ICRAR

International Centre for Radio Astronomy Research

The Distant Universe

Dr Elisabete da Cunha
(on behalf of SU2)

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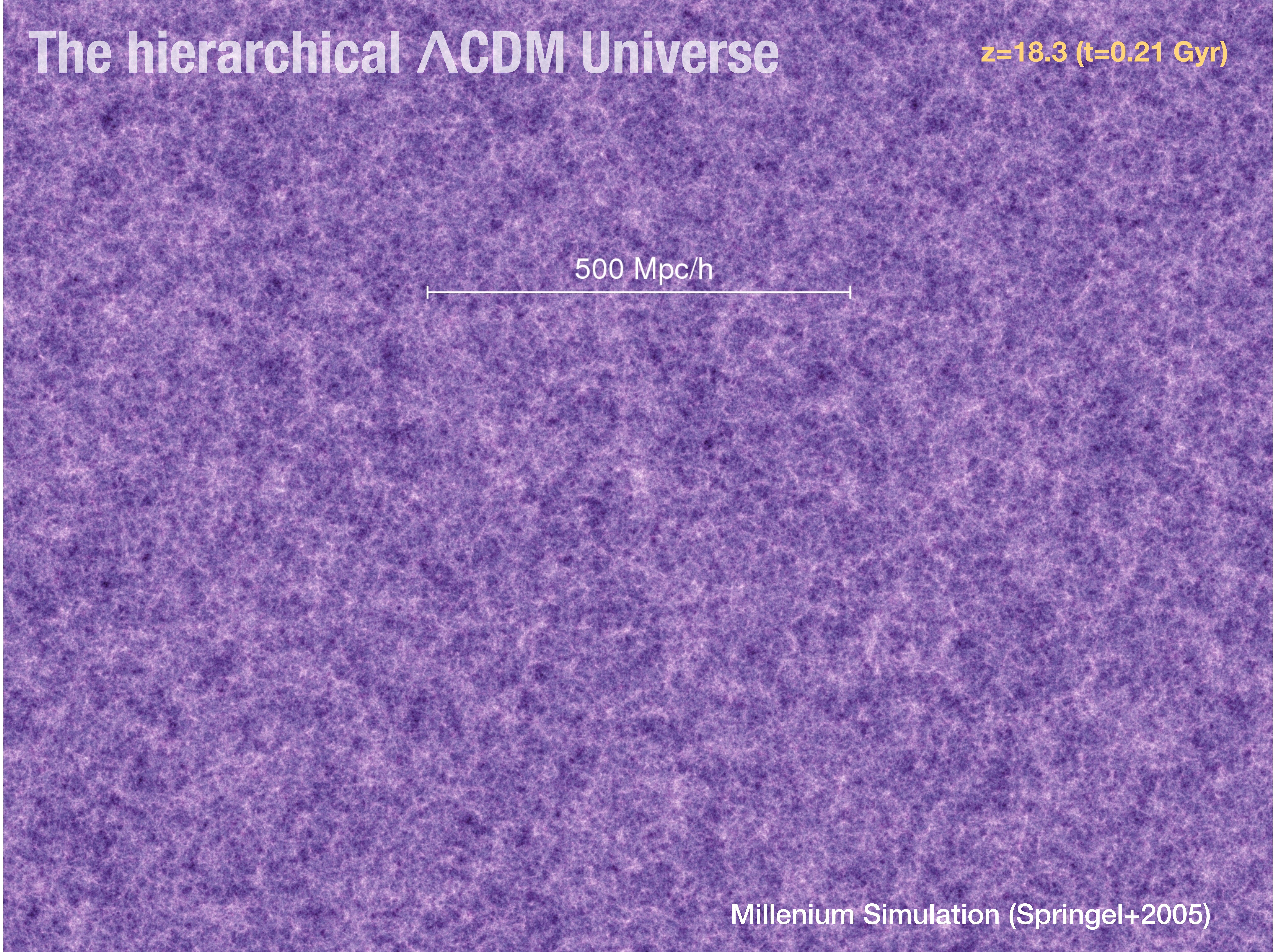
Curtin University

THE UNIVERSITY OF WESTERN AUSTRALIA

Government of Western Australia
Department of the Premier and Cabinet
Office of Science

