ASTROFISICA DELLE STRUTTURE COSMICHE BARIONICHE

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1.3 IL CICLO DEI BARIONI COSMICI

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Mannucci, Bacciotti, Bragaglia, Bono, Brandt, Calura, Carretta, Casasola, Cesaroni, Cresci, Cristallo, Codella, D'Odorico, Franchini, Fontani, Gallazzi, Gallerani, Granato, Gratton, Grieco, Lucatello, Liuzzo, Magrini, Marcelino, Massi, Marconi, Matteucci, Molaro, Morossi, Moscadelli, Olmi, Paladino, Pancino, Randich, Romani, Rygl, Schneider, Silva, Sommariva, Spagna, Spitoni, Straniero, Tosi, Travaglio, Vallenari, Zibetti

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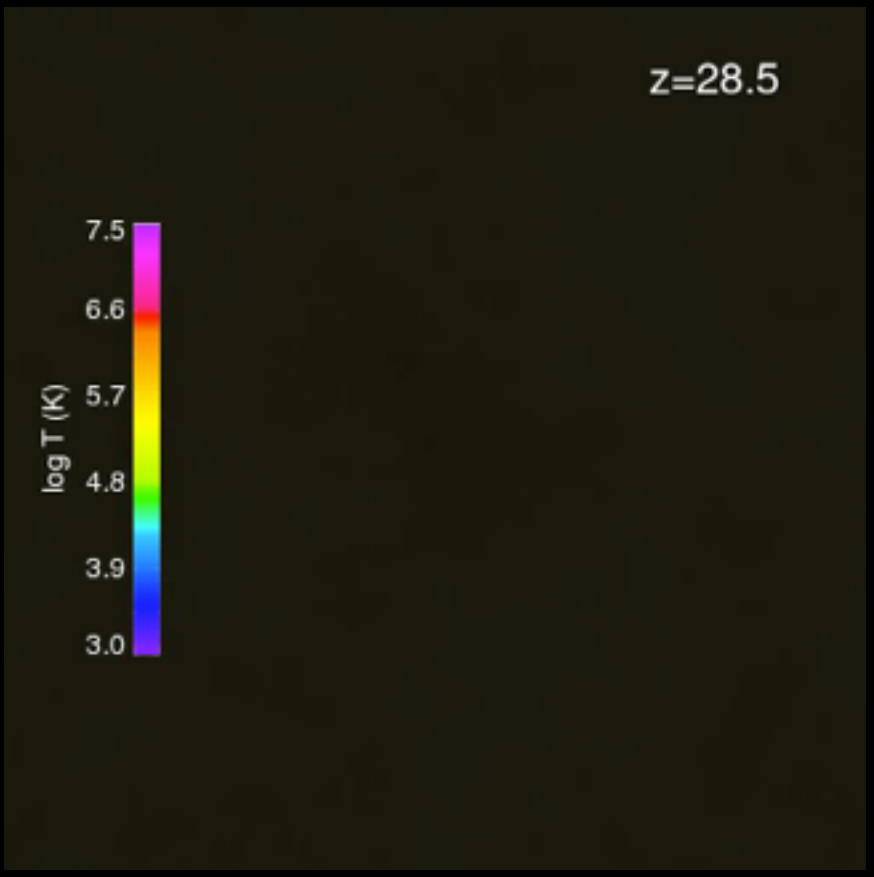
1.3 IL CICLO DEI BARIONI COSMICI: QUALE È LA CONNESSIONE FRA IL MEZZO INTERGALATTICO E LE GALASSIE

How does ordinary matter form the large-scale structures that we see today?



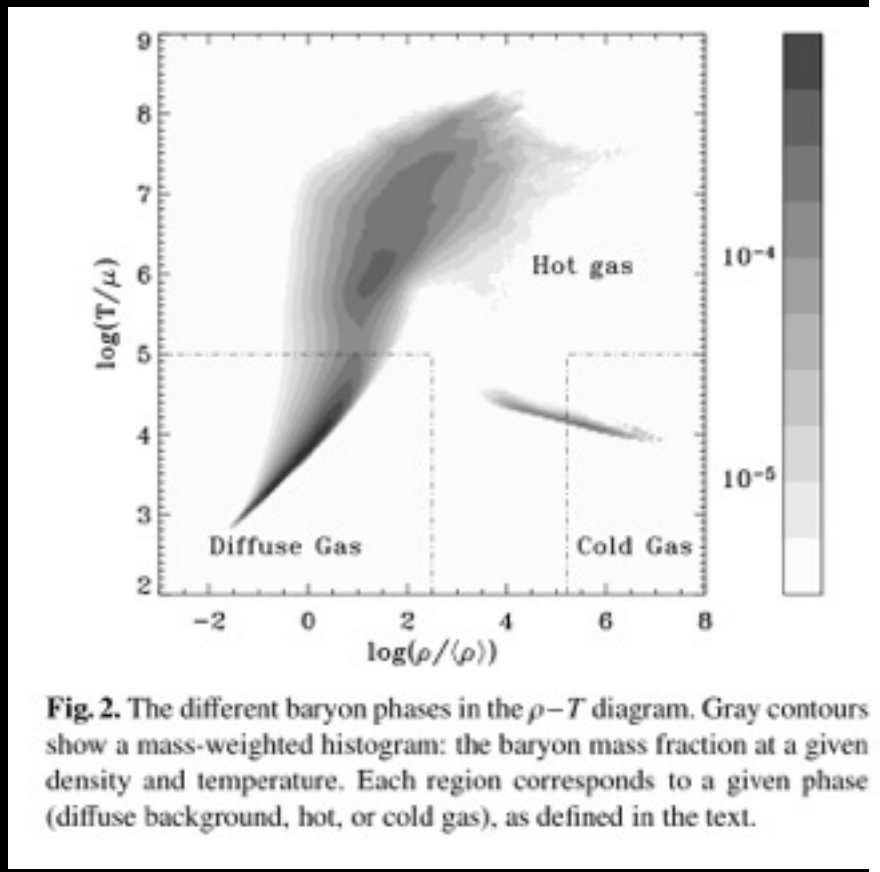


Fig. 2. The different baryon phases in the $\rho - T$ diagram. Gray contours show a mass-weighted histogram: the baryon mass fraction at a given density and temperature. Each region corresponds to a given phase (diffuse background, hot, or cold gas), as defined in the text.

Cappelluzzo et al. 2009

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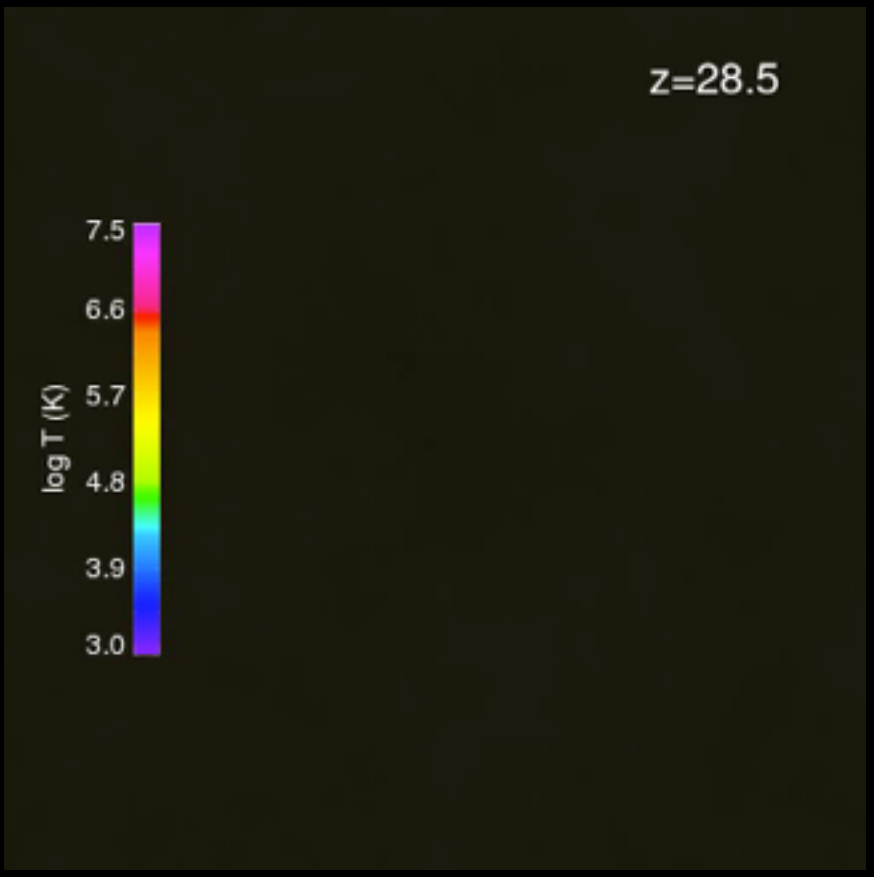

