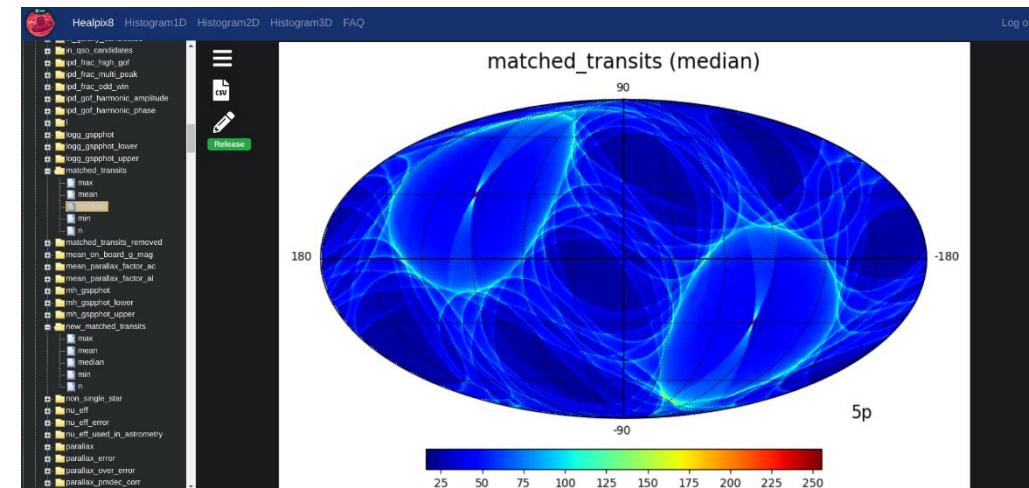
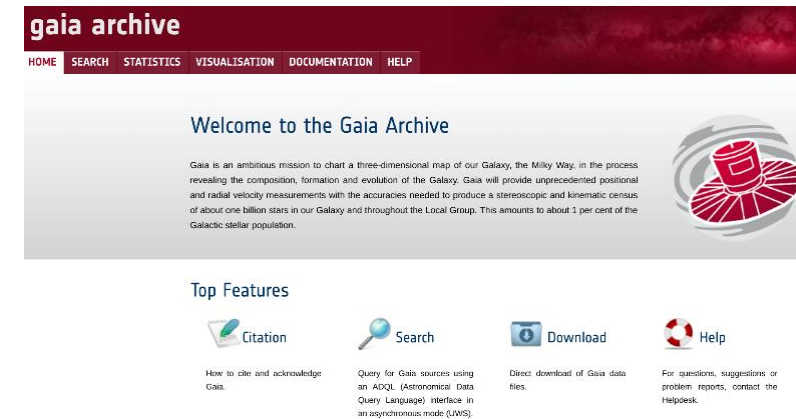


# Gaia: Data processing, validation and visualization



Most activities within the frame of the **Gaia DPAC (Data Processing and Analysis Consortium)**:

- CU9 (**Catalogue Preparation**)
  - Catalogue validation for **DR3** and the **FPR**: many new data types, tables, parameters...
  - Development of software tools for **statistics and validation**, e.g. the **Gaia Analysis Tool (GAT)**
  - **Now working hard on the many DR4 products**
- **Project Office**
  - **Technical interfaces** between Units and Centres; **technical support** to other Units
  - Estimation of database and transfer sizes
  - Curation of Operational Event Logs, support to visualization tools
  - Support to additional (often cross-unit) investigations
- CU3 / IDT (**Initial Data Treatment**)
  - Support to daily operations, monitoring and resolution of onboard/onground issues
- Preparing for Gaia End-of-Life ☹️




*Contributors:*

*C. Fabricius, A. Masip, A. Garcia,  
X. Luri, J. Portell, J. Castañeda et al.*

# Gaia: Additional activities

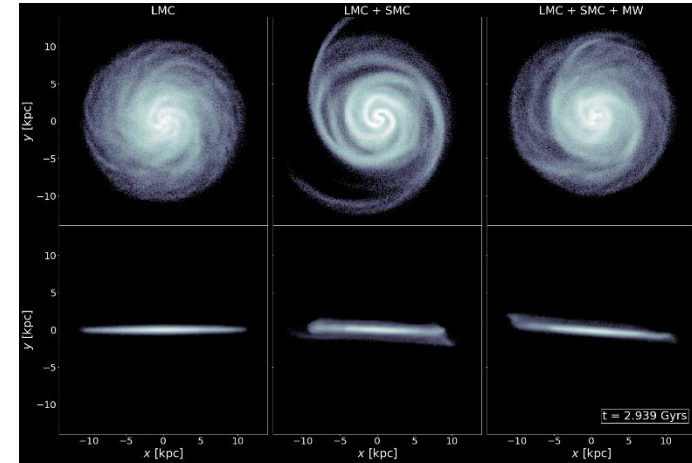


Beyond DPAC, some activities related to Gaia:

