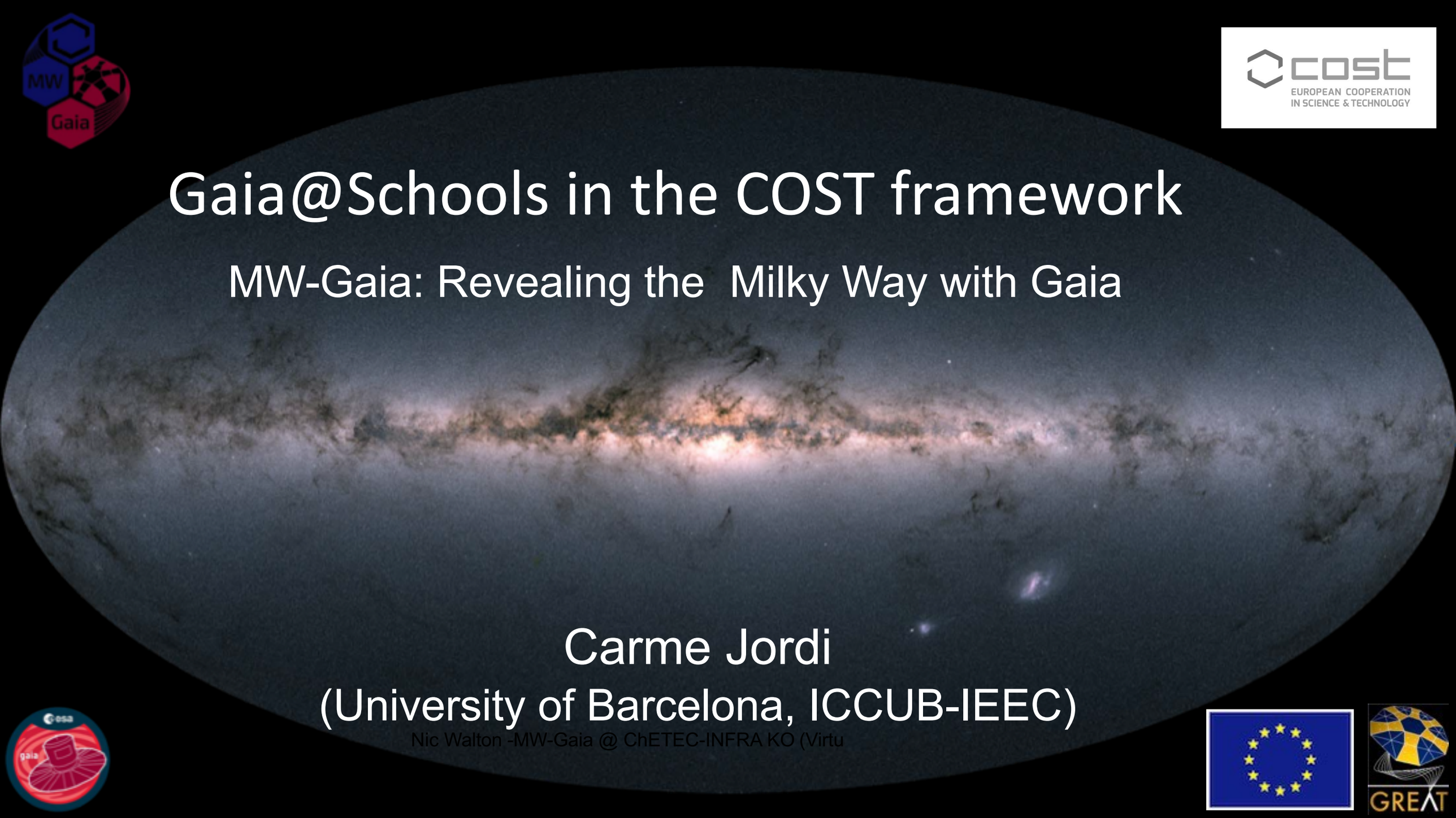
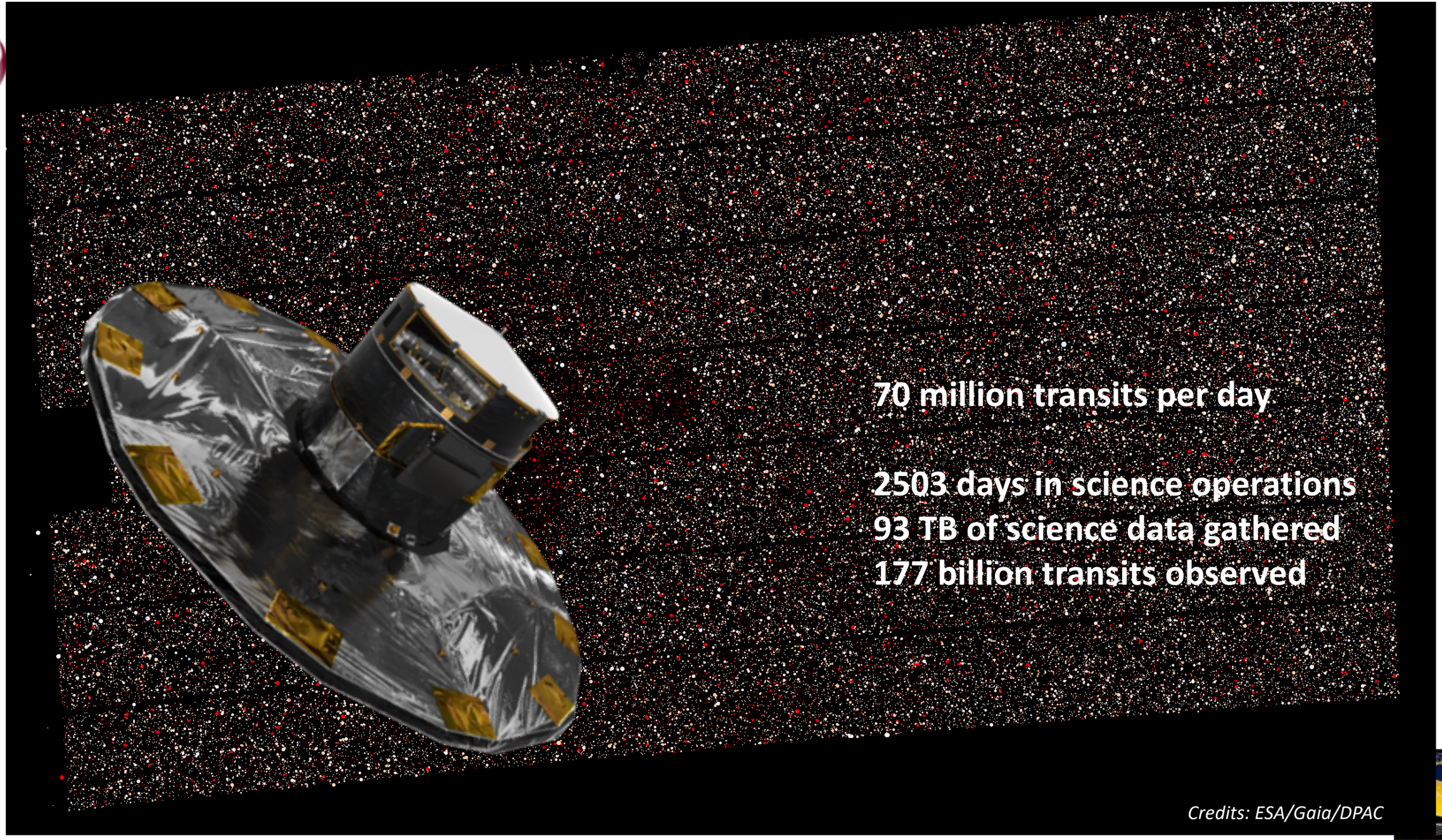
Gaia@Schools in the COST framework

MW-Gaia: Revealing the Milky Way with Gaia

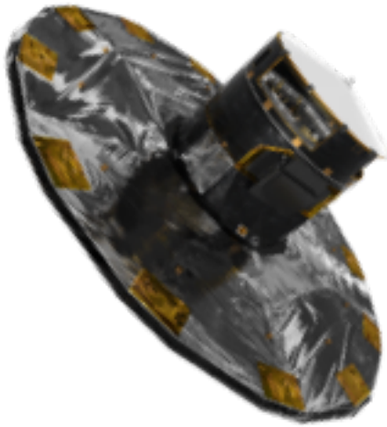


Carme Jordi
(University of Barcelona, ICCUB-IEEC)


70 million transits per day
2503 days in science operations
93 TB of science data gathered
177 billion transits observed
Credits: ESA/Gaia/DPAC

