

Measuring the Star Formation Rate of the Universe at $z \sim 1$ from $H\alpha$ with Multi-Object Near-Infrared Spectroscopy

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Abstract. We have demonstrated the first near-infrared multi-object spectrograph, CIRPASS, on the 4.2-m William Herschel Telescope (WHT) and the 3.9-m Anglo-Australian Telescope. We have conducted an $H\alpha$ survey of $38\ 0.77 < z < 1$ galaxies over ~ 100 arcmin² of the Hubble Deep Field North and Flanking Fields, to determine star formation rates (SFRs) using CIRPASS on the WHT. This represents the first successful application of this technique to observing high redshift galaxies (Doherty *et al.* 2004). Stacking the spectra in the rest-frame, we find a lower limit (uncorrected for dust reddening) on the star formation rate density at redshift $z = 1$ of $0.04 M_{\odot} \text{ yr}^{-1} \text{ Mpc}^{-3}$ (Doherty *et al.* 2006). This implies rapid evolution in the star formation rate density from $z = 0$ to $z = 1$ which is proportional to $(1+z)^{3.1}$. We intend to extend our work with FMOS on Subaru as the *evolSMURF* project (the Evolution of Star-formation and Metallicity in the Universe at high Redshift with FMOS). This will represent nearly two orders-of-magnitude improvement on previous work, and for the first time will provide a sample of sufficient size to measure accurately the $H\alpha$ luminosity function, and so determine the global star formation rate using the same indicator as used in local surveys. Using [O II] 3727 Å, H β , [O III] 5007 Å and $H\alpha$ redshifted into the z , J & H bands, we can chart the star formation history over 70% of the age of the Universe, affording complete coverage up to $z = 1.6$ with the same well-understood diagnostics. The line ratios will also allow the extinction and metallicity to be measured at $z > 1$. This will resolve one of the long-standing puzzles in extragalactic astrophysics – the true evolution of the Madau-Lilly diagram of star formation density.

Keywords. galaxies: high-redshift; evolution; formation; emission lines; techniques: spectroscopic

References

Doherty, M., *et al.* 2004, MNRAS 354, L7

Doherty, M., Bunker, A.J., Sharp, R.G., Dalton, G.B., Parry, I.R., & Lewis, I.J. 2006, MNRAS 370, 331