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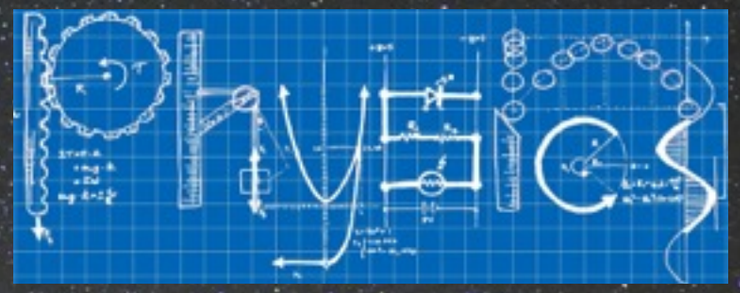
Astro  & High Performance Computing

Dr. Andreas Papadopoulos

30-31 January 2016

1ο Συνέδριο Φυσικής

AHPC

AHPC group @ EUC

www.ahpc.euc.ac.cy

Astrophysics & High Performance Computing

Members:

- Professor Andreas Efstathiou, EUC Vice-Rector
- Assistant Professor Vicky Papadopoulou Lesta
- Dr. Andreas Papadopoulos
- Dr. Natalie Christopher
- + new PhD student Feb2016
- + final year EUC students (senior project)

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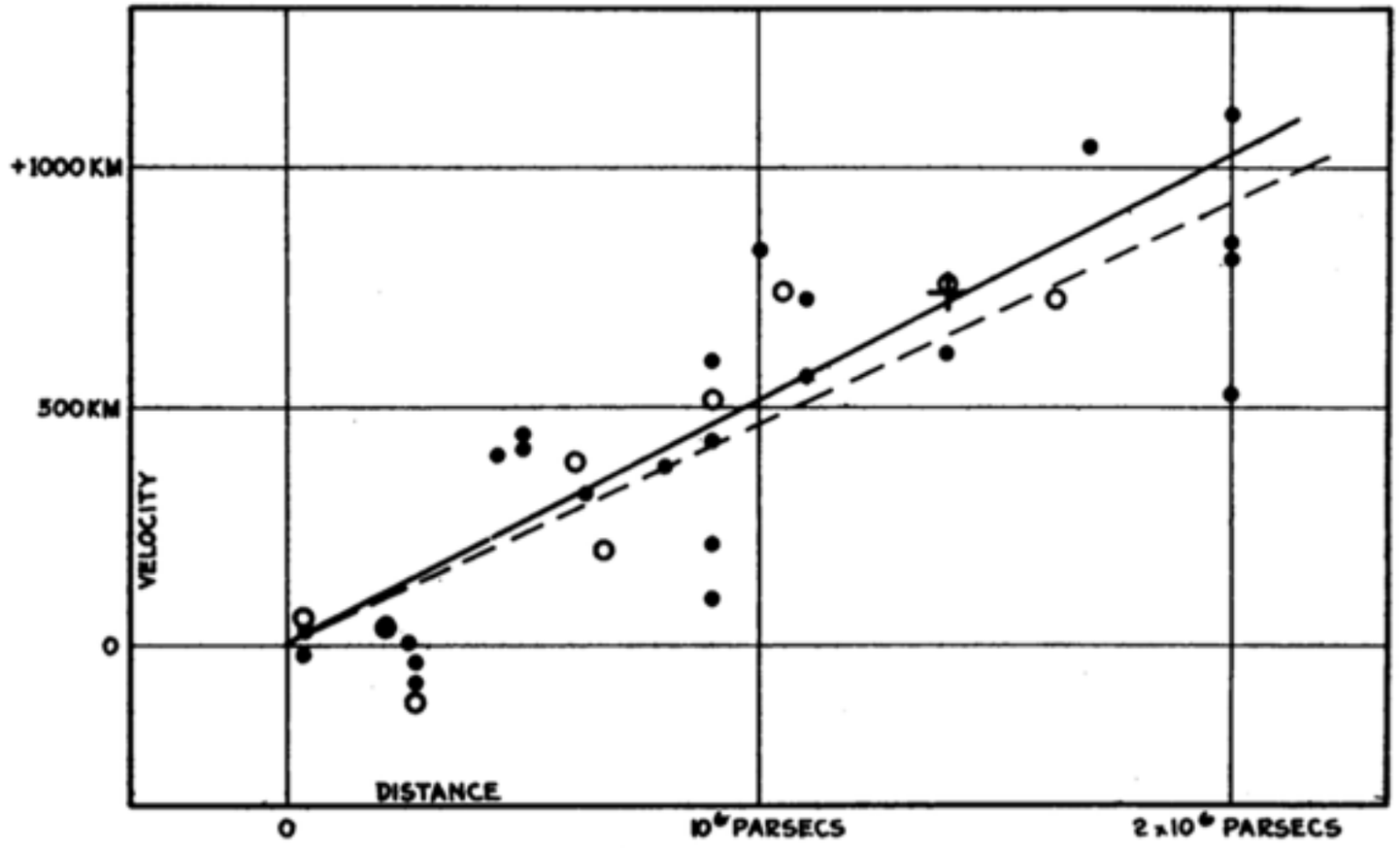
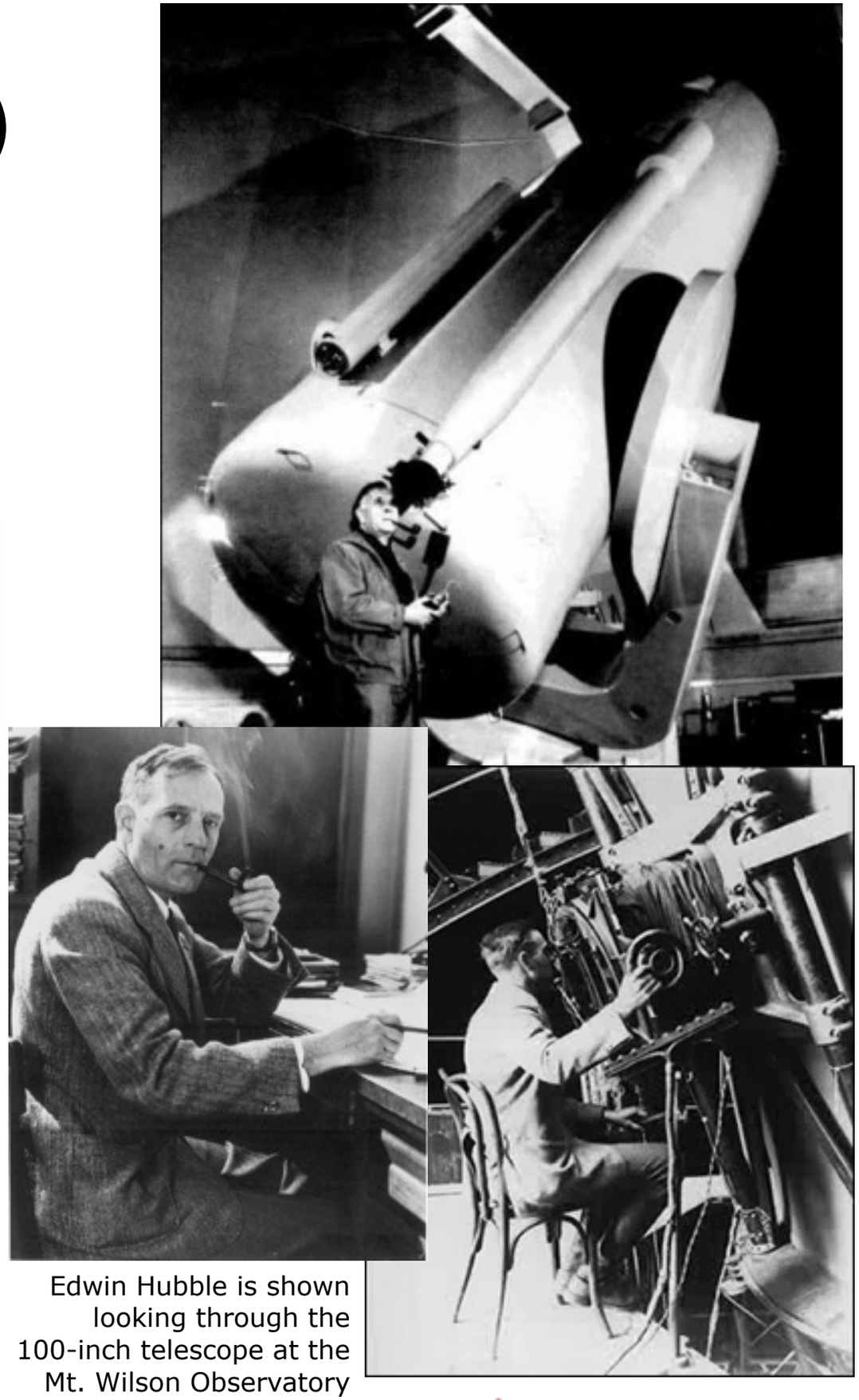
Astronomy (~1920s)



Galaxies further away are moving faster.

$$\upsilon = H_0 \times d$$

The Universe is Expanding!



Edwin Hubble is shown looking through the 100-inch telescope at the Mt. Wilson Observatory (photo date:~1922).

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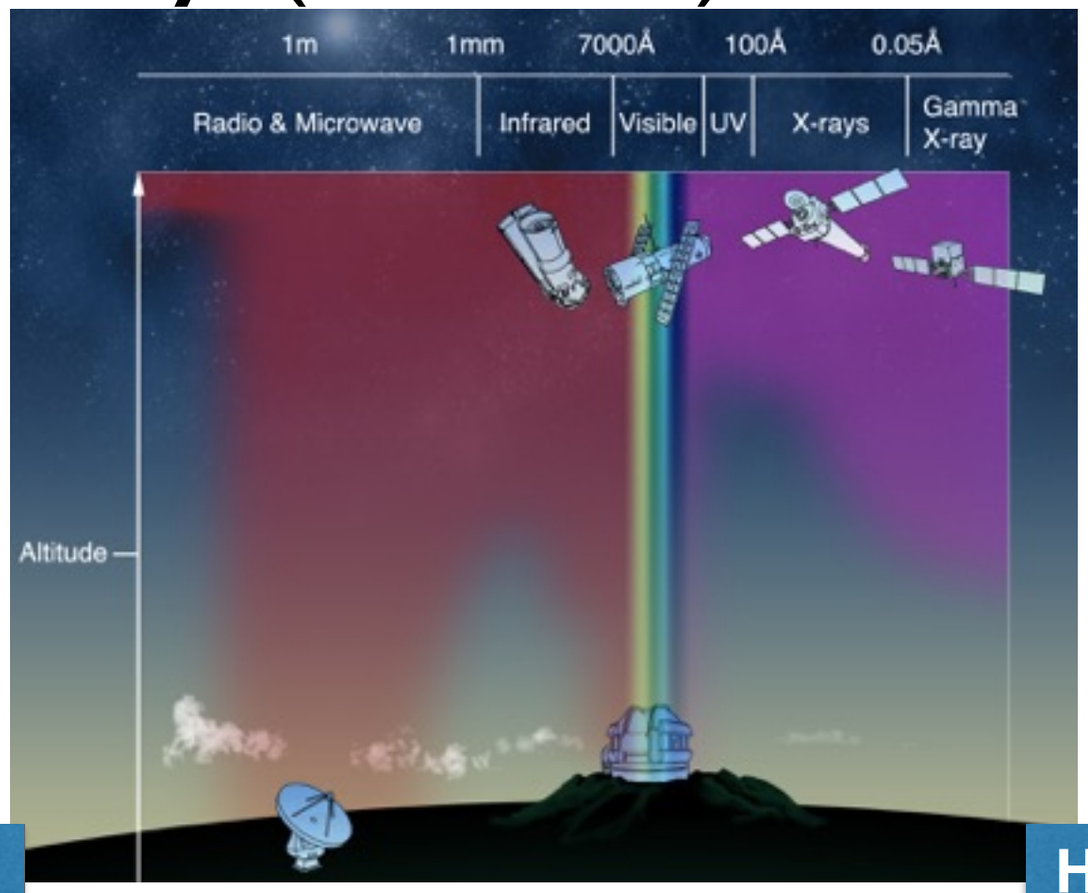
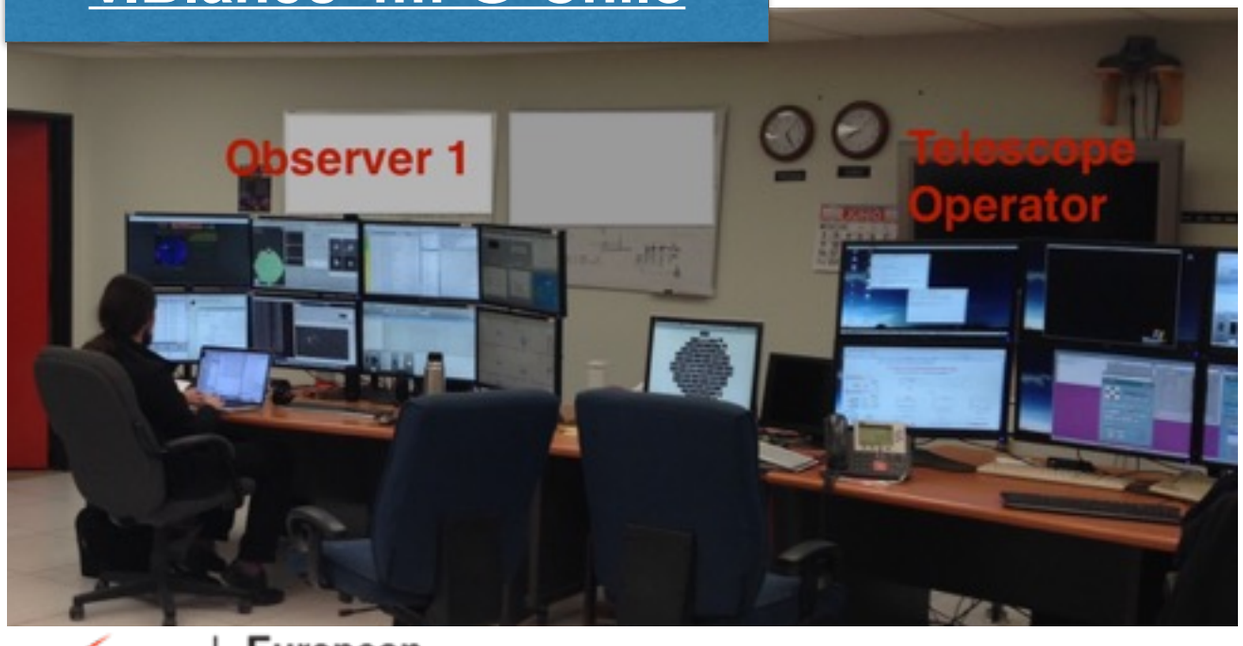
Astronomy (~2010s) + HPC

