Building Virtual Universes to Understand the Real One

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Talk Outline

- Introduction to Astronomy
- Galaxies
- Simulations
- Summary and Questions

The Very Large Telescope (yes, really)

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Me

- Born in Leeds
- Studied Physics with Astronomy at Durham University
- Currently studying for a PhD at the Astrophysics Research Institute, Liverpool

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Astrophysics Research Institute

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Home Working

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What is Astronomy?

Astronomy is a science that studies space and everything in it

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Planets and Moons

The planet Saturn

Lakes of methane on Titan, moon of Saturn

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Stars and Supernova

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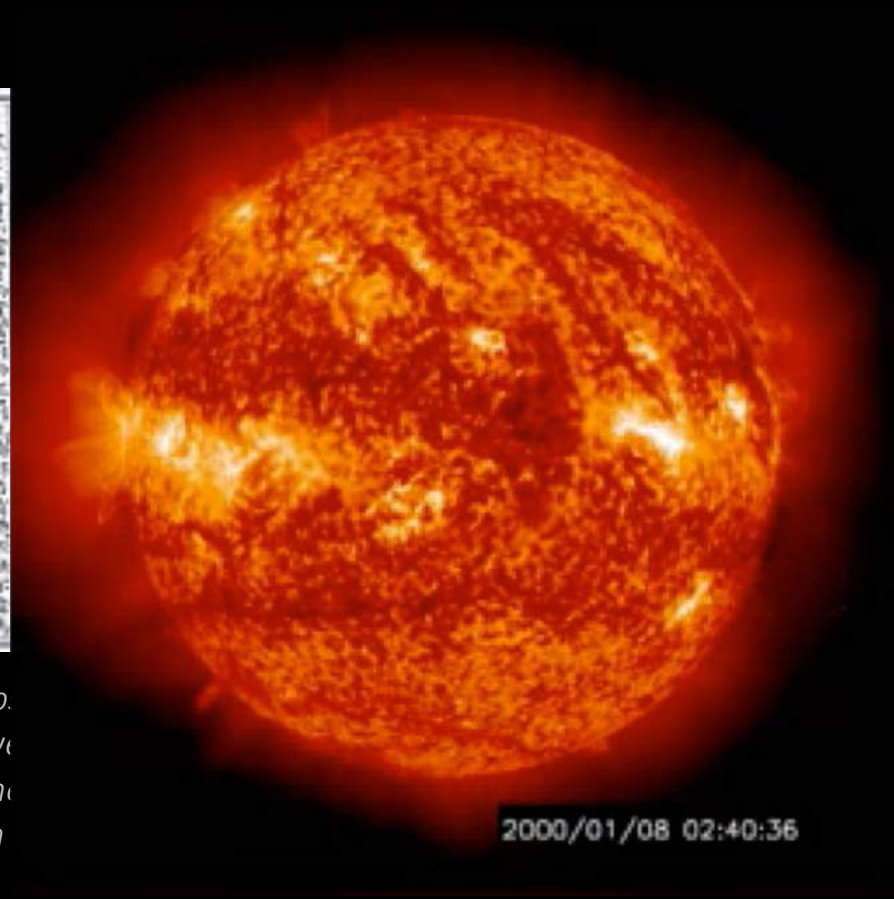
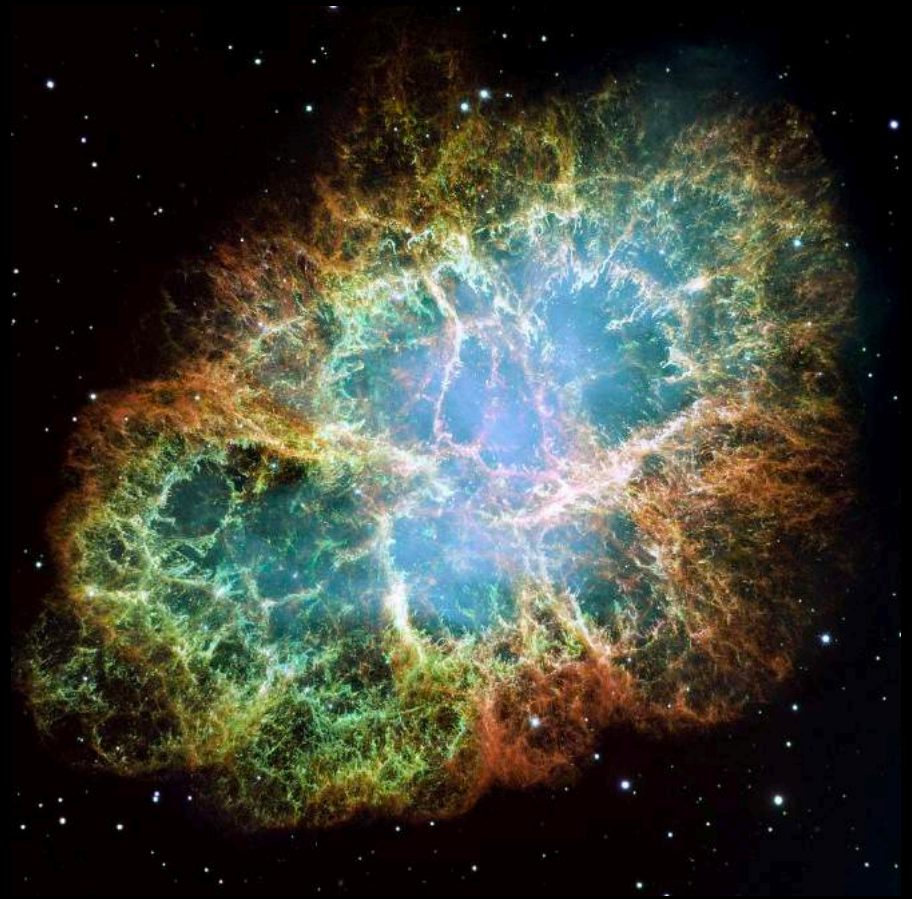
value.

Observation by Chinese Astronomers - 1054



The Sun



Crab Nebula – Present Day

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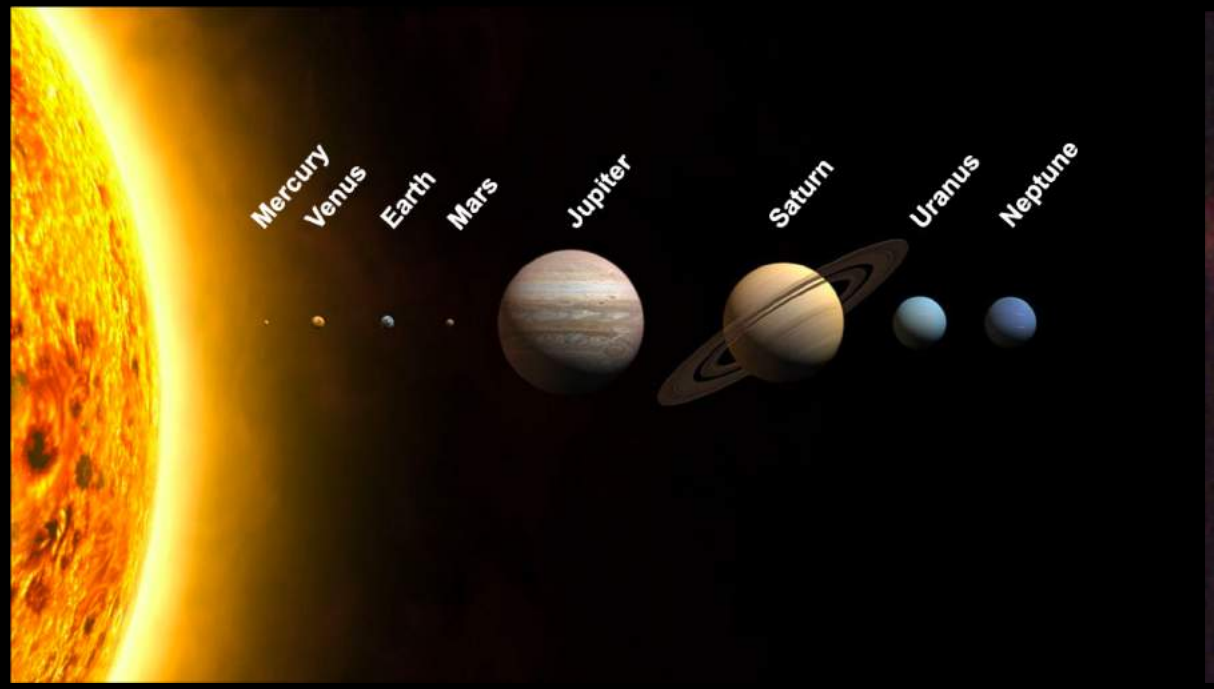
Our Solar System