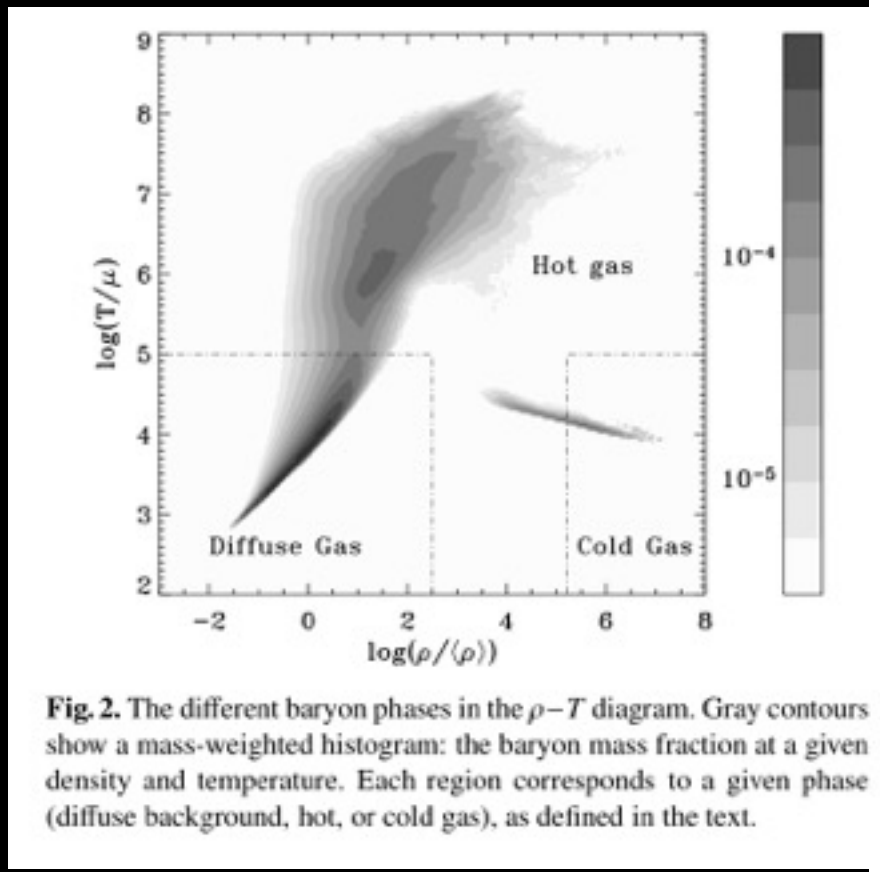

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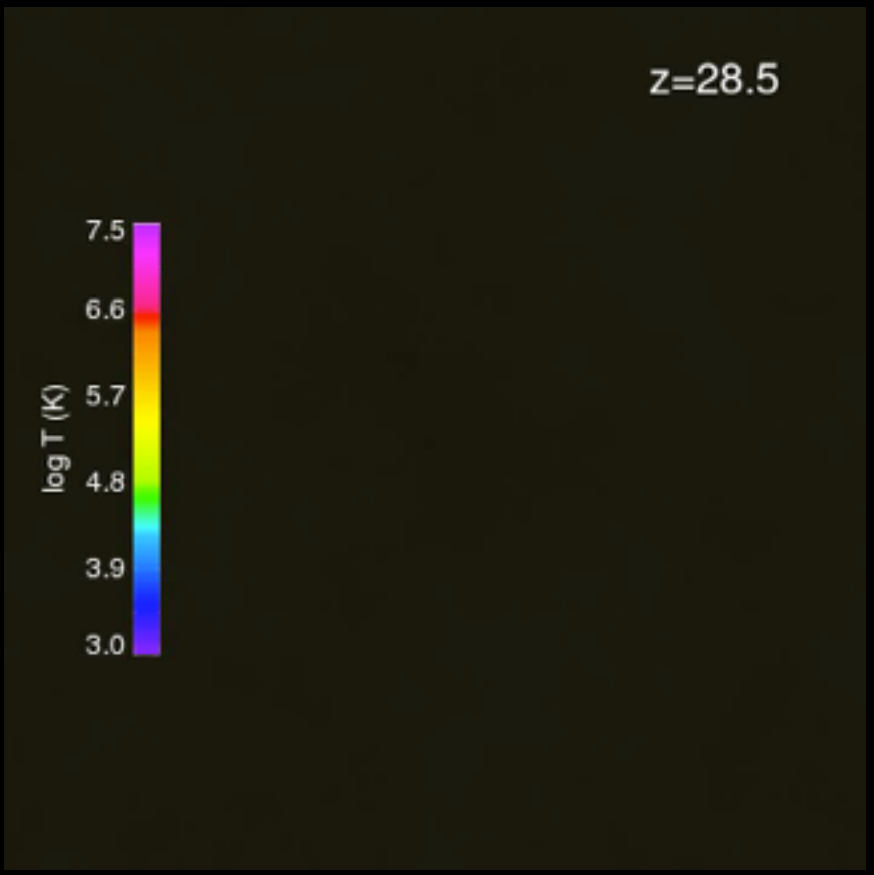

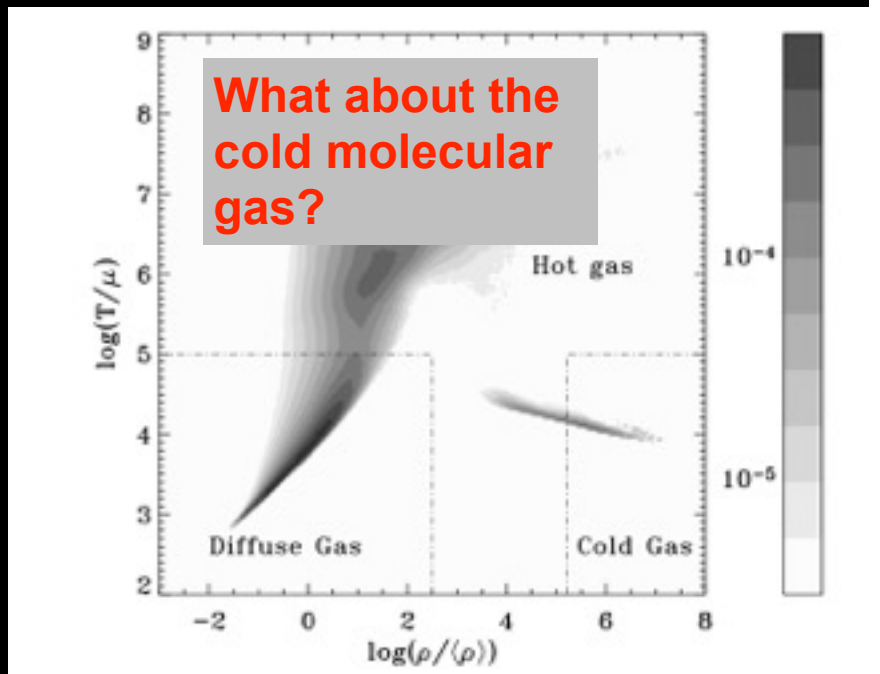

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Cen & Ostriker 1999; Dopita et al. 2009