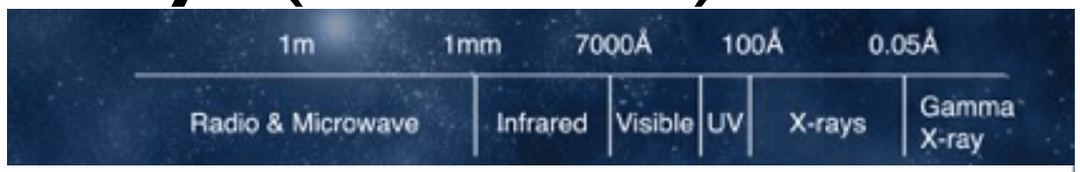
V.Blanco 4m @ Chile

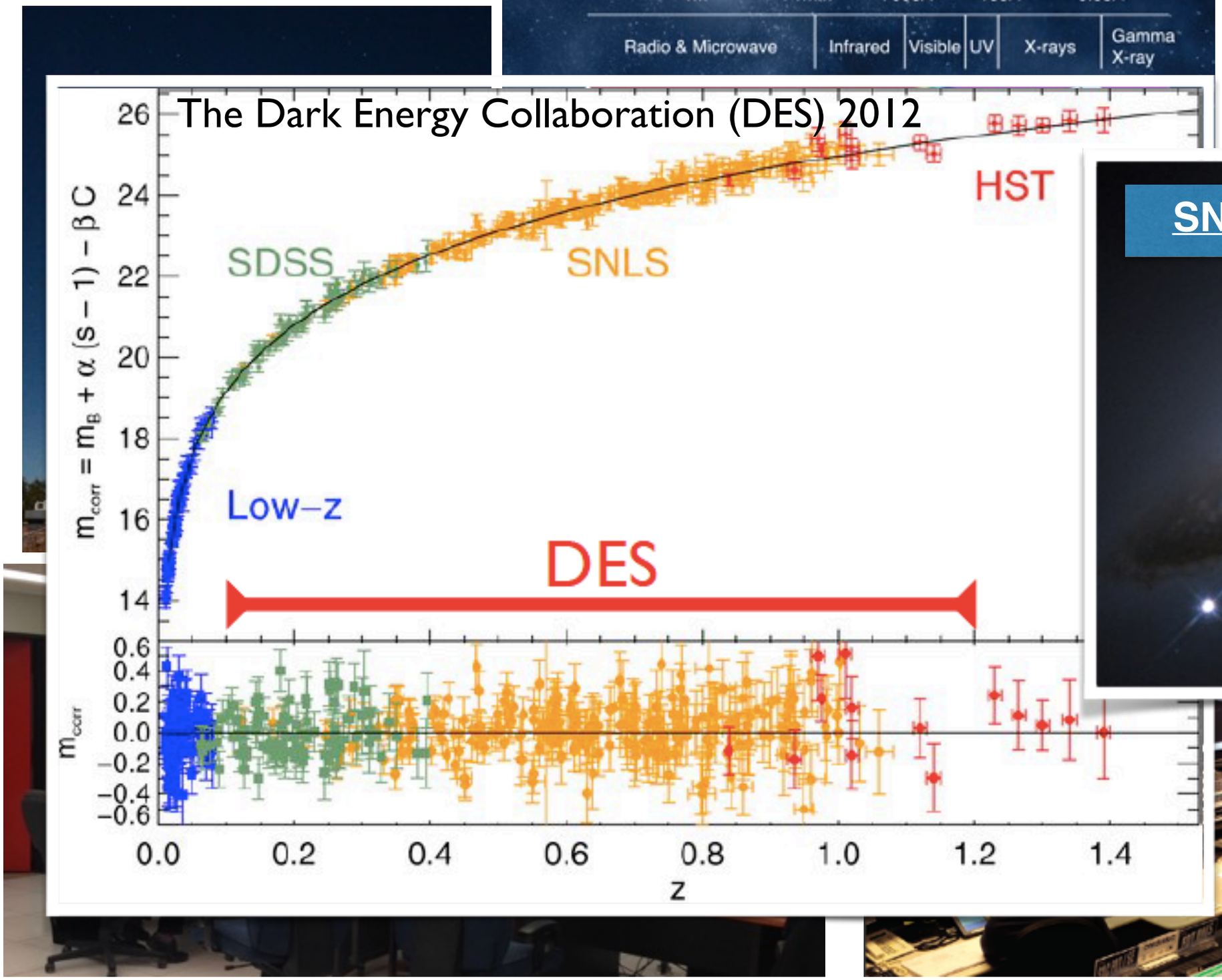


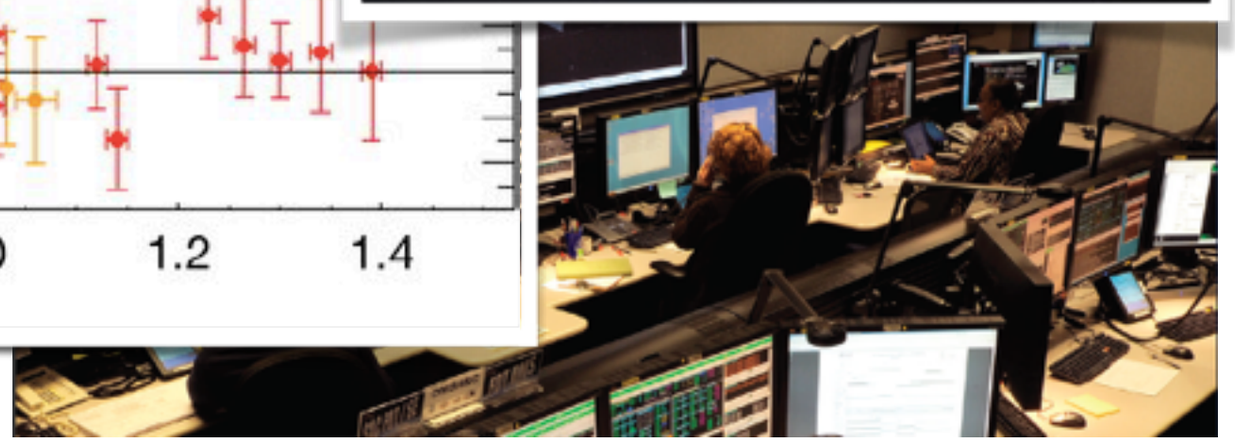
Hubble Space Telescope



Astronomy (~2010s) + HPC

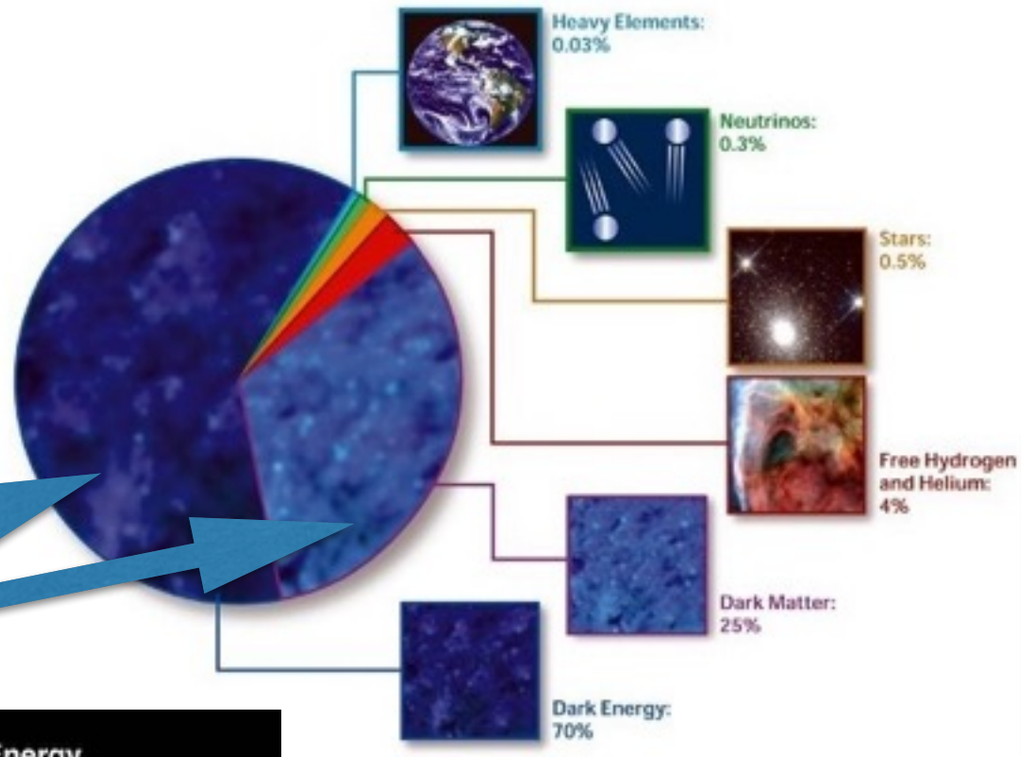


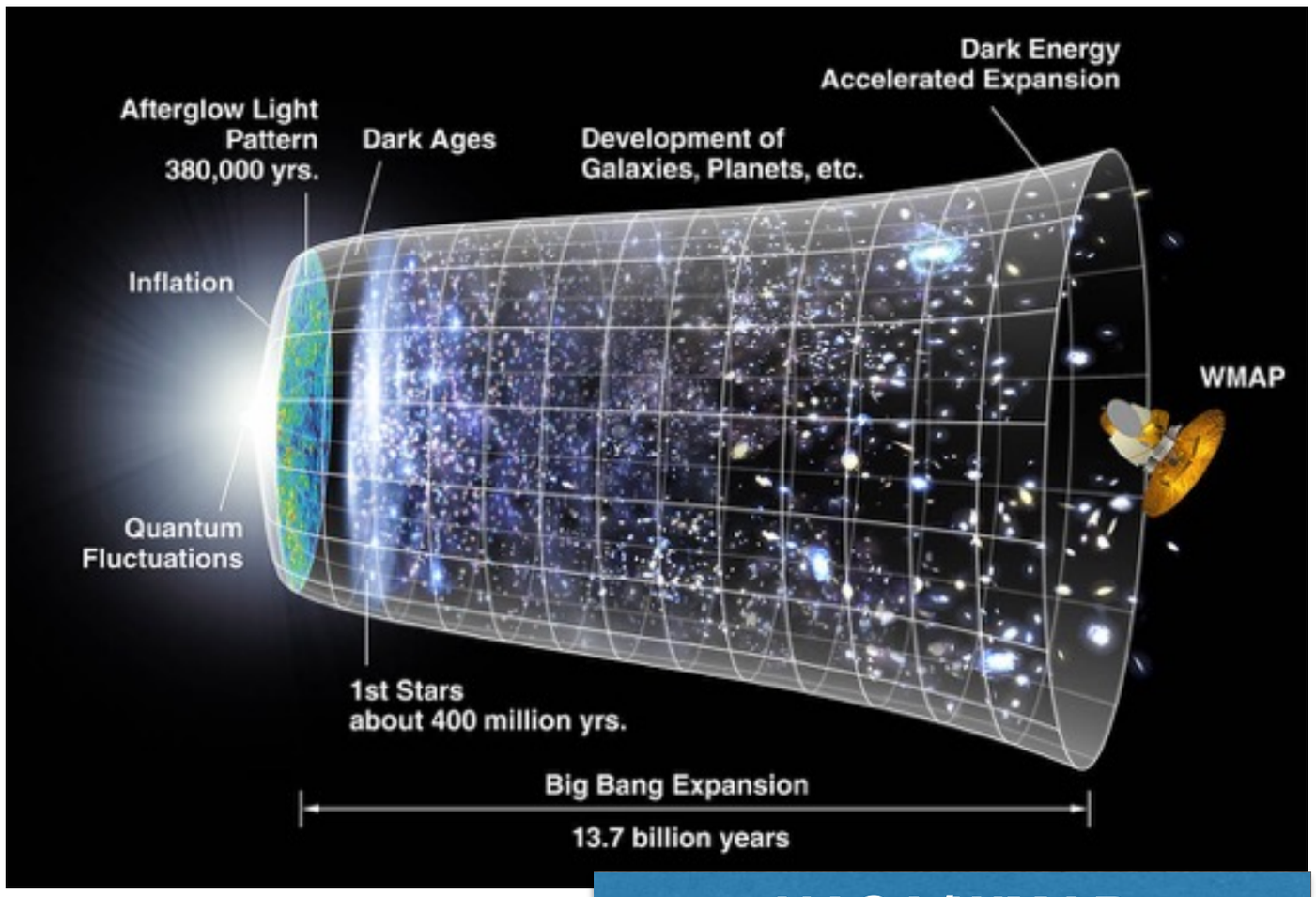




Our Universe

- Started with a Big Bang!
- 13.73 ± 0.12 ×10^9 (billion) years
- Flat geometry of space(Euclidean)
- ΛCDM Cosmology
  - Λ cosmological constant
  - Cold Dark Matter





NASA/WMAP

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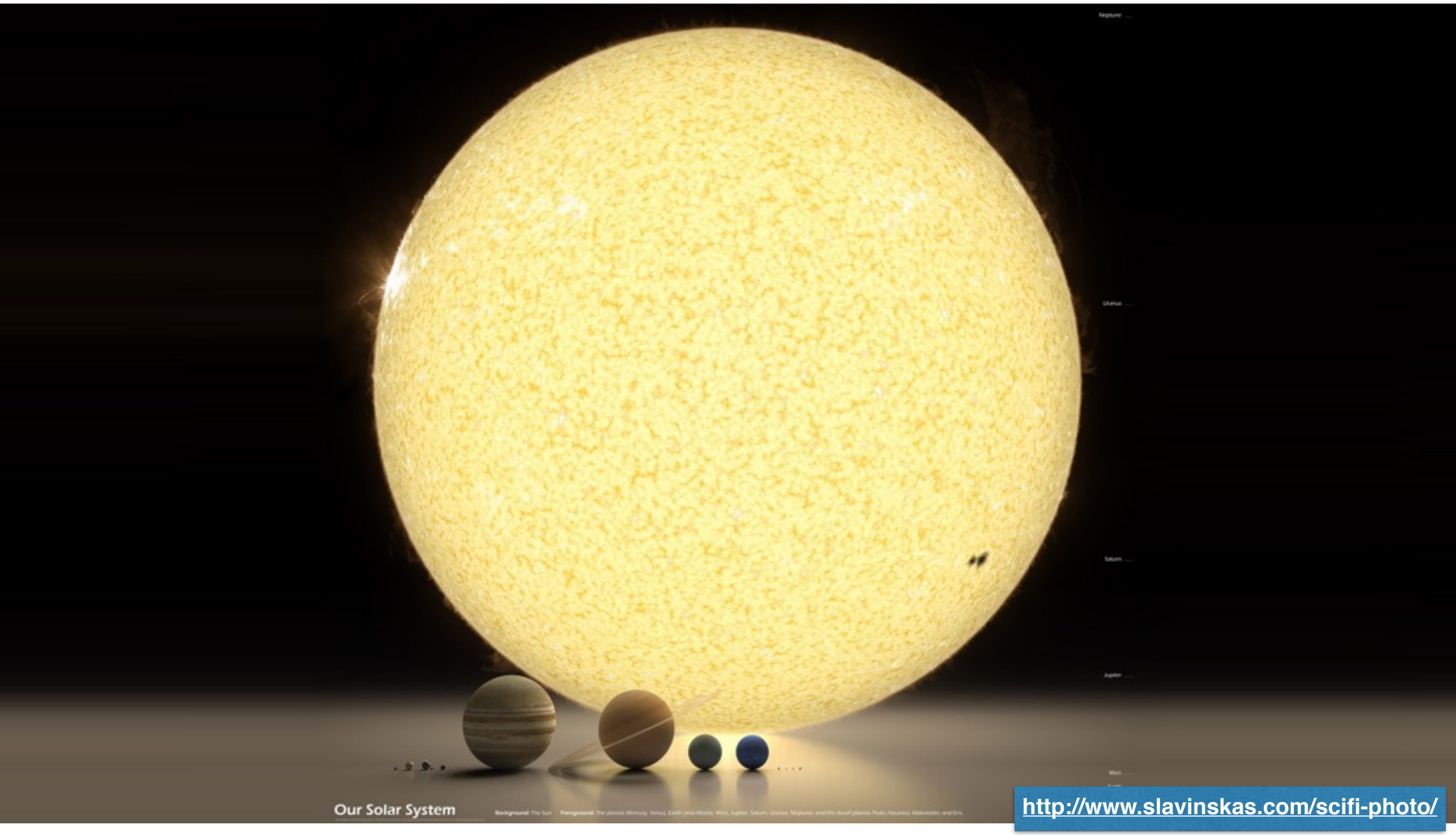
From our Solar System…



