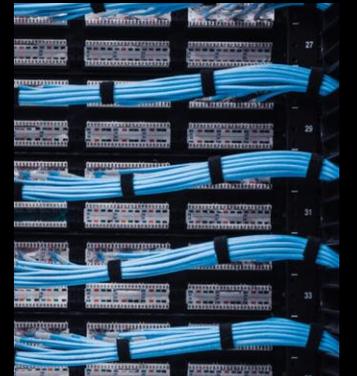


GAIA: Unraveling the Mysteries of the Milky Way



Eduardo Anglada

Sales Engineer



ESA's fleet: from Deep space to Earth Observation

→ ESA'S FLEET IN THE SOLAR SYSTEM

The Solar System is a natural laboratory that allows scientists to explore the nature of the Sun, the planets and their moons, as well as comets and asteroids. ESA's missions have transformed our view of Mars, Venus, Titan and comets, and provided new insight into how the Sun interacts with Earth and its neighbours. The Solar System is the result of 4.6 billion years of formation and evolution. Studying how it appears now allows us to unlock the mysteries of its past and to predict how the various bodies will change in the future.

www.esa.int

European Space Agency

→ ESA'S FLEET ACROSS THE SPECTRUM

Thanks to cutting edge technology, astronomy is unveiling a new world around us. With ESA's fleet of spacecraft, we can witness the full spectrum of light and probe the fundamental physics that underly our entire Universe. From cool and dusty star formation revealed only at infrared wavelengths, to hot and violent high-energy phenomena, ESA missions are charting our cosmos and even looking back to the dawn of time to discover more about our place in space.

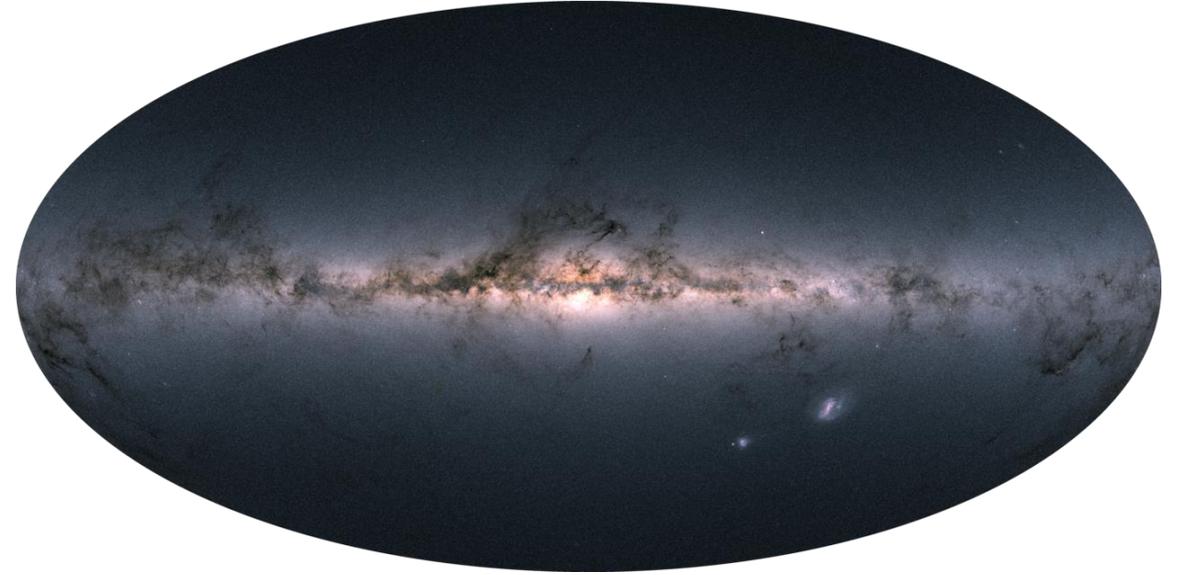
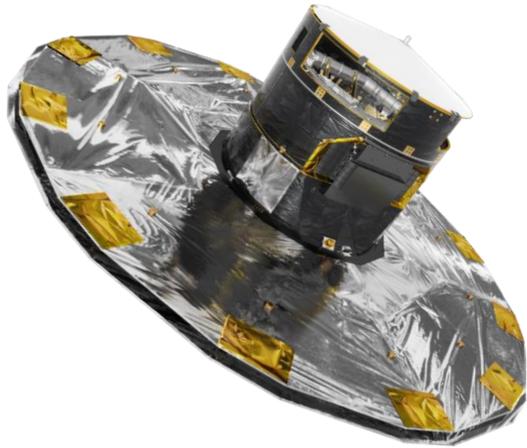
www.esa.int

European Space Agency



GAIA

Main goal is to make the largest, most precise three-dimensional map of our Galaxy, the Milky Way, by surveying an unprecedented 1.6 billion stars.



