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Probing Very Young Galaxies in the present universe

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09.02.2021

Environment Workshop 2021

Republic of Korea

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Very Young Galaxies

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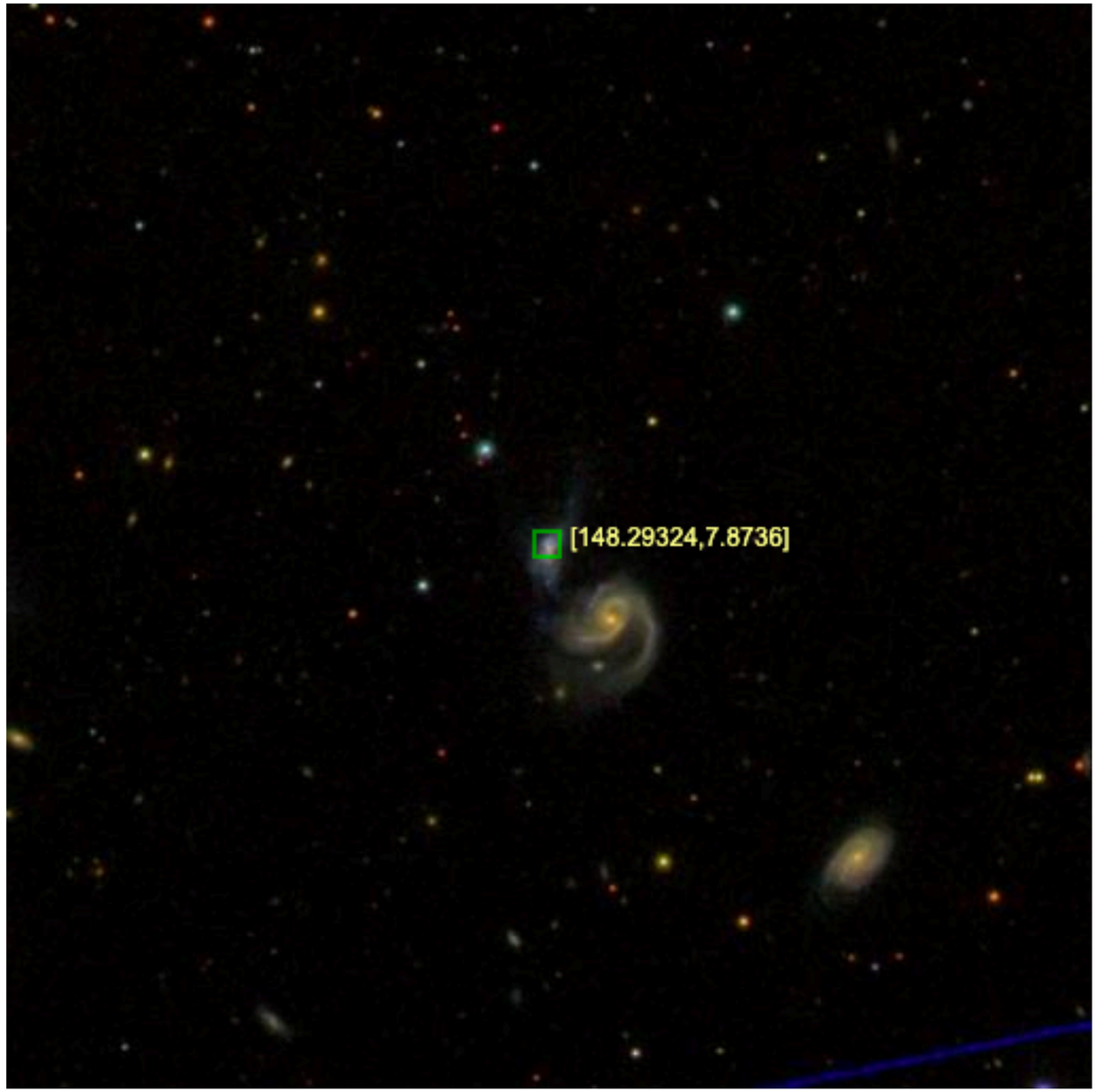
✤ Very Young Galaxies (VYGs), defined to have formed at least 50% of their stellar mass within the last 1 Gyr.