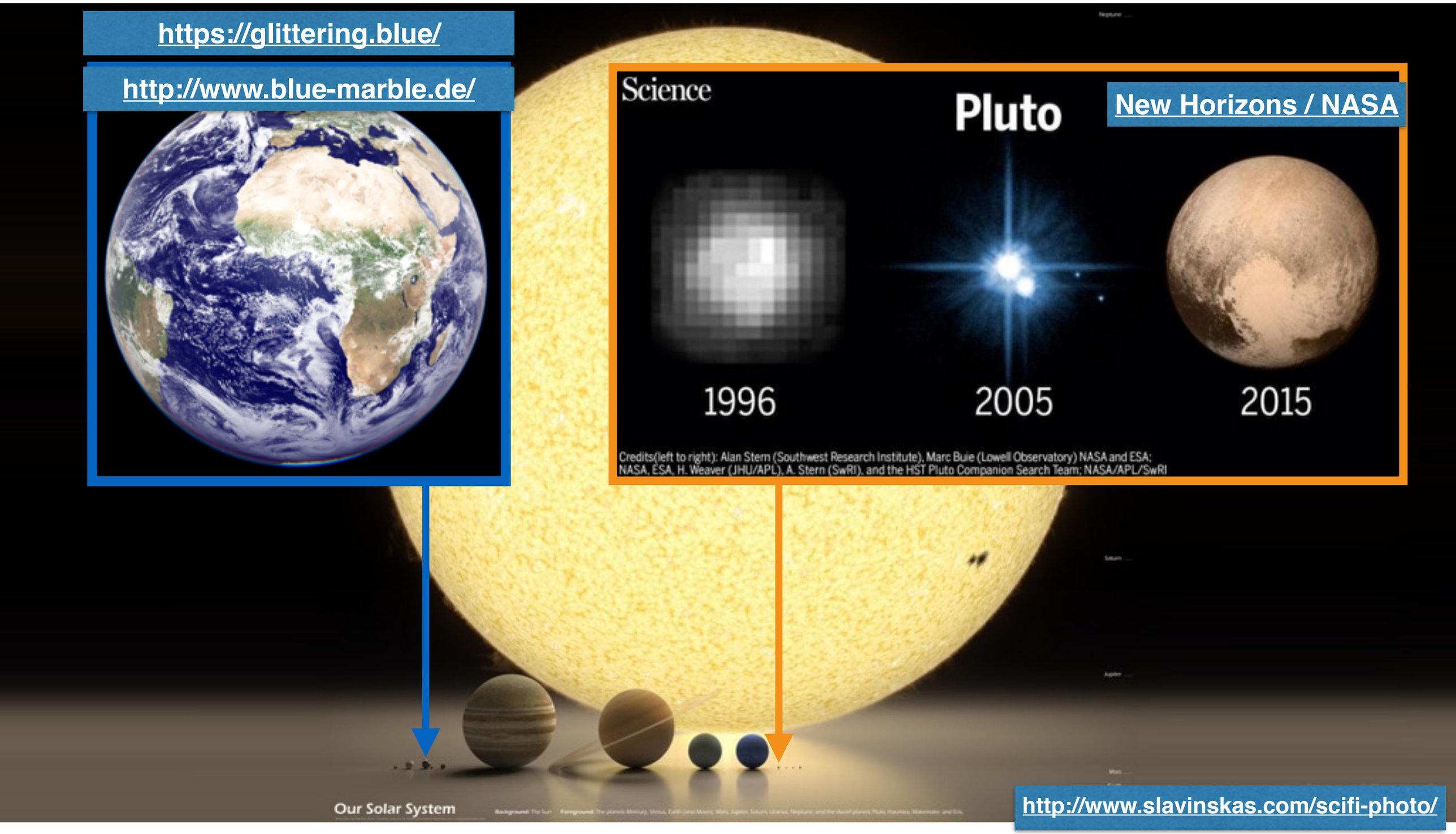
http://www.slavinskas.com/scifi-photo/

From our Solar System…

https://glittering.blue/

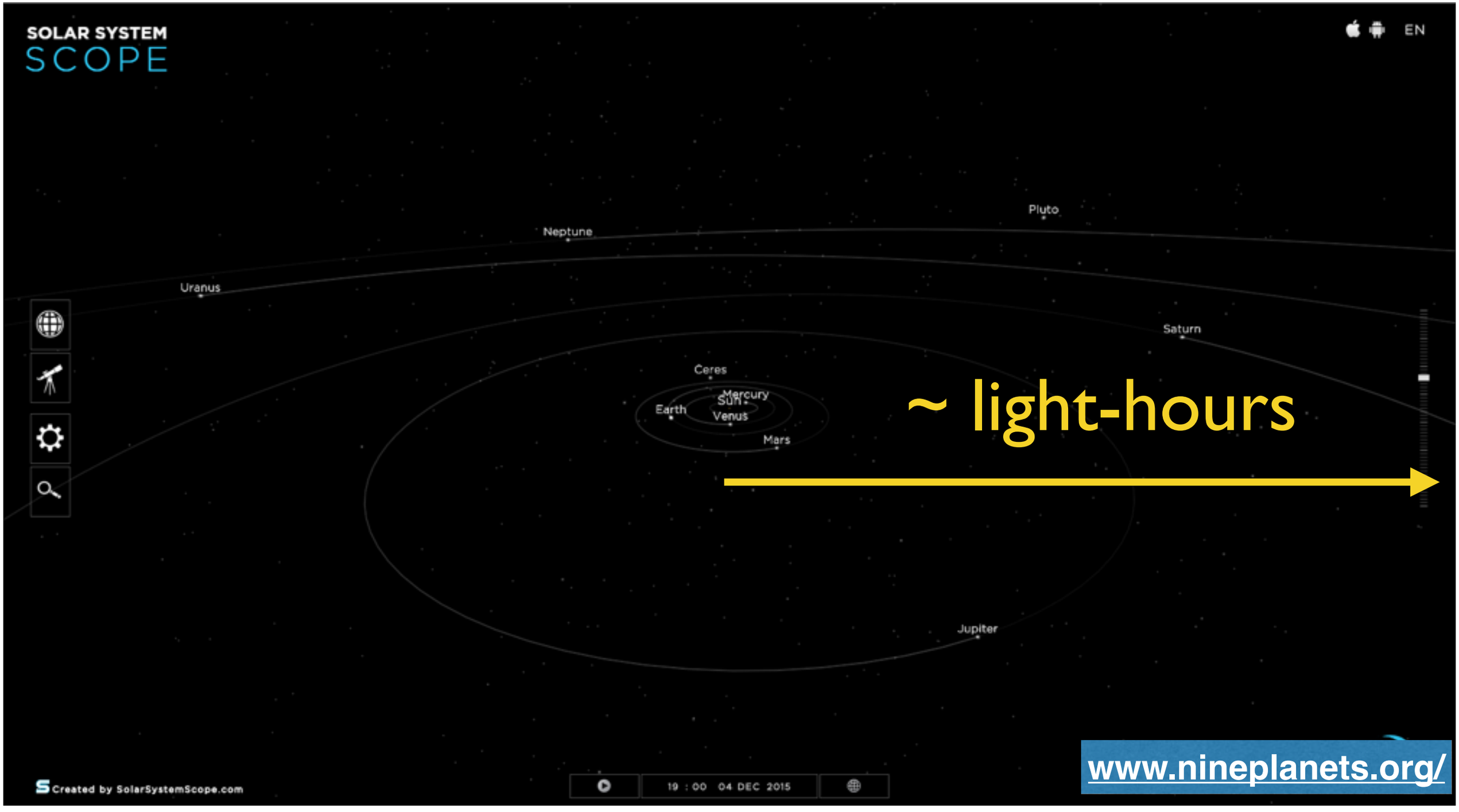
http://www.blue-marble.de/

New Horizons / NASA



http://www.slavinskas.com/scifi-photo/

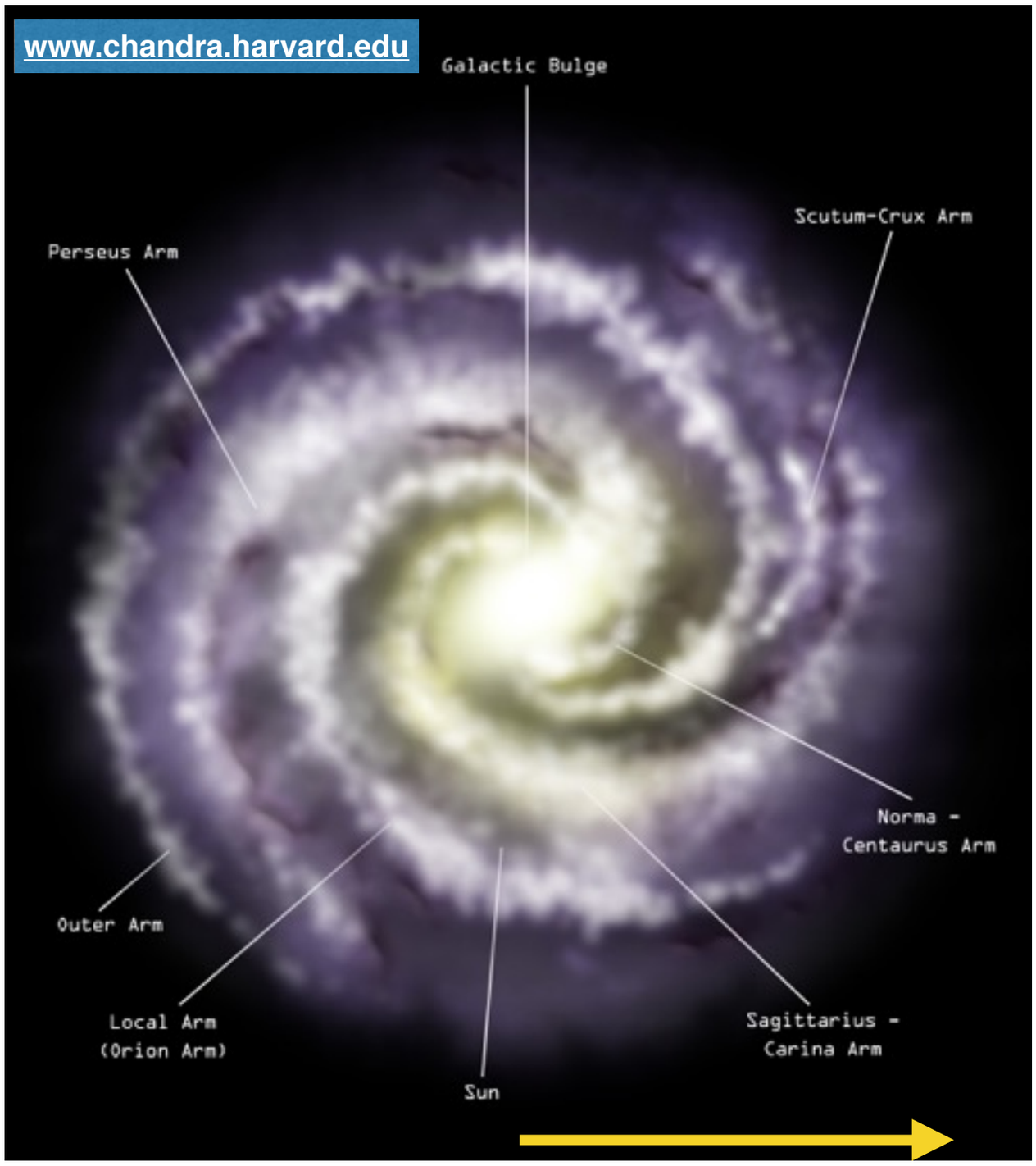
From our Solar System…



…to nearby Star clusters…

…to nearby Star clusters…

The Milky Way Galaxy



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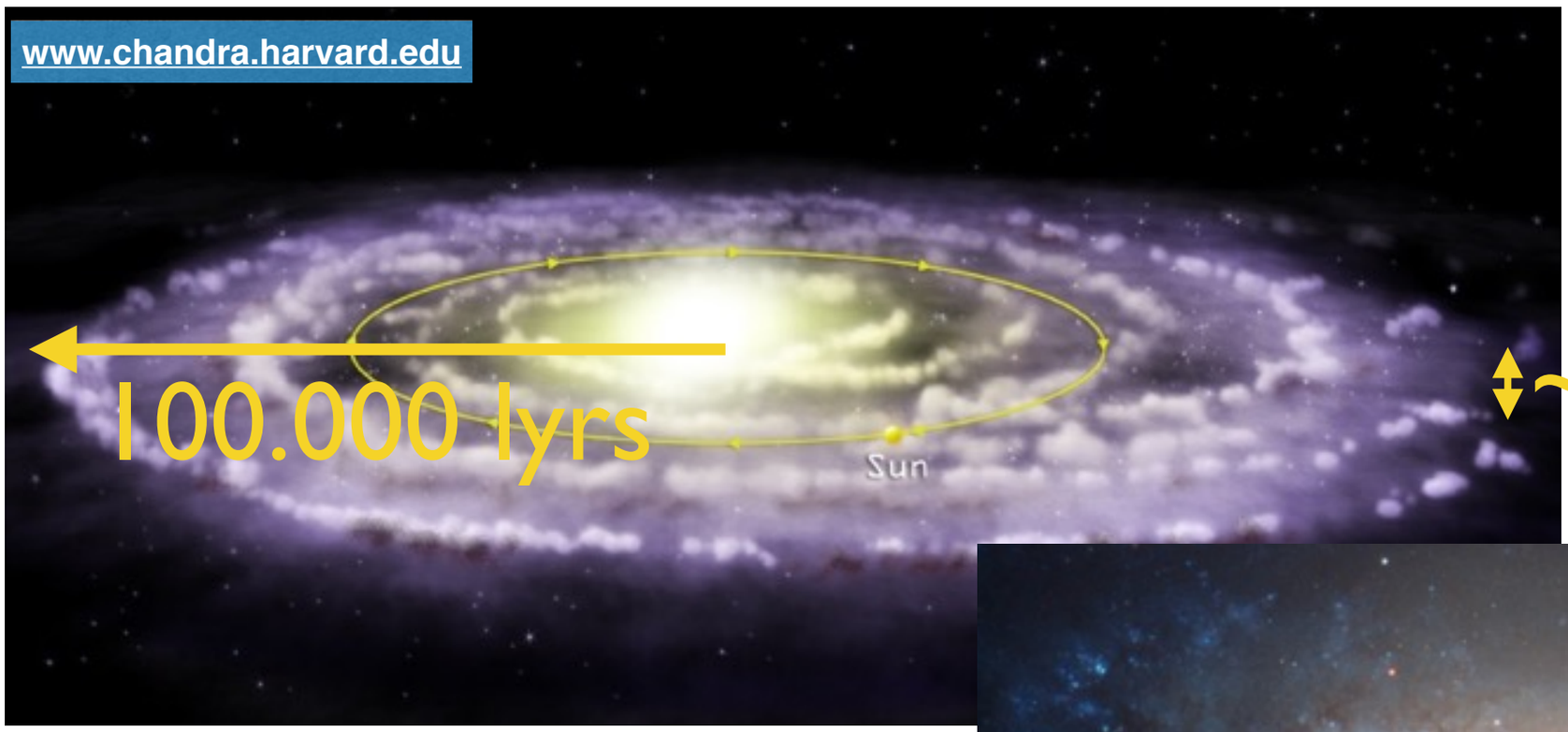
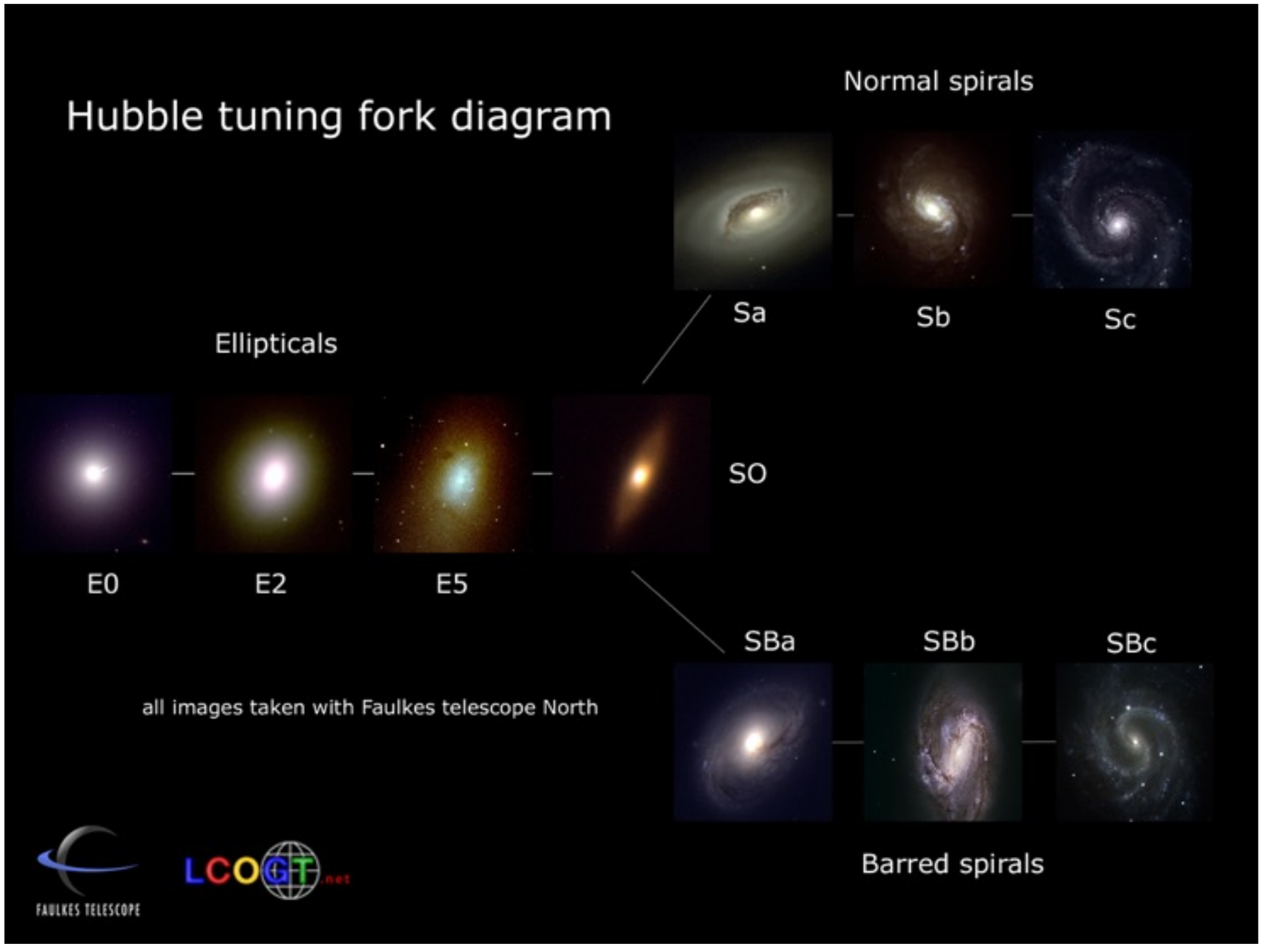
The Milky Way Galaxy



The Hubble sequence @ 1926



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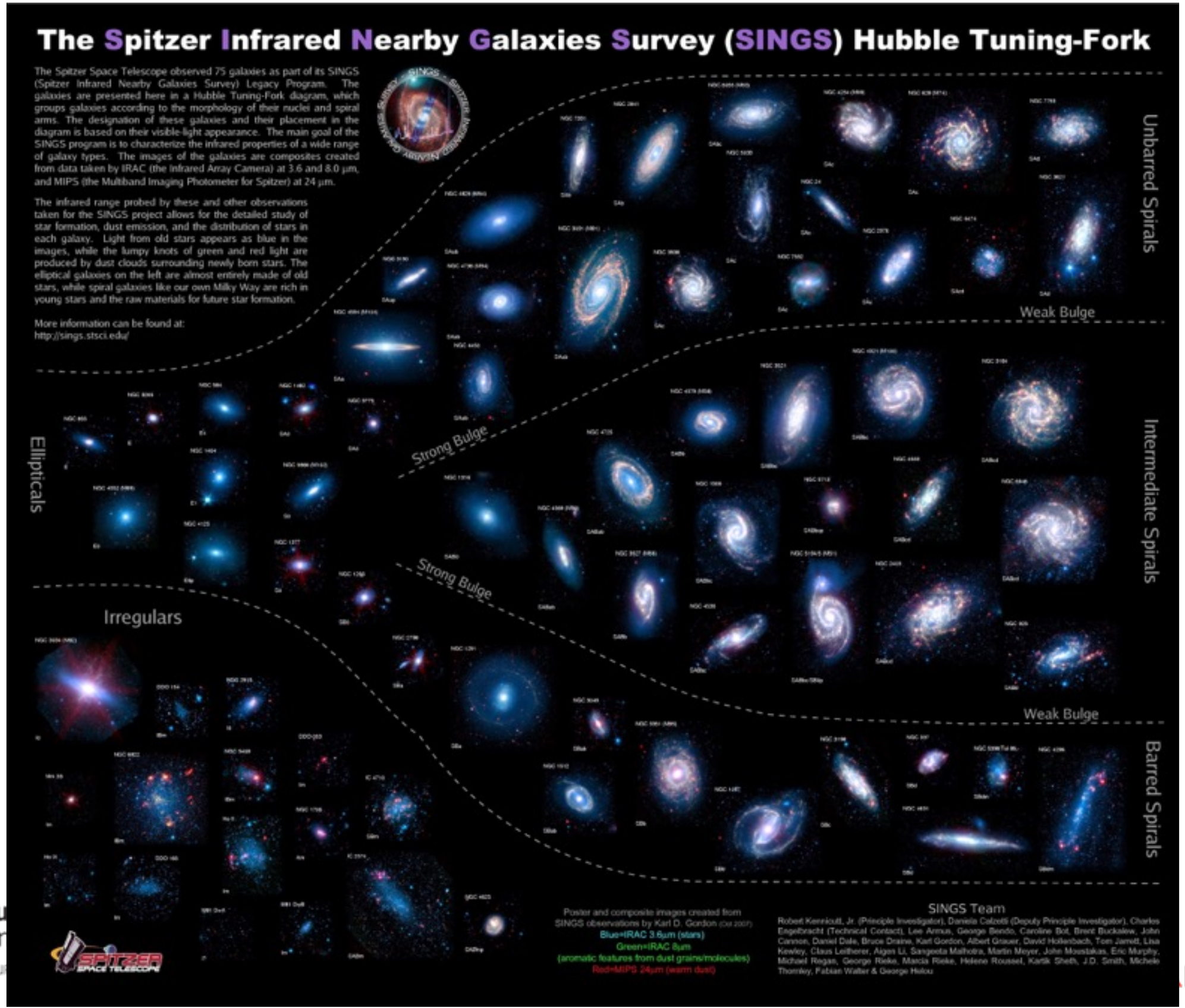
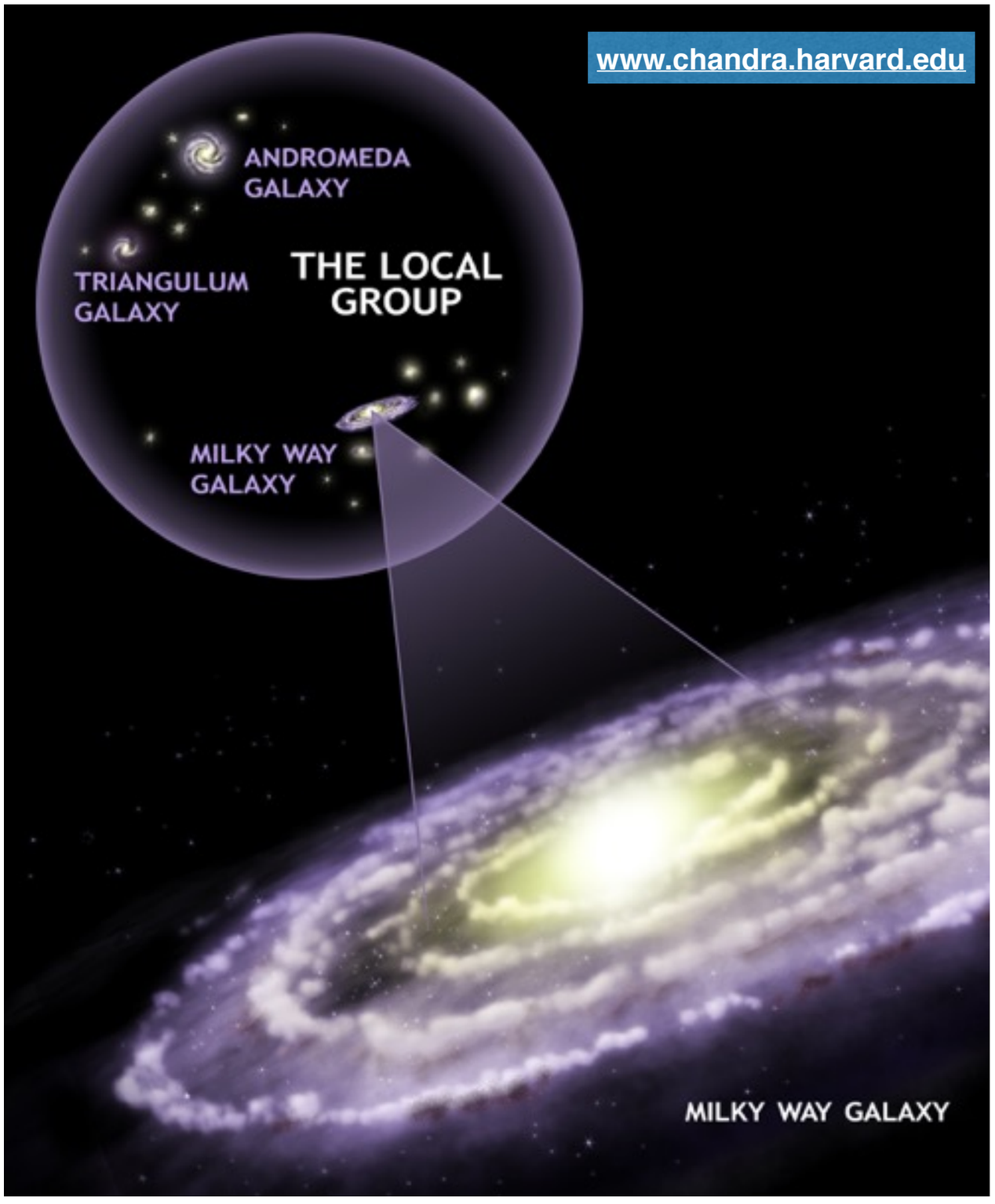
The Hubble sequence @ 2000's