Gaia: ESA's Billion Star Surveyor

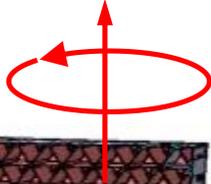
- Launch 19 December 2013
- All-sky survey operating for 7 years
- 106 CCD of $4500 \times 1966 = \sim 1$ Giga-pixel
- Astrometry + Photometry + Spectroscopy
- Gaia DR1: 16 September 2016
- Gaia DR2: 25 April 2018
- Gaia eDR3: 3 December 2020 from 1.6B to 1.8B



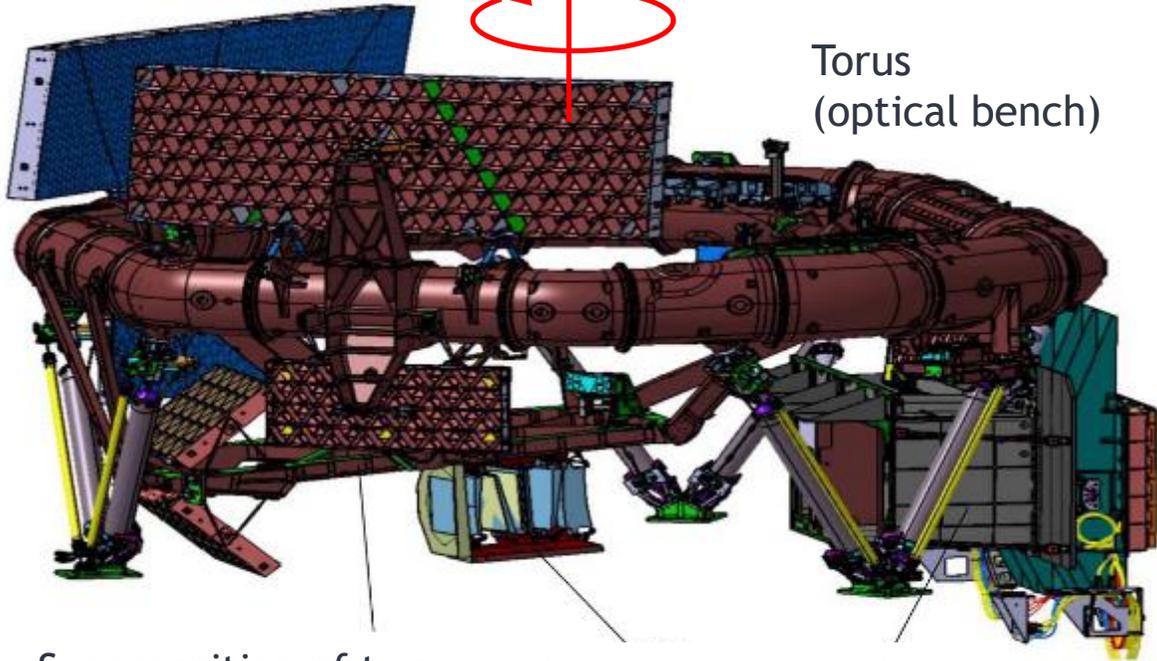
Telescope

Two primary mirrors
 $1.45 \times 0.50 \text{ m}^2$

Rotation axis (6h)



Torus
(optical bench)

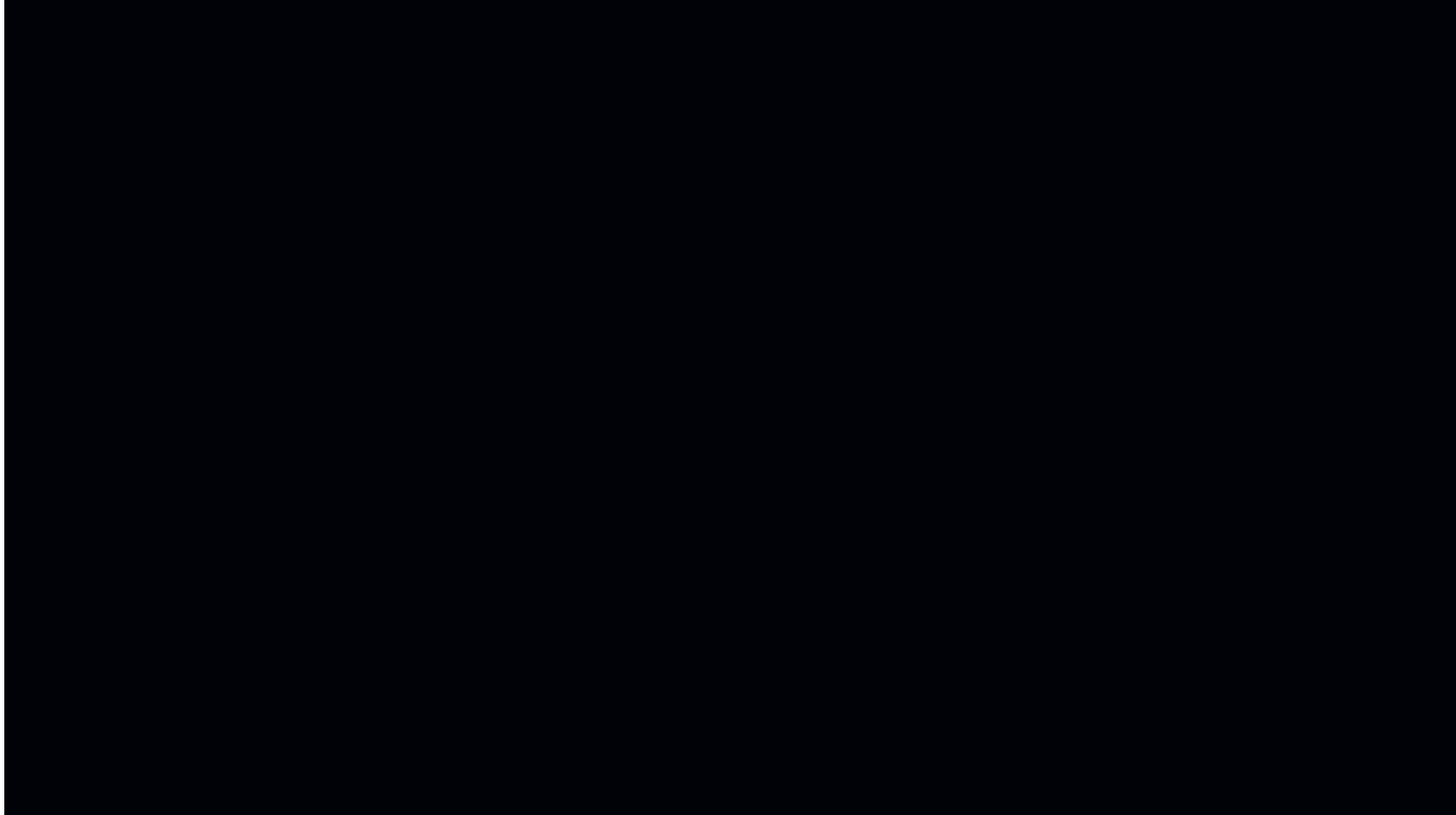


Superposition of two
Fields of View (FoV)

