



Nobel Prize Physics in the classroom

Astrophysics & Cosmology Module

Rosa Doran & Maria Luísa Almeida - NUCLIO

Joann Dempsey - DCU

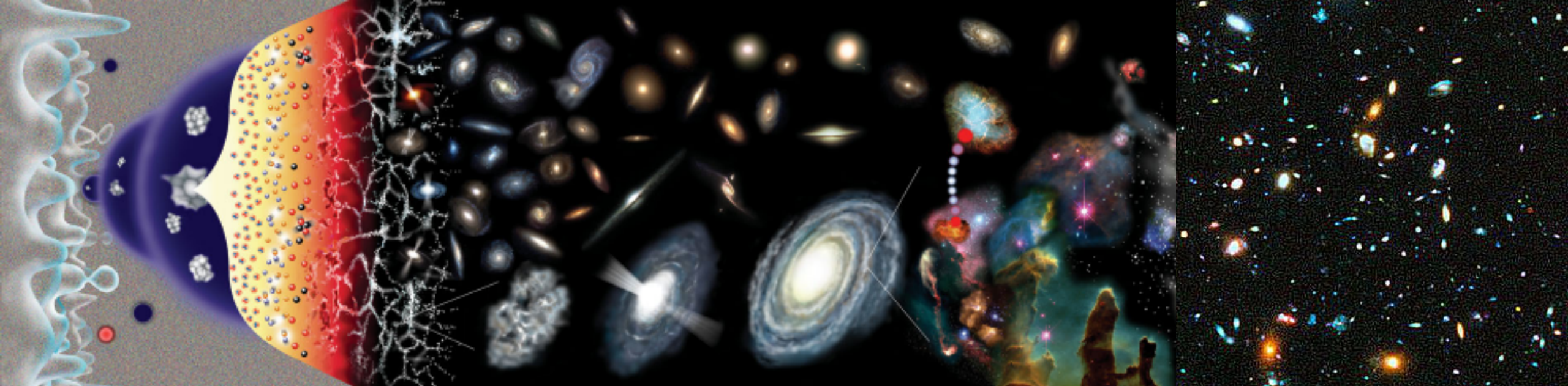
Giulia Vannoni - Paris Centre for Cosmological Physics (PCCP)



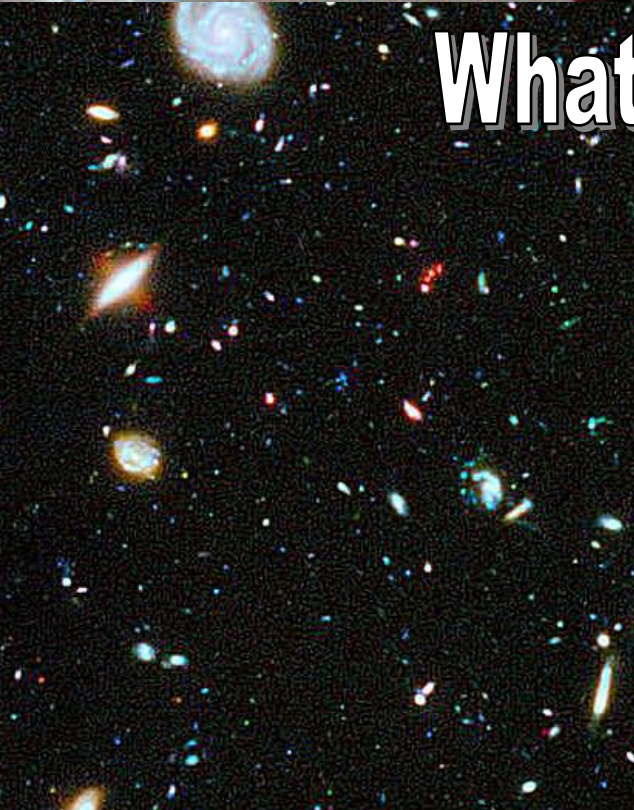
NUCLIO EGO

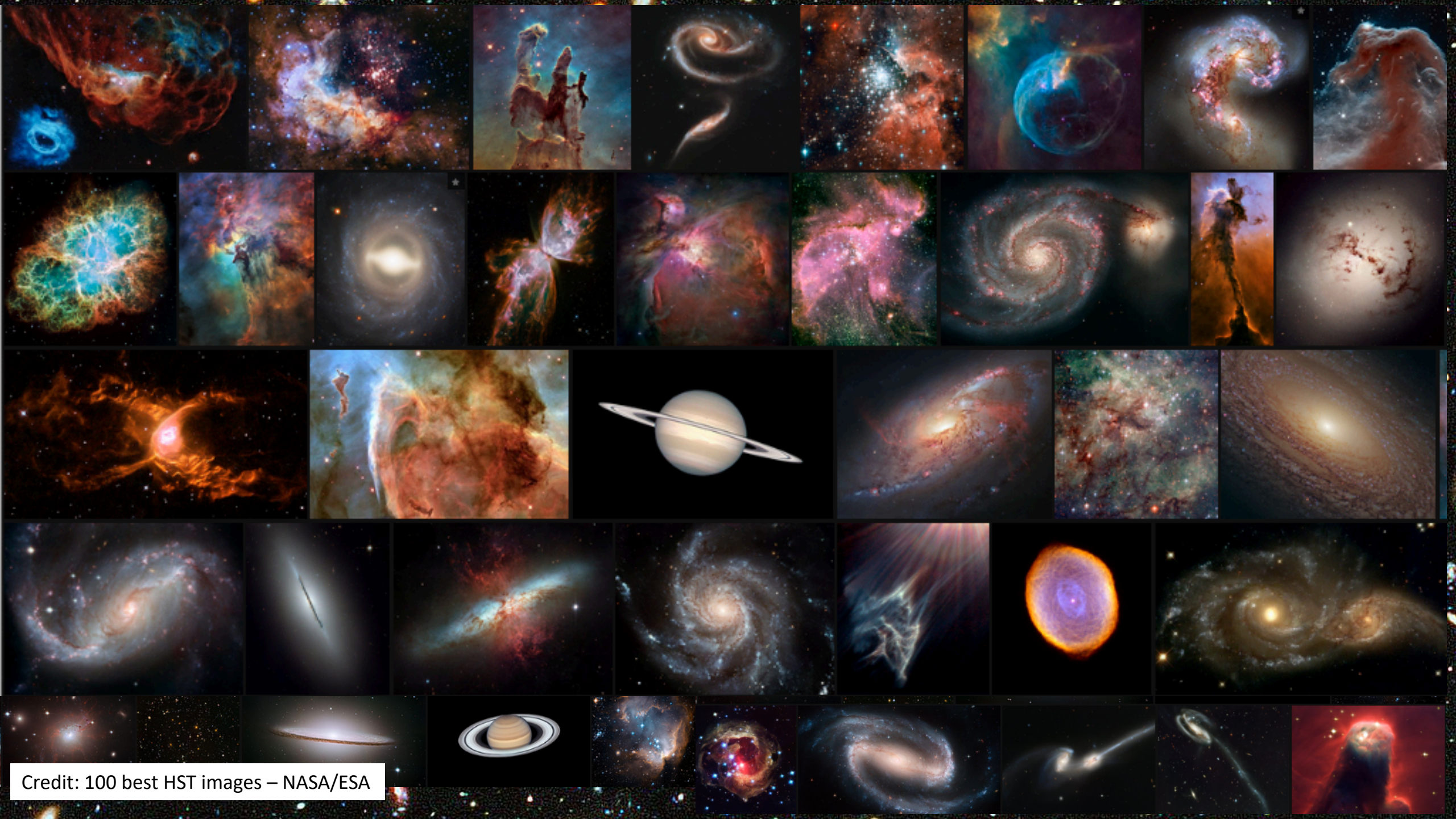
EUROPEAN
GRAVITATIONAL
OBSERVATORY





What do we "know" about our Universe ?!!!





