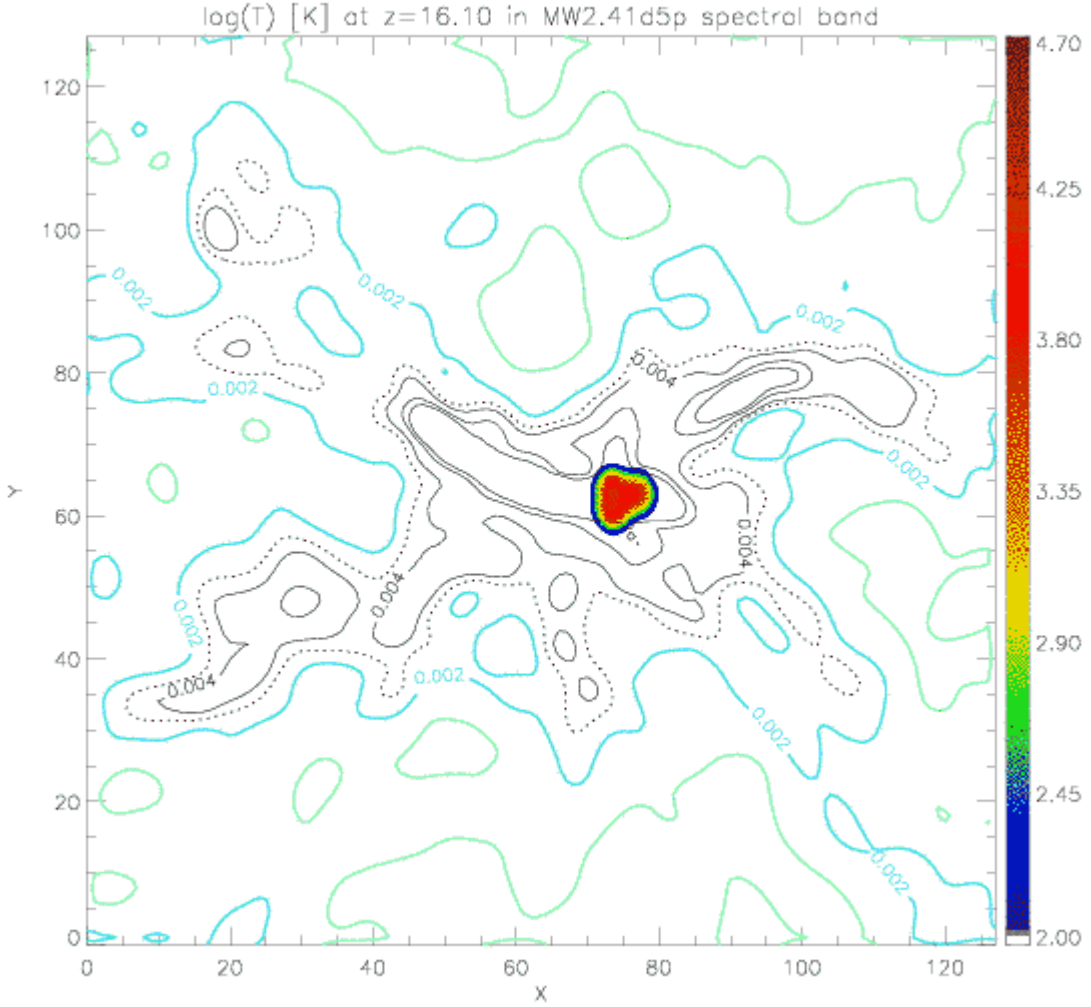

Galaxy formation with chemical and radiative feedback

Luca Graziani

- Local Universe Reionisation
- GAMESH

In collaboration with:

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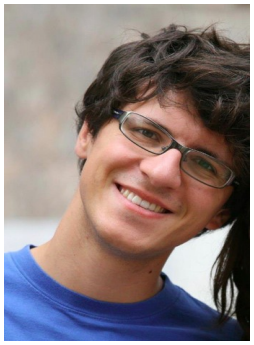
A. Maselli (EventLab, Spain)

Advanced Workshop on Cosmological Structures from Reionization to Galaxies: combining efforts from analytical and numerical methods, ICTP,Trieste 12-15 May 2015

