# Chemical enrichment of the ICM in a hierarchical merger model

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***Abstract***: In this poster we present a semi-analytic model to follow the formation, the evolution and chemical enrichment of cluster galaxies and the intra-cluster gas in a hierarchical dark matter model.

## *High resolution cluster simulation*:

We use collisionless simulations of clusters of galaxies generated using the technique of "zooming-in" (Tormen et al., 1997).
A suite of cluster simulations covering a wide range of masses and structural properties has been carried out by Barbara Lanzoni as part of her Ph.D. thesis (Lanzoni et al., 2002).

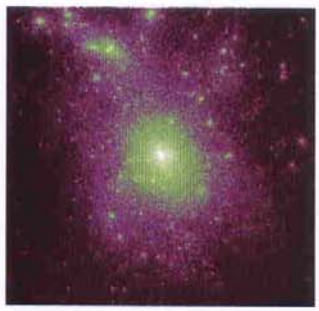

**Figure 1**: *density map for a simulation of a cluster with mass ~$10^{15}$ $M_\odot$. Note the large number of substructures that are clearly shown in the figure.*

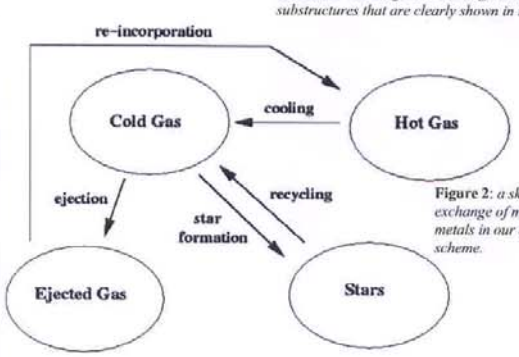


**Figure 2**: *a sketch of the exchange of mass and metals in our ejection scheme.*

***The model***: The model we use is based on the semi-analytic model presented by Springel et al. (2001) with new prescriptions for chemical enrichment and the transfer of mass and metals between different phases. The use of simple physical prescriptions for the transport of metals in the different phases and the choice of a few, physically motivated, parameters allow us to reproduce the relation between stellar mass and metallicity inferred from new SDSS data as well as the observed amount of metals in the ICM.

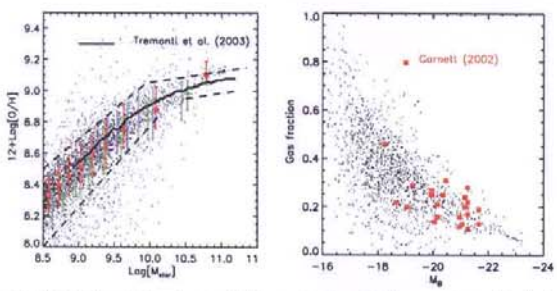


**Figure 3**: *Left panel: Gas phase metallicity as a function of stellar mass for model galaxies (points) compared with the results from a sample of ~20000 galaxies from the SDSS (Tremonti et al., 2003). Right panel: gas fraction as a function of the B-band luminosity compared with data from Garnett (2002).*

## *When and where the metals where ejected into the ICM*:

The chemical pollution of the ICM occurs at relatively high redshift.
Massive galaxies are important contributors to the chemical enrichment of the ICM: ~50 % of the metals today in the ICM were ejected by galaxies with mass larger than $10^{10}$ $M_\odot$.

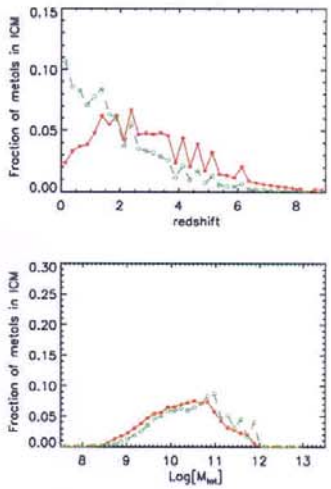


**Figure 4**: *fraction of metals today present in the ICM as a function of the redshift at which they were ejected into the intra-cluster-gas (panel a) and as a function of the total mass of the ejecting galaxies (panel b). Different colours are for models with different prescriptions for the feedback process.*

## *The metal budget of the cluster simulation*:

The good agreement between the model predictions and the observational results for cluster galaxies as well as the chemical content of the ICM suggests that the circulation of metals between the different baryonic components in the clusters is being well tracked.

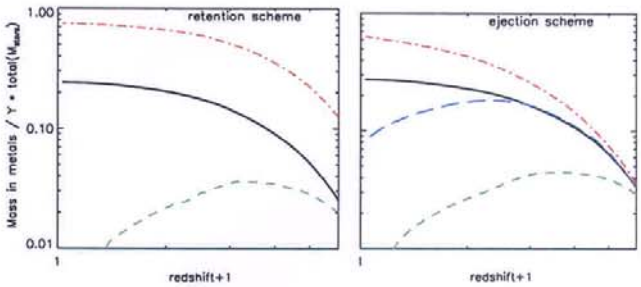


**Figure 5**: *Evolution of the metal content in different phases for two different models. Only galaxies in the cluster are considered. In the left panel we assume that the material reheated by SN explosions goes back to the hot component and can later cool to further enrich the cold gas. In the ejection scheme we assume that the reheated gas is ejected outside the halo and can be later re-incorporated on a time scale which is given by the dynamical time scale of the halo. The black solid line represents the metal content of stars, the red dash-dotted line represents the metal content of the hot component, the green dashed line represents the metal content in the cold gas and the blue long-dashed line represents the metal content in the ejected component. The mass of metals is normalised to the total mass of metals produced.*

***Future prospects***: in future we plan a detailed comparison between model predictions and observational data for cluster galaxies over a large fraction of the cosmic time. Such a comparison will allow to obtain important constraints on physical mechanisms related to galaxy formation and evolution.

**References:**

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