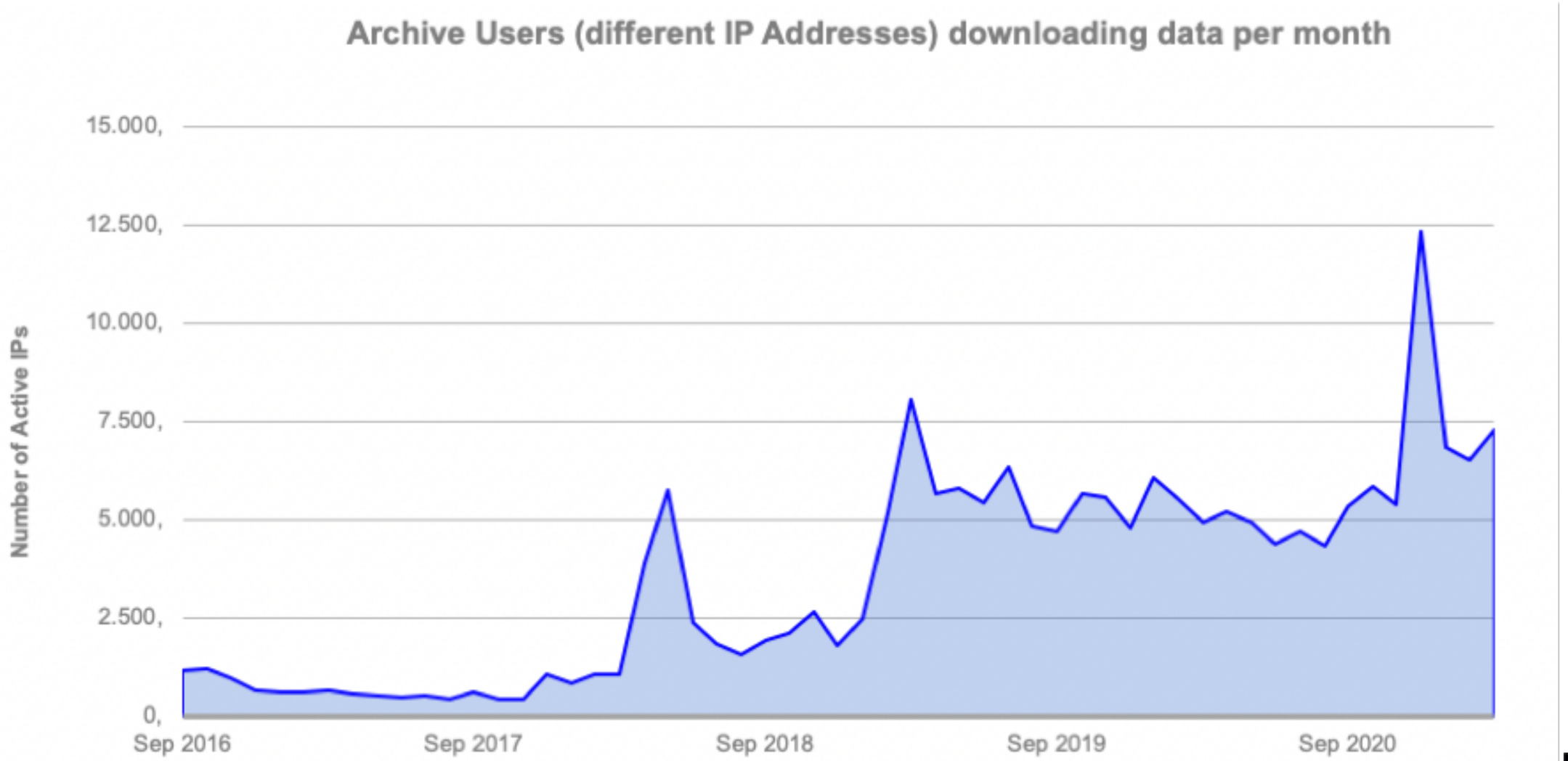
A long history of success

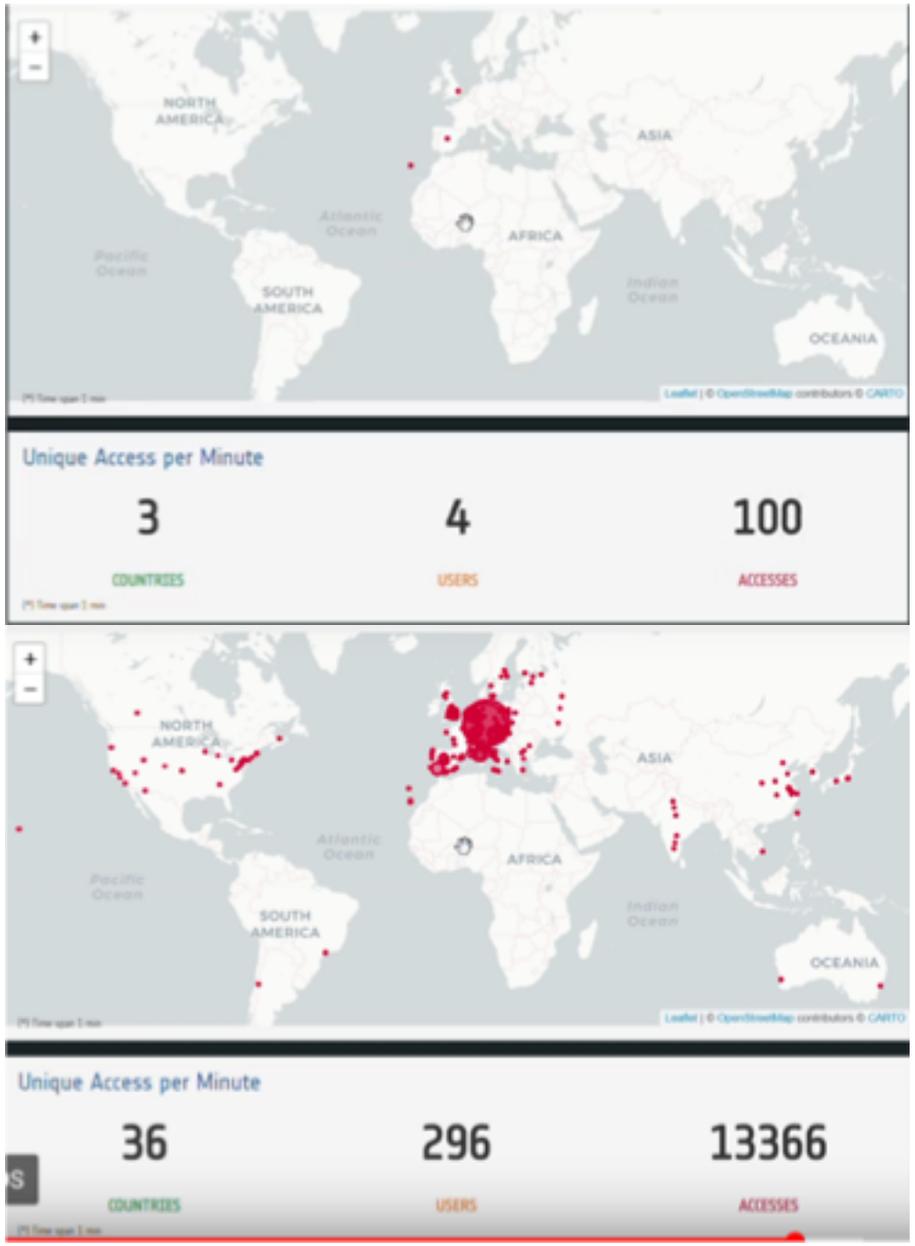
Credits: ESA/Gaia



- First ideas in 1997
- Launch 19-Dec-2013
- Science operations 25-Jul-2014
- DR1 (14 months) 14-Sep-2016
- DR2 (22 months) 25-Apr-2018
- End of nominal mission 16-Jul-2019
- **EDR3 (34 months) 3-Des-2020**
- First mission extension end-2020
- **DR3 (EDR3 + new products): H1-2022**
- **Second mission extension end 2022**
- DR4 (66 months, nominal mission) TBD
- Third mission extension 2025 ?
- Final catalogue TBD