The FIRST team and collaborators



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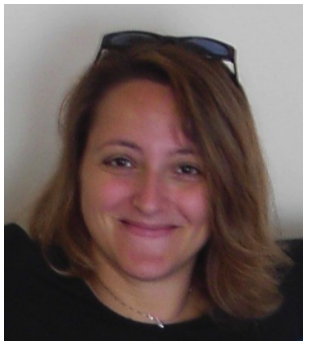

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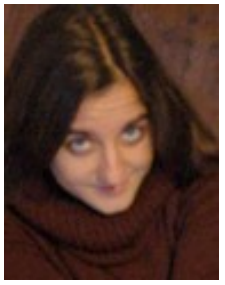

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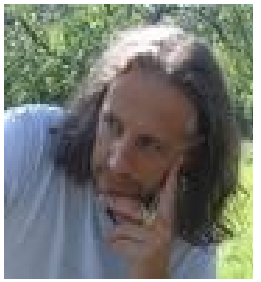

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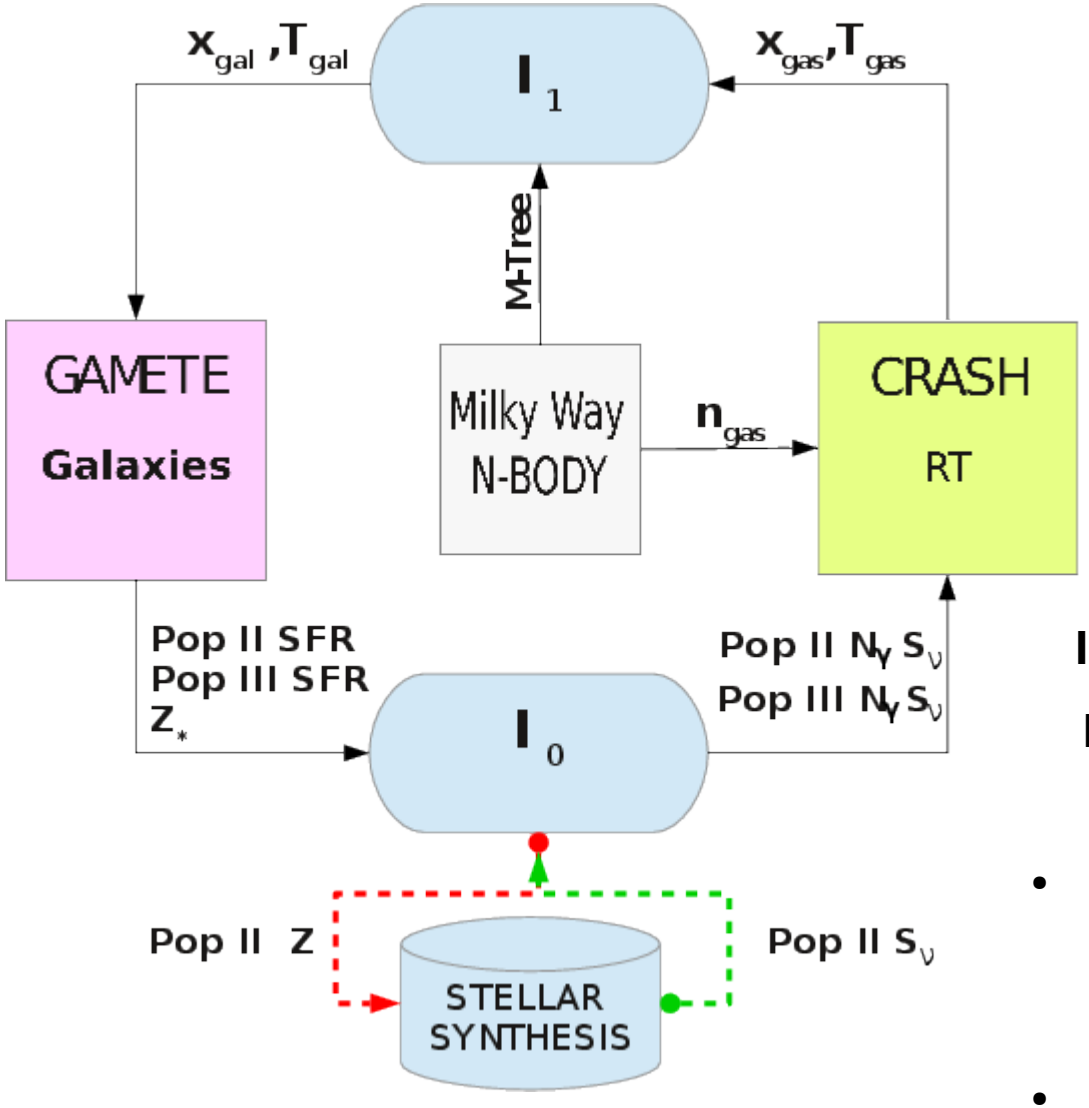
GAMESH = GAMETE + CRASH + Nbody simulation of Milky Way galaxy formation