The hierarchical ΛCDM Universe



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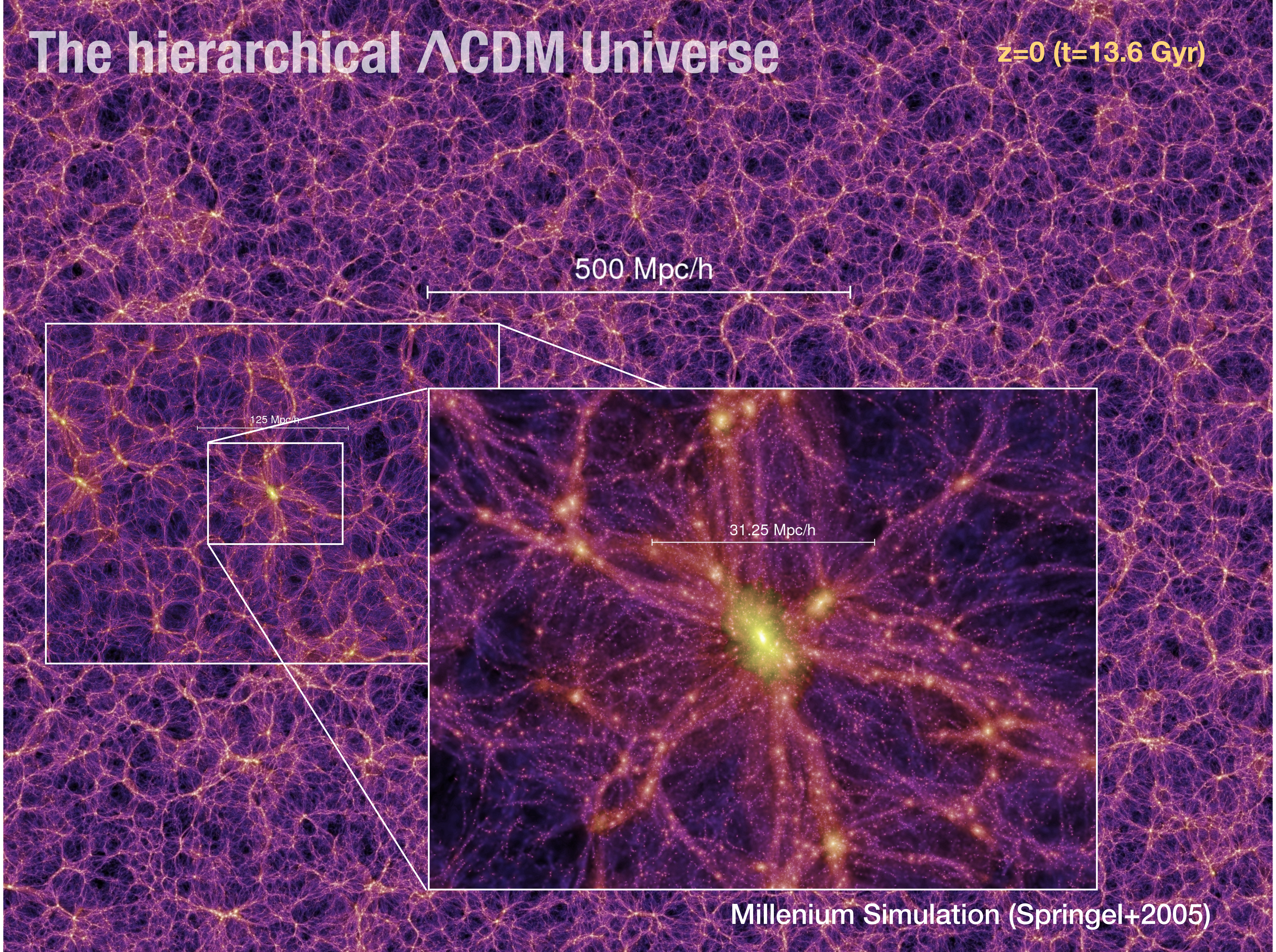
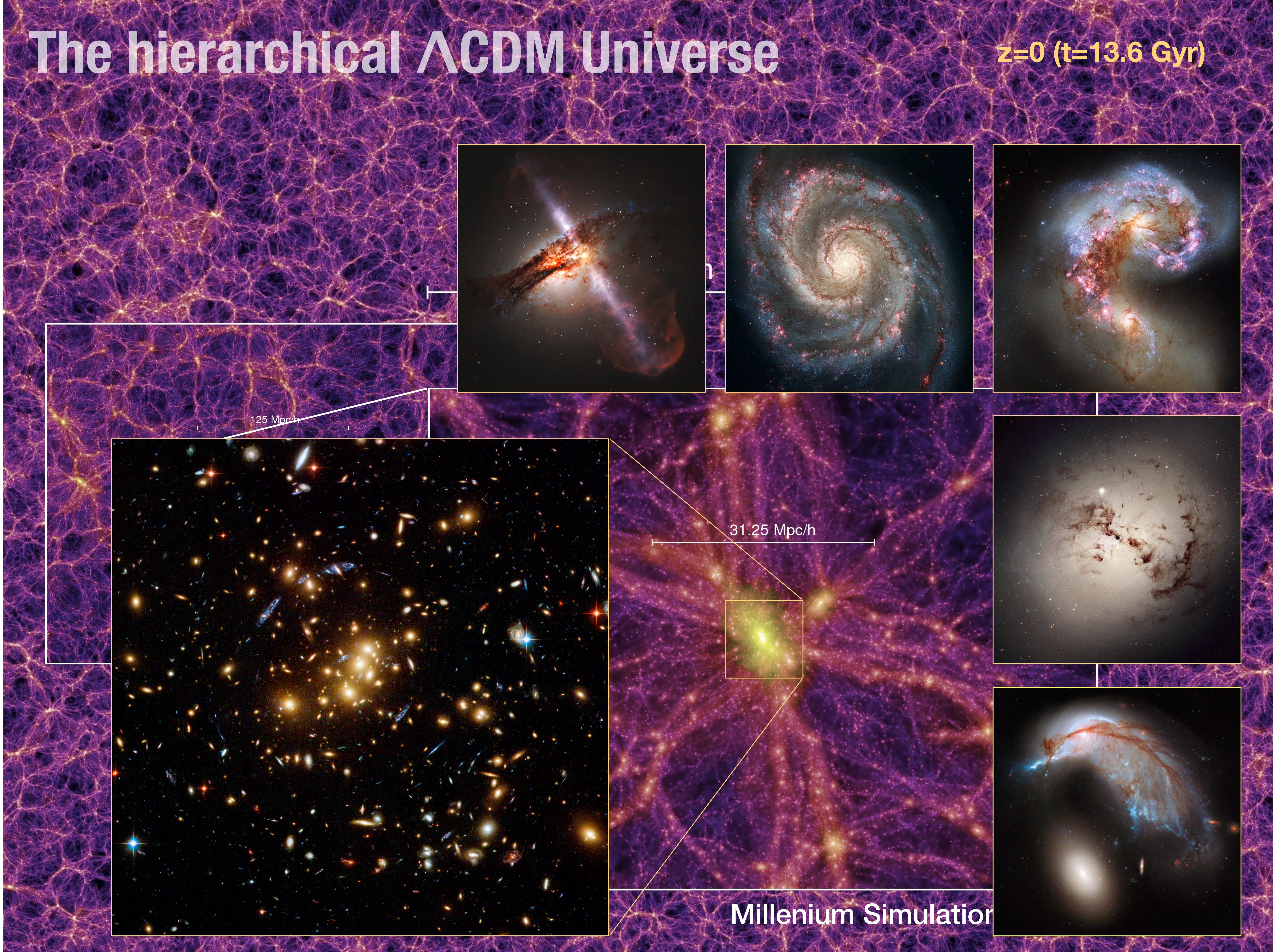
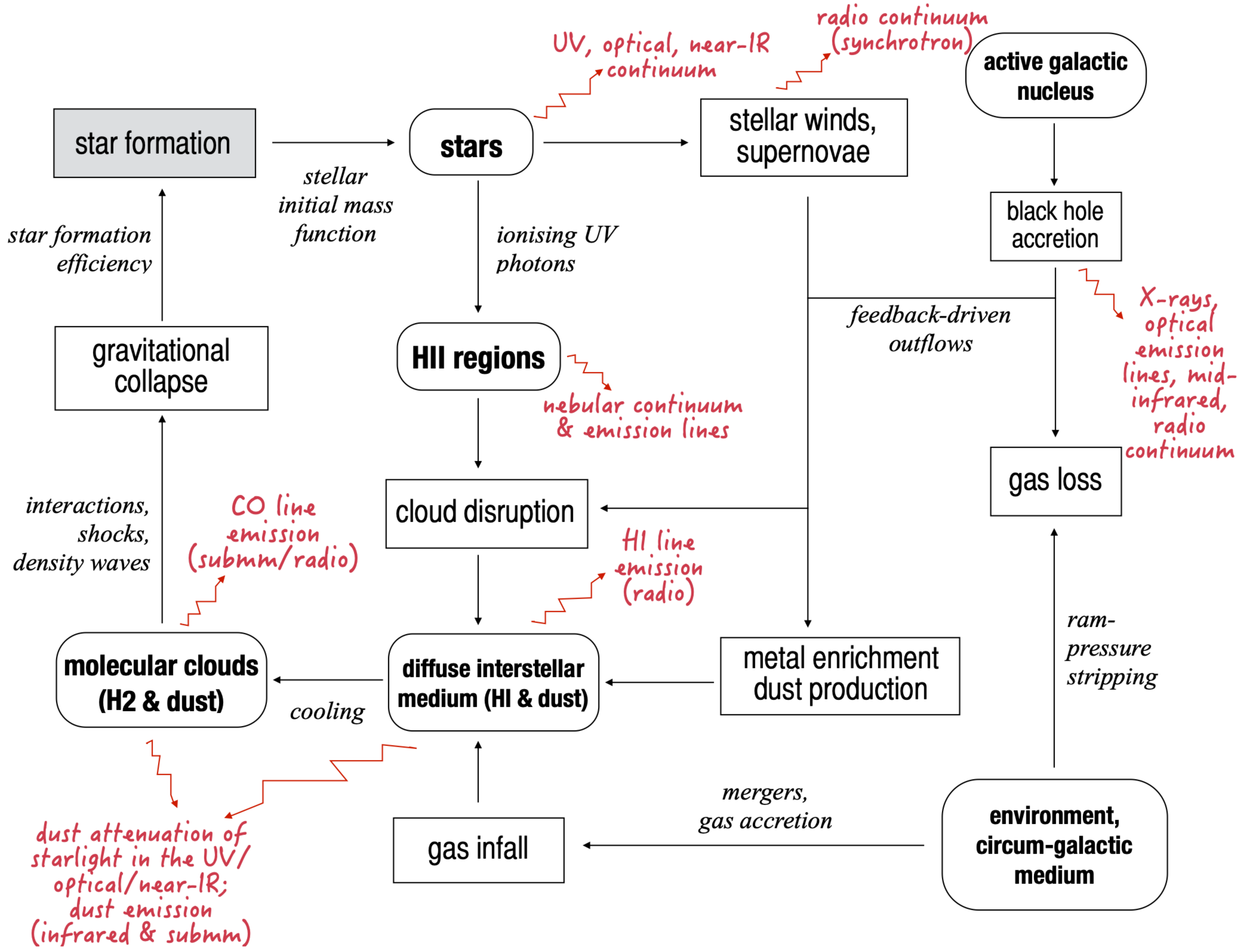


Millenium Simulation (Springel+2005)


The hierarchical ΛCDM Universe
z=0 (t=13.6 Gyr)
125 Mpc/h
31.25 Mpc/h
Millenium Simulation

Galaxy evolution is a complex problem



We cannot yet model all these processes from first principles especially at the smallest scales: **theory and simulations need to be guided by observations.**

Need to observe galaxy populations through the age of the Universe, across the electromagnetic spectrum.

In SU2, we:

- **Carry out surveys (X-rays to radio)**
- **Measure physical parameters**
- **Compare with theory**