- **OCRE / GalacticRainCloudS:**  Open Clouds for Research Environments
  - Galactic Research in Cloud Services
  - **Commercial Cloud Services** (Google) granted by OCRE (European Initiative) to do data mining and research on Gaia data
  - **Spark cluster, Data lake, Linux Virtual Machines, Machine Learning services, Notebooks...**
  - Run large simulations, get richer statistics, find correlations, improve current models
  - Outstanding performance achieved with BigQuery on the DR3 bulk catalogue
- **GDAF:**
  - Gaia Data Analysis Framework
  - **Hadoop + Spark + Parquet + libraries + interfaces**
  - Allow queries, plots and investigations on **Big Gaia Data**
  - Formerly deployed at CESCO/CSUC, now migrating to BSC
- **SPACIOUS:**
  - European project recently granted (2024-26)
  - Massive data mining on Gaia and other missions


*Contributors:*

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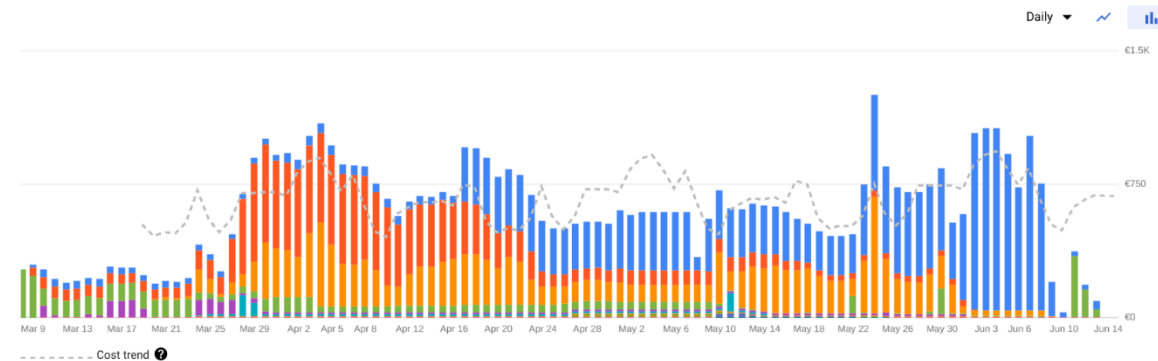


8 March – 14 June 2023 (total cost)   
€58,821.94  
includes -€5,978.01 in credits

↑ 254.82%  
€42,243.92 over 29 November 2022 – 7 March 2023

8 March – 14 June 2023 (forecasted total cost)   
€60,826.67  
includes -€6,381.65 in credits

↑ 266.91%  
€44,248.66 over 29 November 2022 – 7 March 2023





# Gaia: Additional activities



Beyond DPAC, some activities related to Gaia:

- **Gaia4Sustainability** (a.k.a. GAMBONS Plus):
  - Gaia map of the brightness of natural sky
  - Evaluate and identify sources of **light pollution**
  - Now improving it to offer a “proof-of-concept” service to users
  - Software development including modern **web technologies** and **GPU programming**
- **B2CATS / Cloud4Auth**:
  - Slightly related to Gaia (mainly on data handling aspects)
  - Cloud-based continuous authentication based on behavioral sensing
  - Apache Kafka, Docker/Kubernetes, optimized data streaming
- Both projects in close cooperation with Univ. A Coruña

*Contributors:*

*S. Bartolomé, A. Masip, J. Ramírez,  
I. de José, J. Castañeda, J. Portell,  
E. Masana, X. Luri et al.*

## The GAia Map of the Brightness Of Natural Sky

New! Updated to Gaia-EDR3 catalogue. New bands added.

Read carefully the [About](#) page before to use GAMBONS data

### Local Map at

Lon.: 2.1750 / Lat.: 41.3700 Elev. (m.a.s.l.): 0

Date: 7-Feb-2022 Hour: 20 Minute: 37

Time zone: Greenwich Mean Time Europe/London (GMT+0)

Altitude of the Sun above the horizon: -38°

### Airglow and atmospheric parameters

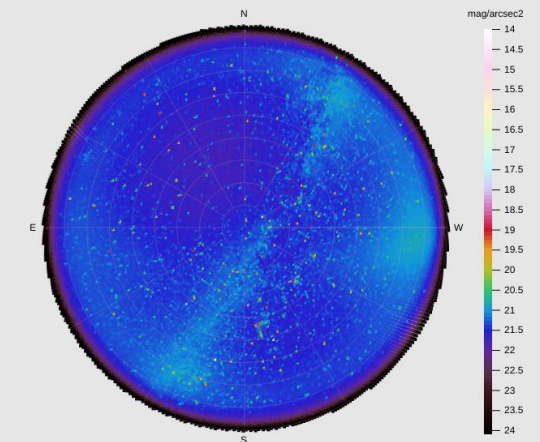
Airglow Spectrum: *AirglowSpectrum.dar*   Value (%): 100