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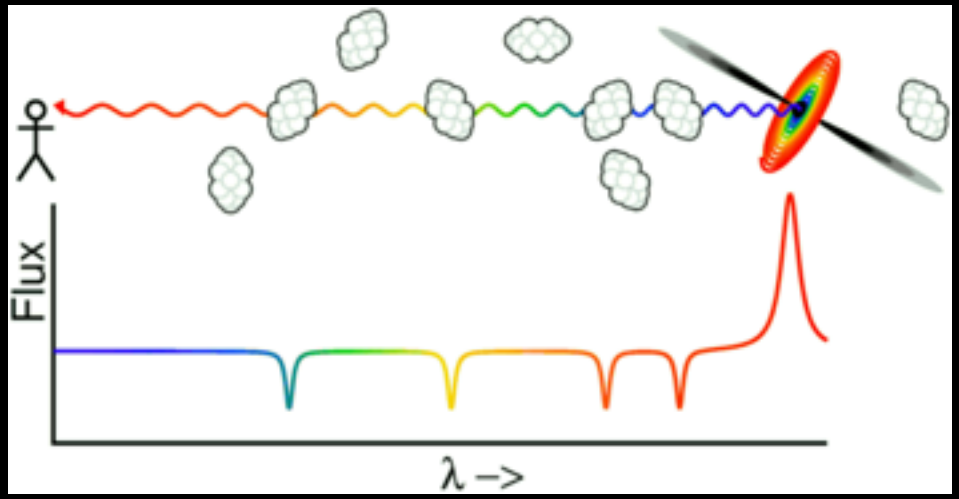
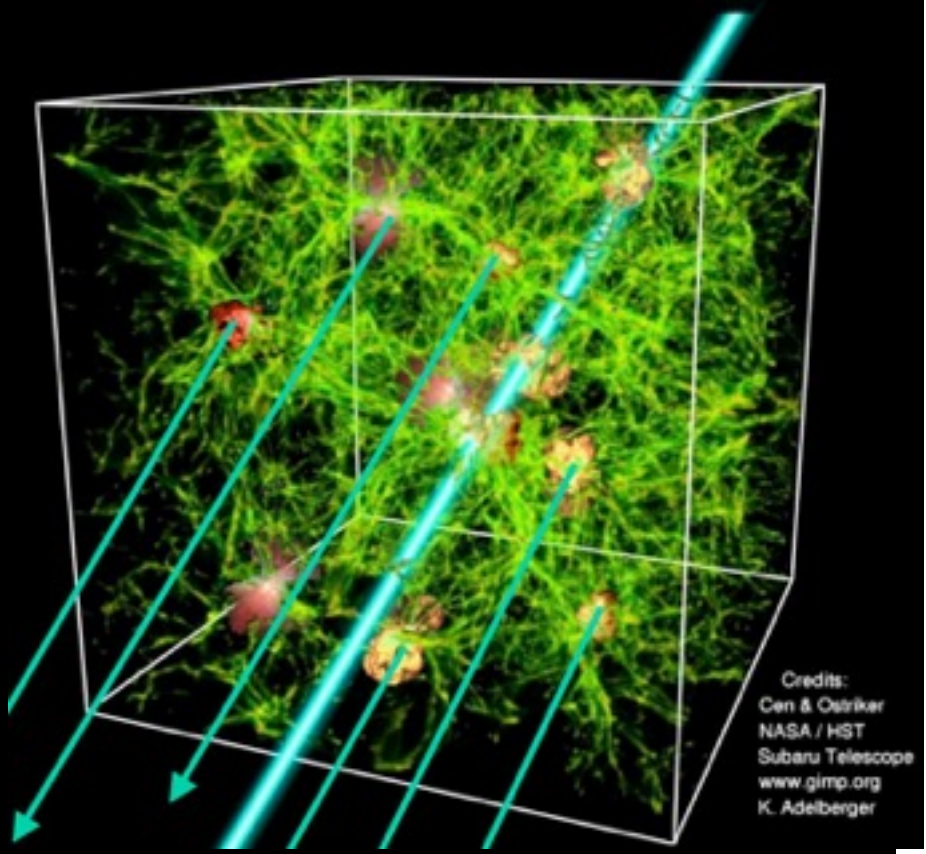
How does ordinary matter form the large-scale structures that we see today?

Cold gas in Lyα clouds dominates the baryonic content at z>2: IGM tomography.





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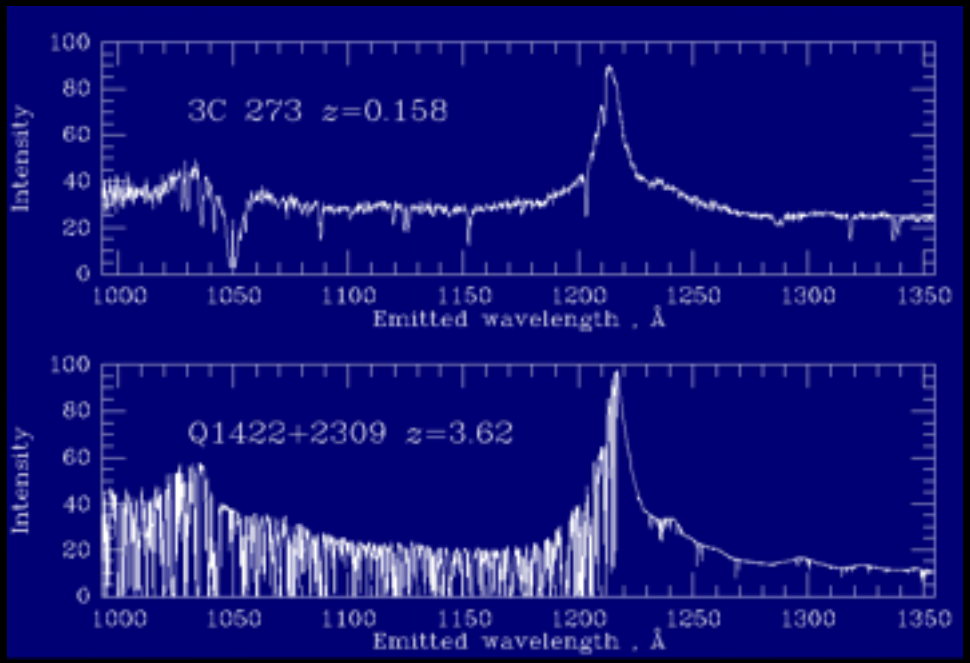

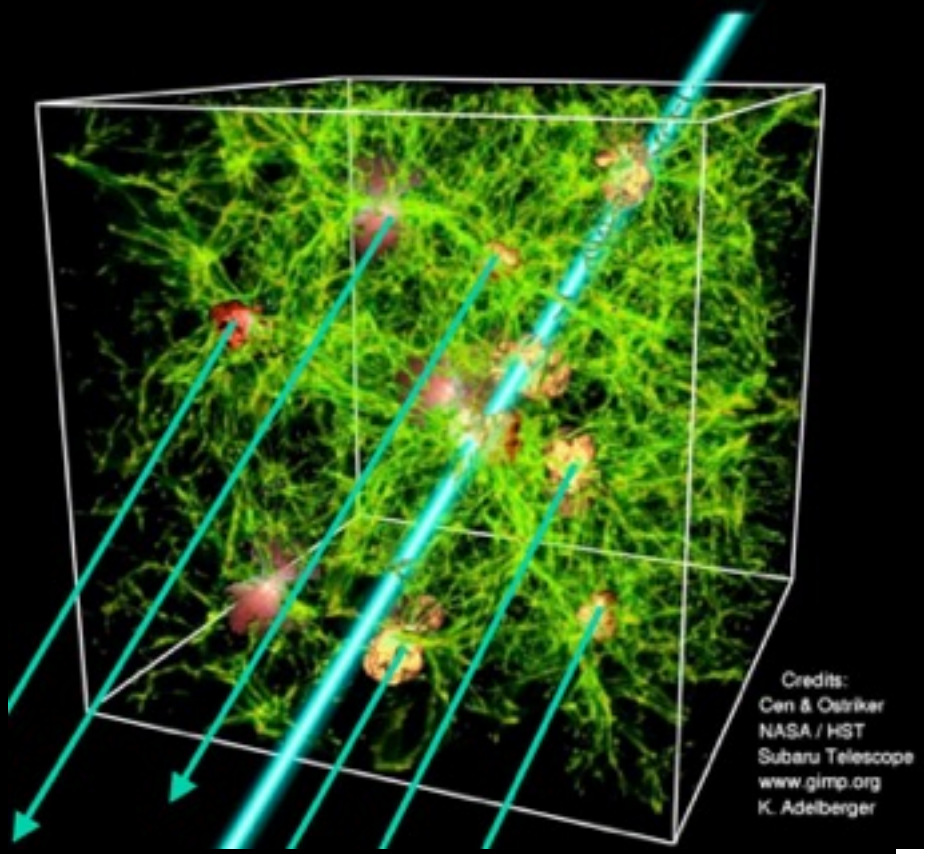

Oppenheimer et al. 2009

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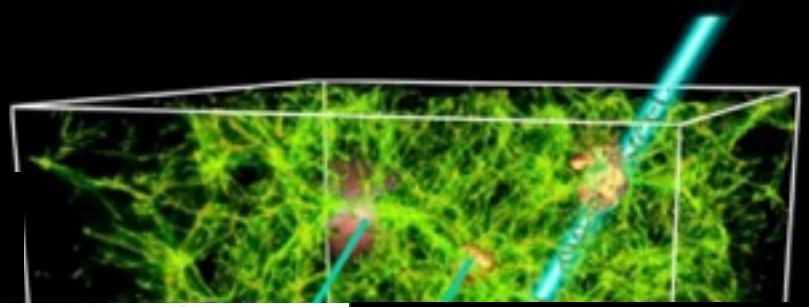
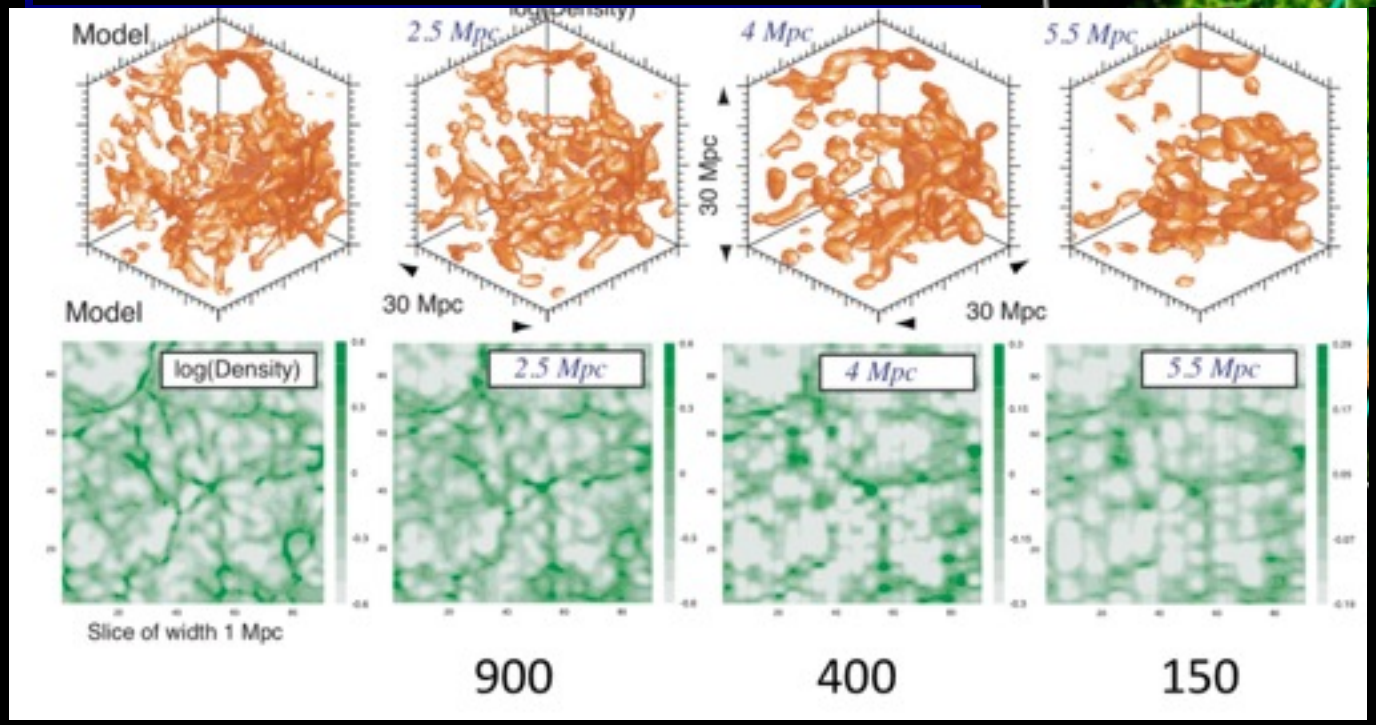
Model and recovered density as a function of distance from LoS.





