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# THE ABUNDANCE OF GALAXIES AND DARK MATTER HALOS IN THE ΛCDM UNIVERSE

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**Using a N-body/gas-dynamical cosmological simulation of the Local Group of galaxies we identify a new mechanism that allows to remove baryons from low-mass halos without appealing to feedback or reionization.**

The Λ Cold Dark Matter cosmological model is the current paradigm for structure formation in the Universe. A long-standing puzzle of this model relates to the striking difference between the shape of galaxy stellar mass function observed and the halo mass function predicted by the model. At the low mass end, on dwarf scales, there are much less observed galaxies than predicted halos massive enough to host them. This result suggests a complex non-linear relation between the stellar mass of a galaxy and that of its surrounding dark matter halo. This is usually reconciled by appealing to baryonic processes that drastically reduce the efficiency of galaxy formation in low-mass halos. Recent models, particularly those that apply the abundance matching technique, require that virtually no dwarf galaxies form in halos with virial mass below $10^{10} M_{\odot}$. We use rotation curves of 221 dwarf galaxies compiled from the literature to explore whether their total enclosed mass is consistent with these constraints. We find that almost one-half of the dwarfs in our sample are at odds with this restriction: they live in halos with masses substantially below $10^{10} M_{\odot}$ (Ferrero et al. 2012). This result seems to present a challenge to the cosmological model ΛCDM and specifically to the abundance matching technique. We use a cosmological simulation of the formation of the Local Group of Galaxies to identify a mechanism that enables the removal of baryons from low-mass halos without appealing to feedback or reionization. This mechanism may help to explain the scarcity of dwarf galaxies compared with the numerous low-mass halos expected in ΛCDM and the large diversity of star formation histories and morphologies characteristic of faint galaxies. We find that some of the dwarf galaxies of the simulated Local Group environment move at high velocities relative to the neighboring large scale structure, the so-called cosmic-web. As these galaxies cross this filamentary structure, they feel a ram-pressure exerted by their gaseous content. Massive galaxies have a restoring gravitational force large enough to avoid gas depletion. However, dwarf galaxies can't retain their gas as they cross these pancake structures at high redshift $z \approx 2$ (Benítez Llambay et al. 2013).

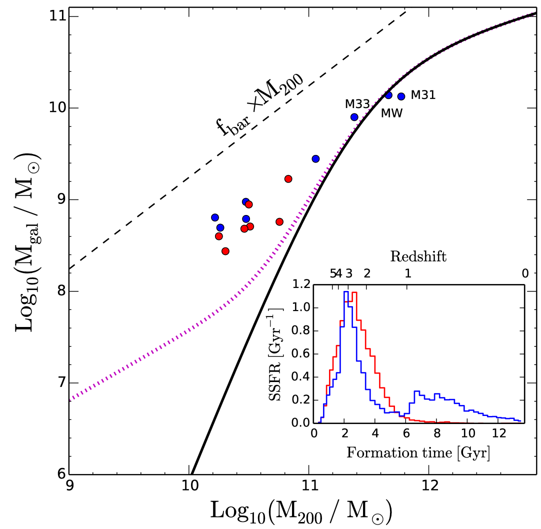


Fig. 1. Galaxy stellar mass as function of its halo virial mass. Black solid line indicates the Guo et al. (2010) abundance-matching model. Black dashed line indicates the halo baryonic mass according to the ΛCDM universal baryon fraction. Magenta dotted curve shows the average galaxy mass-halo mass relation derived from dwarf galaxies in our sample (Ferrero et al. 2012). Blue (red) filled circles, and histograms in the bottom right panel, show galaxies that have (not) retained their gas due to the cosmic-web stripping.

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