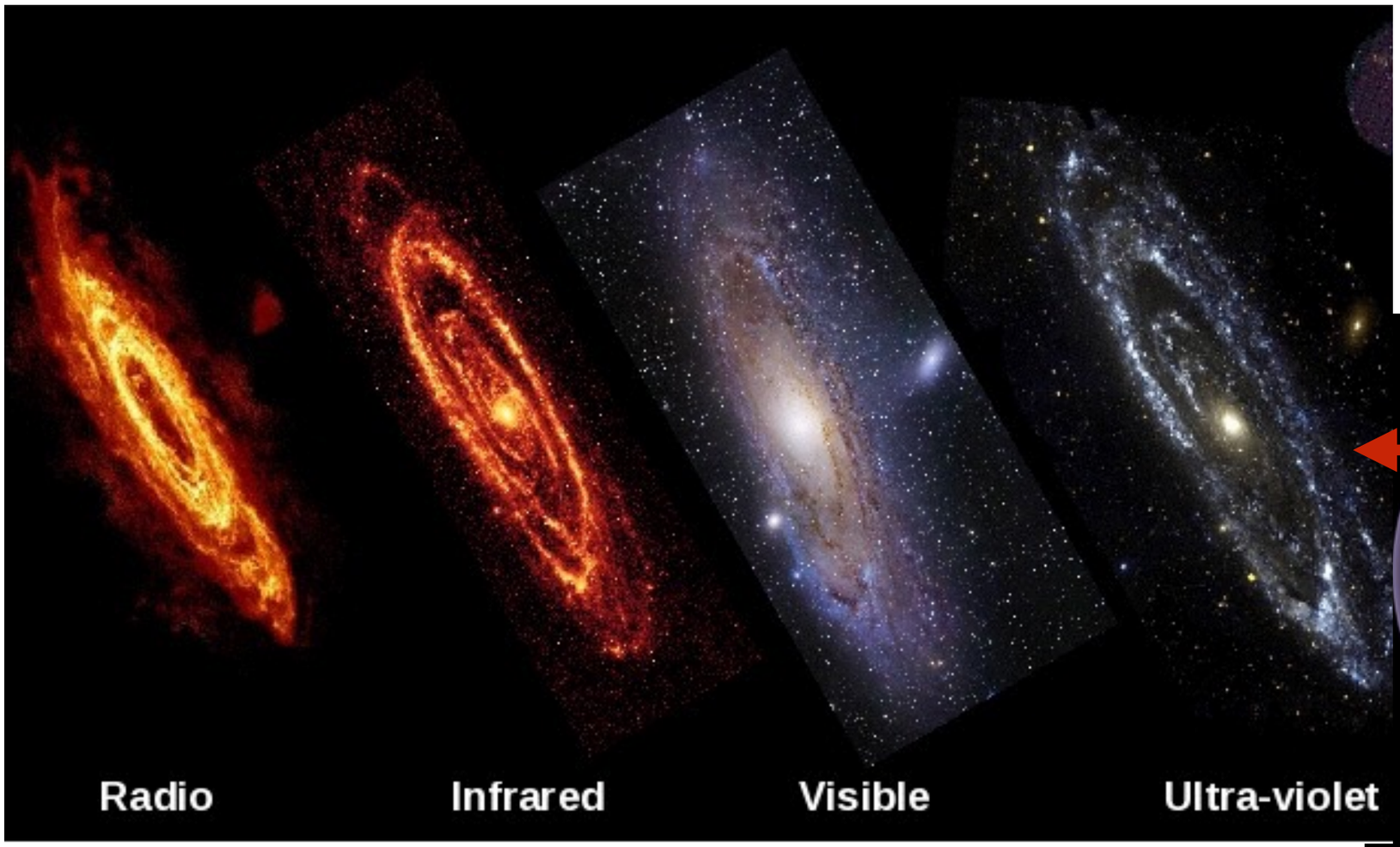


Galaxies Around Us



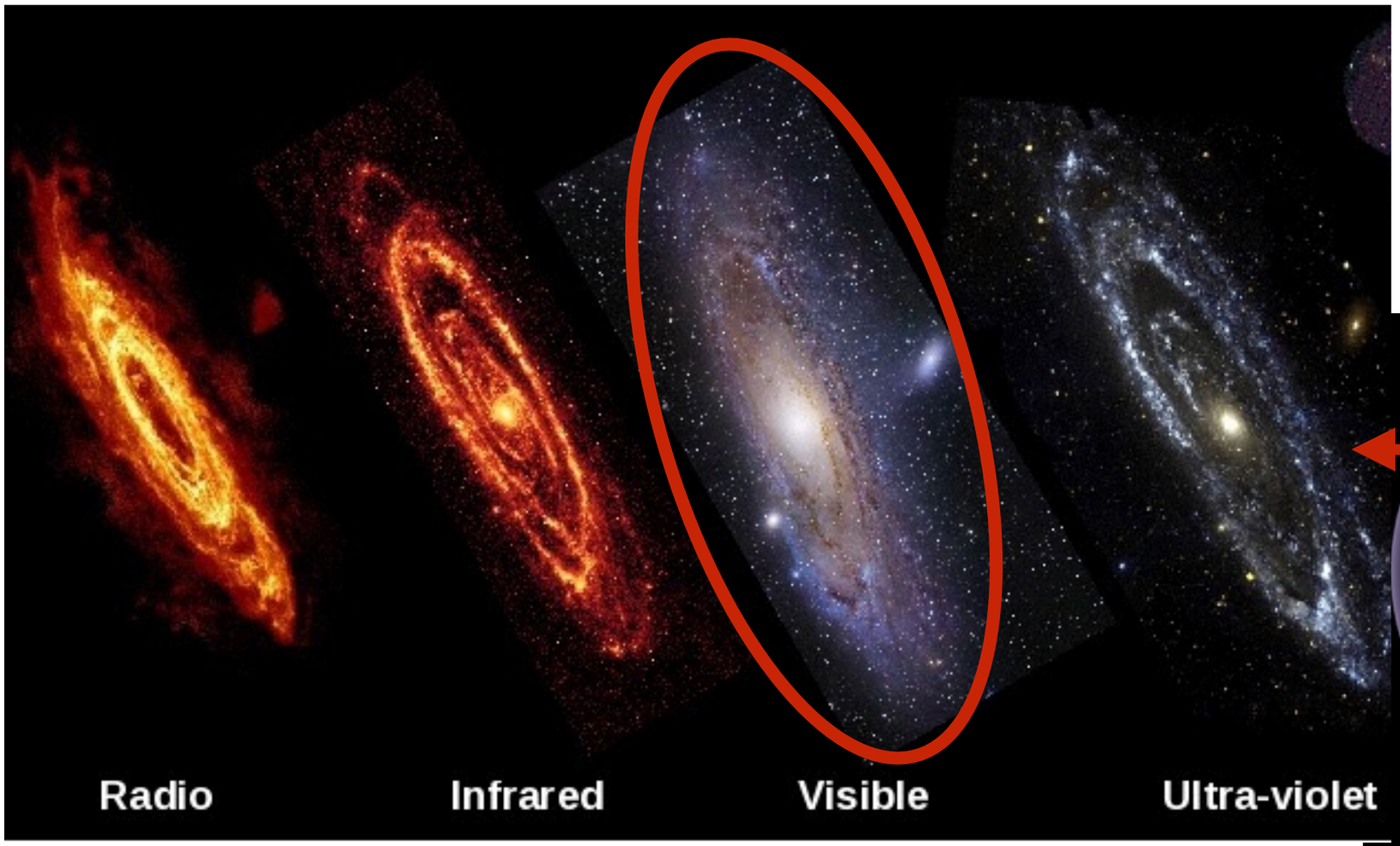
Galaxies Around Us

Very Large Telescope (VLT), ESO, Paranal-Chile



www.chandra.harvard.edu

Galaxies Around Us



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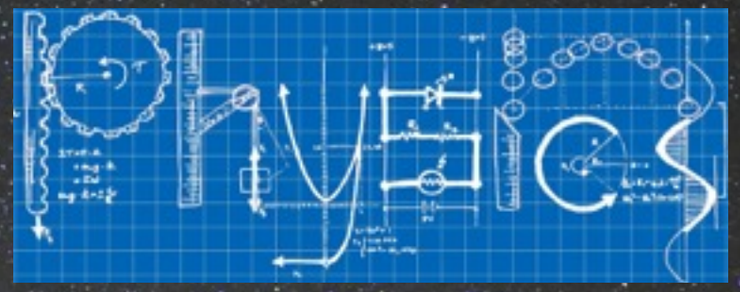
Astro  & High Performance Computing

Dr. Andreas Papadopoulos

30-31 January 2016

Ι Παγκύπριο Συνέδριο Φυσικής

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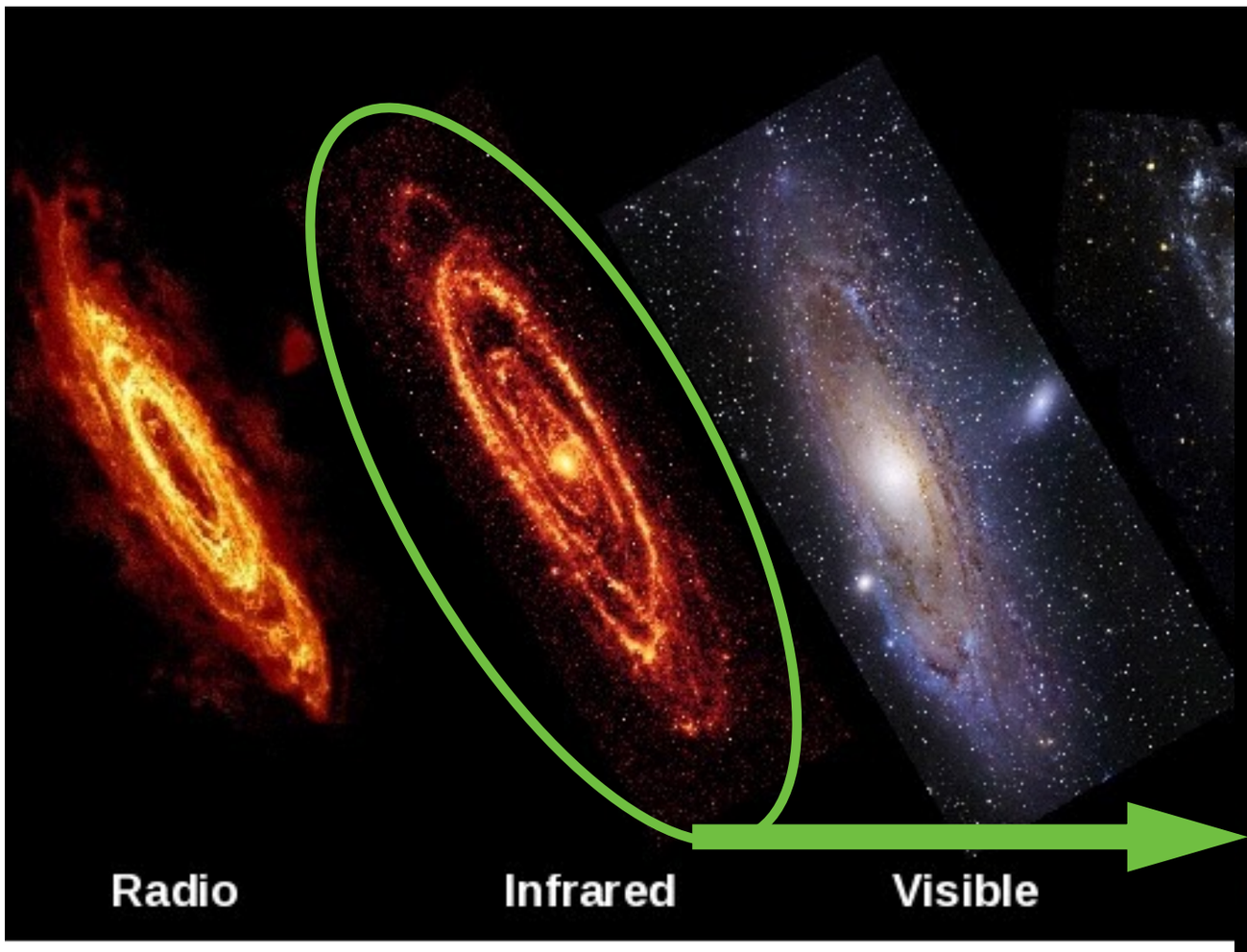
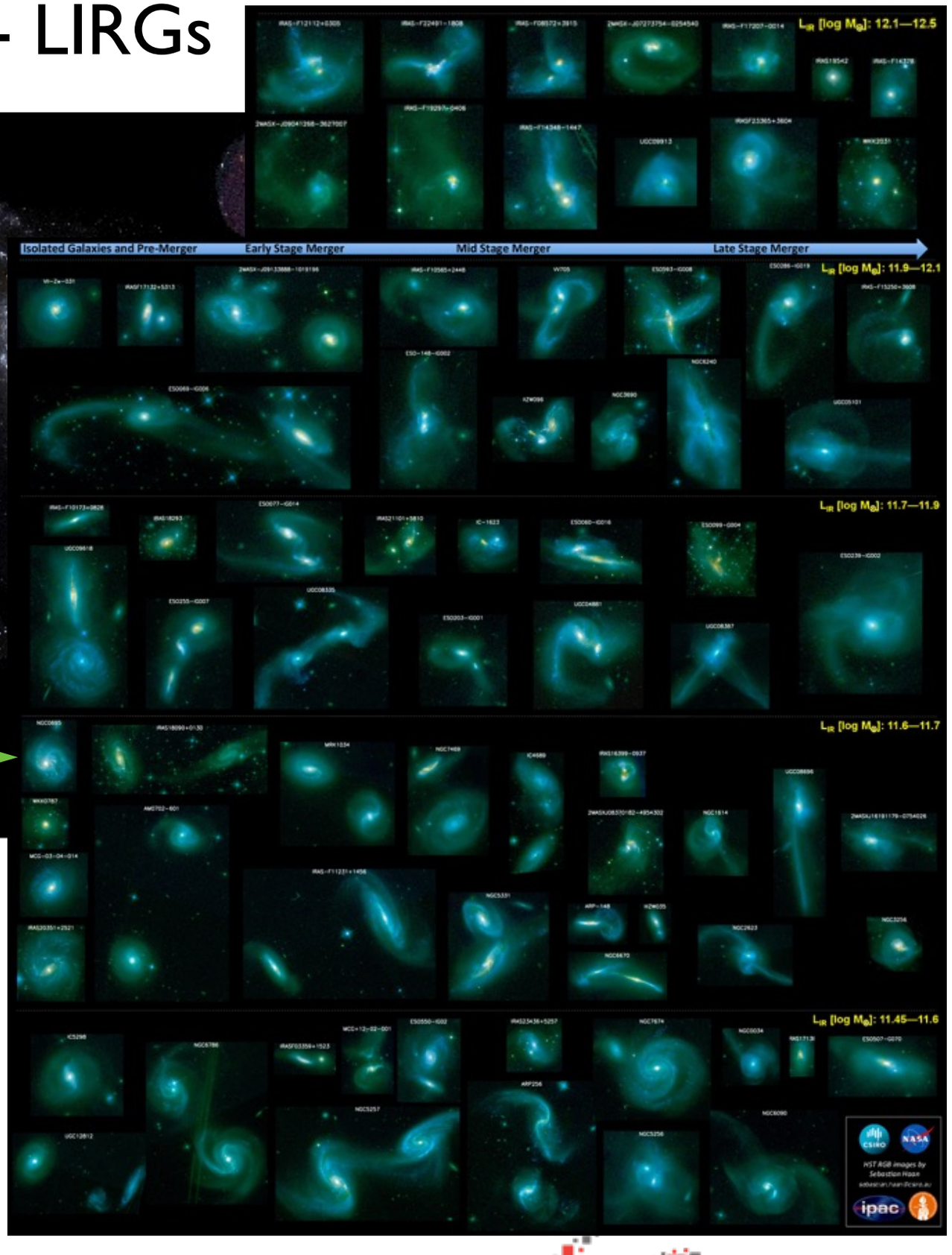
Luminous IR Galaxies - LIRGs





The HST GOALS Sample

Probing the Nature of Local Luminous Infrared Galaxies and Major Mergers

http://goals.ipac.caltech.edu/

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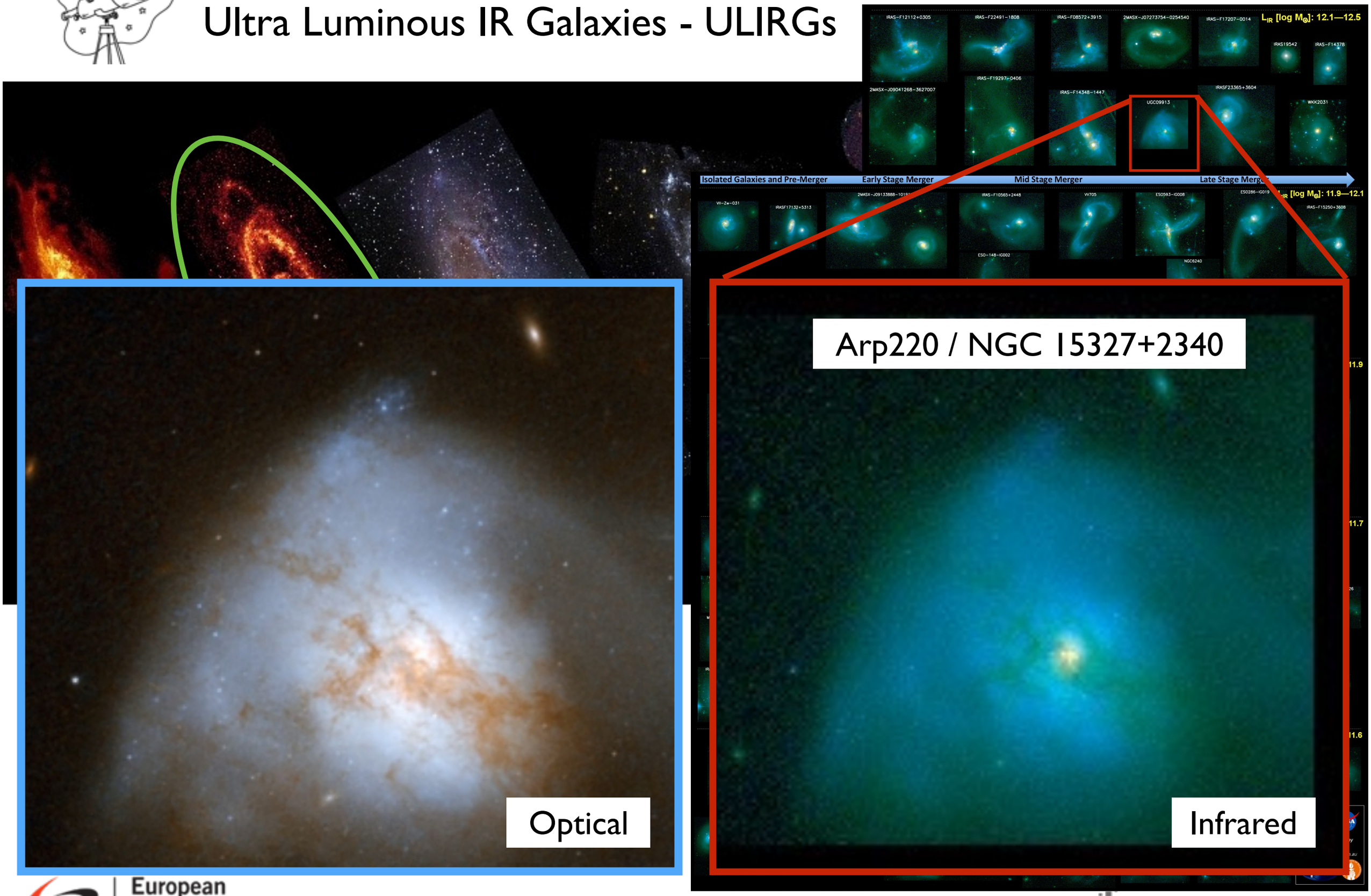
Ultra Luminous IR Galaxies - ULIRGs