Spectrometer (RVS)



From launch to orbit

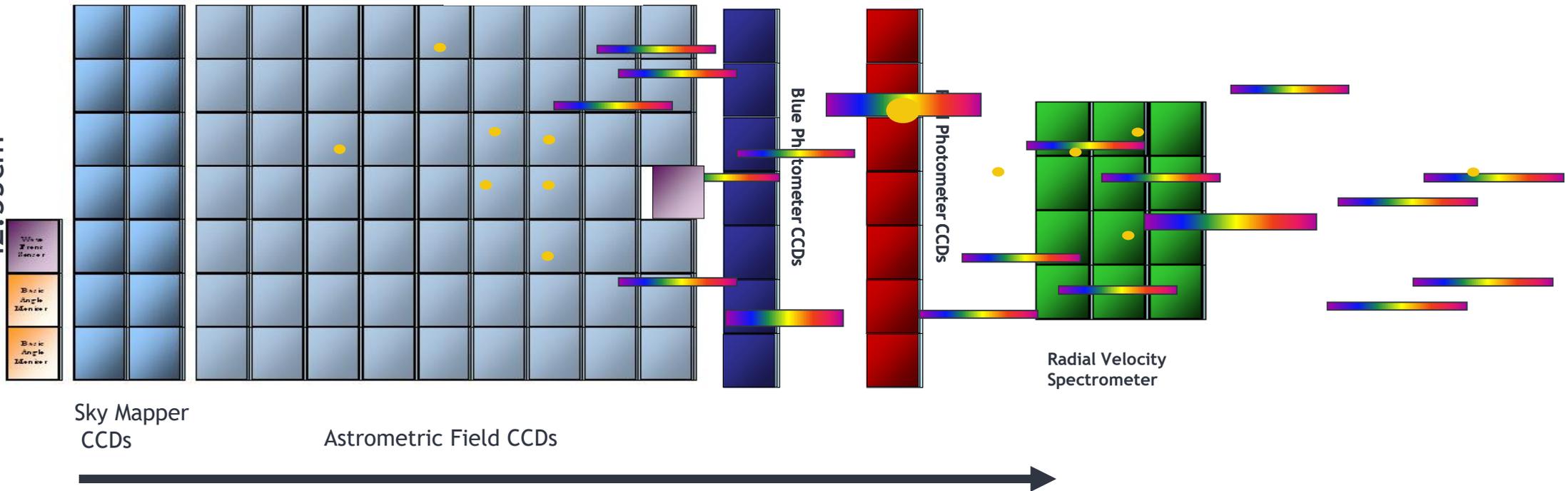


One GigaPixel Focal Plane

106 CCDs , 938 million pixels, 2800 cm²

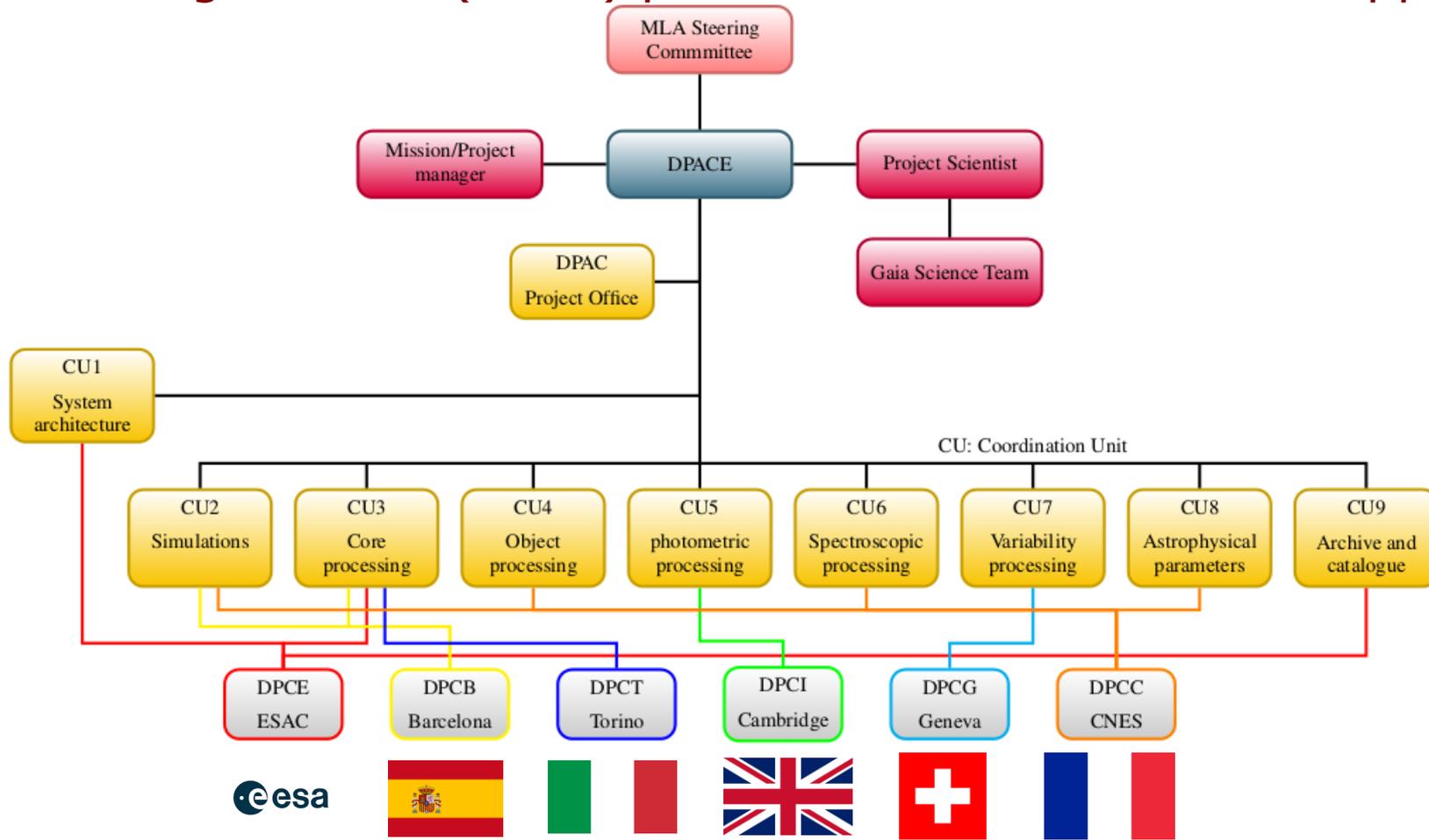
104.26cm

42.35cm



DPAC – Processing Consortium

- Coordination Units (CUs) develop the scientific algorithms