‘The history of astronomy is a history of receding horizons’ - E. P. Hubble

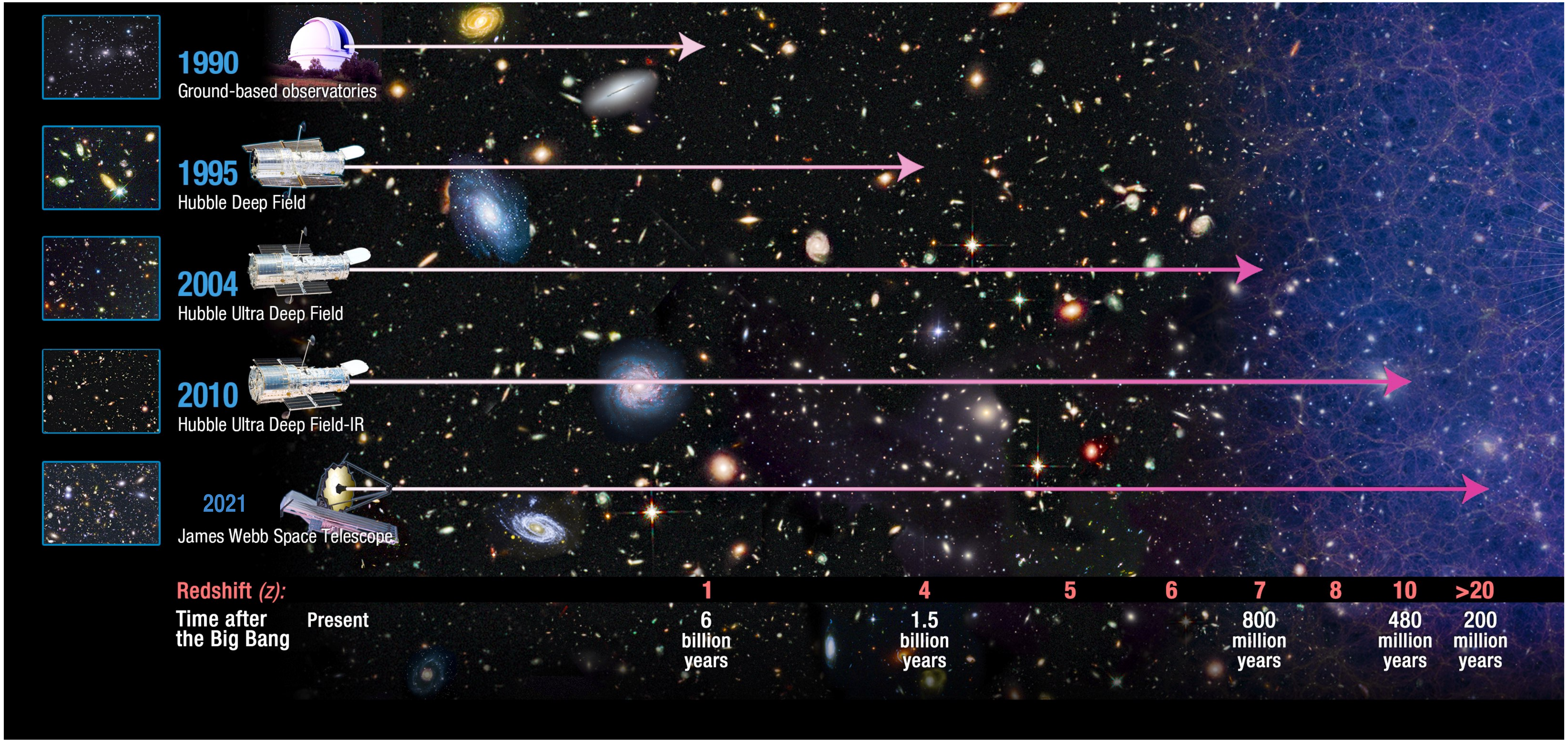


Figure credit: NASA

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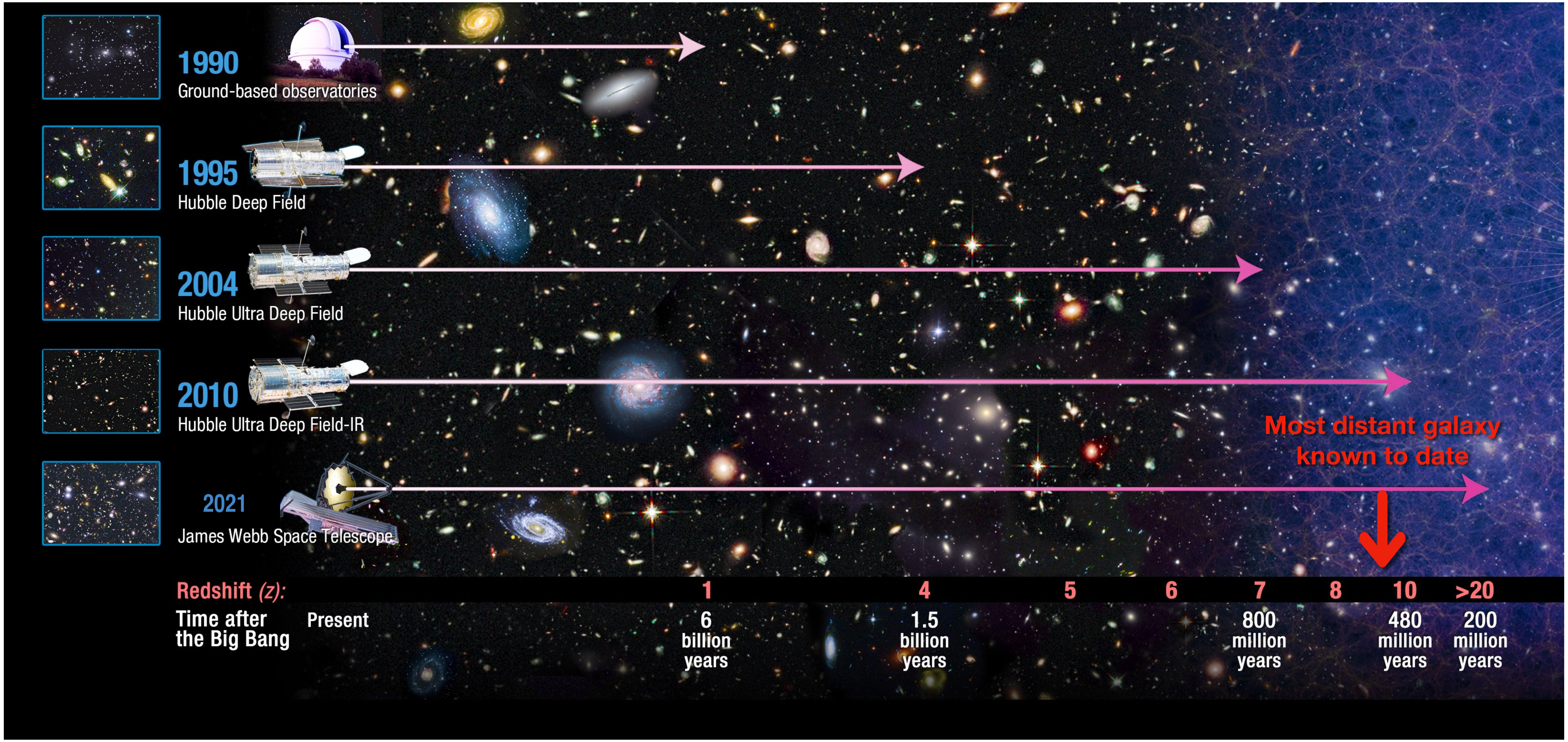

Figure credit: NASA

Mapping The Universe

The baryonic properties (stars, gas, dust), dynamics, locations, environments and dark matter halos of millions of galaxies, spanning over half the age of the Universe

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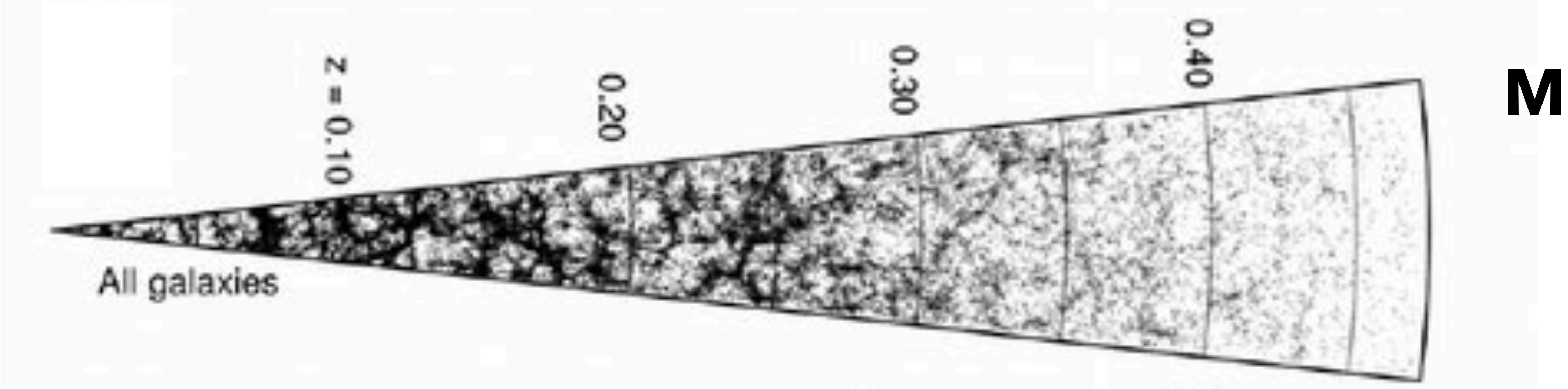

Map out Large-Scale Structure of the Universe

Dark Matter structure/distribution, galaxy locations, evolution of structure as the Universe grows (cosmology)

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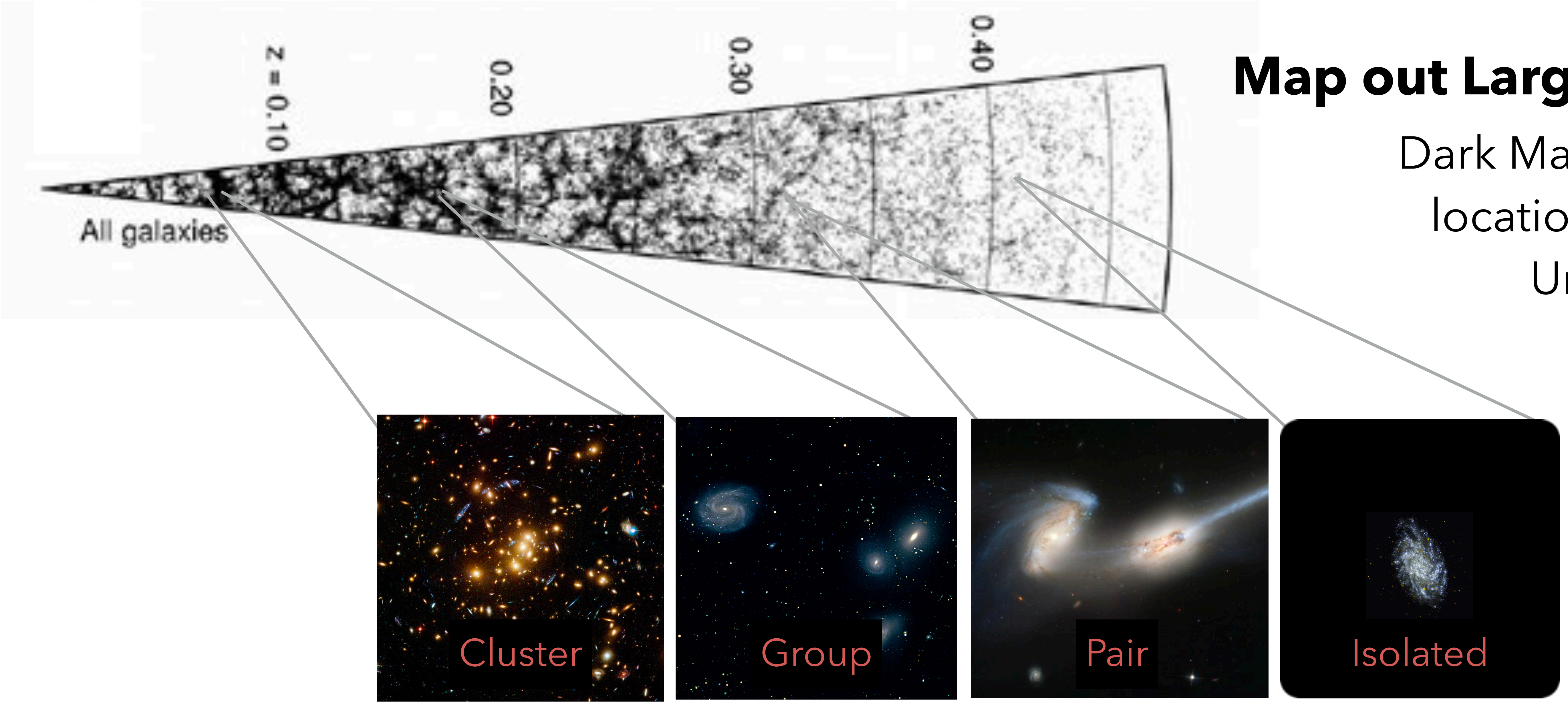