Gaia archive: a worldwide used facility



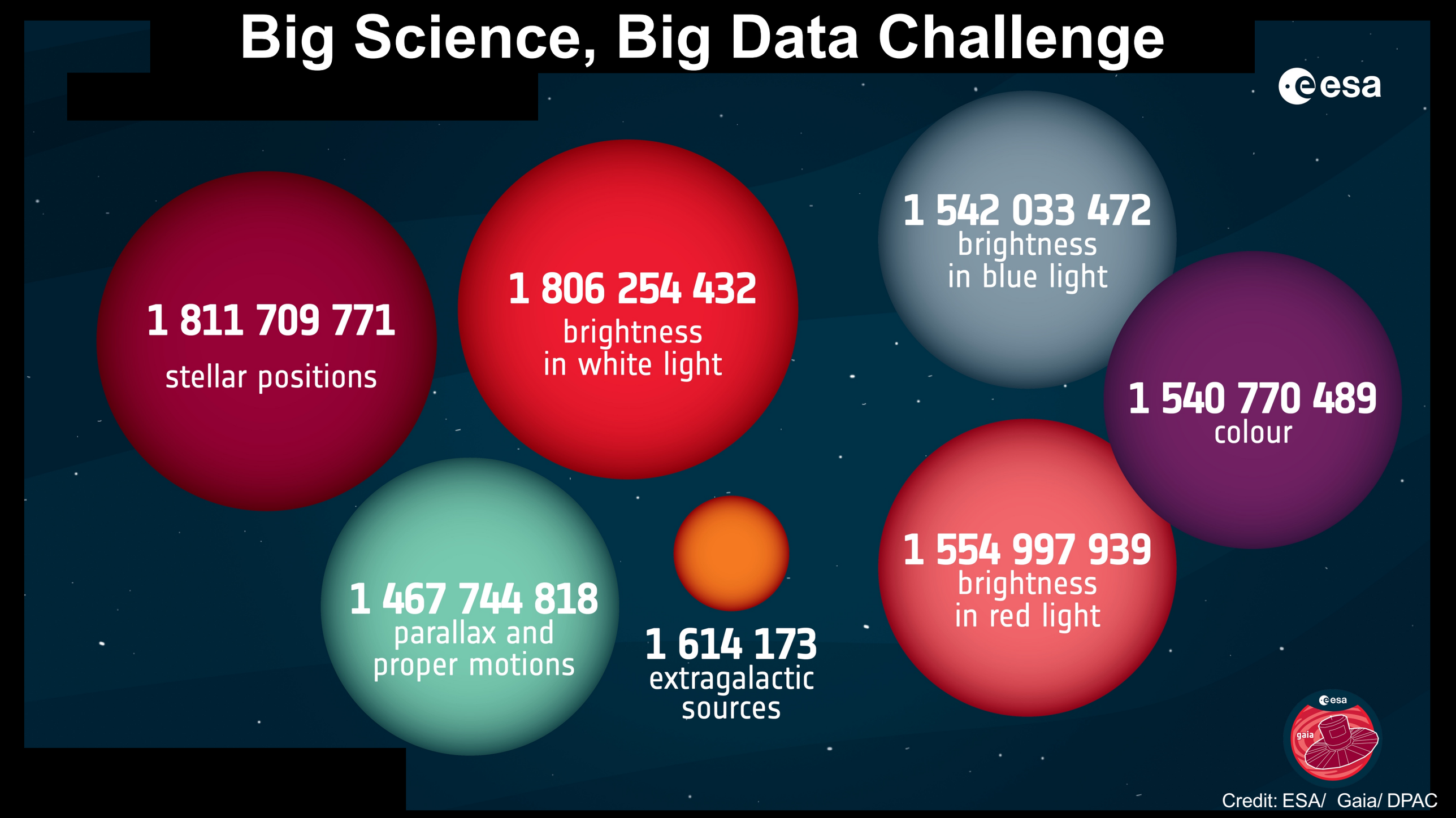


3 Des 2020

before 12:00 CET

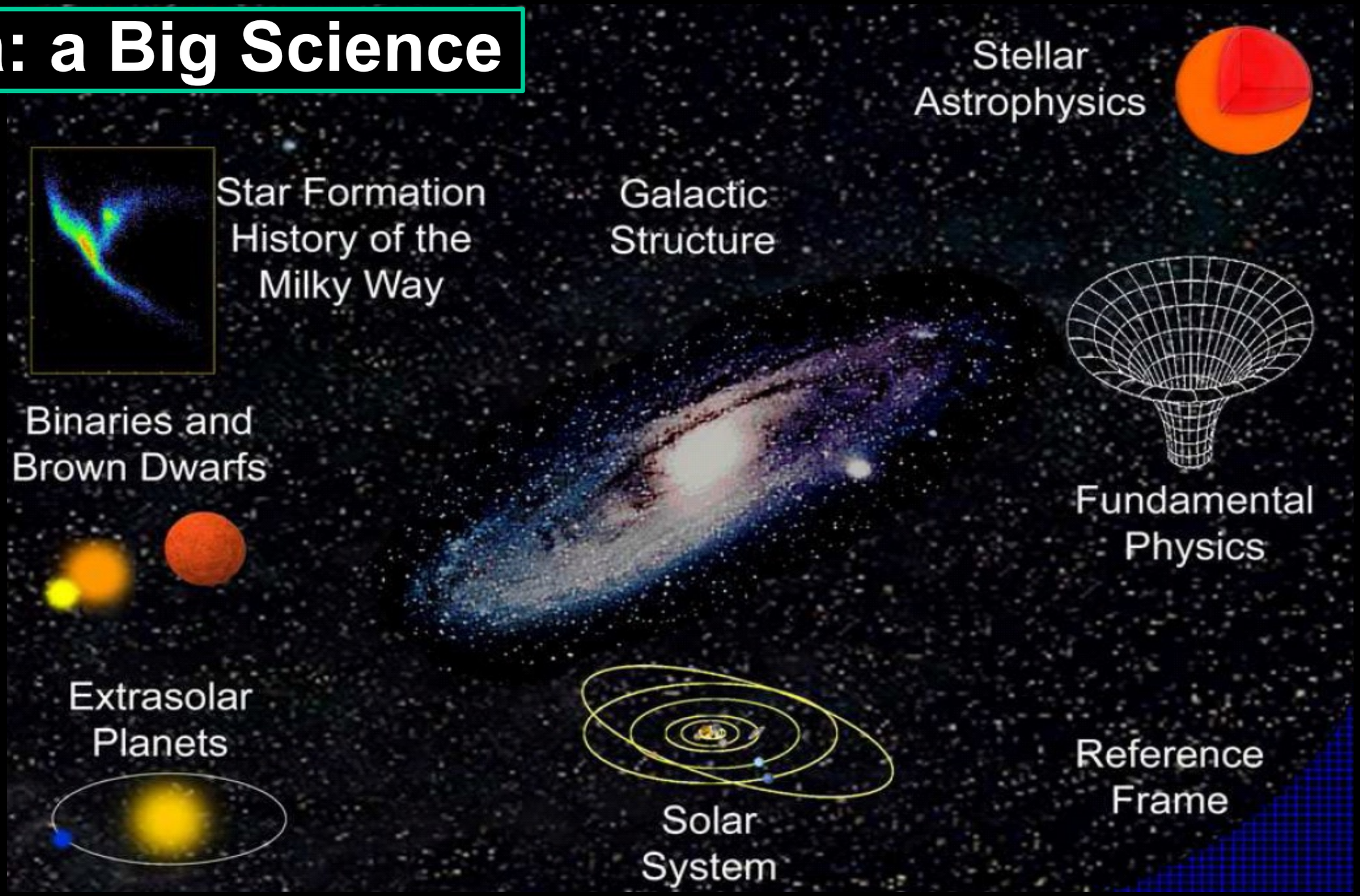
at 12:05 CET

Big Science, Big Data Challenge

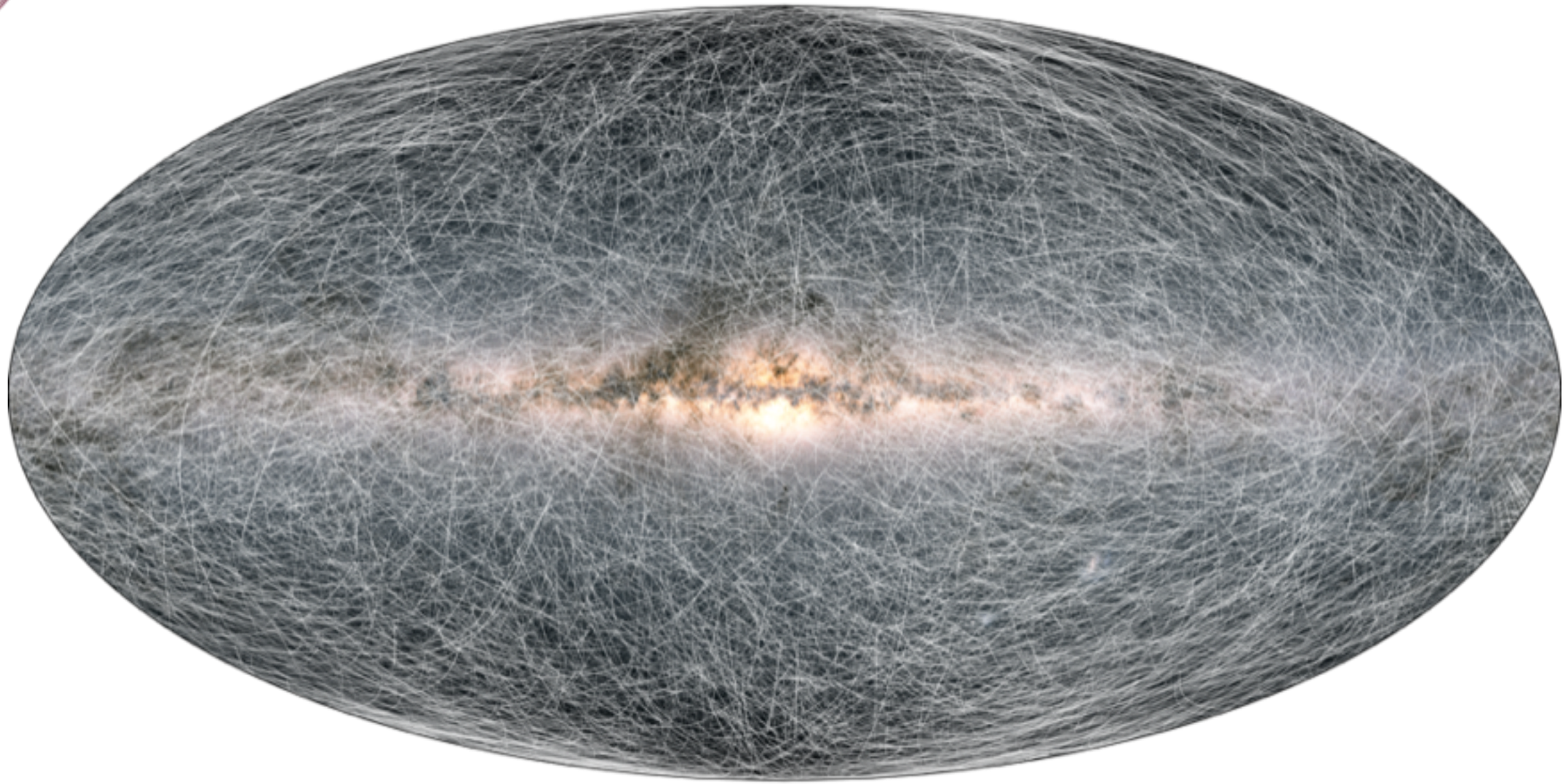


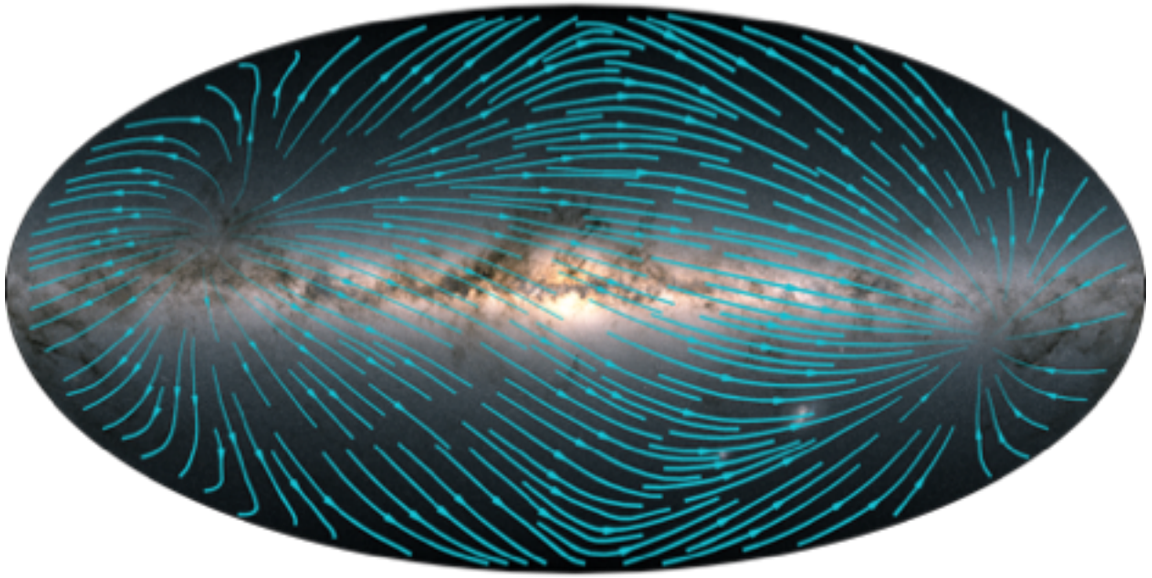
Credit: ESA/ Gaia/ DPAC

Gaia: a Big Science

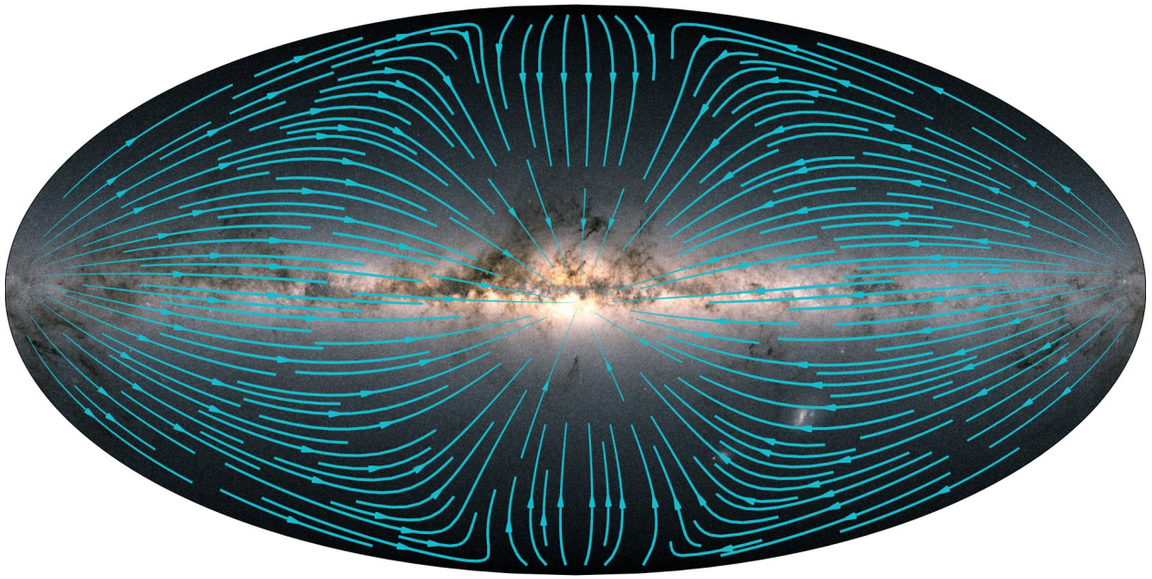


The displacement of stars on the sky 400,000 years into the future



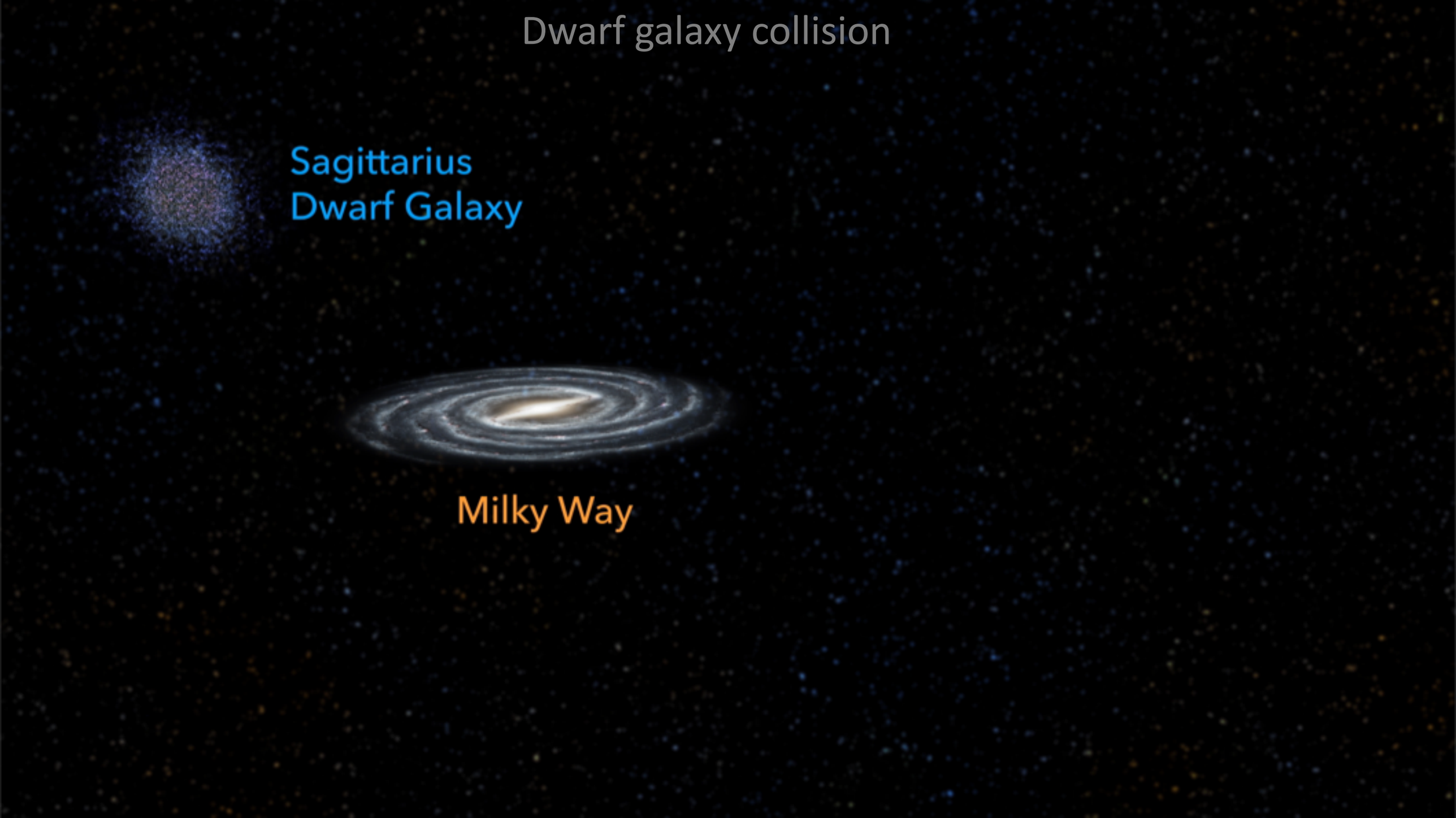


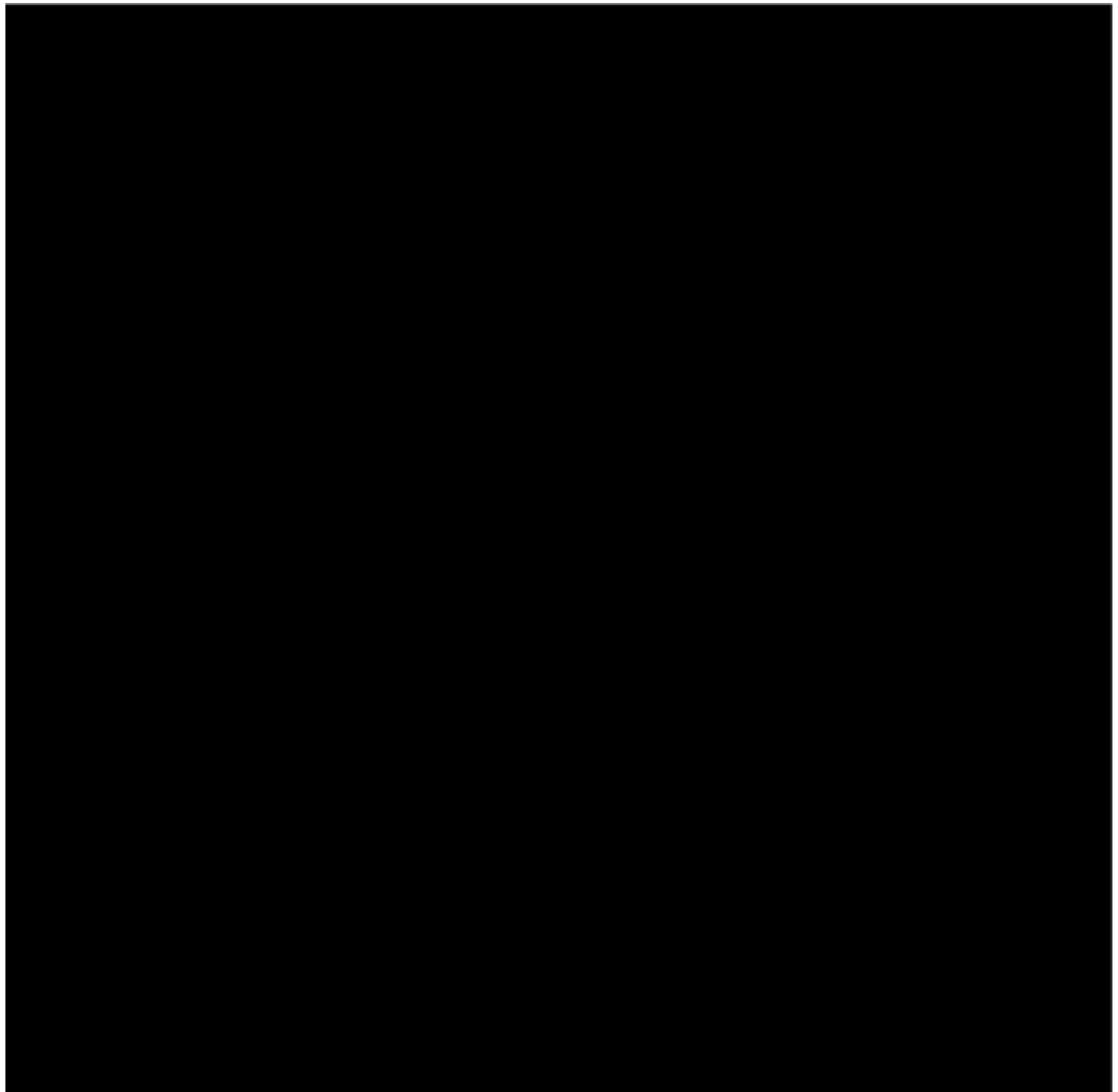