- Data Processing Centres (DPCs) provide infrastructure and support to run them

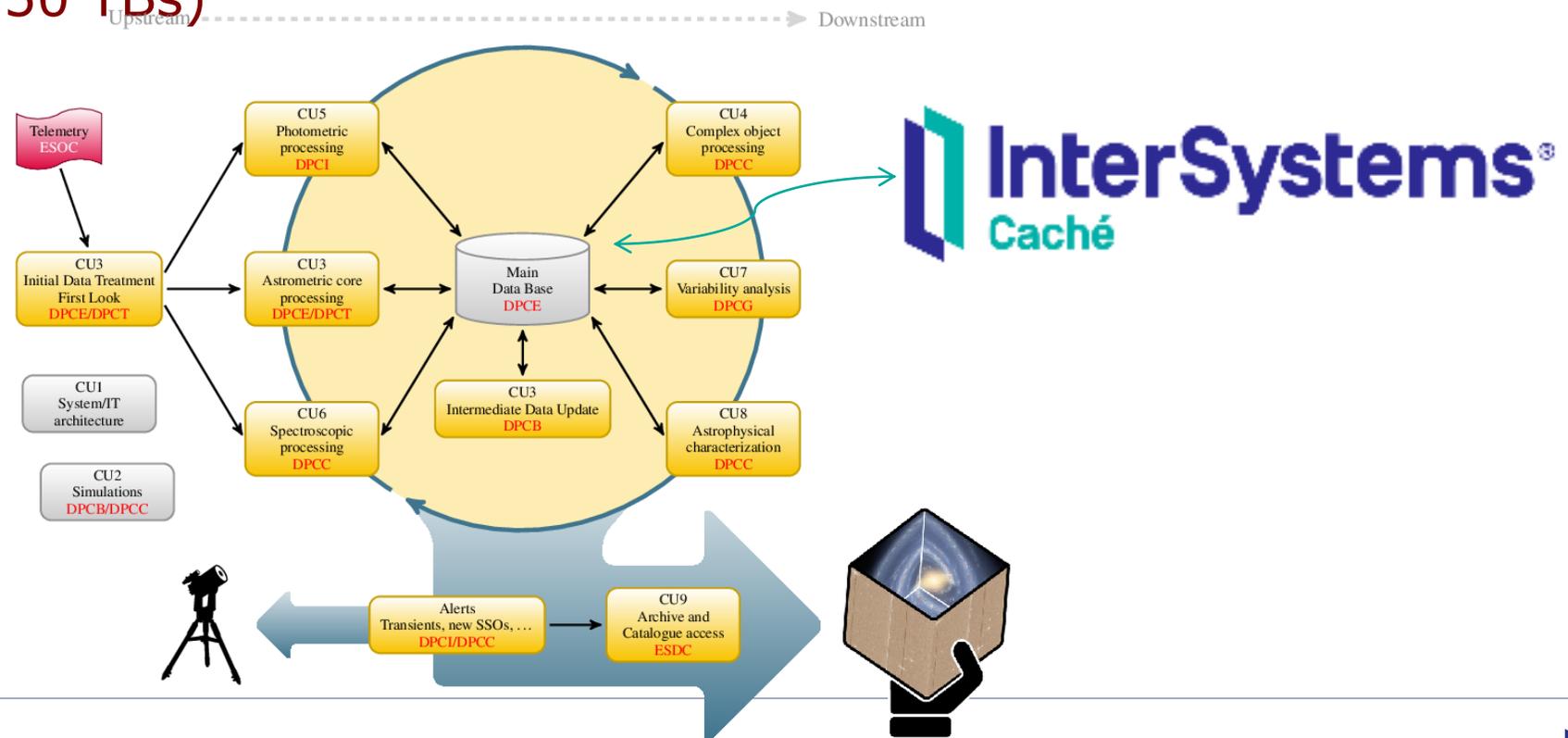


~ 400 scientists



Data Processing: DPAC consortium

- Operations
 - Daily Operations
 - Cyclic Operations
- Main Database (~750 TBs)
- Hub and spokes:



