

H α Equivalent Widths from the 3D-HST survey: evolution with redshift and dependence on stellar mass[†]

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Abstract. We investigate the evolution of the H α equivalent width, EW(H α), with redshift and its dependence on stellar mass, using the first data from the 3D-HST survey, a large spectroscopic Treasury program with the HST-WFC3. Combining our H α measurements of 854 galaxies at $0.8 < z < 1.5$ with those of ground based surveys at lower and higher redshift, we can consistently determine the evolution of the EW(H α) distribution from $z=0$ to $z=2.2$. We find that at all masses the characteristic EW(H α) is decreasing towards the present epoch, and that at each redshift the EW(H α) is lower for high-mass galaxies. We find $EW(H\alpha) \sim (1+z)^{1.8}$ with little mass dependence. Qualitatively, this measurement is a model-independent confirmation of the evolution of star forming galaxies with redshift. A quantitative conversion of EW(H α) to sSFR (specific star-formation rate) is model dependent, because of differential reddening corrections between the continuum and the Balmer lines. The observed EW(H α) can be reproduced with the characteristic evolutionary history for galaxies, whose star formation rises with cosmic time to $z \sim 2.5$ and then decreases to $z = 0$. This implies that EW(H α) rises to 400 Å at $z = 8$. The sSFR evolves faster than EW(H α), as the mass-to-light ratio also evolves with redshift. We find that the sSFR evolves as $(1+z)^{3.2}$, nearly independent of mass, consistent with previous reddening insensitive estimates. We confirm previous results that the observed slope of the sSFR- z relation is steeper than the one predicted by models, but models and observations agree in finding little mass dependence.

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