Aerosols Ångstrom exponent ( $\alpha$ ): 1.0  $\tau_0(\lambda_0)$ : 0.2

Low resolution (faster)

Band: V (Johnson)

Zenith magnitude (average magnitude for zenith angle < 5°): 21.28 (mag-arcsec<sup>-2</sup>)



Horizontal irradiance ( $W \cdot m^{-2}$ ):  $1.292 \cdot 10^{-6}$   
Average upper hemisphere radiance ( $W \cdot m^{-2} \cdot sr^{-1}$ ):  $0.390 \cdot 10^{-6}$   
Average full sphere radiance ( $W \cdot m^{-2} \cdot sr^{-1}$ ):  $0.236 \cdot 10^{-6}$



# Gaia: Recent achievements and outlook



- **Data Release 3 (DR3):**

- Released **13 June 2022**
- Lots of new data products

- **Focused Product Release (FPR):**

- Released **10 October 2023**
- Additional OmegaCen sources, Gravitational Lenses, improved SSO astrometry, LPVs, DIBs

- **Data Release 4 (DR4):**

- Full nominal mission (66 months)
- Around **end'2025**
- **Epoch data** for all data products and sources (incl. astrometry, spectra, etc.)

- **Data Release 5 (DR5):**

- *Extended mission, date TBD*
- *Already working on it!*

**Gaia Focused Product Release**

**A GOLDMINE FOR COSMOLOGISTS: GAIA LOCATES HUNDREDS OF LENSED QUASARS**

ESA's Gaia telescope has peered deep into the distant Universe on the hunt for gravitational lenses: elusive objects that hold key clues to some of our biggest questions about the cosmos.

**The result?** Gaia sees the single quasar as **multiple separate images on the sky** – in this example, 4 images

**How does gravitational lensing work?** Light travels to us from a distant quasar. The gravity of a foreground mass acts as a lens, bending the quasar's light on its way to Gaia.

3 760 032 quasar candidates analysed

381 suspected to be lensed quasars...

including 50 that are highly likely...

...and 5 predicted to be especially rare quadruply-lensed quasars

ESA

**Gaia Focused Product Release**

**GAIA REVEALS THE CROWDED CORE OF MASSIVE STAR CLUSTER**

ESA's billion-star surveyor reveals half a million new Gaia stars at the core of Omega Centauri, the largest globular cluster in our galaxy that can be seen from Earth.

526 587 new Gaia stars revealed

Gaia used a mode not originally planned for science

Gaia observes 9 crowded regions in this way

Gaia now sees 10x more stars in the cluster core

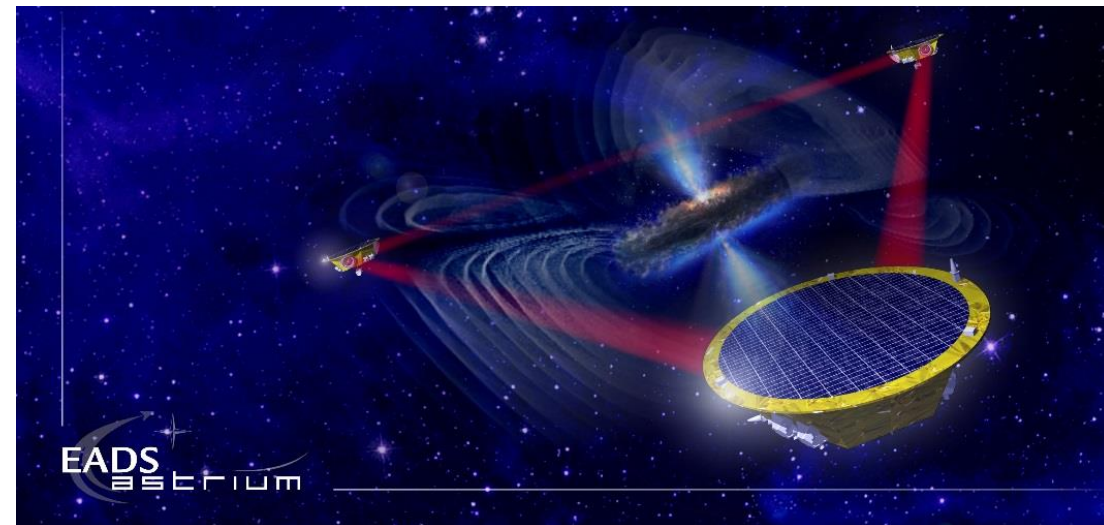
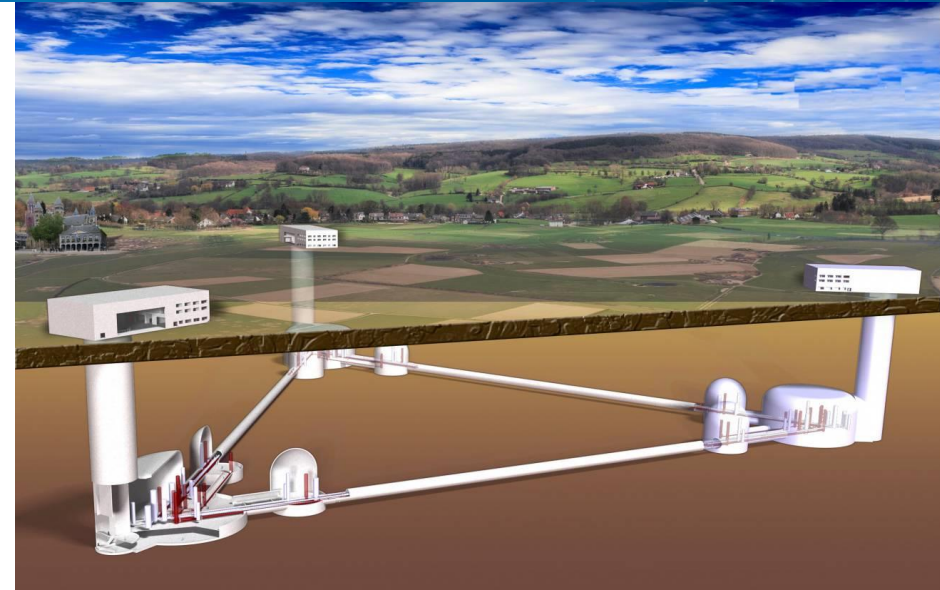
Gaia now charts stars up to 15x fainter in the cluster core