DPCE Daily Processing

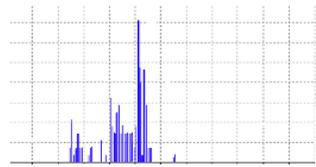


TM + HK ~ 45-110 GB daily



70M transits/day

- MIT:** Unpackage and decompress TM
- IDT:** Basic image parameters determination
- IDT:** CrossMatch
- FL:** Health monitoring
- FL:** Calibrations



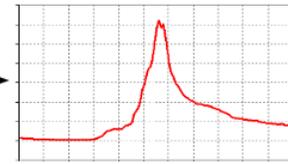
Input
TM files

Ops.
Pipeline

Output



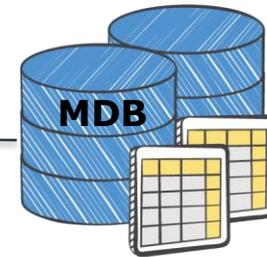
Gbin files



~ 300-500GB



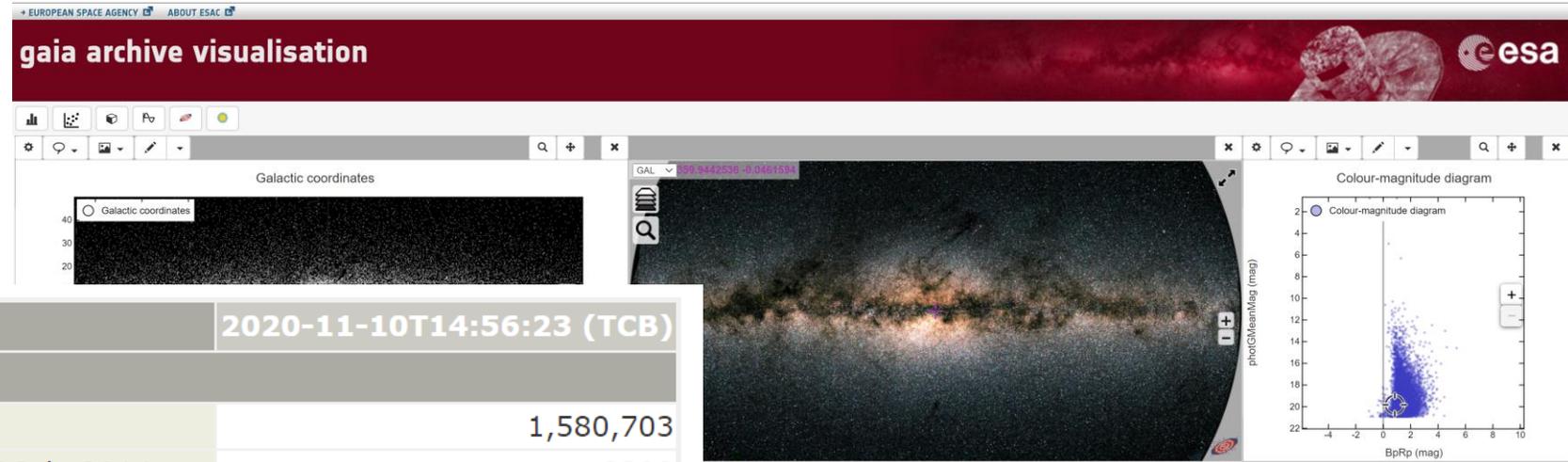
1 Gb/s



Gaia Data Releases

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

- Gaia DR1 Sep 2016
- Gaia DR2 Apr 2018
- Gaia eDR3 Dec 2020



CURRENT DATE AND TIME	2020-11-10T14:56:23 (TCB)
MISSION STATUS	
Satellite distance from Earth (in km)	1,580,703
Number of days having passed since 25 July 2014	2300
Number of days in mission extension	483
OPERATIONS DATA (collected since 2014/07/25)	
Volume of science data collected (in GB)	85,337
Number of object transits through the focal plane	162,090,745,287
Number of astrometric CCD measurements	1,597,751,632,110
Number of photometric CCD measurements	322,415,139,956
Number of spectroscopic CCD measurements	31,464,293,775
Number of object transits through the RVS instrument	10,545,488,120