Credit: 100 best HST images – NASA/ESA

Planets

Our Solar System

Background: The Sun Foreground: The planets Mercury, Venus, Earth (and Moon), Mars, Jupiter, Saturn, Uranus, Neptune, and the dwarf planets Pluto, Haumea, Makemake, and Eris.

Planetary Orbits

Uranus

Saturn

Jupiter

Mars

Earth

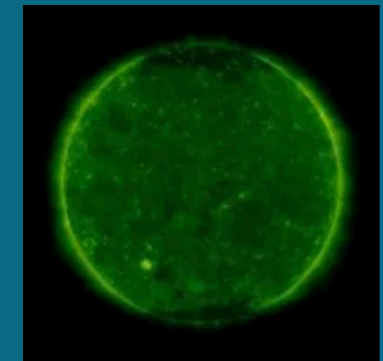
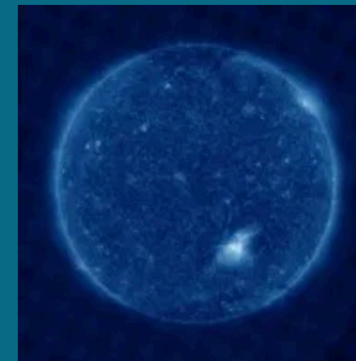
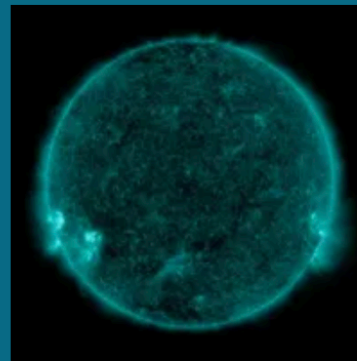
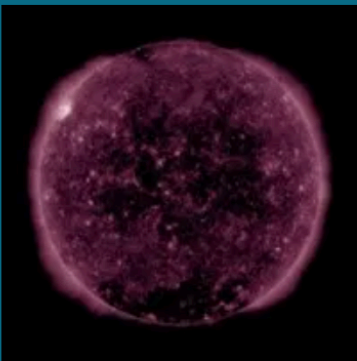
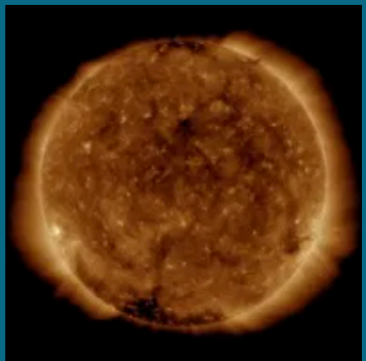
Venus

Mercury

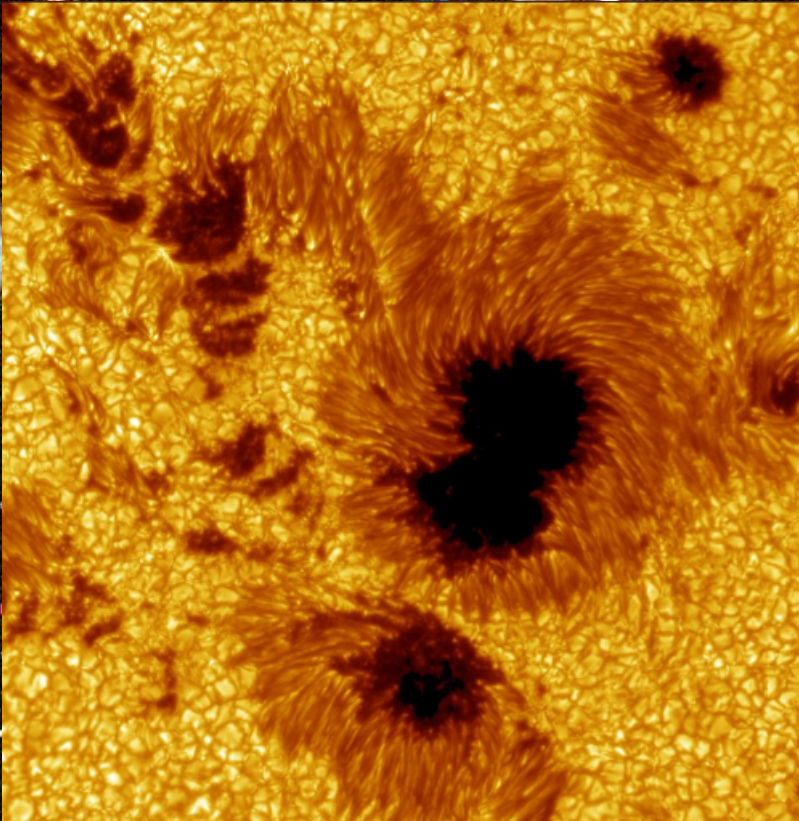
Sun



The Sun as Seen by the Solar Dynamics Observatory (SDO) & the Solar and Heliospheric Observatory (SOHO).



For sure you know our star very well.
Don't you?



Does the Sun Rotate?

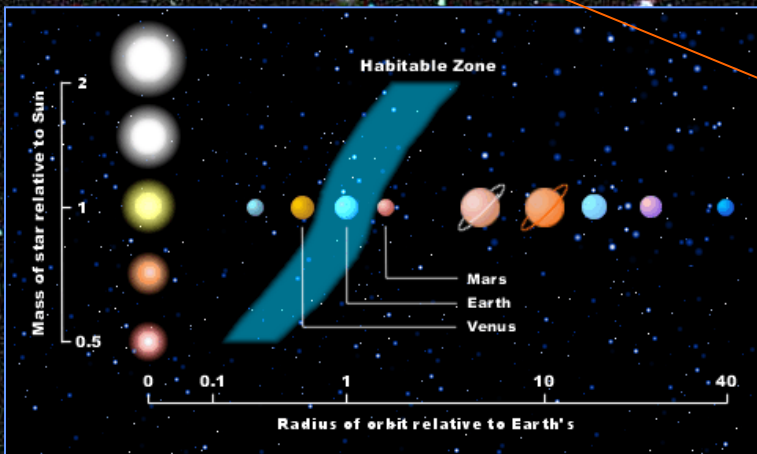
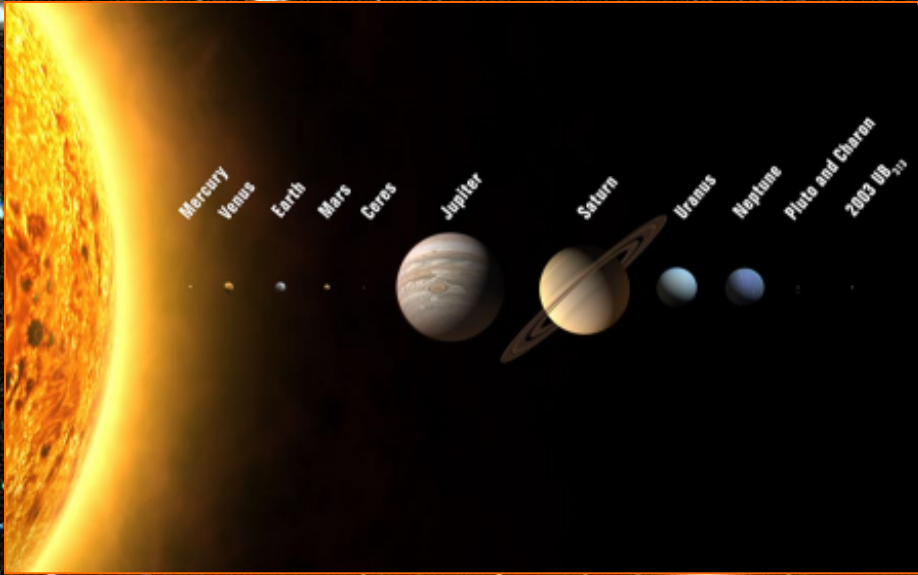
What is the size of these
spots? What are they?