N-body simulation: dynamical evolution of DM halos

GAMETE simulation: Star formation, metal production

CRASH simulation: RT, gas ionisation heating

I_0 : GAMETE galaxies → CRASH sources

I_1 : gas T, ionisation → Star forming halos

- **GAMESH can follow both mergers and spatial evolution of structures**
- **GAMESH implements self-consistent Radiative and chemical feedback**

GAMESH radiative feedback model

- **GAMESH compares T_{vir} of each halo with T_{gas} of the environment from which cold gas can feed star formation.**

  $T_{gas} < T_{vir}$ → star formation allowed in the halo.

- **T_{gas} must be defined depending on the spatial extension of the halo environment.**

- **If $R_{vir} > 0.1$ dx/2 → cells surrounding the halo cell can feed gas**

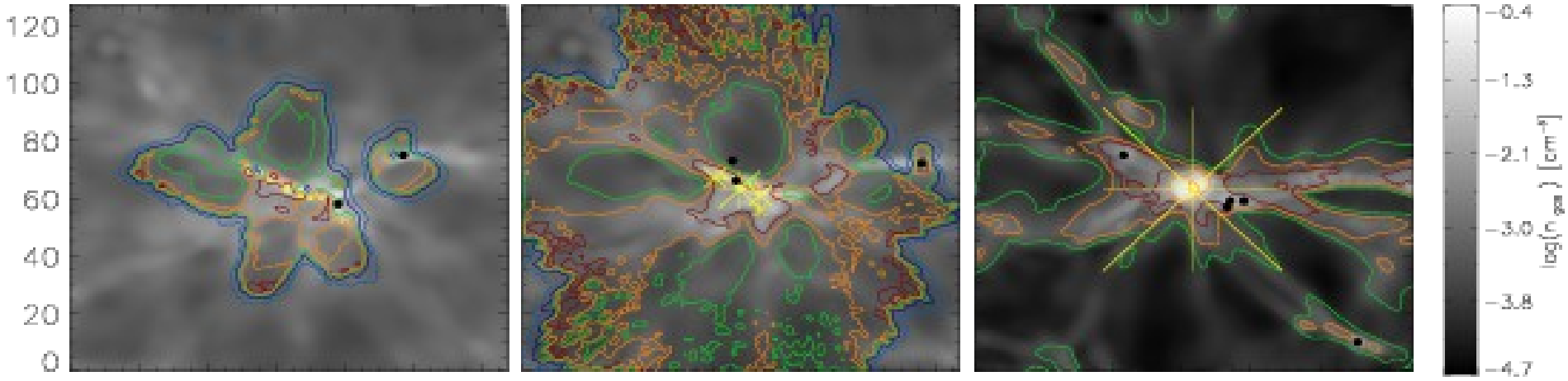
  →

  T_{gas} is the volume average over cells. (EXTERNAL FEEDBACK)

