- THE GAS ACCRETION DURING THE GALAXIES FORMATION AND EVOLUTION -

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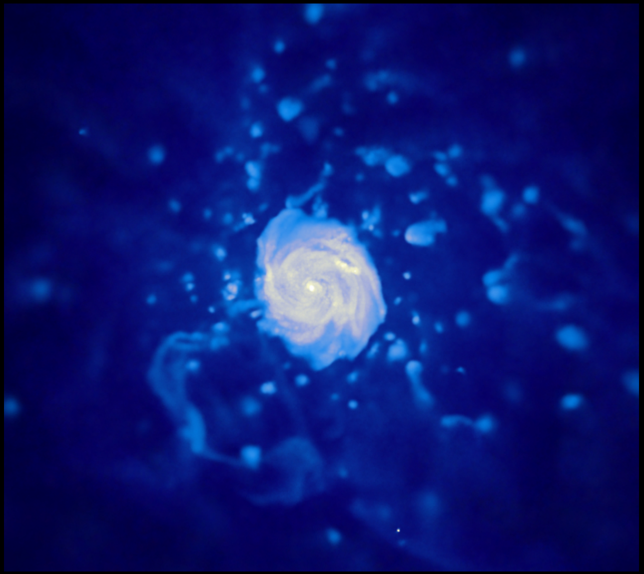
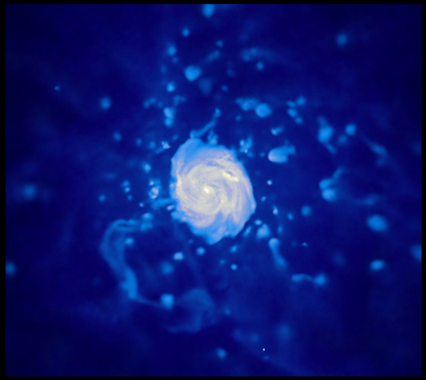


A very quick theoretical background...



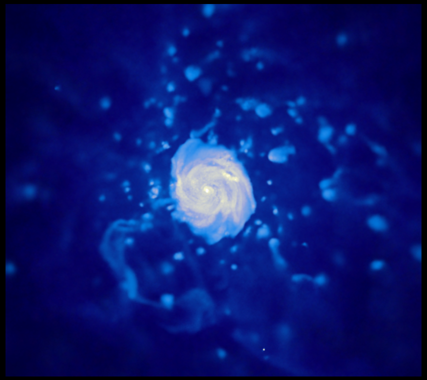
The conventional sketch of galaxy formation has its roots in classic papers of the late 1970s and early 1980s:

- With discussions of collapse and cooling criteria by Rees & Ostriker (1977) and Silk (1977).

- The addition of dark matter haloes by White & Rees (1978).

- The disc formation model of Fall & Efstathiou (1980).

A very quick theoretical background...



According to this sketch:

- Gas falling into a dark matter potential well is shock heated to approximately the halo virial temperature, putting it in quasi-hydrostatic equilibrium with the dark matter.

- Gas in the dense inner regions of this shock-heated halo radiates its thermal energy, loses its pressure support, settles into a centrifugally supported disc and forms stars.

The ideas of these papers have been updated and extended into a powerful 'semi-analytic' framework for galaxy formation calculations (e.g. White & Frenk 1991; …; Somerville & Primack 1999).

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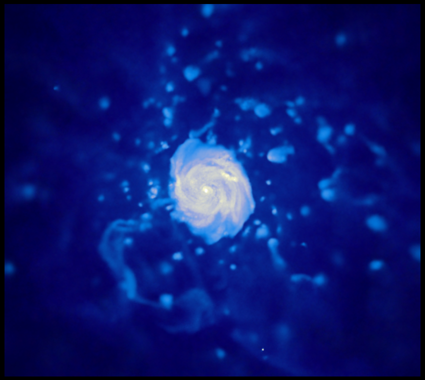