The average motion across the sky for stars located at 1000 parsecs from the Sun.



Apparent motion of distant quasars caused by the acceleration of the Sun.

Dwarf galaxy collision



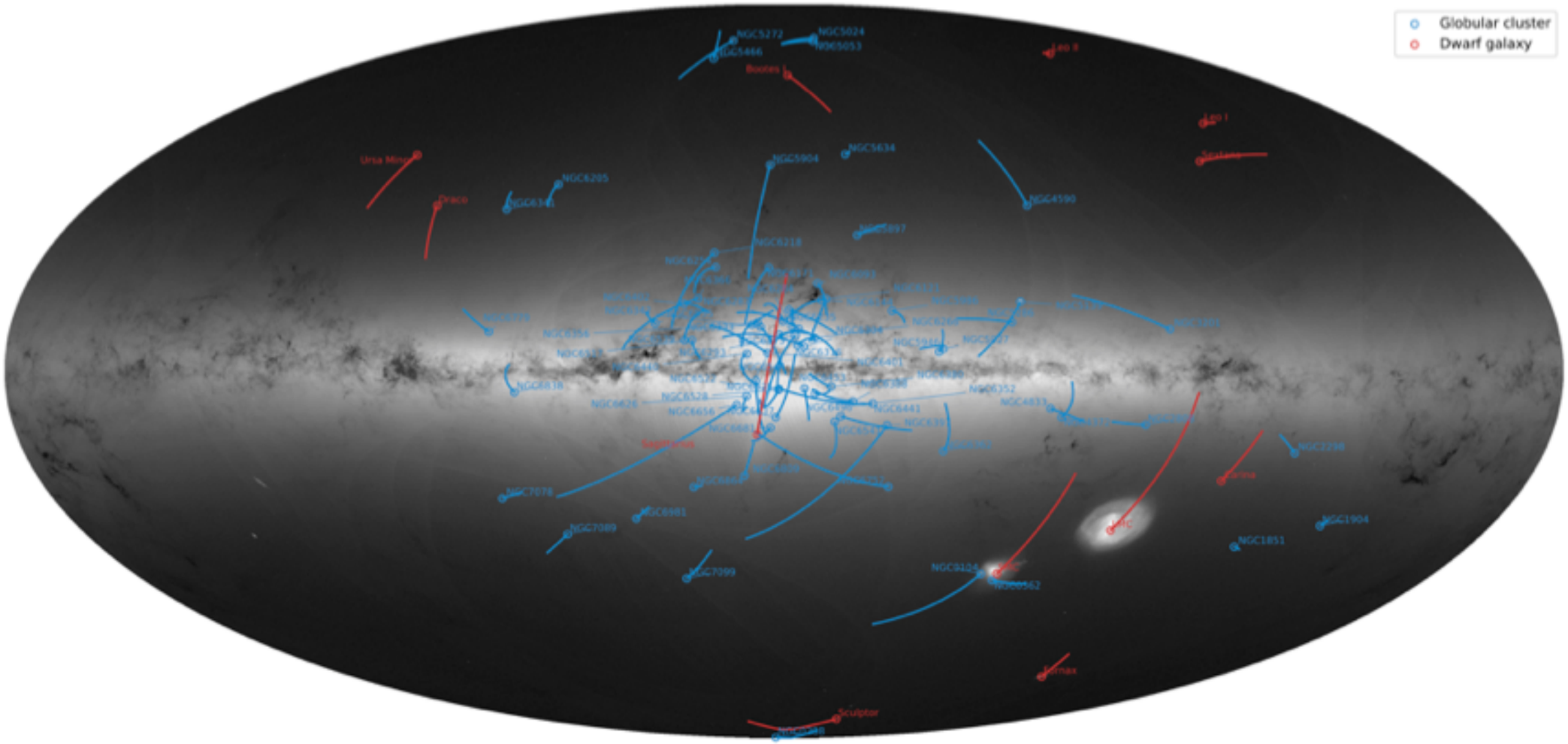


Archaeology

Reading the motion of the stars

Perturbation of orbits by collisions

Estimating the mass of the Galaxy

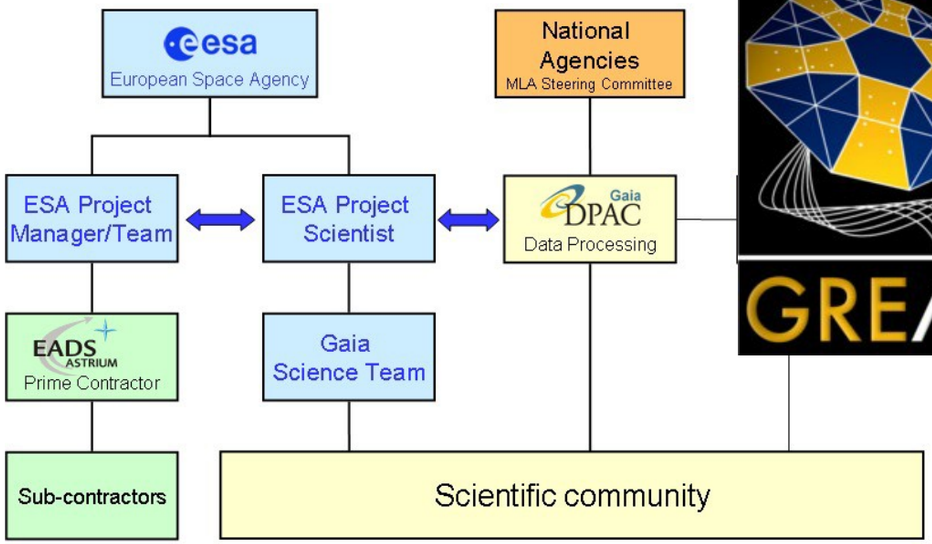


Gaia Research for European Astronomy Training

GREAT 2010-2015

See http://www.great-esf.eu

Some history:



