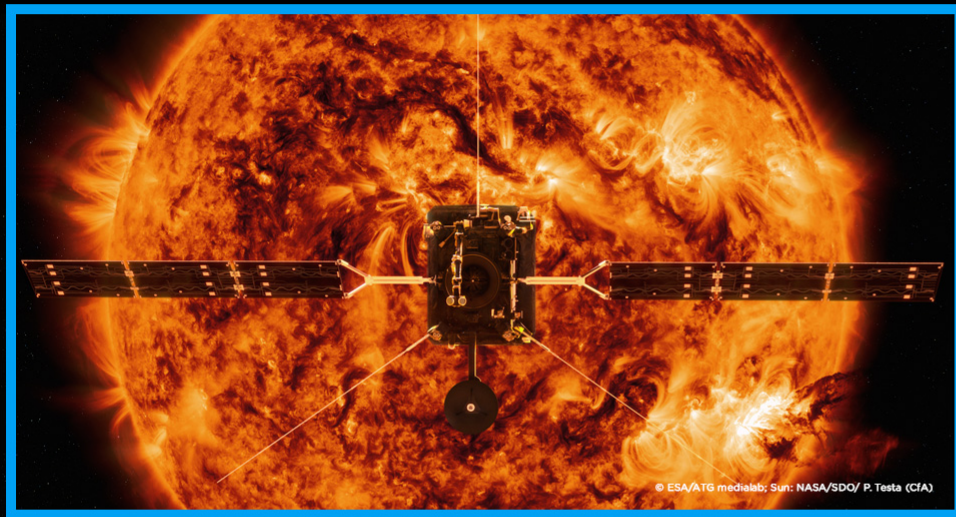




Curso dirigido al profesorado

La Agencia Espacial Europea: estudiar el Sol para viajar al interior de las estrellas



GENERALITAT
VALENCIANA

TOTS
A UNA
VELA

LA CIUTAT
DE LES ARTS I LES CIÈNCIES



EXCELENCIA
SEVERO
OCHOA



Isdefe



PLANETARIO
DE MADRID

Obras Sociales "La Caixa"



INSTITUTO DE
ASTROFÍSICA DE
ANDALUCÍA

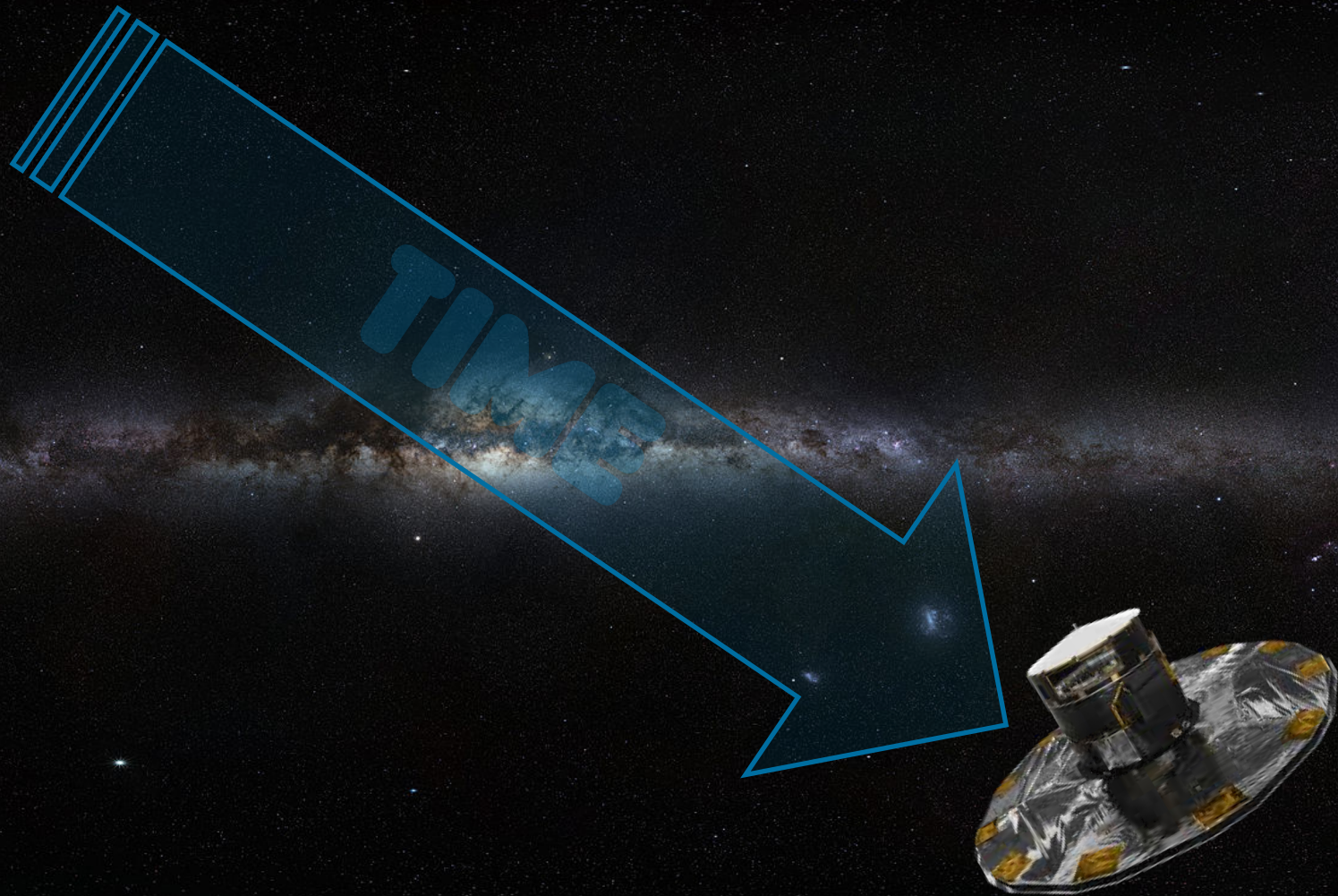


EXCELENCIA
SEVERO
OCHOA

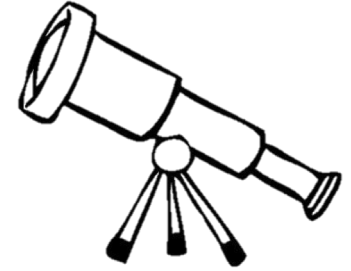
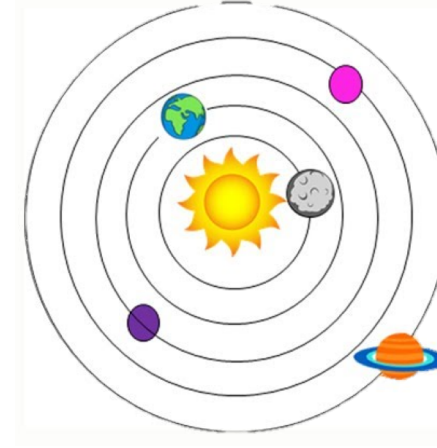
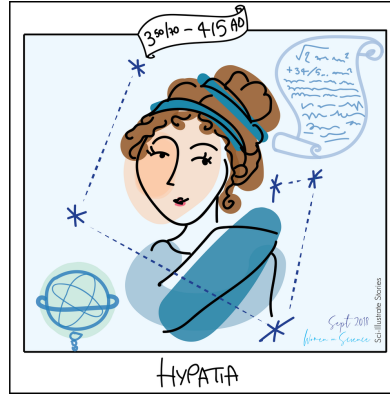
Gaia: unveiling the misteries of the Milky Way

