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From Gaia to Euclid

RNDr. Roman Nagy, PhD.

Bezovec 2025

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- The Milky Way – Our Native Land
- Gaia Mission – Galactic Revolution
- Structure of distant galactic corners
- Mission Eucid – dark universe survey

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The Milky Way – Our Native Galaxy

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The Milky Way – Our Native Galaxy

- Disk radius of 50,000 light years
- The thickness of the disk is approximately 1,000 light years
- Around 400 billion stars
- Mass 1 trillion Solar Masses

Th

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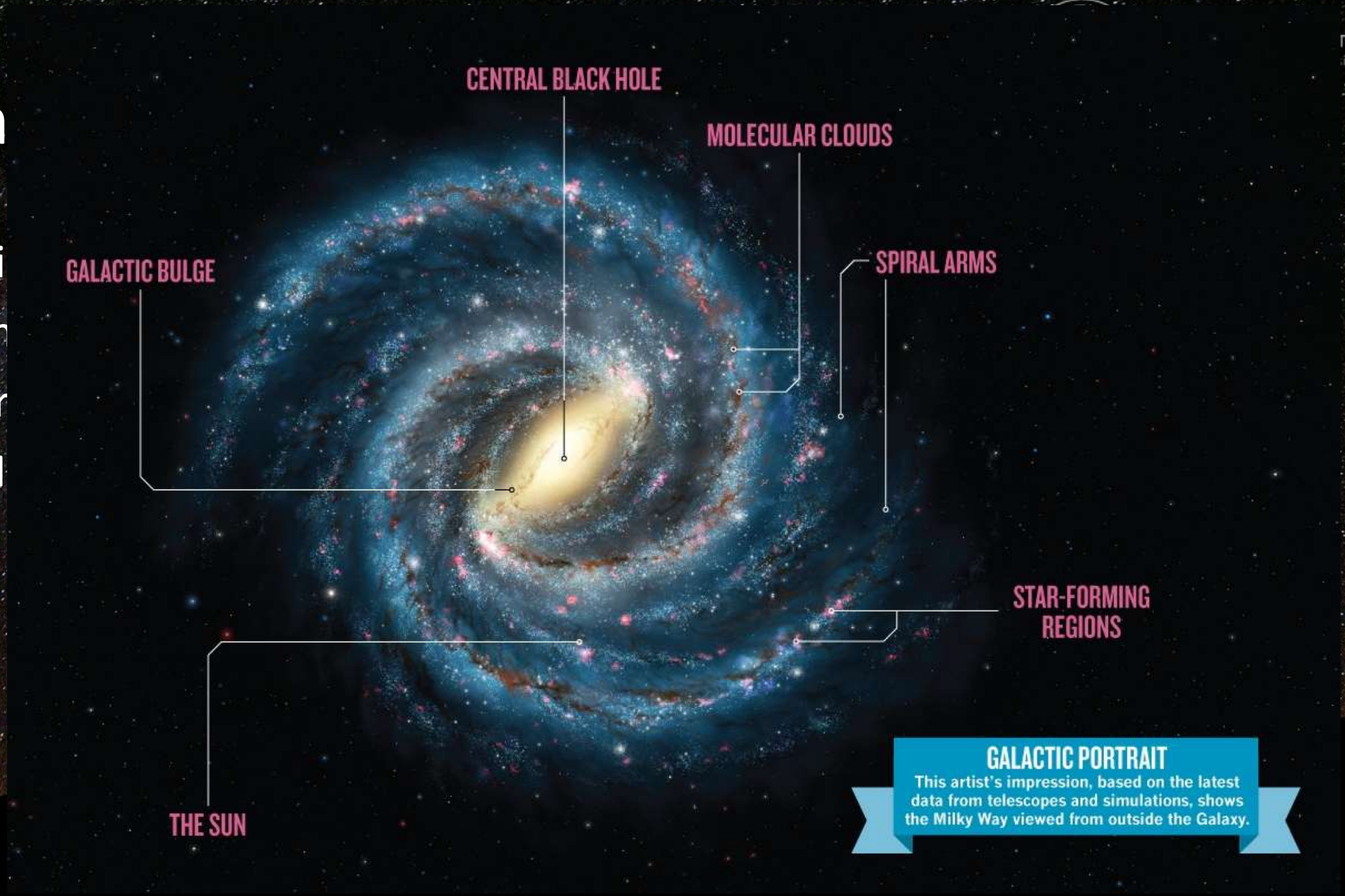
- M


CENTRAL BLACK HOLE
MOLECULAR CLOUDS
GALACTIC BULGE
SPIRAL ARMS
STAR-FORMING REGIONS
THE SUN
GALACTIC PORTRAIT
This artist's impression, based on the latest data from telescopes and simulations, shows the Milky Way viewed from outside the Galaxy.

Th

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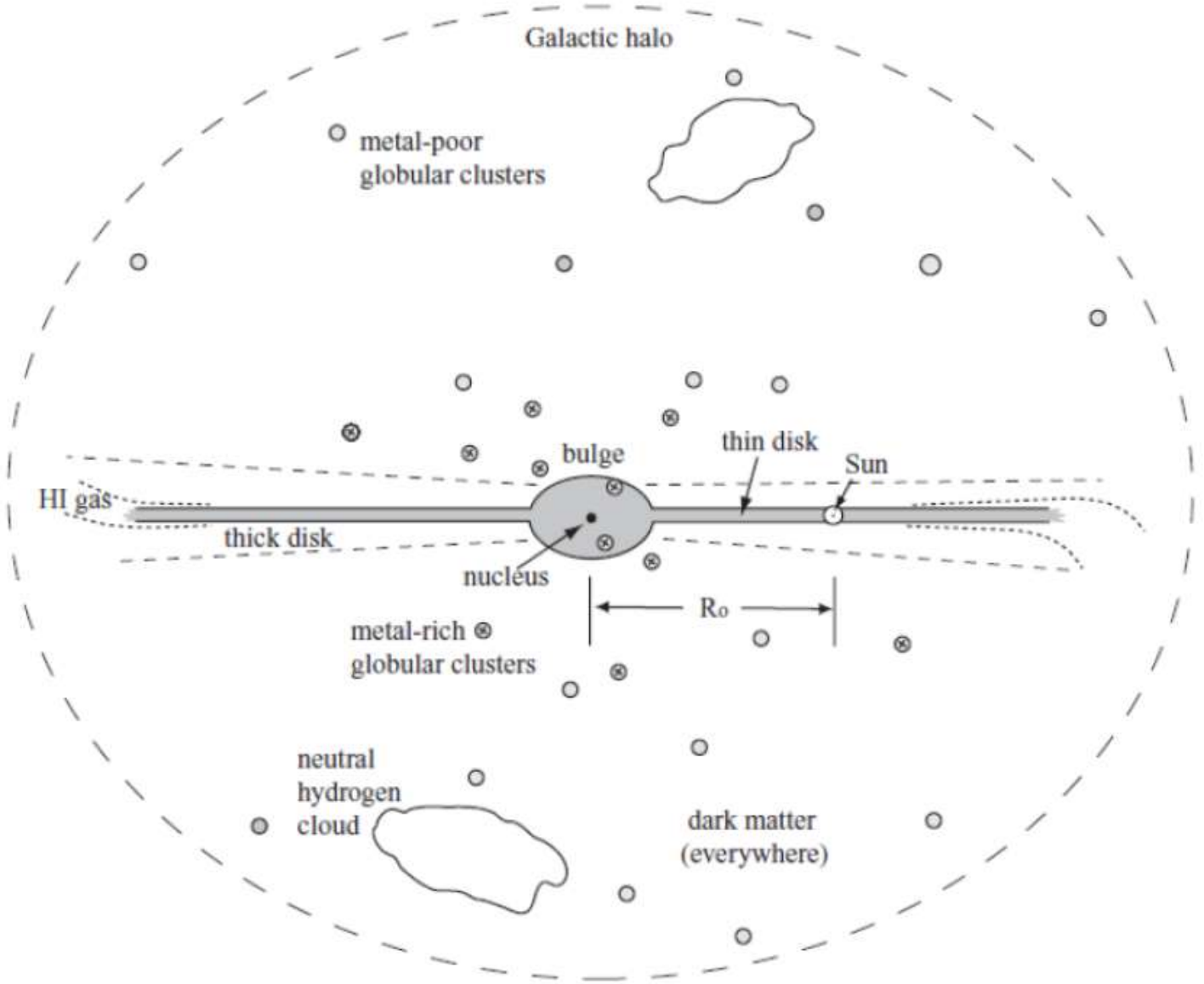
Galactic halo
metal-poor
globular clusters
bulge
thin disk
Sun
HI gas
thick disk
nucleus
R₀
metal-rich
globular clusters
neutral
hydrogen
cloud
dark matter
(everywhere)

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Gaia – Galactic Revolution

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Gaia – Galactic Revolution

- December 2013-2019 (baseline)
- ESA mission in L2
- Astrometric, Photometric and Spectroscopic mission

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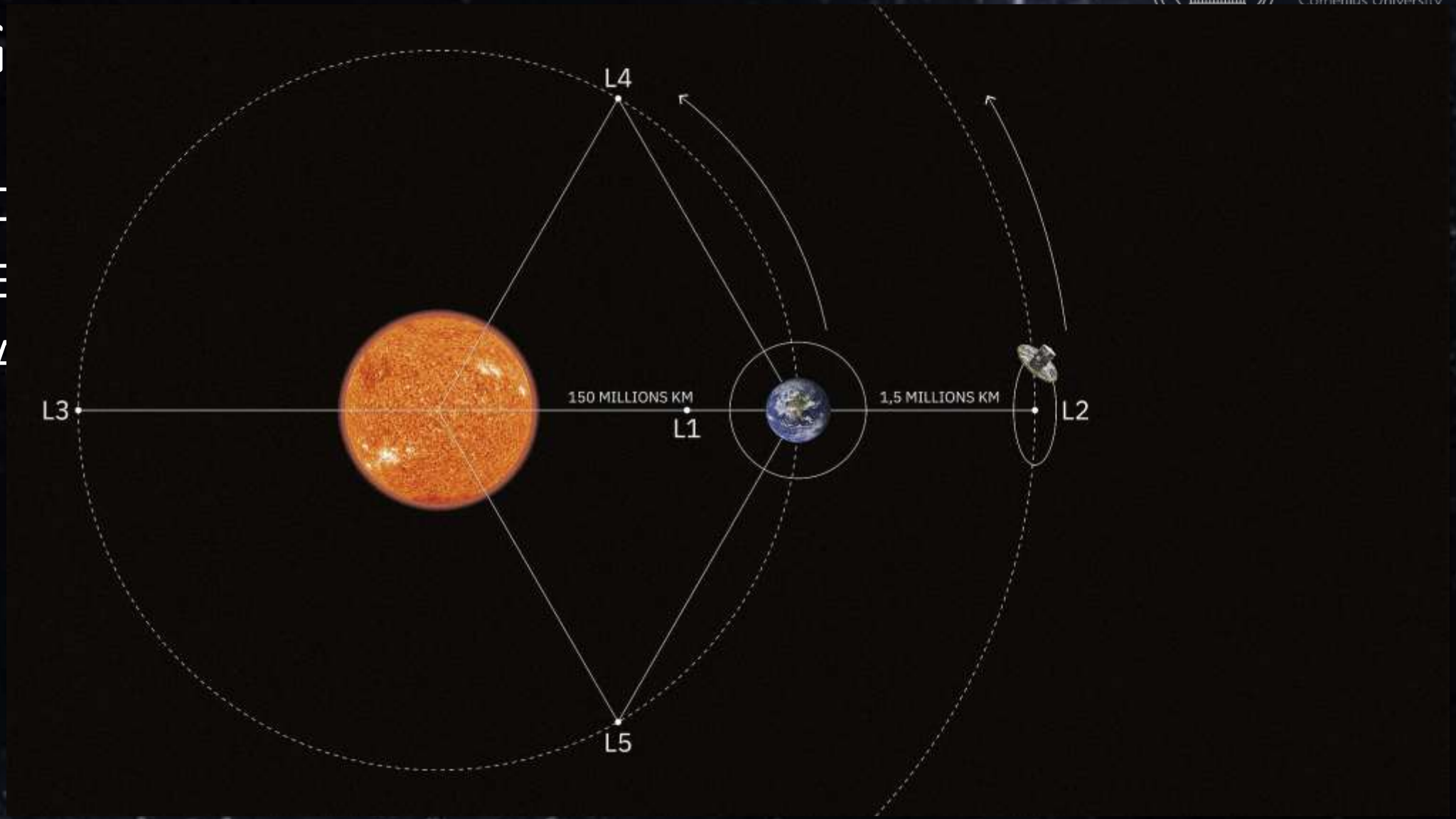

