



The E-ELT Science Case

Science Pep Talk #6



9 Prominent Science Cases

“Prominent” science cases are considered to be among the most important scientifically and are useful for defining capabilities of the telescope.

- Planets and Stars
 - **From giant to terrestrial exoplanets: detection, characterization and evolution**
 - **Circumstellar disks**
 - **Young stellar clusters**
- Stars and Galaxies
 - **Imaging and spectroscopy of resolved stellar populations in galaxies**
 - **Black holes and AGN demographics**
- Galaxies and Cosmology
 - **Physics of high redshift galaxies**
 - **First light – The highest redshift galaxies ($z > 10$)**
 - **Is the low-density IGM metal-enriched?**
 - **A dynamical measurement of the expansion history of the Universe**

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The topic is galaxy formation



How and when did galaxies form?

When did the stars form – when did the structures assemble?

What is the origin of the galactic variety?

What is the role of nature vs nurture?

The topic is galaxy formation

A quick overview:

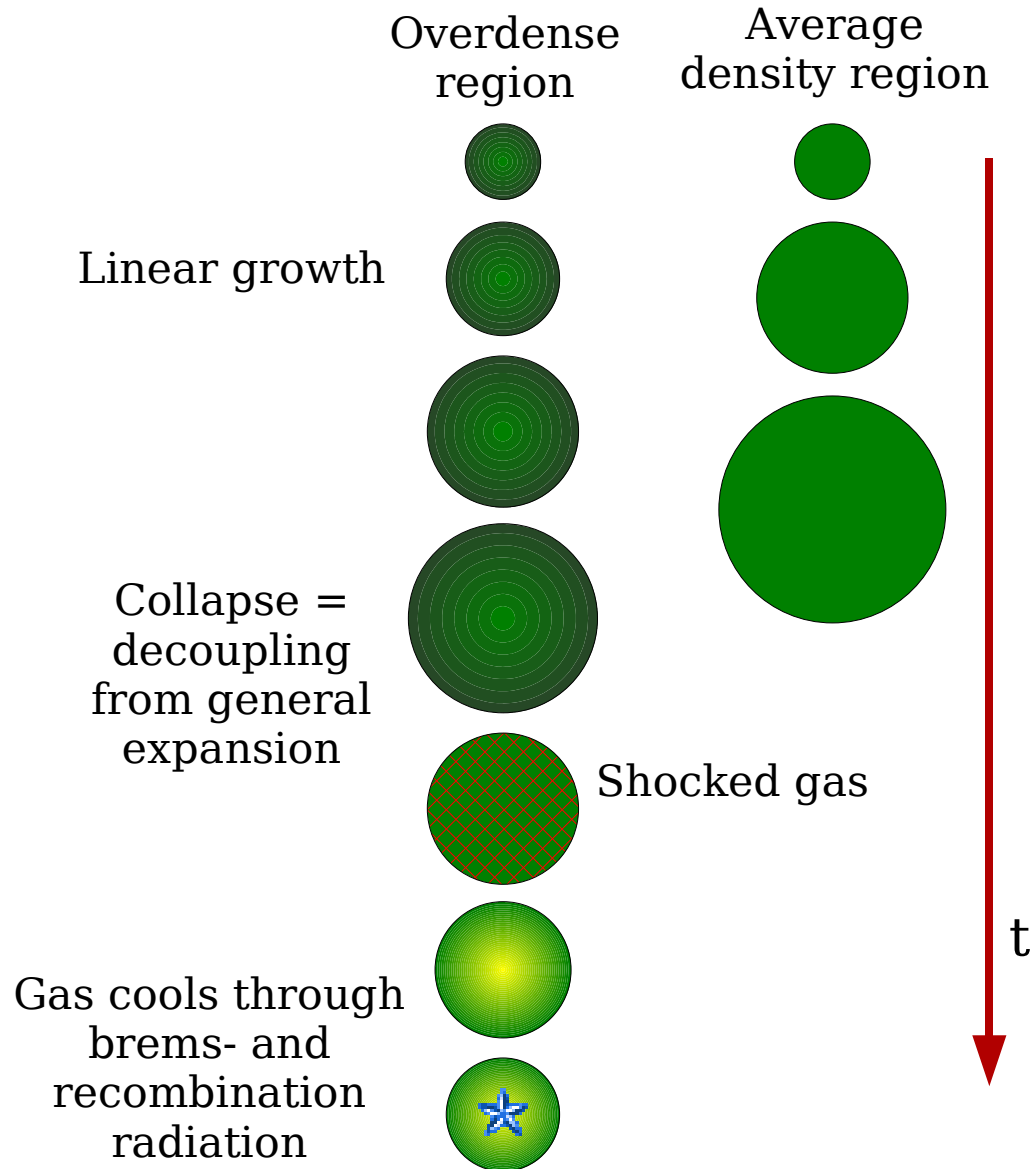
- Galaxy formation and evolution is part of the larger structure formation process.
- Galaxies form inside Dark Matter halos.
- Structure formation (and hence the build-up of galaxies) proceeds hierarchically, i.e. bottom-up.
- Throughout their lives, galaxies may encounter other galaxies.
- Throughout their lives, galaxies may accrete more gas.

