

Galactic Astronomy

2024-2025

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Inherited from:

Carme Jordi Francesca Figueras



 **ICCUB** EXCELENCIA
Institute of Cosmos Sciences MARÍA
DE MAEZTU



UNIVERSITAT DE
BARCELONA

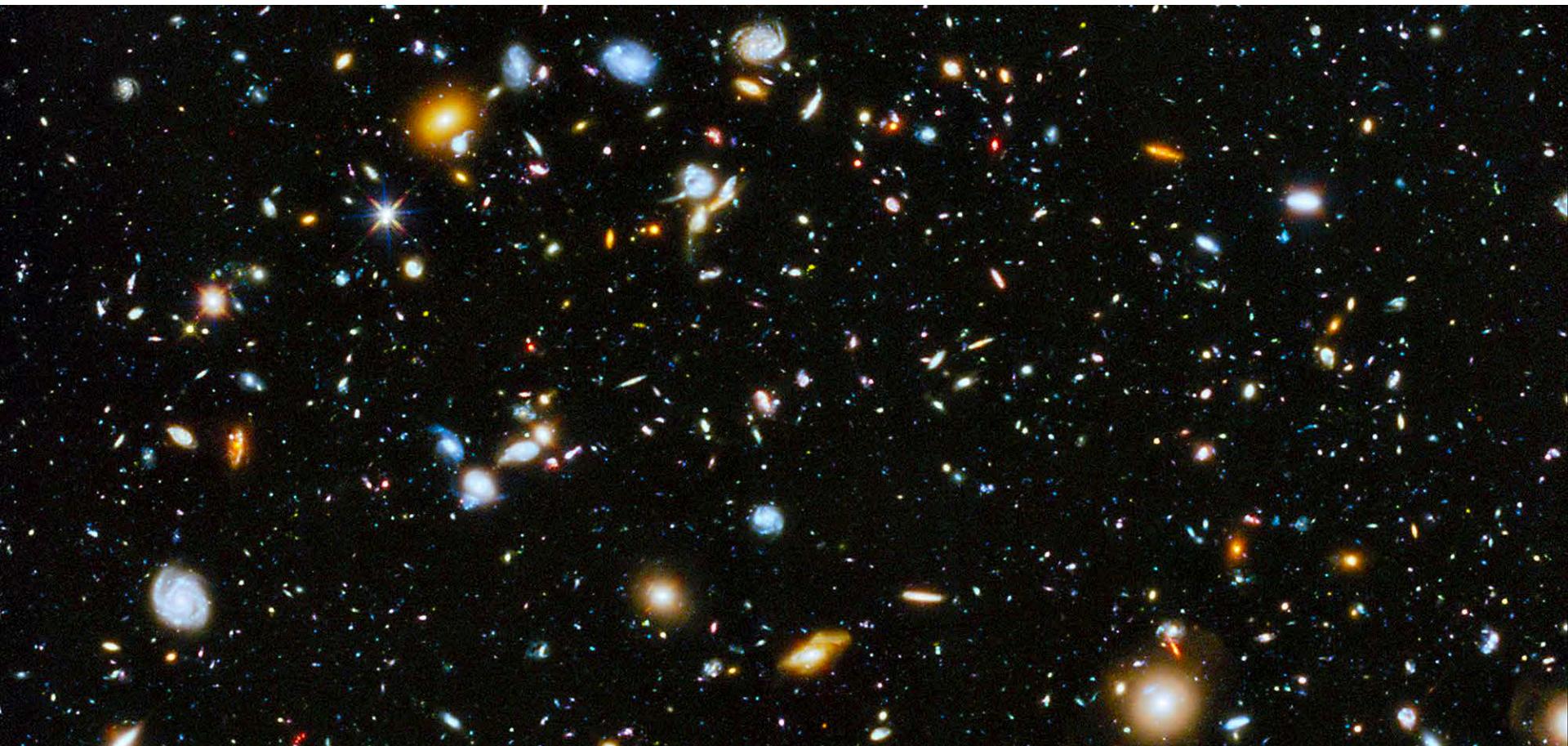


How do galaxies form and evolve?