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Gaia – Galactic Revolution

- December 2013-2019 (baseline)
- ESA mission in L2
- Astrometric, Photometric and Spectroscopic mission

radial velocity

the position of stars

brightness of stars

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Gaia – Galactic Revolution

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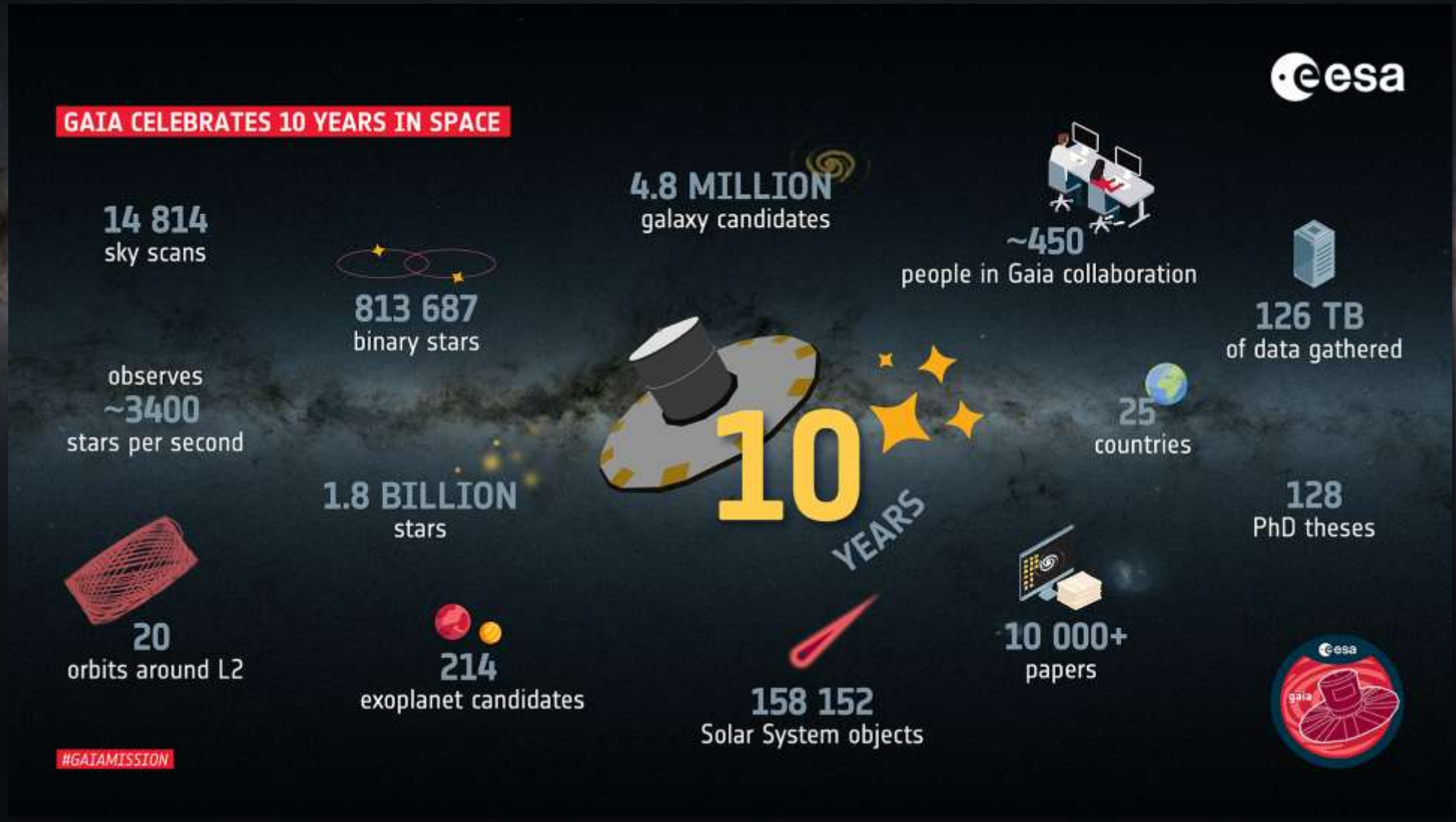
Gaia – Galactic Revolution



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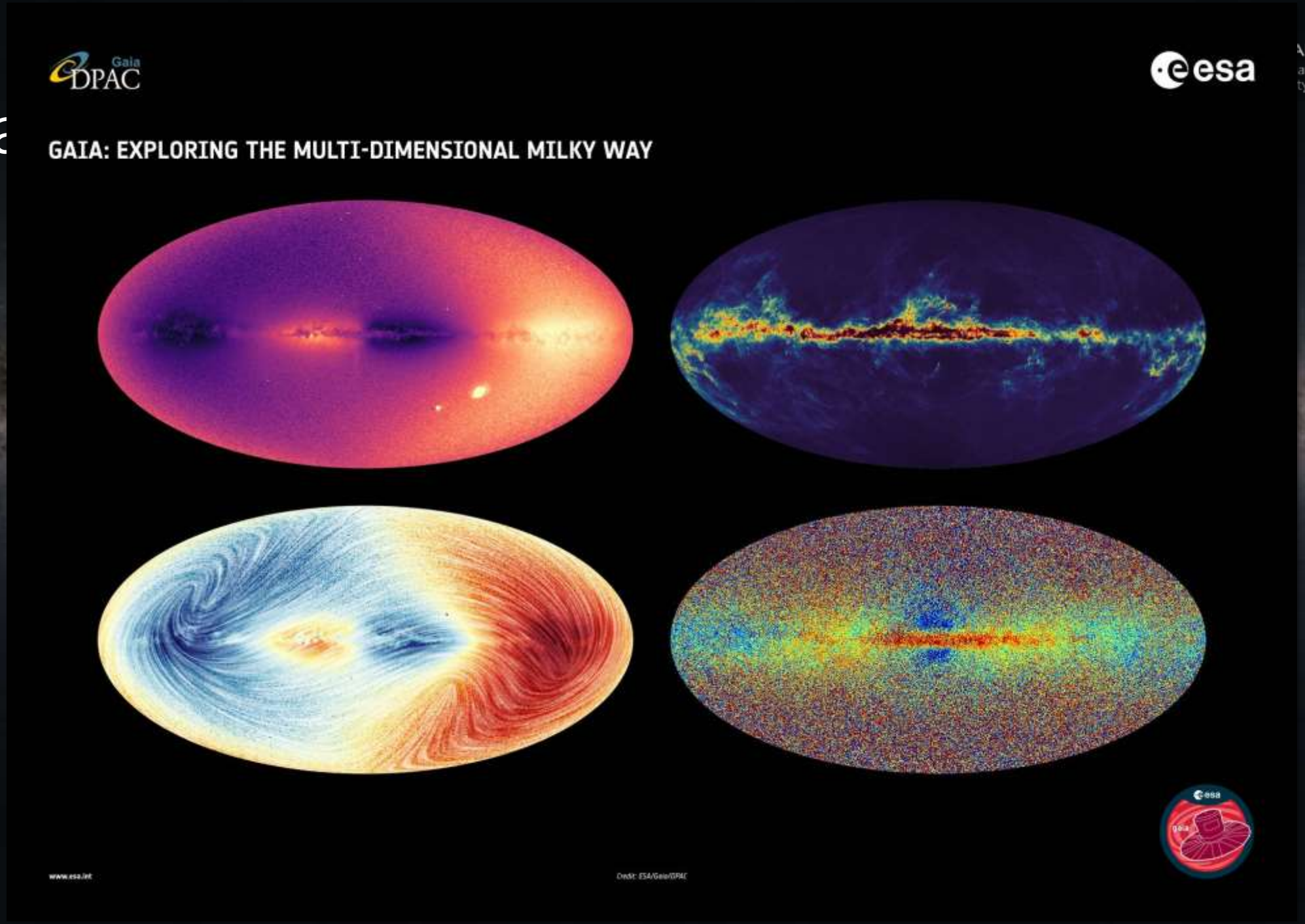

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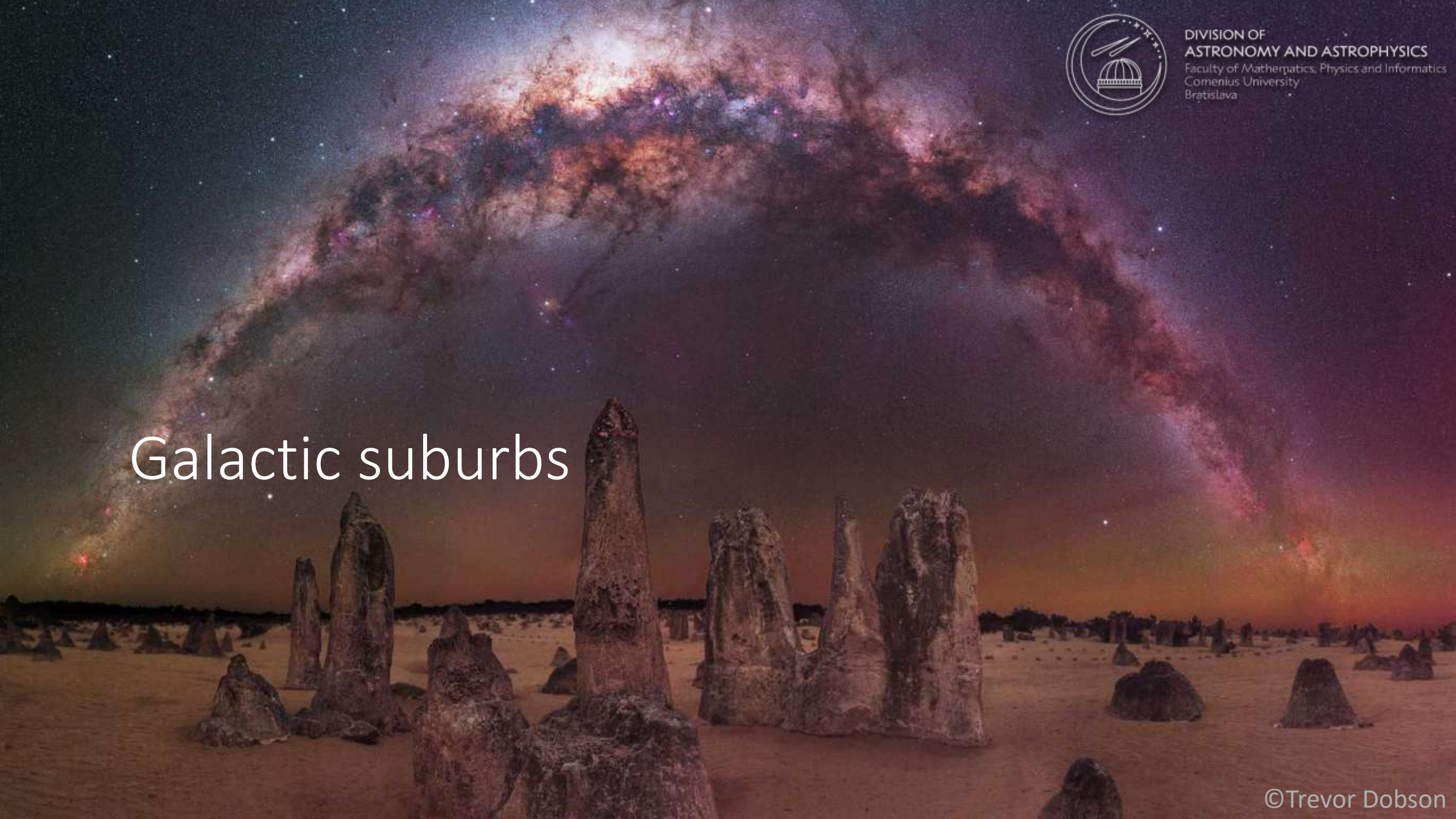