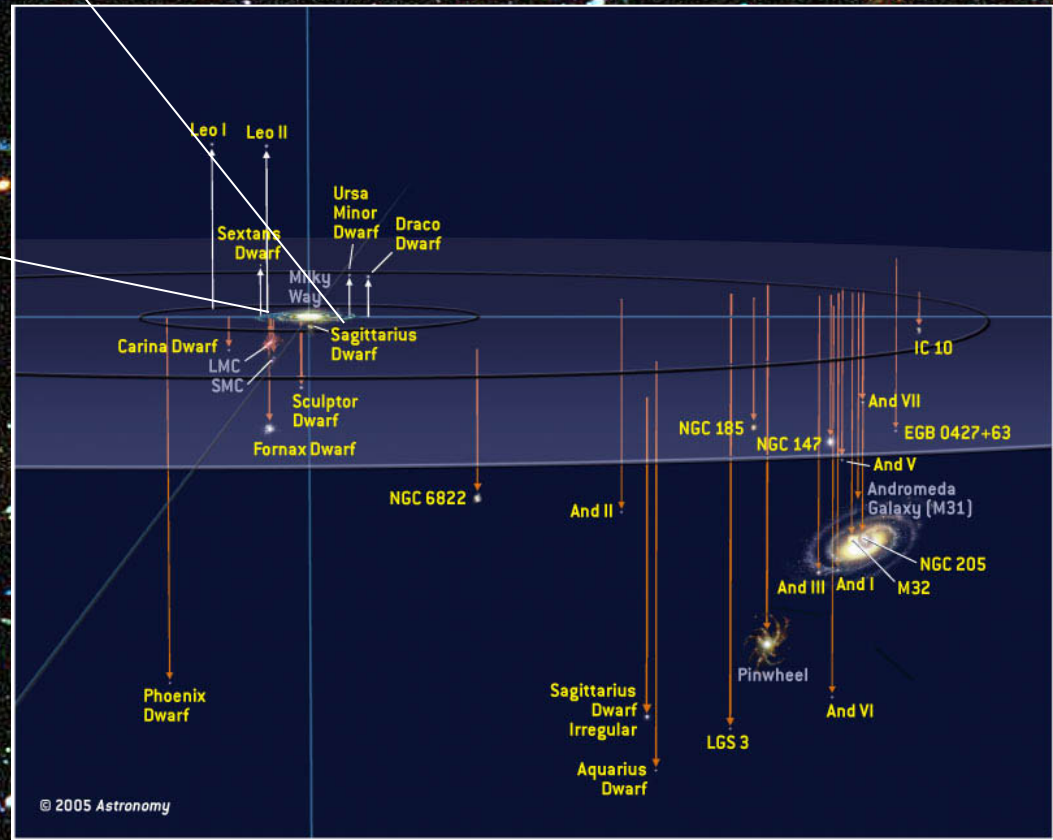
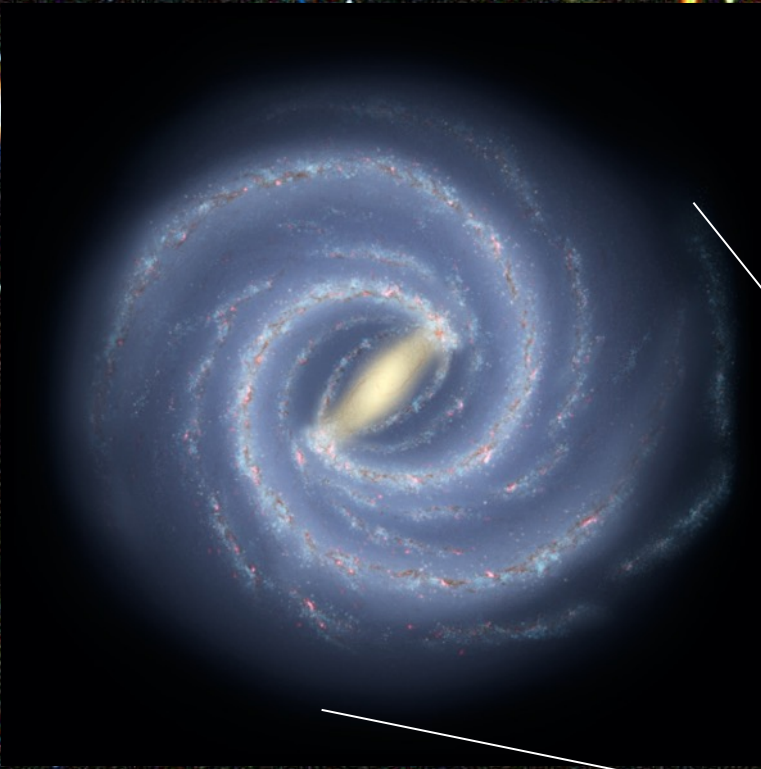
© NASA