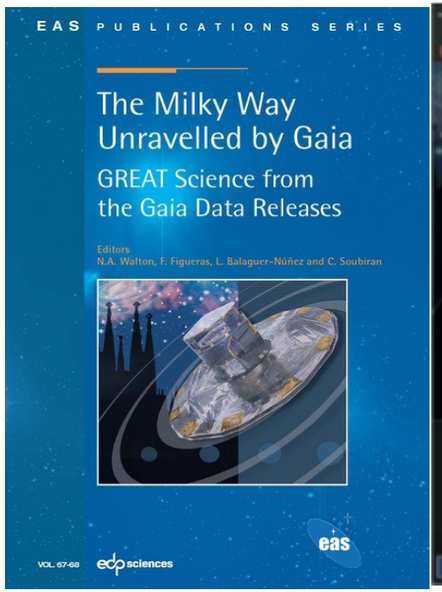
EUROPEAN SCIENCE FOUNDATION

Workshops & Exchanges

Student Training
17 ESR/PhDs

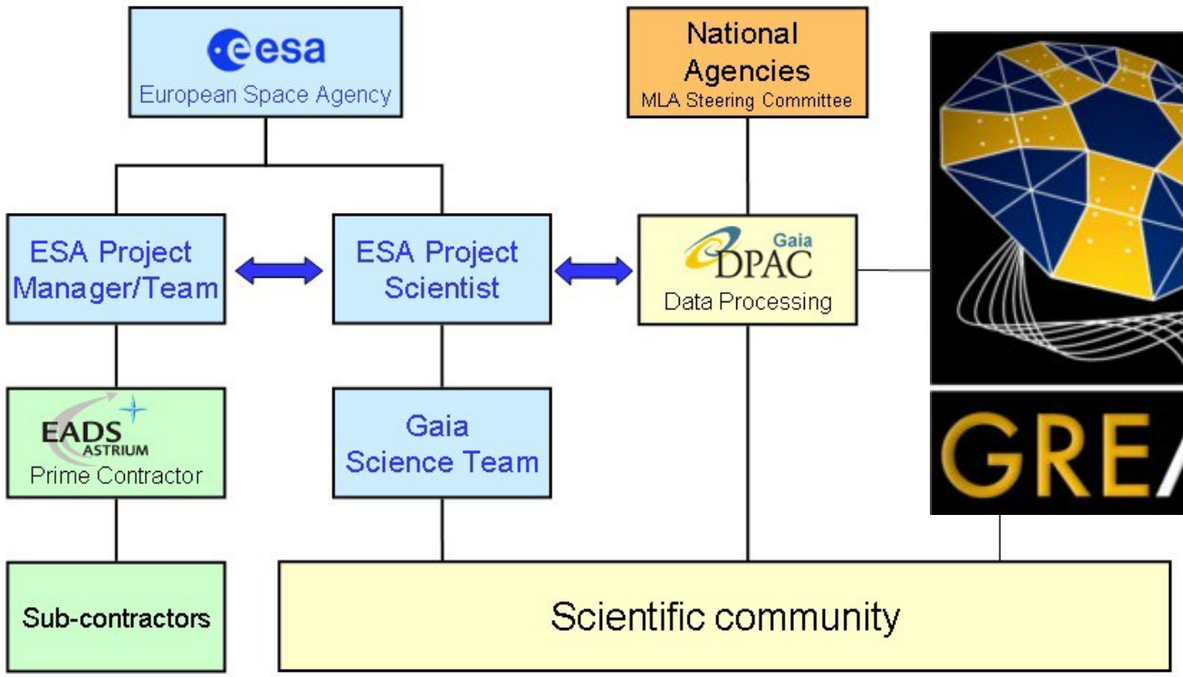
Outputs: science teams, science case for new instruments, case for new networks

over 2000 scientists attending ~60 events



GREAT 2019-2023

See http://www.mw-gaia.org and http://www.great-esf.eu



cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

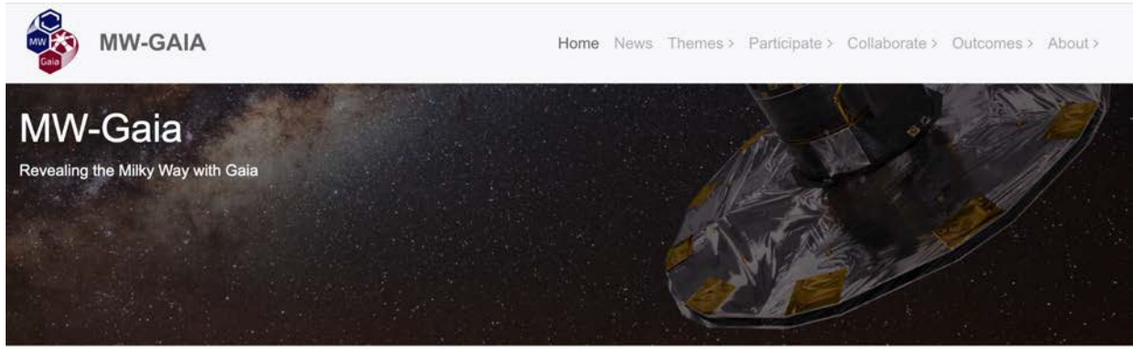
Workshops & Exchanges

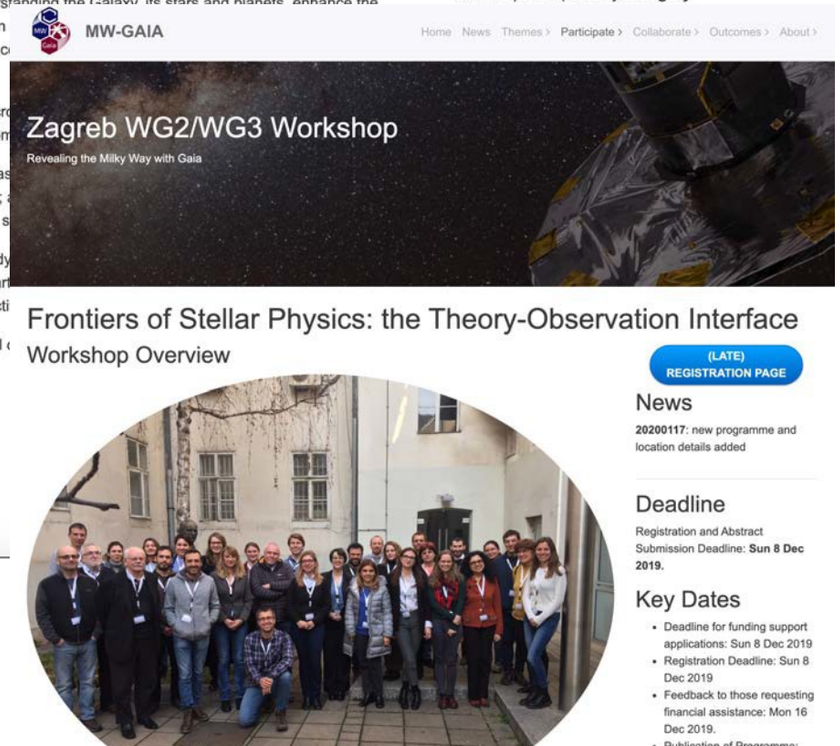
PhD training

Proposal 2021/2

MW-Gaia: http://www.mw-gaia.org

March 2019 to March (September?) 2023





- The MW-Gaia COST Action has participants from 29 (over 38) COST countries and participation from groups in Armenia, Canada, China, Lebanon, Russia, South Africa, Ukraine, USA

- Networks a significant proportion of the science community leading studies of the Milky Way including those responsible for ESA's Gaia mission

Benefit of the MW-Gaia COST Network

Lead not follow, raise profile of Gaia related science & technology

- Increased science visibility and exposure of Gaia key science
  - Build connections across all of Europe (including central and eastern)
- Opportunities for (especially early stage) researcher networking and 'raising awareness' of their science
  - Training that supplements 'traditional' national PhD research
- Development of further competitive proposals to enable research in key science areas
- Influence instrumentation projects deriving from network initiatives
- Support development of future major space missions (e.g. ESA voyage 2050 programme) → position industry participation in eventual build phase

MW:Gaia: Working Groups

MW-Gaia is organised into five working groups (WG):

- WG1: The Milky Way as a Galaxy:
- WG2: The Life and Death of Stars:
- WG3: Planetary Systems Near and Far:
- WG4: Gaia Fundamentals: Space and Time:
- WG5: Impact, Inclusiveness and Outreach:

Each WG has an organizer, with participants able to signup to the WG mailing list

Each WG is responsible for organizing workshops and training events in its topic area → **get involved, sign up to the mailing lists**

MW:Gaia: Working Group Leads

(contact details via the [www] click through)

Action Chair: Nicholas Walton (Cambridge: UK) [www]
Action vice-Chair: Carme Jordi (Barcelona: ES) [www]
WG1 Lead: Despina Hatzidimitriou (Athens: GR) [www]
WG2 Lead: Gisella Clementini (Bologna: IT) [www]
WG3 Lead: Joris De Ridder (Leuven: BE) [www]
WG4 Lead: Sonia Anton (Aveiro: PT) [www]
WG5 Lead: Šarūnas Mikolaitis (Vilnius: LT) [www]
Exchange Visit (STSM) Coordinator: Karri Muinonen (Helsinki: FI) [www]
Country Inclusion Coordinator (TA): Ivanka Stateva (Sofia: BG) [www]
Science Communications (SCM): Anthony Brown (Leiden: NL) [www]
Inclusion and Training (ITM): Corinne Charbonnel (Geneva: CH) [www]

MW-Gaia: WG5
Impact, Inclusiveness and Outreach

Objective: Develop and implement the Action Research Coordination Framework plans, Training Plan, Impact and Inclusion Plan, Outreach and Dissemination Plan. Organise interaction with industry, with schools. Deliver the final Action deliverables and closing conference.

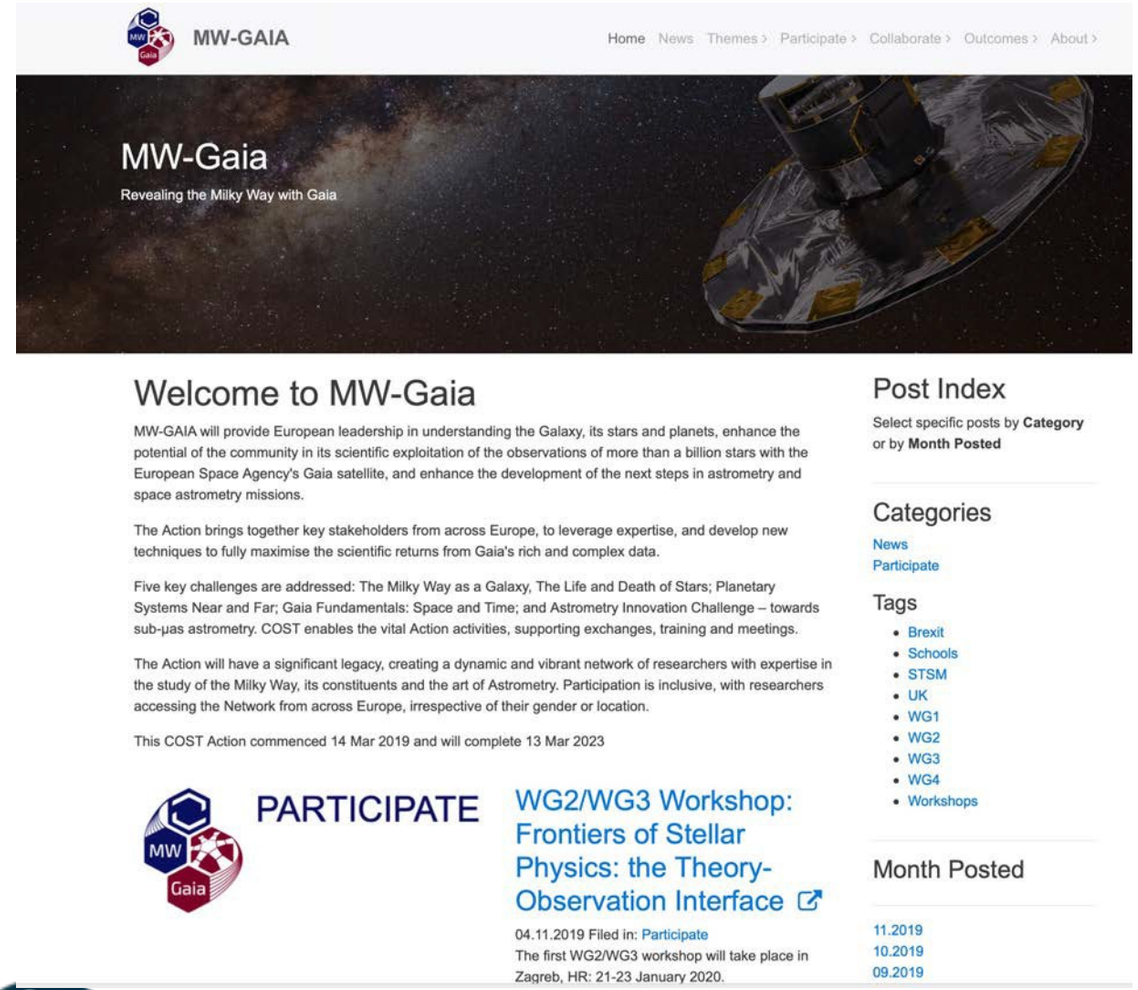
Tasks: **WGT5a:** Deliver Action Impact, primarily through the generation of a science roadmap/case for sub-μas astrometry in delivering the next advances in our understanding of the MW (under the leadership of the Action Core Group)

WGT5b: Ensure the effective implementation of inclusiveness policies (e.g. location, gender, age) and the Action Inclusion and Impact plan.