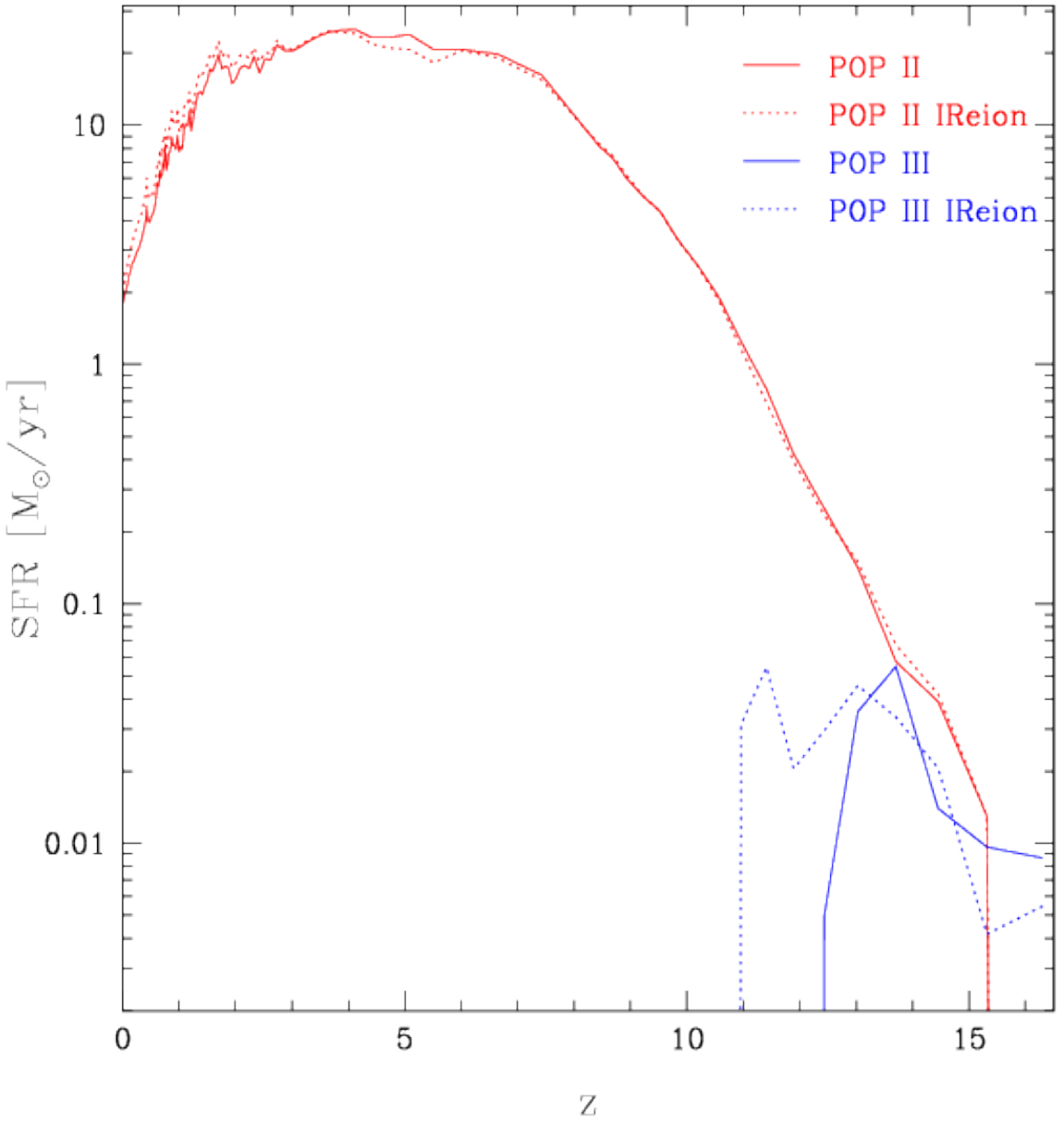
- **If $R_{vir} <= 0.1$ dx/2 → only the halo cell can feed gas**

  →

  T_{gas} is the temperature of the halo cell. (LOCAL FEEDBACK)



GAMESH Results: Pop III SFR, Pop II SFR



Pop II SFR: insensitive to reionisation model.

Pop III SFR: very sensitive to reionisation model.