Pilar Esquej, Gaia SOC

18th November 2021



Astrometry across time



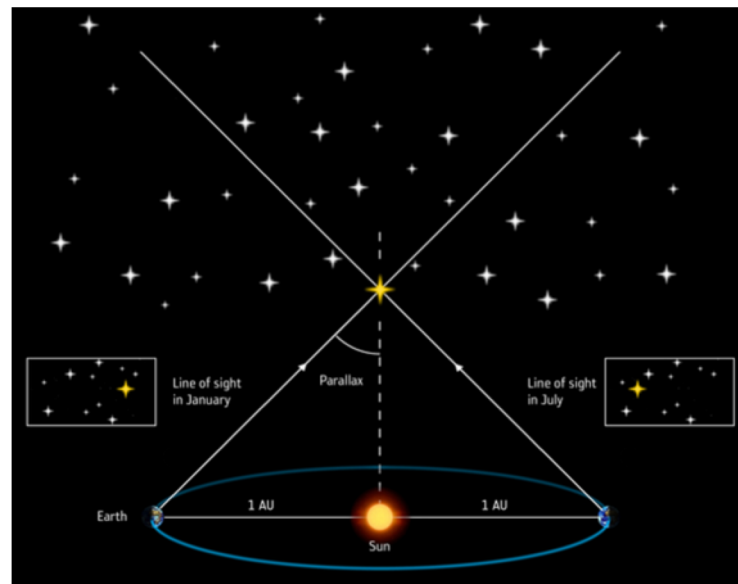
- Around 1000 BCE: Assyro-Babylonians recorded for the first time systematic observations of stars
- Around 300 BCE: Greeks made the first attempts to estimate cosmic scales
- Renaissance: Copernicus revolutionised the view of the cosmos with the heliocentric system
- The availability of improved instruments and the acceptance of the heliocentric system gave astronomers renewed motivation to search for stellar parallax.

Parallax



- The parallax is an apparent movement of a foreground object with respect to its background owing to a change in the observer's position

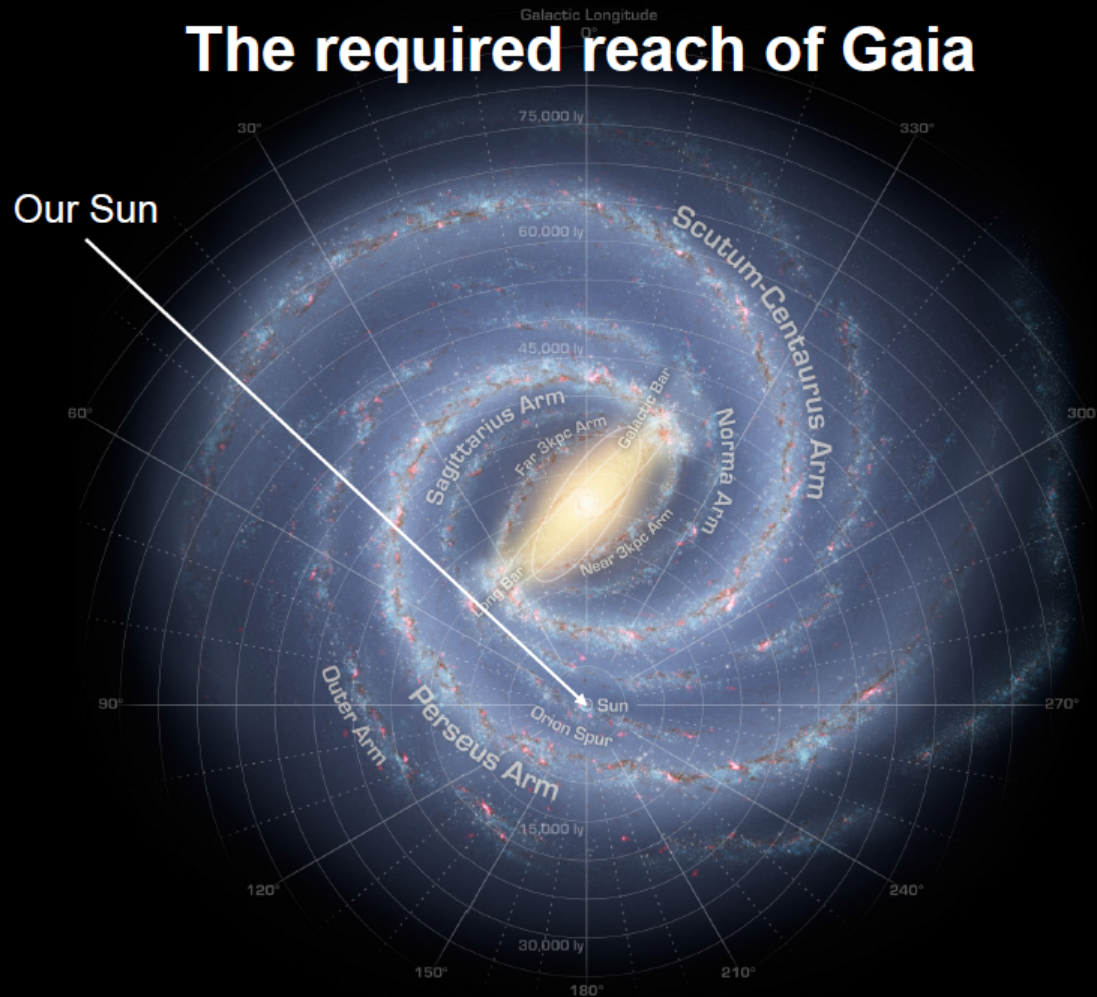
- We have an stereoscopic vision, each eye captures a 2D image and the brain produces a 3D image to perceive a sense of depth.