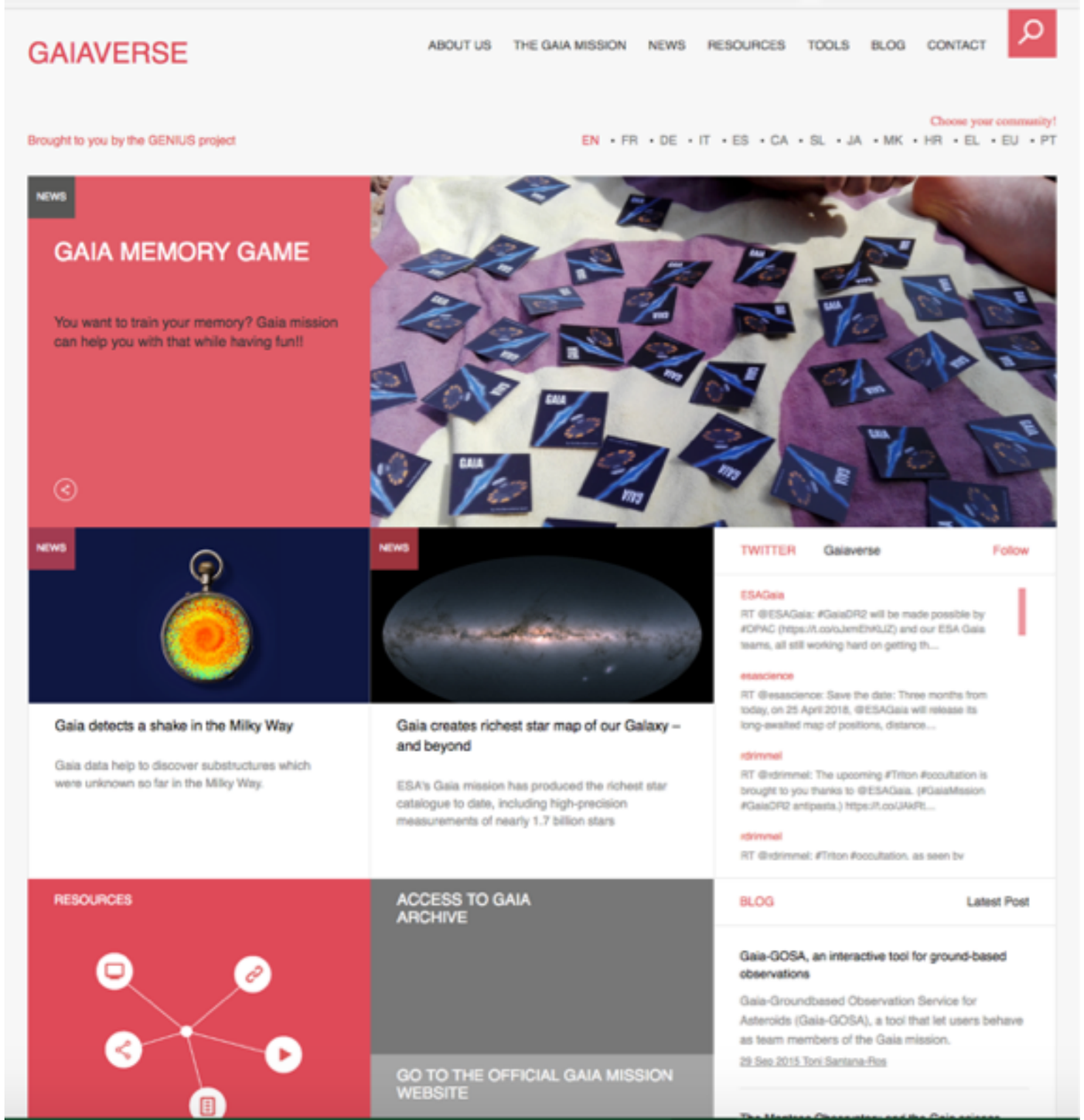
WG5Tc: Coordination of the Action outreach and dissemination activities.

WGT5d: Training for the next generation of astrometry experts, with a priority focus on including ECIs from ITCs in training activities.

MW-Gaia: http://www.mw-gaia.org



- The MW-Gaia COST Action now well underway (in spite of covid-19)
- Check the website for details of network activities
- Workshops, schools
- Open calls for exchange visits, grant for conferences



https://gaiaverse.eu/

Contents of Gaia DR3

Data Product	No. of sources	Comments
Astrometry	1.8 billion	Same as Gaia EDR3
G/BP/RP photometry	1.8 billion	Same as Gaia EDR3
Radial velocities	~30 million	$G_{RVS} \lesssim 14$
Photometric variability: classification, characterization, light curves	7+ million	Includes eclipsing, (MS) pulsating, transients, spotted, flaring, evolved pulsators, and quasars
Source Classification and astrophysical parameters	$\gtrsim$ 300 million	based on the BP/RP/RVS spectra, magnitude limit TBD
Mean BP/RP/RVS spectra	TBD subset	

Contents of Gaia DR3

Data Product	No. of sources	Comments
Solar system objects epoch astrometry/photometry	≳100,000	including orbit solutions
Solar system objects mean BP/RP reflectance spectra	~5000	
Catalogue of astrometric, spectroscopic, eclipsing non-single stars	TBD	Combined solutions where possible
QSO host and galaxy morphological characterization	TBD	Based on input list
G/BP/RP photometry light curves for all sources in 5.5^{o} radius field centred on M31	~1.1 million	Includes variable and non-variable sources

Contents of Gaia DR3

Astrometric non-single star solution types

- acceleration, 7 and 9 parameters
- orbital solutions, 12 parameters
- stochastic solutions
  - single star source model or basic binary star model does not fit
- NOTE: no epoch astrometry or epoch radial velocities will be released as part of Gaia DR3

Astrophysical parameters based on BP/RP/RVS spectra

- T_{eff}, $\log g$, A_G, $E(G_{BP} - G_{RP})$, metallicity, abundances, distances, radii, masses, activity index
  - solutions from multiple algorithms will be provided
  - rotational velocity for bright subset of stars (TBC)
- Extinction map
- Source classification (star, binary, galaxy, . . .)