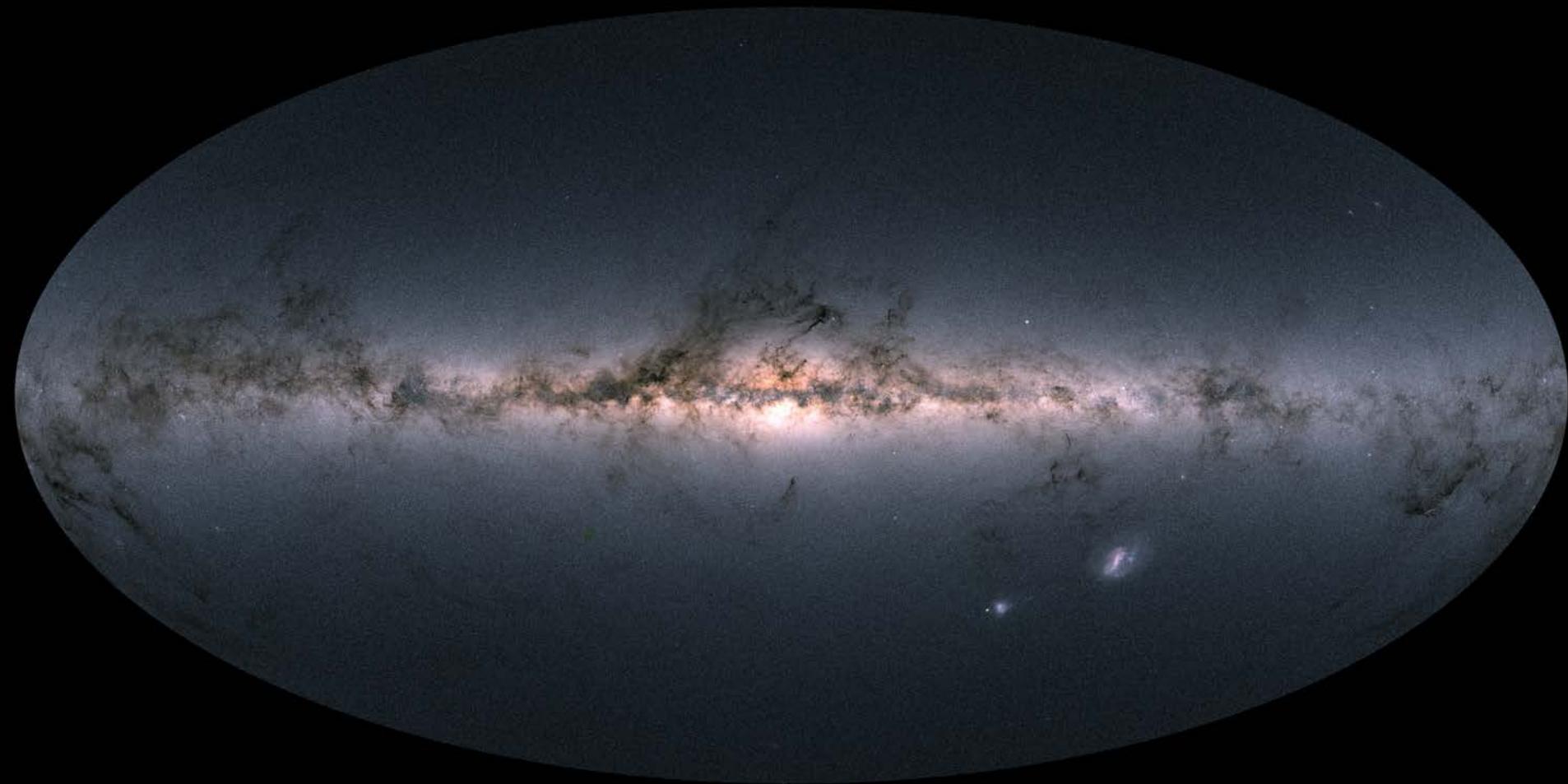
One of the key questions in modern astrophysics:

- A Science Vision for European Astronomy, ASTRONET, 2007
- Science Vision and Infrastructure Roadmap, ASTRONET, 2022 (*DRAFT*)

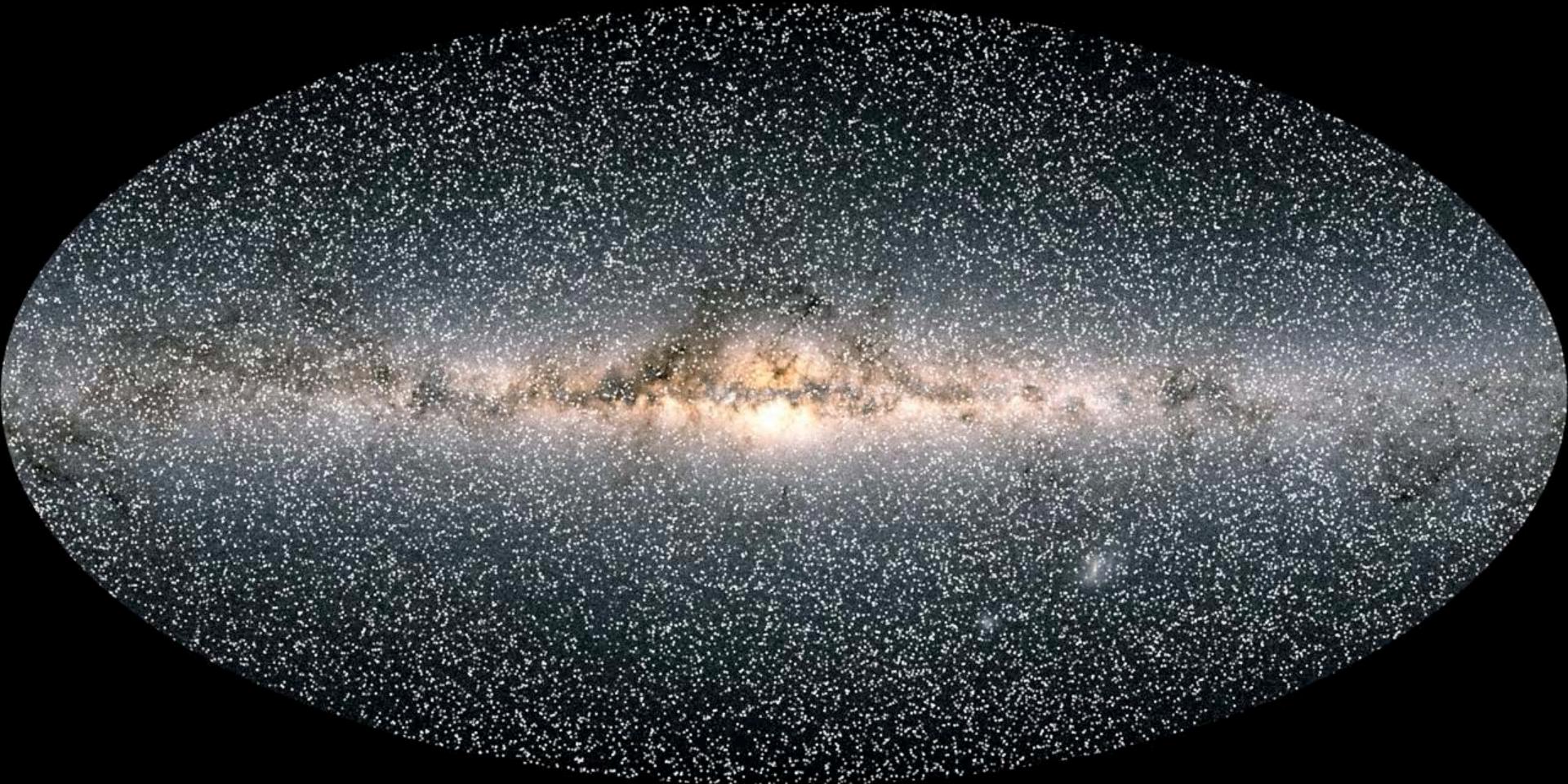
Hubble Ultra Deep Field