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Parameterise galaxy environments

Dark Matter halo mass, galaxy distributions, galaxy interactions

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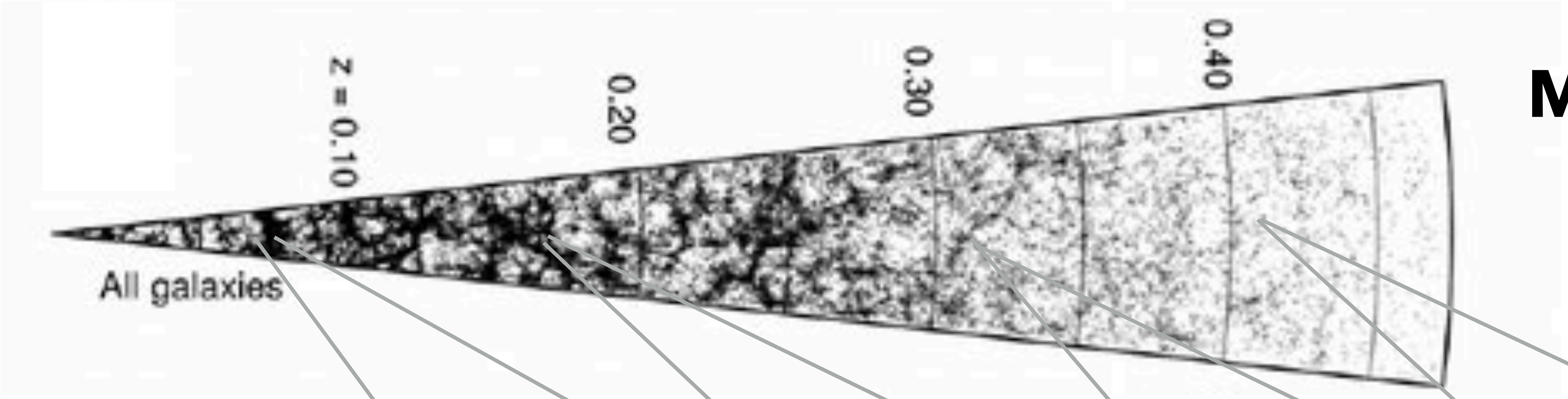

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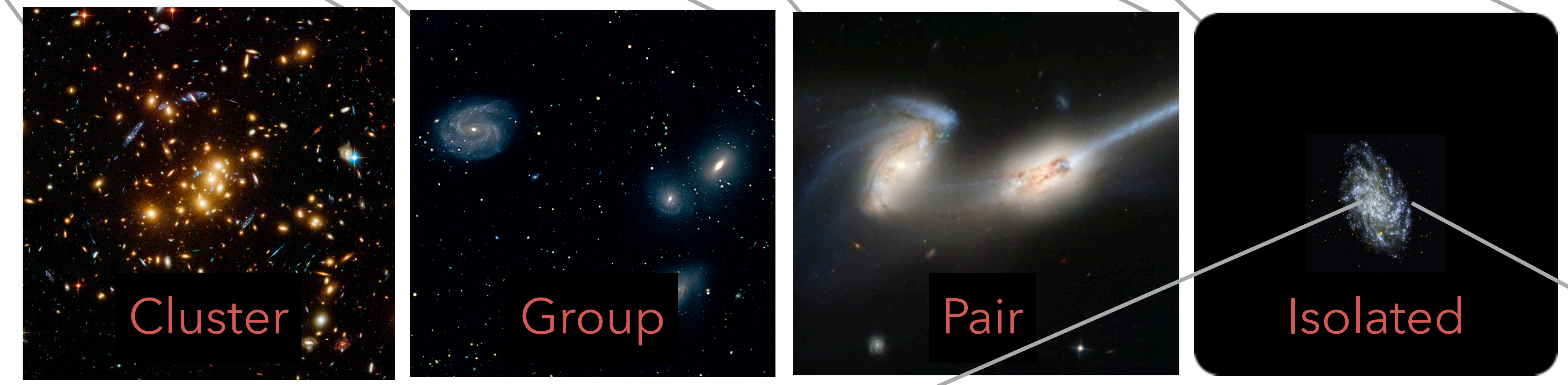

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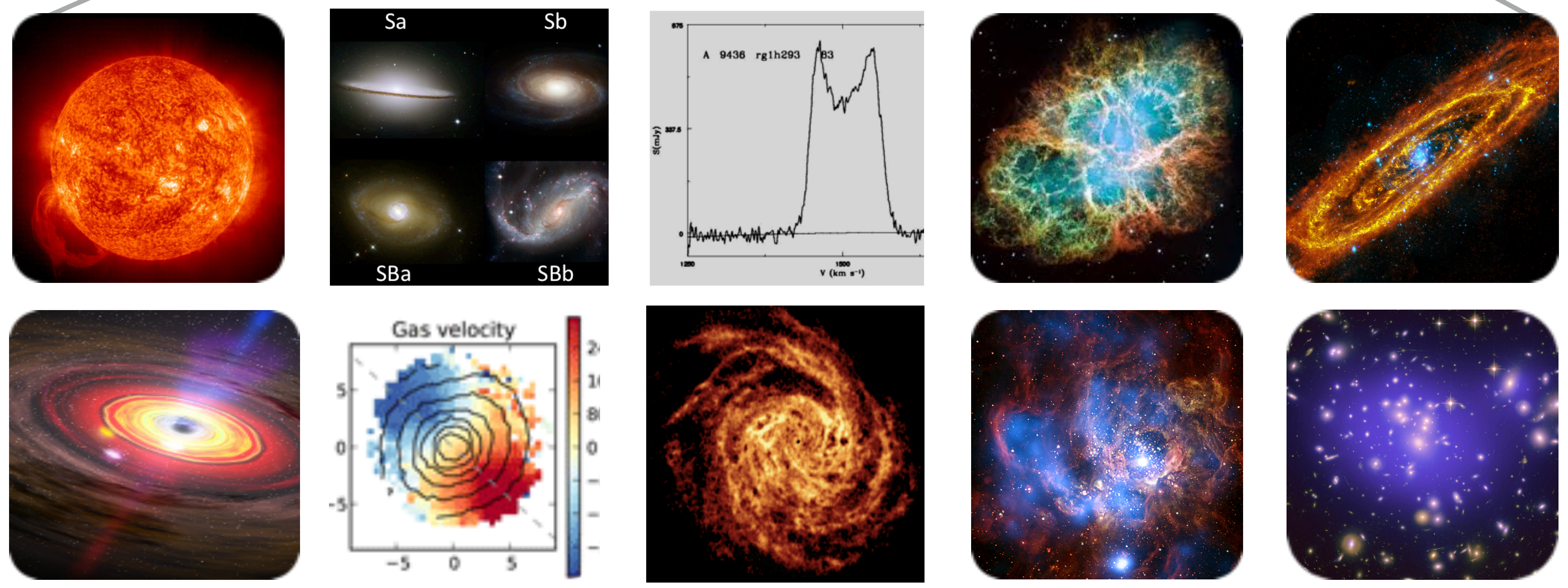
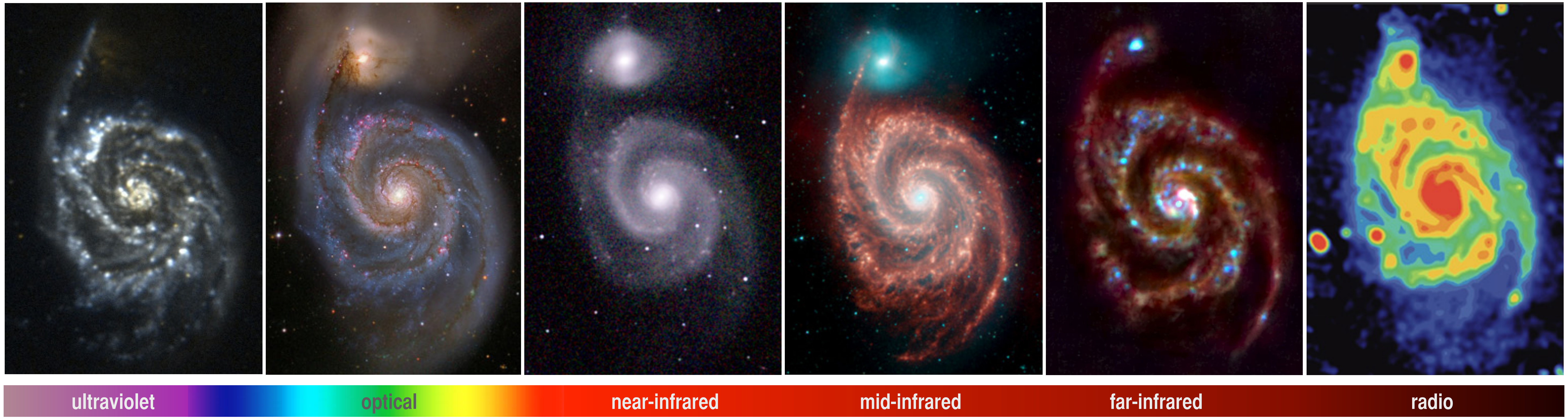
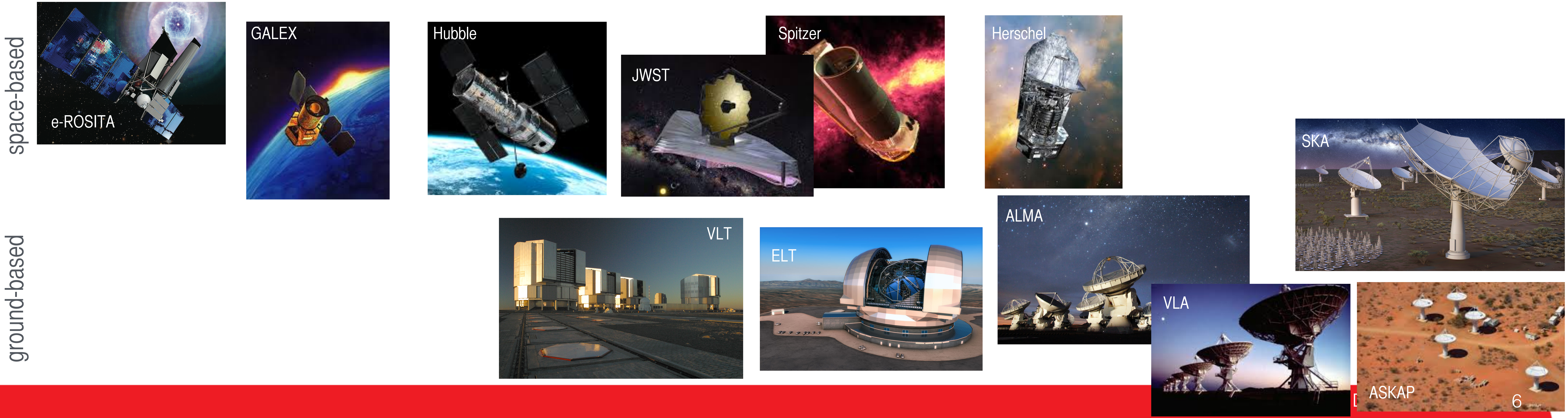