Mean BP/RP/RVS spectra

- For subset of sources only
- Tool to handle BP/RP spectra will be provided

Solar system objects

- Orbits
- Reflectance spectra

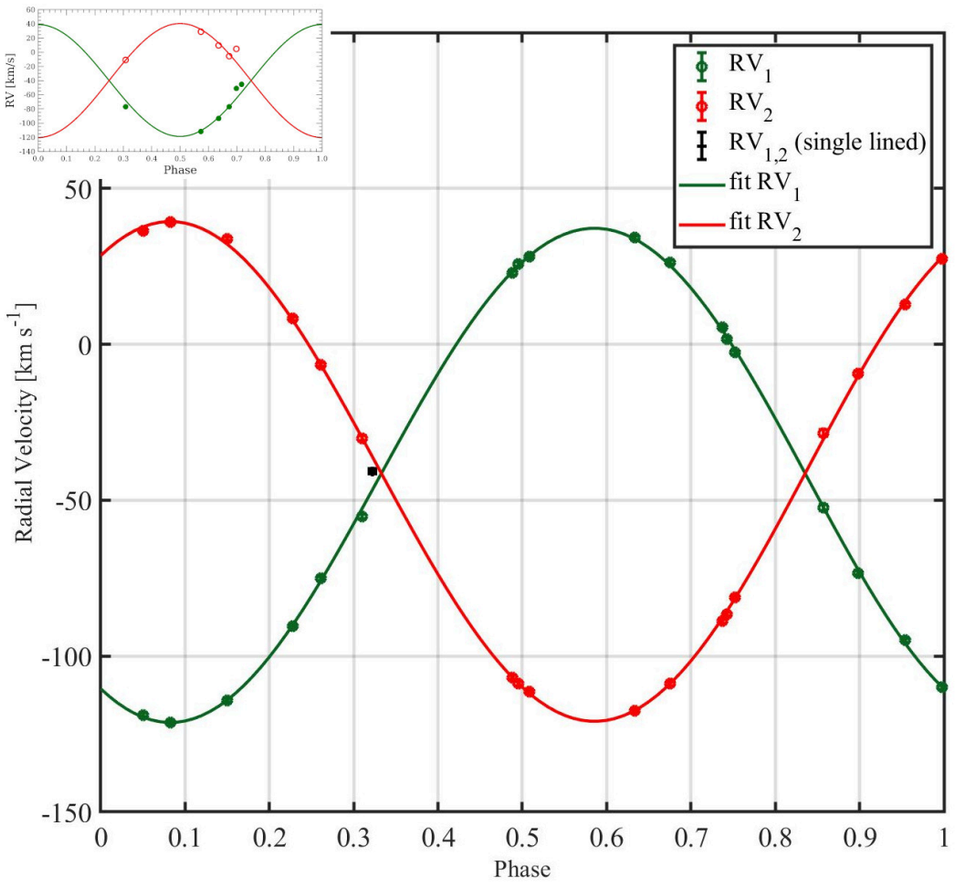
QSO hosts and galaxies

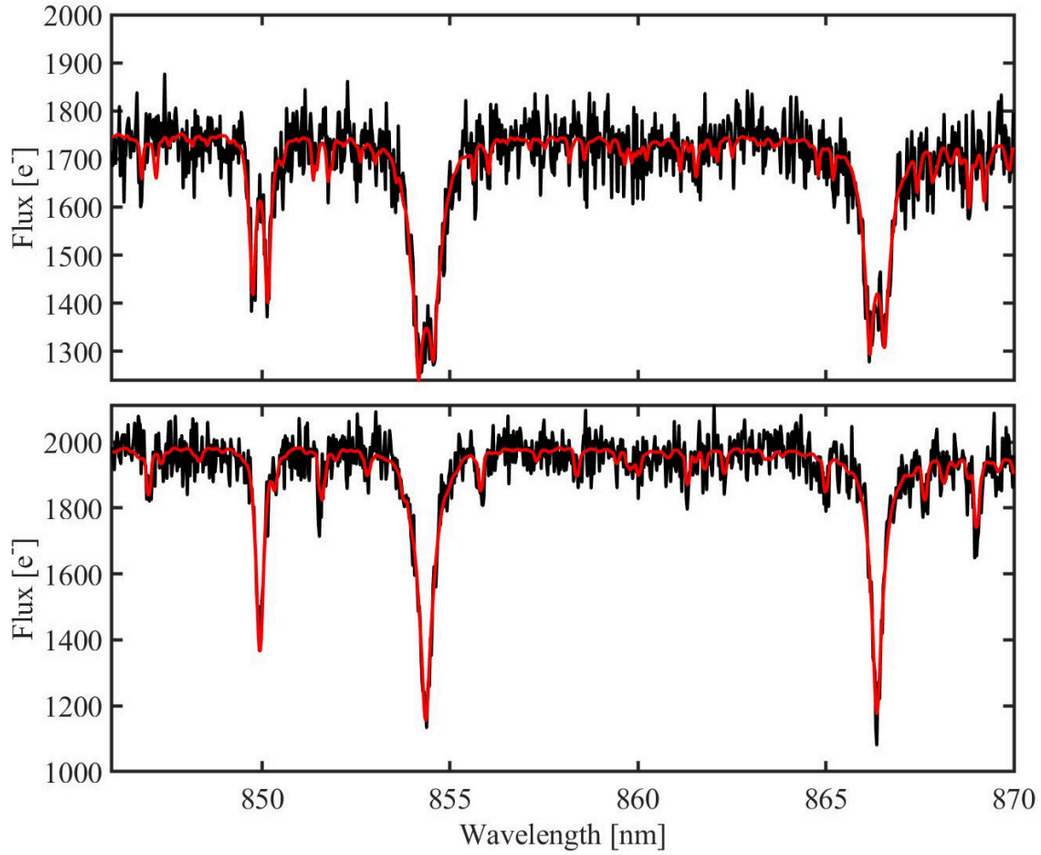
- Morphological characterization

Light curves for field around M31

- Preview of Gaia DR4 epoch photometry

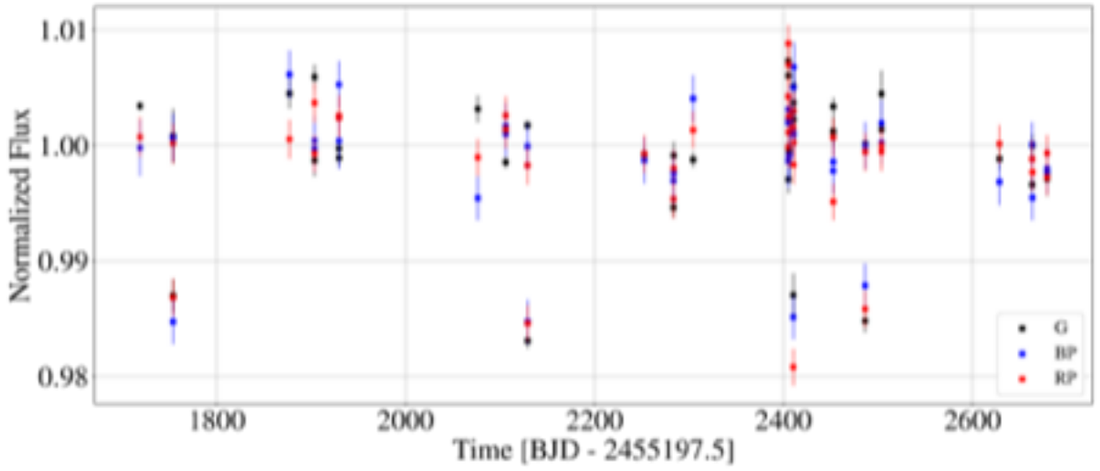
Double lined spectroscopic binary

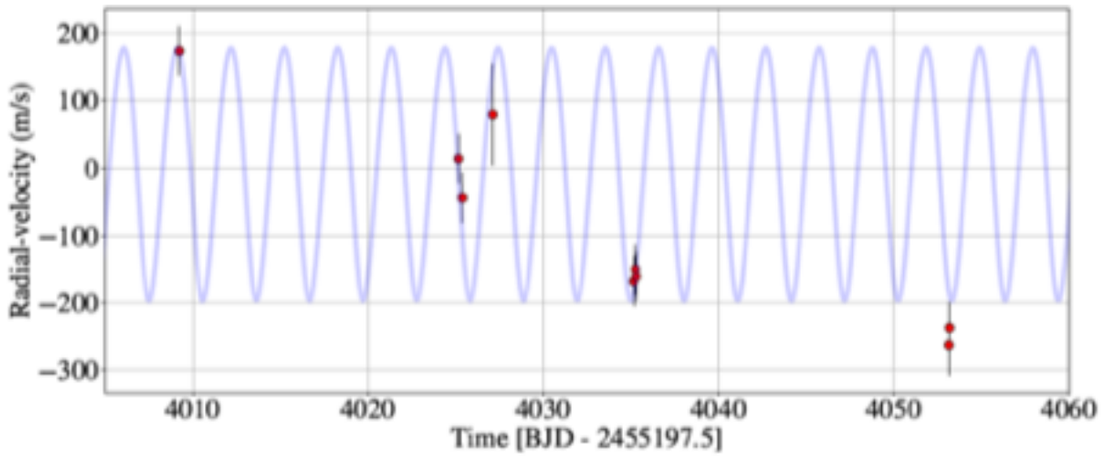


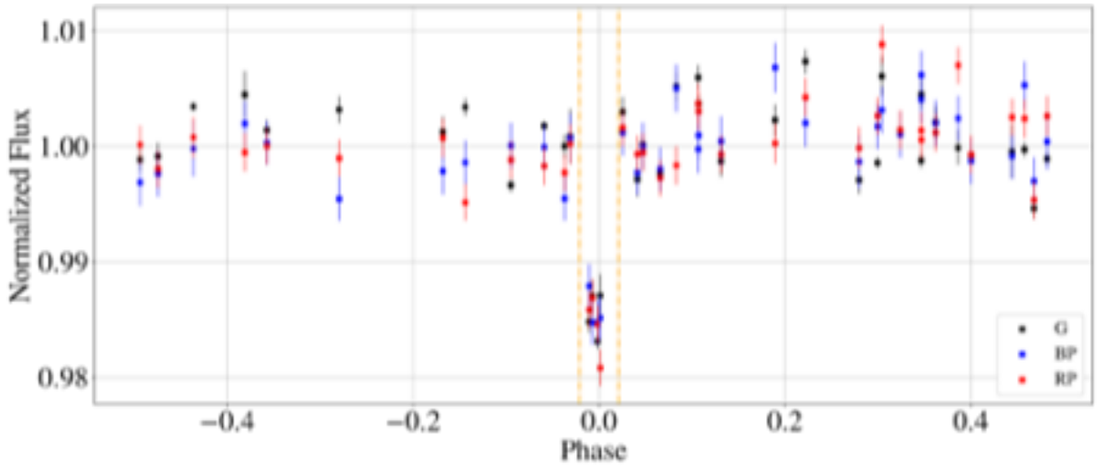


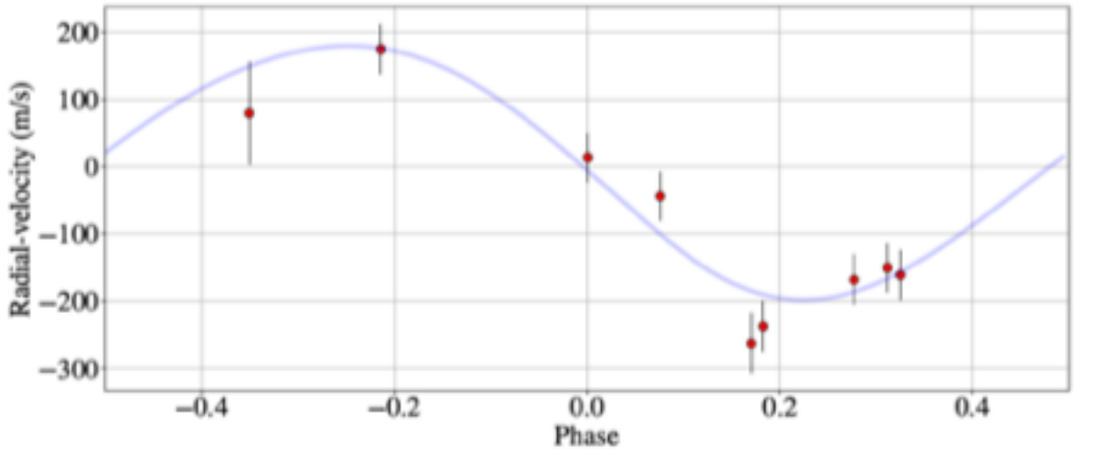
https://www.cosmos.esa.int/web/gaia/iow_20210427