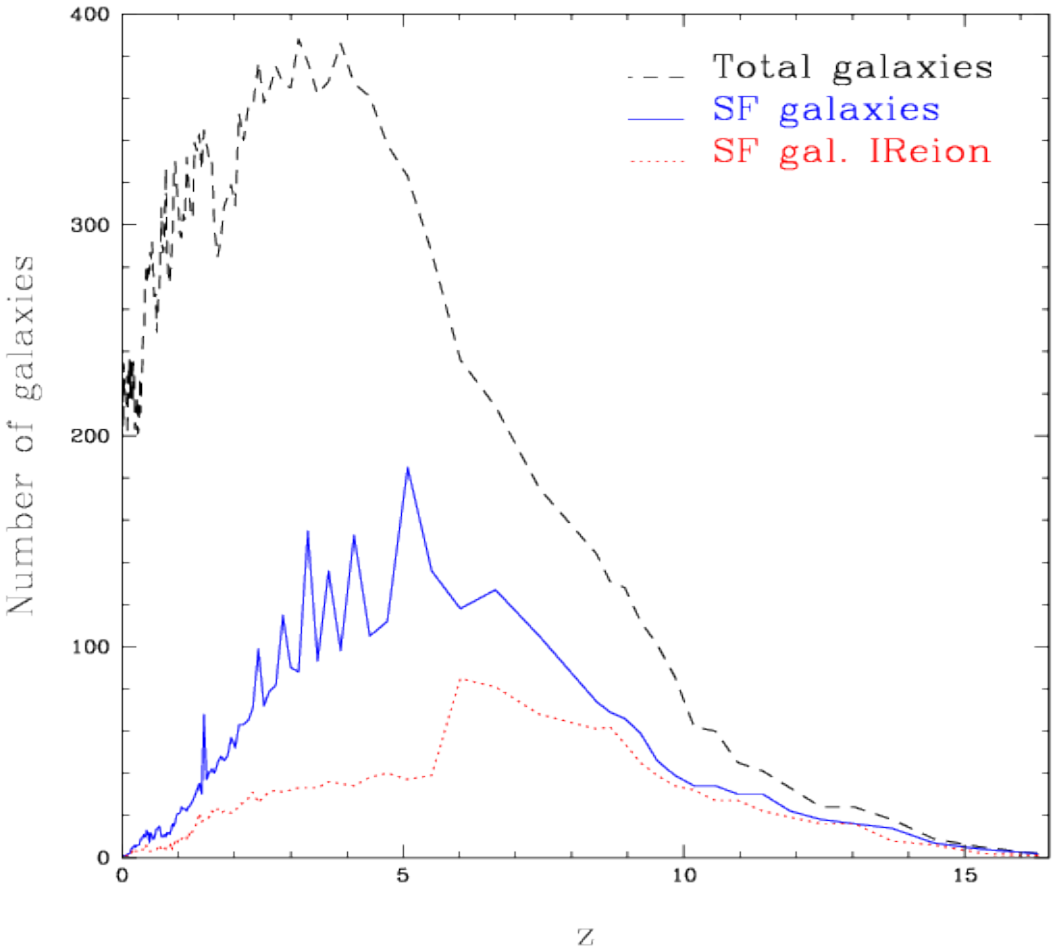
Both IReion and GAMESH provide values at z=0 in agreeemnt with observed SFR at z=0.

Pop III → Pop II: sensitive to the Radiative feedback model and the interplay with chemical feedback.

Pop III bubbles remain isolated in space →

Local feedack at high-z

GAMESH Results: Radiative Feedback stats

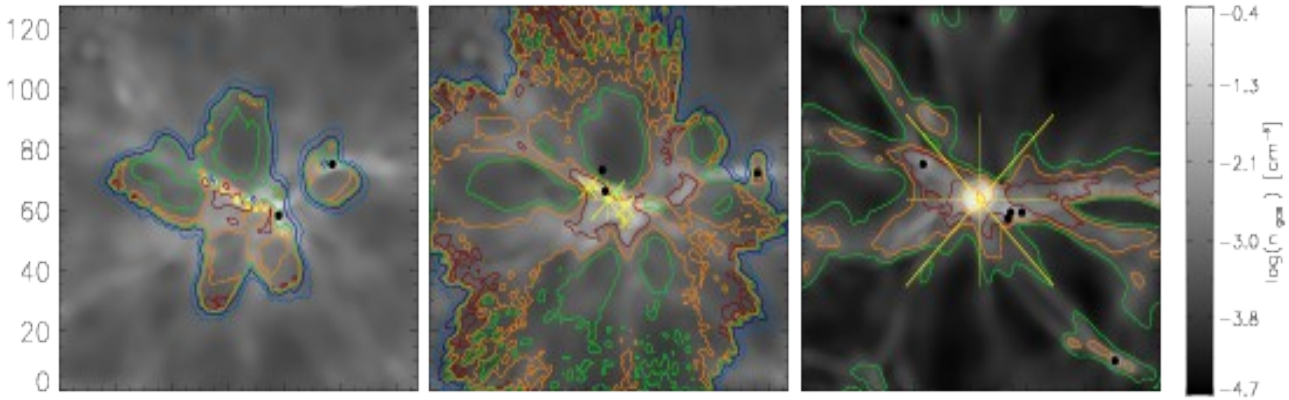


Radiative Feedback stats:
sensitive to reionisation model.