Pale Blue Dot (The Earth from Beyond Neptune), 1990

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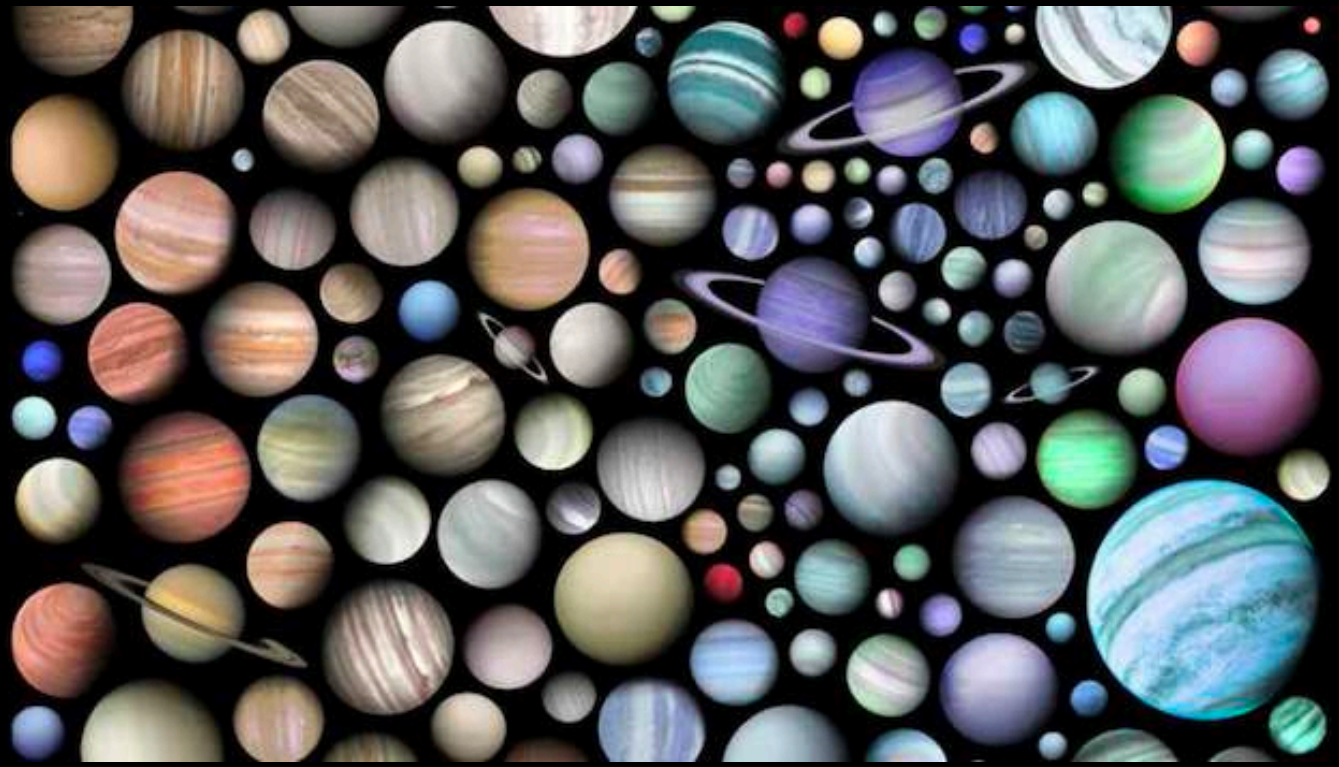
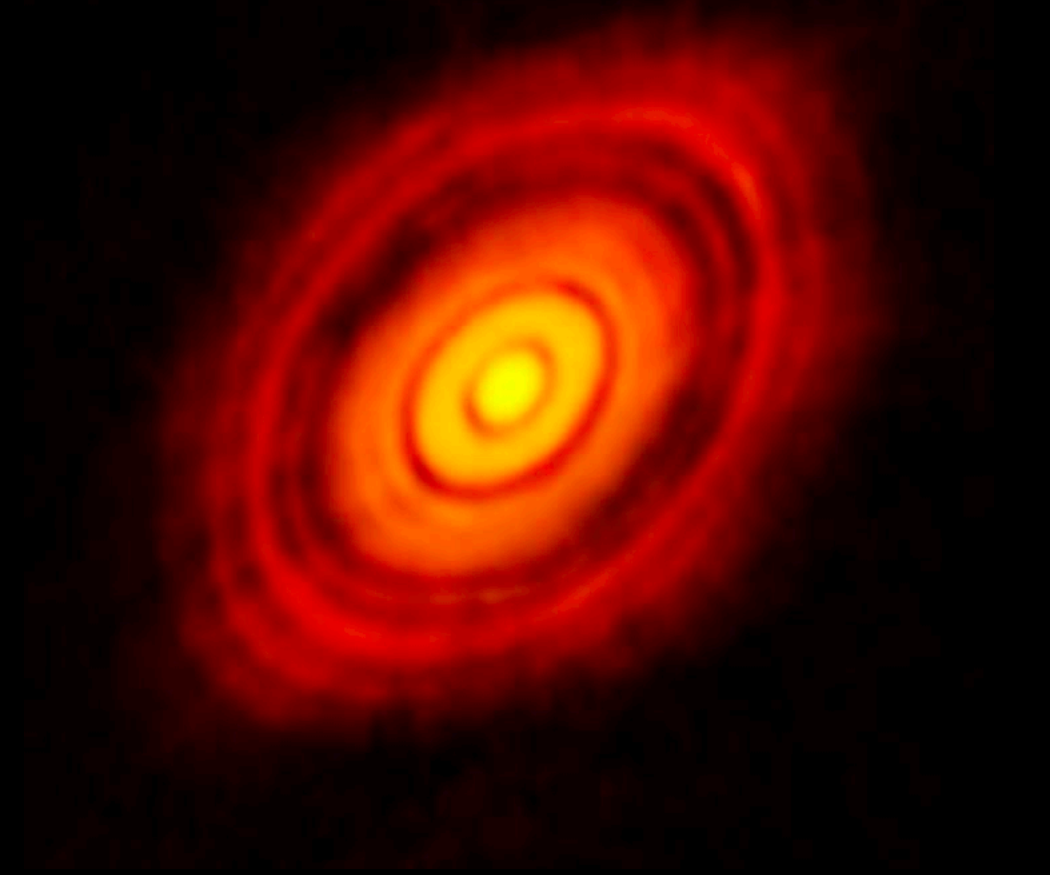
Solar Systems