First Transiting Exoplanet by Gaia



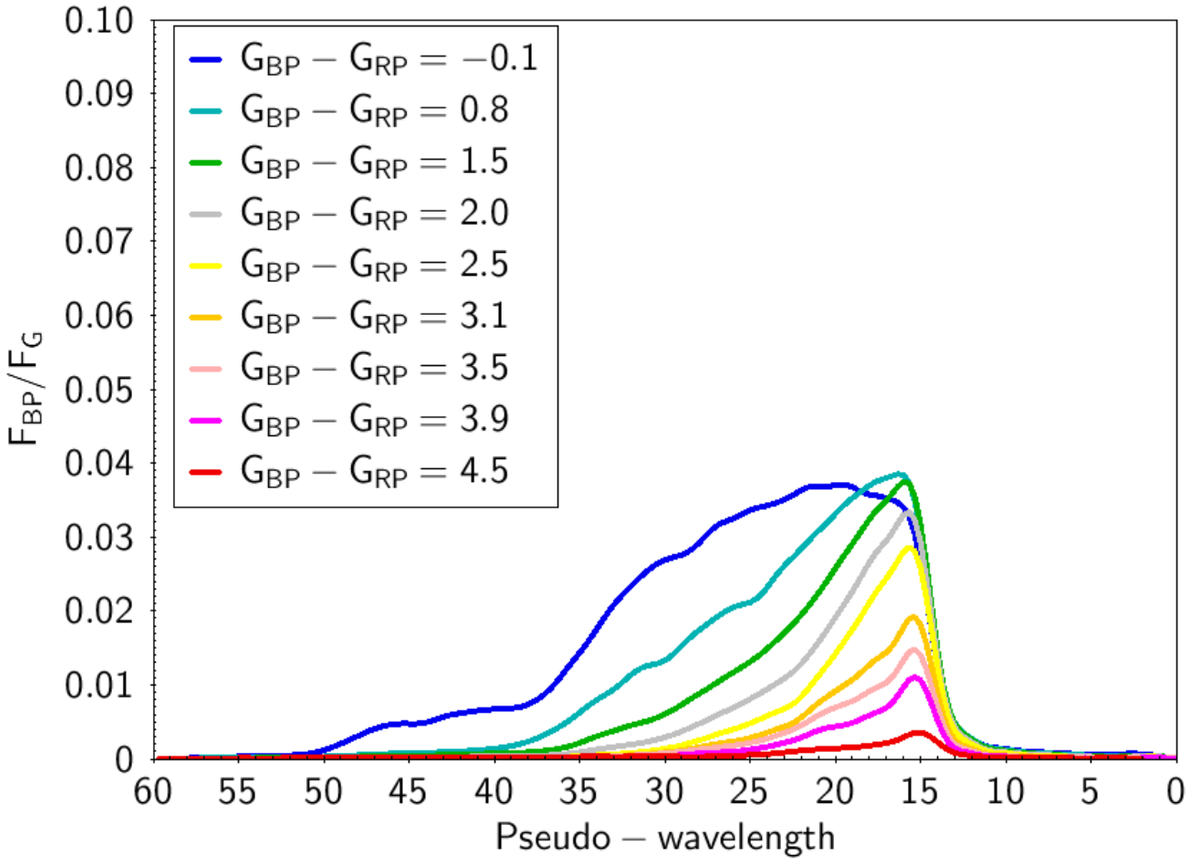


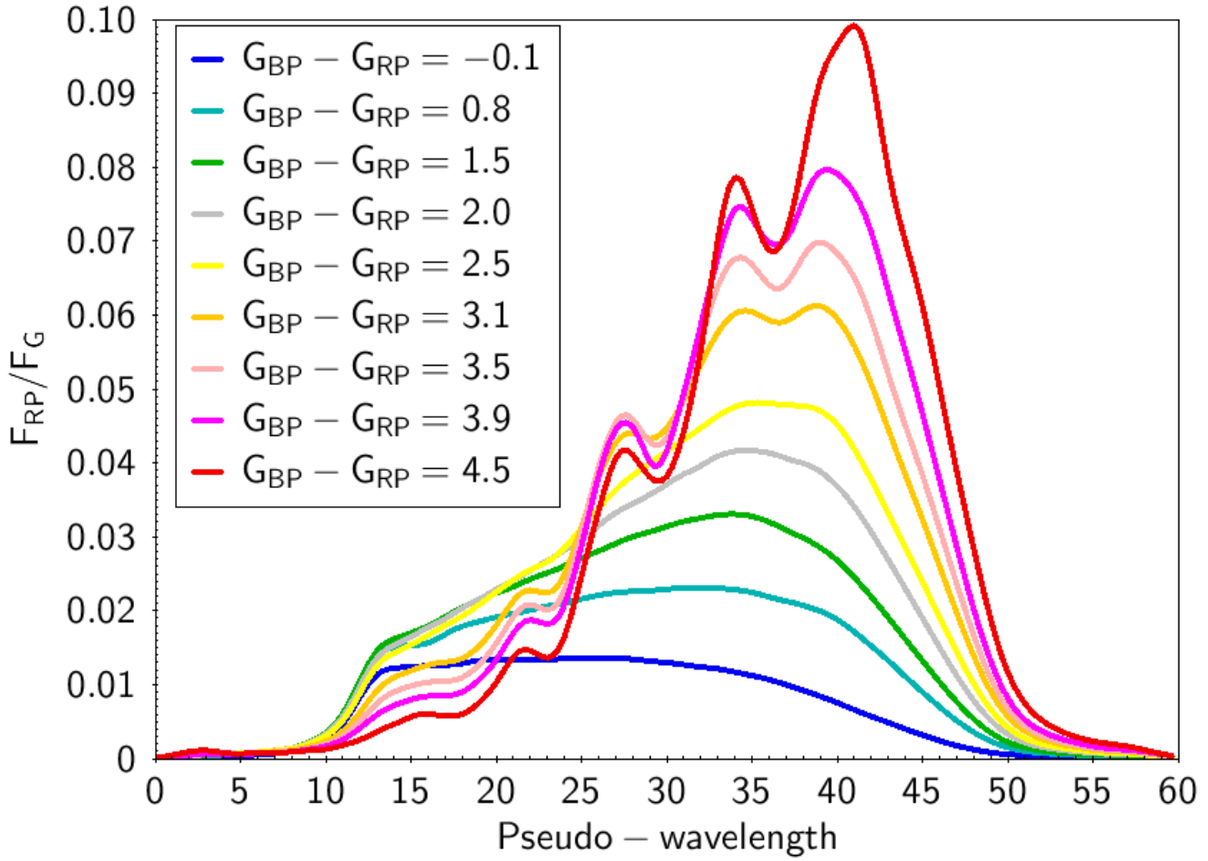




https://www.cosmos.esa.int/web/gaia/iow_20210330

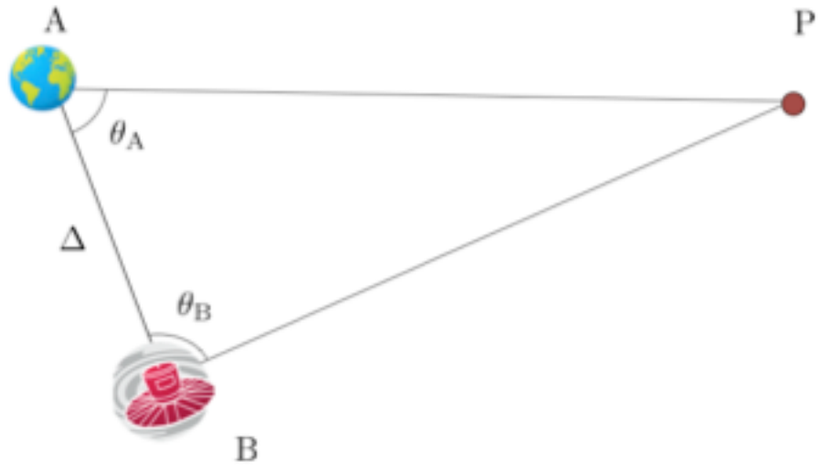
First calibrated XP spectra



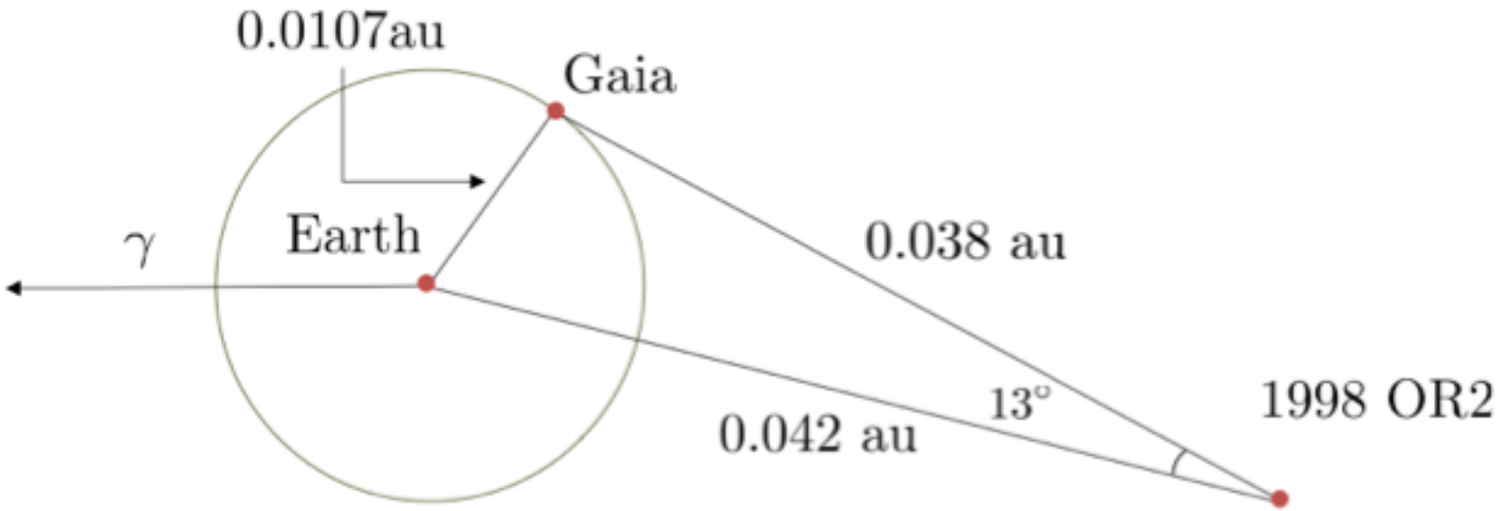


https://www.cosmos.esa.int/web/gaia/iow_20200812

Gaia and the size of the Solar system

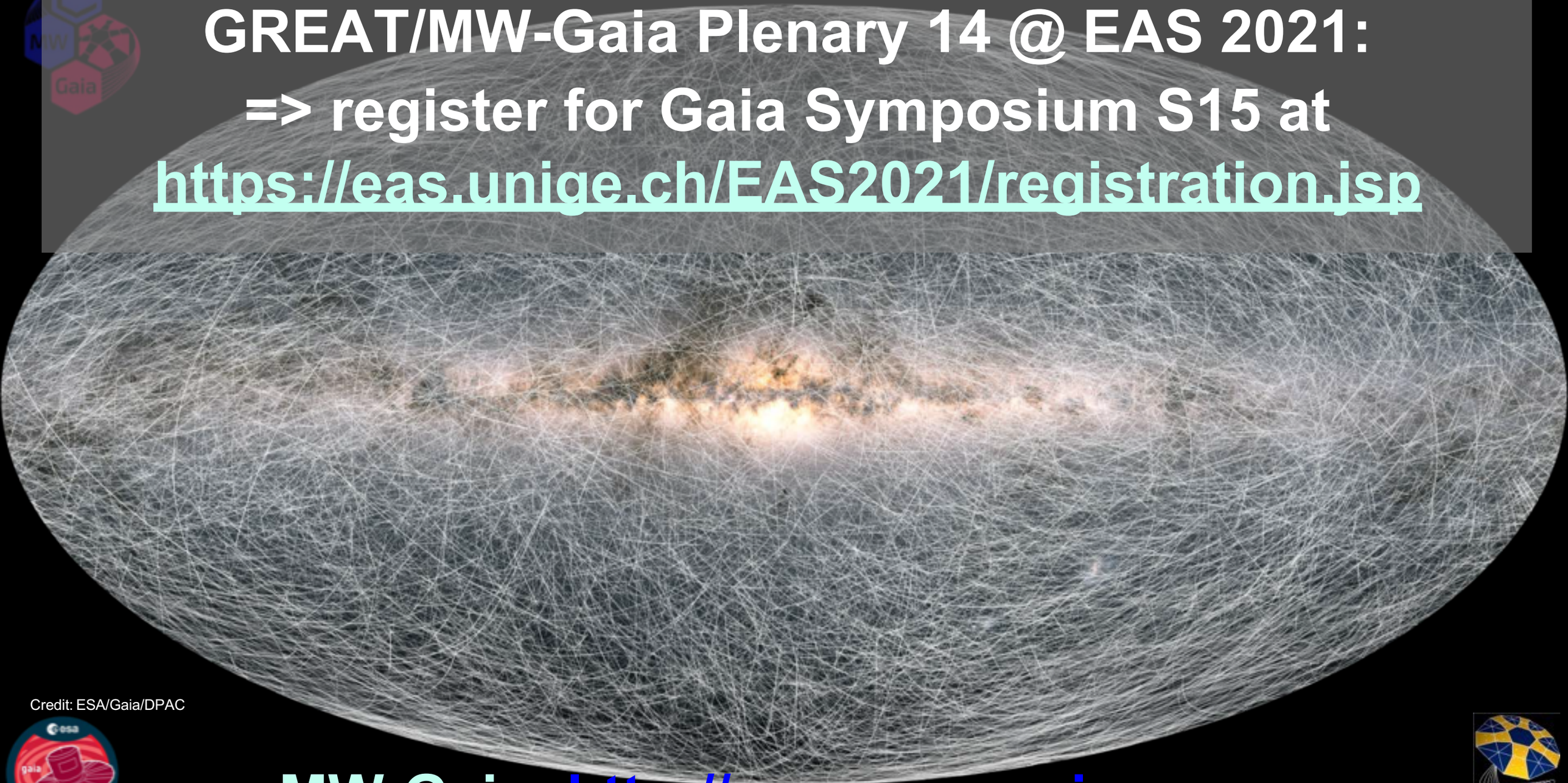


Geometric configuration during the Gaia observation of 1998 OR2 on 28 April 2020



The Solar Parallax with Gaia / GAIA-C4-TN-OCA-FM-061

GREAT/MW-Gaia Plenary 14 @ EAS 2021:
=> register for Gaia Symposium S15 at
https://eas.unige.ch/EAS2021/registration.jsp



Credit: ESA/Gaia/DPAC

MW-Gaia: http://www.mw-gaia.org