Chemical Evolution of the Stellar and Gaseous Components of Galaxies in Hydrodynamical Cosmological Simulations

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**Abstract.** We present preliminary results on the effects of mergers on the chemical properties of galactic objects in hierarchical clustering scenarios. We adopt a hydrodynamical chemical code that allows to describe the coupled evolution of dark matter and baryons within a cosmological context. We found that disk-like and spheroid-like objects have distinctive metallicity patterns that may be the result of different evolution.

The implementation of a chemical model in a cosmological code provides a useful tool for the study of the chemical properties of galaxies in relation to their formation and evolution in a cosmological framework. We performed numerical simulations with the hydrodynamical AP3MSPH code that includes star formation (SF) and metal enrichment from nucleosynthesis ejecta of supernovae type I and type II (Mosconi et al. 2000). This code allows the description of the star formation and chemical history of the gas and stars of galactic objects in hierarchical clustering scenarios where mergers and interactions play a crucial role in regulating SF.

The chemical content of the stellar population and the interstellar medium (ISM) of the identified galaxy-like objects (GLOs) at $z = 0$ is determined by the way in which the SF proceeds in the different clumps that assemble to form the final object. We found GLOs at $z = 0$ that have stellar components with mean age metallicity relations and abundance distribution functions, such as the relation between $[\text{O/Fe}]$ and $[\text{Fe/H}]$, that reproduce fairly well the observed patterns for the Milky-Way.

The chemical abundances in the ISM in gas-rich galaxies allow to trace the evolution of individual galaxies. The steep negative abundance gradients of the gaseous component found for the GLOs are within the expected values for the oxygen and nitrogen, as result from the comparison with HII regions and early B-type main sequence objects. We found that spheroid-like objects have slopes less pronounced than those GLOs where the gas forms a well-defined disk, indicating very different histories of formation and evolution where the mergers
Figure 1. (a) Mean oxygen gas abundances as a function of the mass fraction for a typical GLO in one of the simulations at six different redshifts. (b) SFR for the same GLO. The merger event is pointed out.

have a significant role. In order to understand the way in which mergers affect the chemical abundances in the ISM, we followed the chemical evolution of the gaseous component in a typical GLO in one of the simulations during its main merger event. Figure 1a shows the evolution with redshift of the gas mean oxygen abundances as a function of the mass-fraction in concentric shells, while in figure 1b we have the SF rate of this GLO with the merger event clearly pointed out. The metallicity profile is steep before the merger. As the companion approaches, it raises up because of the enhancement of chemical production at the central regions, produced by the tidally induced starburst (Tissera 2000). The final profile is flatter than the original one, reflecting the fact that gas particles of different metallicities have been well-mixed during the merger. A detailed study of the effects of mergers on the matter distribution is on preparation (Cora et al. 2001).

To sum up, in our simulations, GLOs have different evolutionary histories in consistency with a hierarchical clustering scenario that affect their SF rates and chemical evolution. This chemical model can take all these physical processes into account, resulting in a powerful tool for studying galaxy formation.

References

Cora et al. 2001, in preparation
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Tissera, P. B. 2000, ApJ, 534, 636