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Galactic suburbs

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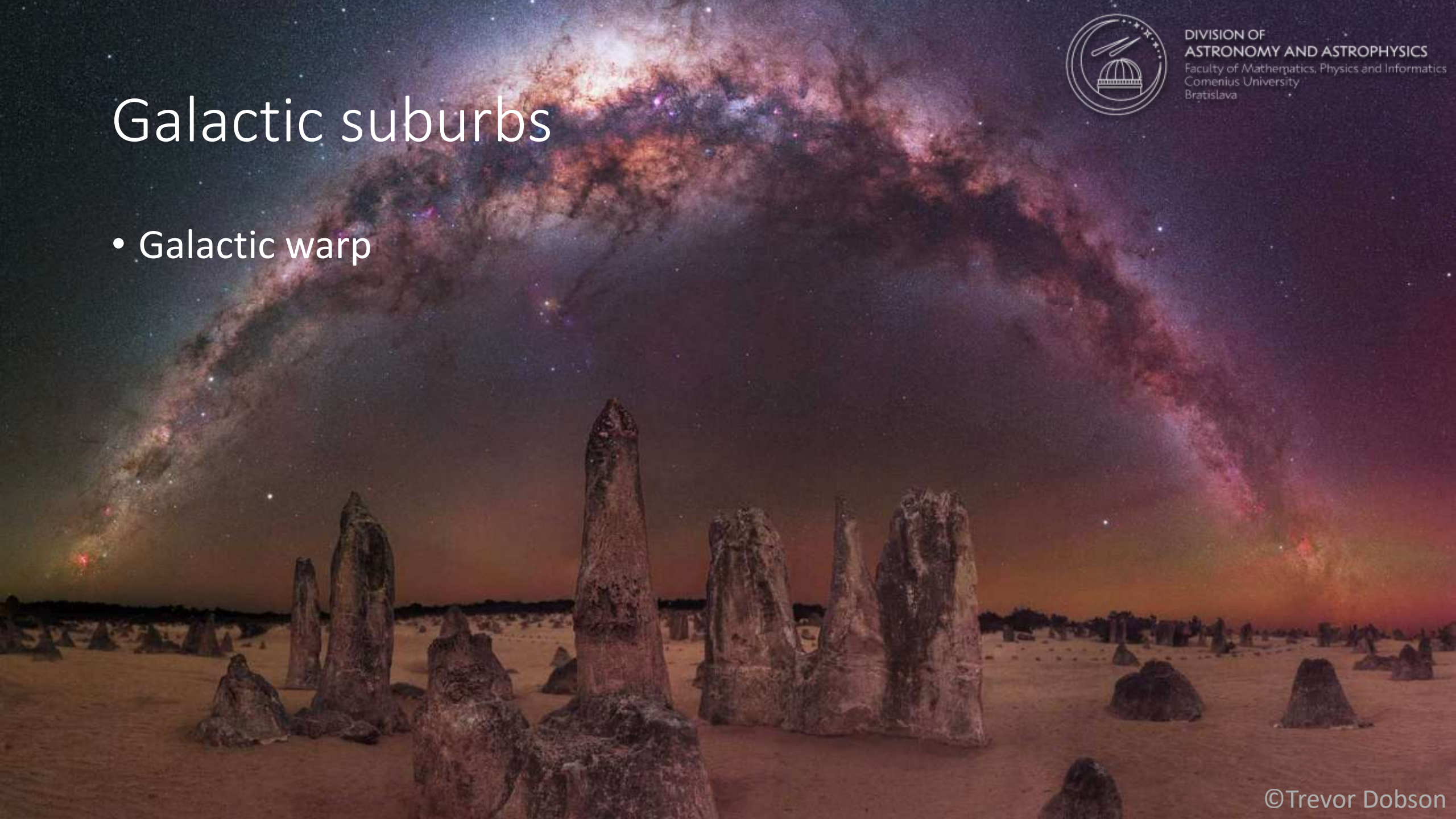
Galactic suburbs

- Galactic warp



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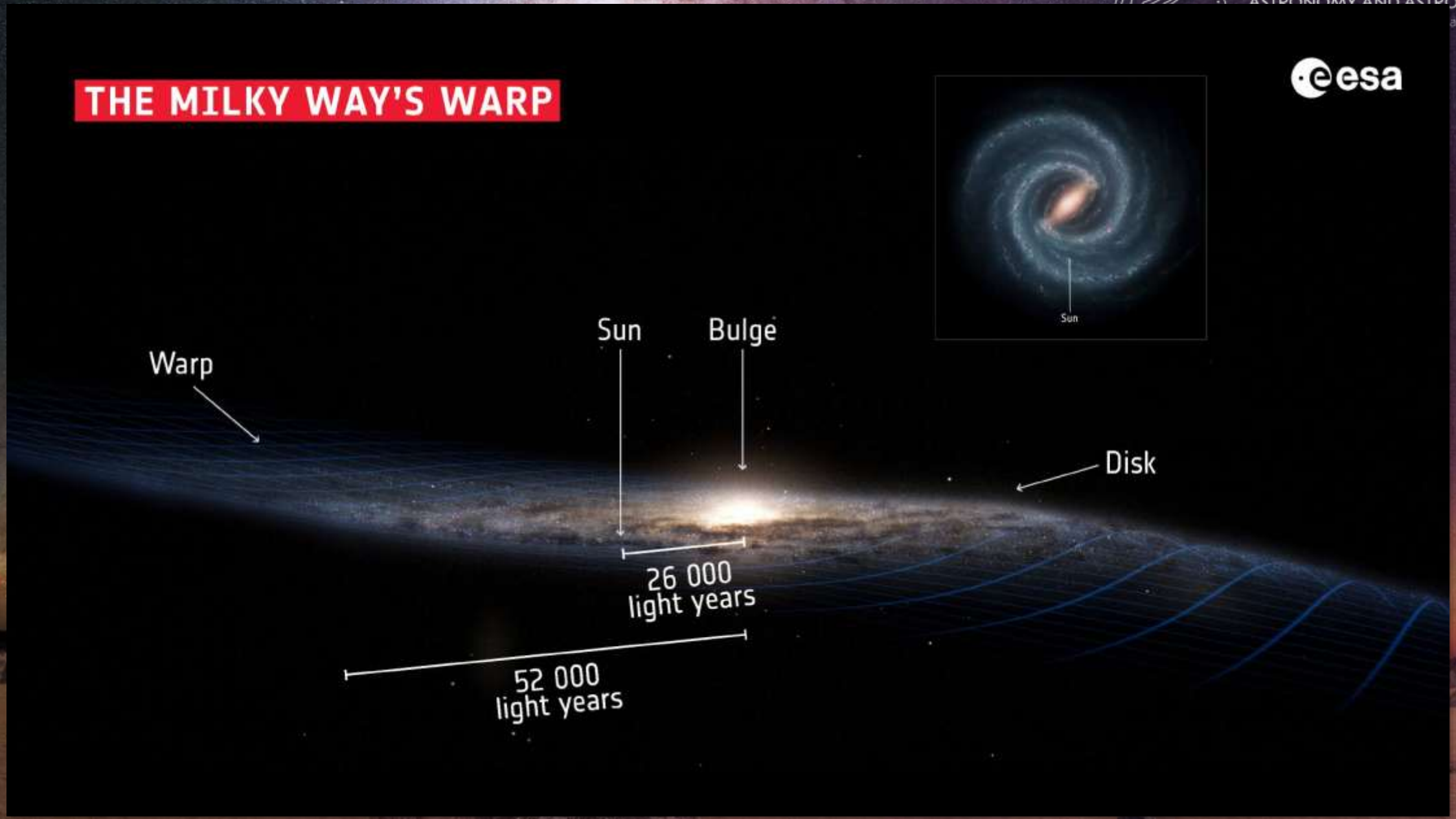

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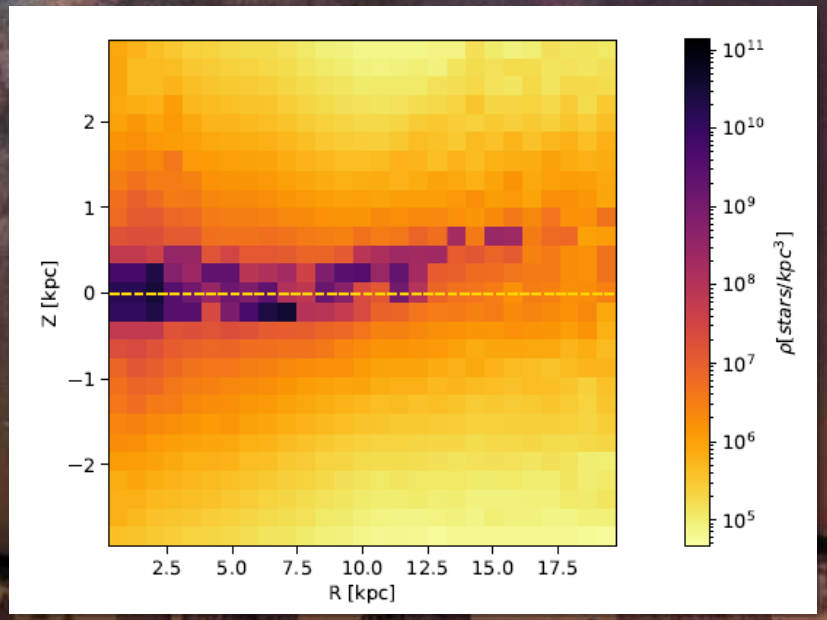
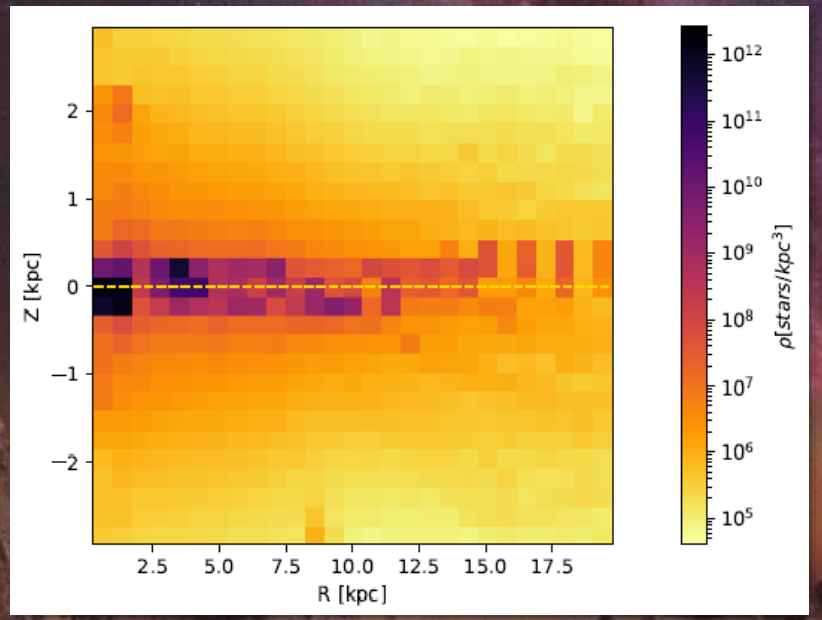
Galactic suburbs

- Galactic warp





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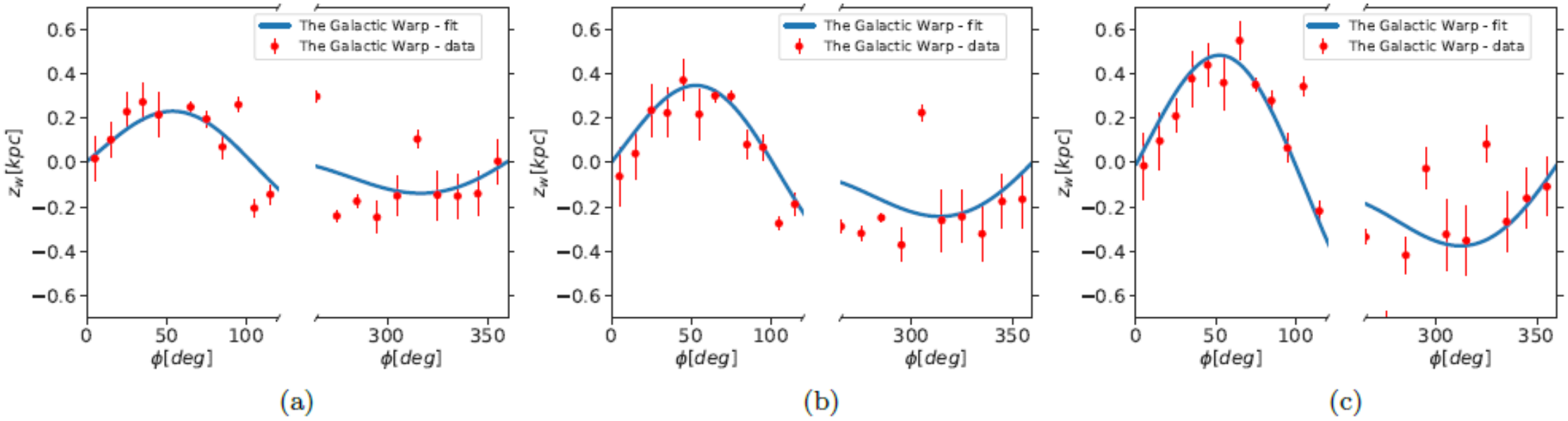
- Galactic warp