✤ Candidates with possible triggering of star-formation at low-redshift due to various reasons

✤ Interesting for the study of interactions & mergers in the environment



Trevisan et al. 2020

Looking for VYG candidates

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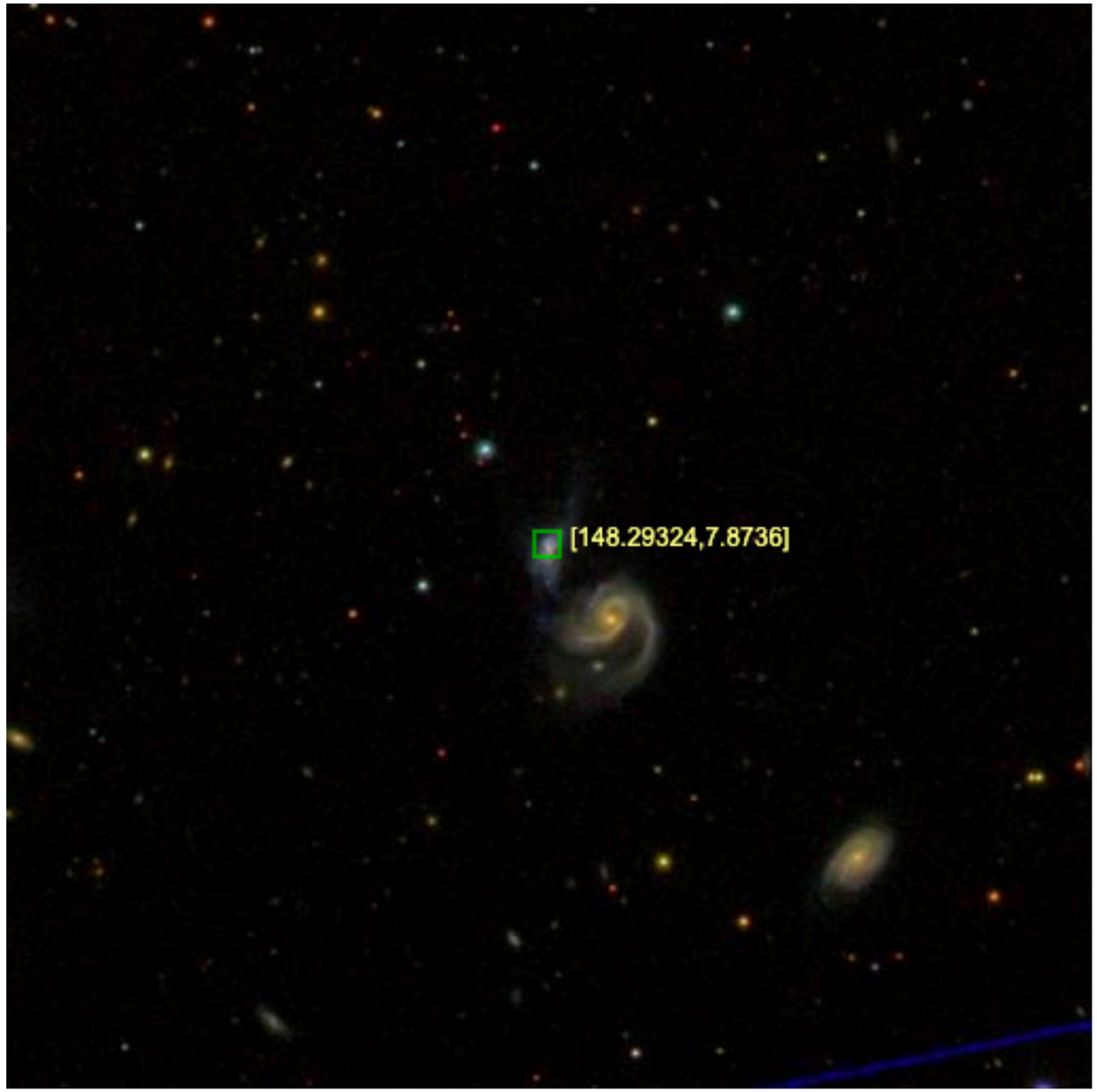
✤ Large sky surveys such as SDSS are good for searching VYG candidates