Observational facts

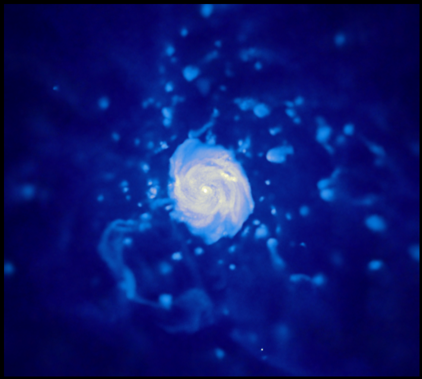
- Both observational and theoretical models indicate that the accretion of gas from the IGM is a fundamental driver of galaxy formation and evolution.

- Such accretion is necessary to explain the observed evolution of cold gas in and around galaxies (e.g. Prochaska & Wolfe 2009).

- We also require a continuous supply of gas from the IGM in order to mantain star formation over most of the Hubble time (e.g., Erb 2008, Bauermeister et al. 2010).

- All of this requirements are naturally predicts in theoretical and numerical models of galaxy formation in a ΛCDM universe.

A very quick theoretical background...



Why is the gas interesting?

The physics of the gas is richer than other components:

- Cooling and heating effects: Compton Cooling, Radiative Cooling, Photoionization Heating, etc.

- The gas has preassure.

- The gas can interact with Magnetic Fields.

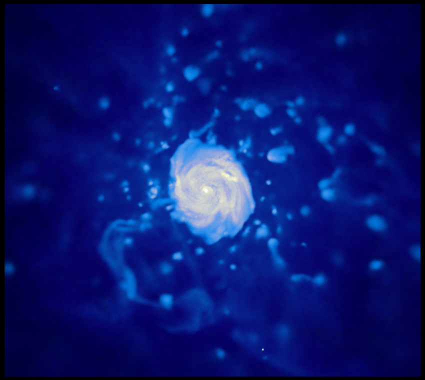
- Presence of Accretion Shocks, Density waves, etc.

- Thermal and Hydrodynamical Instabilites.

- Heat Conduction.

- Star formation.

A very quick theoretical background...



The current understanding...

- The underliying calculations in semi-analytic codes ussualy works with spherical geometry.

- The geometry seen in N-body and hydrodinamical cosmological simulations is more complicated than a simply spherical geometry.

Important: roughly half of the gas accreted by the simulated galaxies is never shock heated close to the halo virial temperature (T ~ 10^6 K fot a MW type galaxy). (Keres et al. 2005)

A very quick theoretical background...

There are in fact two modes of gas accretion:

COLD MODE

Dominates for lower-mass galaxies.

$$M_{gal} < 2 \times 10^{10} M_{\odot}$$

Dominates at high redshift (z>3) and in low density environments today.

HOT MODE

Dominates the growth of high-mass systems.

$$M_{gal} > 2 \times 10^{10} M_{\odot}$$

Dominates in group and cluster environments at low redshift.

A very quick theoretical background...

COLD MODE

The cold mode is caracterized by strems that can penetrate the halos on a free fal time. So, they are very effective at transporting gas to their centers and may be connected with:

-The observed high-redshift star forming galaxies.