Today:
VLT VIMOS/UVES
ESPRESSO/MOONS
QSOs->100deg^2
a start

With E-ELT MOS/HIRES
LBGs ->1000deg^2
full density field will be recovered

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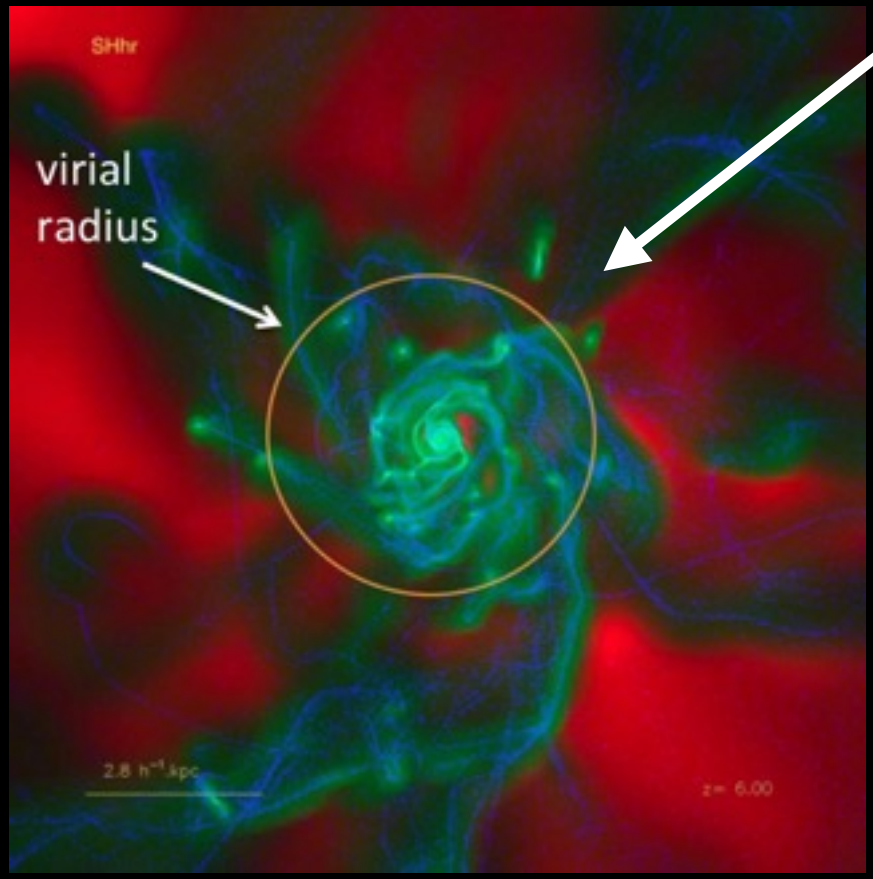
The baryonic life cycle of galaxies: inflows, galactic winds, metal enrichment



Simulations! First HI obs. up to z=1-1.5 with SKA1? JVLA, ASKAP, Meerkat?
Ionized gas: IFU, MOS HIRES, first on VLT then on ELT

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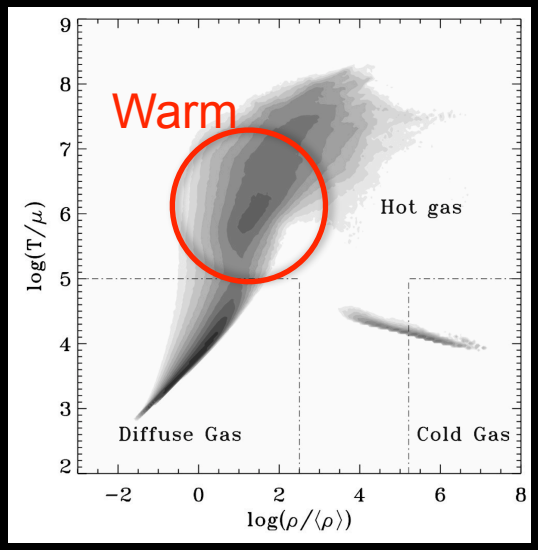
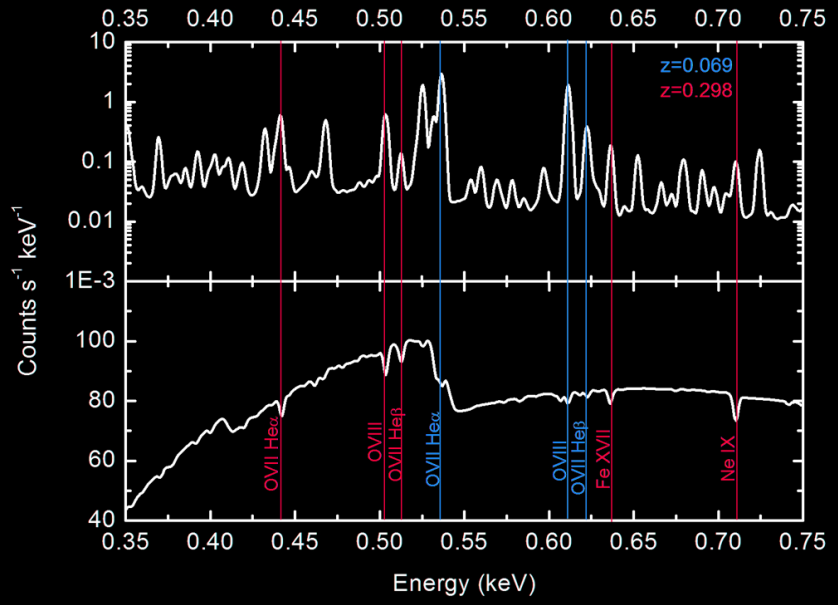
How does ordinary matter form the large-scale structures that we see today?

Hot gas in clusters, groups and the IGM dominates the baryonic content at z<1, so understanding how this hot component forms and evolves is crucial. X-rays, emission & absorption studies: Athena



Are the missing baryons in the warm phase?