ESA

	# sources in Gaia DR3
<b>Total number of sources</b>	<b>1,811,709,771</b>
	Gaia Early Data Release 3
Number of sources with full astrometry	1,467,744,818
Number of 5-parameter sources	585,416,709
Number of 6-parameter sources	882,328,109
Number of 2-parameter sources	343,964,953
Gaia-CRF sources	1,614,173
Sources with mean G magnitude	1,806,254,432
Sources with mean G <sub>BP</sub> -band photometry	1,542,033,472
Sources with mean G <sub>RP</sub> -band photometry	1,554,997,939
	New in Gaia Data Release 3
Sources with radial velocities	33,812,183
Sources with mean G <sub>RVS</sub> -band magnitudes	32,232,187
Sources with rotational velocities	3,524,677
Mean BP/RP spectra	219,197,643
Mean RVS spectra	999,645
Variable-source analysis	10,509,536
Variability types (supervised machine learning)	24
Supervised machine-learning classification for variables	9,976,881
Specific Object Studies – Cepheids	15,021
Specific Object Studies – Compact companions	6,306
Specific Object Studies – Eclipsing binaries	2,184,477
Specific Object Studies – Long-period variables	1,720,588
Specific Object Studies – Microlensing events	363
Specific Object Studies – Planetary transits	214
Specific Object Studies – RR Lyrae stars	271,779
Specific Object Studies – Short-timescale variables	471,679
Specific Object Studies – Solar-like rotational modulation variables	474,026
Specific Object Studies – Upper-main-sequence oscillators	54,476
Specific Object Studies – Active galactic nuclei	872,228



# Gravitational Waves





# Virgo: Contributions to the Gravitational Waves Observatory

- **ICCUB Virgo participation was triggered from the Technological Unit**

- Initially aiming at contributions on **Computing** and **Instrumentation**
- Now also **outreach**, **data analysis** and **science modelling and exploitation**
- Member of the Virgo Collaboration since **July 2018**
- ICCUB-Virgo group has grown a lot! Nearly **20 members**
- Here we just focus on computing and data analysis

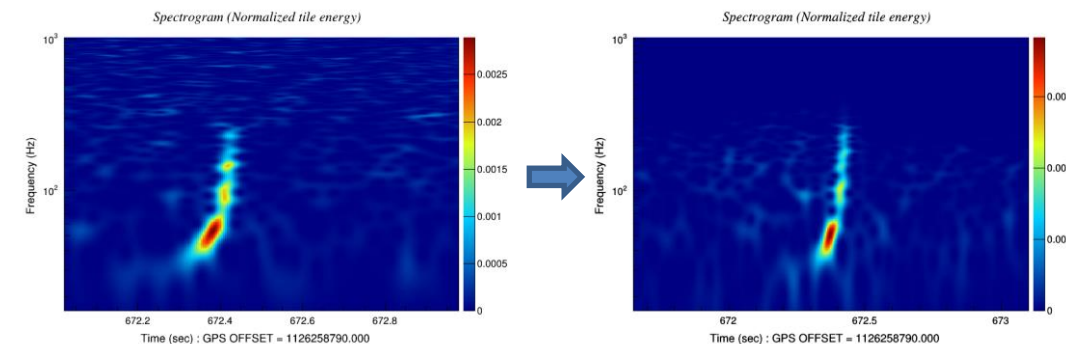


- **Data analysis:**

- **Denosing** plugin (based on iterative rROF) for Bursts pipeline (unmodelled searches), up to **~17% SNR improvement** (paper in Phys. Rev. D by Barneo et al., and recent thesis by P. Barneo)
- Working on new **GW templates** and models: High eccentricity, precession, gravitational lensing...
- Also on new **pipelines** and improved template **interfaces**

