THE UNIVERSITY
of EDINBURGH

BAGPIPES

THE PHYSICAL PROPERTIES OF MASSIVE QUIESCENT GALAXIES AT $1.0 < z < 1.3$

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ESO VIMOS public spectroscopic survey of UDS and CDFS
2100 galaxies with average integration time of 45 hours
High-SNR spectroscopy for physical parameter recovery

13 per cent (268) are massive quiescent galaxies at $1.0 < z < 2.5$

$N = 180$, $1.0 < z < 1.5$
Total exposure time: 7,040 hours!
BAYESIAN ANALYSIS OF GALAXIES FOR PHYSICAL INFERENCE AND PARAMETER ESTIMATION

Carnall et al. (2019b)

http://bagpipes.readthedocs.io
Bayesian Analysis of Galaxies for Physical Inference and Parameter Estimation

Carnall et al. (2019b)

http://bagpipes.readthedocs.io
Trends with UVJ Colours

$1.0 < z < 1.3$

$M_* > 10^{10.3} \, \text{M}_\odot$

Carnall et al. (2019b)
TRENDS WITH UVJ COLOURS

\[ 1.0 < z < 1.3 \]
\[ M_* > 10^{10.3} \, M_\odot \]

Carnall et al. (2019b)
TRENDS WITH UVJ COLOURS

\log_{10}(sSFR/\text{yr}^{-1}) \gtrsim -10.5

\log_{10}(sSFR/\text{yr}^{-1}) \lesssim -10.5

Carnall et al. (2019b)
TIME EVOLUTION OF UVJ COLOURS

1.0 < z < 1.3

$M_\ast > 10^{10.3} M_\odot$

Carnall et al. (2019b)
TIME EVOLUTION OF UVJ COLOURS

Carnall et al. (2019b)
FORMATION REDSHIFTS

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FORMATION REDSHIFTS

Carnall et al. (2019b)
Formation Redshifts

Carnall et al. (2019b)
The Oldest Galaxies at $z=1$
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\[
\log_{10}(M_*/M_\odot) = 11.26^{+0.12}_{-0.10}
\]
THE OLDEST GALAXIES AT $z=1$

$z_{\text{form}} = 7.4^{+3.2}_{-1.9}$

$\log_{10}(M_*/M_\odot) = 11.26^{+0.12}_{-0.10}$
The Oldest Galaxies at $z=1$

Carnall, Walker et al. (2020): photometric selection and physical properties of $2 < z < 5$ massive quiescent galaxies in CANDELS UDS and GOODS-South
**Stellar Metallicities**

- Gallazzi et al. (2006) $z \sim 0.1$
- Gallazzi et al. (2014) $z \sim 0.7$
- Carnall et al. (2019b) $z \sim 1.15$

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**Optical**

**UV**
Stellar Metallicities

Best fit (Carnall et al. 2019b)

$z = 1.135 \quad Z^* = 0.51^{+0.09}_{-0.08} Z_\odot$

VANDELS spectrum

KMOS YJ
Stellar Metallicities

(Preliminary)

$1.0 < z < 1.1$
CONCLUSIONS

Full spectral fitting is the right way to learn about galaxy physical properties, a Bayesian approach with flexible noise modelling can make this possible.

The $z \gtrsim 1$ quiescent population already has a diverse range of SFHs, upcoming surveys will provide the statistics to constrain high redshift quenching models.

Evidence for the earliest massive quiescent galaxies forming at $z \sim 6$.