Measure galaxy properties

Stellar mass, gas mass, DM mass, SFR, SFH, AGN, structure/morphology, kinematics, dust content, metallicity….

Observing across the spectrum





Core Science Topics

Impact of environment on galaxy evolution
(how where a galaxy lives affects its life)

The evolution of star-formation and stellar mass
(how galaxies grow with time)

The energy budget of the Universe
(how and where are photons produced in the Universe)

Resolved studies of galaxies and dynamics
(how galaxies move and where are stars formed)

Morphology and structure of galaxies over time
(how galaxies look and what it tells us about how they formed)

Very high redshift galaxies
(understanding the first galaxies that form in the Universe)

HI gas content of galaxies
(understanding the fuel that galaxies have to form new stars)

Software for studying galaxy evolution
(developing new software for studying galaxies)

Management of large galaxy surveys
(observations, data management, software for data collection)

Group Lead

Simon Driver

The growth of mass, energy and structure through ground and space based surveys.

Senior staff

Luke Davies

The growth of mass, energy and structure through ground and space based surveys.

Aaron Robotham

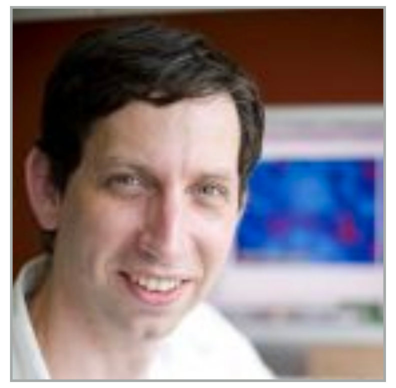
Extraction of the physical properties of galaxies & groups. Interface with simulations.

Elisabete da Cunha

Modelling the emission from stars, gas, and dust in distant galaxies observed with ALMA and JWST.

Luca Cortese

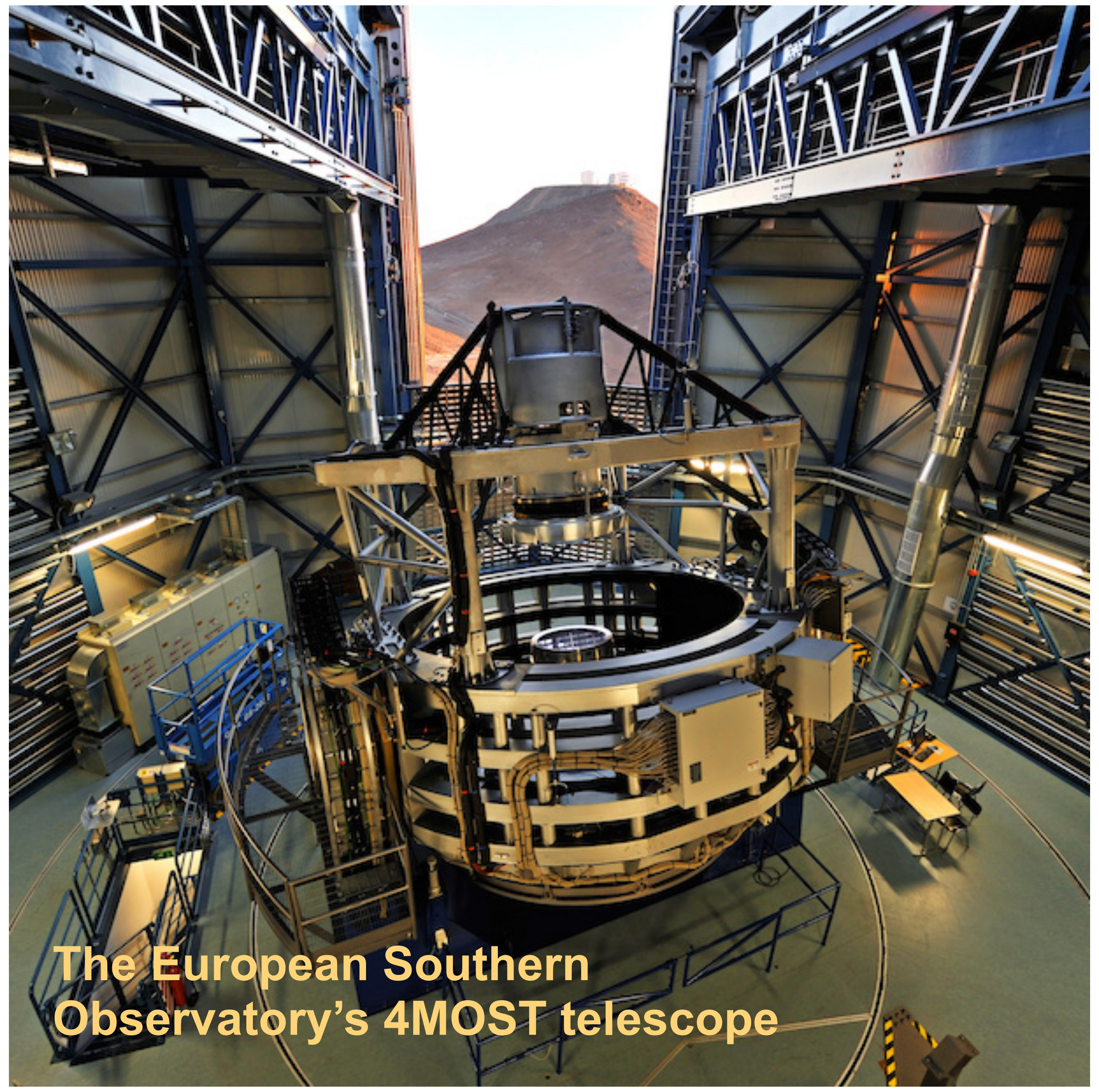
Studies of the angular momentum of galaxies, and their gas-star-dust lifecycle with time.