✤ Ideal for photometric verification and further spectroscopic analysis

✤ Interesting for the study of interactions & mergers in the environment



Trevisan et al. 2020

Literature on VYGs

- Some low-mass star-forming galaxies in local universe detected with extremely low metallicity (Searle & Sargent 1972)
- Their analysis was suggestive that they have have very young stellar populations. (Papaderos et al. 2002)
- Special case - I Zw 18 seems to have formed most stars within 500 Myr but the result inconclusive
- Tweed et al. (2018) studies the frequency of VYGs in the local universe using analytical models
- Models alone are inconclusive on various properties of VYGs such as stellar mass distribution
- Mamon et al. (2020) extends this study with observations from large sky SDSS survey

Creating a CLEAN SDSS sample

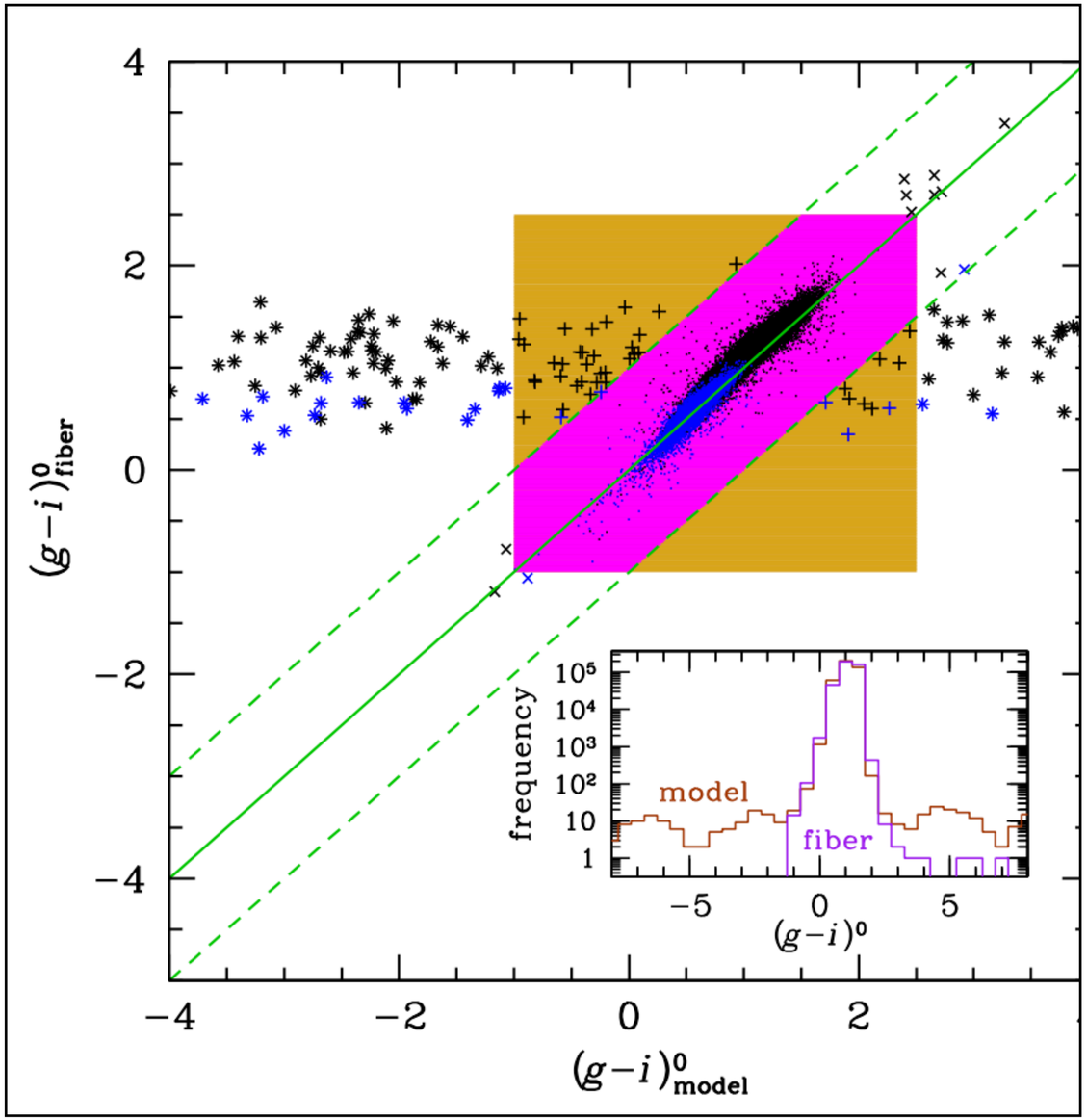
We extracted our sample from the MGS of the SDSS data release 12 (DR12, Alam et al. 2015), according to the following criteria:

(i) flux limit: $r^0_{\rm Petro} \leq 17.77$;
(ii) object spectra obtained with original 3 arcsec fibre;
(iii) redshift range: $0.005 < z < 0.12$;
(iv) the STARLIGHT (Cid Fernandes et al. 2005) SFH code does not fail when applied to the object;
(v) object is in the VErsatile SPectral Analysis data base (VESPA, Tojeiro et al. 2009)[2] of SFHs;
(vi) single spectrum for each galaxy;
(vii) surface brightness limit: $\mu^0_{r,50} \leq 23.0$;
(viii) stellar mass range: $6 < \log(m/\mathrm{M}_\odot) < 12.5$ for all spectral models;
(ix) reasonable magnitudes: $g_{\rm Petro} > 0$, $r_{\rm Petro} > 0$, $i_{\rm Petro} > 0$;
(x) colours are not extreme:
$-1 < (g-i)^0_{\rm model} < 2.5$ AND $-1 < (g-i)^0_{\rm fibre} < 2.5$;
(xi) fiber colours are not too different from model colours:
$|(g-i)^0_{\rm fibre} - (g-i)^0_{\rm model}| < 1$;
(xii) all six spectral fits yield $\chi^2 > 0$;
(xiii) redshift is not too large to fail to see passive galaxies:
$z < z_{\rm max}(m)$.

In addition, we allowed ourselves to apply the following criteria to the VYG candidates (but not to the parent sample):

(xiv) galaxy does not contain an *Active Galactic Nucleus* (AGN, using the curve of Kauffmann et al. 2003 that conservatively separates AGN from SFGs in the Baldwin, Phillips & Terlevich 1981, hereafter BPT, diagram);
(xv) fiber colour is not bluer than the model colour:
$(g-i)^0_{\rm fibre} > (g-i)^0_{\rm model}$.