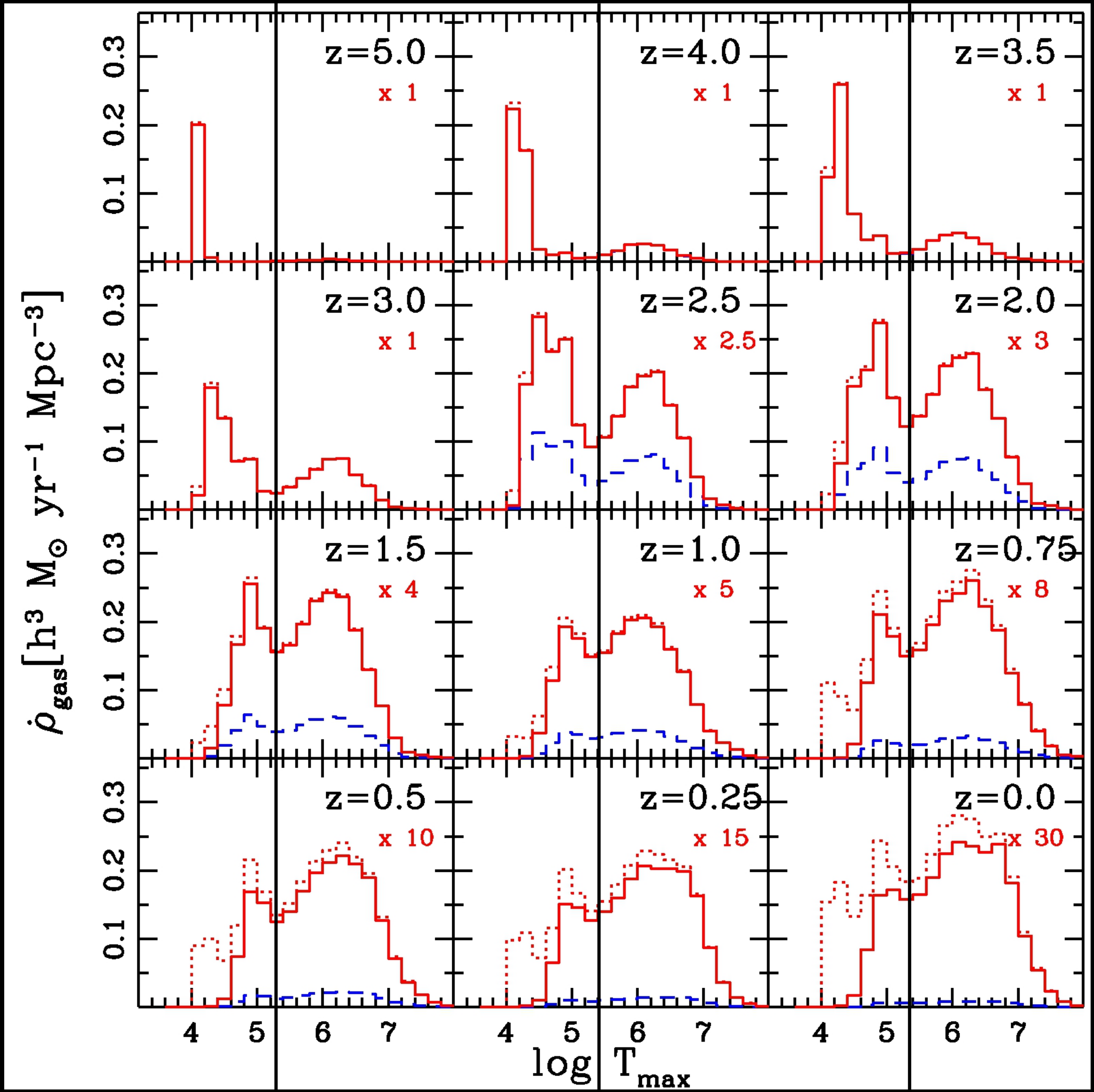
- Dense obsorption systems in quasar and galaxy spectra.

- High velocity clouds around local galaxies.