M83



The required reach of Gaia

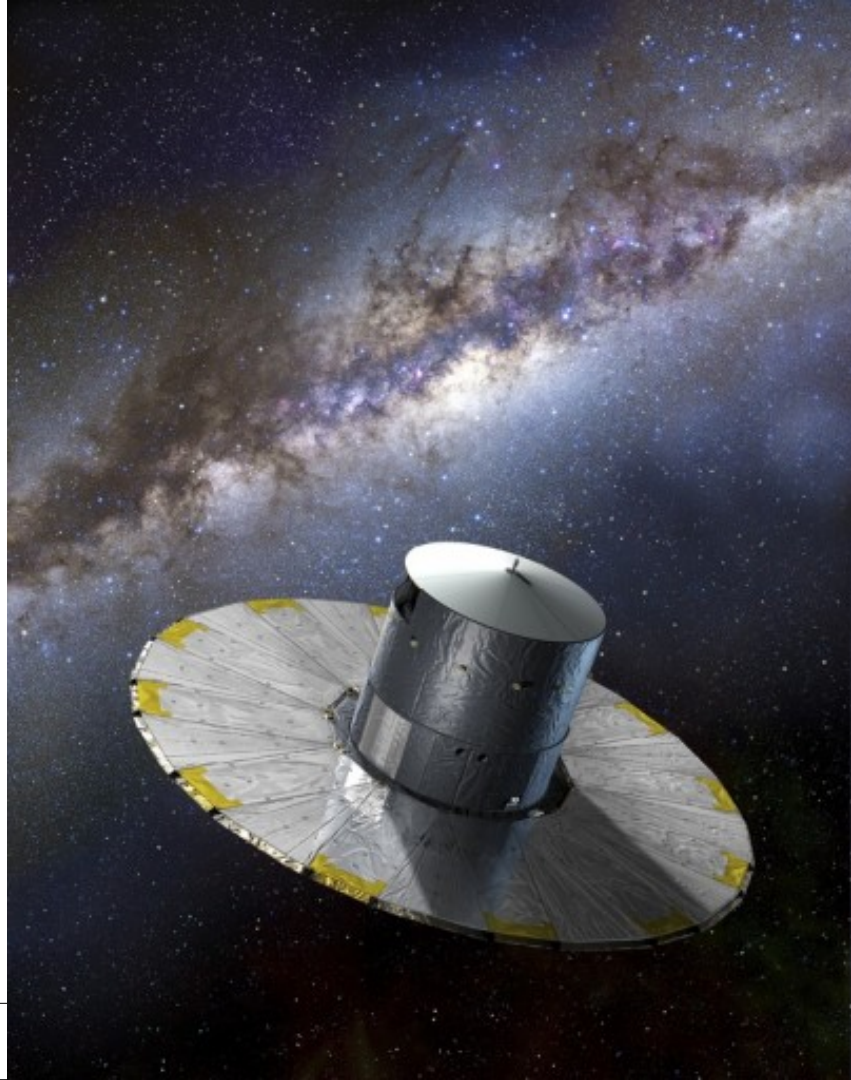


Figures courtesy NASA/JPL-Caltech/R. Hurt and X. Luri & the DPAC-CU2

Gaia

- Gaia is a fully European mission designed, built and operated by ESA.
- Launch on 19 December 2013, 09:12 UTC from Kourou Space Port (French Guayana)
- The main goal of Gaia is to make the largest, most precise 3D map of our Galaxy by surveying an unprecedented one per cent of the galaxy's population of 100 billions of stars
- The Gaia Data Processing and Analysis Consortium (DPAC) are responsible for processing the data, which is published in the Gaia catalogue.

Gaia

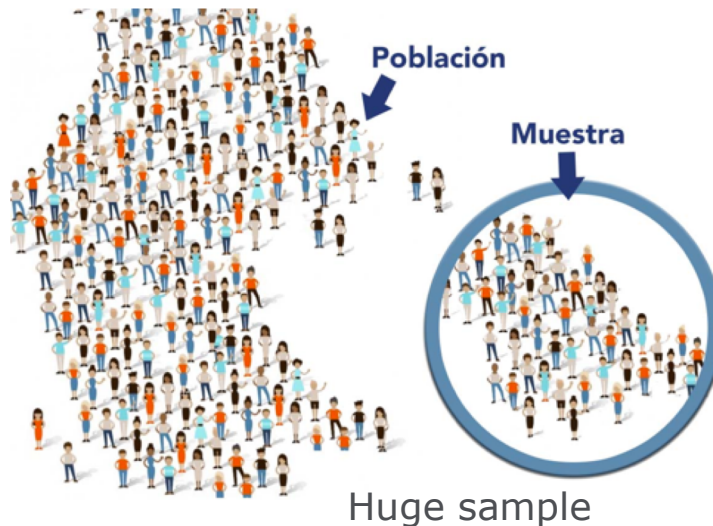


Understanding our Galaxy with Gaia

- Gaia will obtain data which allows us unravelling its formation history, getting insight of the past and present merger activity of the Galaxy



Gaia measures the position, movement and brightness of stars with unprecedented levels of accuracy

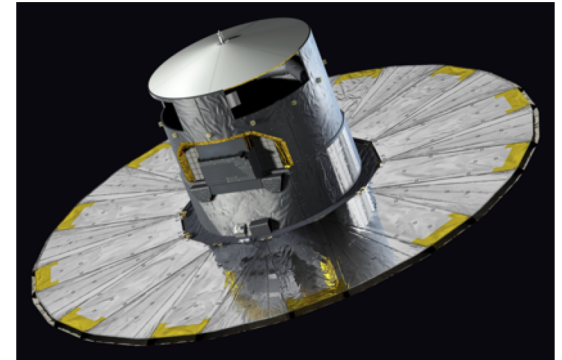


Time machine!

The spacecraft – how to achieve microarcsec accuracy?

The Gaia spacecraft has a size of 3.8 m diameter and a height of 3.5 m (10.2m with the sunshield fully deployed)

