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Origin of HI in galaxies

There is observational evidence that the instantaneous HI content of galaxies is governed by (at least) two effects: recent accretion, and environment. Recent accretion, either smooth or via a merger, provides either an enhancement or decrease to the reservoir of HI depending on the properties of the merging galaxies, while galaxies in denser environments can have their HI attenuated through many processes such as stripping and starvation. We quantitatively examine how these effects operate using cosmological hydrodynamic simulations that include a heuristic galactic outflow model previously shown to reproduce basic observed trends of HI in galaxies. We show that this model surprisingly matches the observed scatter in HI at a given stellar mass, as quantified by the HI mass function in bins of stellar mass, though it appears the scatter in the models is somewhat less than observed. By tracking the history of HI in galaxies, we explicitly the correlation between recent mergers and the amount of HI, and show that the HI content is not much affected although it is shortly followed by an uptick in the stellar content. Turning to environment, we show that HI and stellar mass populate halos differently via their two-point correlation functions. HI in satellite galaxies in particular is strongly impacted by a hot halo environment, all the way down to halo masses of 1012 M below which ram pressure stripping is likely to be ineffective. This suggests that the HI content in satellites is predominantly determined by the ability to accrete gas from their surroundings, at least in these modestly- massive halos. We explicitly demonstrate this by tracking the HI history of galaxies as they fall into massive halos.