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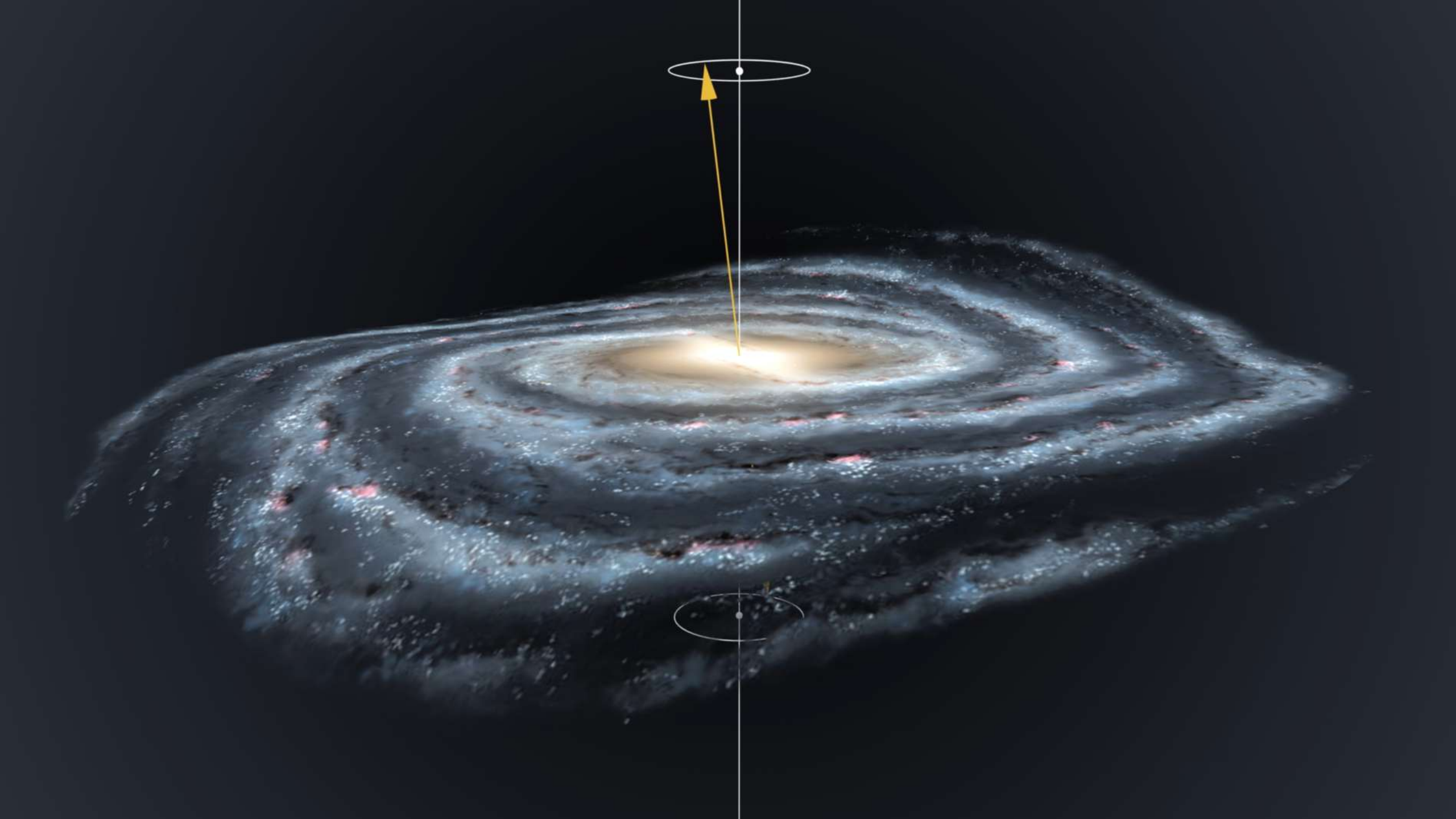

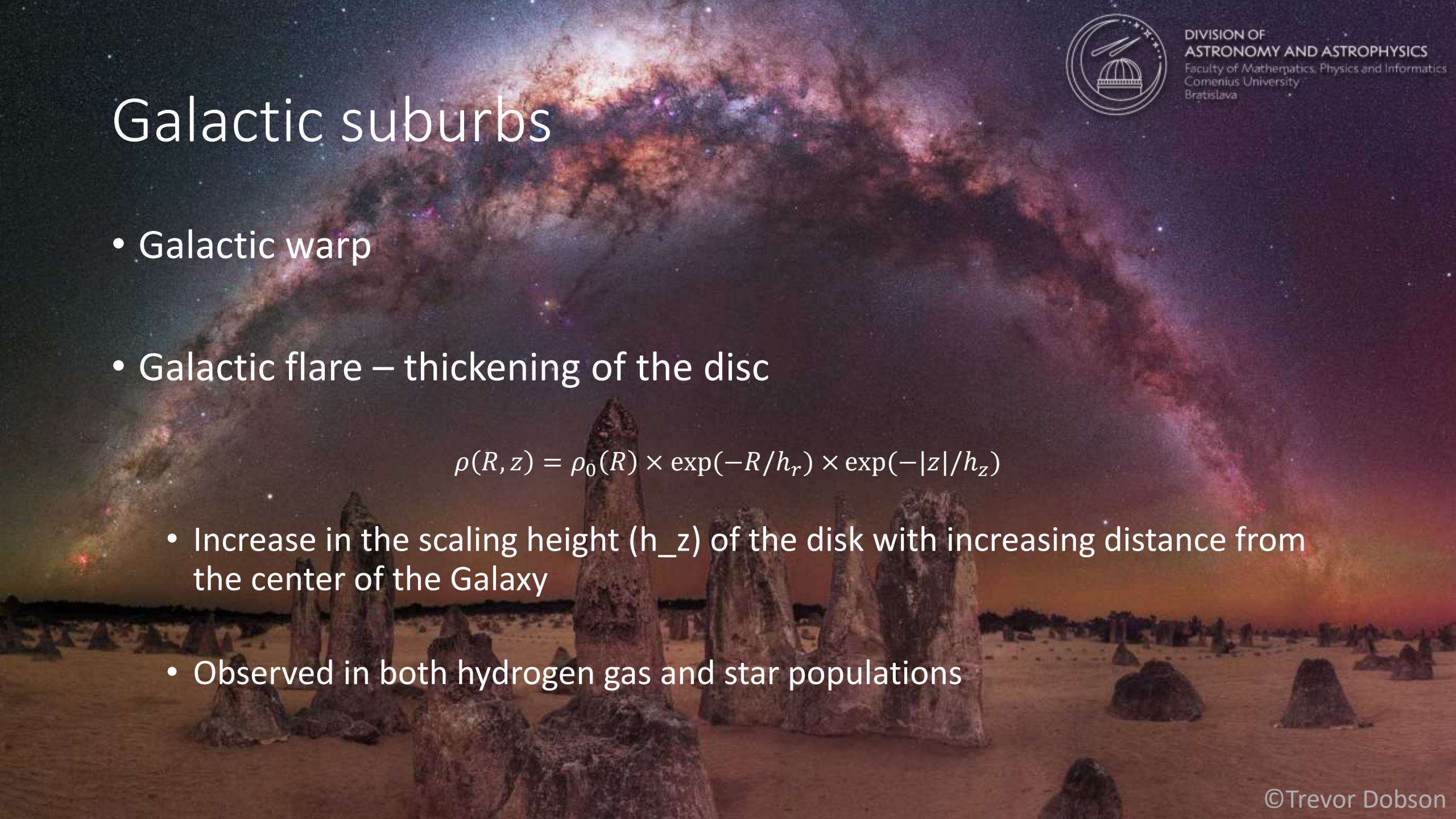

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Galactic suburbs

- Galactic warp

- Galactic flare – thickening of the disc

$$\rho(R,z) = \rho_0(R) \times \exp(-R/h_r) \times \exp(-|z|/h_z)$$

  - Increase in the scaling height (h_z) of the disk with increasing distance from the center of the Galaxy

  - Observed in both hydrogen gas and star populations

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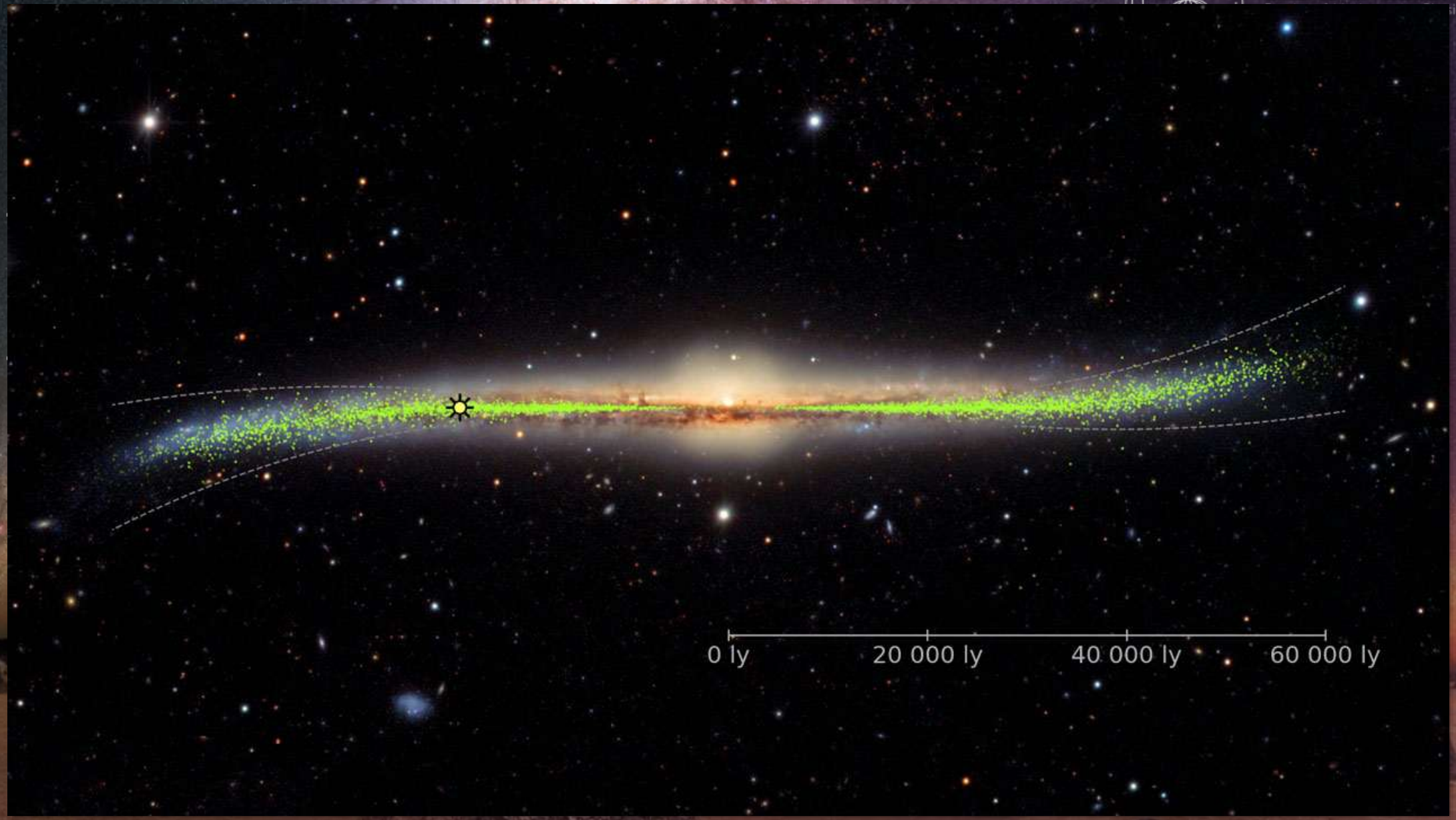