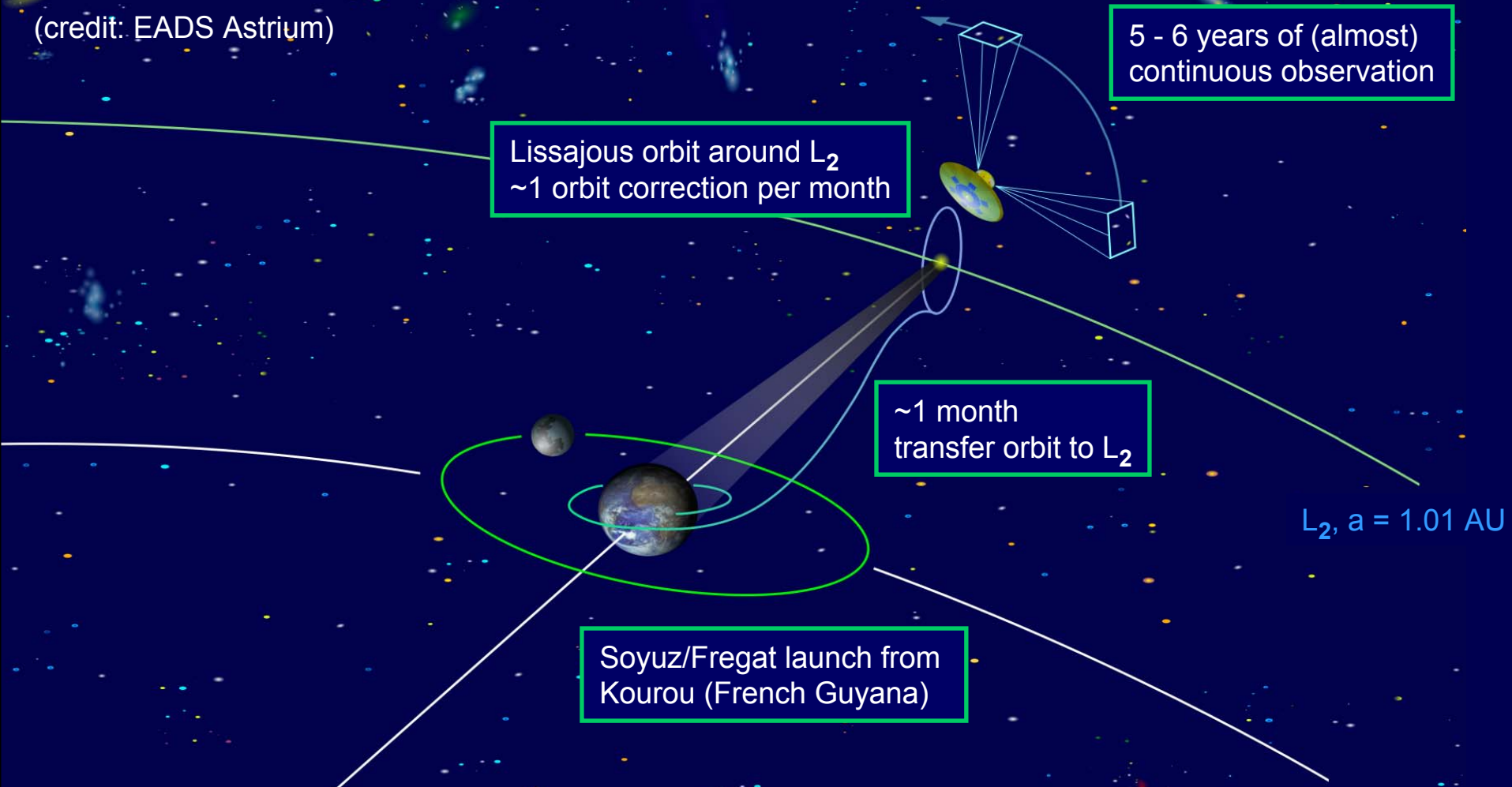
- Thermally stable: sun shield, L2 orbit, design s/c
- Stable mechanical elements:
 - x Extensive use of silicon Carbide for the structures and mirrors
 - x High mechanical and thermal decoupling between payload and service modules
- Largest focal plane
 - x The FPA is very large (1.9m × 1m × 1.2m) and complex
- Ultra-precise atomic-clock
- 80 observations per source along the mission
- Complex data processing



Gaia

Gaia launch and orbit

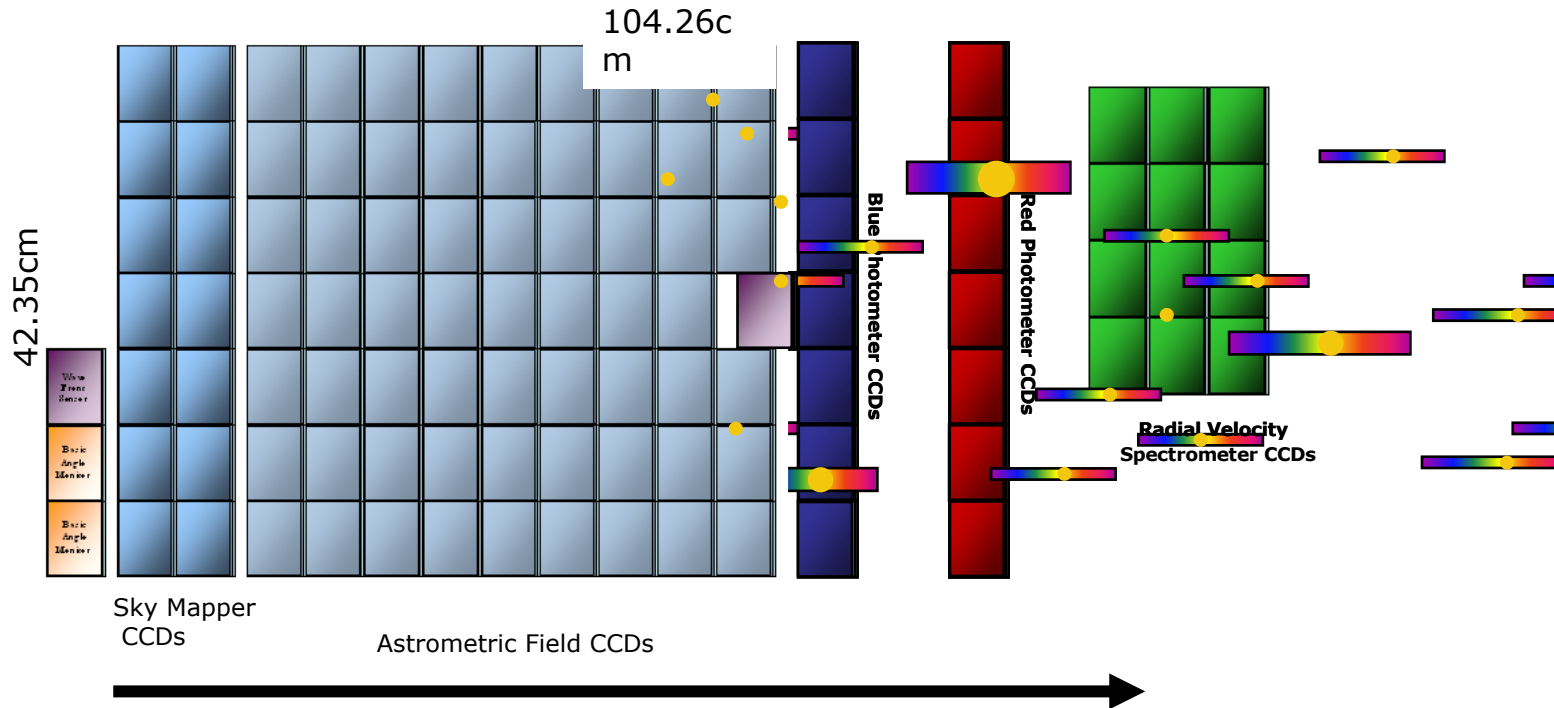
(credit: EADS Astrium)