Zoo of Exoplanets



The birth of a solar system

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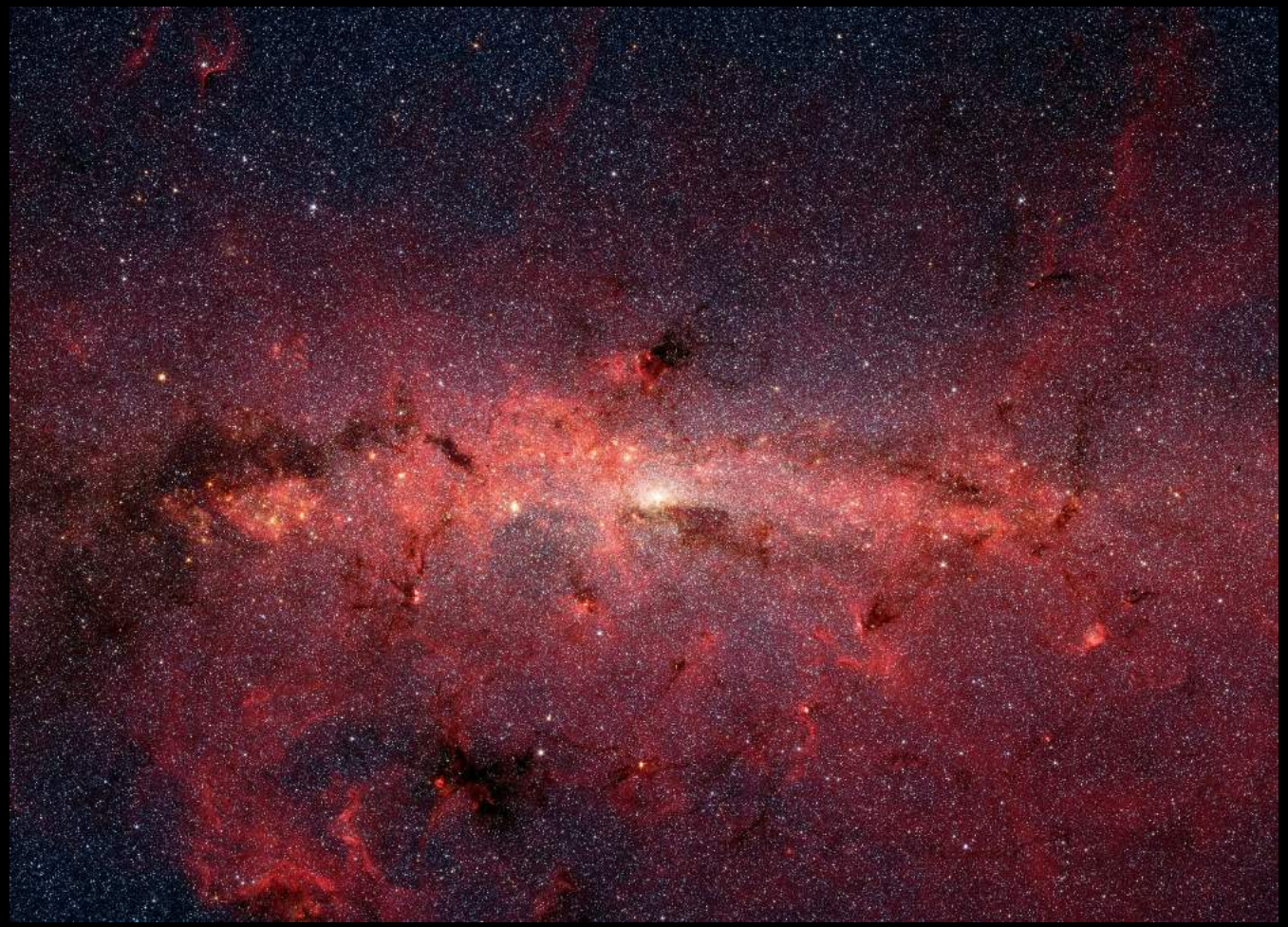
Nebulae and Galaxies



100,000s of stars in the Milky Way

Image of Andromeda taken in 1899

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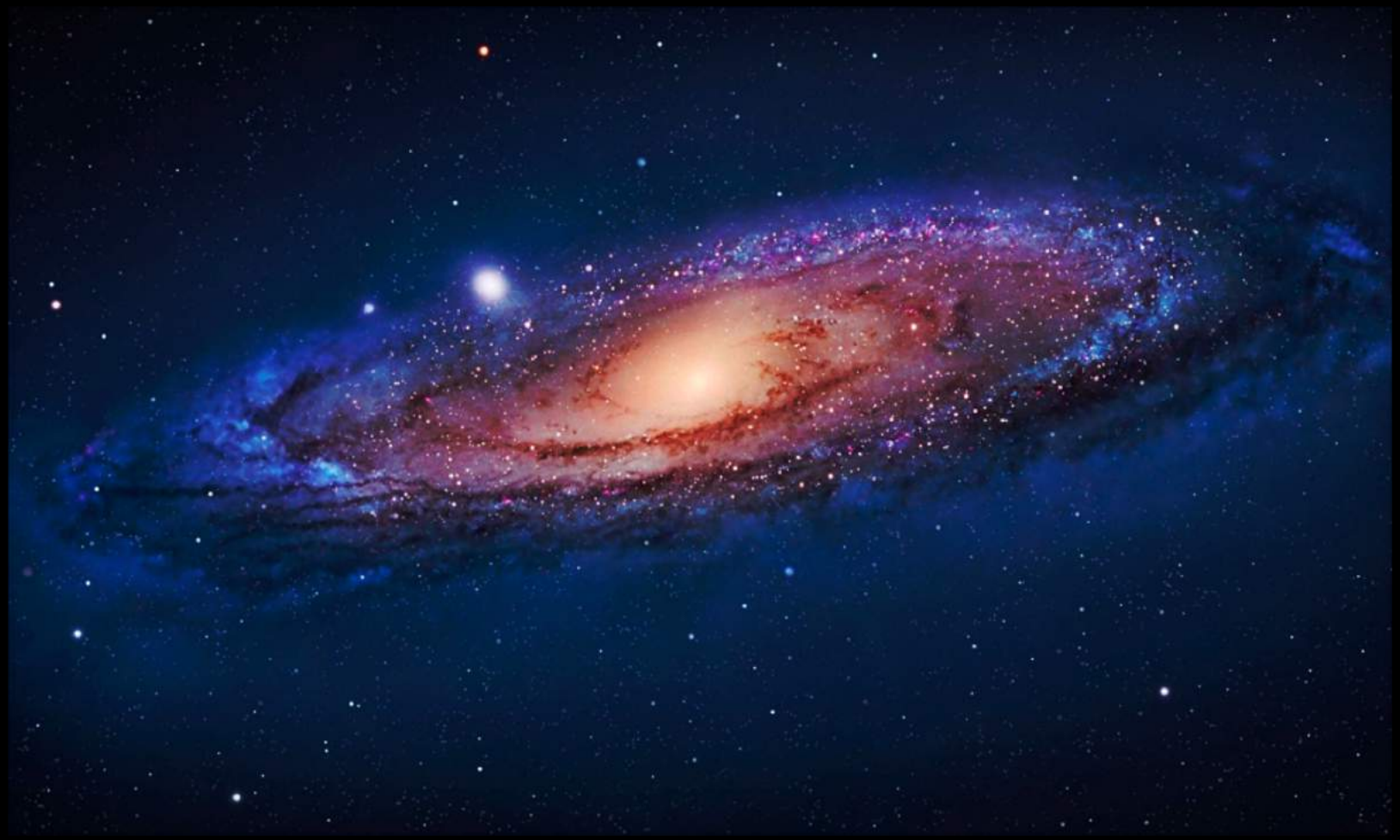
Galaxies

Abd al-Rahman al-Sufi



The Andromeda Galaxy

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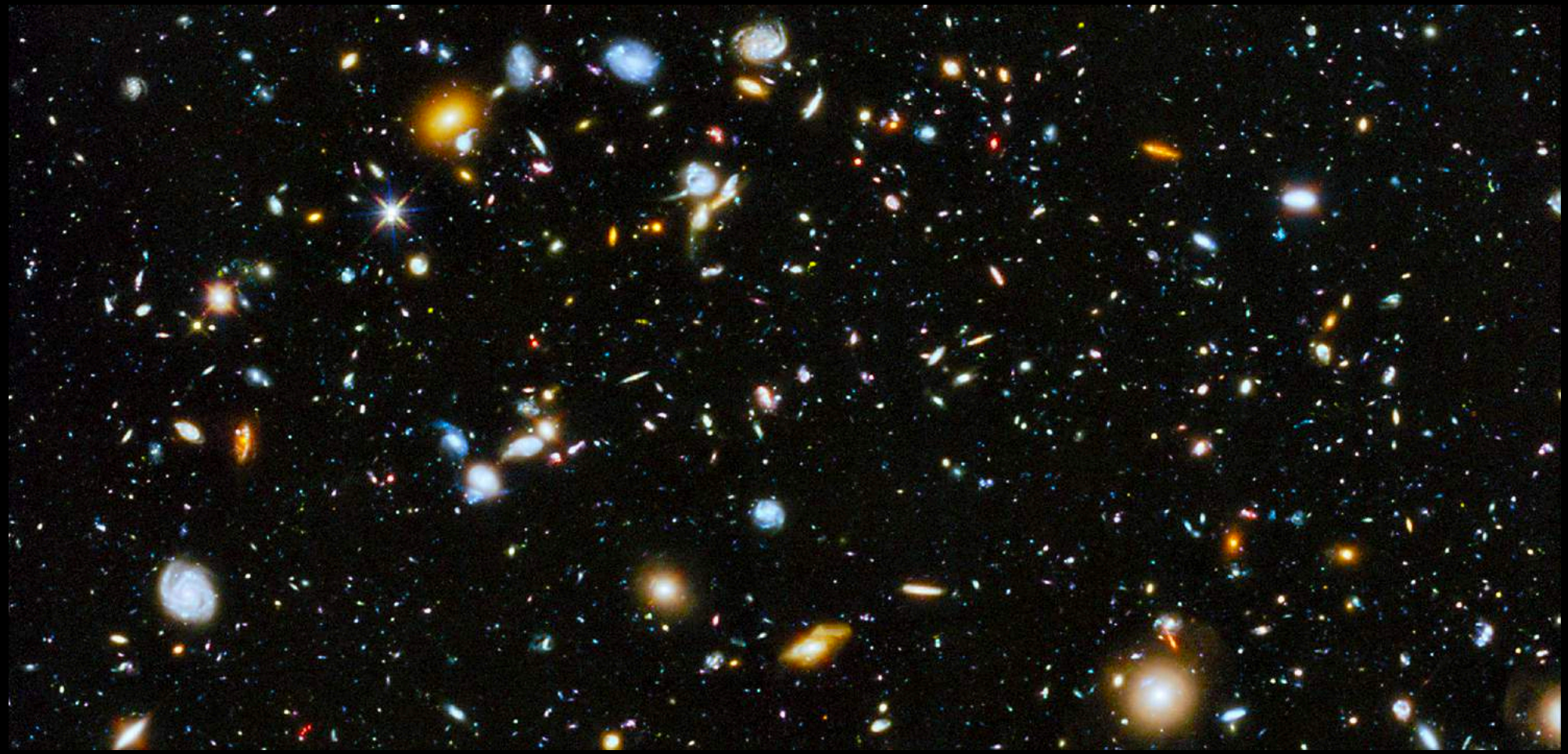
Galaxies