Cappelluzzo et al. 2009

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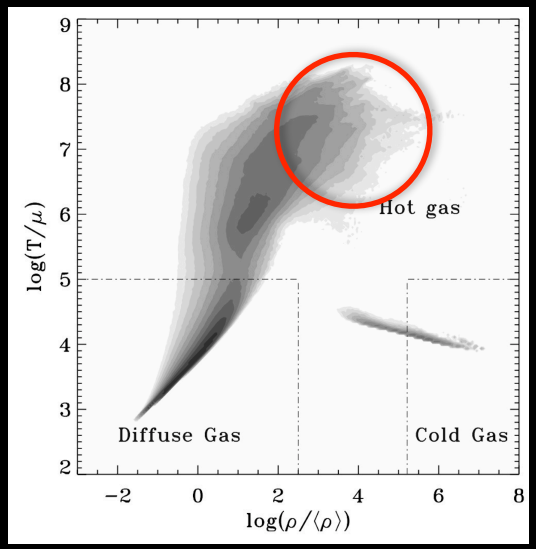
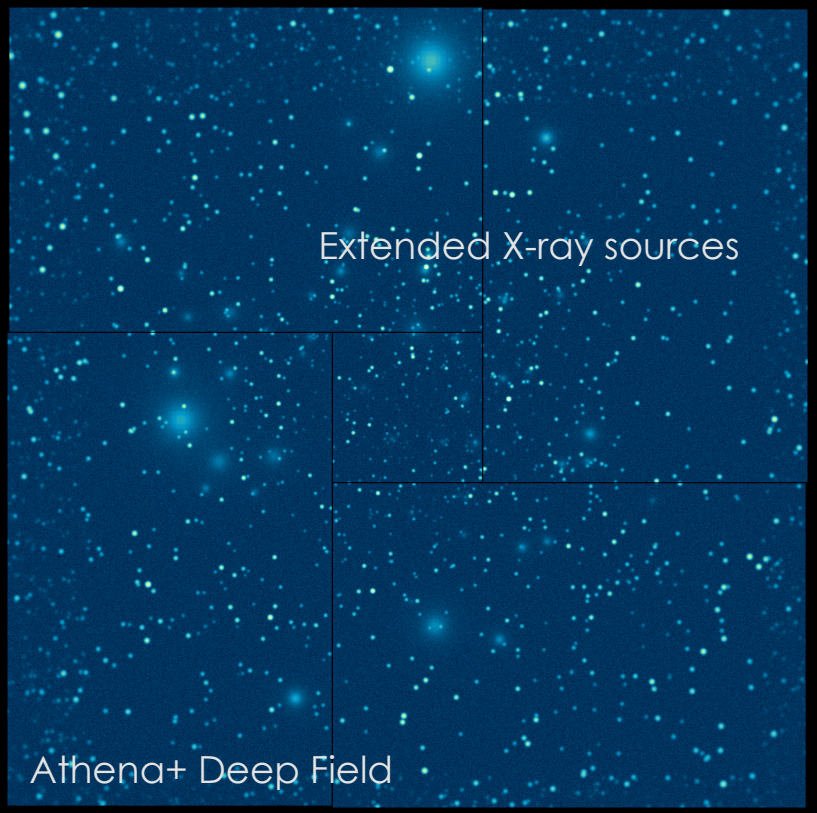
When do galaxy groups and clusters form and how they subsequently evolve?





X-rays: Chandra/XMM, eRosita, Athena.

SZ: Planck, SPT, ACT … NIR deep&wide field spectroscopy: JWST, Euclid.

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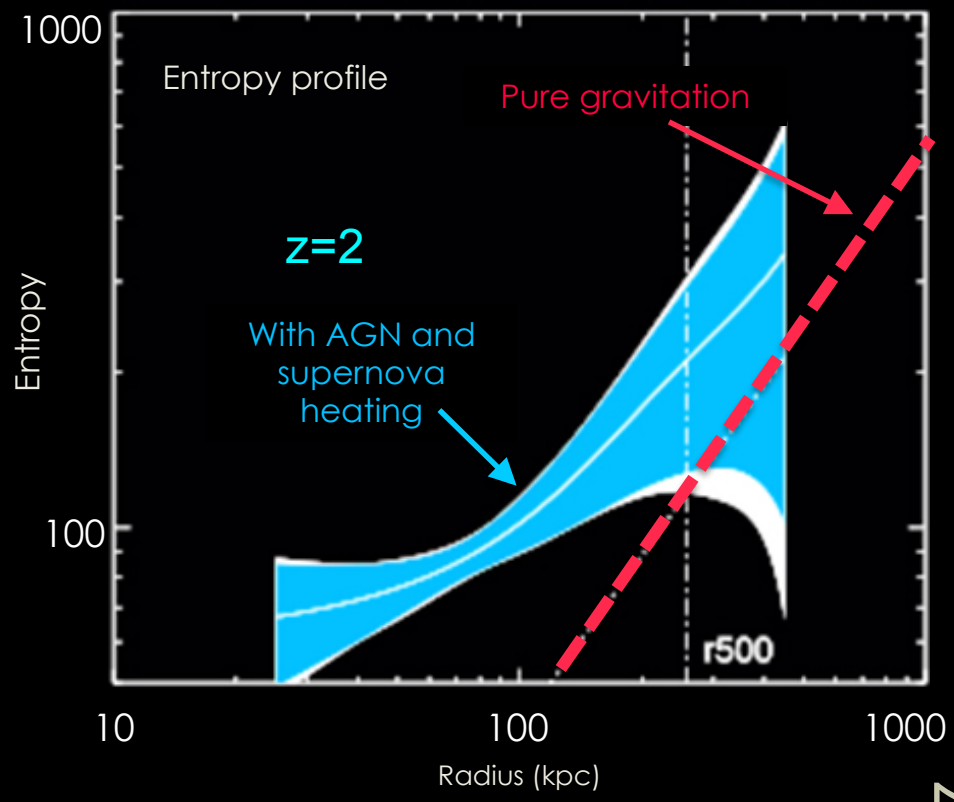
The relative importance of gravitational and non-gravitational heating in assembling structures. Measure thermodynamics chemical composition and velocity of the gas. AGN feedback as a function of the cosmic time.

1. Why clusters do not quickly cool-off?
There must be a compensating energy injection, i.e higher entropy.

2. If clusters were self-similar $L_X \approx T^2$ while $L_X \approx T^3$ is observed.
$< L_X$ at a given T, imply < density, i.e. > Entropy=$k_B T n_e^{-2/3}$

Measure energy injection (gas entropy) at the time of formation



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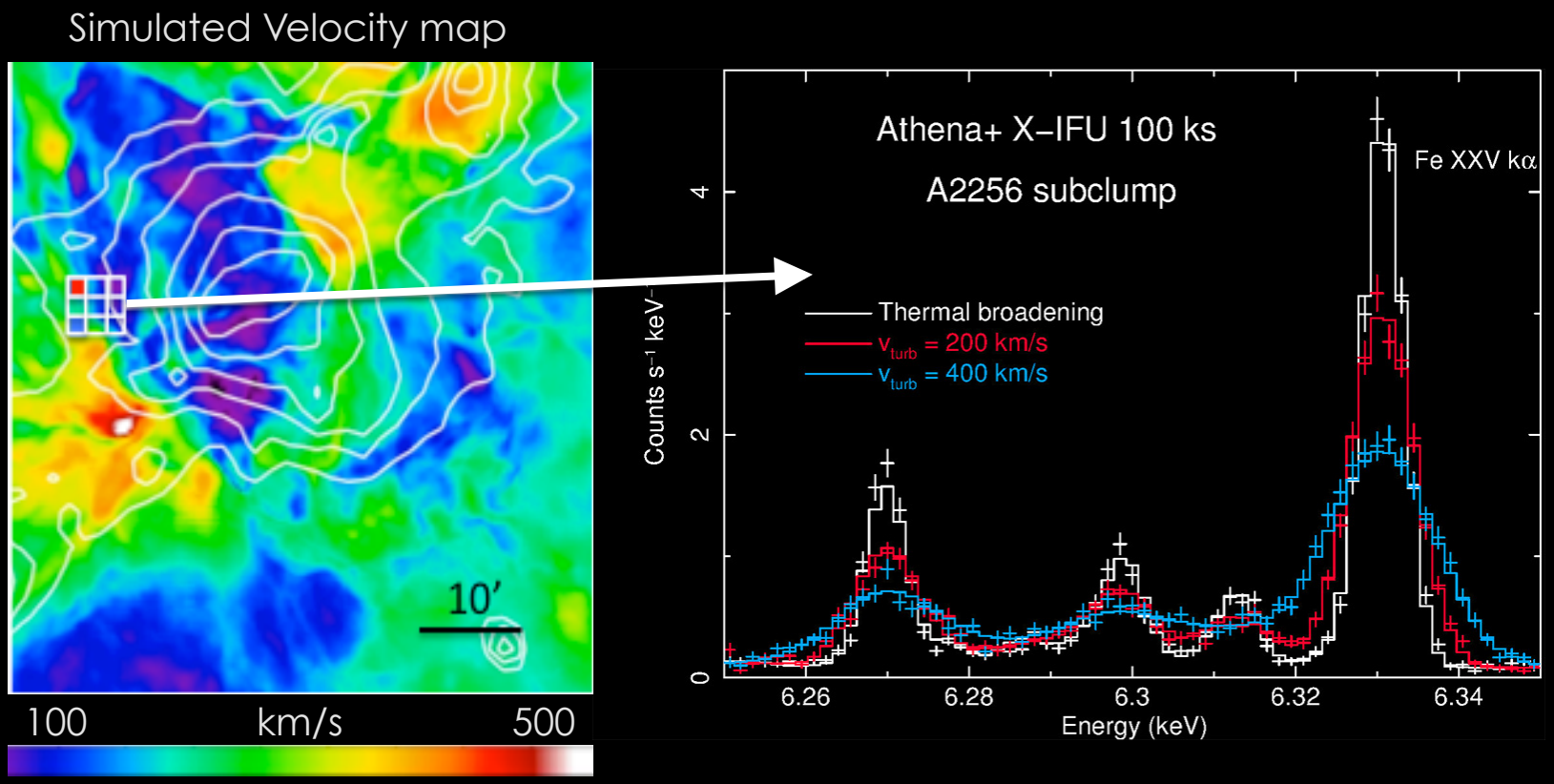