Gaia DR2 in numbers



<https://sci.esa.int/web/gaia>



We are here

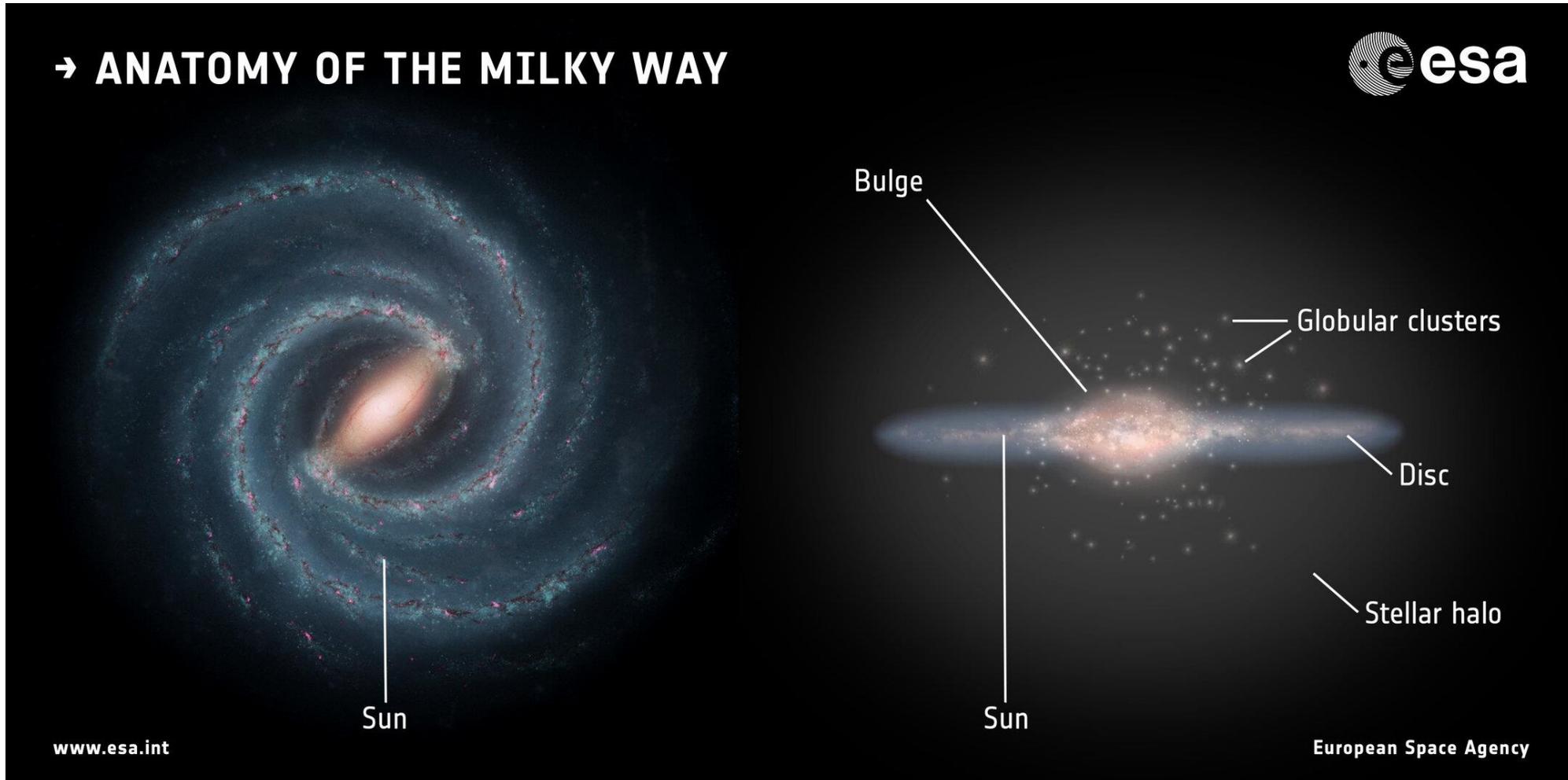


Gaia DR1

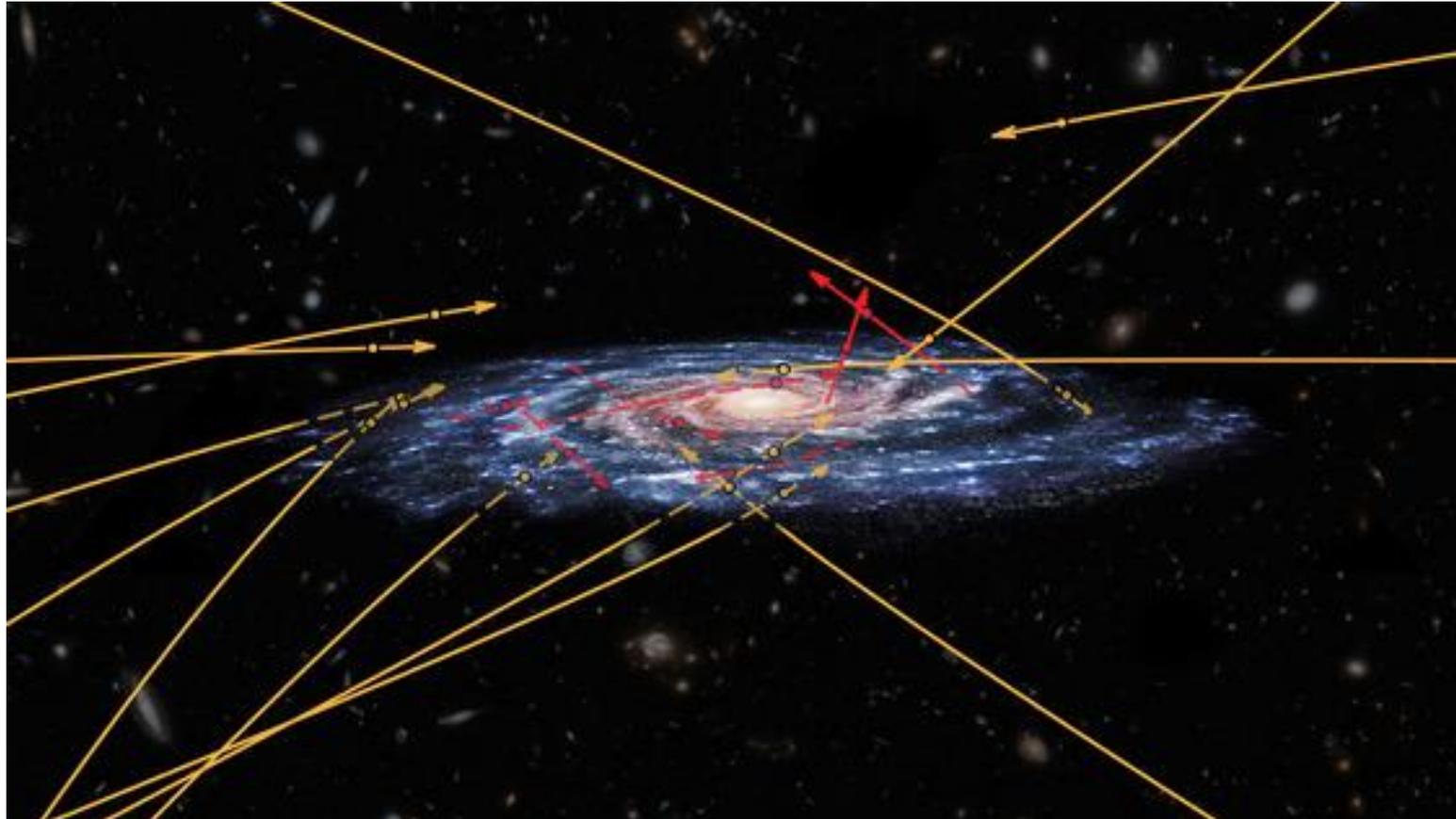