- **Computing:**

- Working on a federated **authentication service** for Virgo (in collab. with LIGO and KAGRA)
- Also: support to scientists  
centralized monitoring of Rucio data handling and HTCondor jobs



*Contributors:*

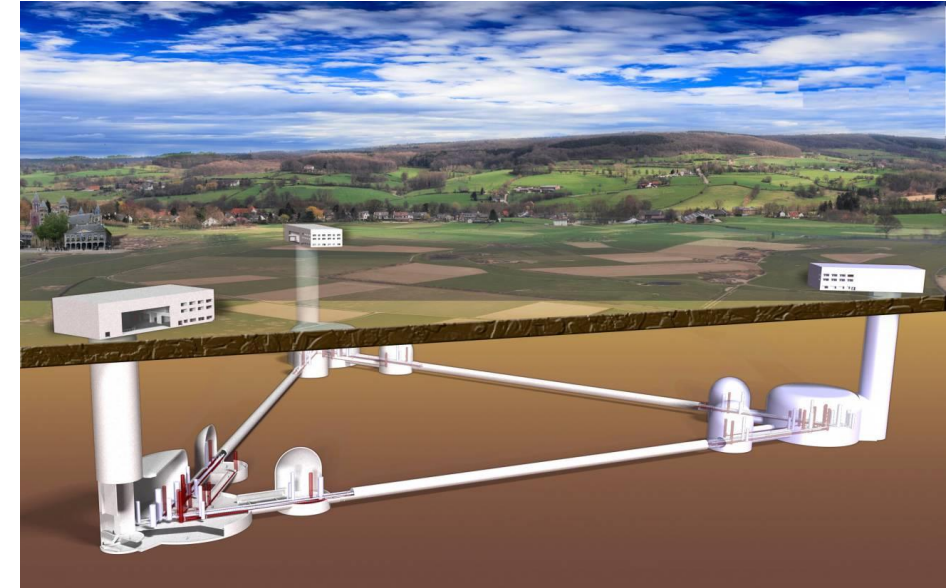
*P. Barneo, P. Jasal, J. Castañeda, J. Portell, J. Trenado et al.*



# Contributions to other Gravitational Waves projects

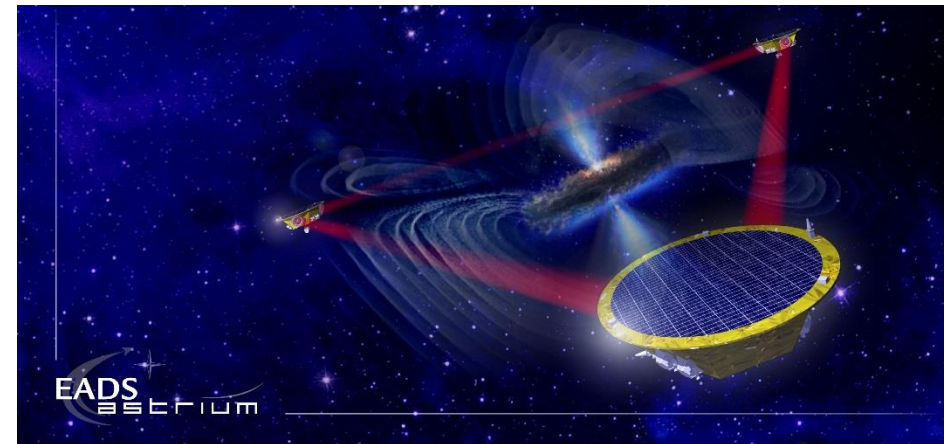
## Einstein Telescope (ET):

- Third-generation GW observatory, expected ~2035
- 3 nested detectors, **10km arms**, underground, cryogenic parts
- Now part of ESFRI roadmap
- Envisaged contributions from ICCUB:
  - Science case and data analysis
  - Outreach
  - **“E-Infrastructure” (Computing & Software):**  
Contributions to the general computing model and architecture, efficient data handling, cloud and Big Data technologies, software engineering...