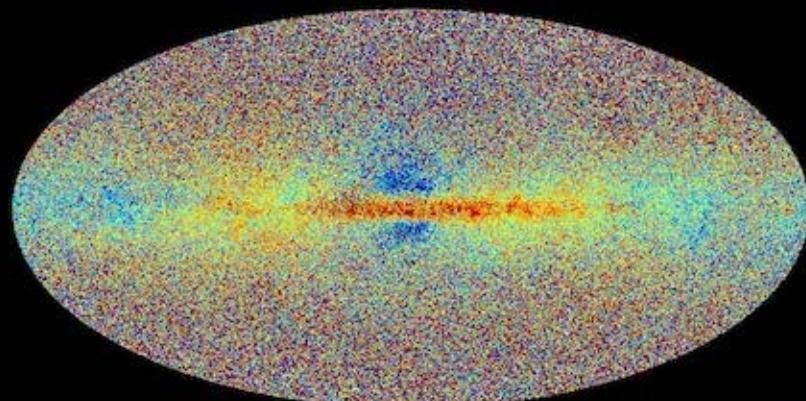
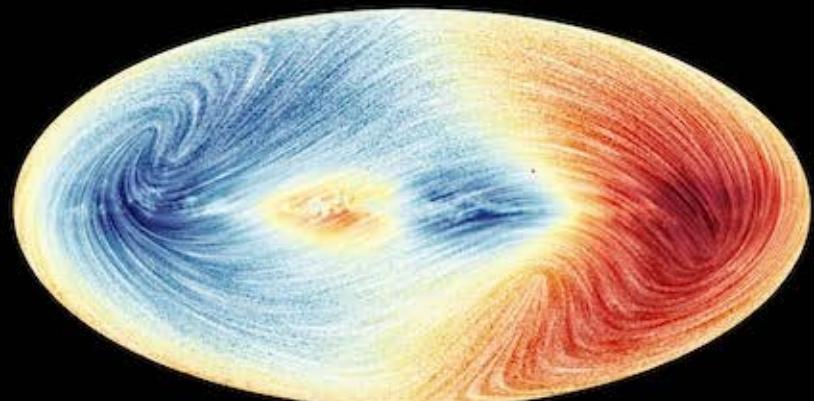
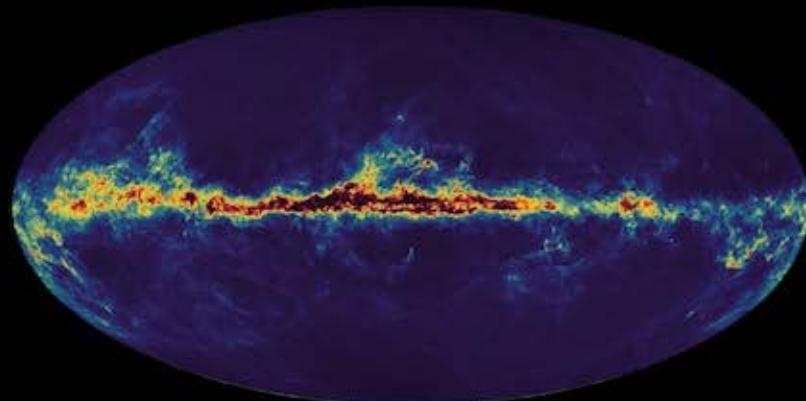
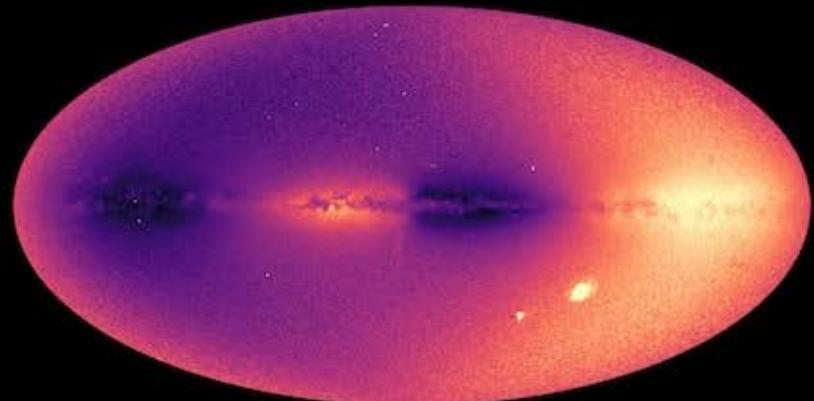
Gaia DR2