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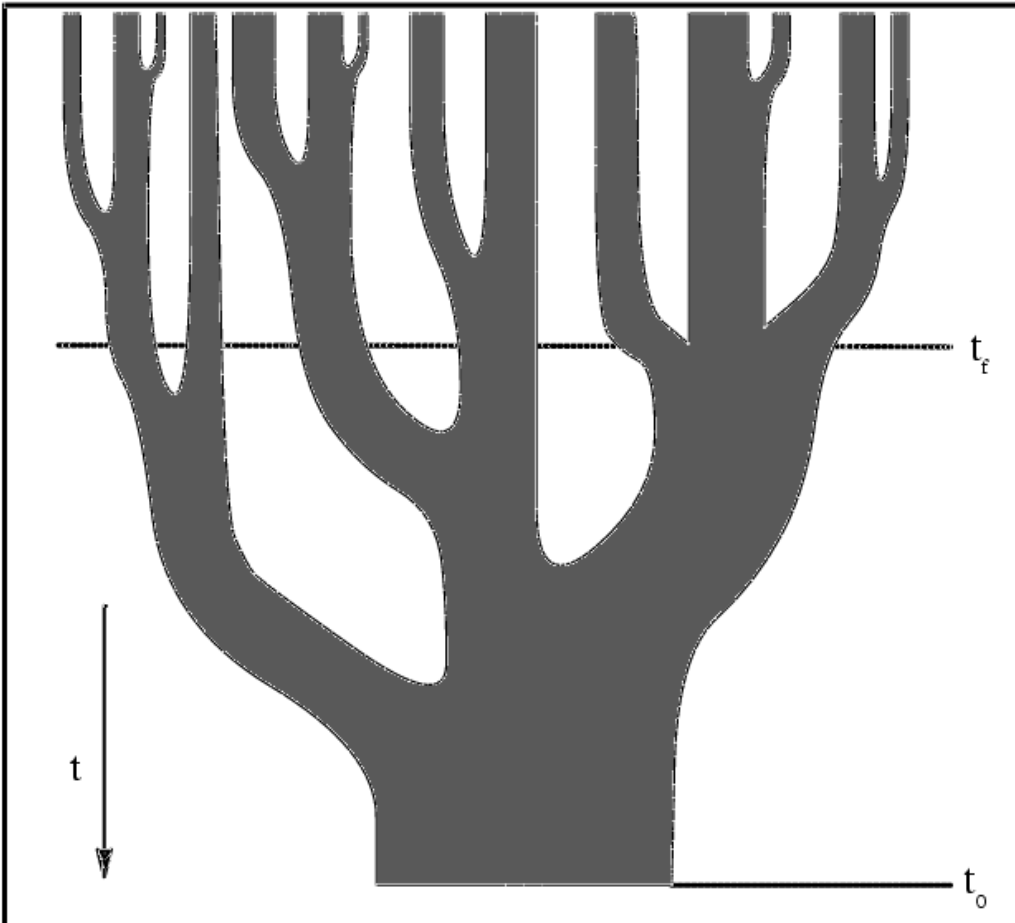


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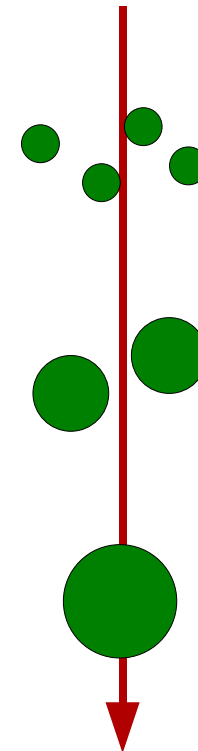
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Hierarchical build-up



Merger tree



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Questions for the E-ELT

- What were massive galaxies like when the Universe was only 1-2 billion years old?
- How massive were they?
- Were they rotating disks?
- Did they assemble through merging?
- How old are their stars by the time we observe them?
- How strong was their ongoing star-formation?
- How much dust did they contain?
- What was their morphology?
- Did they have distinct structural components?
- Were there strong inflows or outflows of gas?
- How do all of the above depend on the galaxy's environment?

E-ELT will answer...

...by providing:

- High resolution (LTAO) optical--near-IR imaging.
- ➔ Detailed morphologies, structures, colour gradients, rough mass estimates, etc, for $\sim 10,000$ galaxies.
- Low-intermediate resolution, spatially resolved (GLAO/MOAO), near-IR spectroscopy with multiplexing ~ 20 .
- ➔ Dynamics of gas and stars, stellar ages, metallicities, masses, dust extinction, star-formation activity, etc, for ~ 1000 galaxies.
- Very deep, integrated (seeing-limited), low-resolution, multi-object spectroscopy.
- ➔ Surveys of the very first galaxies imaged by JWST.