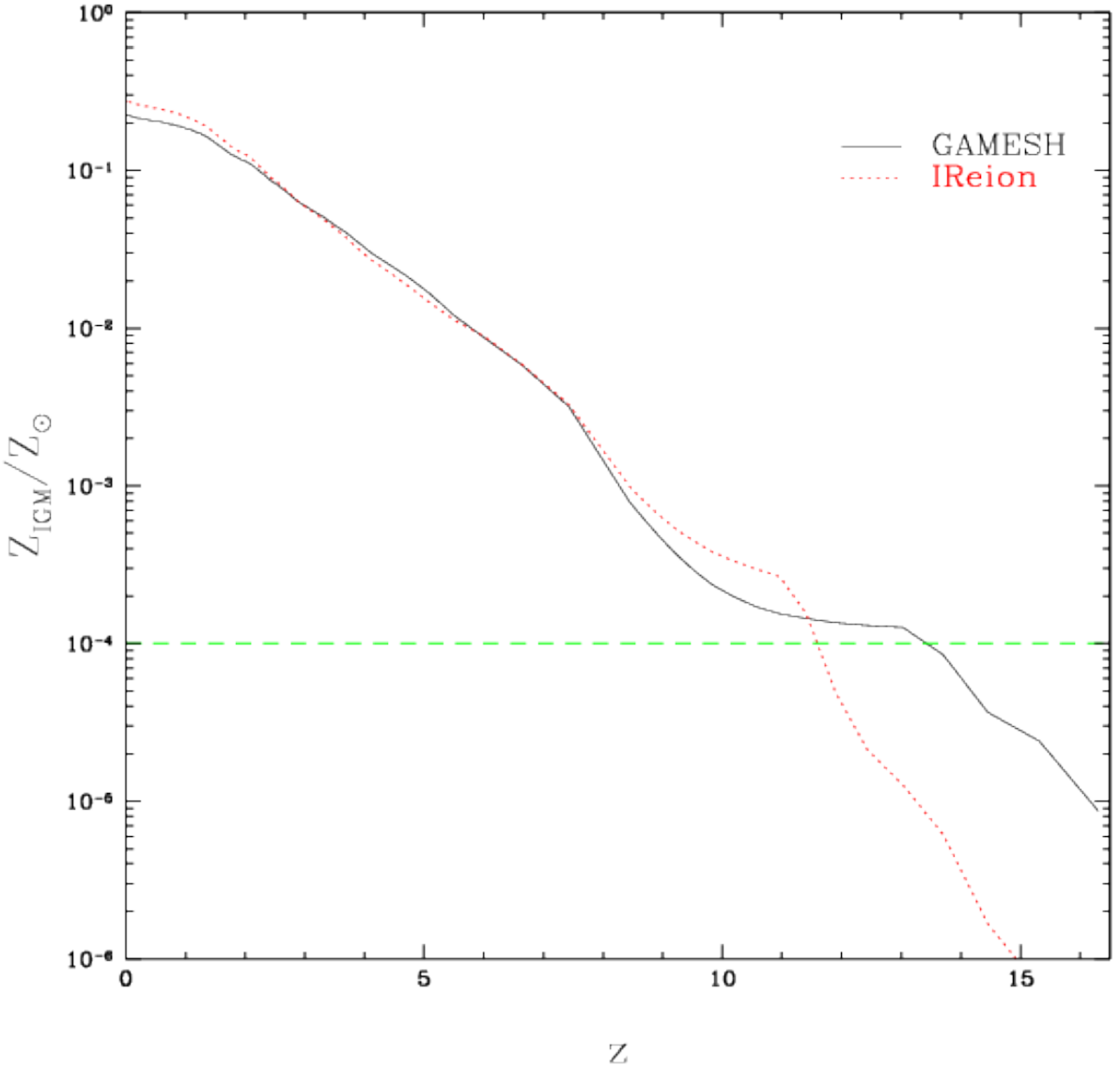
Radiative Feedback stats:
not reflected in SFR both at high and low z.

Radiative Feedback stats affected by inhomogeneities

Radiative Feedback is working quite well even in low spatial resolution grids.



GAMESH Results: interplay with chemical feedback



IGM metallicity sensitive to reionisation model.