Habitable Zone

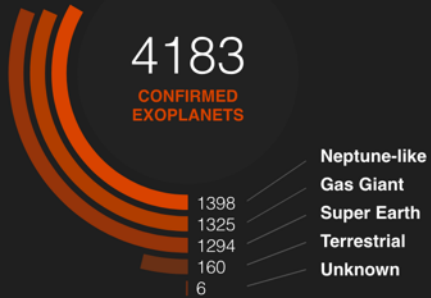


Local Group

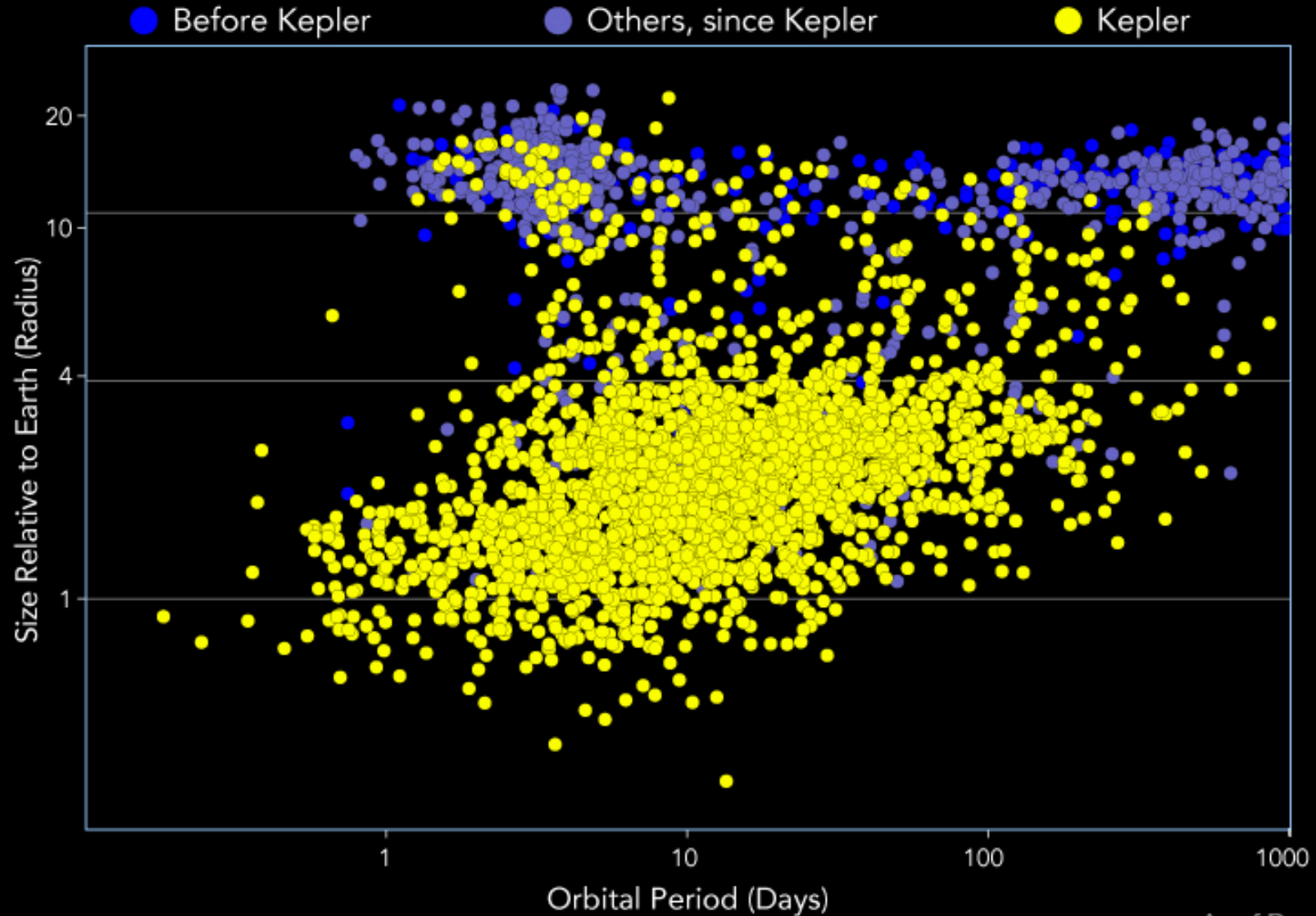


Exoplanet Discoveries

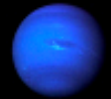
Planet Types



Total
Kepler
= 2,525



Jupiter

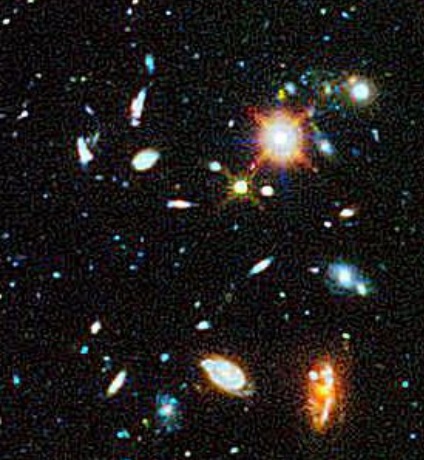


Neptune

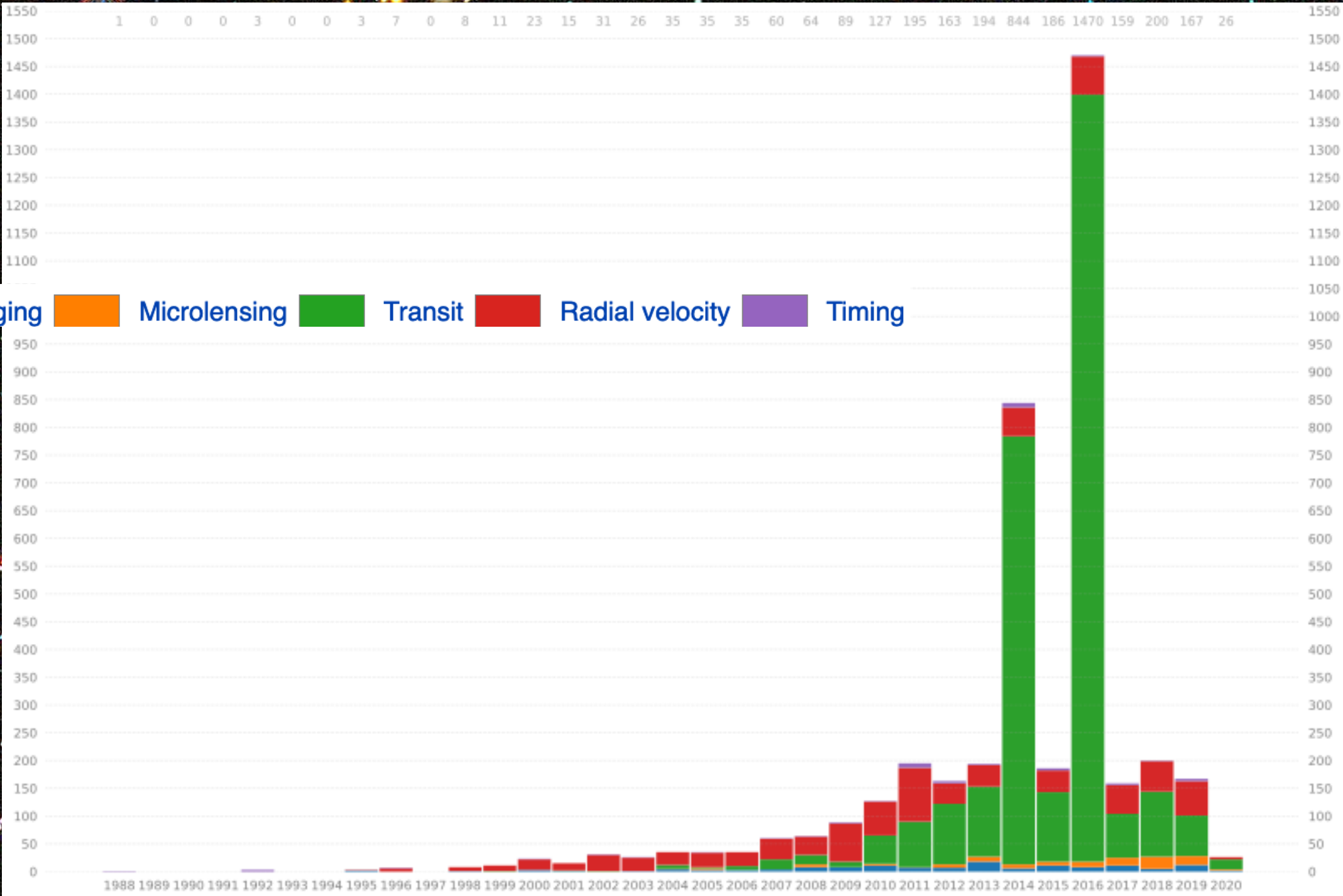


Earth

As of December 14, 2017



Direct imaging

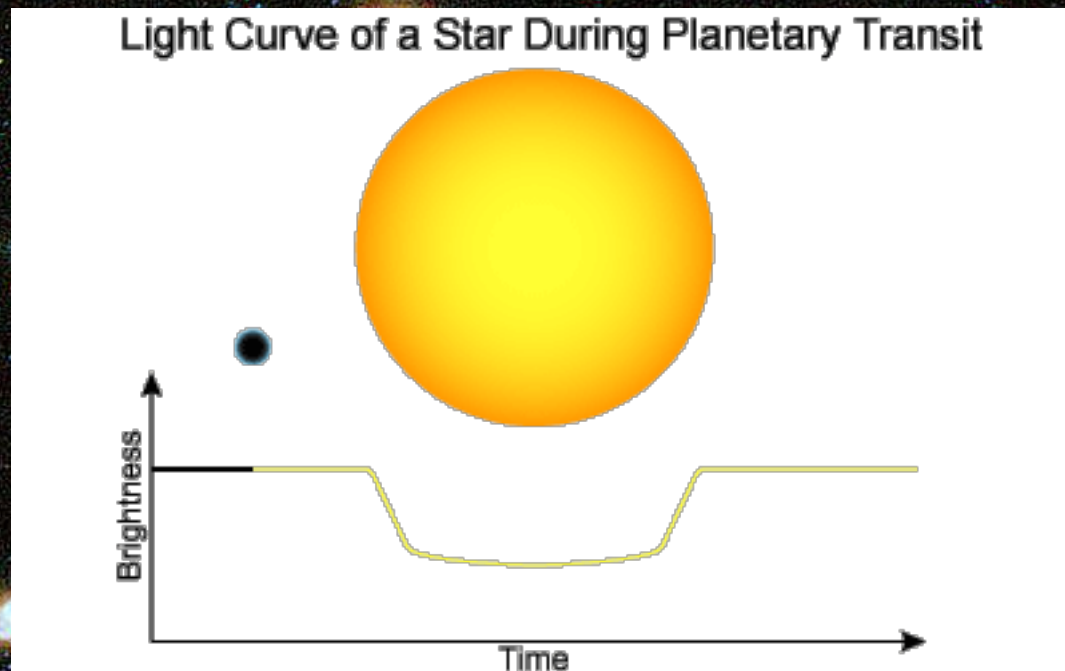


An artist's impression of the TRAPPIST-1 system. The left side of the image shows a close-up, curved view of a reddish-orange planetary surface, heavily cratered and textured. The right side shows a vast, dark space filled