## LISA:

- Space-based GW observatory, expected ~2035
- 3 detectors, **2.5 million km arms**
- **Recently adopted by ESA!**
- Envisaged contributions from ICCUB:
  - **Distributed Computing Center of Barcelona**
  - Mock data challenge, data analysis, pipelines...
  - Close cooperation with ICE/IEEC



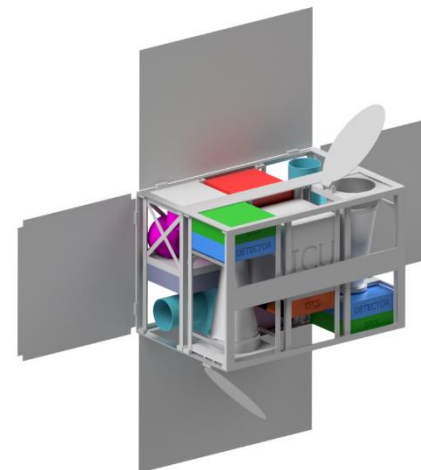
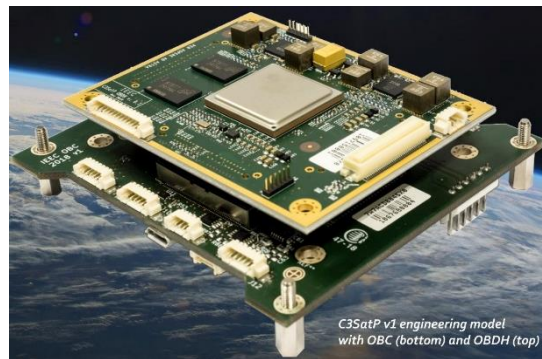
*Contributors:*

*P. Barneo, P. Jasal, G. Skorobogatov,  
J. Portell, J. Castañeda, J. Trenado et al.*

# Other projects



**PLATO**



**Nanosatellites / NewSpace**

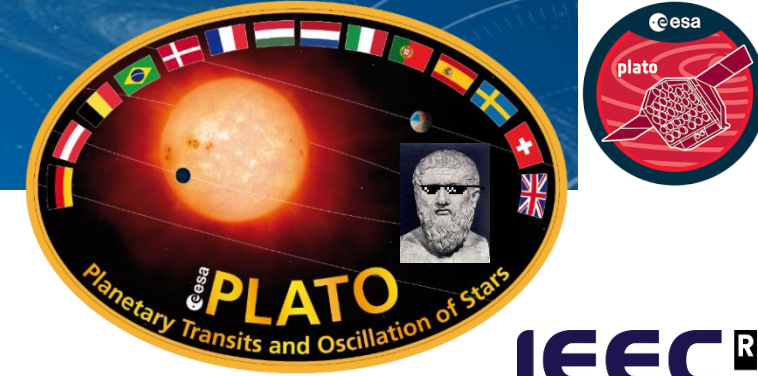


**Future space missions**





# PLATO



ESA mission, launch expected ~2026.

ICCUB contribution: **Ground-based follow-up of exoplanet candidates (GOP, Ground-based Observation Programme):**

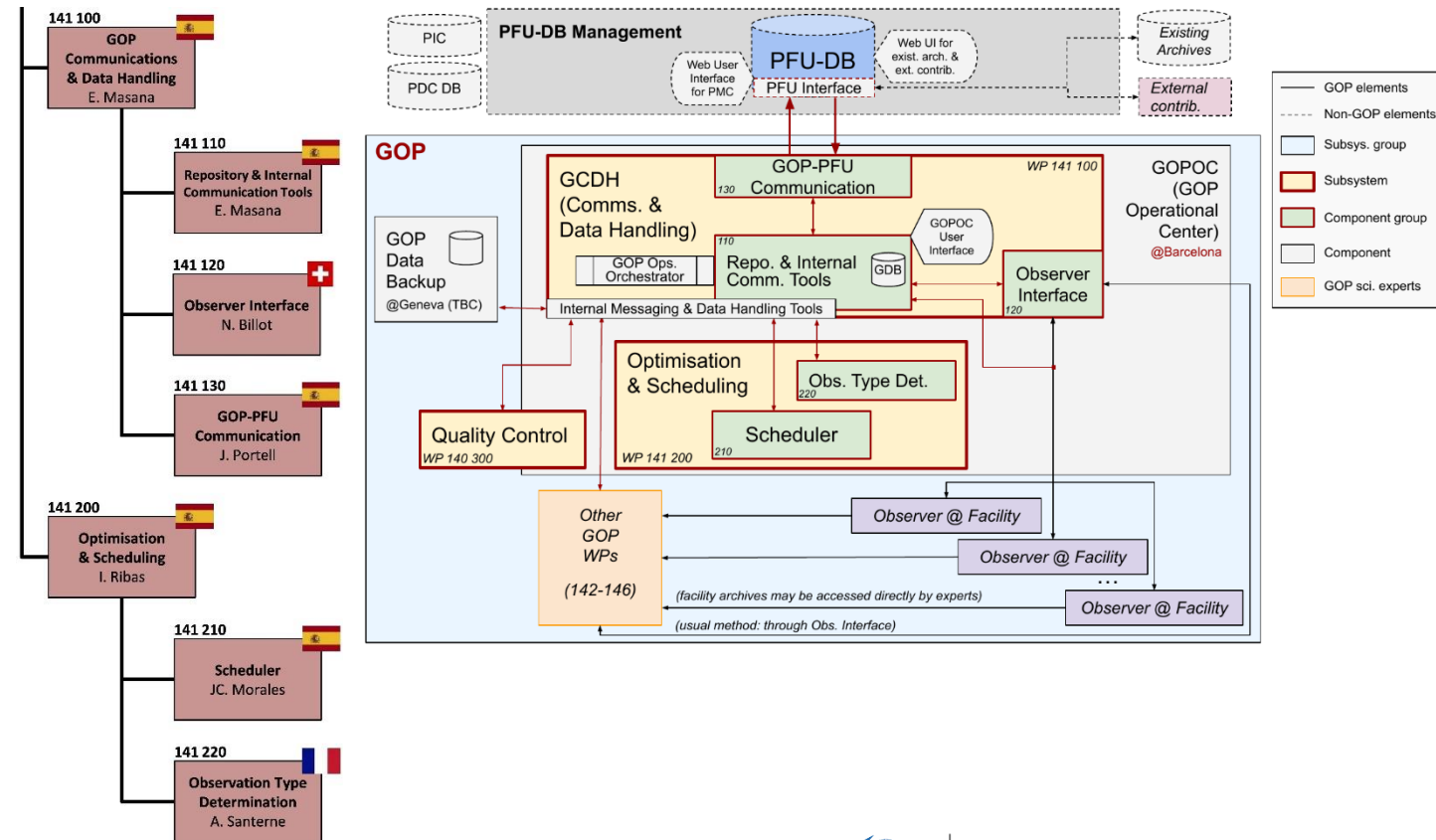
- Definition of **subsystems architecture and requirements**
- **GOP Operational Center**
- **Interfaces** and protocols with other PLATO centers and with Observatories
- Database, repository, metadata
- Orchestrator for all tasks
- Observational constraints
- Software implementation