HOT MODE

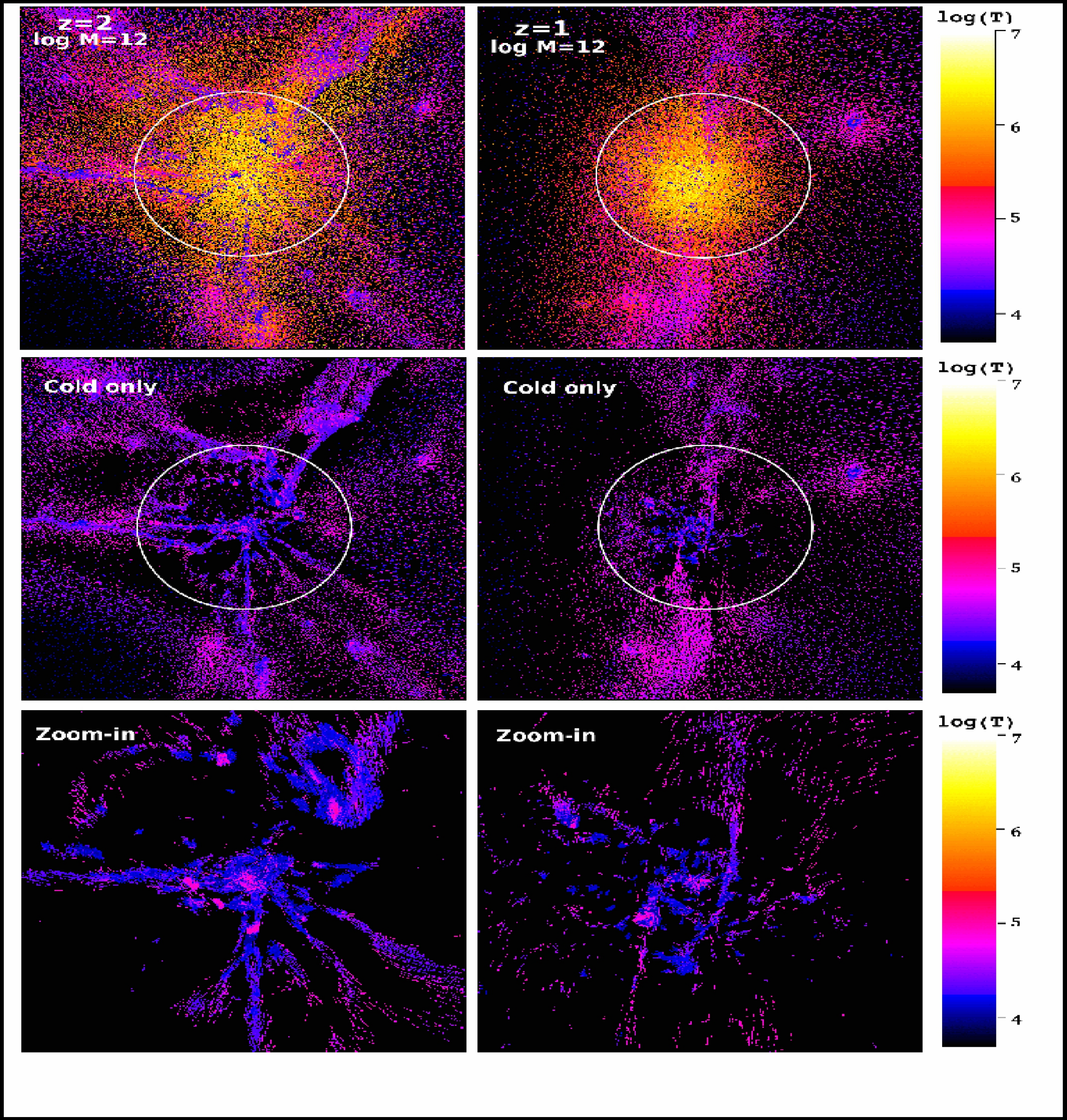
In the hot mode, the accreting gas shock heats before cooling in a more spherically symmetric fashion onto the central galaxy, like the first presented sketch.

A very quick theoretical background...



Keres et al. 2005

A very quick theoretical background...