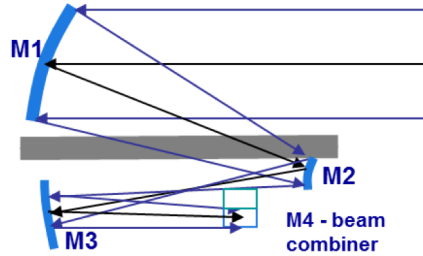
A Giga pixel focal plane

106 CCDs , 938 million pixels, 2800 cm²

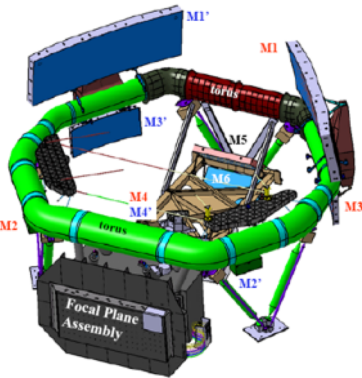
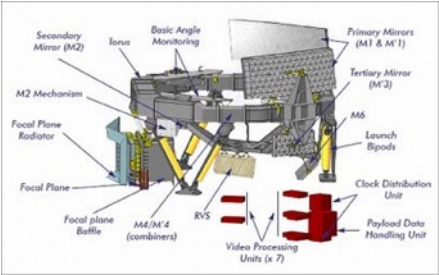
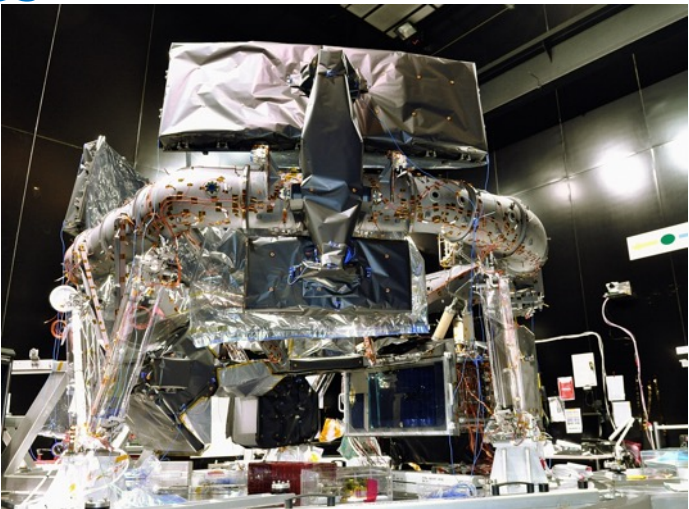
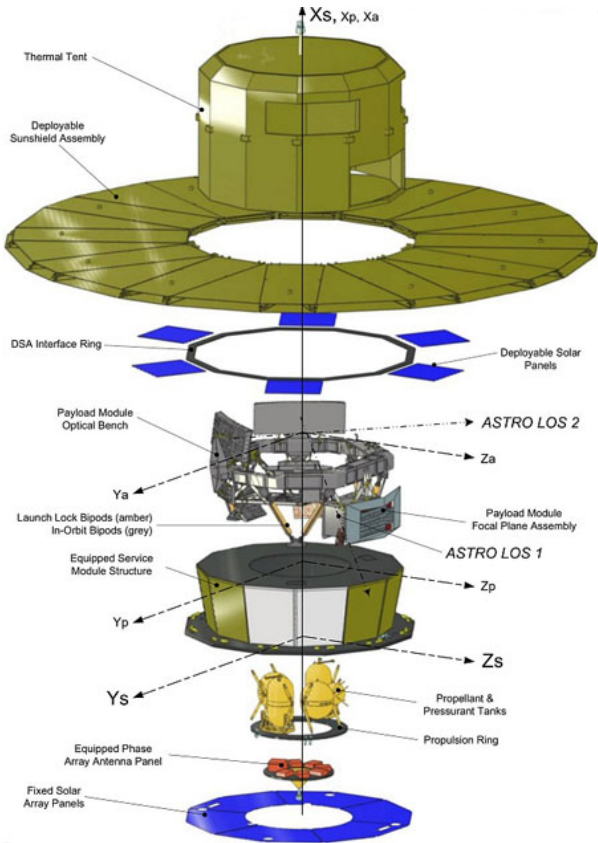
2



Telescopes and mirrors



Service and Payload Modules



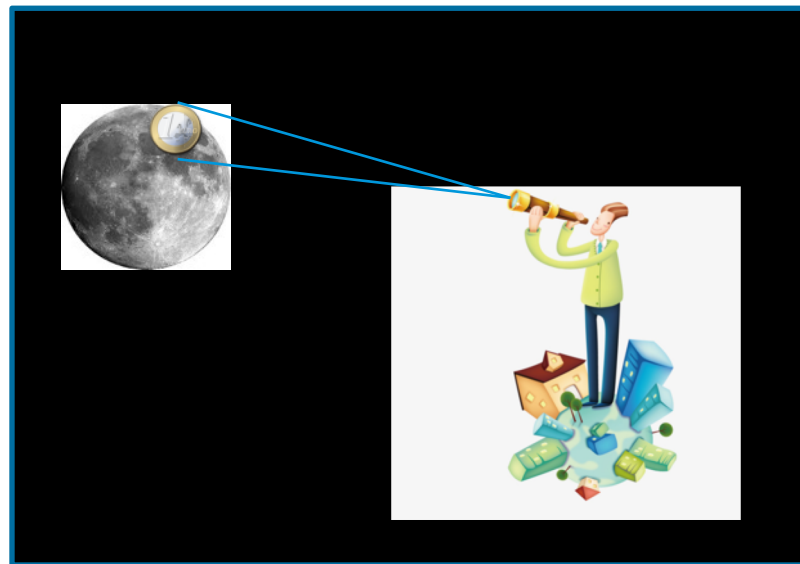
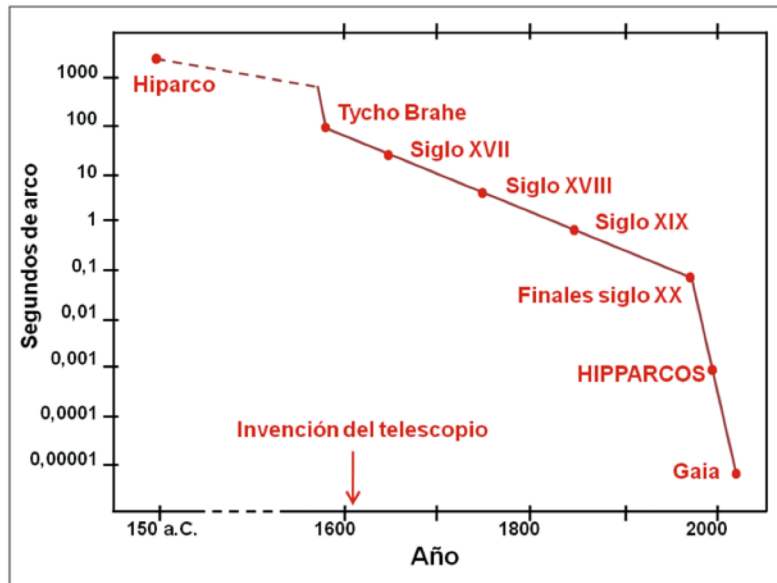
Gaia