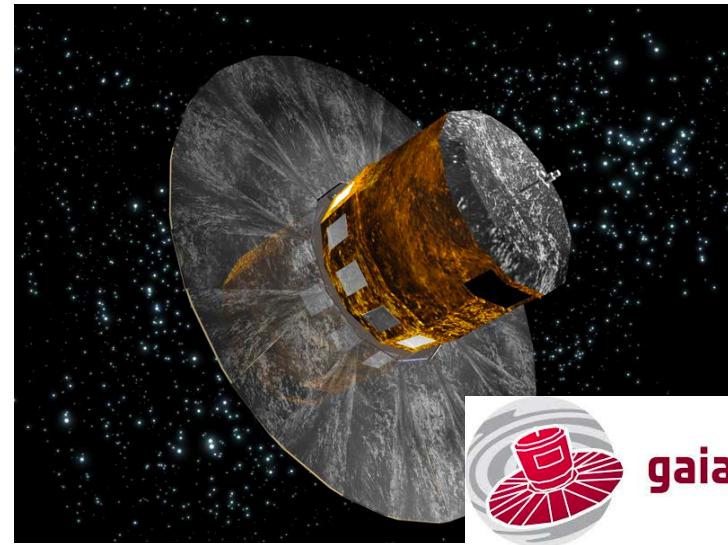
Gaia EDR3



GAIA: EXPLORING THE MULTI-DIMENSIONAL MILKY WAY



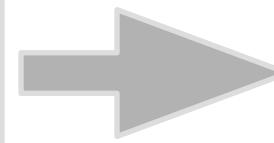
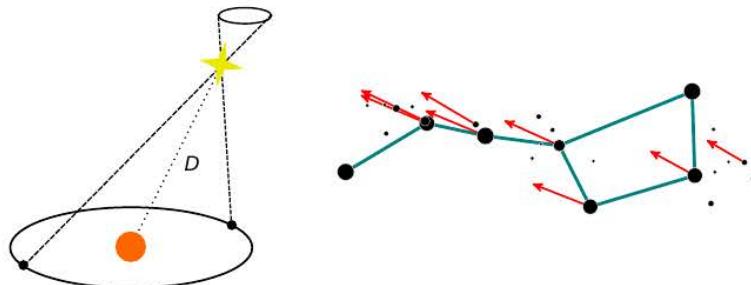
Measurements: Gaia mission