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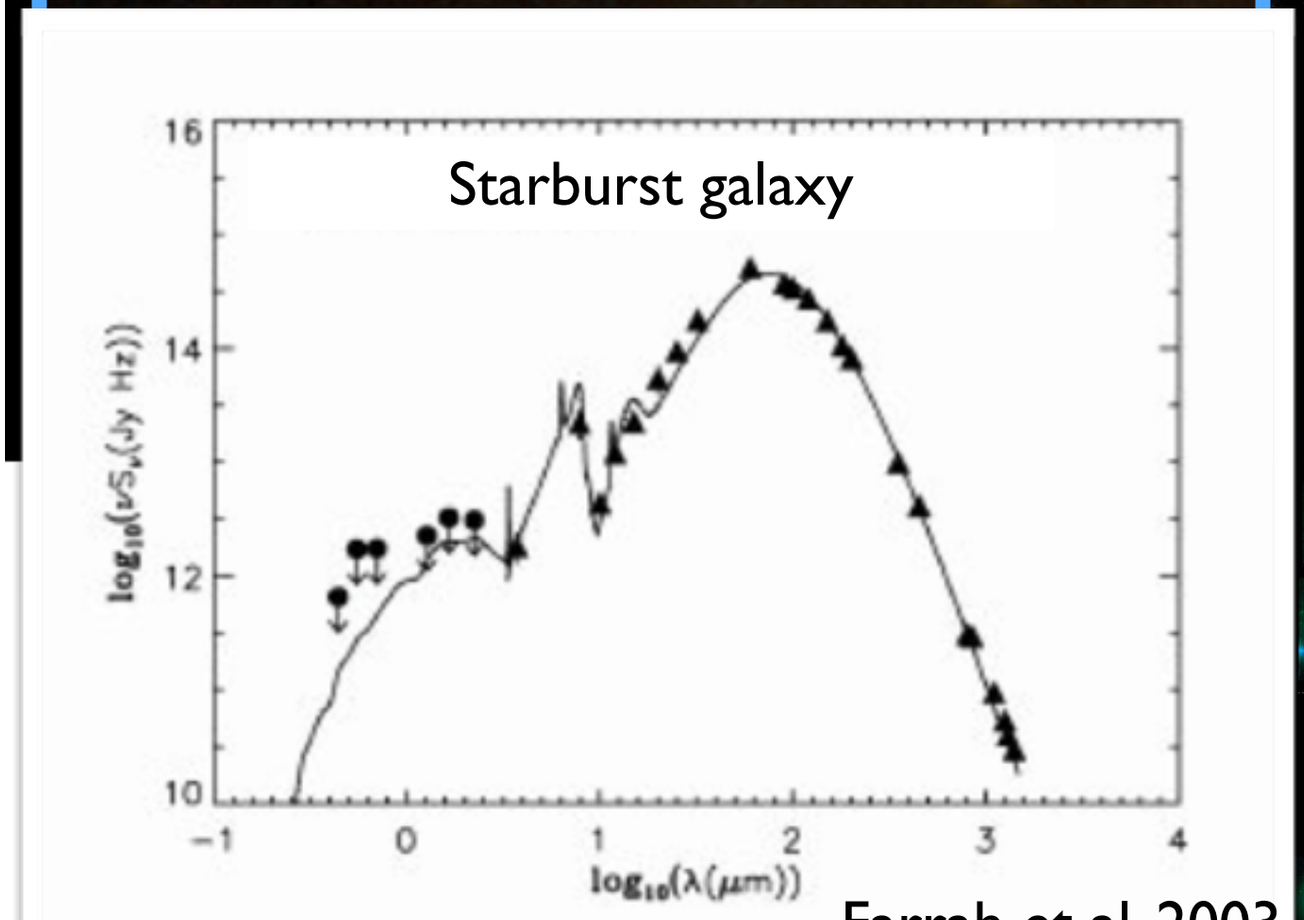
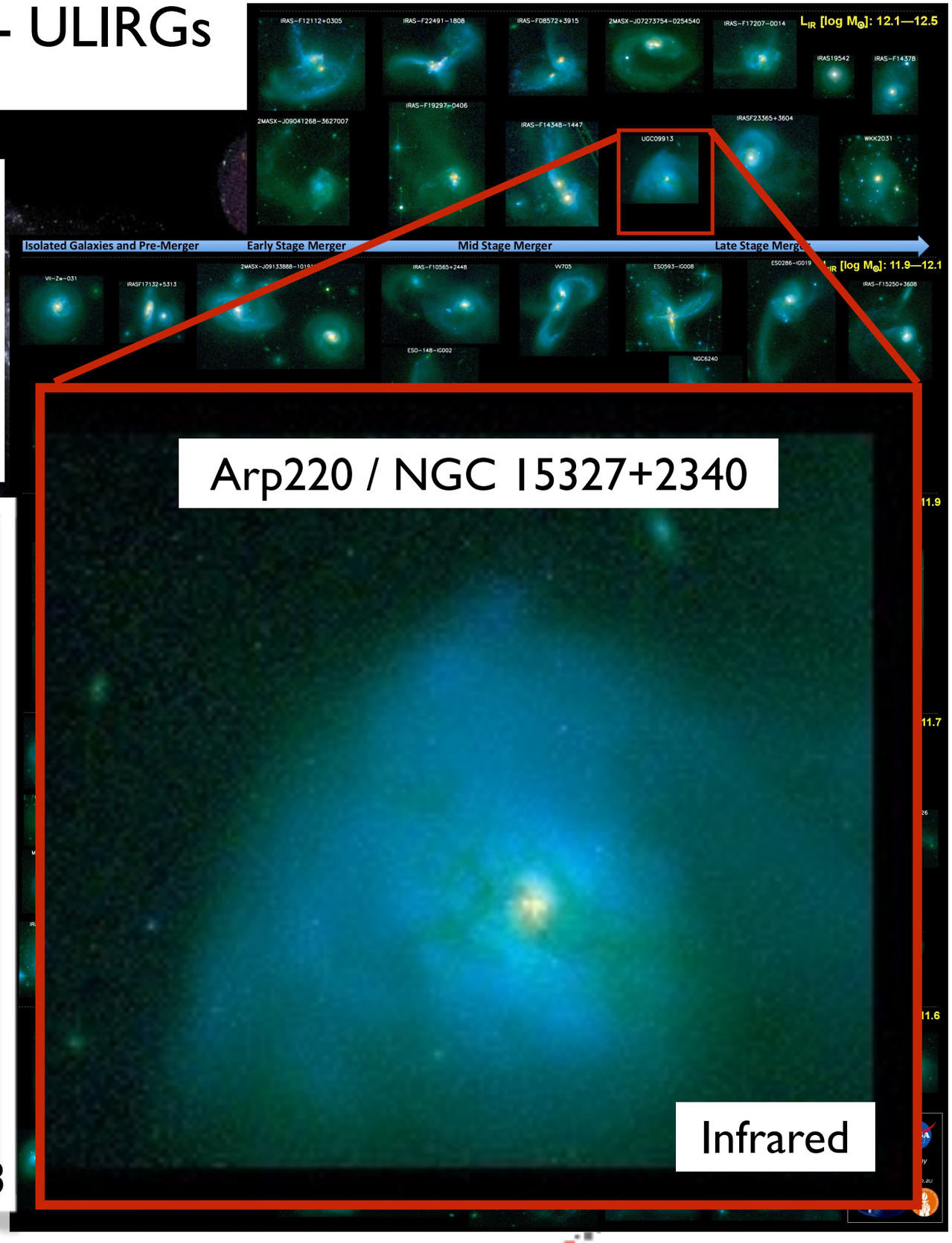
Ultra Luminous IR Galaxies - ULIRGs

Astrophysics & High Performance Computing:

- CyTera (Cyl)
- Serial / Parallel Algoritms
- IDL / Python / Fortran
- MCMC / Levenberg–Marquardt

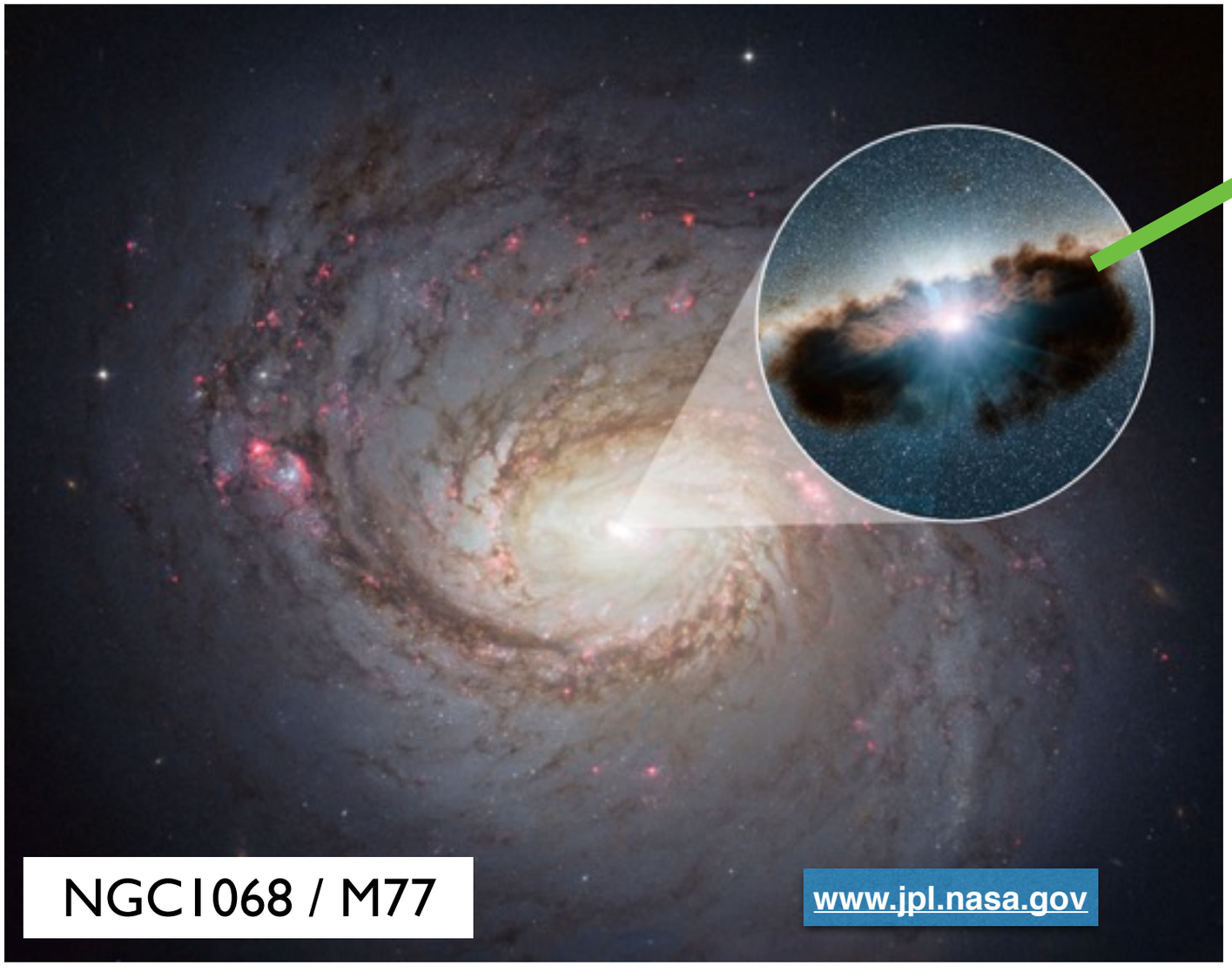


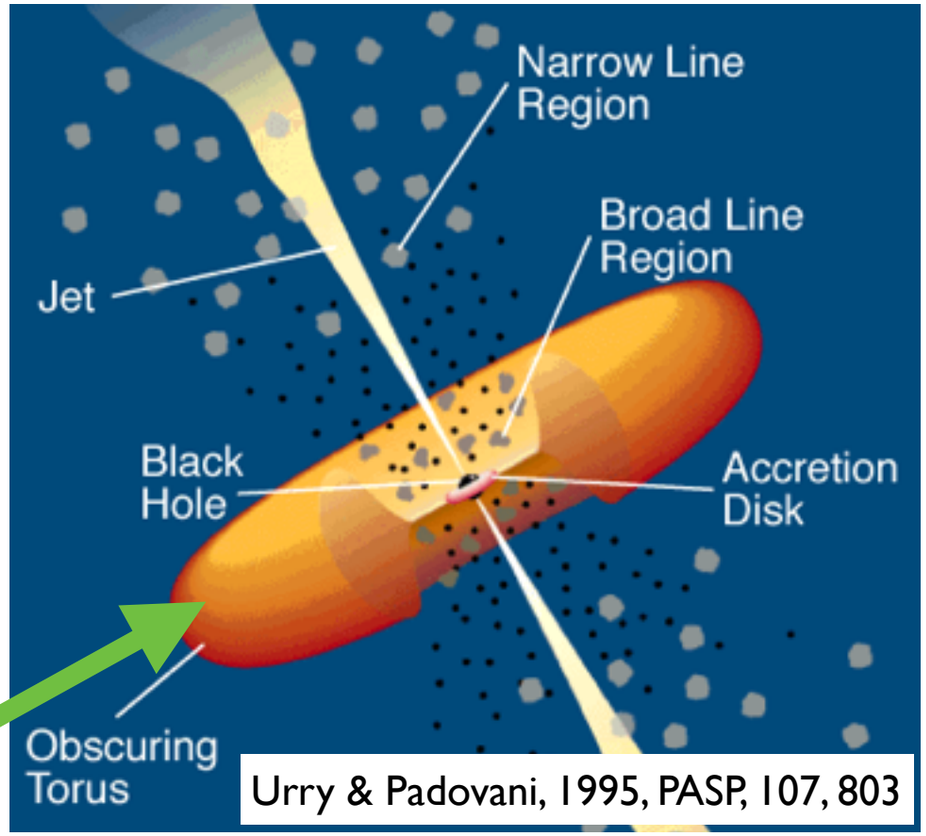
Farrah et al. 2003

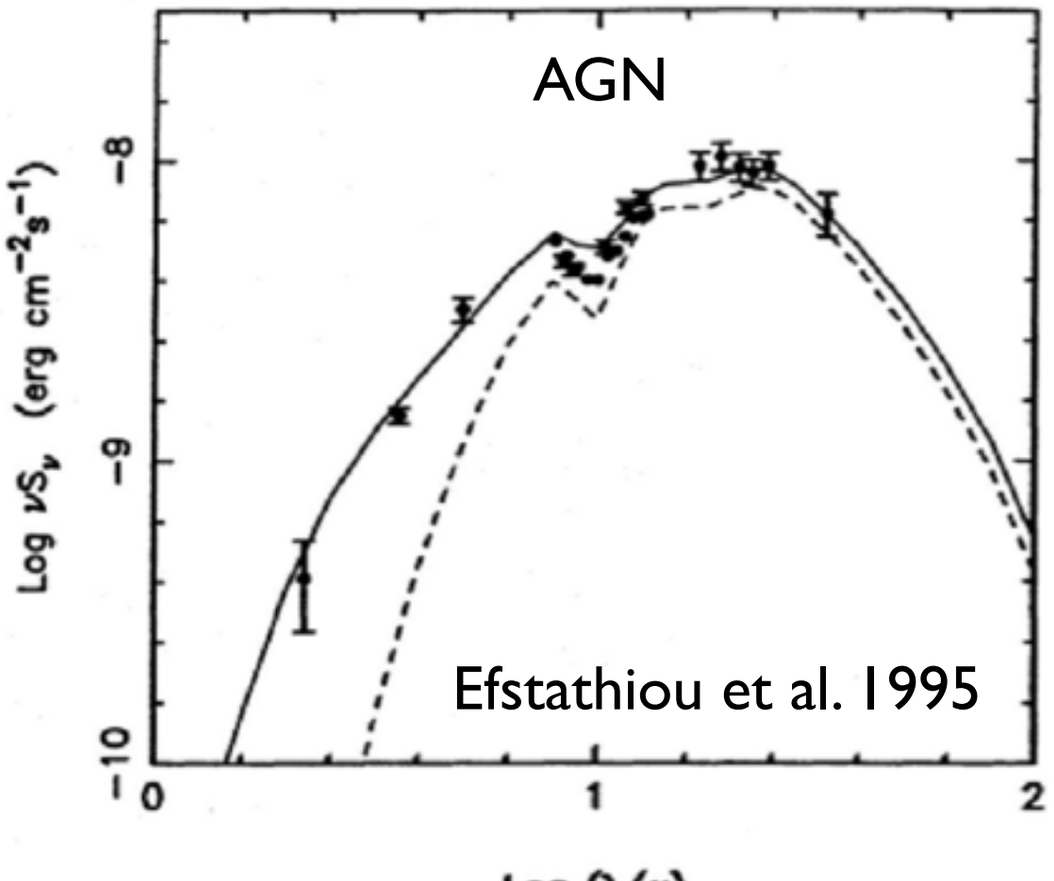


Ultra Luminous IR Galaxies - ULIRGs

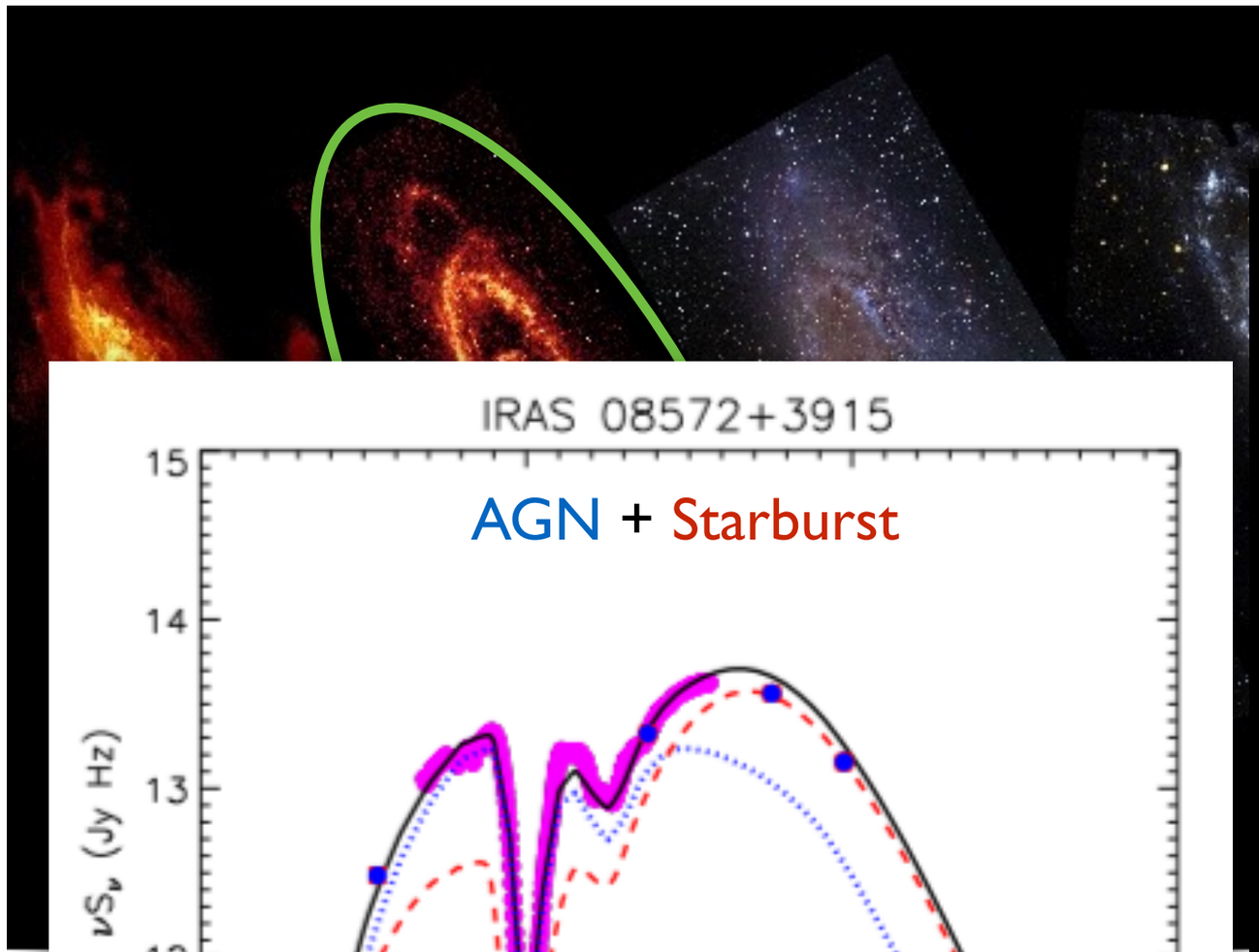
- Active Galactic Nuclei - AGN
  - Massive Black Hole in the centre
  - Dusty torus around