with numerous small, distant stars. A bright, glowing yellow-orange star, the TRAPPIST-1 host star, is positioned in the upper right, casting a strong light across the scene. A small, dark planet is visible as a tiny dot just to the left of the star. Several other planets are visible as small, distant orange and red dots in the lower right quadrant of the image.

Artist's impression shows the
view from the surface of one
of the planets in the
TRAPPIST-1 system

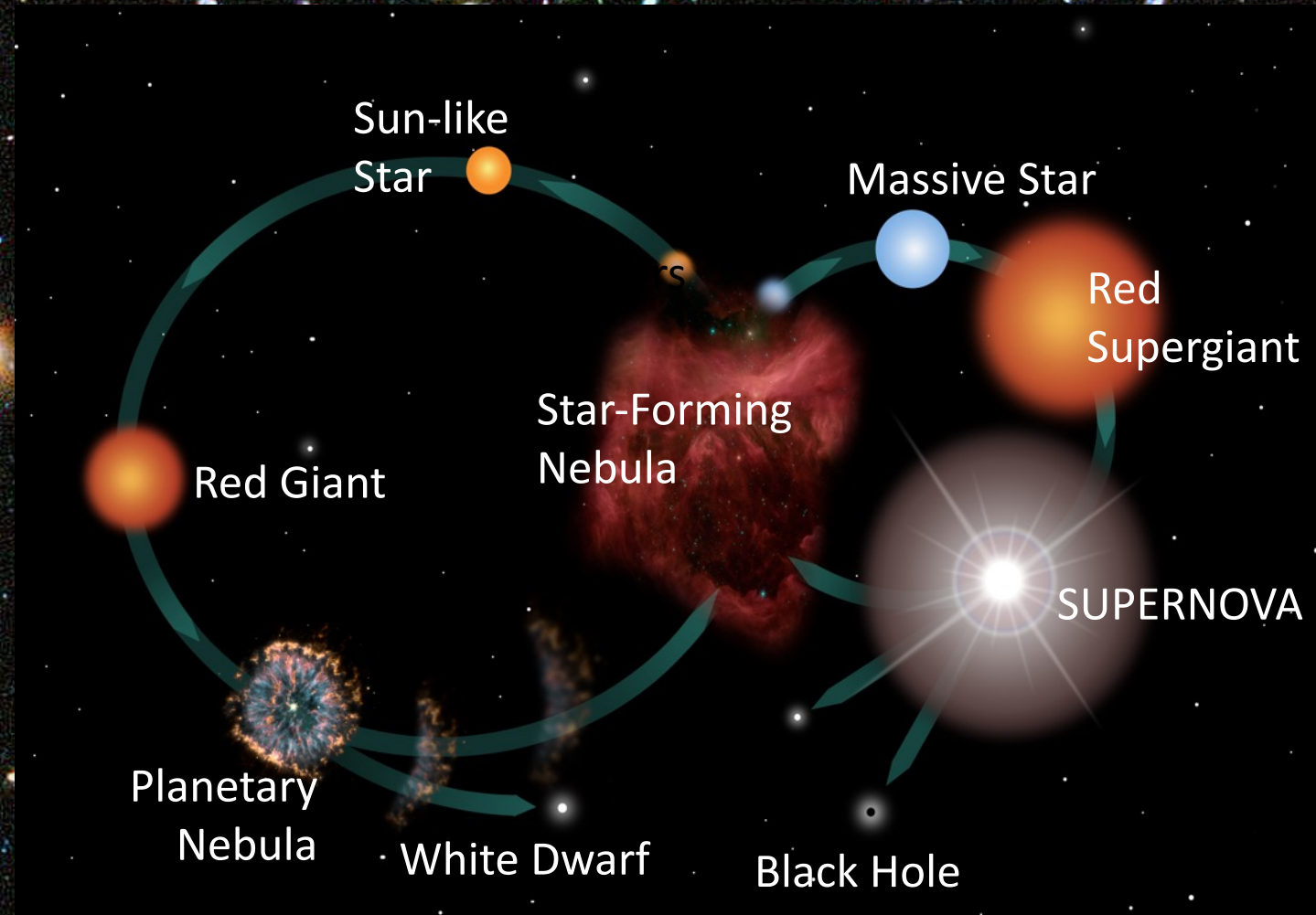
What If...?

Fancy finding new Exo-planets?

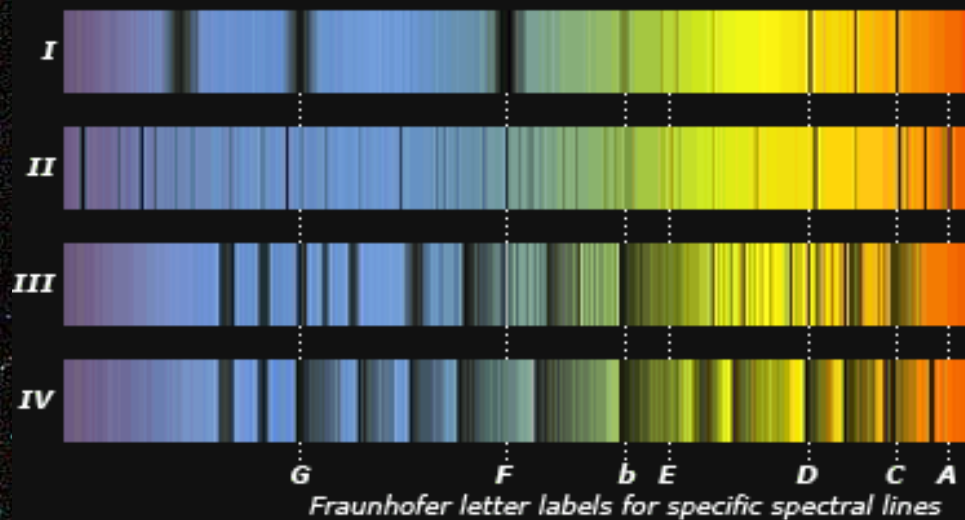


Life Cycle of Stars

How do we know!?!?