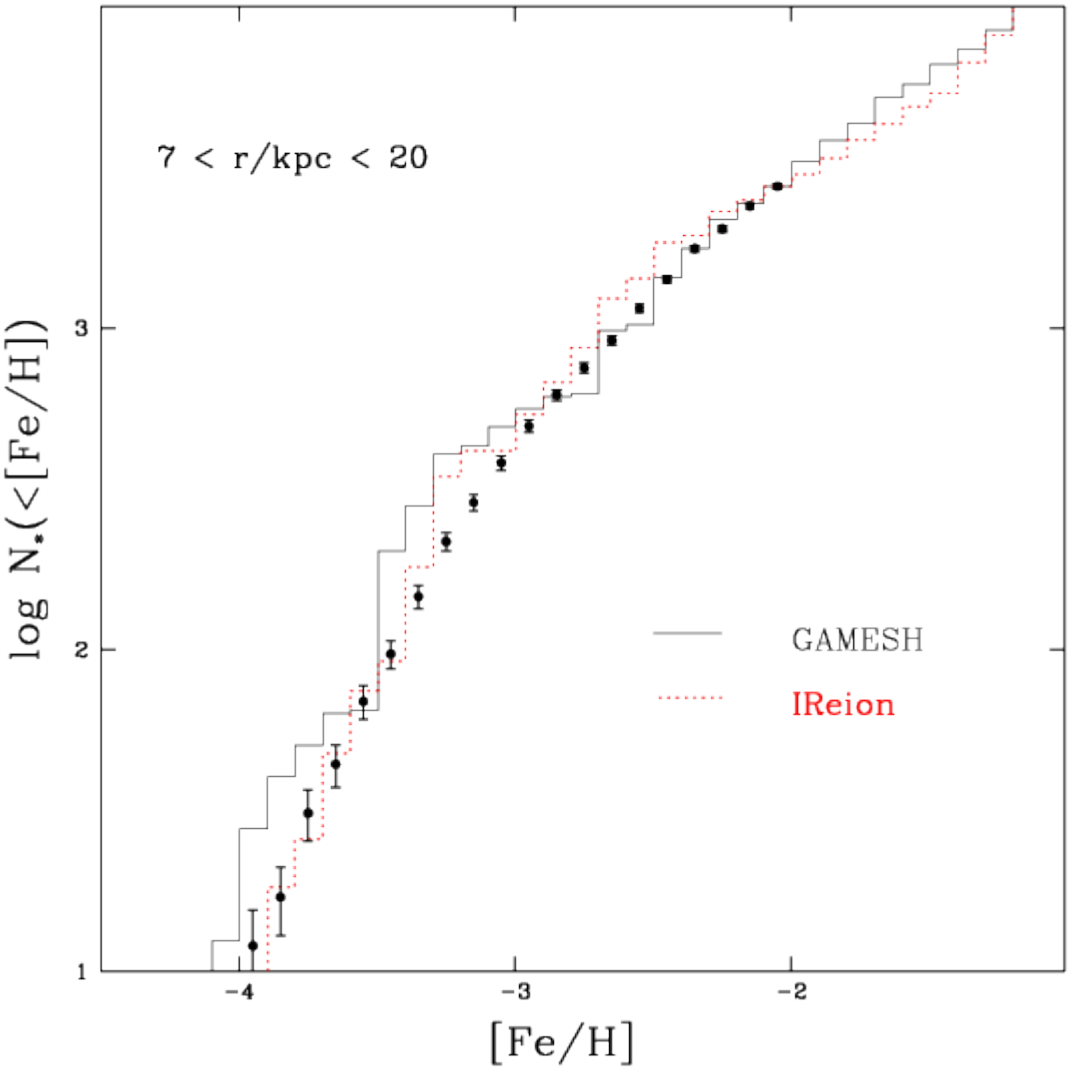
Evidence of Interplay between radiative and chemical feedback.

High-z enrichment needs corrections.

Improve mass resolution N-body

Improve enrichment model

GAMESH Results: interplay with chemical feedback - MW MDF



IGM metallicity sensitive to reionisation model.

Evidence of Interplay between radiative and chemical feedback.

High-z enrichment needs corrections.

Decent MDF?!

Improve low metallicity tail MDF

GAMESH Conclusions

GAMESH is ready and working: first example of semi-analytic and numerical RT Coupling. Self-consistent!

GAMESH is providing interesting results on low-resolution N-body simulations.

Graziani et al., 2015, MNRAS, 449, 3, 3137-3148.

Self-consistent radiative and chemical evolution requires better metal enrichment modelling.

Better mass resolution simulations could be used to address the Missing Satellite problem!!

H_2-cooling halos require also better SF prescription and LW RT implementation.

A better GAMETE is in development → Better metal enrichment scheme

A better CRASH is in development → LW RT!!

A new GAMESH will be ready soon!