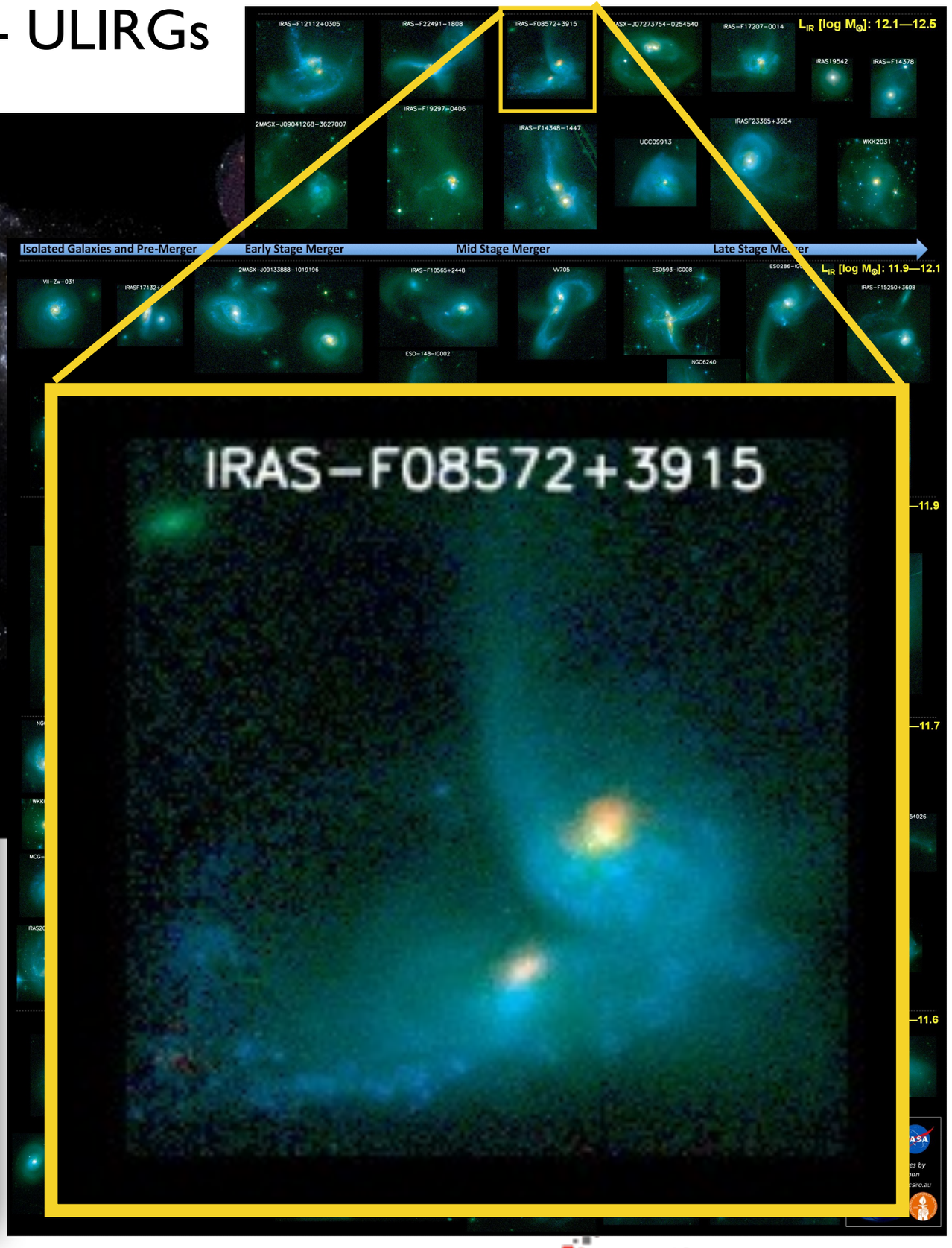






Ultra Luminous IR Galaxies - ULIRGs





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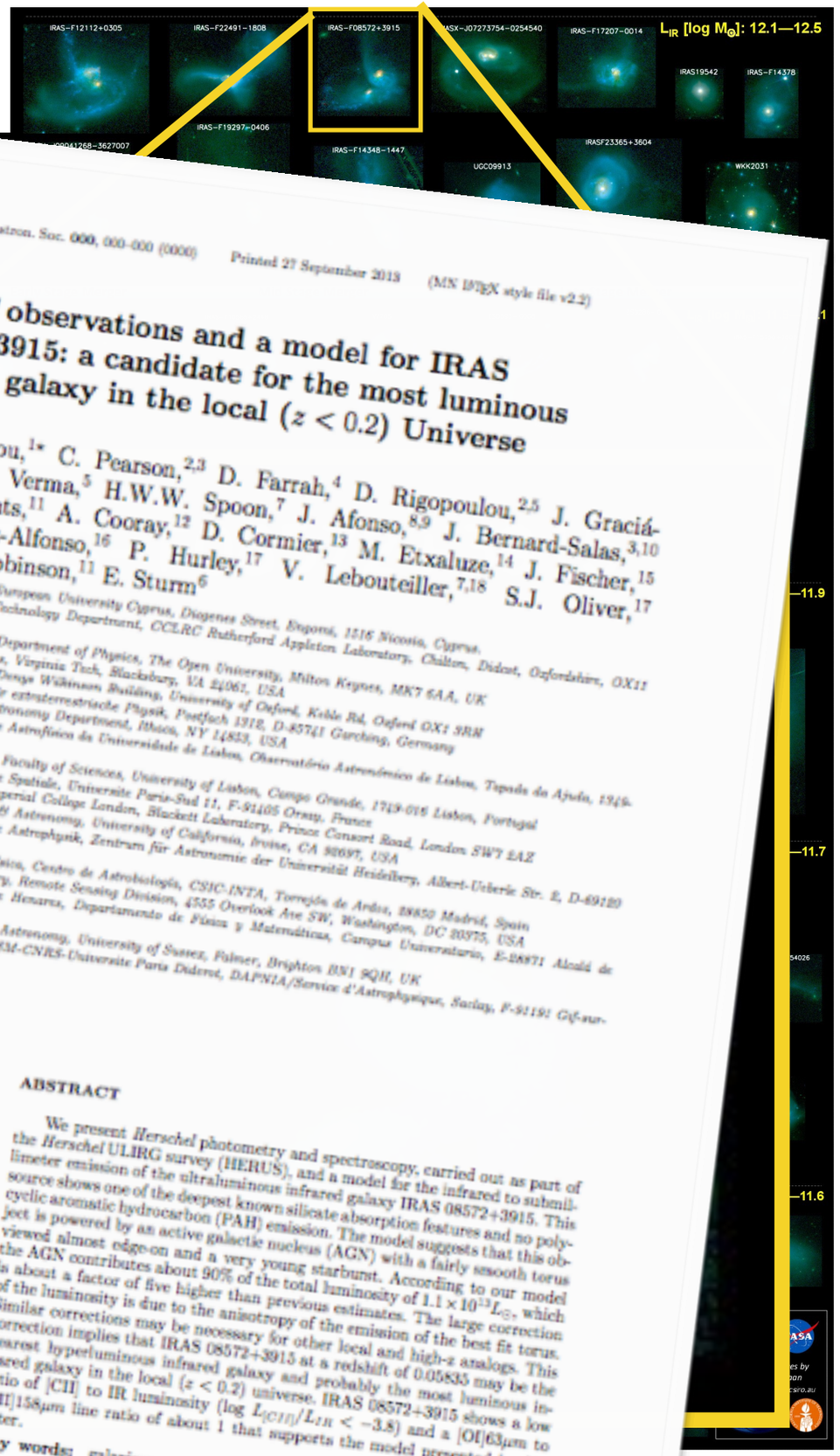
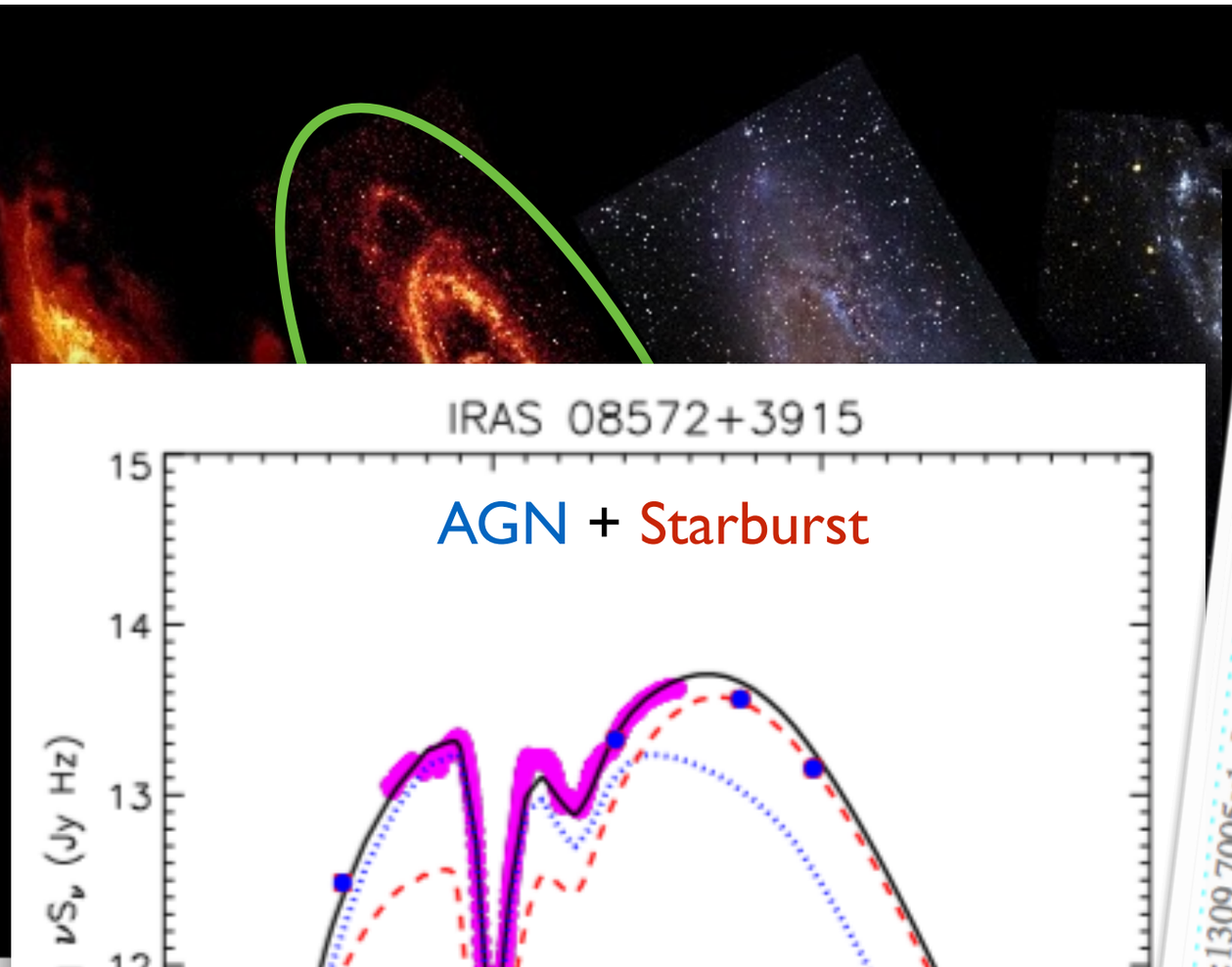
Ultra Luminous IR Galaxies - ULIRGs





Mon. Not. R. Astron. Soc. **000**, 000–000 (0000) Printed 27 September 2013 (MN LaTeX style file v2.2)

Herschel observations and a model for IRAS 08572+3915: a candidate for the most luminous infrared galaxy in the local ($z < 0.2$) Universe

A. Efstathiou,[1*] C. Pearson,[2,3] D. Farrah,[4] D. Rigopoulou,[2,5] J. Graciá-Carpio,[6] A. Verma,[5] H.W.W. Spoon,[7] J. Afonso,[8,9] J. Bernard-Salas,[3,10] D.L. Clements,[11] A. Cooray,[12] D. Cormier,[13] M. Etxaluze,[14] J. Fischer,[15] E. González-Alfonso,[16] P. Hurley,[17] V. Lebouteiller,[7,18] S.J. Oliver,[17] M. Rowan-Robinson,[11] E. Sturm[6]

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[18] Laboratoire AIM, CEA/DSM-CNRS-Université Paris Diderot, DAPNIA/Service d'Astrophysique, Saclay, F-91191 Gif-sur-Yvette Cedex, France

27 September 2013

ABSTRACT

We present *Herschel* photometry and spectroscopy, carried out as part of the *Herschel* ULIRG survey (HERUS), and a model for the infrared to submillimeter emission of the ultraluminous infrared galaxy IRAS 08572+3915. This source shows one of the deepest known silicate absorption features and no polycyclic aromatic hydrocarbon (PAH) emission. The model suggests that this object is powered by an active galactic nucleus (AGN) with a fairly smooth torus viewed almost edge-on and a very young starburst. According to our model the AGN contributes about 90% of the total luminosity of $1.1 \times 10^{13} L_\odot$, which is about a factor of five higher than previous estimates. The large correction of the luminosity is due to the anisotropy of the emission of the best fit torus. Similar corrections may be necessary for other local and high-z analogs. This correction implies that IRAS 08572+3915 at a redshift of 0.05835 may be the nearest hyperluminous infrared galaxy and probably the most luminous infrared galaxy in the local ($z < 0.2$) universe. IRAS 08572+3915 shows a low ratio of [CII] to IR luminosity (log $L_{[CII]}/L_{IR} < -3.8$) and a [OI]63μm to [CII]158μm line ratio of about 1 that supports the model presented in this letter.