19th century diagram of the four Secchi type spectra



Black Holes

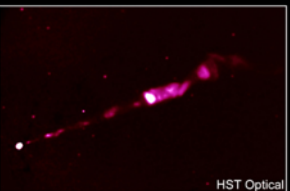
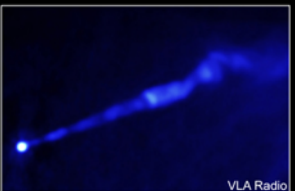


M87

Biggest black hole known

55 million years away

Jet that is 5000 light-year long



BH and NS Mass Chart

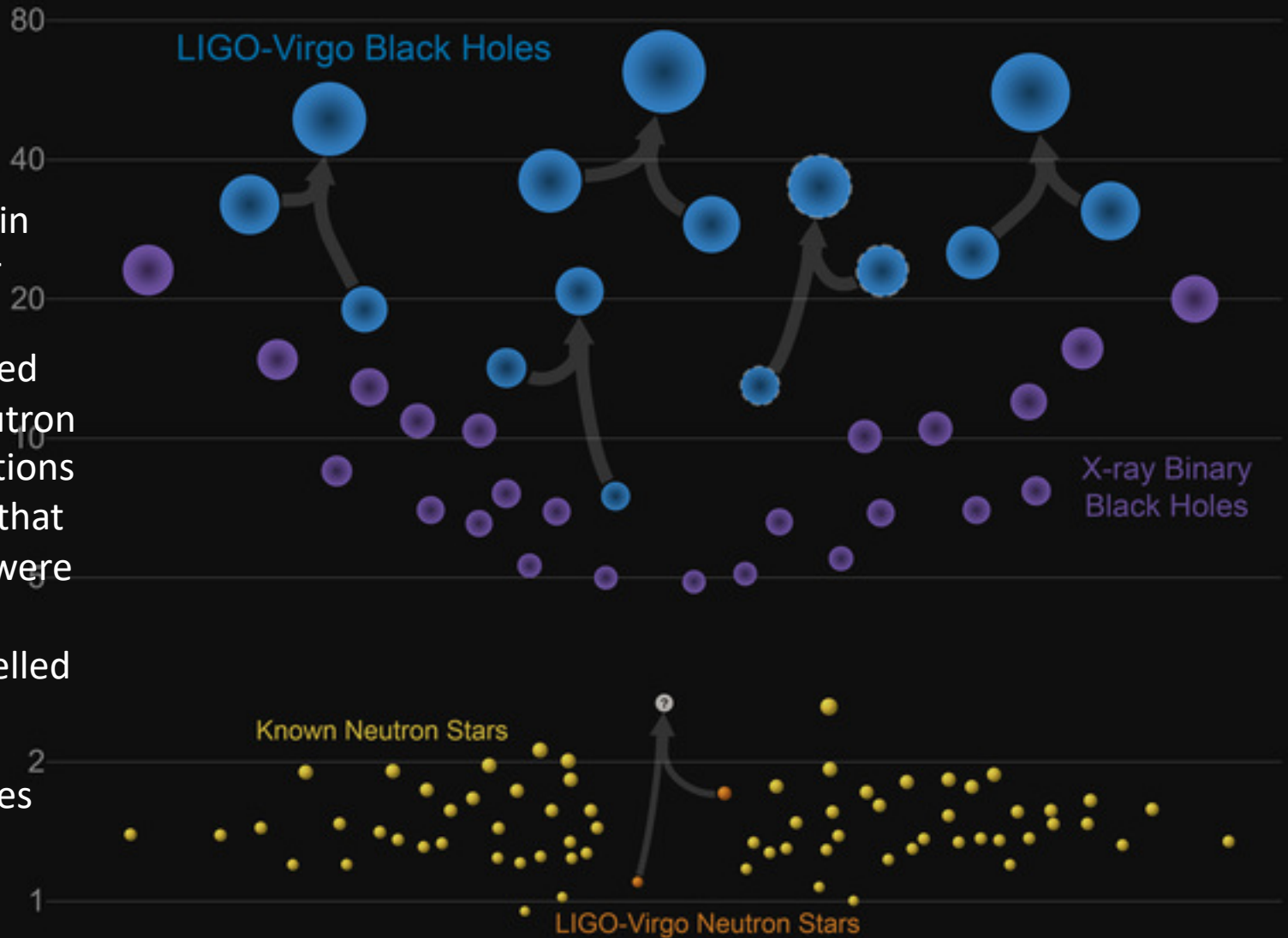
The masses of stellar remnants are measured in many ways. This graphic shows the masses for black holes detected through electromagnetic observations (purple); the black holes measured by gravitational-wave observations (blue); neutron stars measured with electromagnetic observations (yellow); and the masses of the neutron stars that merged in an event called GW170817, which were detected in gravitational waves (orange). The remnant of GW170817 is unclassified and labelled as a question mark.

There are currently more than 50 X-Ray Binaries being followed

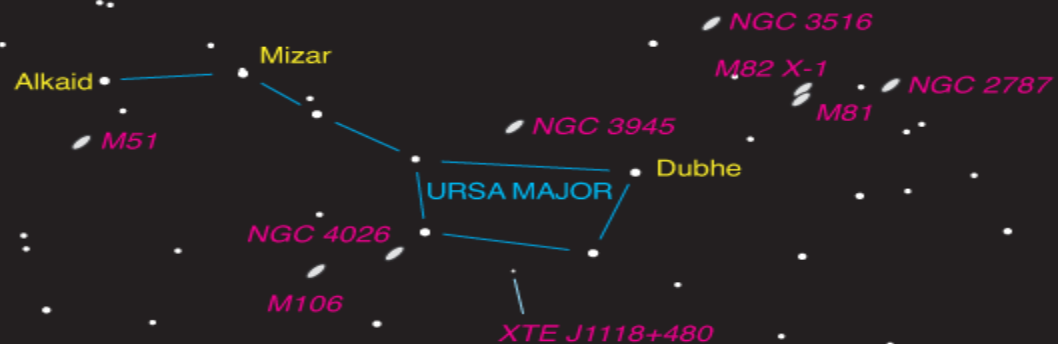
<http://www.faulkes-telescope.com/xrb/>

Masses in the Stellar Graveyard

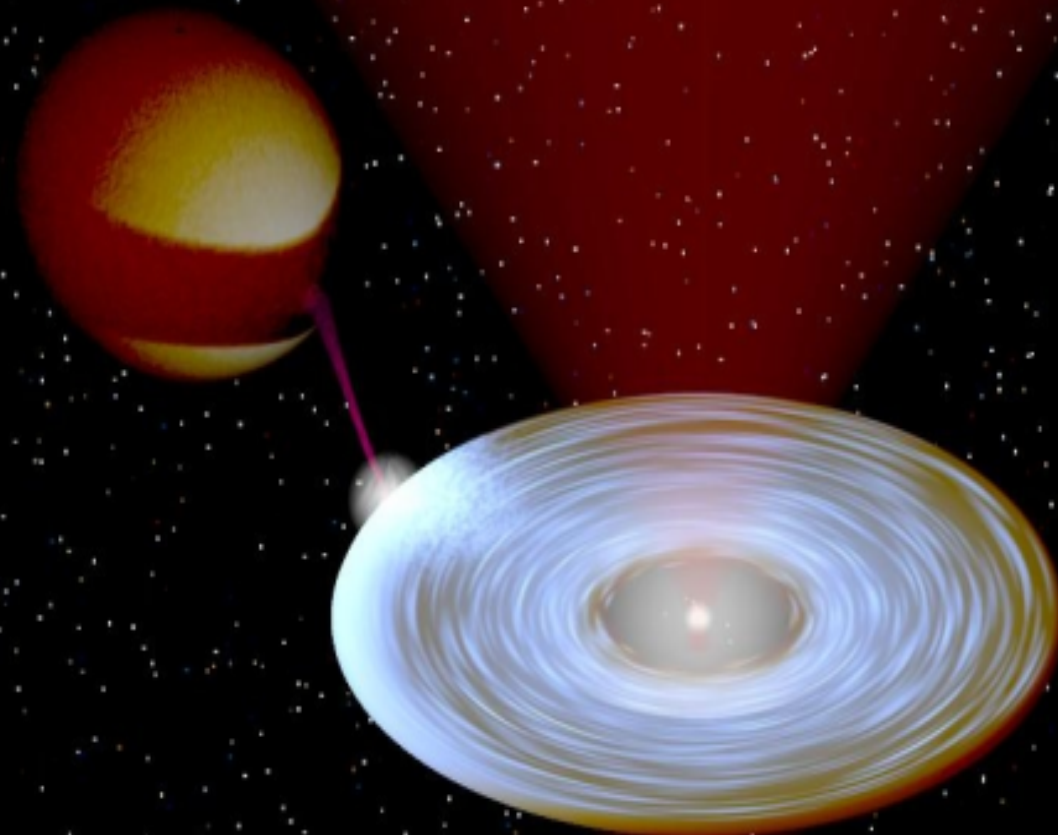
in Solar Masses



We will study a stellar mass black hole candidate using a series of 62 images taken with the Faulkes Telescope