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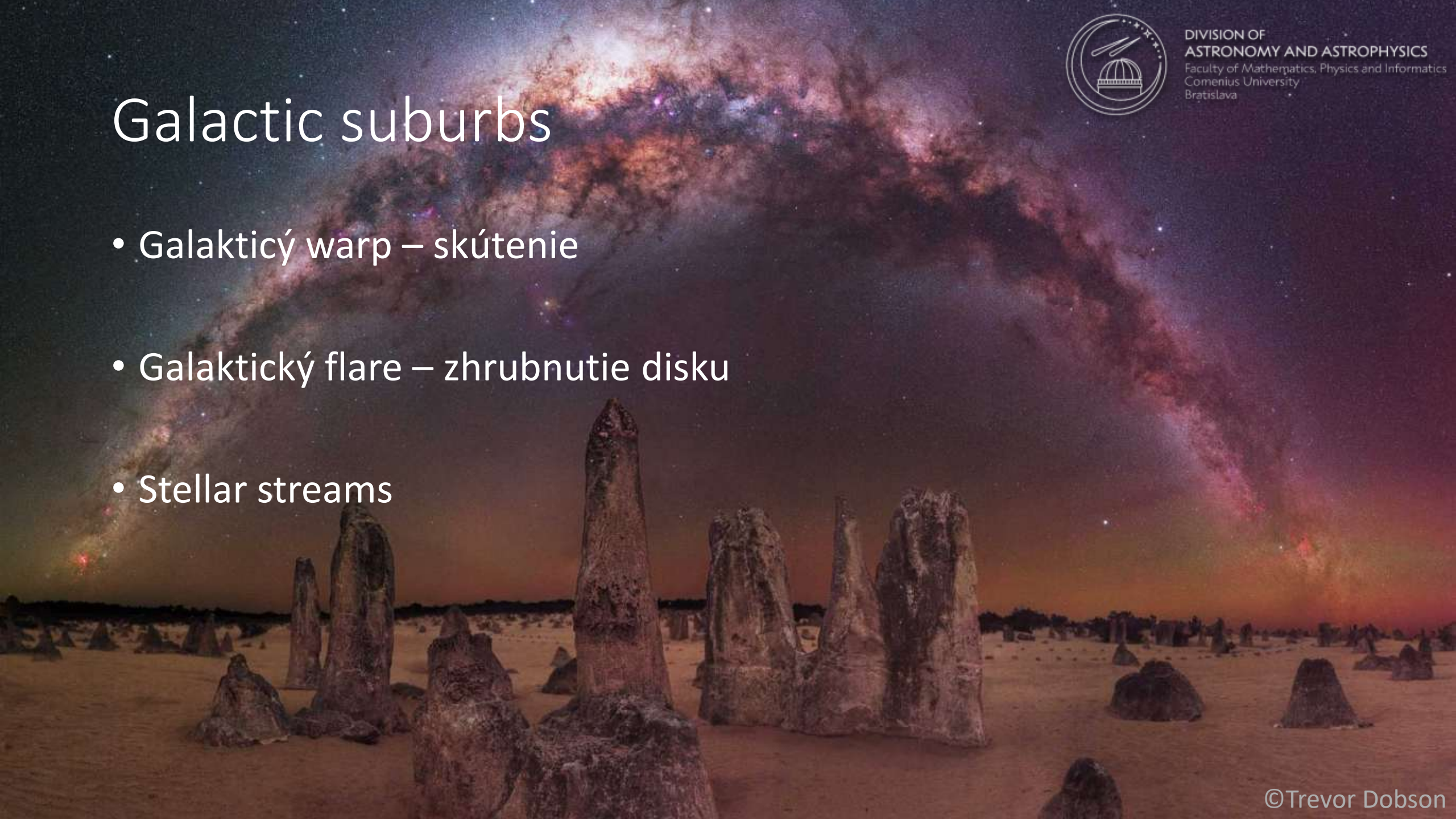

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Galactic suburbs

- Galakticý warp – skútenie
- Galaktický flare – zhrubnutie disku
- Stellar streams

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Galactic suburbs

-
-
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Goodbye Gaia – March 25

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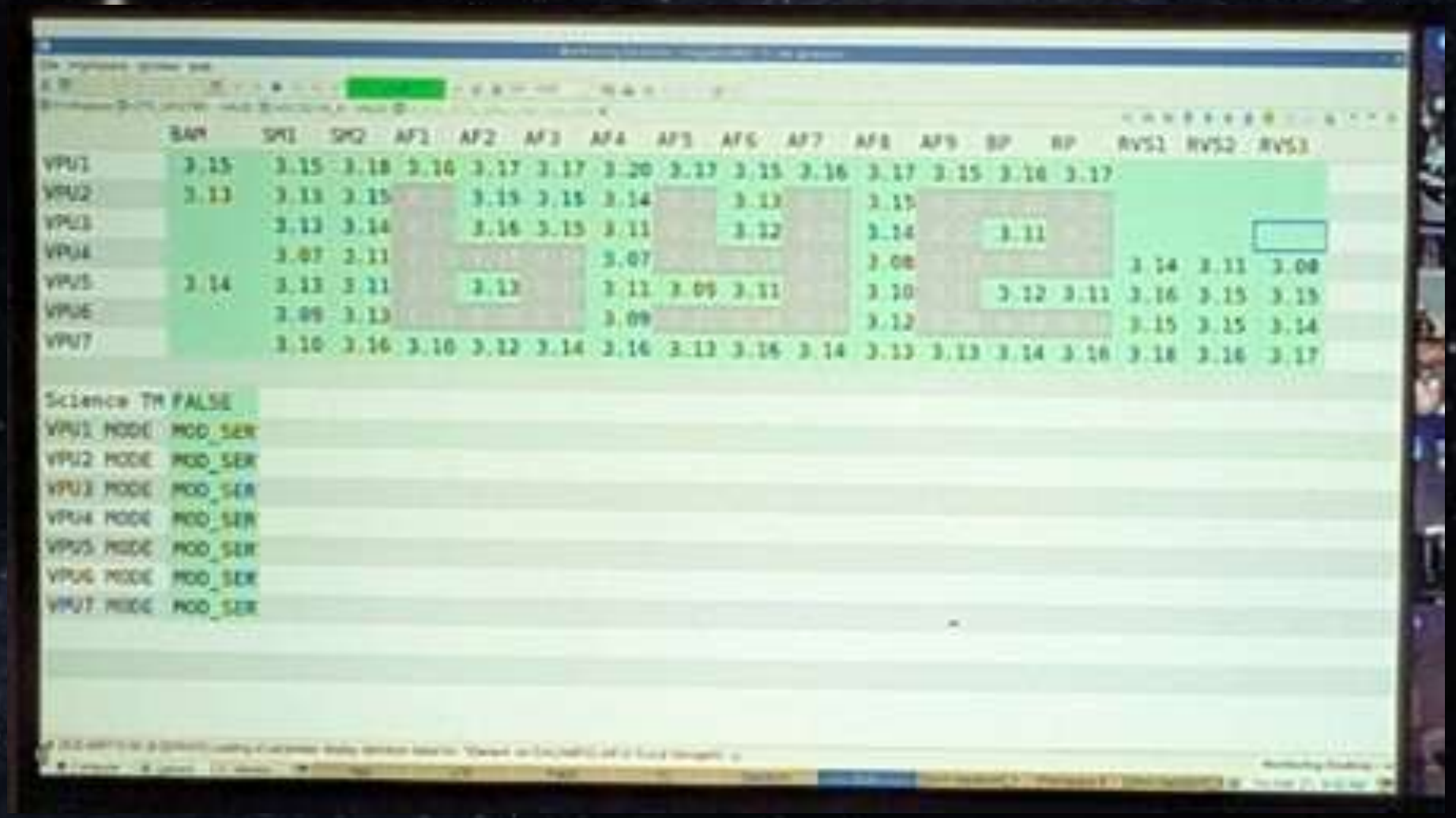

	BAM	SM1	SM2	AF1	AF2	AF3	AF4	AF5	AF6	AF7	AF8	AF9	BP	RP	RVS1	RVS2	RVS3
VPU1	3.15	3.15	3.18	3.16	3.17	3.17	3.20	3.17	3.15	3.16	3.17	3.15	3.16	3.17			
VPU2	3.13	3.13	3.15		3.15	3.15	3.14		3.13		3.15						
VPU3		3.13	3.14		3.16	3.15	3.11		3.12		3.14		3.11				
VPU4		3.07	3.11				3.07				3.08				3.14	3.11	3.08
VPU5	3.14	3.13	3.11		3.13		3.11	3.09	3.11		3.10		3.12	3.11	3.16	3.15	3.15
VPU6		3.09	3.13				3.09				3.12				3.15	3.15	3.14
VPU7		3.10	3.16	3.10	3.12	3.14	3.16	3.13	3.16	3.14	3.13	3.13	3.14	3.16	3.18	3.16	3.17

Science TM	FALSE
VPU1 MODE	MOD_SER
VPU2 MODE	MOD_SER
VPU3 MODE	MOD_SER
VPU4 MODE	MOD_SER
VPU5 MODE	MOD_SER
VPU6 MODE	MOD_SER
VPU7 MODE	MOD_SER

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Euclid – Extragalactic Revolution

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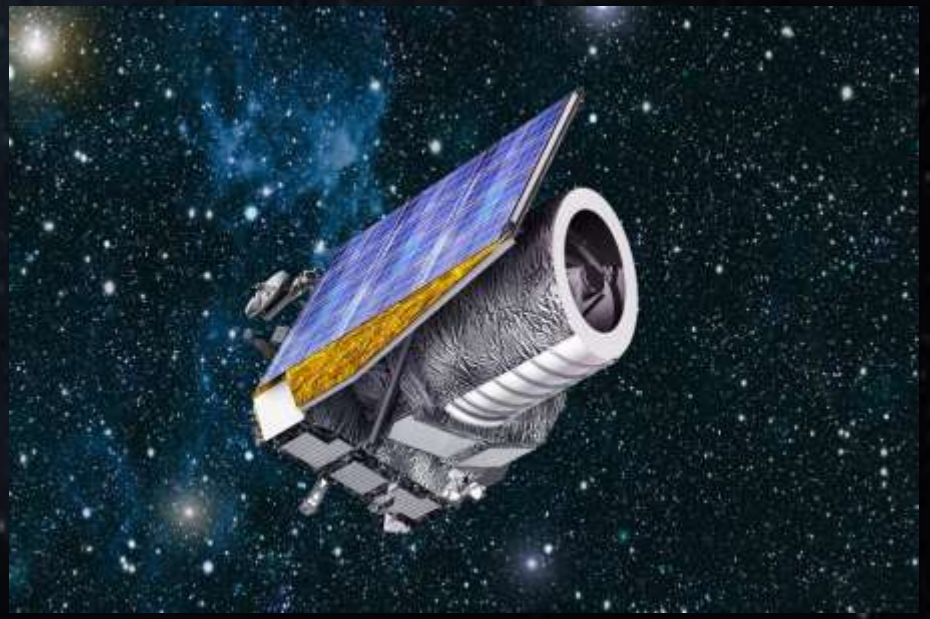
Euclid – Deep Space Exploration

- 2023, first data 2025
- ESA mission in L2
- 600 mpx camera, 0,5 deg x 0,5 deg
- 1,2m diameter in optical and near IR