Key words: galaxies: active - galaxies: individual (IRAS 08572+3915) - infrared: galaxies - dust: - radiative transfer:

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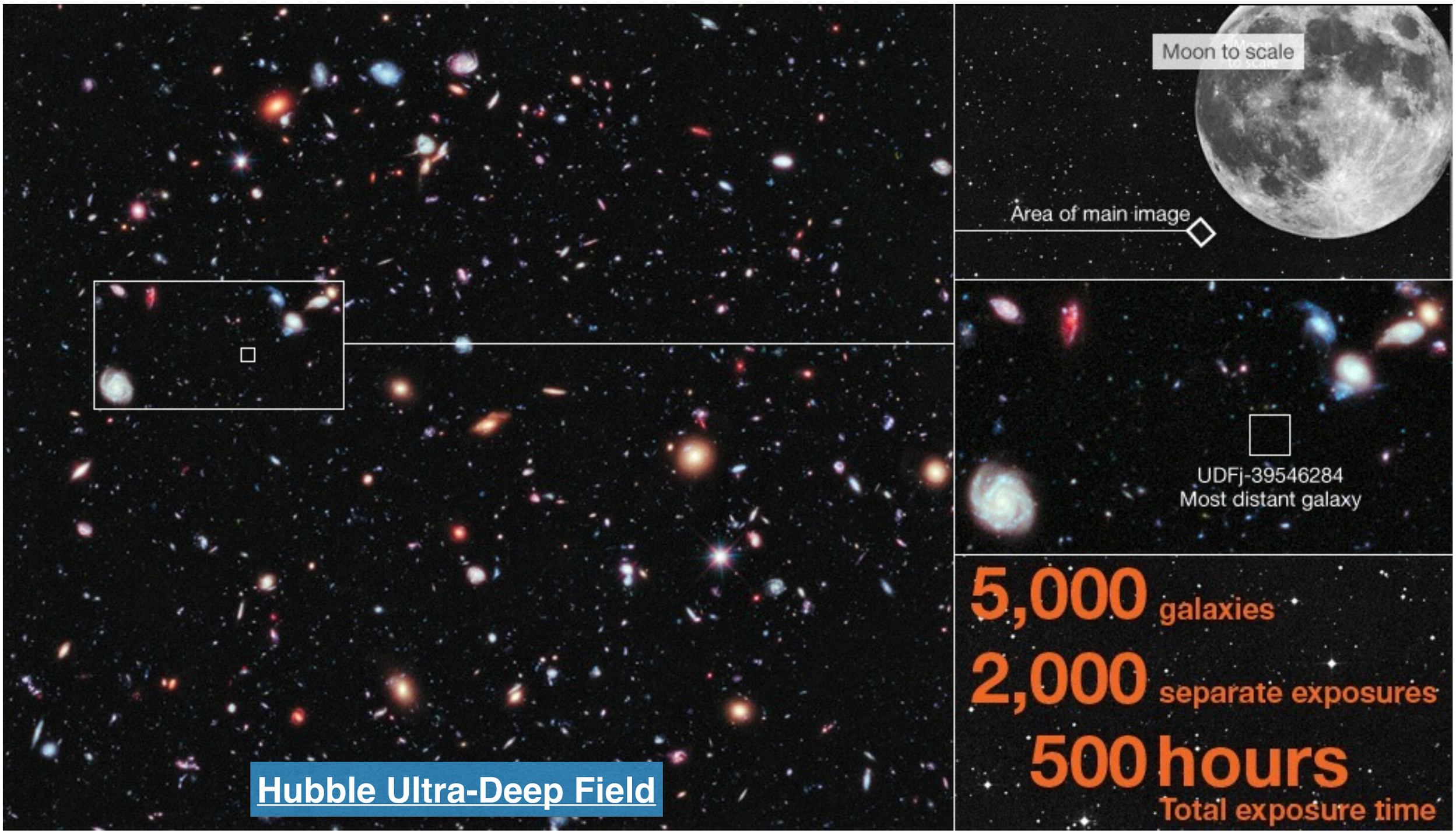
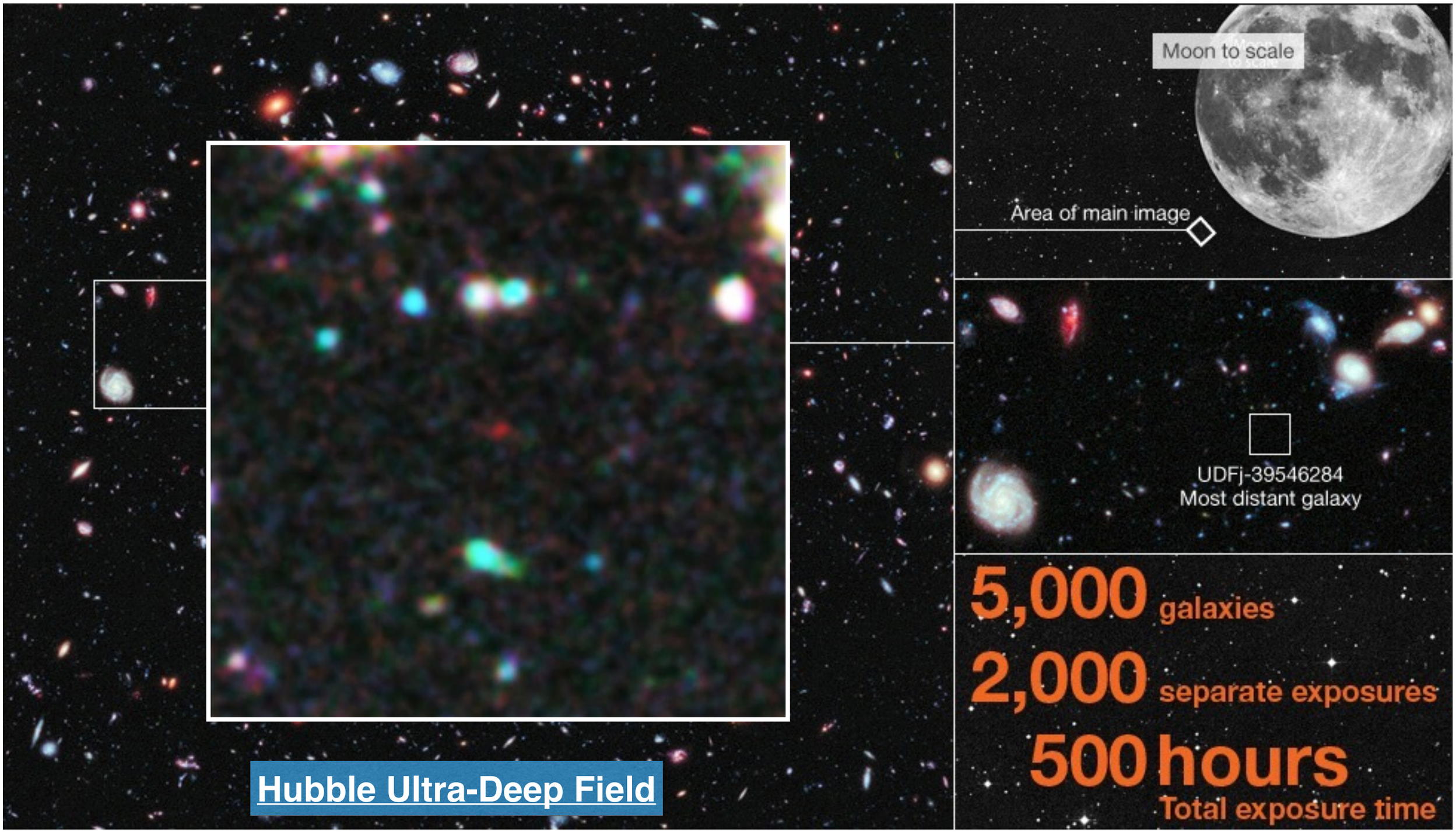
arXiv:1309.7005v1 [astro-ph.CO] 26 Sep 2013

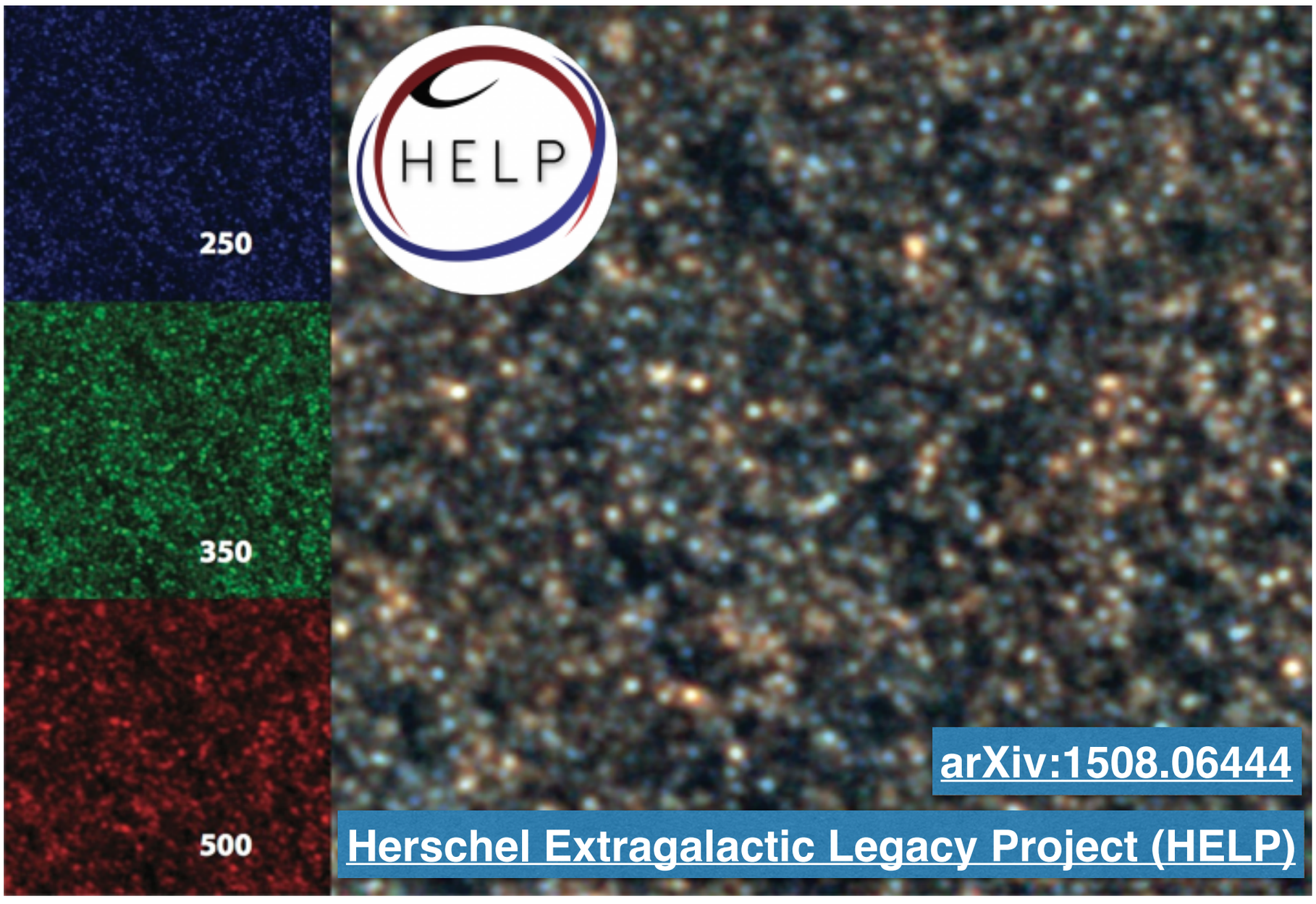
More Galaxies…



More Galaxies…



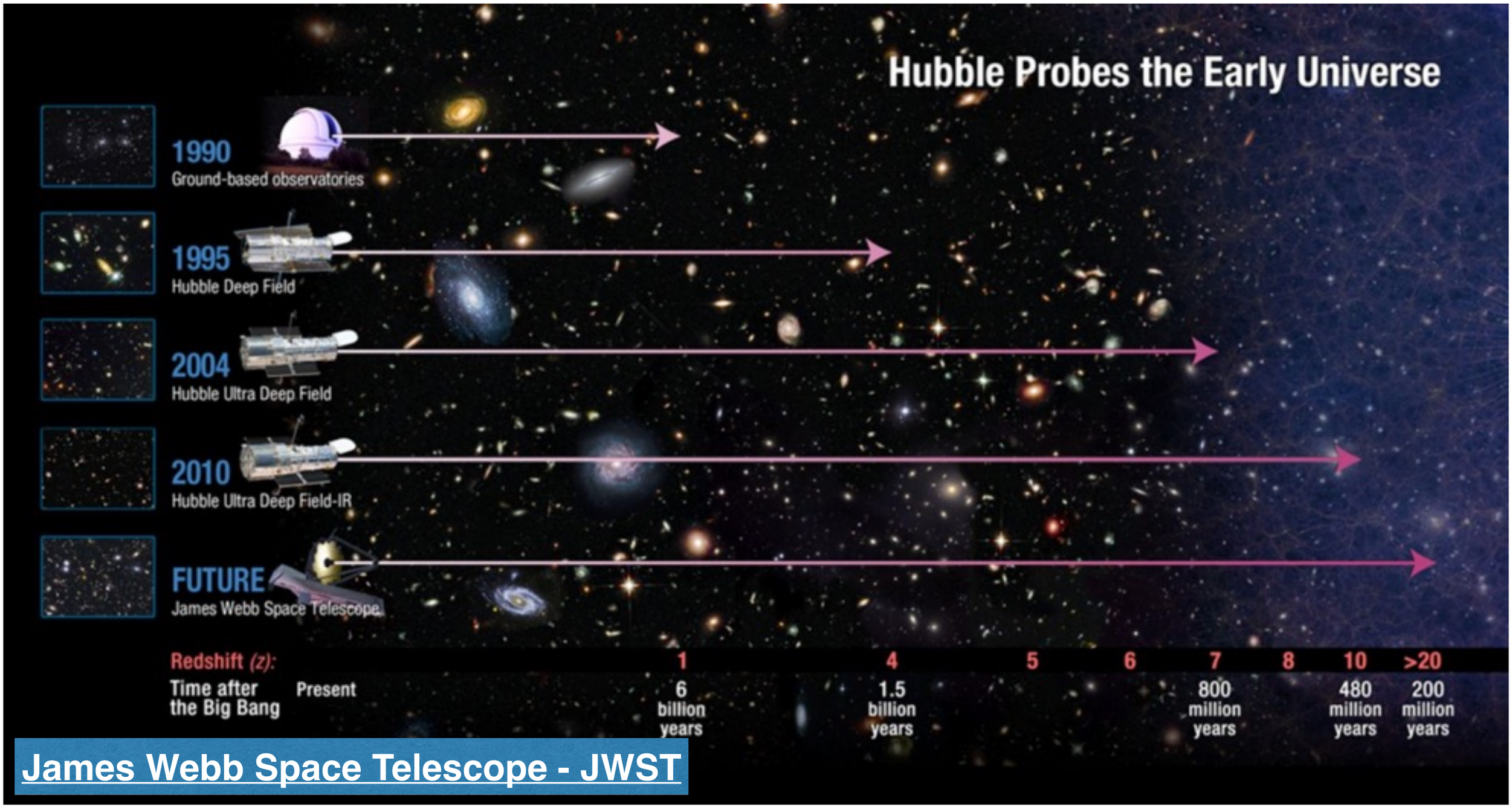
More (IR-)Galaxies…



esa

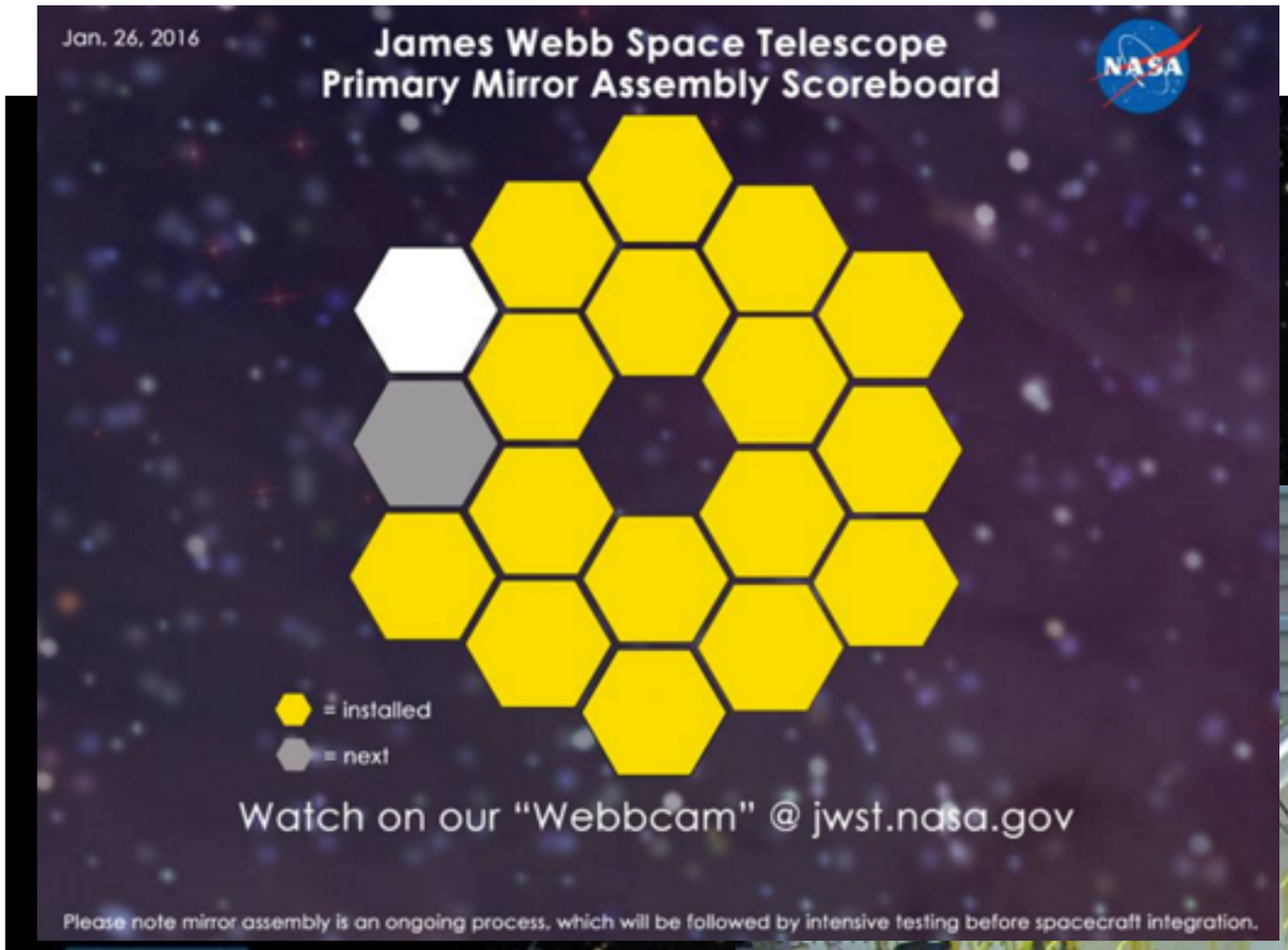
SEVENTH FRAMEWORK PROGRAMME

Going forward…

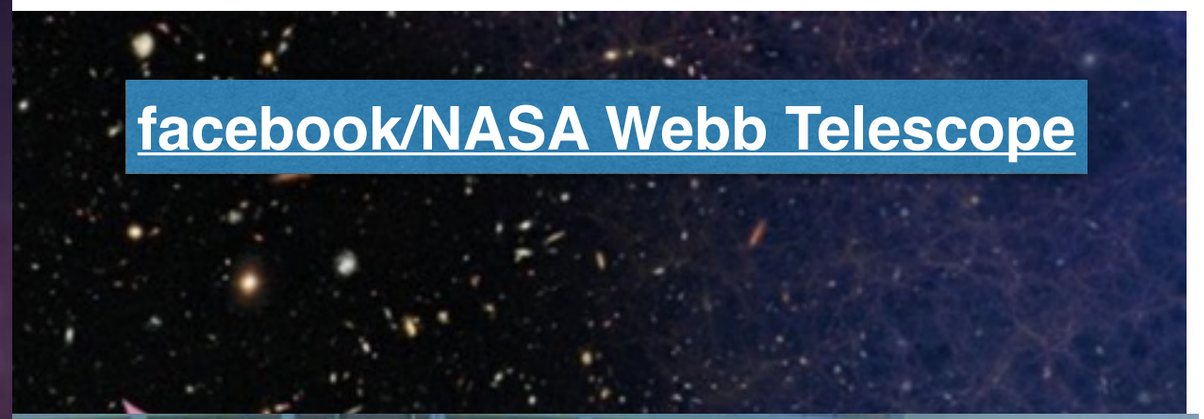


[James Webb Space Telescope - JWST]

