
The star formation quenching and transition epoch in Horizon-AGN galaxies

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Abstract

It's been discussed a long time how the internal or external effects of galaxies affect the star formation activity of galaxies. Although many studies have suggested which mechanisms could contribute to today's star formation rate of galaxies, we need to further investigate long-term effects throughout their total life, which is a challenge in observation.

Using a large-scale hydrodynamic cosmological simulation Horizon-AGN, which provides statistically sufficient samples of about a hundred thousand galaxies and hundreds of massive (greater than $1e13$ solar mass) dark matter halos, we examine the entire star formation histories of galaxies and evaluate their quenching timescale with their surrounding environments considered simultaneously.

We find that more massive galaxies have shorter star formation-quenching timescales than less massive galaxies regardless of their environment and the residing time in their host halos. On the other hand, low mass satellites in massive halos have significantly low quenching time scales, in which the timescales are shorter for satellites with longer time since infall to their host. This trend gets apparent for morphologically late-type galaxies.

The difference in quenching timescale of star formation histories naturally leads to the star formation transition epoch between cluster and field galaxies. We find that low mass galaxies in field environments were less star-forming than their counterparts in the cluster until about 8 Gyr ago. Whereas, these transition epochs for massive galaxies in a massive cluster or low mass galaxies in a low mass group go down to 6 Gyr ago. Meanwhile, galaxies with relatively high stellar mass for their host mass have no difference in star formation histories from field galaxies. Thus, there are no transition epochs for those galaxies.

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