- Photometric and spectroscopic

The brightness of galaxies

Radial velocity



Eu

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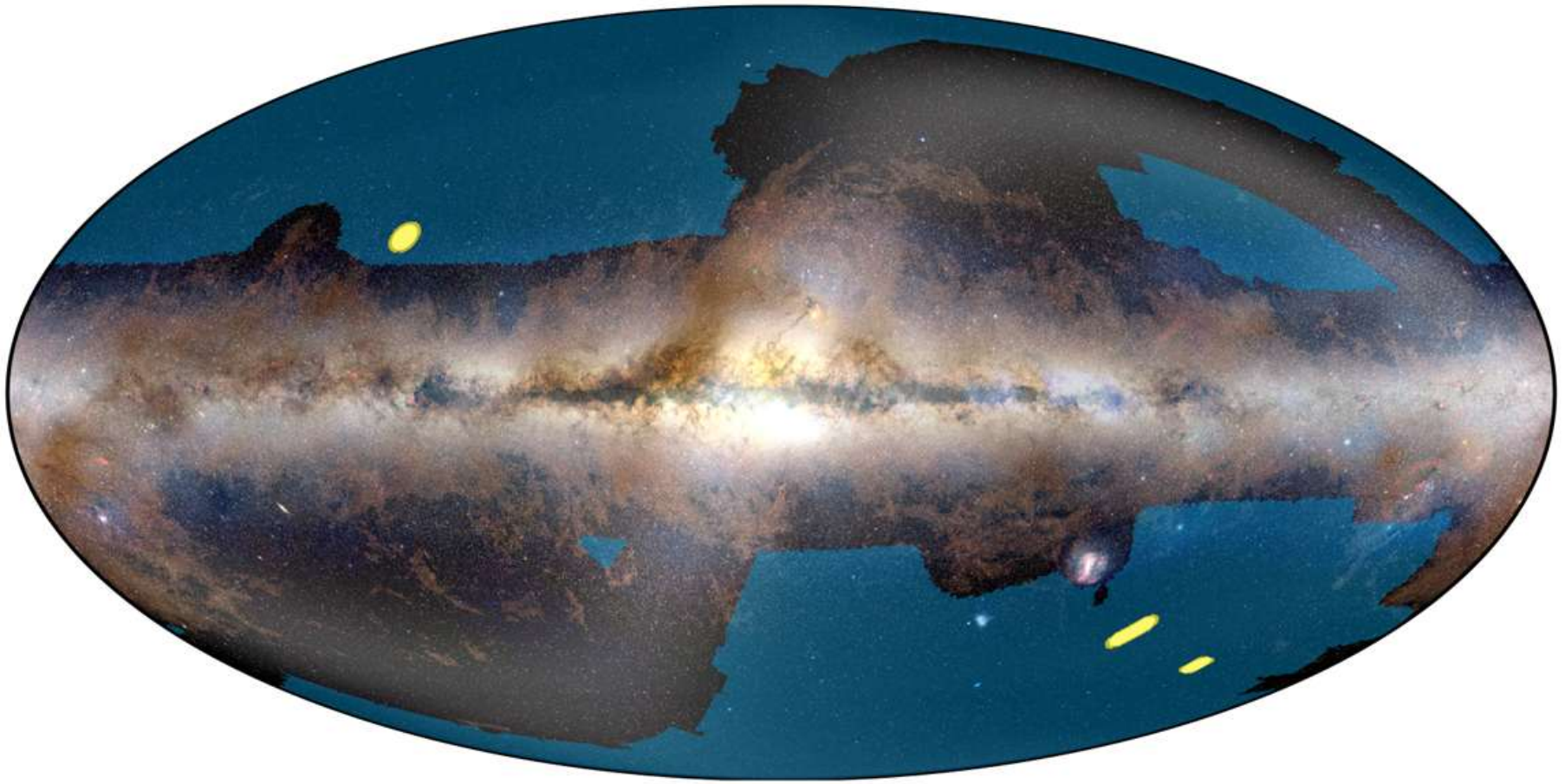

The Euclid Wide Survey and the Euclid Deep Survey

Euclid Wide Survey : 13,345 deg^2 in 6 years, avoiding the galactic plane (stars, dust) and the ecliptic plane (zodiacal light)

Euclid Deep Fields : North=20 deg^2 (top left), Fornax=10 deg^2 (bottom right), South=23 deg^2 [+ extended coverage]

⇒ The Euclid survey focuses on the two galactic caps to explore the extragalactic sky (total coverage = 2200 deg^2/year)

Background: Euclid Consortium / Planck Collaboration / A. Mellinger

The brightne
of galaxies

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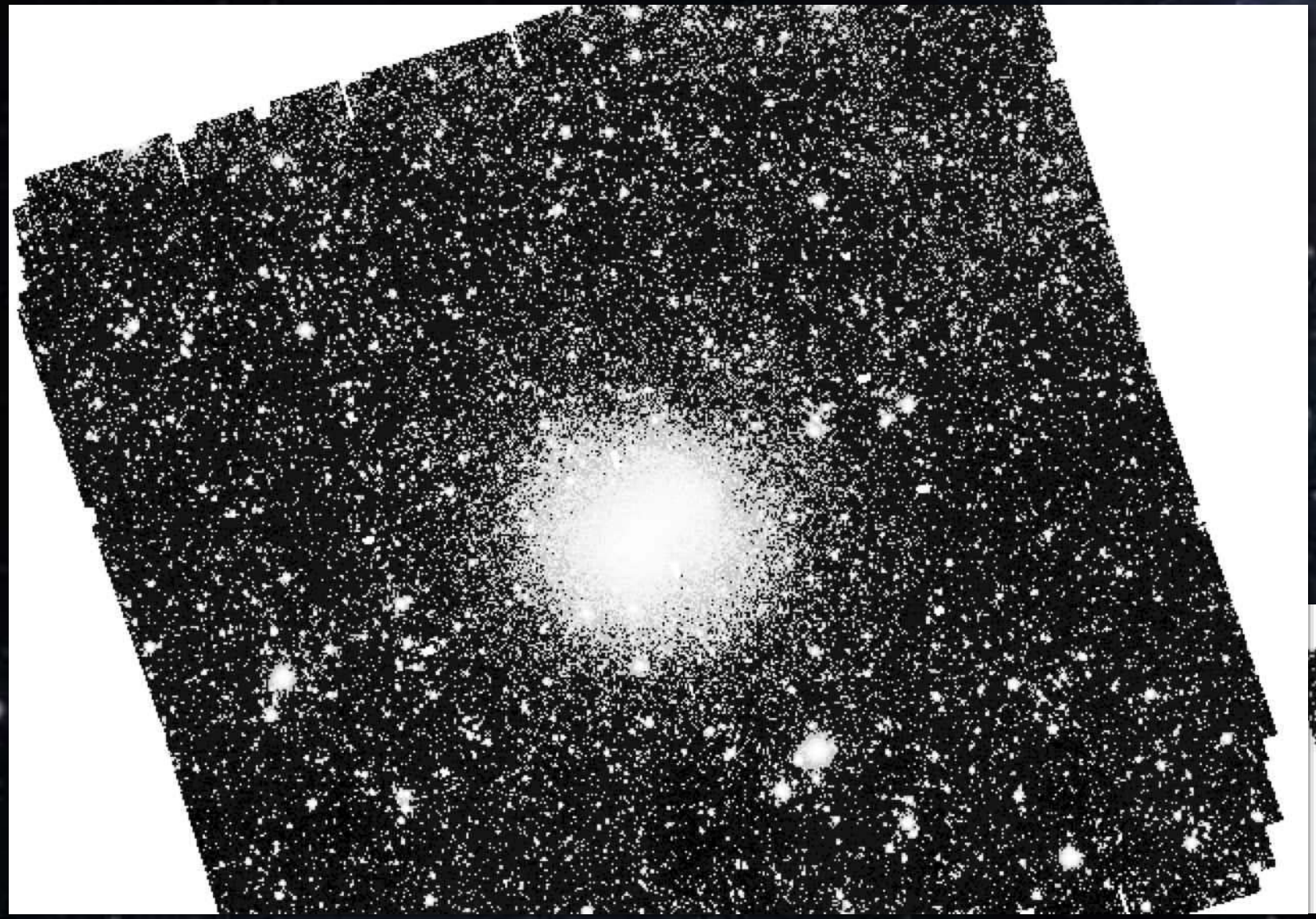