The Hubble Ultra Deep Field

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What's the Point?

- *Telecommunications*
- *Weather monitoring*
- *Satellite TV*
- *Internet Connection?*

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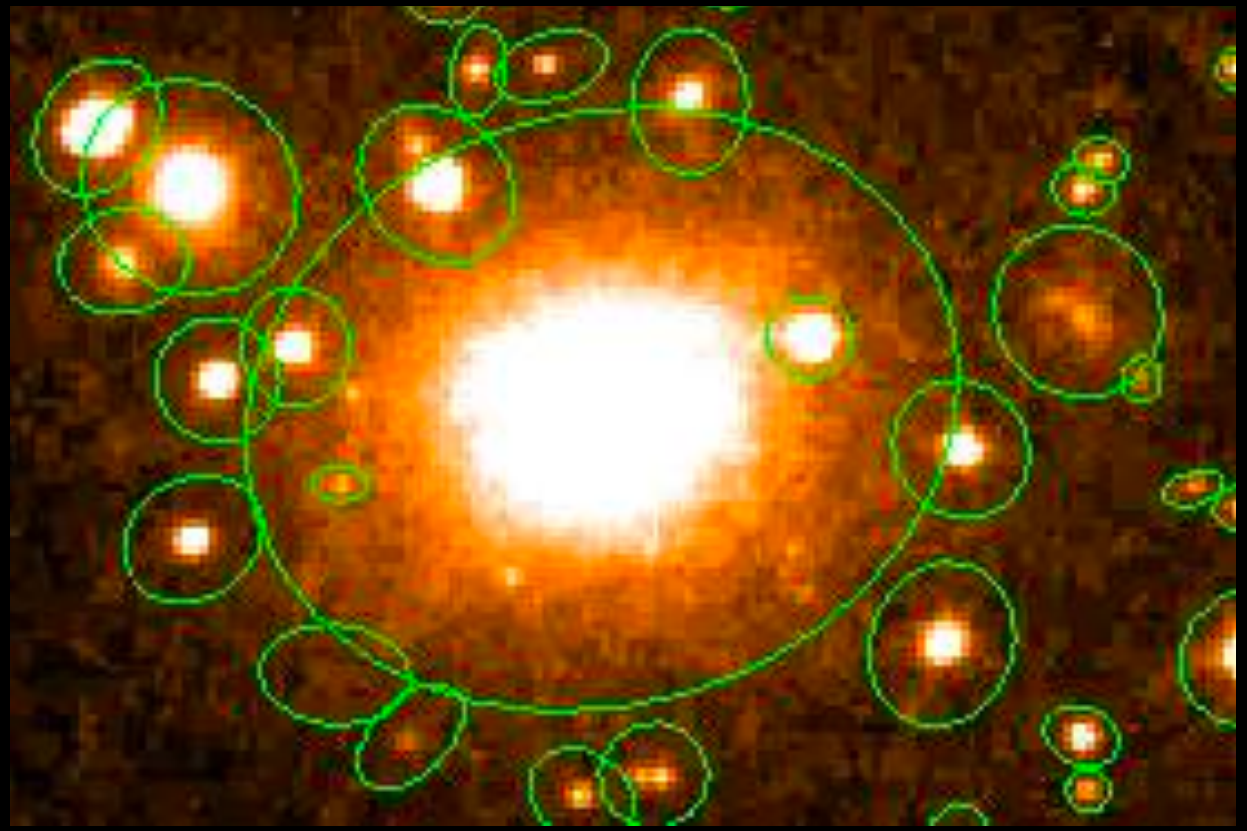
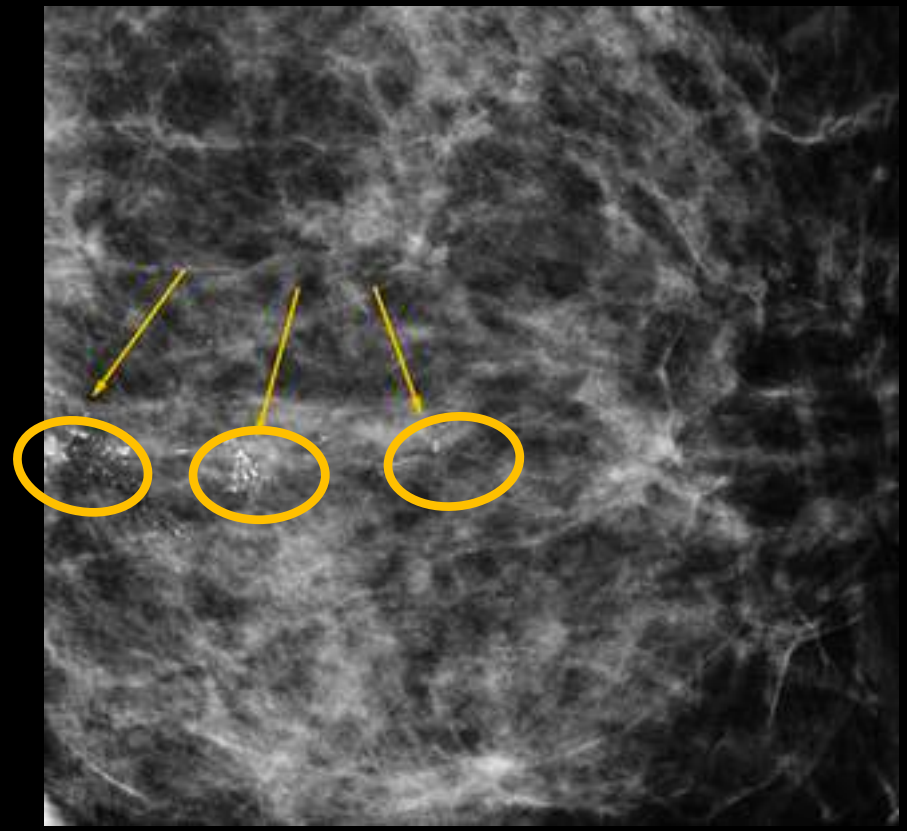
What's the Point?