Close cooperation with ICE/IEEC

Full-speed since ~Q2'23,  
now approaching GS Design Review

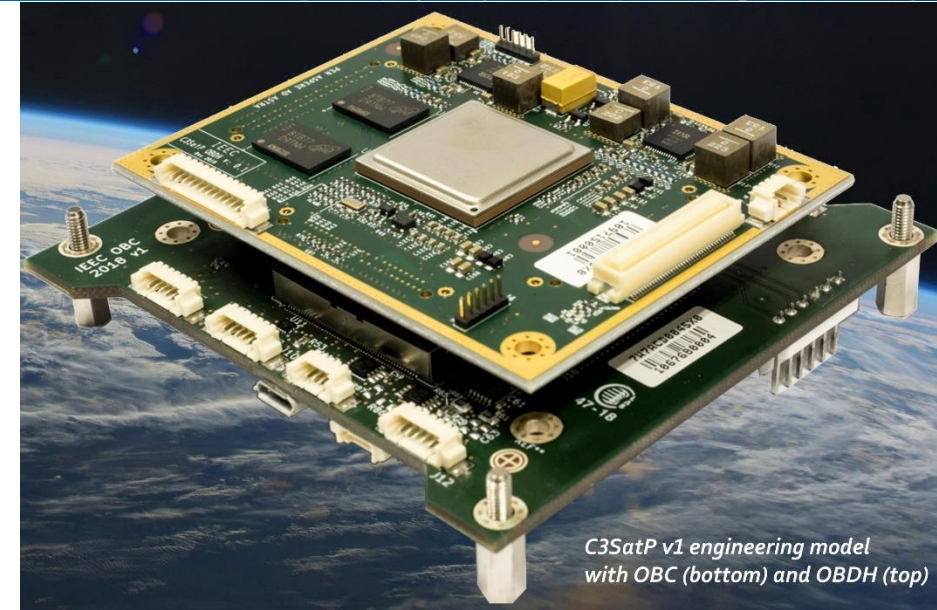
*Contributors:*

*J. Poyatos, J. Portell, E. Masana et al.*



# Nanosatellites (NewSpace)

- IEEC's **C3SatP platform**:  
CCSDS packetization stack, Reed-Solomon error detection and correction, efficient **data compression** (DAPCOM/FAPEC + UAB/CCSDS)
  - ARM-based processor
  - Feasibility to compress payload data even on a low-end OnBoard Computer (OBC)
  - **High-throughput software-based data compression**
  - Collaboration with our spin-off (DAPCOM Data Services)
- **Commissioned during 2023 onboard Menut!**
  - 2nd nanosatellite of the Catalan Government (Earth Observation, launched 3-Jan-2023)
  - Tested on 35 Mpix 7-band 12-bit images
  - Up to 120 MB/s (almost **1 Gbps**) lossless compression
  - Near-lossless compression **above 10:1 at 30 MB/s**
- Further improvements to image data compression algorithms for cubesats
  - Catalan NewSpace/IEEC funding, collab. with GICI/UAB experts



C3SatP v1 engineering model with OBC (bottom) and OBDH (top)

