Inhomogeneous enrichment in chemodynamical simulations of galaxies

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Heavy elements are synthesized in stars and ejected at their deaths into interstellar medium [1]. The next generation of stars forms from gas clouds that include heavy elements from the previous generations. This chemical enrichment process takes place inhomogeneously, and therefore it is necessary to use hydrodynamical simulations including star formation and chemical enrichment (chemodynamical simulations) for galactic archaeology. I show that the variation of elemental abundances caused by i) migration, ii) minor mergers, and iii) in-situ star formation with my chemodynamical simulations of Milky Way Galaxy [2].

At earlier stages of galaxy formation, the inhomogeneous enrichment becomes more important. The low [alpha/Fe] ratios of extremely metal-poor stars can be explained with the mass dependence of normal supernovae [3]. However, the carbon enhancement requires additional physics. The observed elemental abundance patterns of five most metal-poor stars ([Fe/H] <-4.5) can be well reproduced not with pair-instability supernovae but with faint supernovae [4]. Where are massive stars with >140Msun?

Finally, I show that the origin of the seed black holes is the death of Population III stars. In cosmological simulations with feedback from active galactic nuclei, with the seed mass of ~100-1000Msun, we successfully reproduce the cosmic star formation rate history, black hole mass-galaxy mass relation, and the size-mass relation of galaxies [5].

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