Keres et al. 2009

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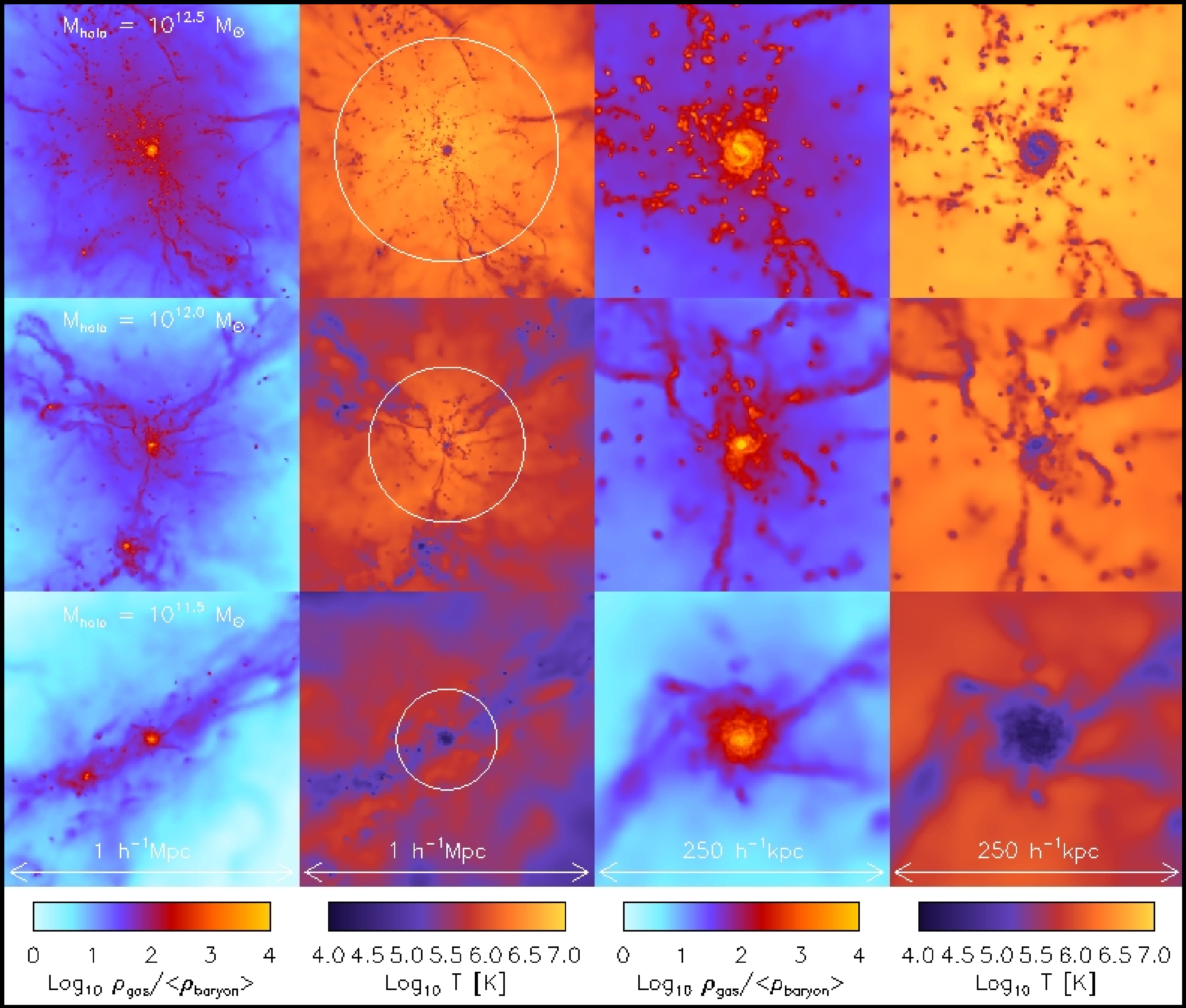
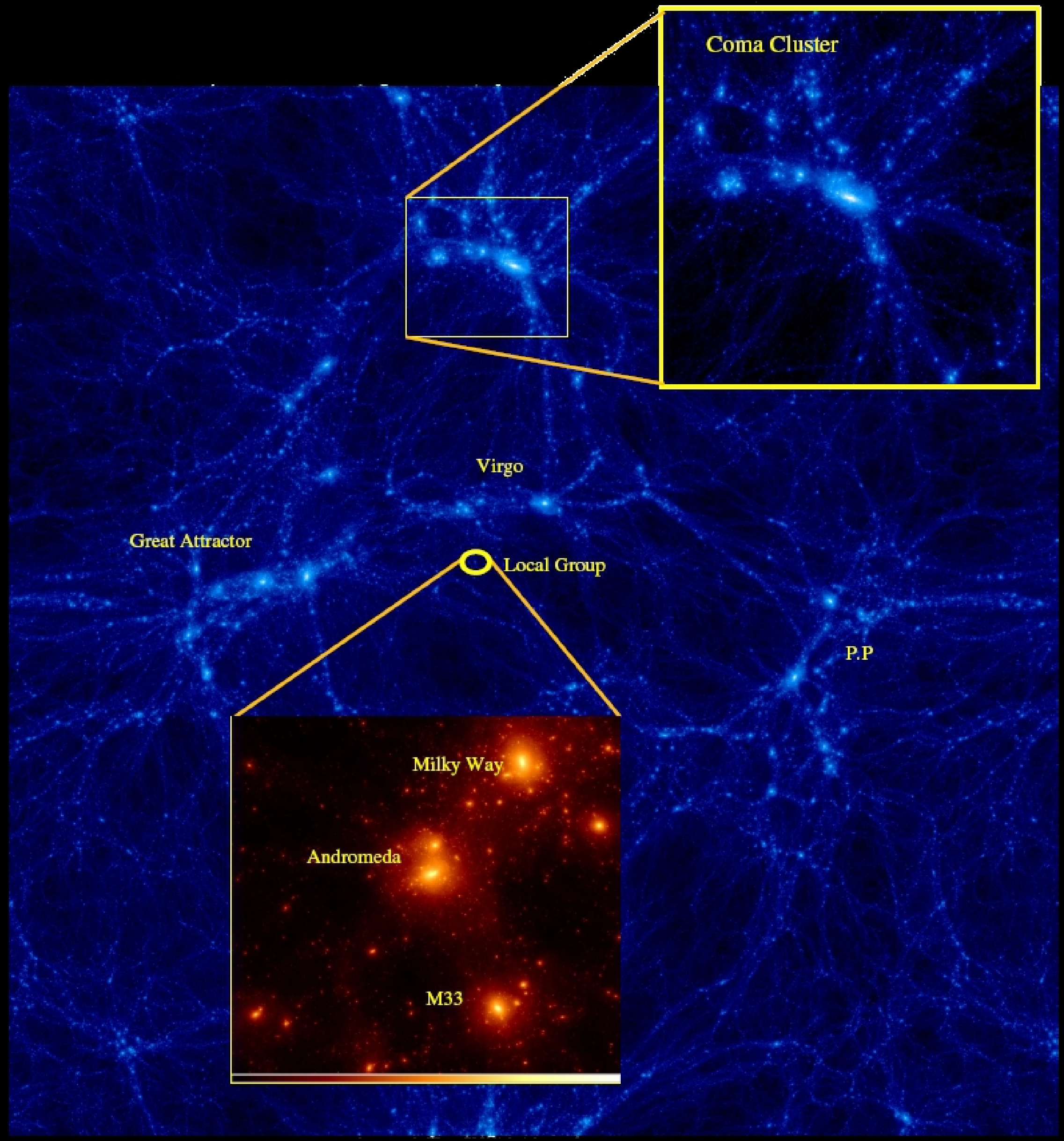