Gaia DR2

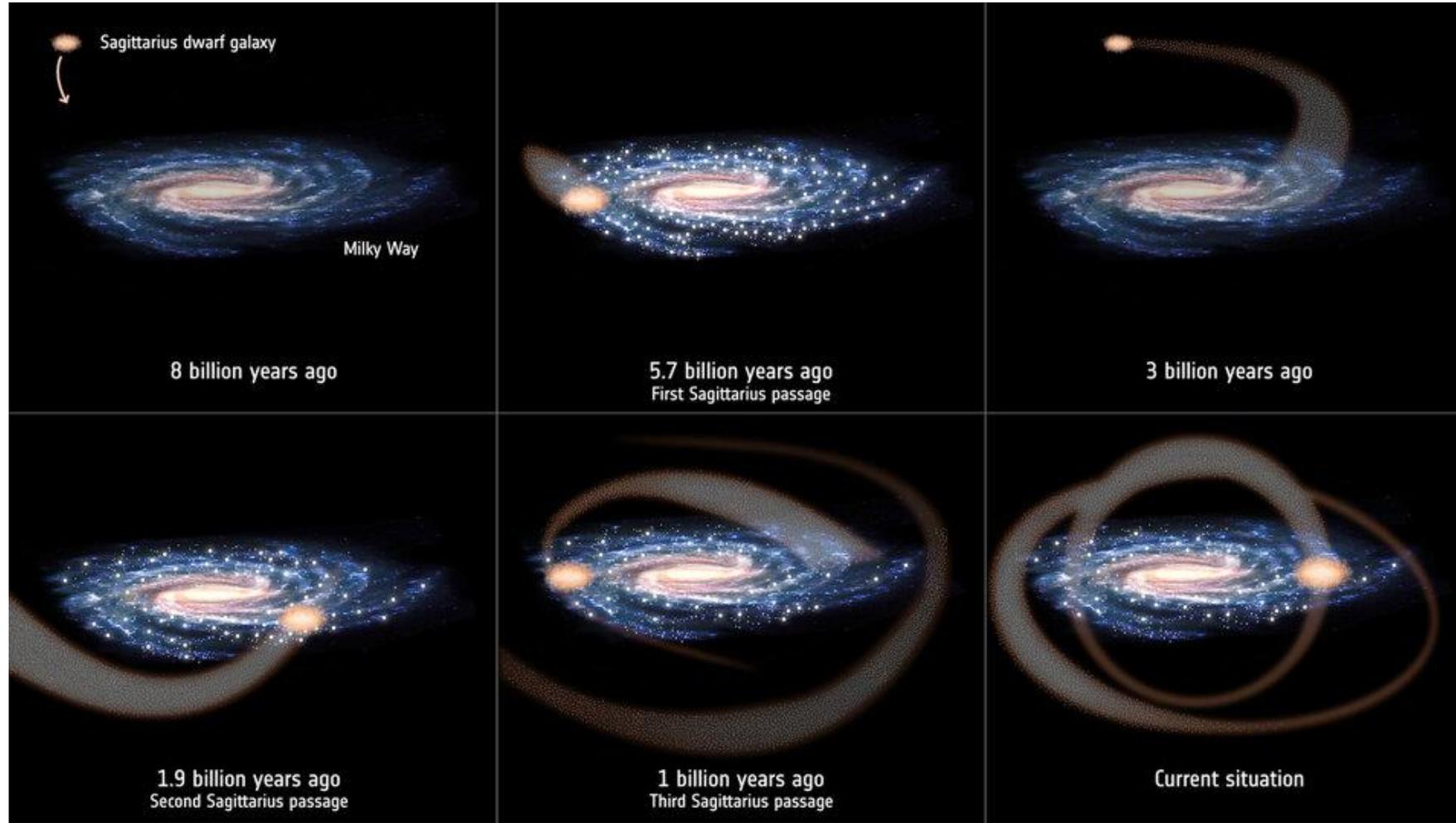
Anatomy of the Milky Way



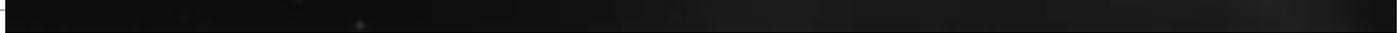
Star Motion: stars flying between galaxies!