Gaia

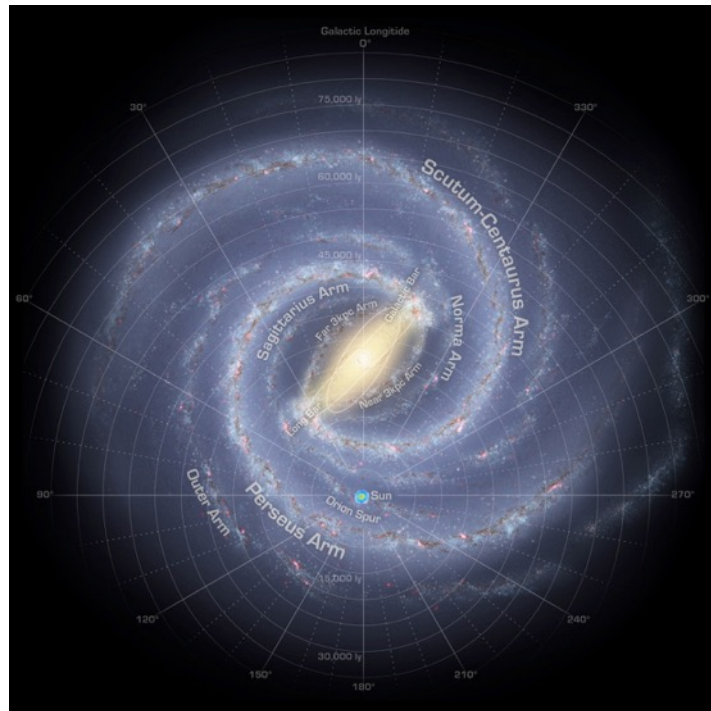
Unprecedented accuracy: 10 microarcseconds!



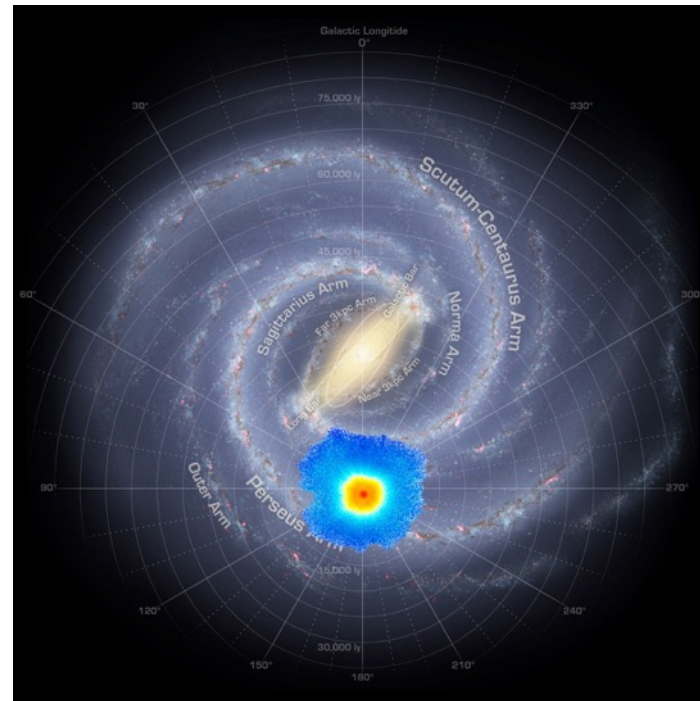
- It is the angle of an euro coin on the surface of the moon seen from the Earth
- Or the width of a hair seen from 500km
- A 100m building in Uranus seen from the Earth



