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The Structure and Kinematics of the ISM in Simulated Star-forming Galaxies

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Abstract. We performed 3D N-body/hydrodynamic simulations of local and high-z ($z \sim 2$) star-forming galaxies (SFGs) to investigate the structure and kinematic properties of the different ISM phases (i.e., ionized, atomic, and molecular gases). We took into account, for the first time, a fully non-equilibrium radiative cooling by solving the non-equilibrium chemistries of atoms (H, He, C and O) and molecules (H_2 and CO), as well as radiative heating, star formation, heating by H_{II} region and supernova explosions.

1. Background and Results

The thermal and kinematic properties of the ISM are crucially important to understand the evolution of galaxies. Although there are some theoretical studies on the ISM properties in local and high-z SFGs, there is no theoretical study on the kinematics of "the different ISM phases". In order to investigate the detailed properties of the ISM in local/high-z SFGs, it is required that the non-equilibrium chemical network and associated cooling/heating processes should be taken into account in galactic-scale hydrodynamic simulations.

We used the N-body/SPH code `ASURA-2` (Saitoh & Makino 2010) and solved the hydrodynamics and stellar dynamics of both MW-like ($f_{gas} = 10\%$) and High-z ($f_{gas} = 50\%$ suggested by e.g., Tacconi *et al.* 2010) SFG models by taken into account "non-equilibrium chemistry" and heating/cooling processes simultaneously. The High-z SFG model succeeded to reproduce the clumpy stellar distribution, as well as giant H_{II} regions, observed in high-z SFGs (e.g., Forster Schreiber *et al.* 2009). This model predicts that molecular gas associates with massive star clumps and distributes in a thin layer ($\sim$5 pc) as same as MW galaxy. The velocity dispersion of the ionized gas correlates with the star formation rates, but it is much smaller than observed values in high-z SFGs (e.g., Forster Schreiber *et al.* 2009). This suggests that other energy sources are required to drive the large velocity dispersion of the ionized gas in high-z SFGs.

References

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