van de Voort et al.2010

Our current work...



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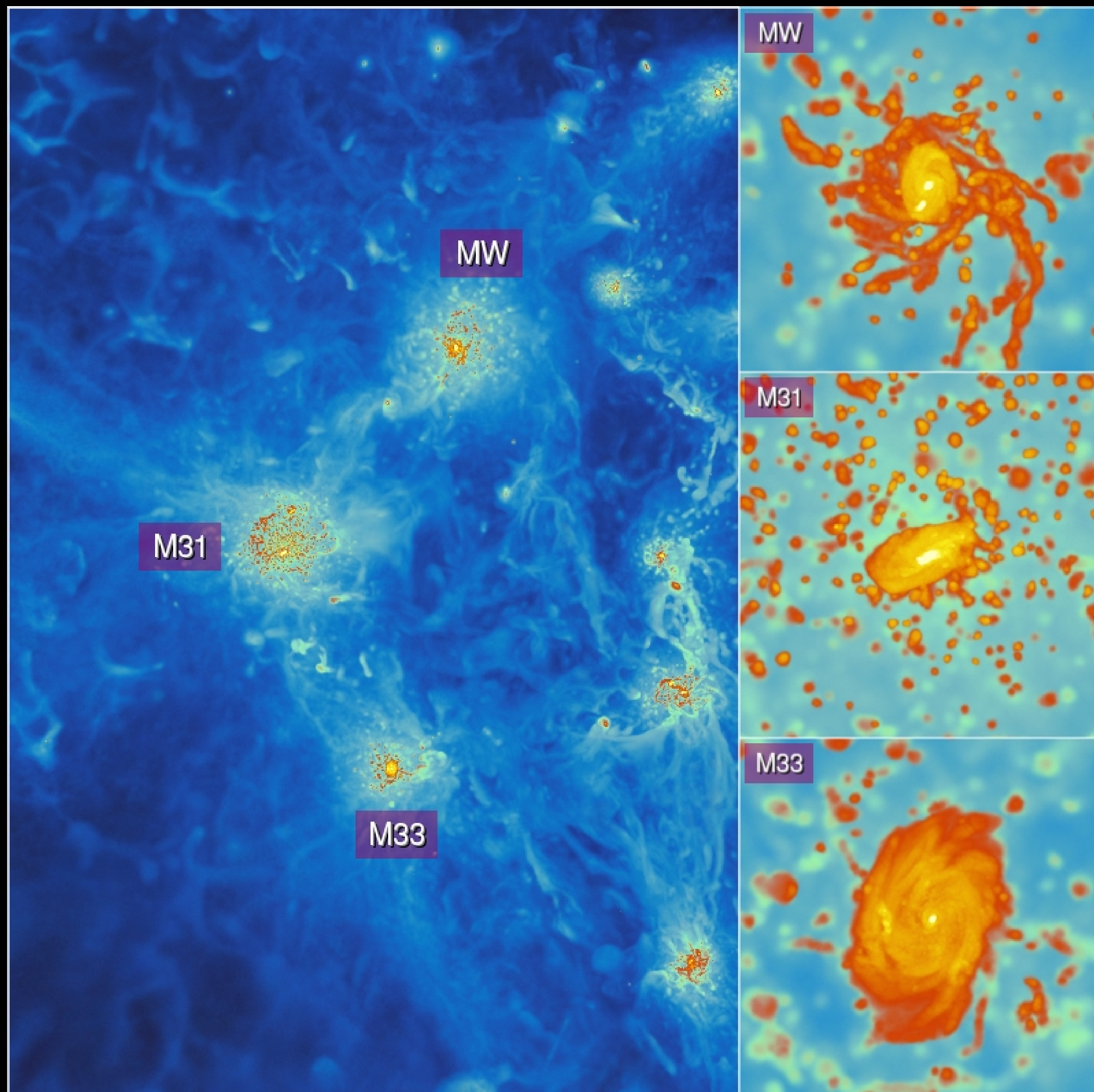

Our current work...

CLUES
Constrained Local UniversE Simulations

What can we do?

We can study:

- The baryonic (in particular gas) assembly of dark matter haloes.

- The thermal history of the gas.

- The geometric structure of the hot and cold accretion modes.

- The relationship in the rho-temperature space.

- The individual track of gas particles in the simulation as a whole.

- Think new methods in order to quantify or to understand the accretion physics onto galaxies.

Our current work...

The rho-T plane