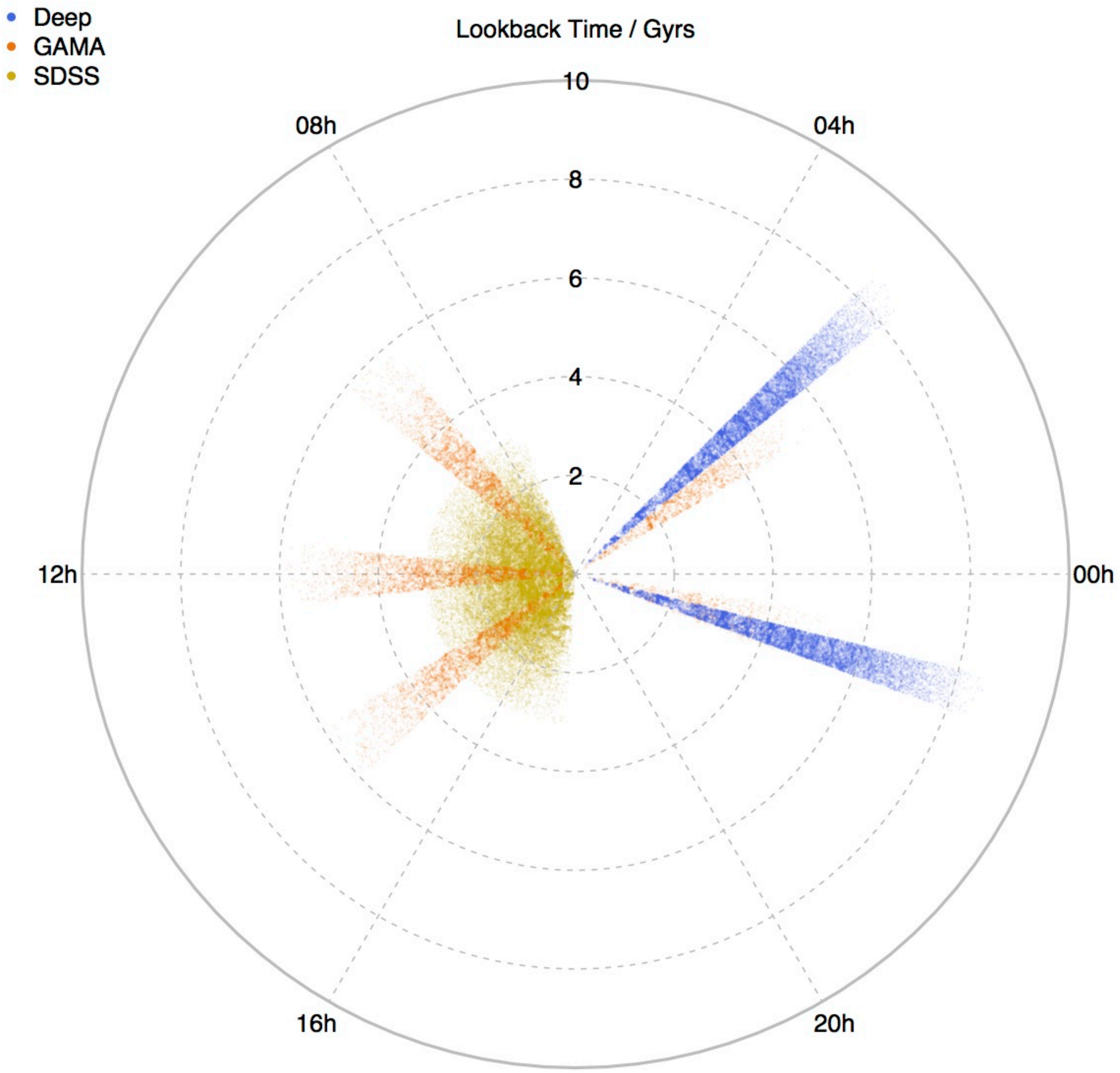


Martin Meyer

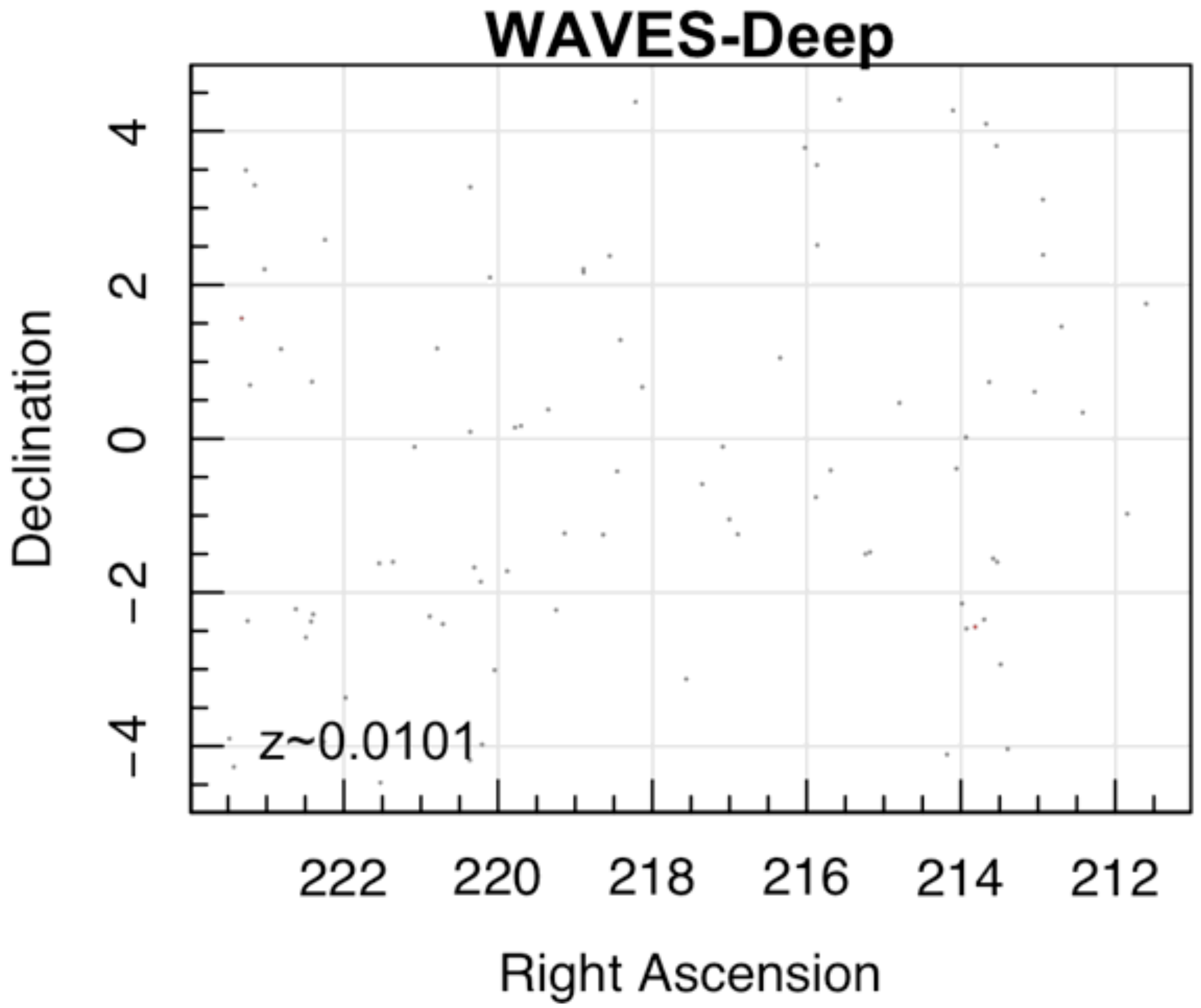
The evolution of hydrogen gas and the reservoirs from which galaxies grow with ASKAP/SKA.

WAVES: Wide Area Vista Extragalactic Survey





UWA's goal is to map the Dark Matter and its evolution by finding and tracing the galaxy groups.



Project opportunity: optimizing the survey design for dark matter mapping: group finding + simulations

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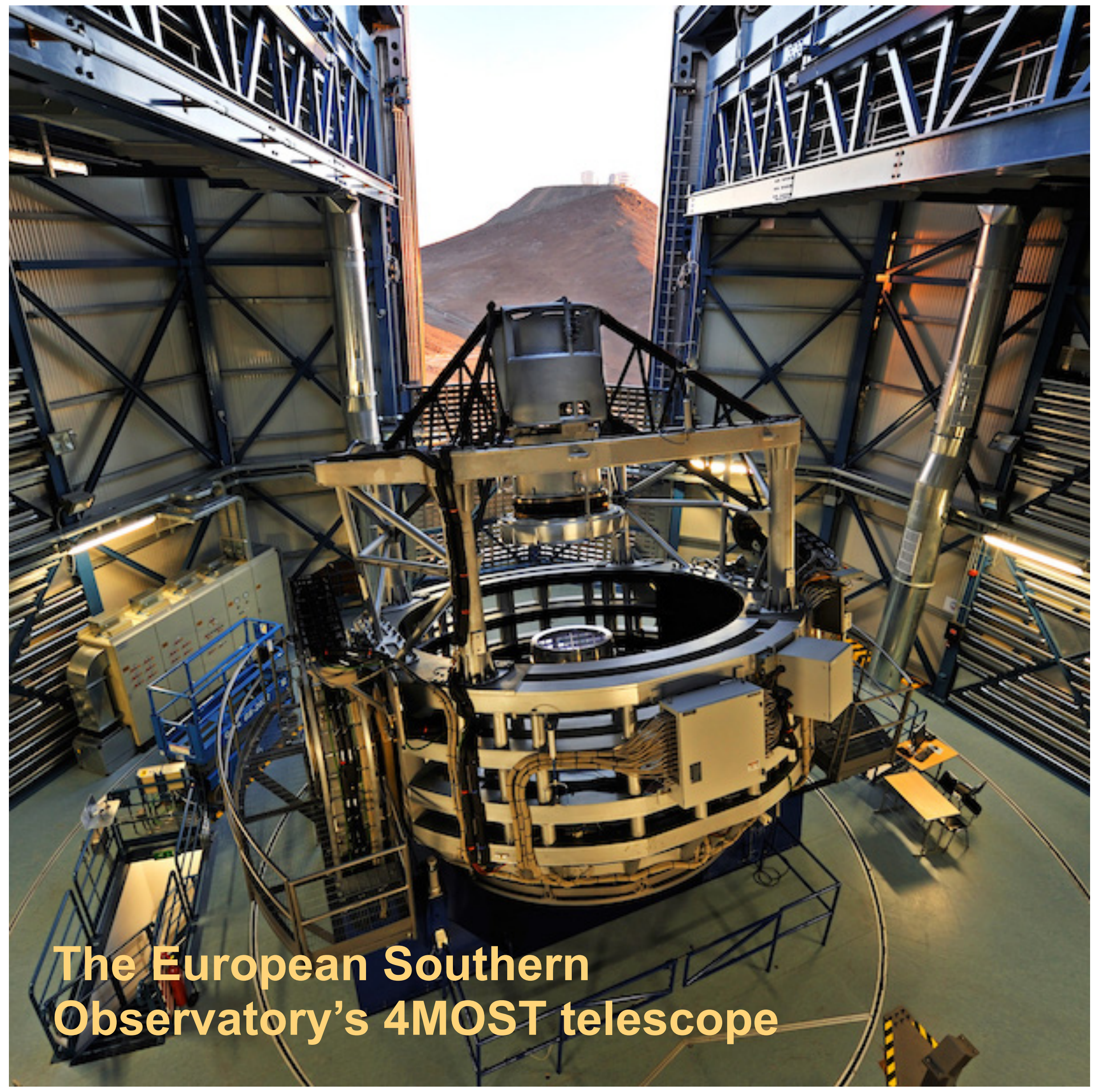