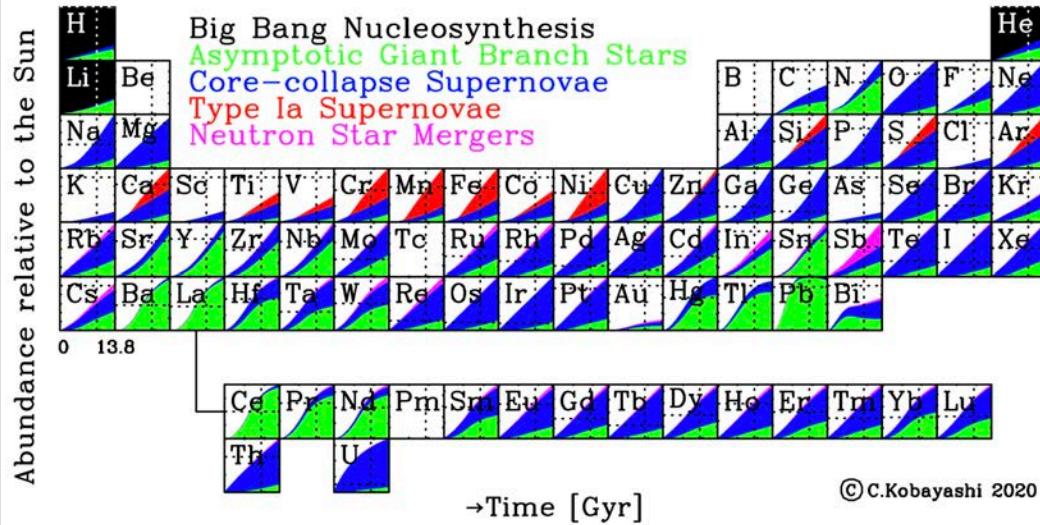
**December 19th, 2013
10:12 CET**

How did our galaxy and its components form?

