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EFFECTS OF CHEMICAL AND ENERGY FEEDBACK IN THE FORMATION OF GALAXIES

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We study the effects of Supernova feedback in the evolution of galaxies by using a newly developed model for chemical enrichment and energy feedback within the code GADGET-2. Our model suceeds in producing a self-regulated cycle for star formation and in triggering strong outflows of enriched material which contaminate the outer regions of galaxies. This result could in principle explain the presence of metals observed in the intergalactic medium. One of the main advantages of this model over early approaches is that it has been developed without introducing scale or resolution dependent paramaters which might depend on the virial mass of galaxies, becoming an important tool to study cosmological structure formation.

Supernova (SN) explosions are thought to play a fundamental role in the evolution of galaxies. Supernovae originate at the end of life of massive stars, ejecting metals and energy into their surroundings. These processes are thought to be responsible for setting a self-regulated process for star formation, and for triggering important galactic outflows which transport enriched material into the intergalactic medium (e.g., Lehnert & Heckman 1996).

Numerical simulations are a powerful tool to study galaxy formation since they can account for a consistent treatment of gravity and hydrodynamics in a cosmological context. However, the implementation of SN feedback models within galaxy formation simulations have remained problematic.

We have developed a new model for chemical enrichment and energy feedback by SN (Scannapieco et al. 2005, 2006), within the code GADGET-2 (Springel 2005). Our model is tight to a multiphase treatment for the gas component, and considers metal-dependent radiative cooling.

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One of the main advantages of the model is that no scale or resolution dependent parameter is included, and hence it is well suited for the study of structure formation in a cosmological context. We have analised simulations of disc-type galaxies, both isolated and in their correct cosmological setting, finding the following results:

- Our treatment of SN feedback helps to set a self-regulated mechanism for star formation, through its capability to generate and mantain a well-defined hot phase and to produce important outflows of gas. Smaller mass systems such as dwarf galaxies are found to be more strongly affected by SN feedback, as expected. Whereas the star formation histories of the largest galaxies are found to be reduced at most by moderate factors of up to a few, in smaller systems the effects are much larger, lowering the star formation activity by an order of magnitude, and giving the star formation an episodic, bursty character. This is consistent with recent observational results (e.g. Kauffmann et al. 2003), and with theoretical considerations (e.g. Larson 1976).

- As a result of the heating up of cold gas owing to SN explosions, strong outflows are generated after starburt episodes. These outflows are found to be mostly perpendicular to the disc plane, and to transport an important fraction of gas and metals into the outer regions of galaxies. These findings suggest that SN feedback could indeed contribute to the contamination of the intergalactic medium.

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