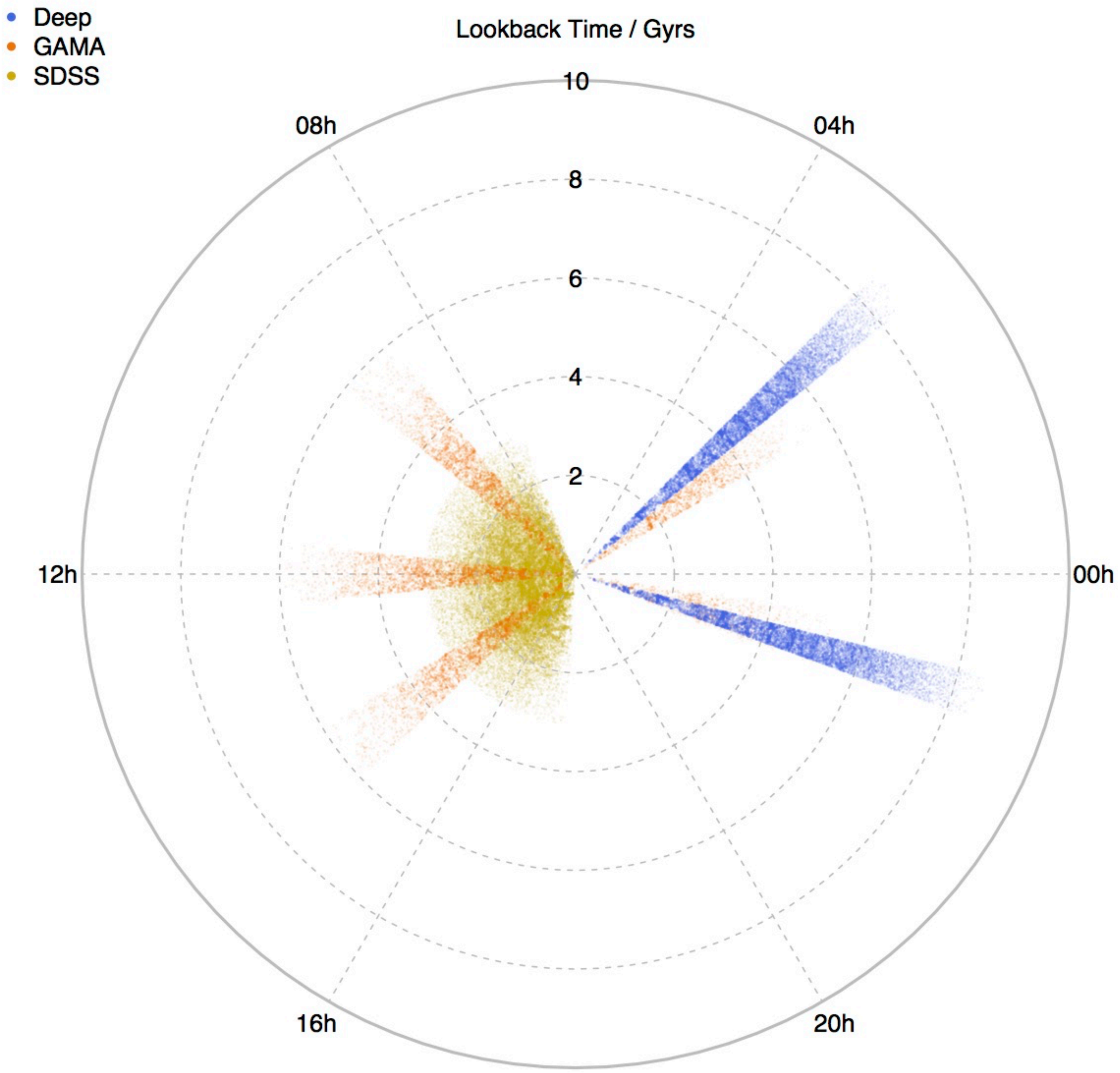

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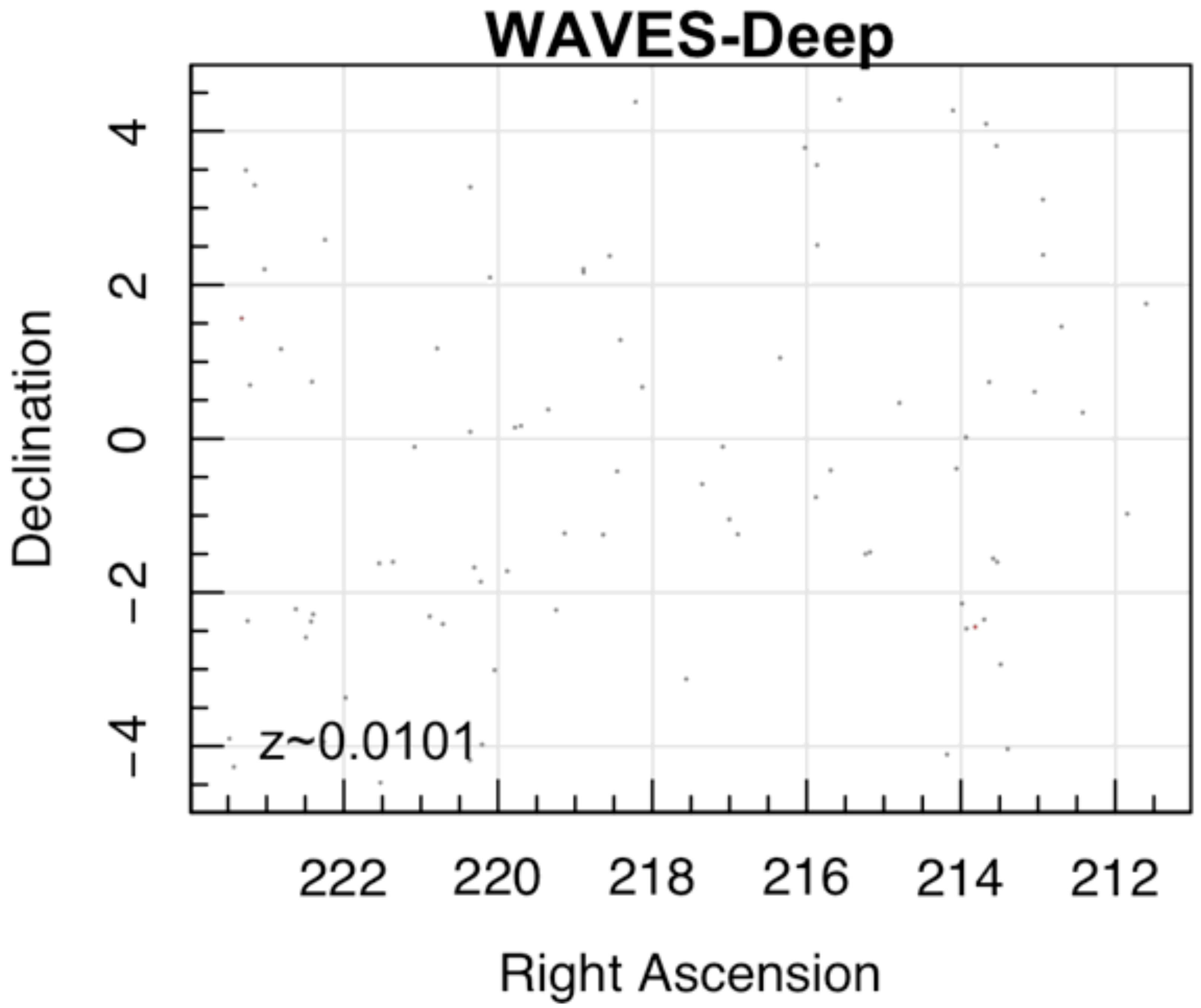