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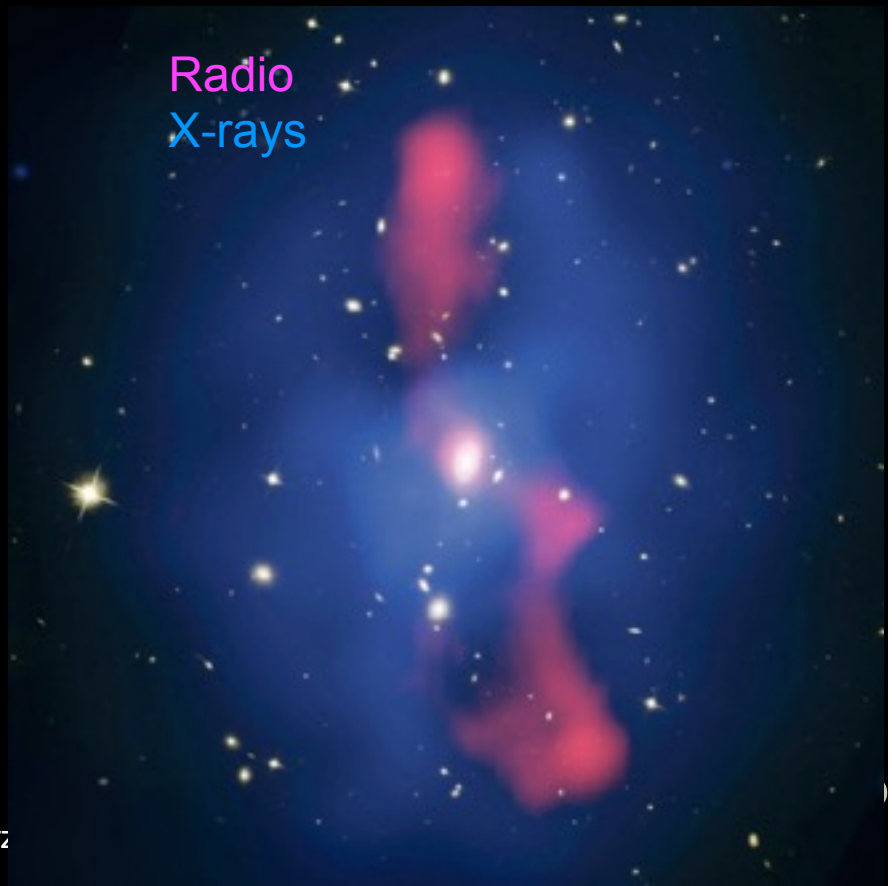
Only Bright Central Galaxies with low inner entropy (cold accretion) have active nuclei and are actively forming stars:

A delicate feedback mechanism:

AGN input energy regulates the gas entropy and, in turn, further gas accretion and SF (stars can form from low entropy, cold and dense gas only).



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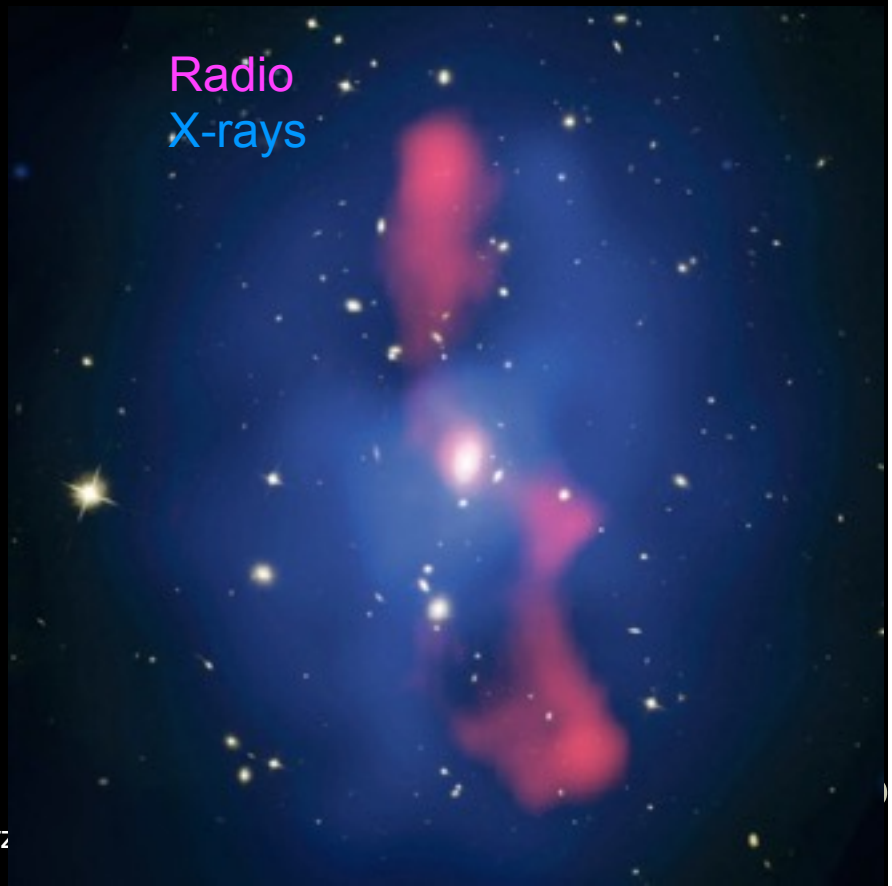
Today studies limited to local Universe
AGN fraction <1%

Push feedback studies up to the golden epoch of AGN/galaxy evolution (z=1-3, AGN fraction 10-30%)
And up to the epoch of formation of first galaxies and BH (z=6-10)

ALMA, JVLA, SKA, Athena



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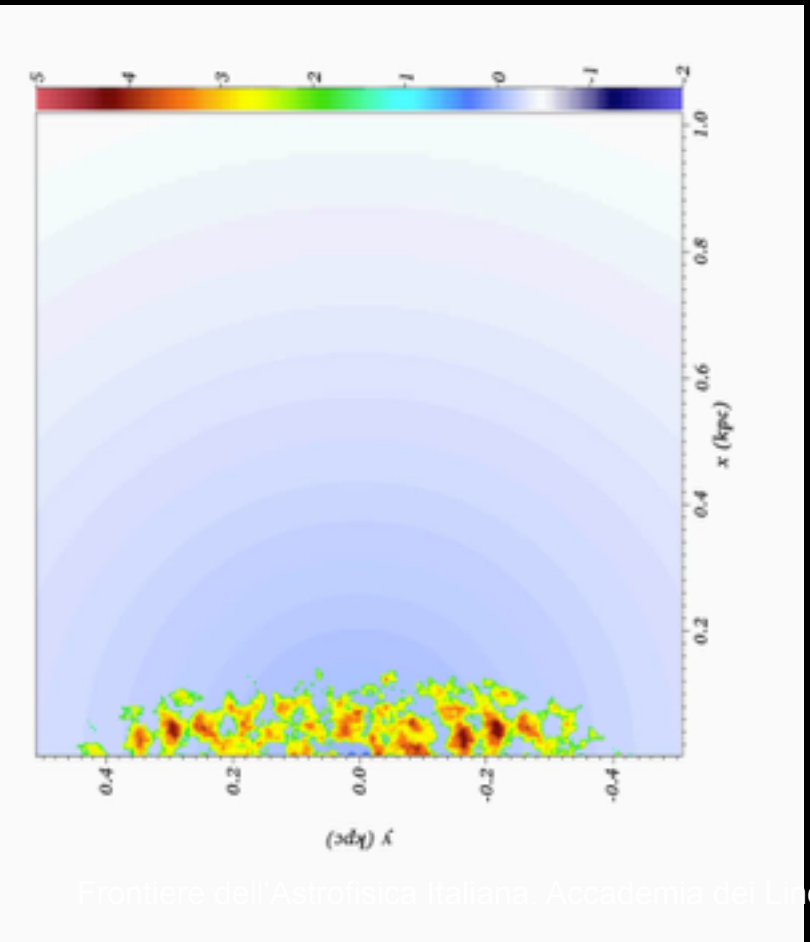
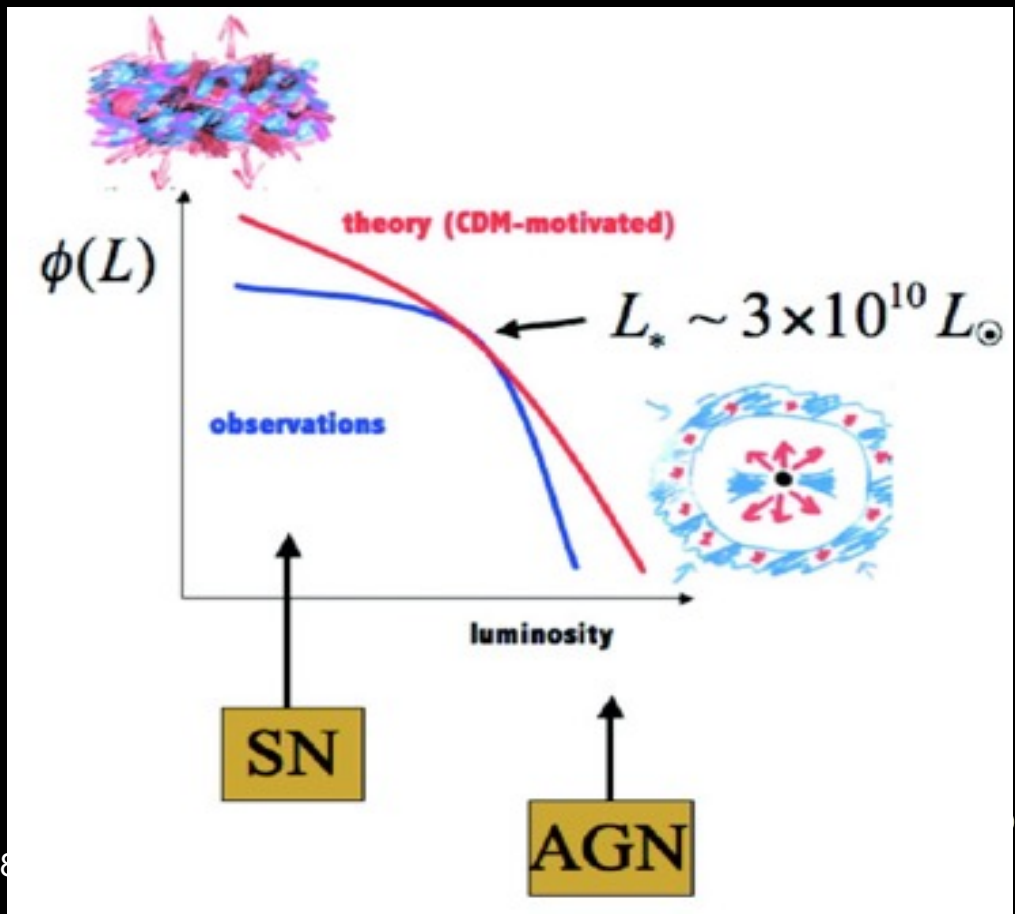
AGN feedback may be ***ubiquitous*** (winds, in addition to jets, seen in ionized, atomic, molecular gas). A solution for a major problem in galaxy evolution?