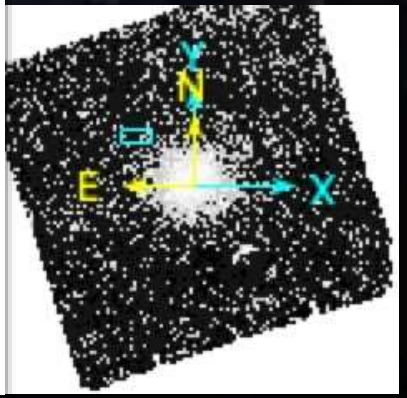

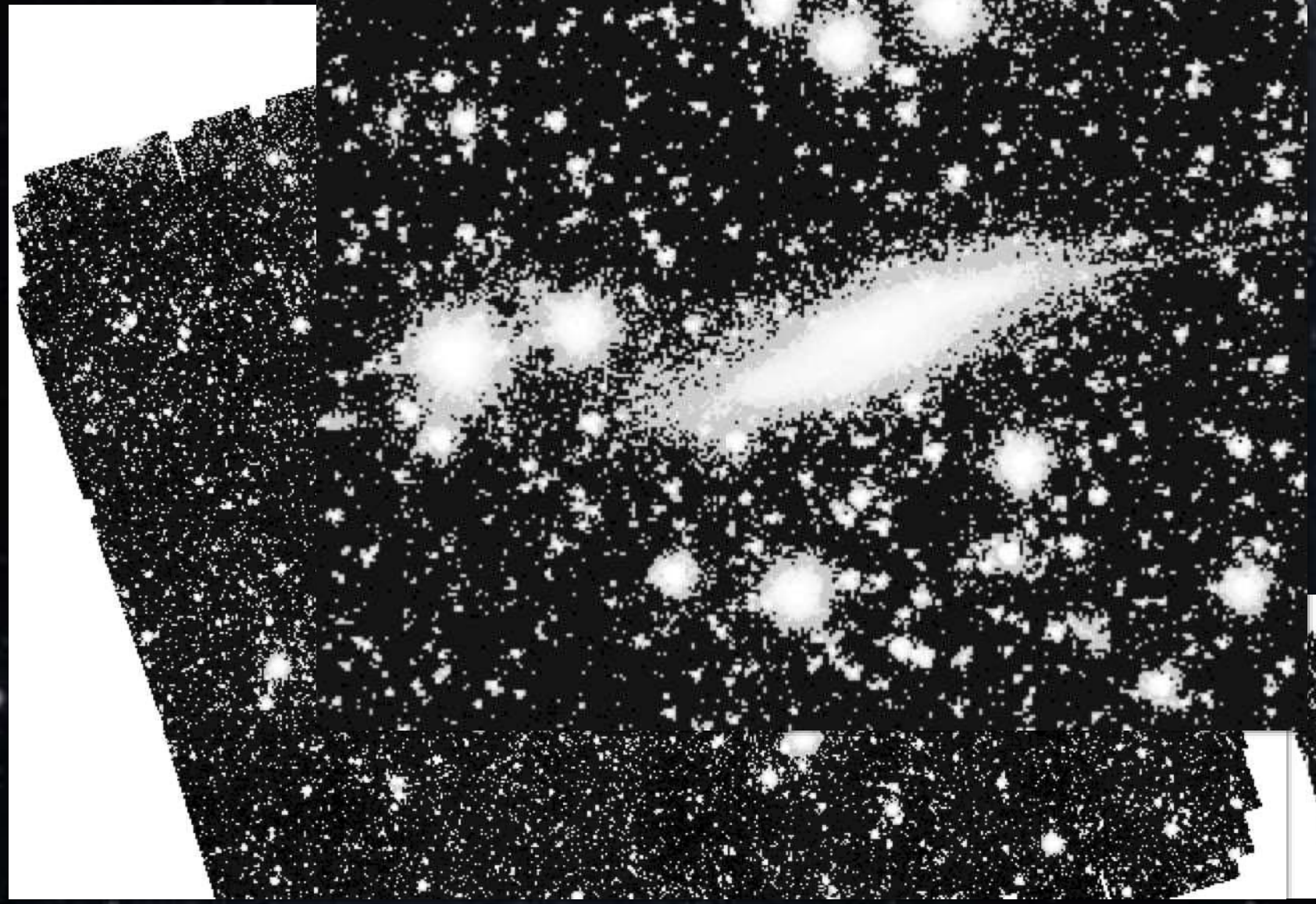

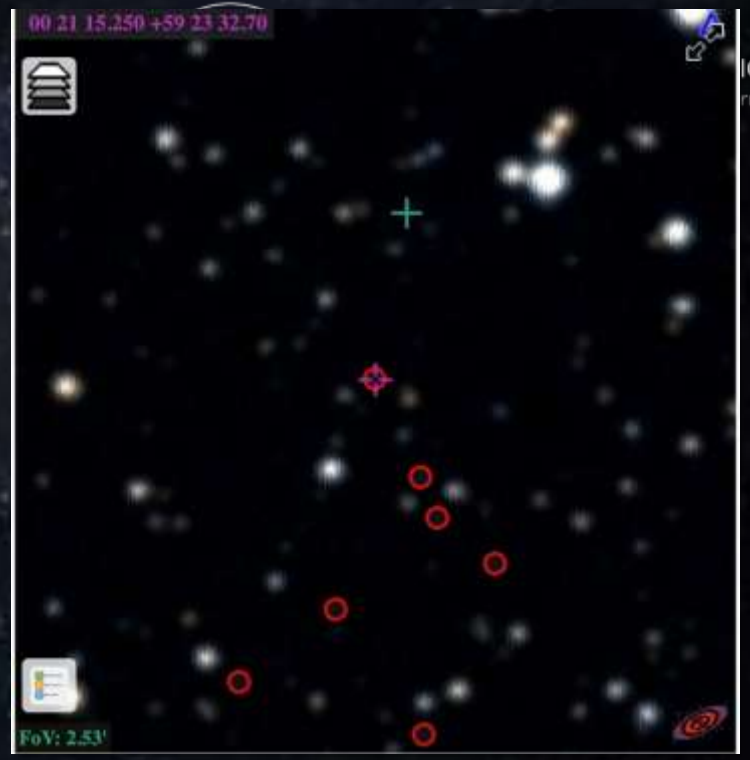
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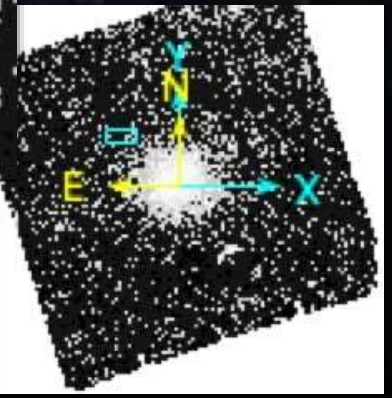
FoV: 2.53'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Galactic Warp and Other Galaxies

- Time for AI... ML Methods for Galactic Warp Detection
- UCL London, TUKE Košice, Comenius University Bratislava
- SDSS DR7 - 15 000 galaxies

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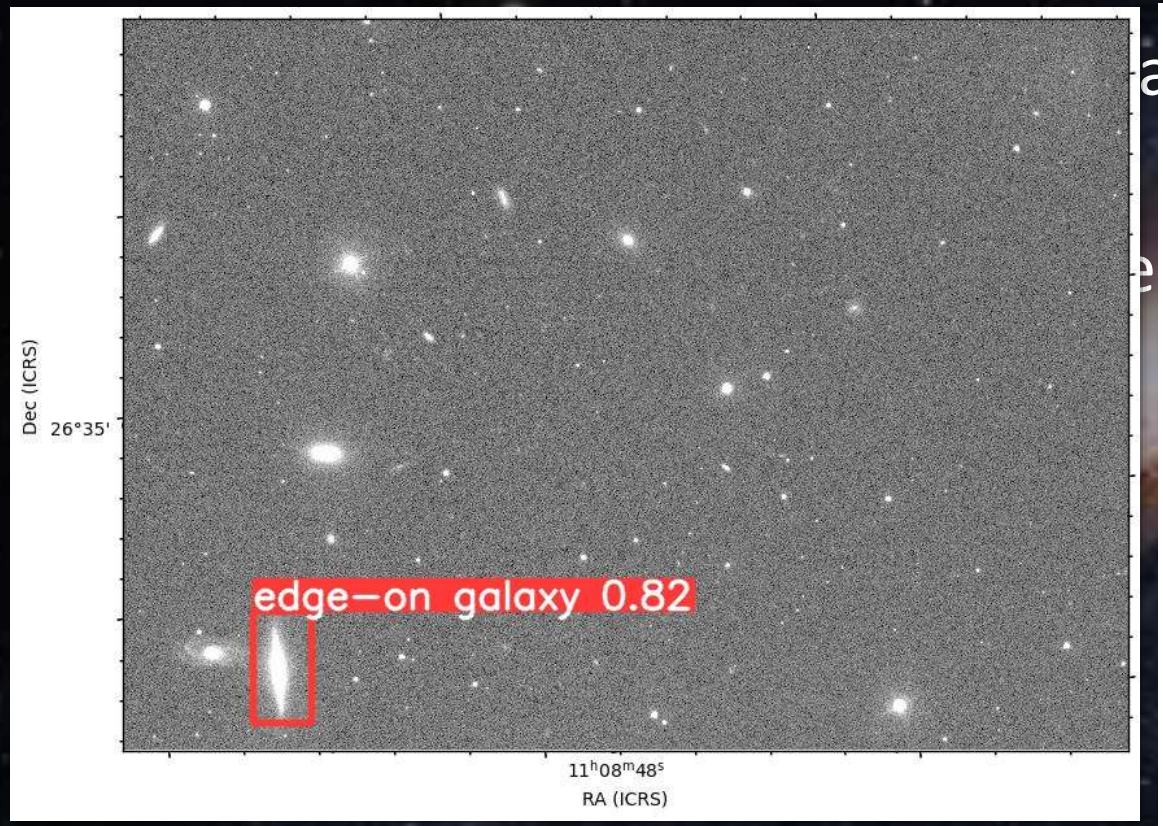

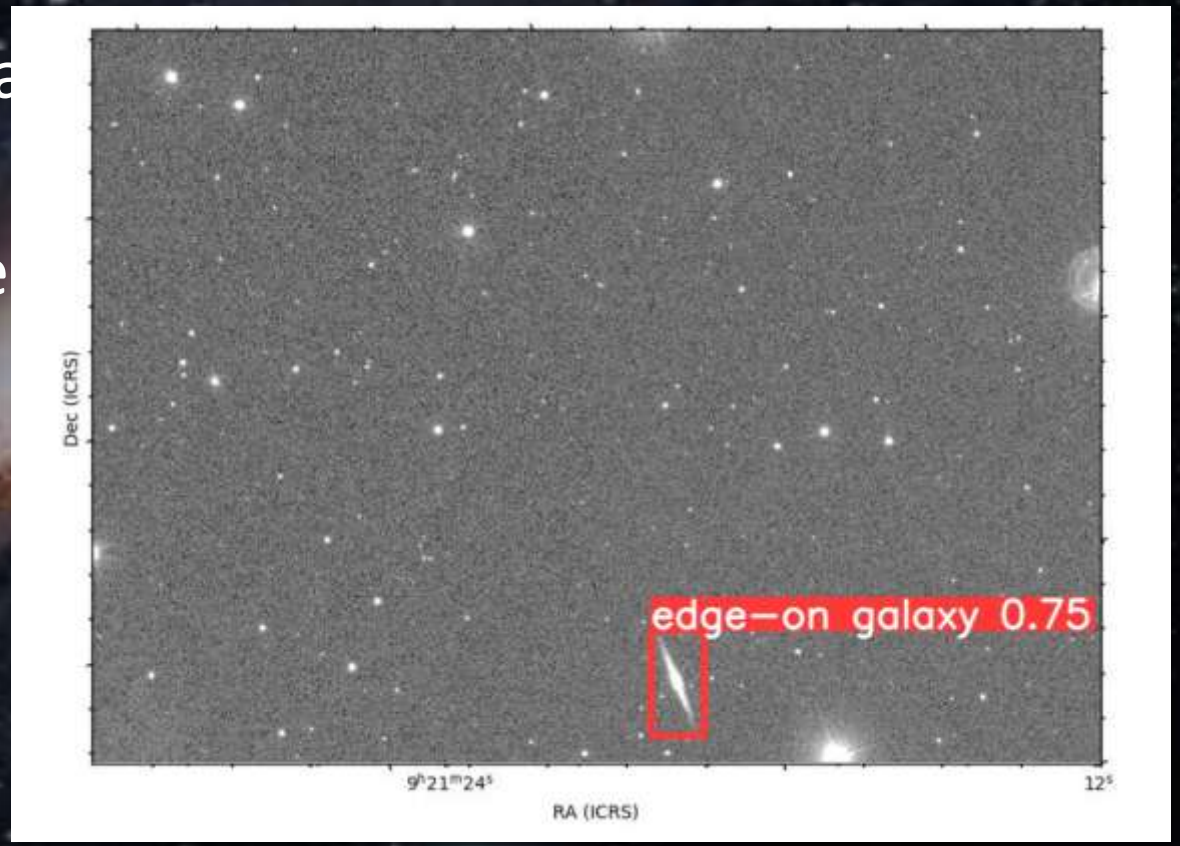

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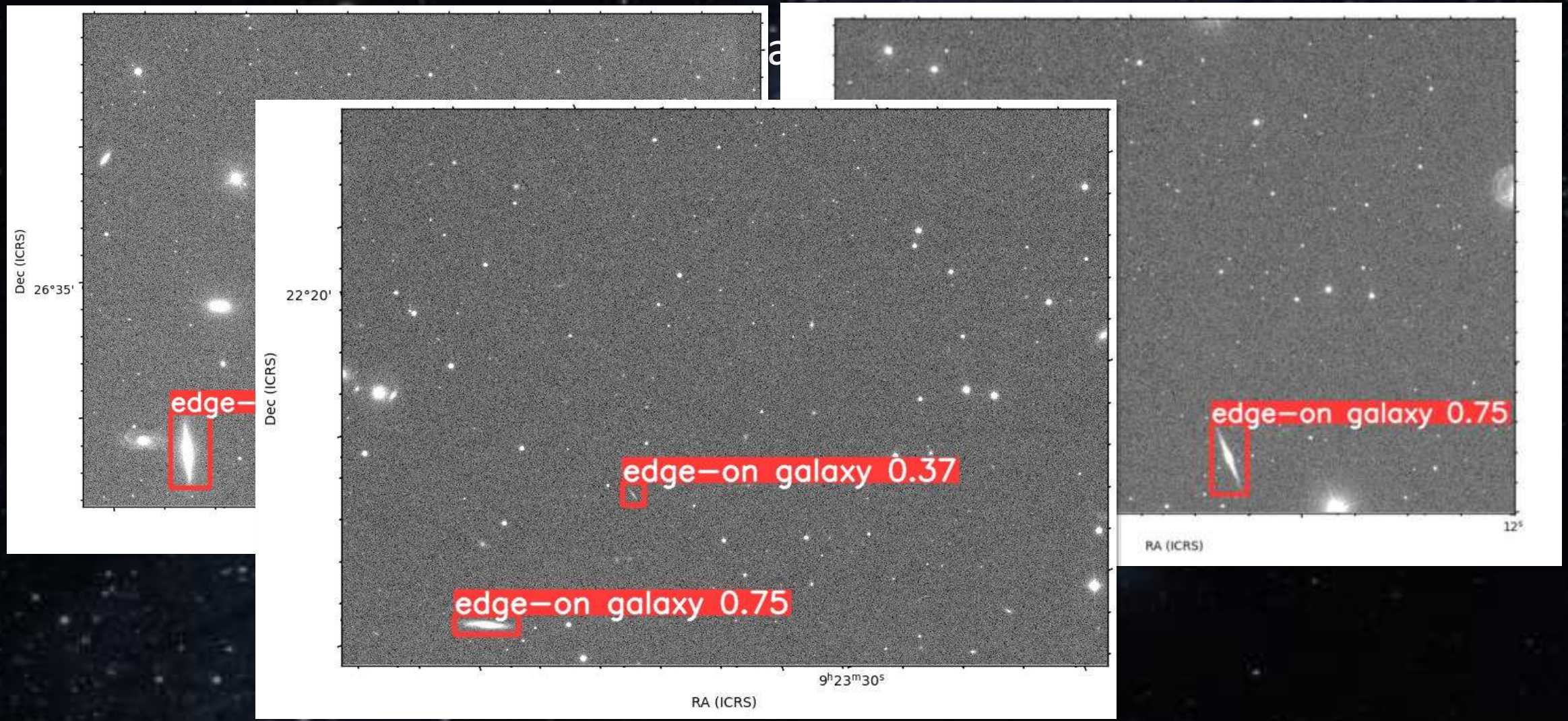
Galactic Warp and Other Galaxies



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Galactic Warp and Other Galaxies

- Time for AI... ML Methods for Galactic Warp Detection
- UCL London, TUKE Košice, Comenius University Bratislava
- SDSS DR7 - 15 000 galaxies
- Zooniverse for galaxy annotation
- YOLOv5