Astronomical observation



Mammogram

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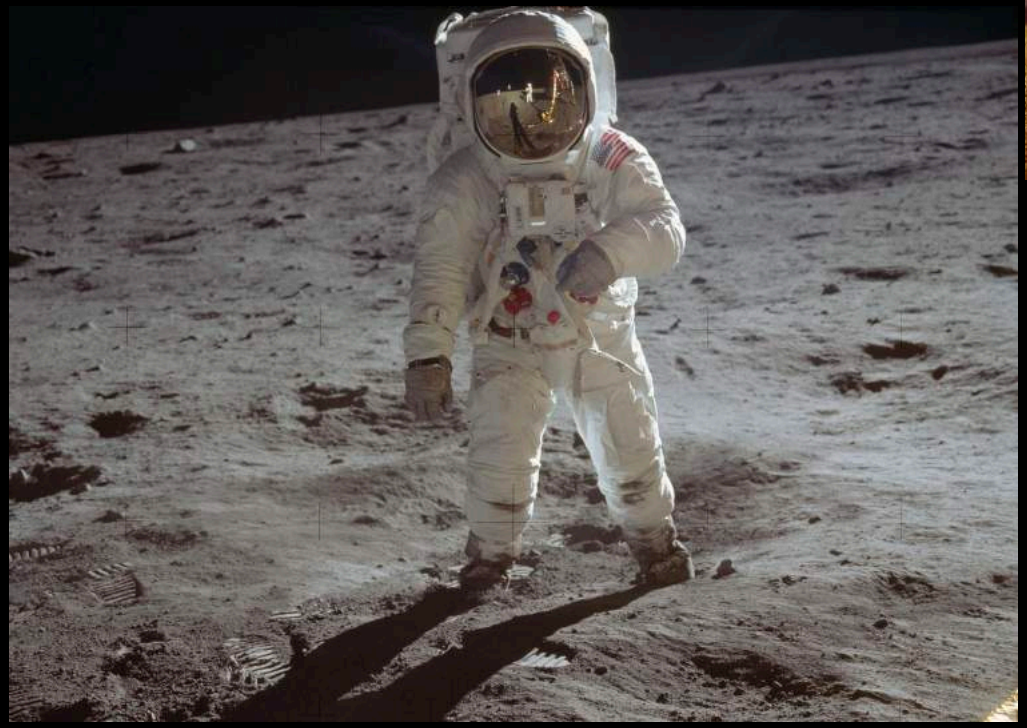
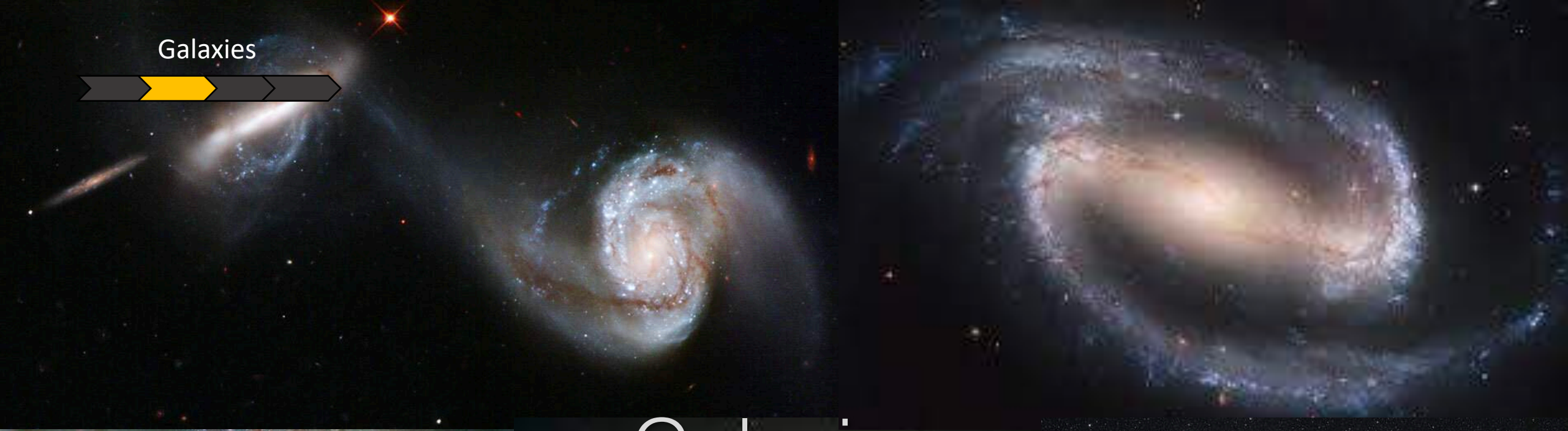
What's the Point?





Galaxies

Galaxies

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How did these galaxies come to be? What is their life-cycle?

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Lifecycle of a Butterfly

Time = 1 month

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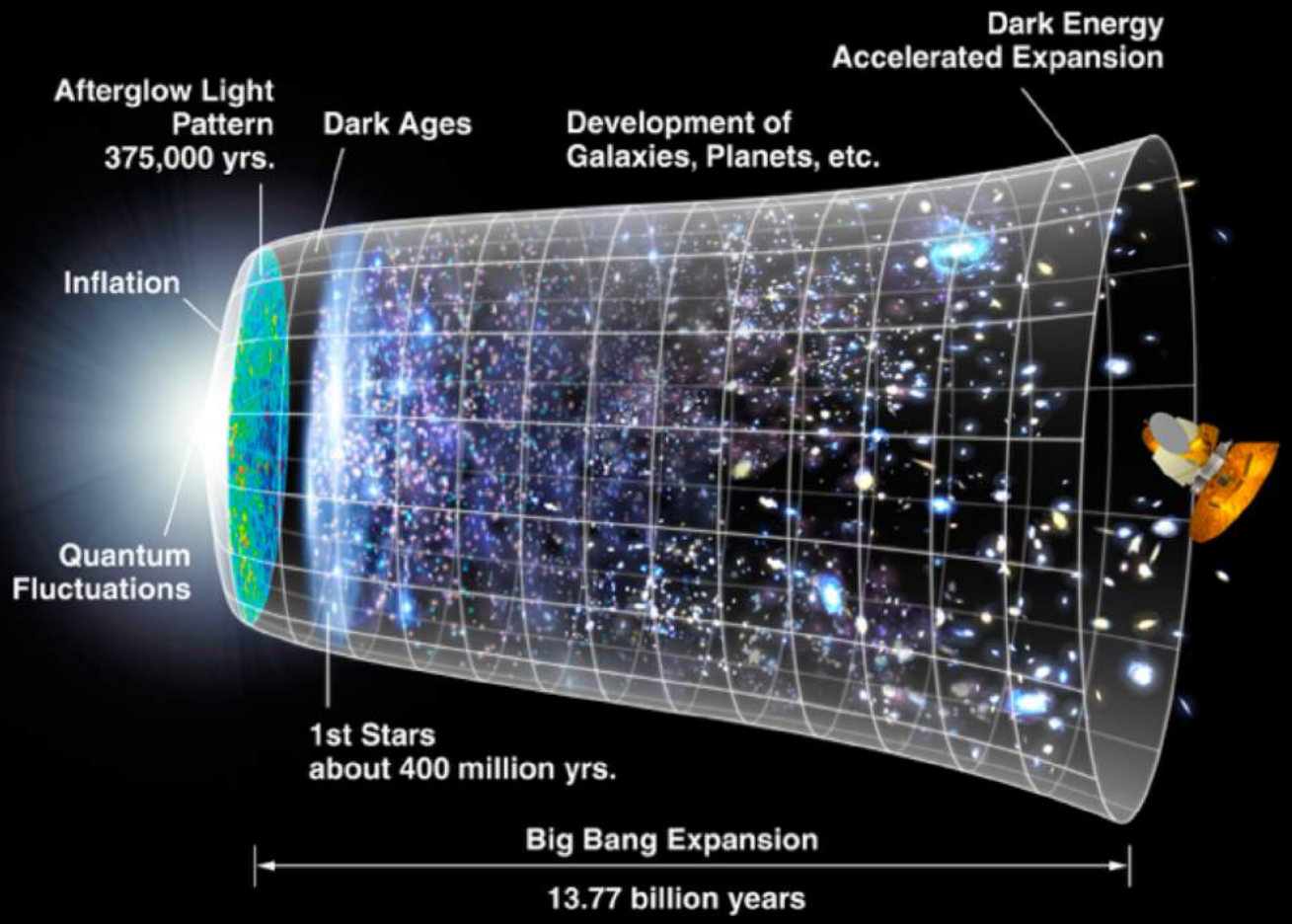
Lifecycle of a Universe