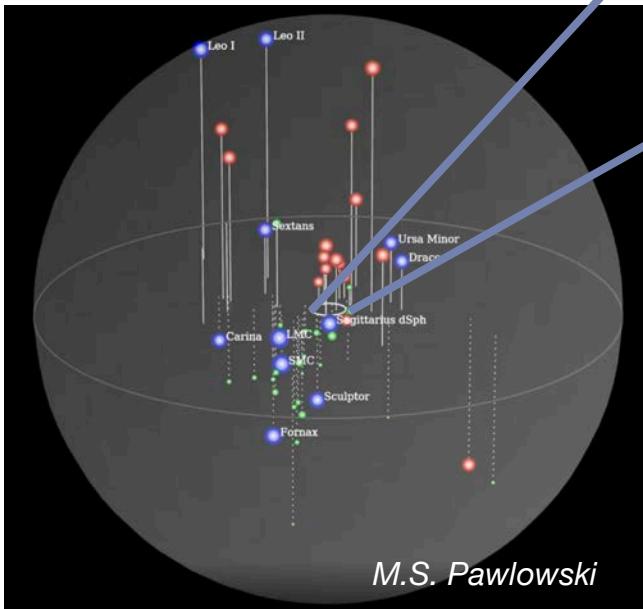
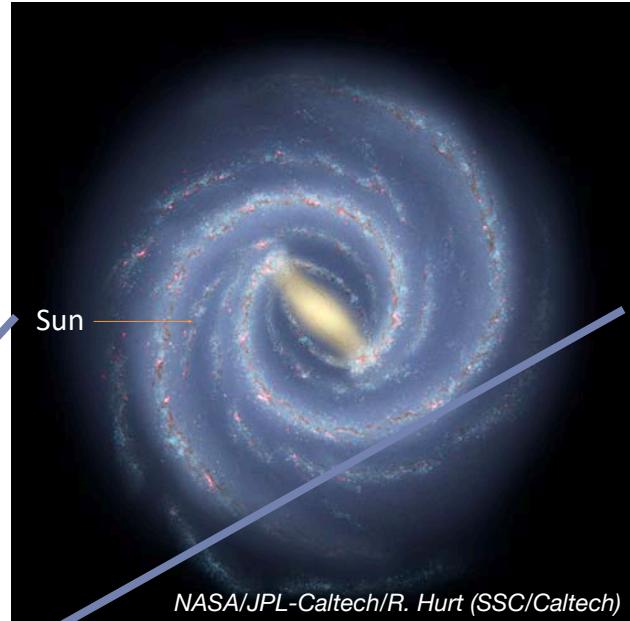
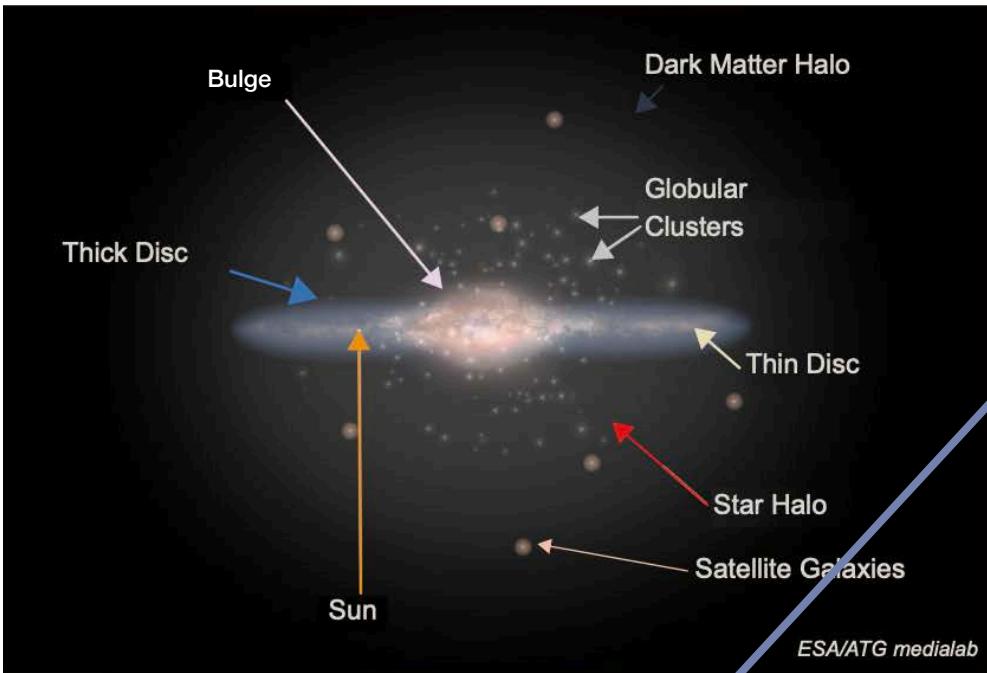
Astronomical measurements in Galactic Astronomy



- Galaxy gravitational potential (mass distribution)
- History and evolution



What we think the MW looks like



PROGRAMA

1. Introduction TERESA

16 set

- 1.1. Galaxies and their role in the Universe
- 1.2. Galactic astronomy history
- 1.3. Global description of the Milky Way: our present knowledge

2. Galactic Dynamics I: basic concepts

- 2.1. Gravitational potentials & Poisson equation TERESA 17, 18, 19, 25 sept
- 2.2. Orbits TERESA 26 30 set 1,2 oct
- 2.3. Collisionless dynamics MERCE ,3 nov

+2h hands-on orbits MERCE, 14 15 oct

3. Astronomical measurements FEDE

, 16 17 21 oct

- 3.1. Astrometry
- 3.2. Photometry
- 3.3. Spectroscopy

+2h Exercises measurements FEDE 22 23 oct

4. Statistical astronomy FEDE

24,28 29 30 oct

- 4.1. Apparent distribution of stars
- 4.2. Stellar statistics fundamental equation
- 4.3. Stellar luminosity function
- 4.4. Initial Mass Function and Star formation History
- 4.5. Galactic models for star count predictions

5. Galactic kinematics TERESA

31 oct 4 5 6 nov

- 5.1. Galactocentric reference systems
- 5.2. Kinematics of solar neighbourhood stars
- 5.3. Large scale kinematics
- 5.4. Rotation curve and Oort constants