Sagittarius flyby: star formation!



“Home” of the first interstellar comet detected: Oumuamua



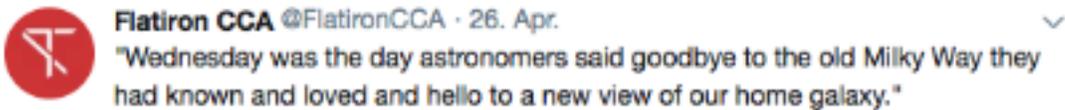
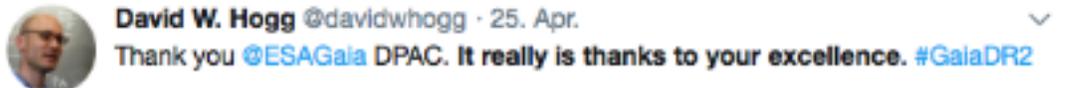
Worldwide positive media echo on Gaia DR2

US astronomer Jackie Faherty:



"Today is probably the most important day for astronomy ever"

Astronomer David Hogg + research group:



NASA's deputy director of Science Thomas Zurbuchen:



2011 Physics Nobel Laureate Adam Riess:

MILKY WAY CEPHEID STANDARDS FOR MEASURING COSMIC DISTANCES AND APPLICATION TO *Gaia* DR2: IMPLICATIONS FOR THE HUBBLE CONSTANT

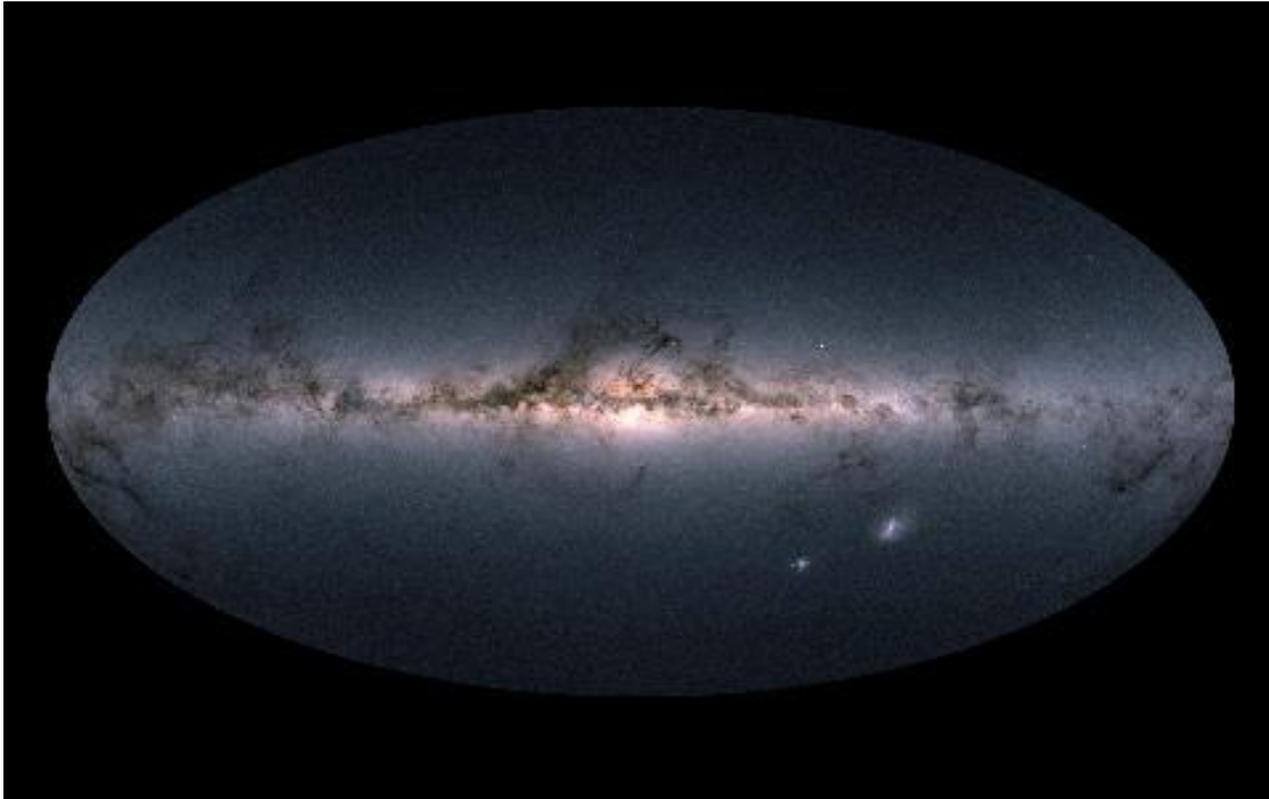
ADAM G. RIESS,^{1,2} STEFANO CASERTANO,^{1,2} WENLONG YUAN,^{2,3} LUCAS MACRI,³ BEATRICE BUCCIARELLI,⁴ MARIO G. LATTANZI,⁴ JOHN W. MACKENTY,¹ J. BRADLEY BOWERS,^{2,2} WEIKANG ZHENG,⁵ ALEXEI V. FILIPPENKO,^{1,6} CAROLINE HUANG,² AND RICHARD I. ANDERSON⁷

We are grateful to the entire Gaia collaboration for providing data and assistance which made this project possible. We congratulate them on their tremendous achievement to date.

Publication rate at the moment: ~3 per day



Thank You! Questions?



<https://www.gaia.ac.uk/mission>

<https://sci.esa.int/web/gaia>





InterSystems®
Creative data technology