Time = **13.7 BILLION YEARS**

History of the Universe

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Dark Matter

Ordinary (Luminous) Matter

Dark Matter

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Dark Matter

Evidence for Dark Matter – Gravitational Lensing

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Simulating the Universe

Dark Matter

+

Gas

+

Laws of Physics

High Performance Computing Centre, Stuttgart

Stars

+

Large Scale Structure

Uses of Simulations

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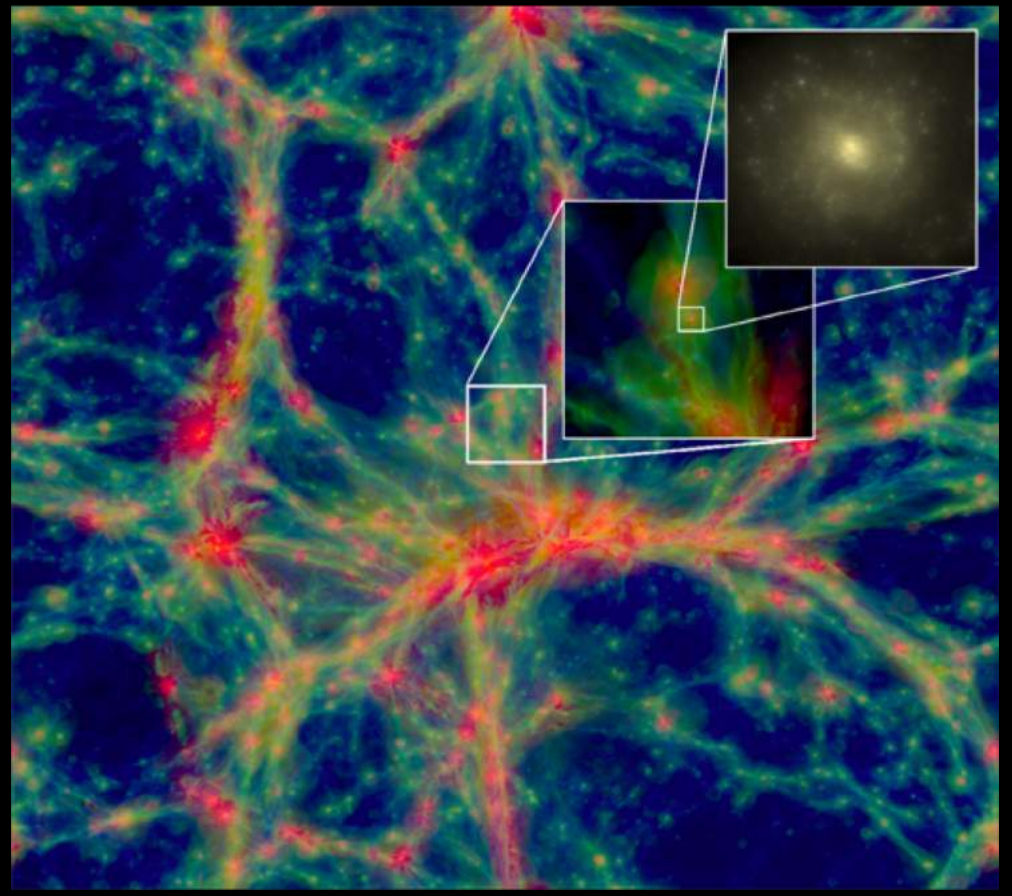
- Used to test our theories by comparing the virtual universe with reality
- Understand observed events by watching them take place in a simulation
- Create fake observations to test how good we are at removing error



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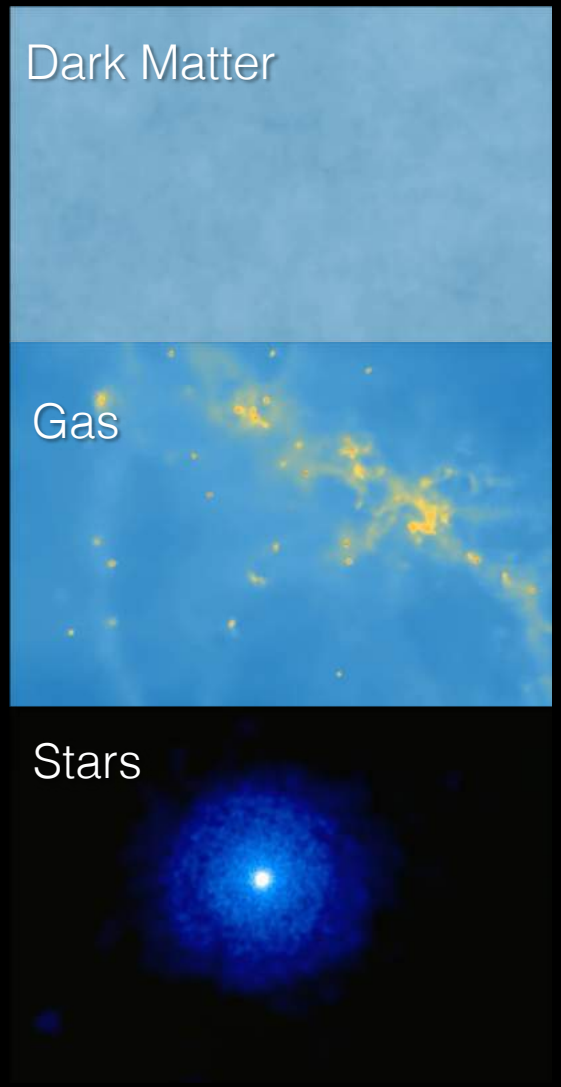
Simulation of the Universe



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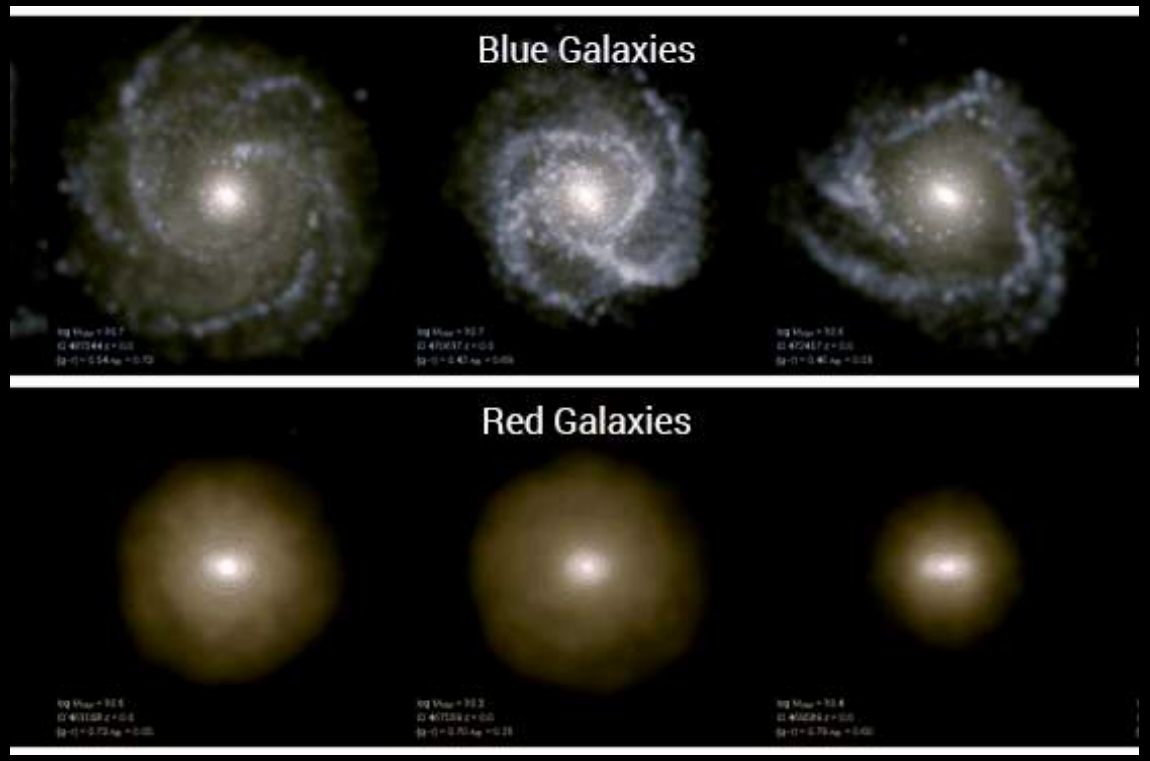
Comparison with Reality