Going forward…

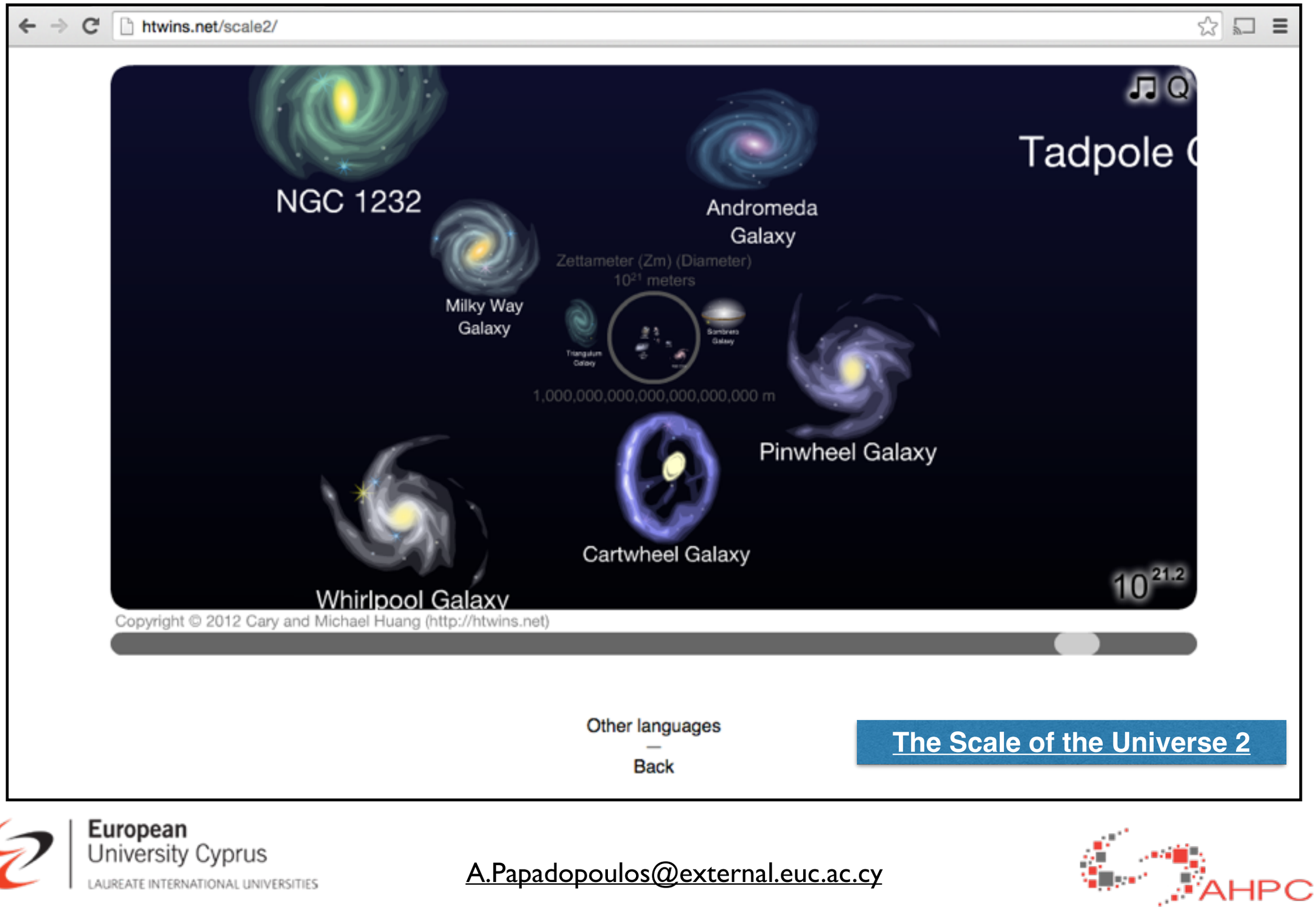


James Webb Space Teles



facebook/NASA Webb Telescope

The Universe in the Classroom #1



The Universe in the Classroom #2

Astronomy Picture of the Day

Discover the cosmos! Each day a different image or photograph of our fascinating universe is featured, along with a brief explanation written by a professional astronomer.

2015 June 13

1000 Sols

Image Credit: NASA, JPL-Caltech; *Mosaic Processing:* Marco Di Lorenzo, Kenneth Kremer

Explanation: Shortly before Mars' June 2015 conjunction, the Curiosity Rover celebrated 1000 sols on the red planet. After its August 5, 2012 landing, Curiosity's 1000th sol or martian day on the surface corresponded to planet Earth's calendar date May 31, 2015. Because the line-of-sight to Mars is close to the Sun near the conjunction, radio communications are affected and the six-wheeled, car-sized robotic rover cautiously remains parked at this spot for now. The view looks back toward the stomping grounds for Curiosity's nearly 10.6 kilometer trek so far, with the hazy rim of Gale Crater in the distance. The mosaicked panorama was constructed with images from navigation cameras taken on Curiosity's sol 997.

Tomorrow's picture: Pinwheel MCI

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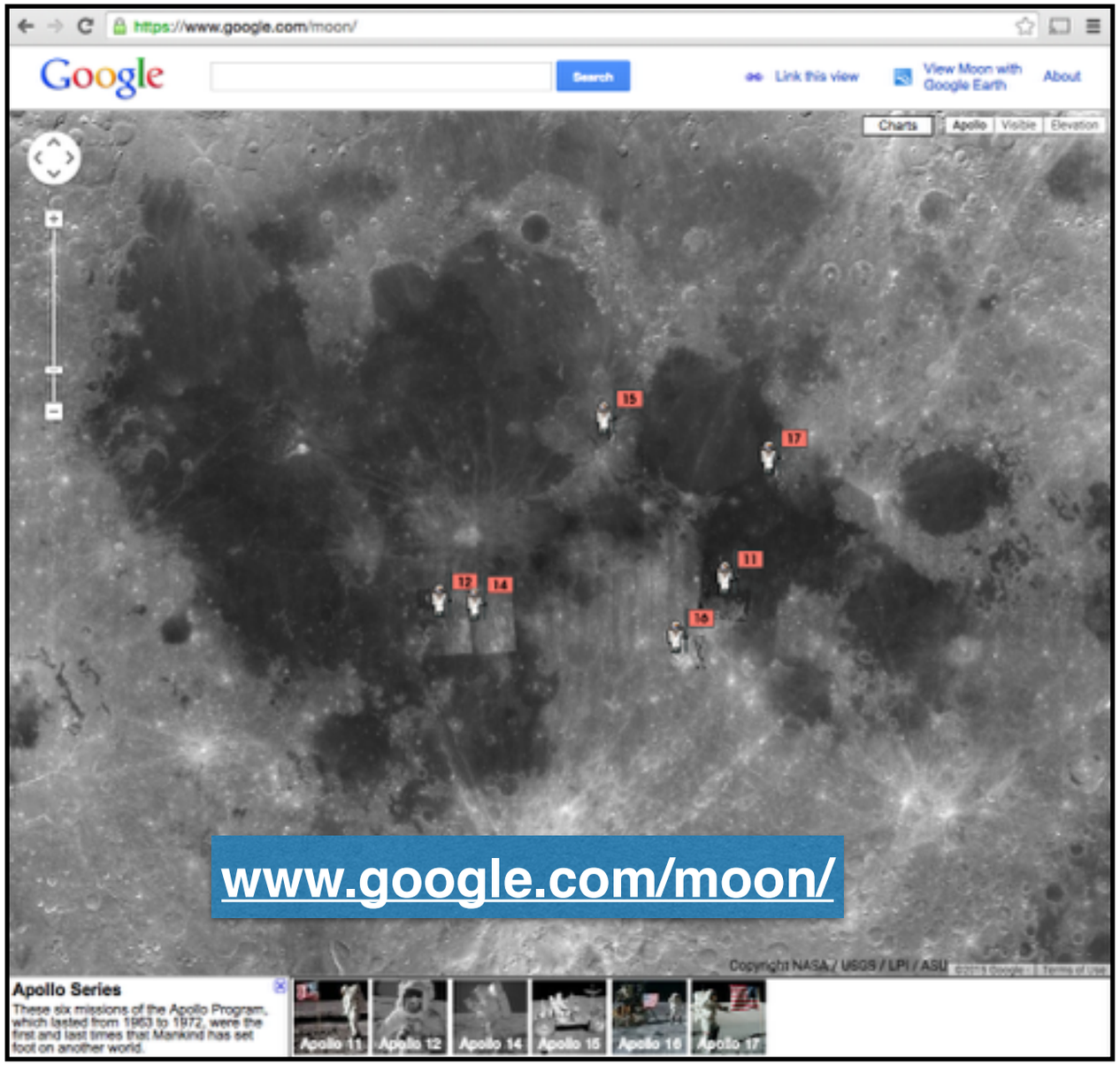
The Universe in the Classroom #3



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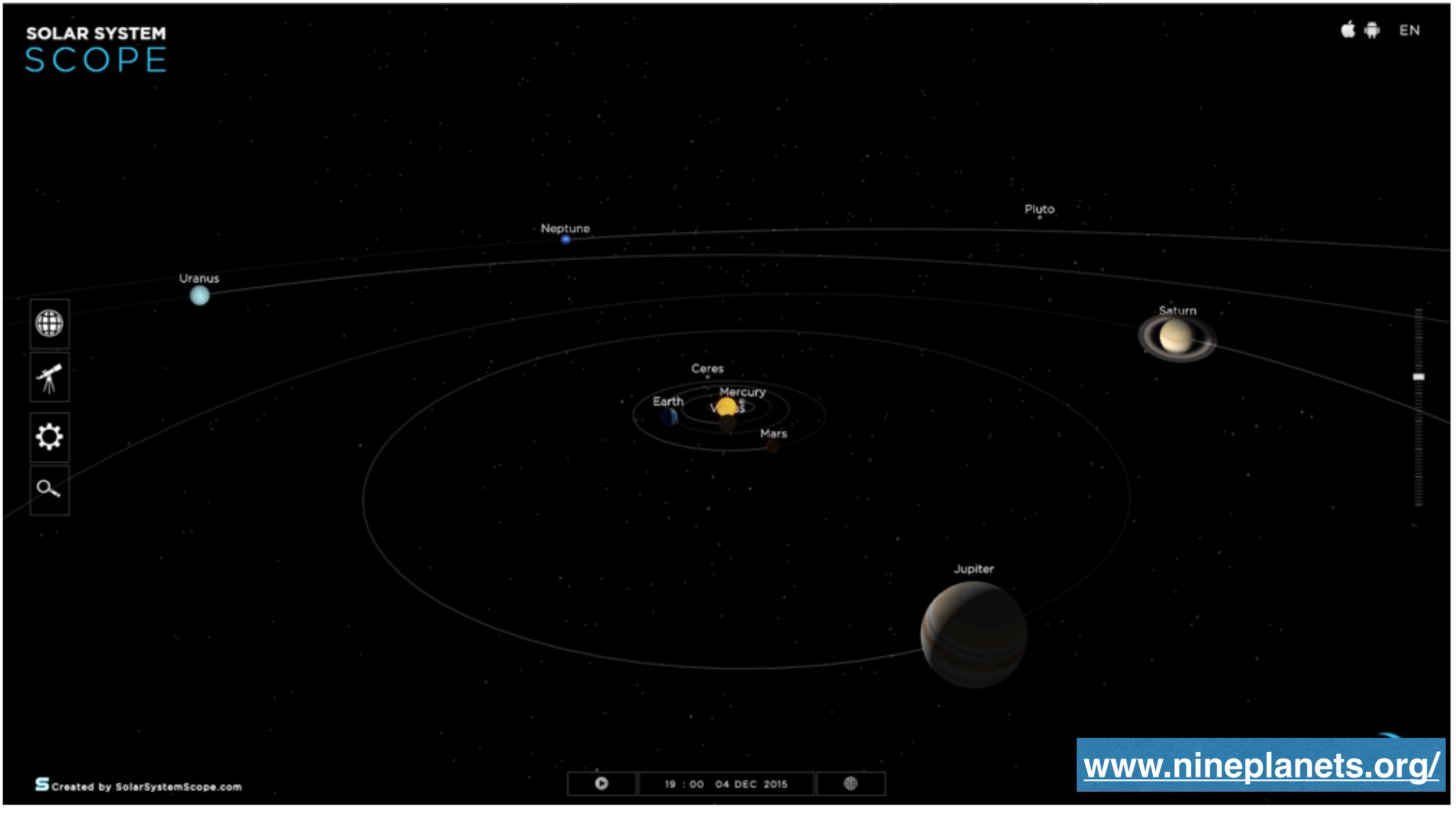
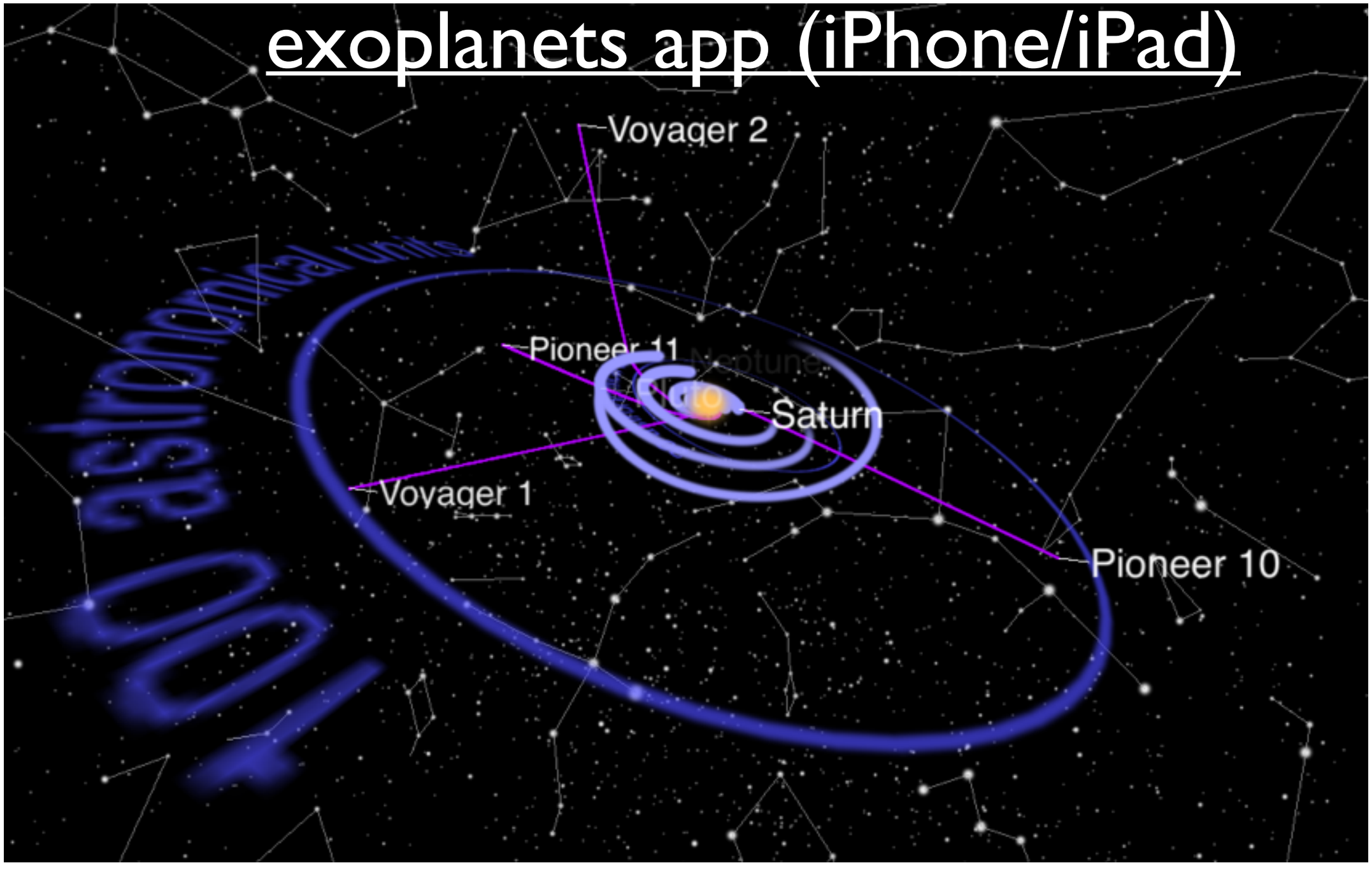
The Universe in the Classroom #4



The Universe in the Classroom #5

exoplanets app (iPhone/iPad)



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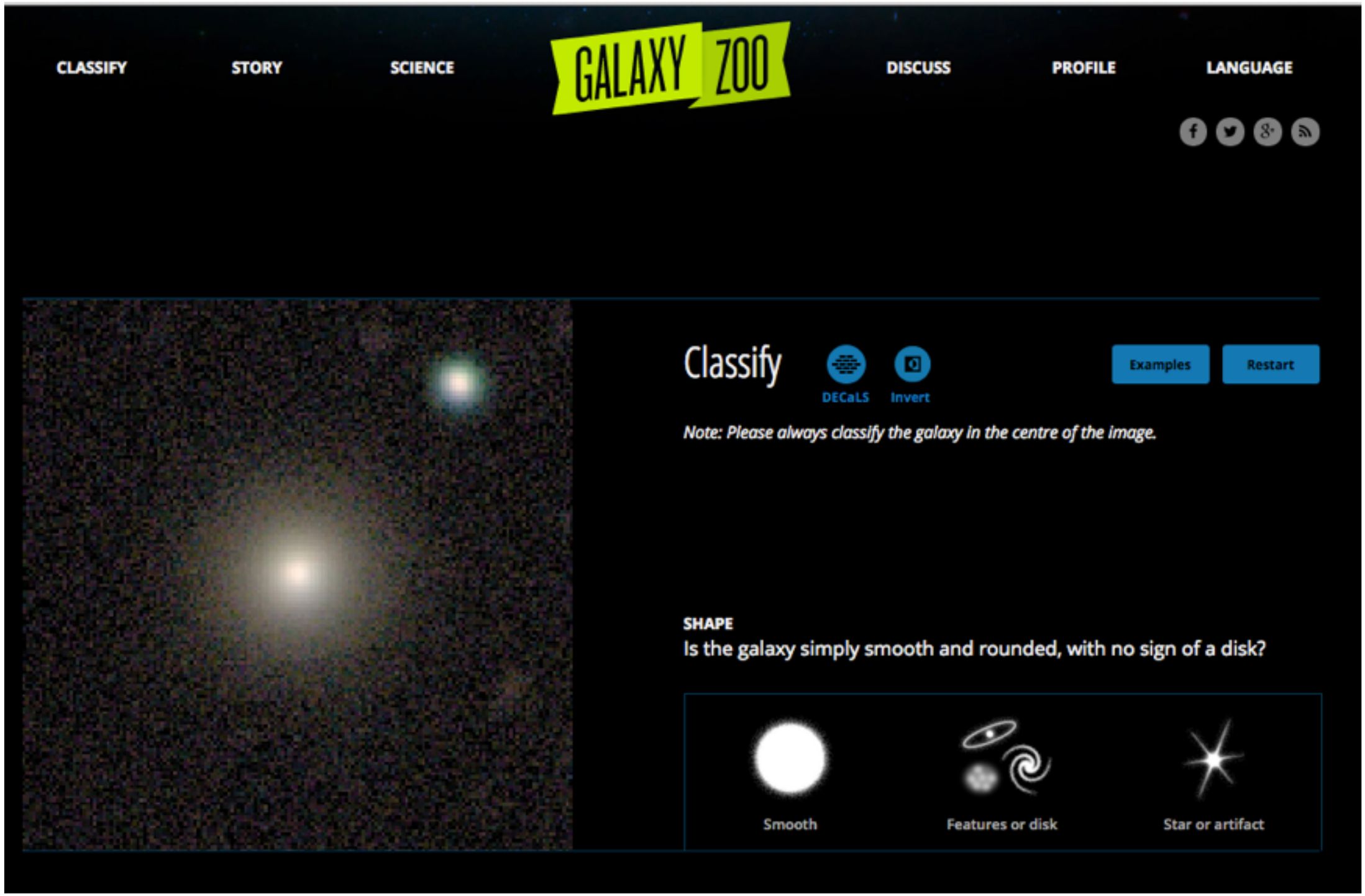

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