Comparing Semi-Analytical and Numerical Modelling of the ICM Chemical Enrichment

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The dependence of iron abundance on cluster temperature is subject to continuous debate. There are some evidences of decreasing abundances from ∼0.7 to ∼0.3 times the solar metallicity in the temperature range of $\sim 3 - 10$ keV [1], while a roughly constant value of ∼0.3 times solar is claimed [2]. Physical interpretation of these ambiguous observational results calls for robust theoretical models that can predict systematic trends for the enrichment of clusters of different masses.

We use both semi-analytical and numerical modelling to investigate the relationship between metal enrichment of the intracluster/intragroup medium and the mass of the system. On one hand, the hybrid model combines a cosmological non-radiative N-Body/SPH simulation of a galaxy cluster (code GADGET, [3]) and a semi-analytic model of galaxy formation [4]; metals ejected from the galaxies of the semi-analytic model are distributed among gas particles in the underlying hydrodynamic simulation. On the other, the metal pollution of the intracluster gas has been implemented self-consistently in a N-Body/SPH simulation of a galaxy cluster [5], which uses a recent version of GADGET [6]. The comparison between these two numerical techniques will help to improve the modellization of the physical processes involved in galaxy formation and the consequent metal enrichment of the intracluster/intragroup gas.

The chemical model implemented in both models considers the contribution of different chemical elements provided by low- and intermediate-mass stars and core-collapse and type Ia supernovae, for which we have used analytical fitting formulas [7]. We adopt a Salpeter IMF and relax the IRA approximation by taking into account the different stellar lifetimes [8].

We present preliminary results on the spatial distribution of different chemical element abundances in the intracluster medium of a massive cluster provided by our models. They give similar Fe profiles, as shown in Figure 1. However, O and Si abundances given by the self-consistent code are lower than those obtained from the hybrid one. Thus, differences between these two models become evident in the results obtained for those species mainly produced by core-collapse supernovae. The impact of star formation and supernovae feedback prescriptions included in both numerical techniques will

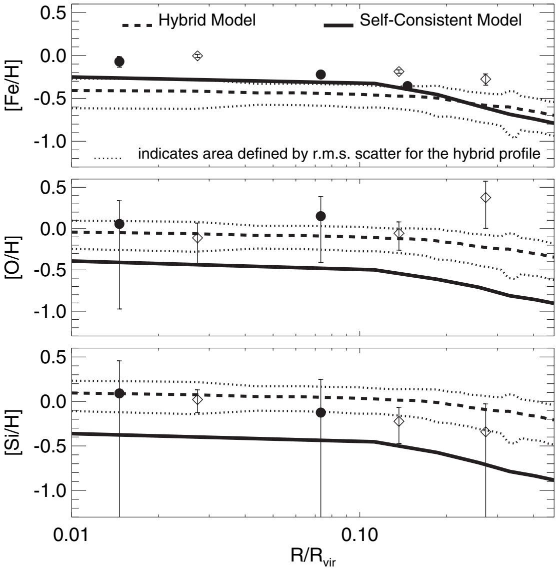

Fig. 1. Abundance profiles of Fe, O and Si relative to H, respect to the solar value [9] for the self-consistent simulation (solid line) and the hybrid model (dashed line). Symbols with error bars are observational data [10] for hot clusters ($k_{\mathrm{B}}T > 6\,\mathrm{keV}$, filled circles) and medium-temperature clusters ($3 < k_{\mathrm{B}}T < 6\,\mathrm{keV}$, open diamonds).

be analysed in detail to find out about the origin of these differences. We will extend this analysis in order to understand the developement of abundance patterns in a set of clusters with different temperatures.

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