Simulated



Real

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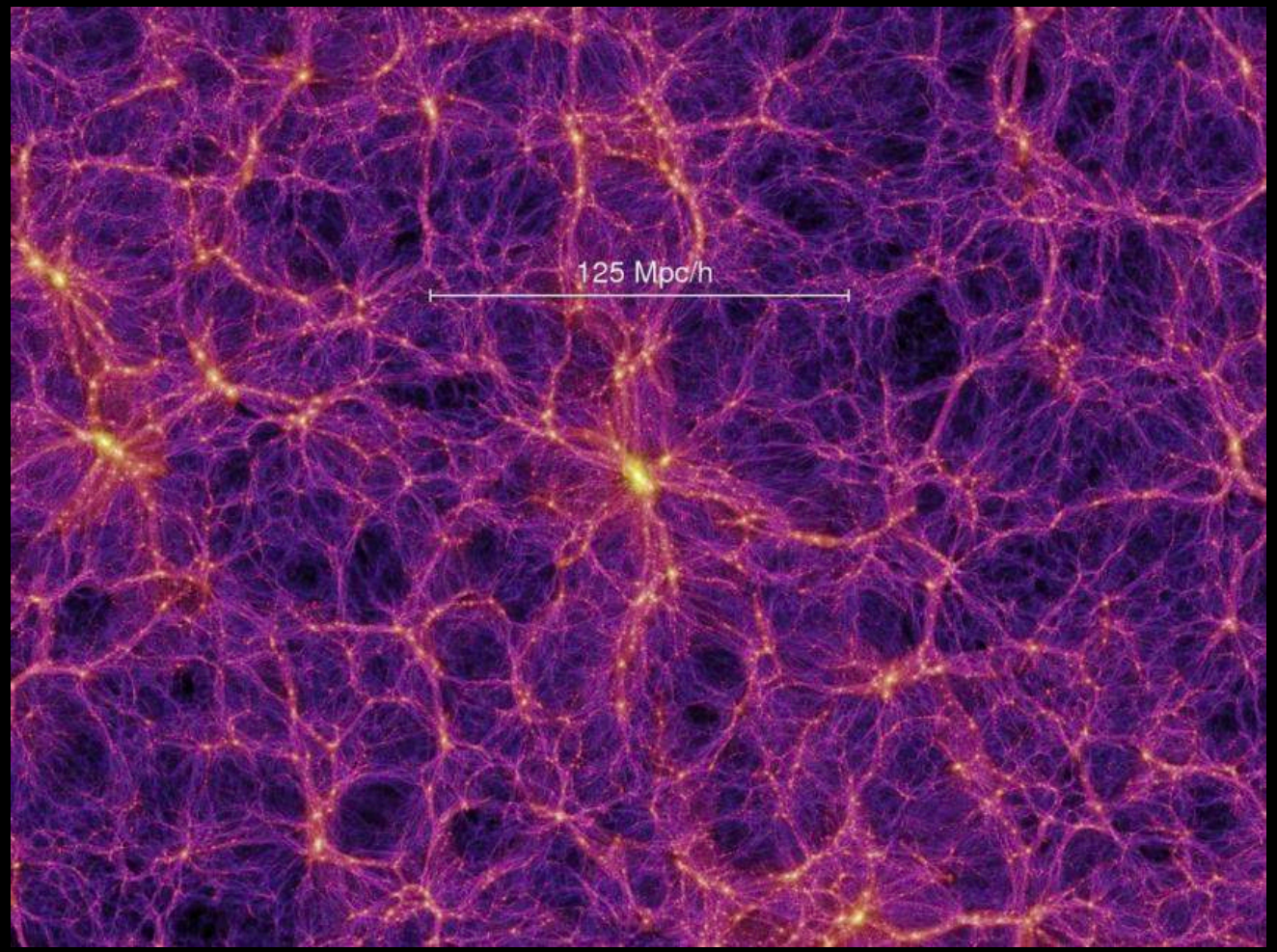
Caveats

- Simulations have a key role in modern astronomy
- However, they aren't the real universe
- Not all of their results are predictions



Summary

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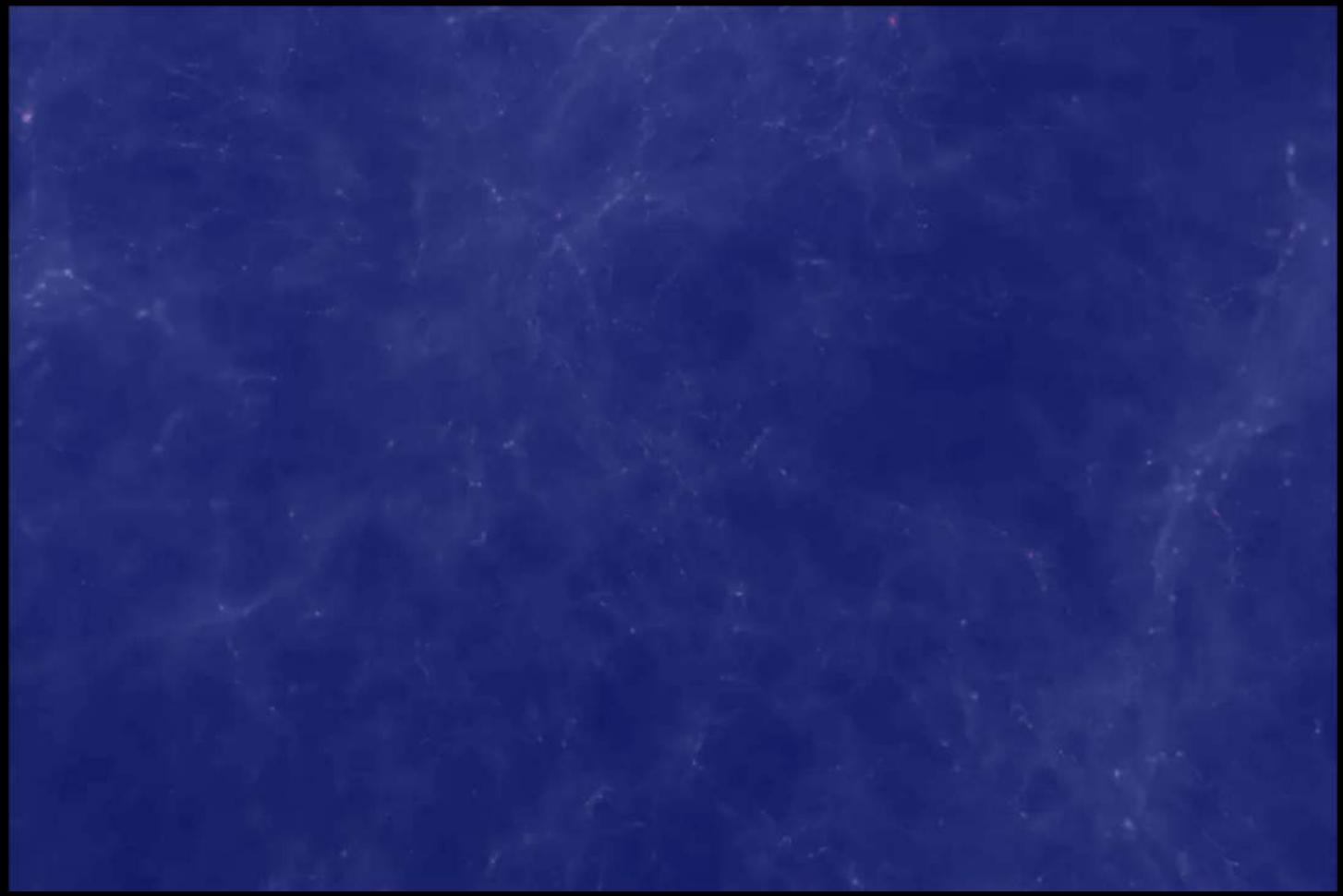
- Astronomy is a science rich with areas of exploration
- Astronomy is a gateway science!
- The study of the Universe can be assisted with simulations
- Simulations can never be perfect!
- They make cool movies



Careers

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Astronomy is a gateway science!