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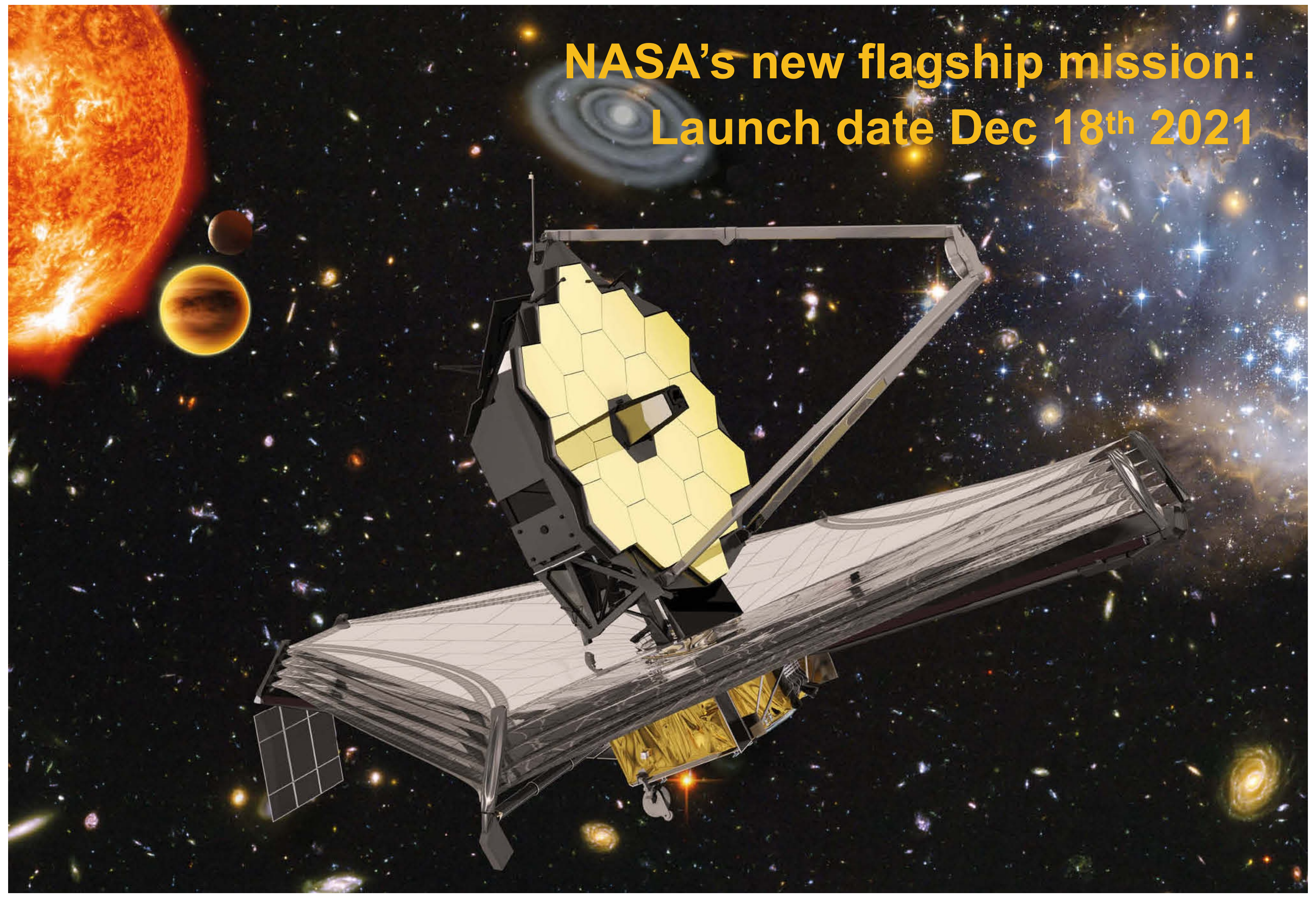
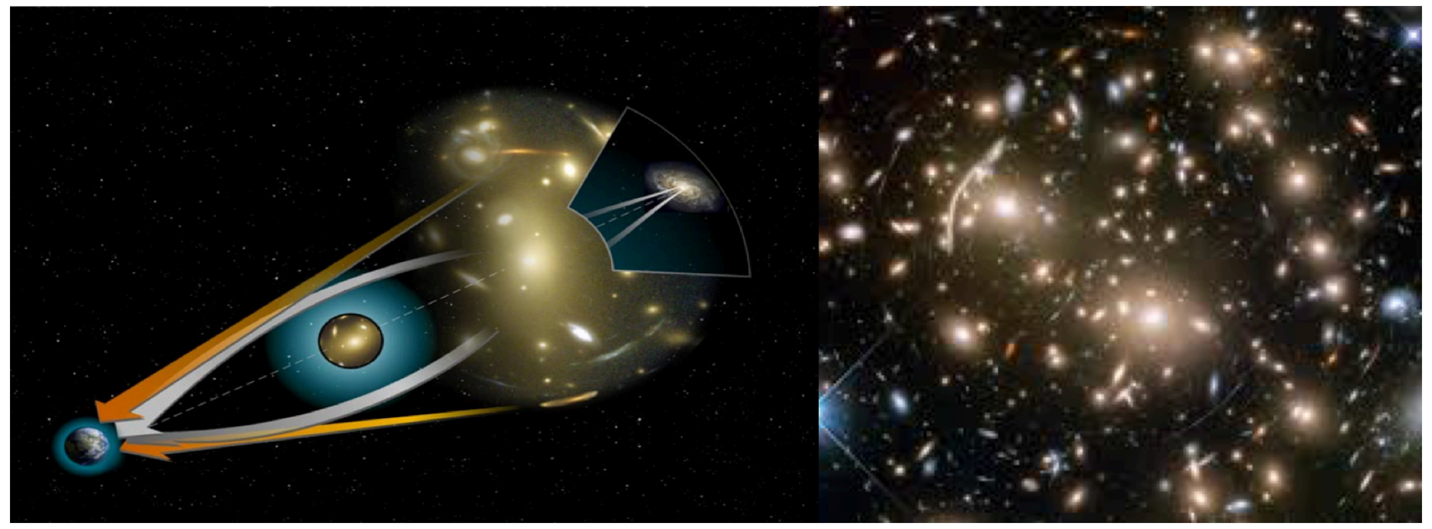
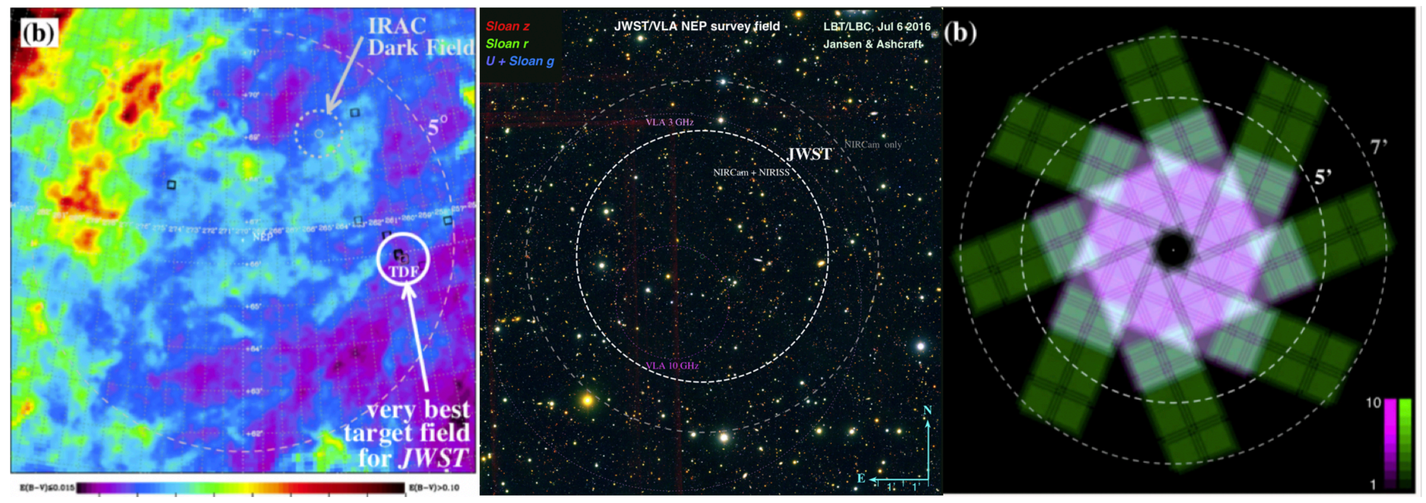
Pushing the limits with JWST

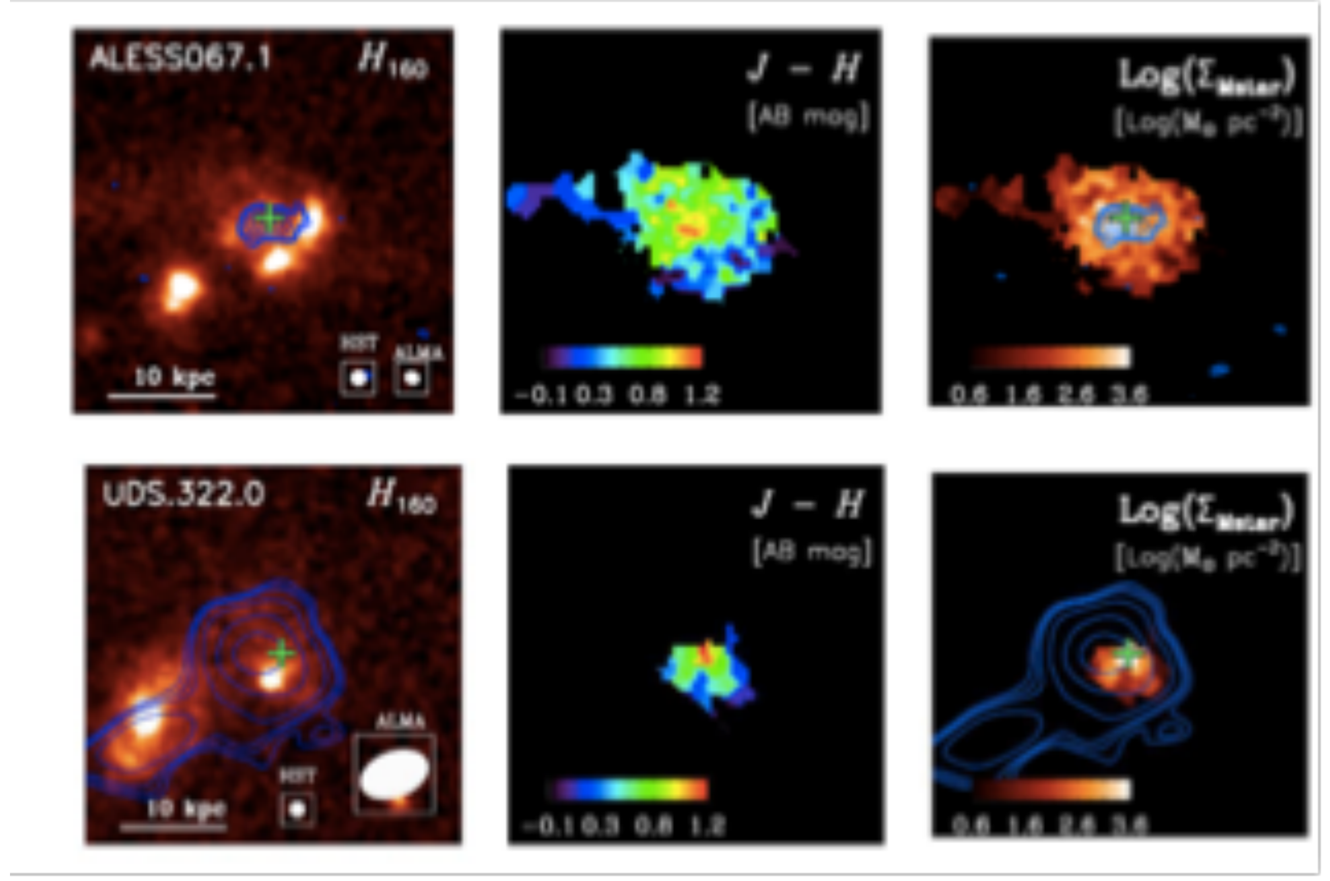


220hrs of Guaranteed Time (Team member Driver) to find the first galaxies.
UWA will be the first institution in Australia to received JWST data





14 hours of JWST Cycle 1 time (PIs Hodge & da Cunha) to study how the most massive starburst galaxies have assembled. Combined with very high resolution ALMA observations.



Project opportunities: process the data, determine physical properties, and compare to numerical simulations.