6. Galactic dynamics II: advanced

- 6.1. Dynamics of spiral structure and bars 7 11 12 13 14 nov MERCE
- 6.2. Collisions and encounters of stellar systems MARK/INVITED 18 19 20 nov
- 6.3. Galaxy interactions, non-axisymmetry, Gaia TERESA 21,25 nov

+2h hands-on kinematic/Gaia recent data TERESA 26 27 nov

+1h Journal Club TERESA 28 nov

7. Chemical evolution of the Milky Way FEDE

9 10 11 12 16 17 18 19 dec

- 7.1. Observational evidence
- 7.2. Surface gas density, supernova explosion rate and metal enrichment
- 7.3. Basic elements of a model of chemical evolution
- 7.4. Some simple models

5 themes:

- Galactic dynamics
- Astronomical measurements
- Statistical galactic astronomy
- Galactic kinematics
- Chemical evolution of the Milky Way

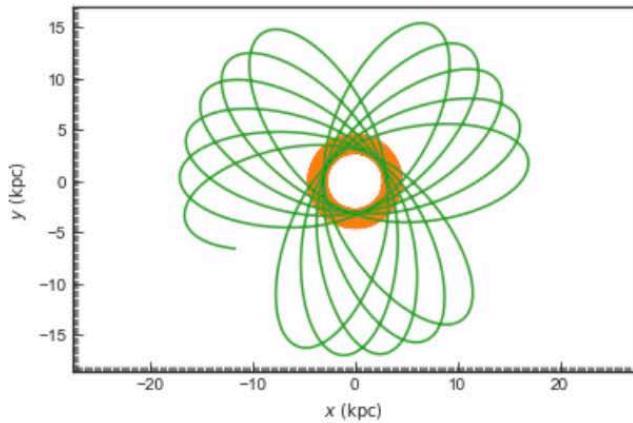
Not 100% definitive

• Hand-on exercises

- Analysis of *Gaia* data
- Orbits in Galactic potentials

In [25]:

```
1 omw1.plot(d1='x',d2='y')
2 omw2.plot(d1='x',d2='y',overplot=True)
3 omw3.plot(d1='x',d2='y',overplot=True)
4
5 plt.axis('equal')
6 plt.show()
```



• Paper reading and discussion (journal club)

• Short tasks TBD

1. TBD: Gaia Archive & Gaia measurements / Statistical astronomy, Besançon model

gaia archive

HOME SEARCH STATISTICS VISUALIZATION HELP DOCUMENTATION

Simple Form ADQL Form Query Results

Position File

Name Equatorial

Target in Circle Box

Name for Simbad Radius 5 arc min

Search in: Gaia Source Tycho-Gaia Astrometric Solution (TGAS) public_gaia_source

► Extra conditions

► Display columns

Max. number of results: 500 Reset Form Show Query Submit Query

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HTTP://
ARCHIVES.ESA
C.ESA.INT/
GAIA/

- Lectures from invited professors

TBC



Collisional dynamics

- Basic concepts for collisional systems: relaxation, core collapse, etc
- Dynamics of Globular Clusters

Nov 2023

Evaluation

Short tasks + presentations

Hands-on work

Participation

40%

Exam

5/10 required

60%

Exam date: TBD

<https://campusvirtual.ub.edu/>

- Detailed calendar
- Pdfs of lectures
- Material for hands-on, exercises, etc
- Additional material, papers, etc

Master's thesis

- Open clusters
- Galactic Disk dynamics
- Satellite galaxies
- Stellar evolution
- Population synthesis
- White dwarfs
- Big Data and Machine learning
- Galaxy formation and cosmology
- Spectroscopic stellar surveys
- Globular clusters
- Light pollution
- Chemical evolution of the MW

*F. Anders, T. Antoja, L. Balaguer, J. M. Carrasco, F. Figueras, M. Gieles,
X. Luri, E. Masana, M. Romero-Gomez, M. Semcsuk*