**IEEC**<sup>R</sup>  
Institut d'Estudis  
Espacials de Catalunya



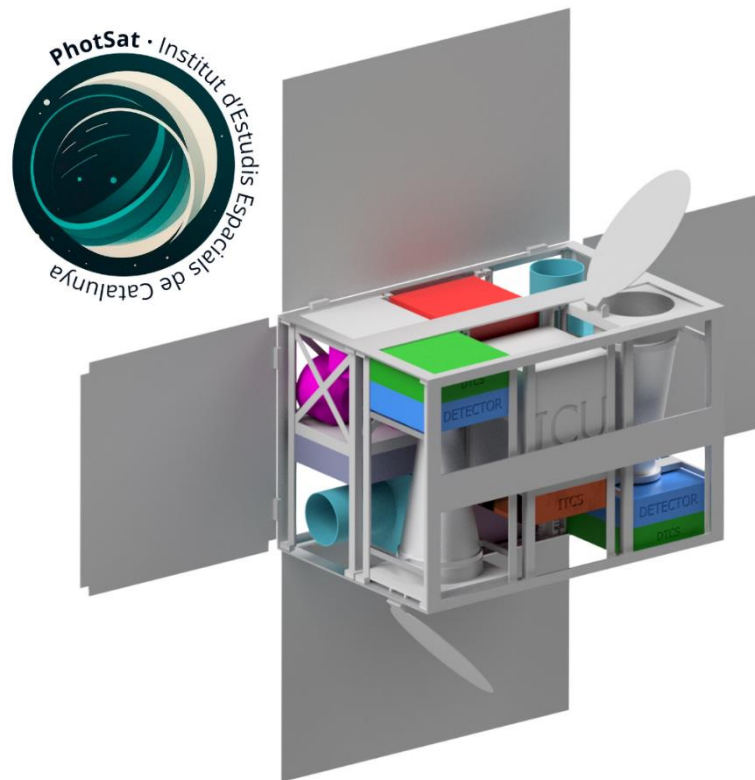
*Contributors:*

*J. Portell, A. Masip,  
J. Mauricio, J.M. Gomez et al.*



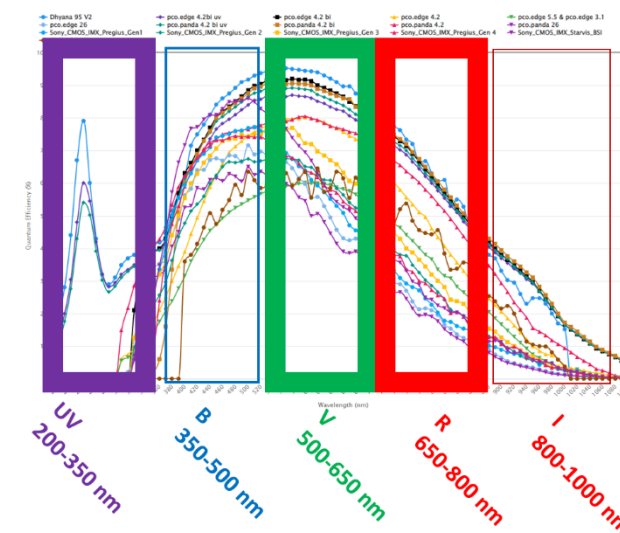
# Photsat

- IEEC's **astrophysical nanosatellite**
  - Visible + **UV** photometry from space (LEO)
  - All-sky monitoring of ~10M stars
  - Short revisit time: ~2 days
  - Launch planned for ~end'2025!
- **ICCUB-Tech contributions:**
  - Fast on-board photometric alerts
  - On-ground raw data handling, repository and data access framework
  - On-ground photometric alerts
  - Basic monitoring of ground segment
- Starting now, details being refined
  - Aggressive schedule!



**IEEC**<sup>R</sup>  
Institut d'Estudis  
Espacials de Catalunya

## Pass bands (tentative):



### Contributors:

*F. Sunyol, J. Portell, A. Masip,  
J. Castañeda, N. Blagoródnova,  
O. Fors et al.*

# Other projects and activities

- **GaiaNIR:**

- Support to initial definition
- On-board data handling, on-ground raw data processing and initial data treatment, ...
- Voyage 2050 science case white paper for now



- **Euclid:**

- Launched 2023
- Support to data handling activities for its stellar measurements



- **Jasmine:**

- Being defined: perhaps support to some PSF models, simulations, and eventually data processing/analysis
- Launch ~2028



- **Data fusion** of Gaia data with other catalogues: JPAS/JPLUS, WEAVE, Euclid, LSST...

- **Support** to other ICCUB projects and scientists

- HTCondor expertise, Machine Learning, cloud, containers (docker/Kubernetes), computing resources...

- **Outreach and workshops**

- TechnoWeeks: Nanosatellites, Cloud computing



# Thank you

Jordi Portell ([jjportell@icc.ub.edu](mailto:jjportell@icc.ub.edu))

*on behalf of the ICCUB-Tech Computing Division*