Why galaxy formation is so inefficient?





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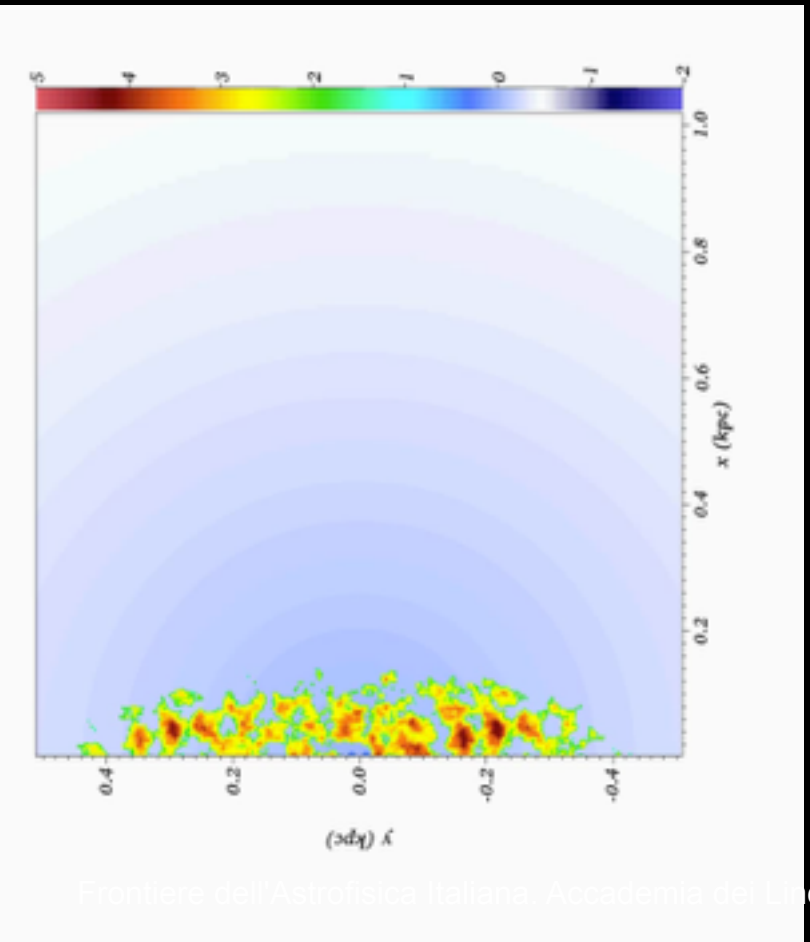

