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Enriched haloes at redshift $z=2$ with no star-formation: Implications for accretion and wind scenarios

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[Abridged] In order to understand which process (e.g. galactic winds, cold accretion) is responsible for the cool (T~10^4 K) halo gas around galaxies, we embarked on a program to study the star-formation properties of galaxies selected by their MgII absorption signature in quasar spectra. Specifically, we searched for the H-alpha line emission from galaxies near very strong z=2 MgII absorbers (with rest-frame equivalent width EW>2 \AA) because these could be the sign-posts of outflows or inflows. Surprisingly, we detect H-alpha from only 4 hosts out of 20 sight-lines (and 2 out of the 19 HI-selected sight-lines), despite reaching a star-formation rate (SFR) sensitivity limit of 2.9 M/yr (5-sigma) for a Chabrier initial mass function. This low success rate is in contrast with our z=1 survey where we detected 66%\ (14/21) of the MgII hosts. Taking into account the difference in sensitivity between the two surveys, we should have been able to detect >11.4 of the 20 z=2 hosts whereas we found only 4 galaxies. Interestingly, all the z=2 detected hosts have observed SFR greater than 9 M/yr, well above our sensitivity limit, while at z=1 they all have SFR less than 9 M/yr, an evolution that is in good agreement with the evolution of the SFR main sequence. Moreover, we show that the z=2 undetected hosts are not hidden under the quasar continuum after stacking our data and that they also cannot be outside our surveyed area. Hence, strong MgII absorbers could trace star-formation driven winds in low-mass halos (Mhalo < 10^{10.6} Msun). Alternatively, our results imply that z=2 galaxies traced by strong MgII absorbers do not form stars at a rate expected (3--10 M/yr) for their (halo or stellar) masses, supporting the existence of a transition in accretion efficiency at Mhalo ~ 10^{11} Msun. This scenario can explain both the detections and the non-detections.

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