XTE J1118+480



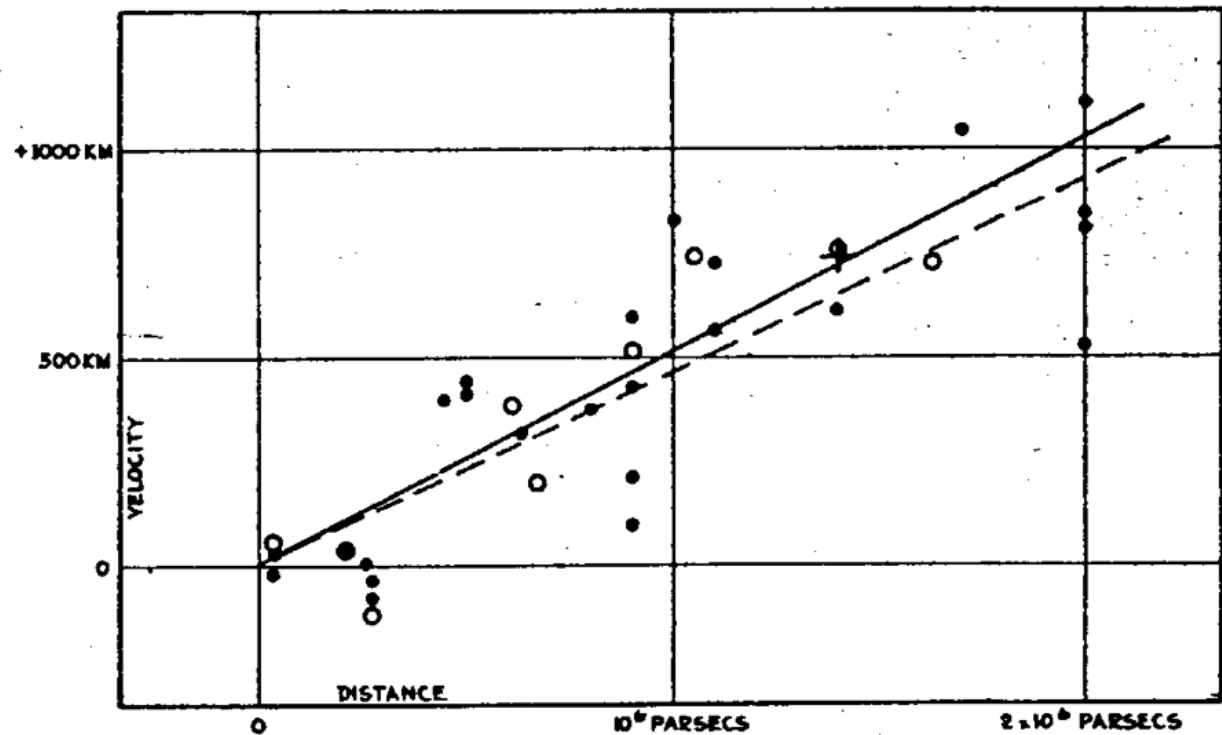
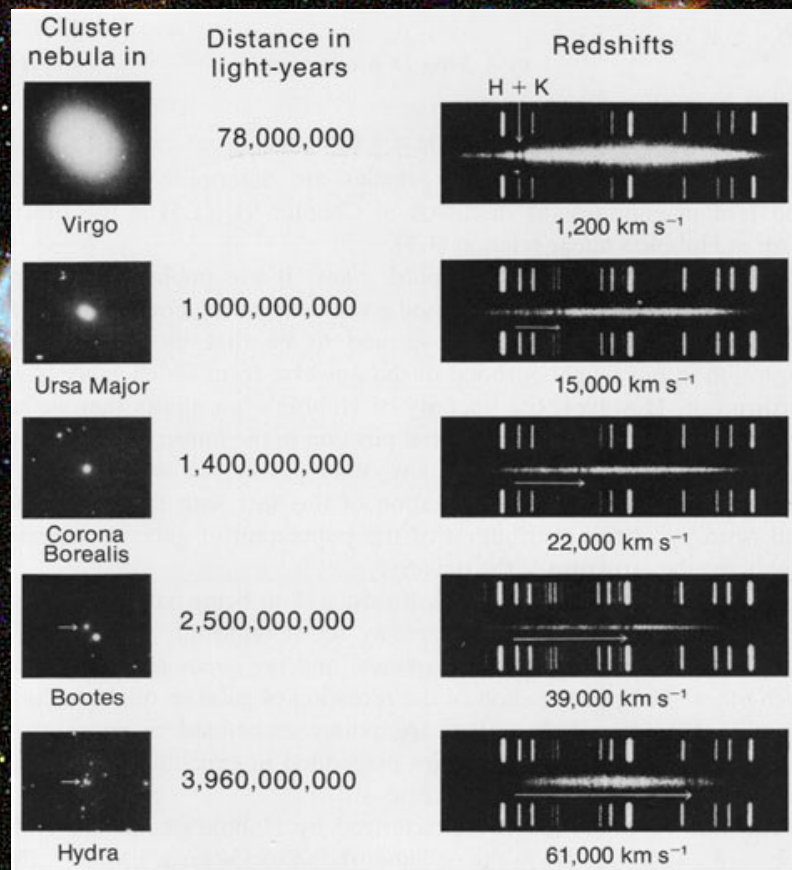
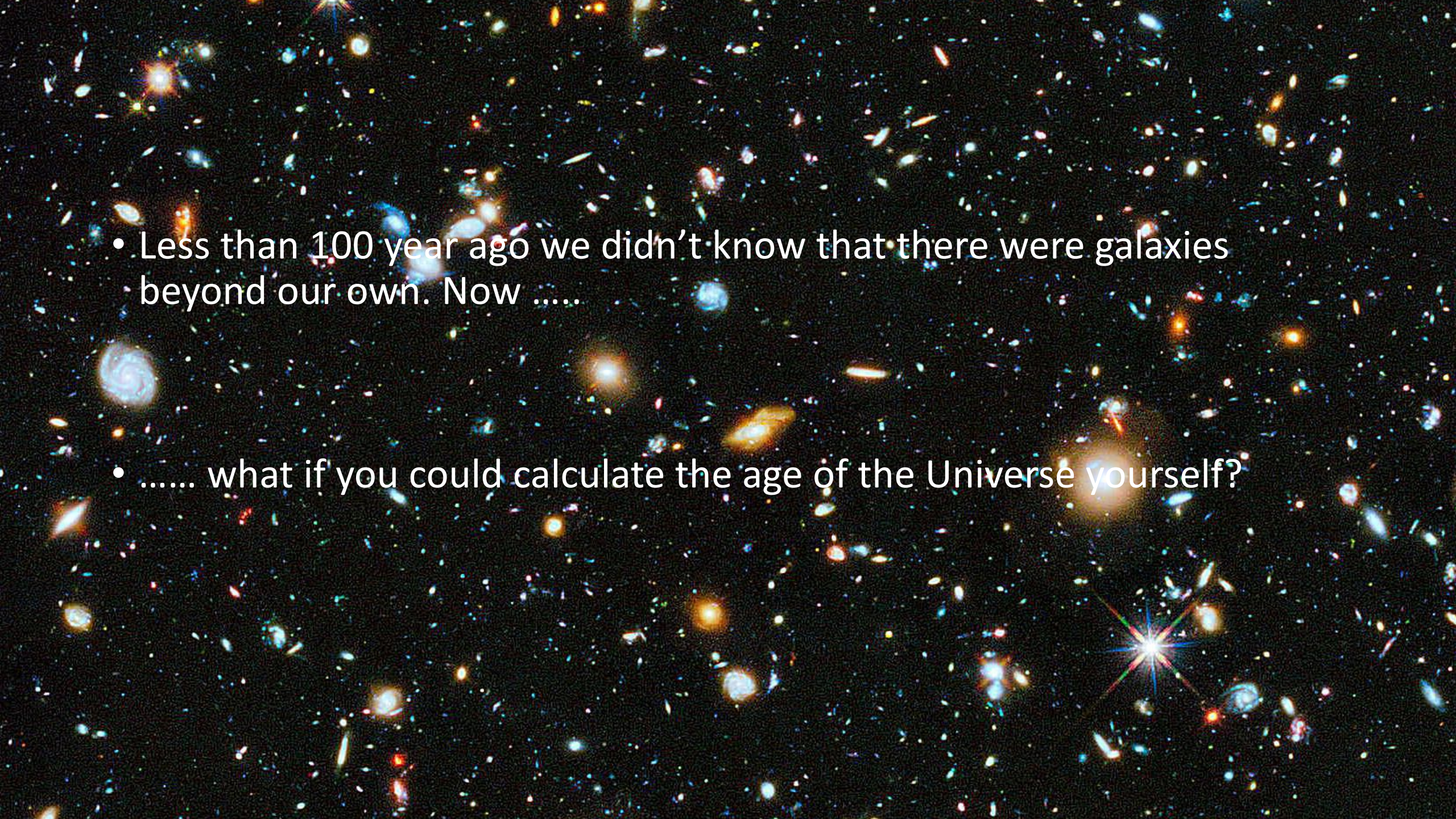