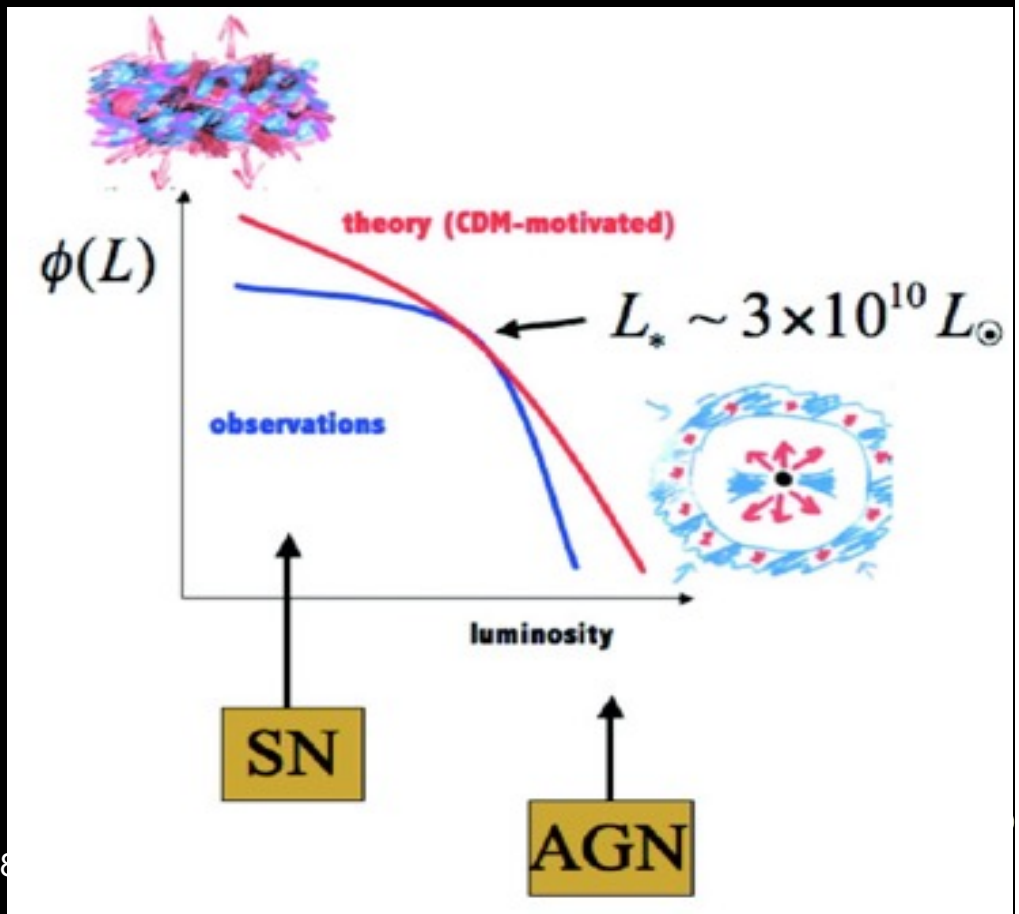

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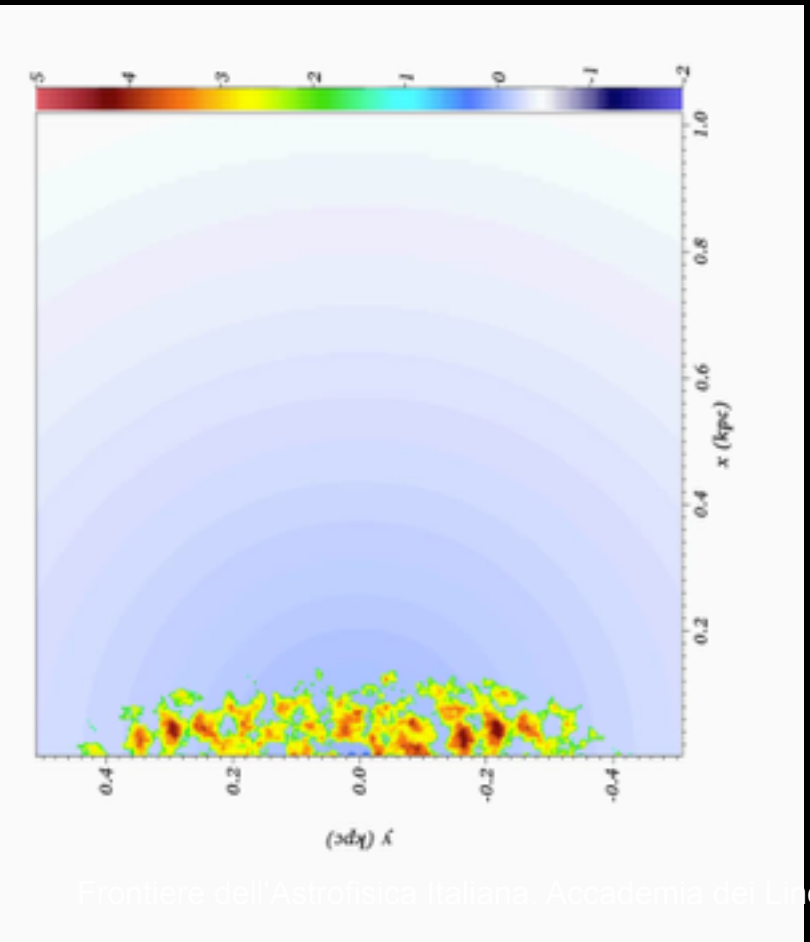

Why galaxy formation is so inefficient?

Sistematic study of wind interactions with galaxy ISM and ISM modifications

High spatial resolution (50-100 mas) spectroscopy (tens of pc for local galaxies for detailed studies, hundred pc for z=1-2 galaxies)

Ionized gas:

IFUs today VLT, LBT, tomorrow E-ELT

Molecular gas:

ALMA

Atomic gas

SKA and precursors

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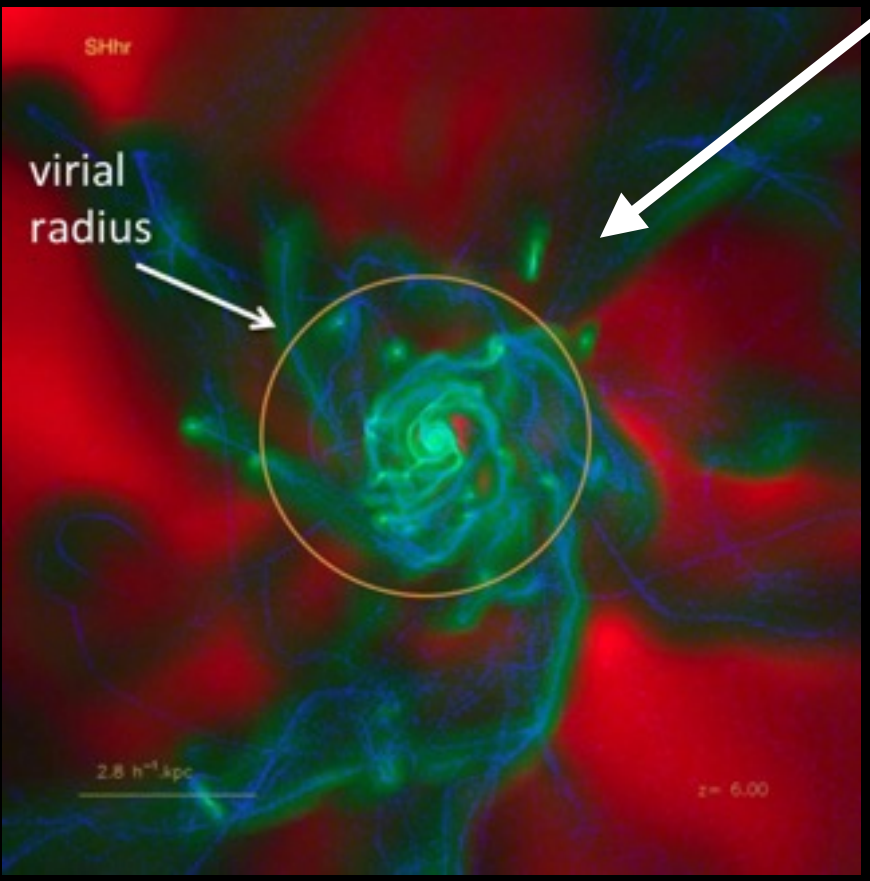
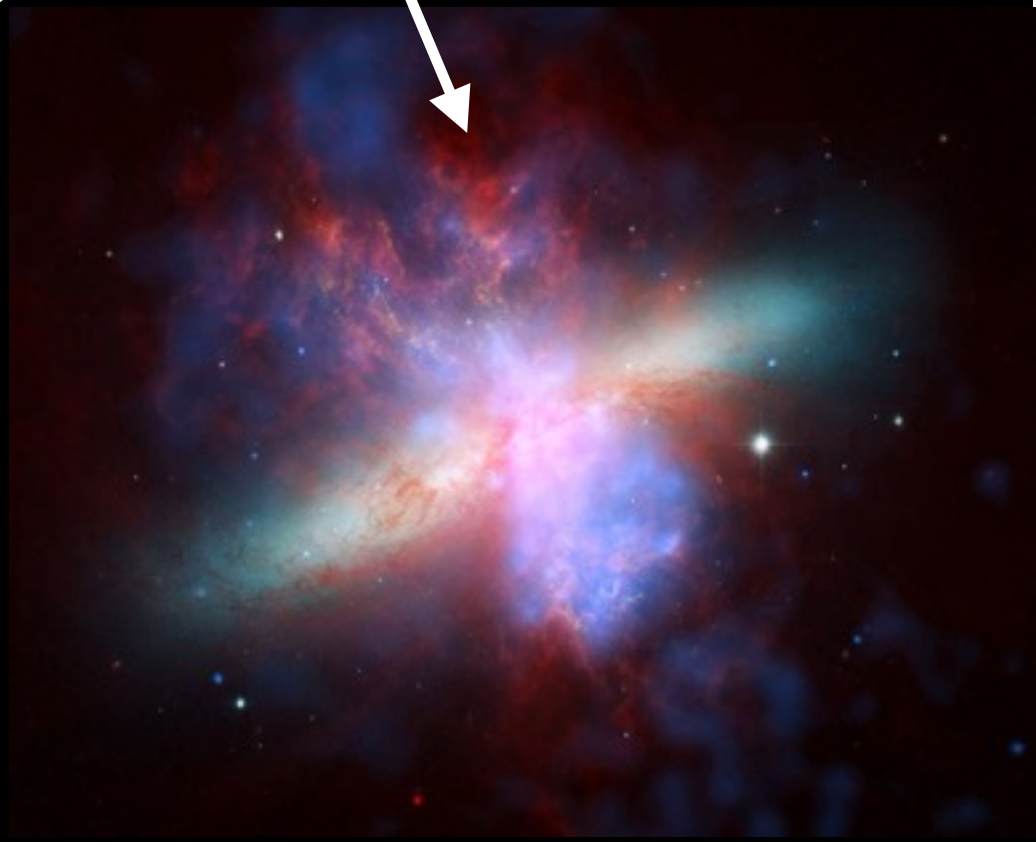
The baryonic life cycle of galaxies: inflows, galactic winds, metal enrichment





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Grandi infrastrutture di riferimento:

- Chandra/XMM, HST, VLT, ALMA,
- JWST,
- Athena, E-ELT, SKA

Comunita' di riferimento:

- Molto vasta e autorevole: principalmente Trieste, Milano, Padova, Bologna, Firenze, Pisa, Roma. Include sia senior staff che young Post-Docs. >50 FTE (esempio: 163 Italiani nei WG scientifici di Athena)
- Attiva sia su osservazioni multibanda (da X-ray a radio) che su modelli (numerici e semianalitici)
- Diverse posizioni di responsabilita' (CoPI Athena/XIFU, PI ELT/HIRES, 2 ECB members, 3 Chairs di SWG Athena, Chair LBT board, etc.). Commisurate alla forza della comunita'?

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Problematiche:

- Mantenere e rinnovare la comunita' attiva e forte nella preparazione per Athena.
  - Spettroscopia ad alta risoluzione, IFU, survey speed.
  - Chandra/XMM oggi, Astro-H/eRosita domani
- Mantenere e rinnovare la comunita' attiva e forte nella preparazione per E-ELT
  - Spettroscopia spazialmente risolta (HARMONY, MOS/HIRES)
  - LBT (LUCI, LBTI, AO NIR/ottico), VLT (VIMOS/KMOS) oggi, ESPRESSO/MOONS/ERIS in 5 anni).
- Scarso accesso ad ALMA e a strumentazione SZ (Olimpo?). Come migliorare?
- Accesso ai precursori di SKA, incluso JVLA, in preparazione a SKA1
- Sviluppo dei modelli numerici (vedi Discussione Cosmologia)

FRONTIERE DELL'ASTROFISICA ITALIANA:

come ottimizzare il ritorno scientifico dalle grandi infrastrutture internazionali

18 - 19 Marzo 2015

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