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Hα Equivalent Widths from the 3D-HST survey: evolution with redshift and dependence on stellar mass†

Mattia Fumagalli[1], Shannon G. Patel[1], Marijn Franx[1], Gabriel Brammer[2], Pieter van Dokkum[3], Elisabete da Cunha[5], Mariska Kriek[4], Britt Lundgren[3], Ivelina Momcheva [3], Hans-Walter Rix[5], Kasper B. Schmidt[5], Rosalind E. Skelton[3], Katherine E. Whitaker[3], Ivo Labbe[1], and Erica Nelson[3]

[1] Leiden Observatory, Leiden University, P.O. Box 9513, 2300 RA Leiden, Netherlands
[2] European Southern Observatory, Alonso de Crdova 3107,Casilla 19001,Santiago, Chile
[3] Department of Astronomy, Yale University, New Haven, CT 06511, USA
[4] Department of Astronomy, University of California, Berkeley, CA 94720, USA
[5] Max Planck Institute for Astronomy (MPIA), Knigstuhl 17, 69117 Heidelberg, Germany

Abstract. We investigate the evolution of the Hα equivalent width, EW(Hα), 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 Hα 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(Hα) distribution from z=0 to z=2.2. We find that at all masses the characteristic EW(Hα) is decreasing towards the present epoch, and that at each redshift the EW(Hα) is lower for high-mass galaxies. We find EW(Hα) $\sim (1+z)^{1.8}$ 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(Hα) to sSFR (specific star-formation rate) is model dependent, because of differential reddening corrections between the continuum and the Balmer lines. The observed EW(Hα) 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(Hα) rises to 400 Å at $z = 8$. The sSFR evolves faster than EW(Hα), 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.

Keywords. galaxies: evolution galaxies: formation galaxies: high-redshift

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