Our Galaxy before and after Gaia



Hipparcos
2M



Gaia
1.8B

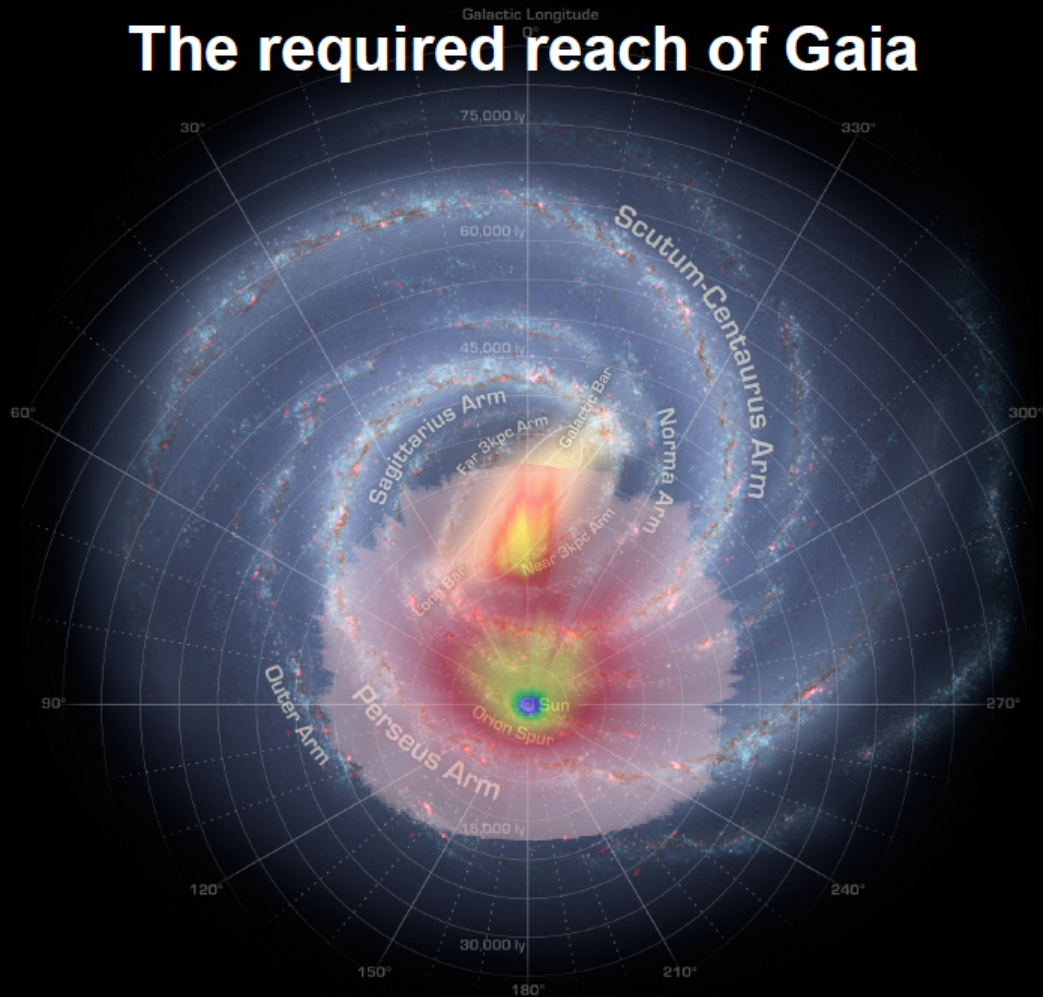
Gaia

ESAC | 15/10/2021 | Slide 18

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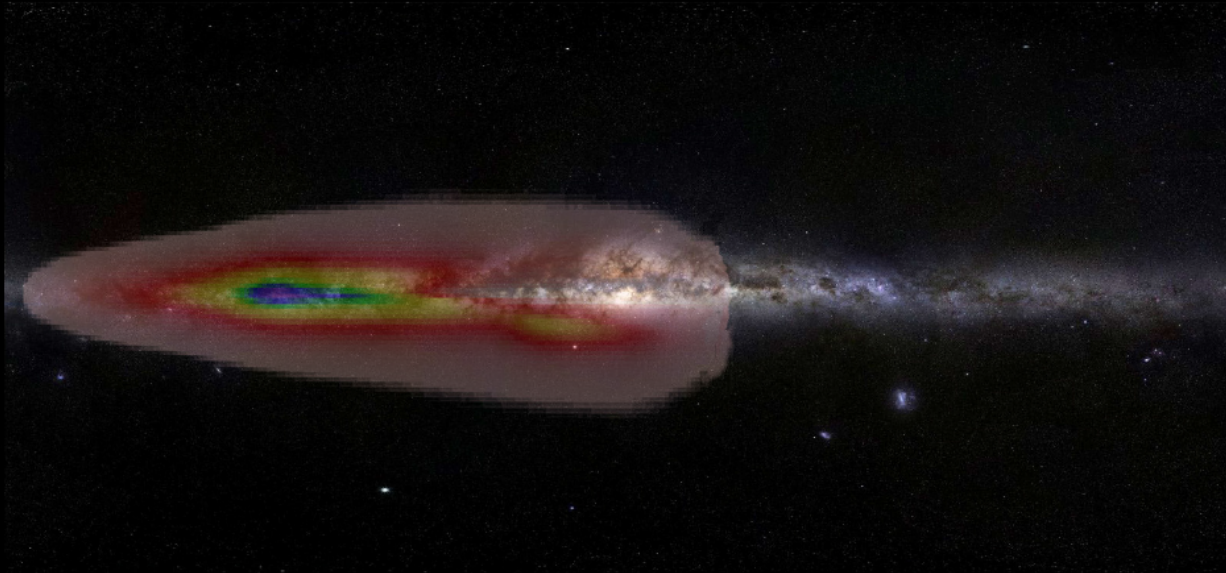


The required reach of Gaia



Figures courtesy NASA/JPL-Caltech/R. Hurt and X. Luri & the DPAC-CU2

The required reach of Gaia

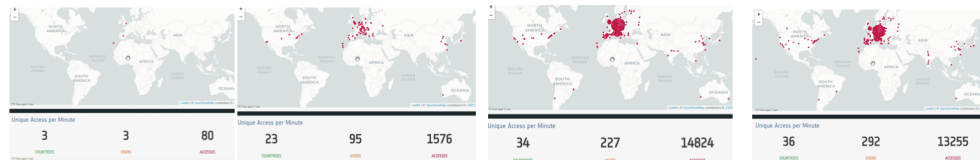


Figures courtesy GigaGalaxyZoom.org and X. Luri & the DPAC-CU2

Gaia Early Data Release 3



- Gaia has produced the largest, most precise 3D map of our Galaxy by surveying an unprecedented one per cent of the galaxy's population of 100 billions of stars
- Released on Dec 3th 2020 @12:00 - <https://gea.esac.esa.int/archive/>

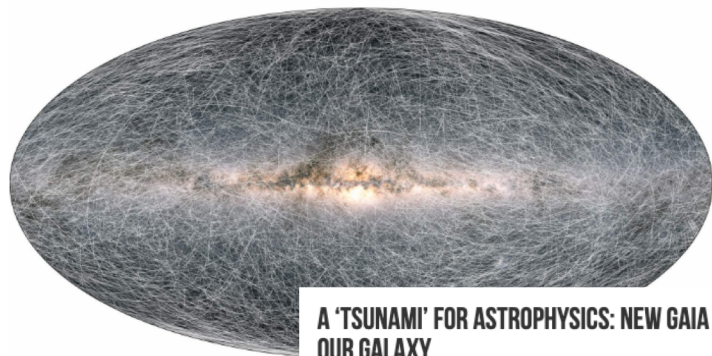


Opening

1 min later

2 min later

3 min later



A 'TSUNAMI' FOR ASTROPHYSICS: NEW GAIA DATA SHOWS THE BEST MAP OF OUR GALAXY

December 3, 2020 Science 2 Views

Gaia

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NEWS • 25 APRIL 2018

Billion-star map of Milky Way set to transform astronomy

European Gaia spacecraft's first major data dump – the most detailed 3D chart yet of our Galaxy – will keep researchers busy for decades.