FIGURE 1

In 1920s → the Solar System is located in a galaxy
 1923 → Andromeda is another Galaxy
 1929 – All galaxies were moving away from us with a velocity directly proportional to their distance:

$$v = H_0 * d$$

- 
- Less than 100 year ago we didn't know that there were galaxies beyond our own. Now
 - what if you could calculate the age of the Universe yourself?

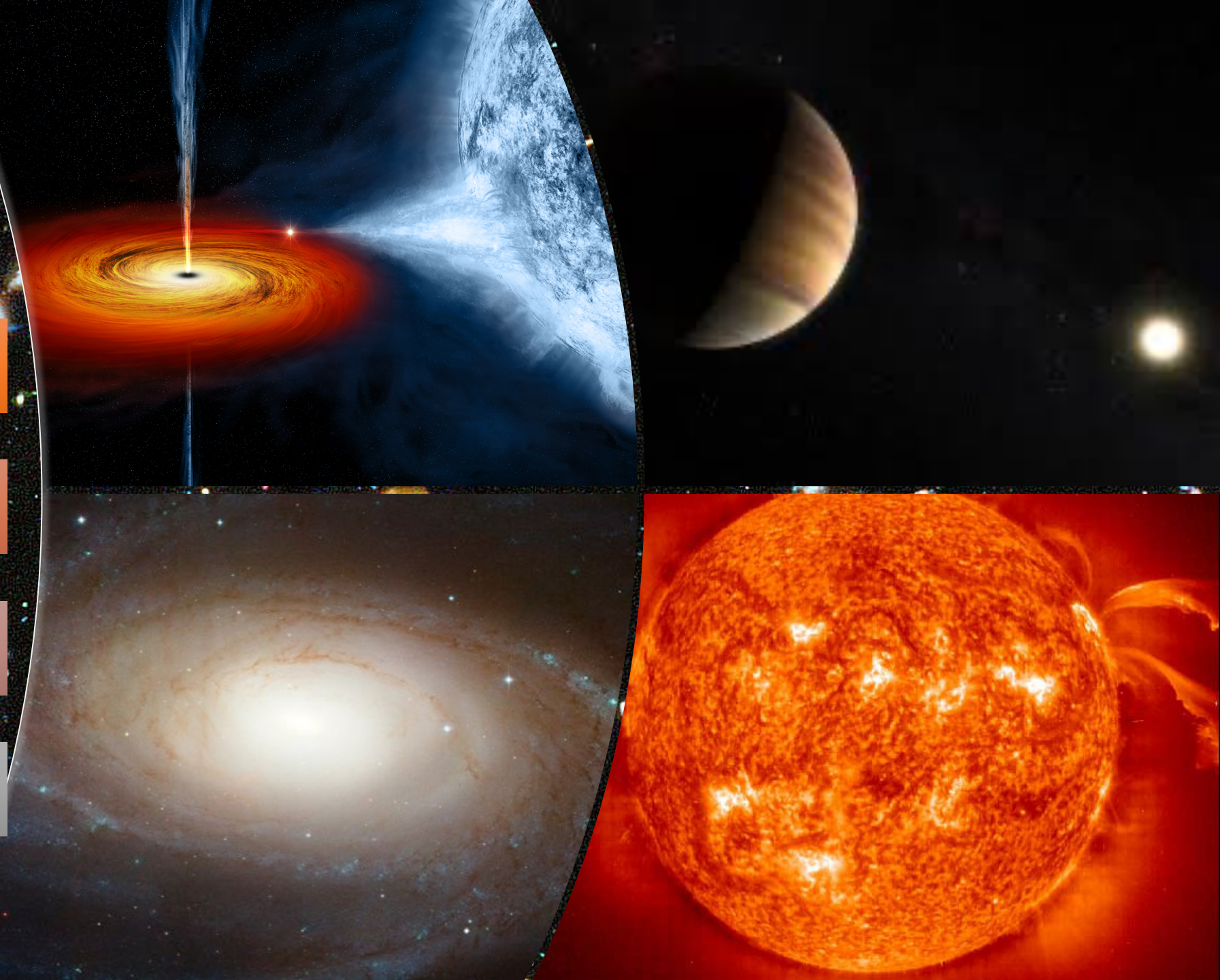
Topics of this module

Exoplanets

Blackholes

Age of the Universe

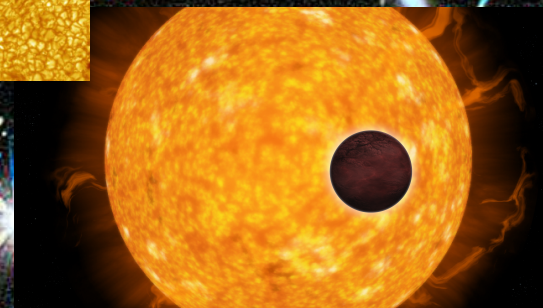
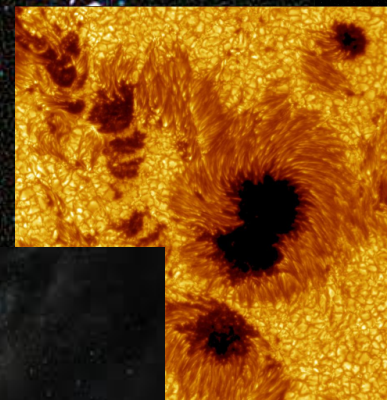
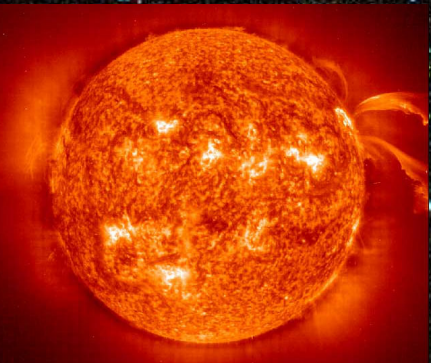
The Sun





Nobel Prize Physics in the classroom

Thank you!



This project is funded by the European Union.



NUCLIO EGO EUROPEAN GRAVITATIONAL OBSERVATORY