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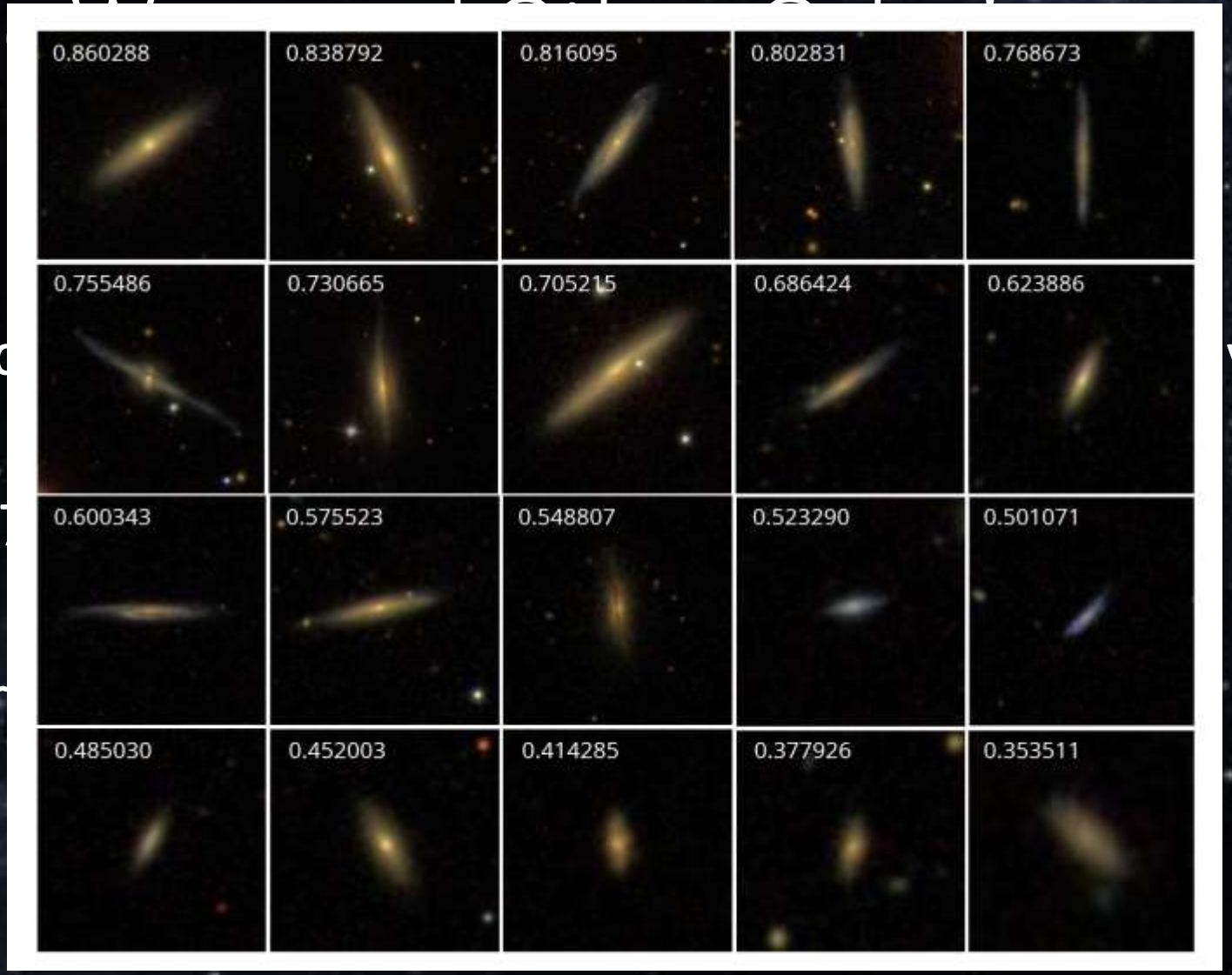
Galacti

- Time for
- UCL Lond va
- SDSS DR
- Zooniver
- YOLOv5



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Galacti

- Time for
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- Zooniver
- YOLOv5

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CrossMark

Deep Learning-based Detection and Segmentation of Edge-on and Highly Inclined Galaxies

Ž. Chrobáková[1], V. Krešňáková[2], R. Nagy[3], J. Gazdová[2], and P. Butka[2]
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[2] Department of Cybernetics and Artificial Intelligence, Faculty of Electrical Engineering and Informatics, Technical University of Kosice, 042 00 Košice, Slovakia
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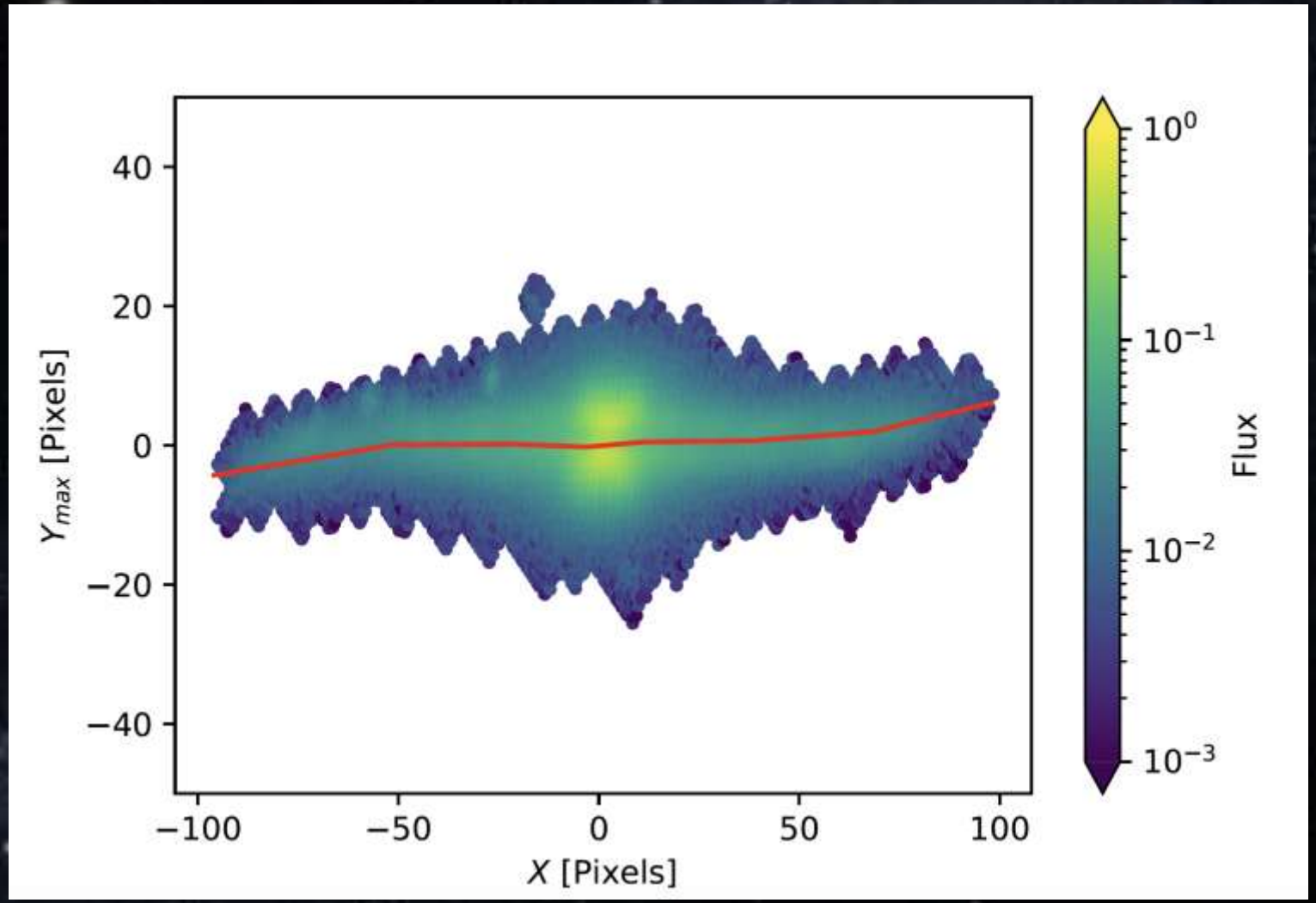
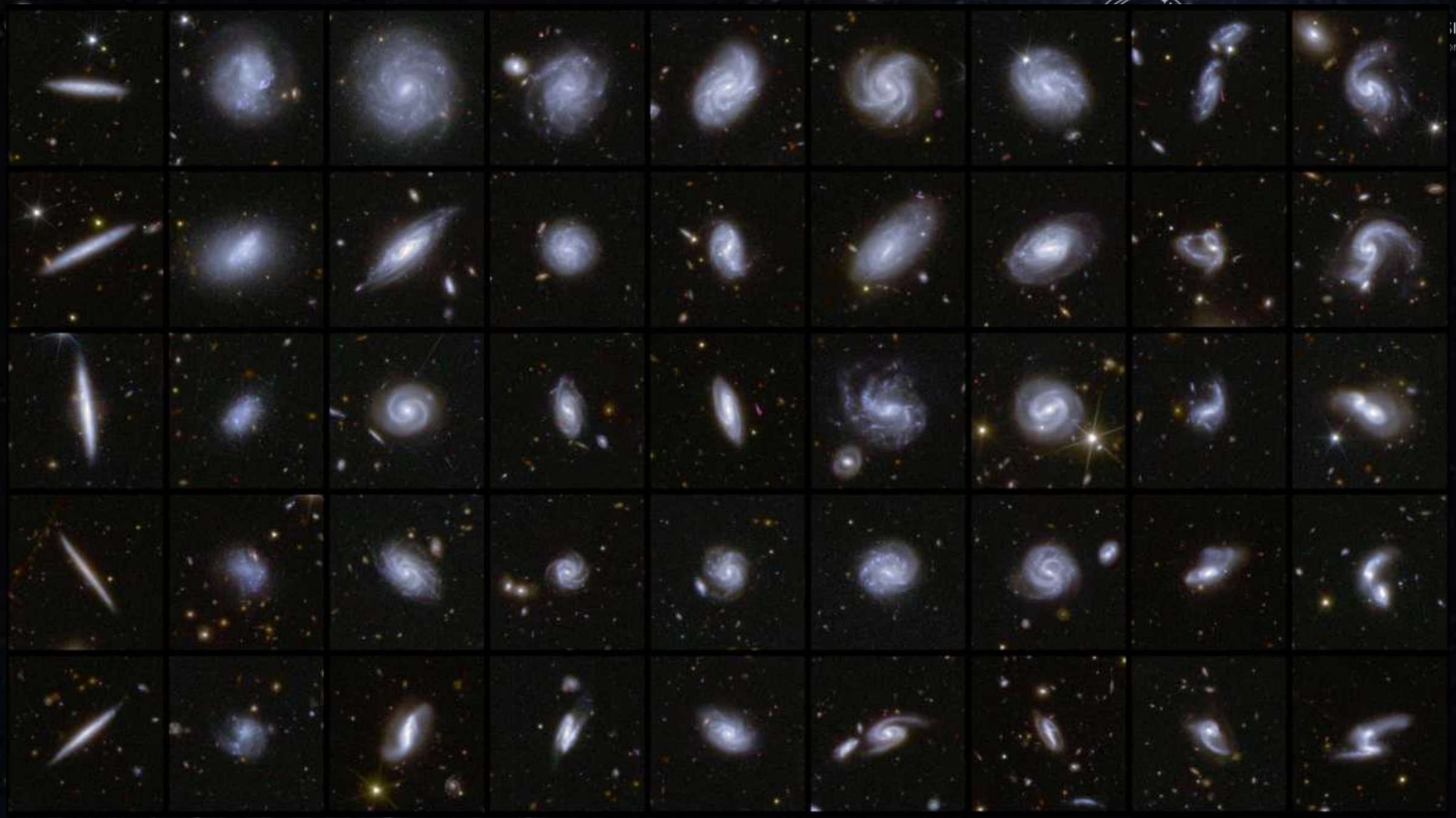
Extragalactic warps using AI





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Summary of the (Galactic) Revolution

- The Milky Way and its structures
- Gaia Mission – Galactic Revolution
- Structure of distant galactic corners
- Euclid – Extragalacric Revolution

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Thank you for your attention

roman.nagy33

GTC - 10,4m - najväčší optický ďalekohľad na svete
2 267 m n. m., La Palma, Kanárske ostrovy