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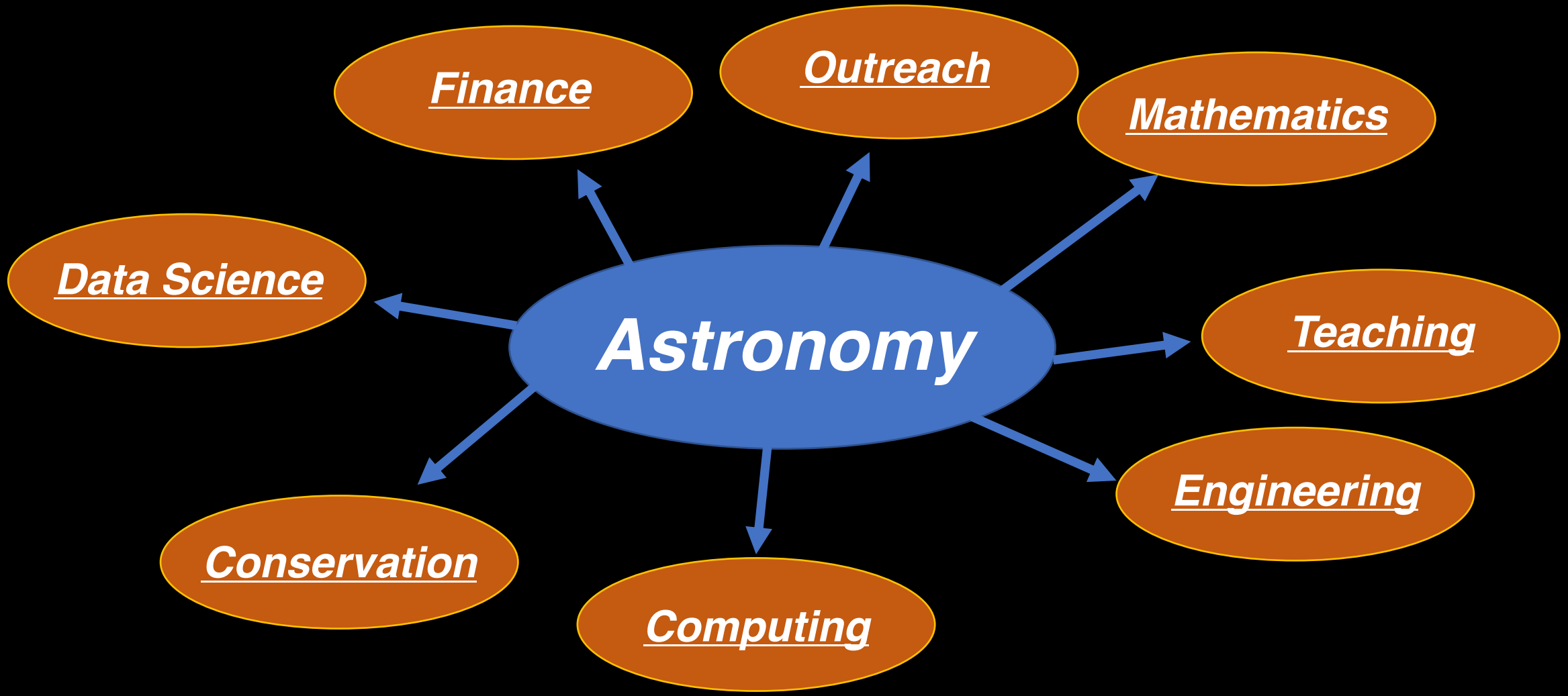
Careers



Summary

Conservation

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Spot the monkeys

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Summary

Thermal Imaging

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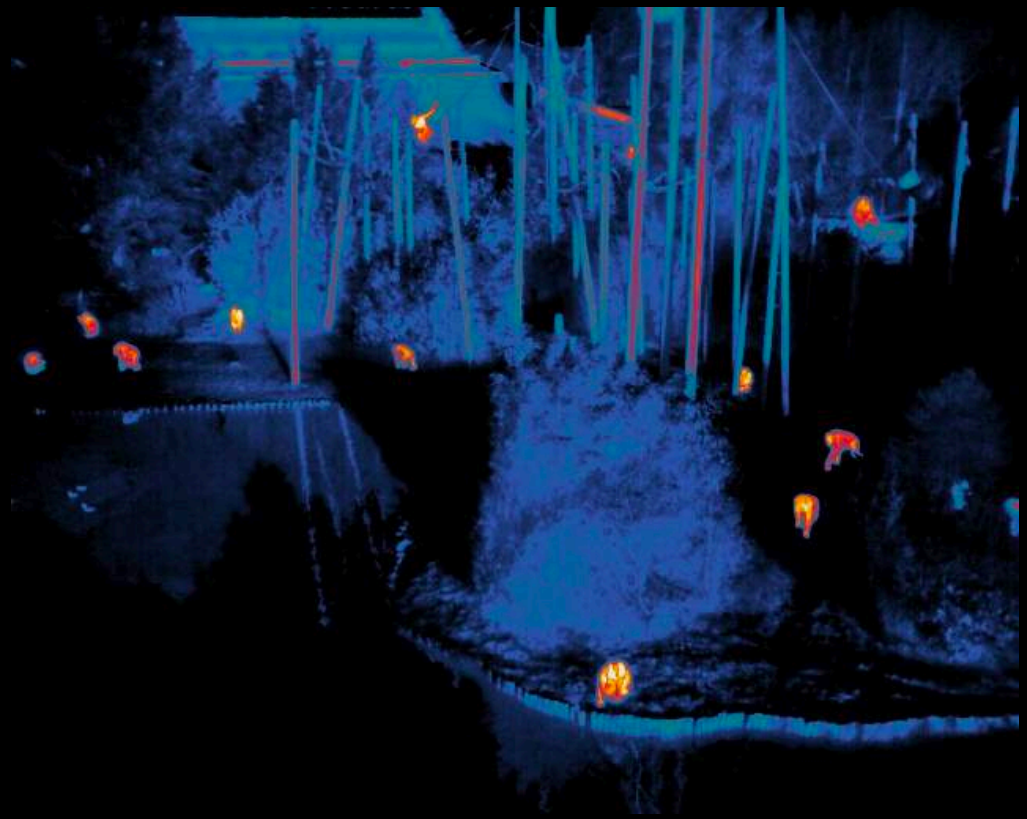

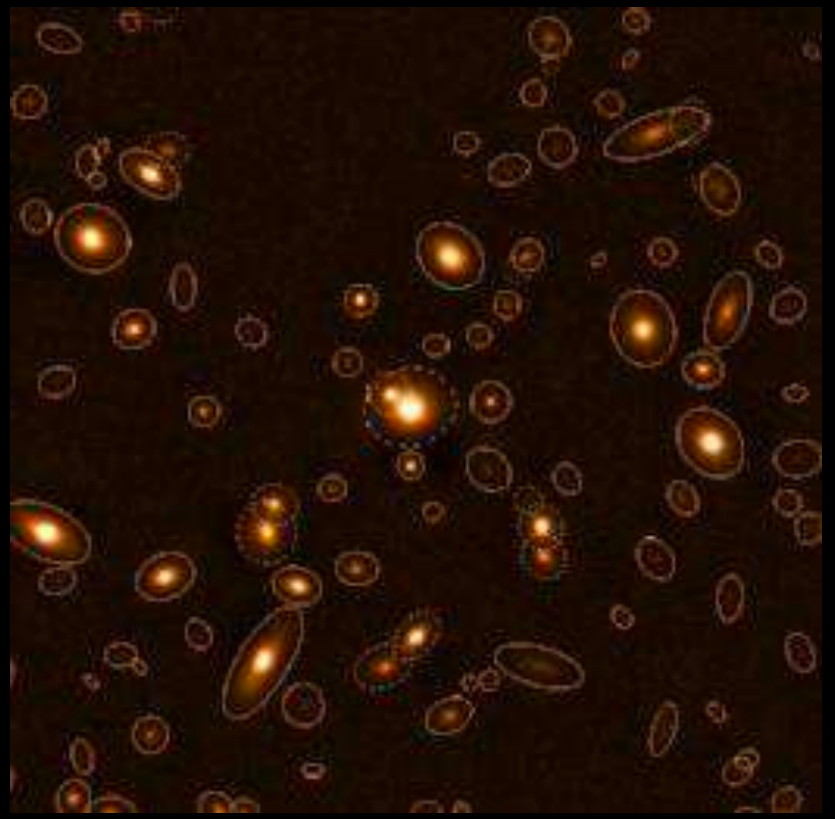

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Astronomy Takes You Places!

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South Pole Telescope