GAIA EARLY DATA RELEASE 3



1 811 709 771
stellar positions

1 806 254 432
brightness
in white light

1 542 033 472
brightness
in blue light

1 540 770 489
colour

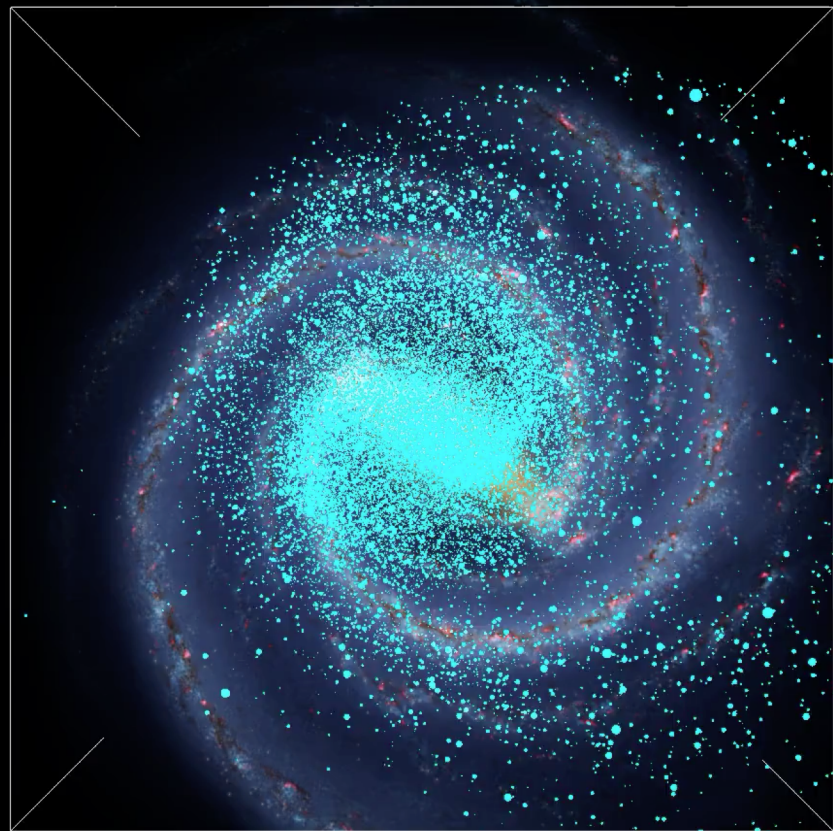
1 467 744 818
parallax and
proper motions

1 614 173
extragalactic
sources

1 554 997 939
brightness
in red light

#SpaceCore #ExploreFurther

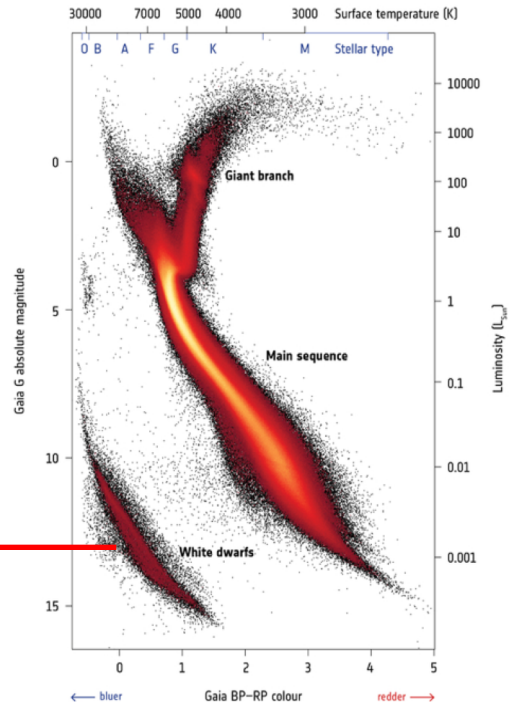
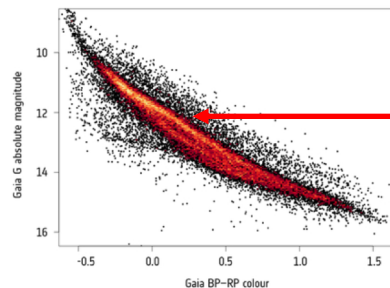
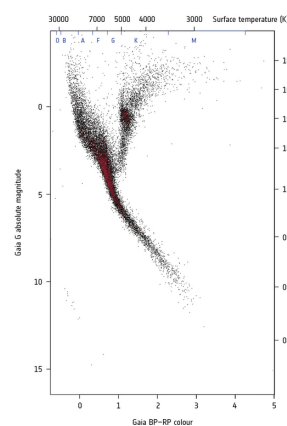
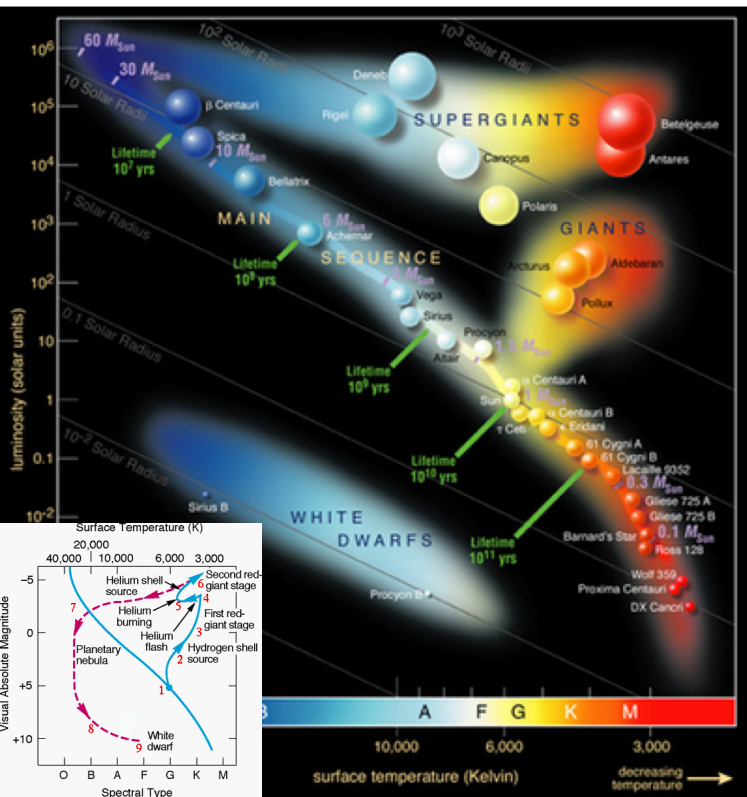




Hertzprung-Russel Diagram: stellar family portrait



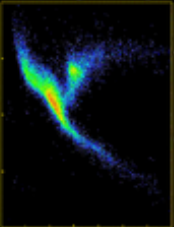
- Most detailed ever seen with Gaia! ~100 times more stars than with Hipparcos.



Gaia

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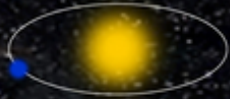
Star Formation
History of the
Milky Way

Galactic
Structure

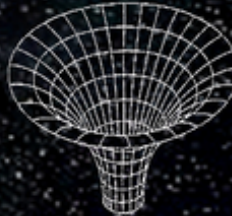
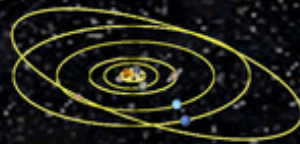
Binaries and
Brown Dwarfs



Extrasolar
Planets



Solar
System



Fundamental
Physics

Reference
Frame

But not only about
the Milky Way and
its stars...

... Gaia brings a
revolution in
every Astronomy
field.

<https://www.cosmos.esa.int/web/gaia/science>

Gaia

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