Mamon et al. 2020



Mamon+2020 results

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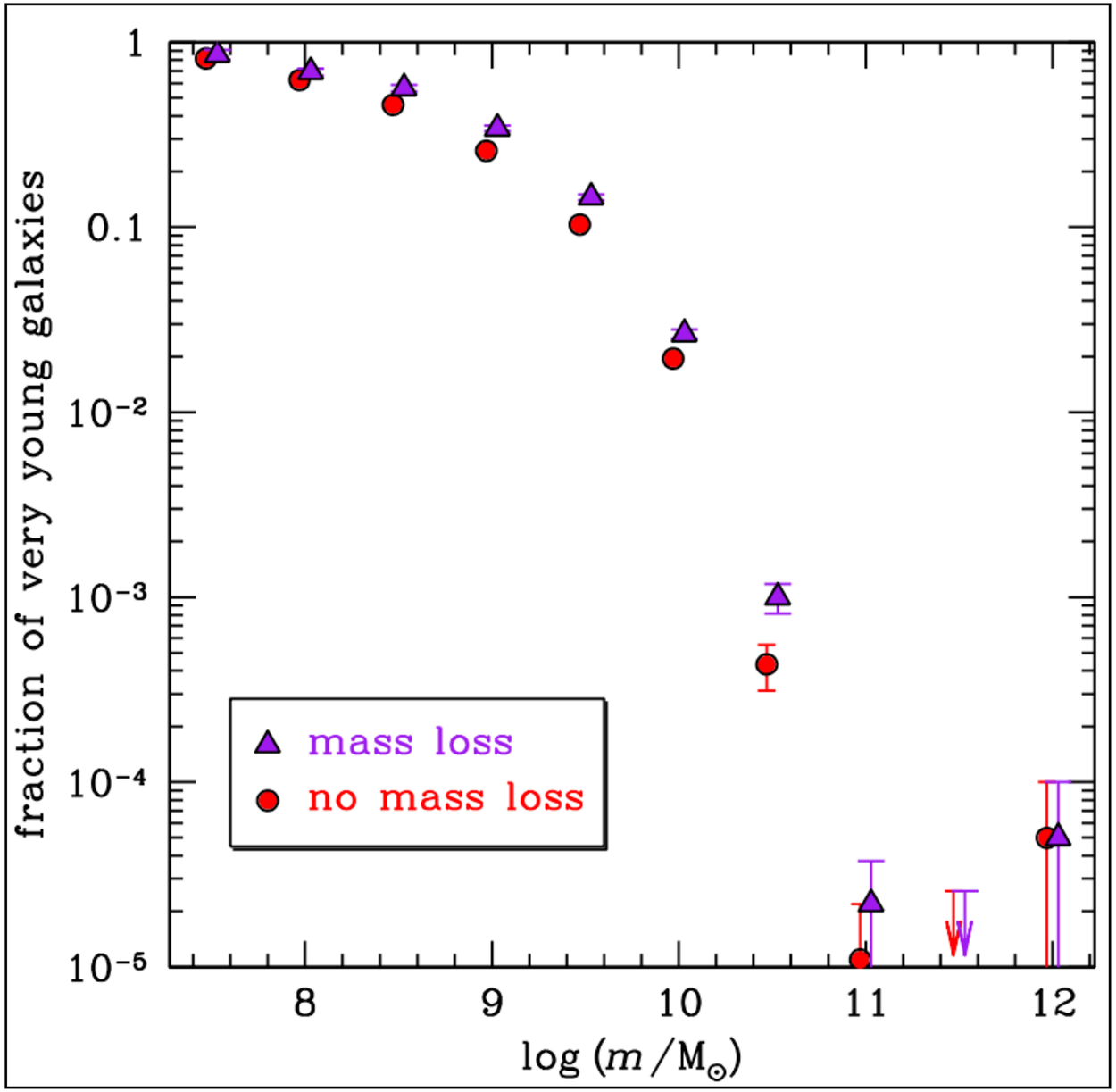
✤ VYG fractions decrease with increasing galaxy stellar mass

✤ VYG fractions versus mass decrease more gradually (compared to SAM), a result consistent with SIMBA simulations

✤ Galaxies above $10^8\,M_\odot$ undergo at most four major starbursts on average



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Additional criteria for VYGs

i) their median ages are younger than 1 Gyr according to all 3 spectral models (V15 with STARLIGHT, and the 2-component dust BC03 and M05 models with VESPA; 1214 galaxies);

ii) their stellar masses derived with STARLIGHT using V15 models are $\geq 10^8\,M_\odot$ (838 galaxies);

iii) the signal to noise of their SDSS spectra satisfy S/N $\geq$ 10, where S/N is computed within a window of 50 Å centered at 4755 Å (rest frame; 654 galaxies);

iv) their specific SF rates (sSFRs) are available in the MPA/JHU `SpecLineExtra` table of the SDSS database (634 galaxies);

v) they do not lie in the AGN region of the BPT diagram (Baldwin, Phillips & Terlevich 1981) – we adopted the relation by Kewley et al. (2001) to separate the star-forming and AGN galaxies (633 galaxies);

vi) they show blue colour gradients: $\Delta(g-i) = (g-i)_{\rm model} - (g-i)_{\rm fiber} \leq 0$ (207 galaxies).

- 207 VYG galaxies
- 1242 Control sample galaxies

Trevisan et al. 2020

Trevisan+2020 results

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✤ **Control sample (CSG)**

indistinguishable from VYGs in

redshift and blue color gradient

✤ **Although the stellar mass and θ_{50}**

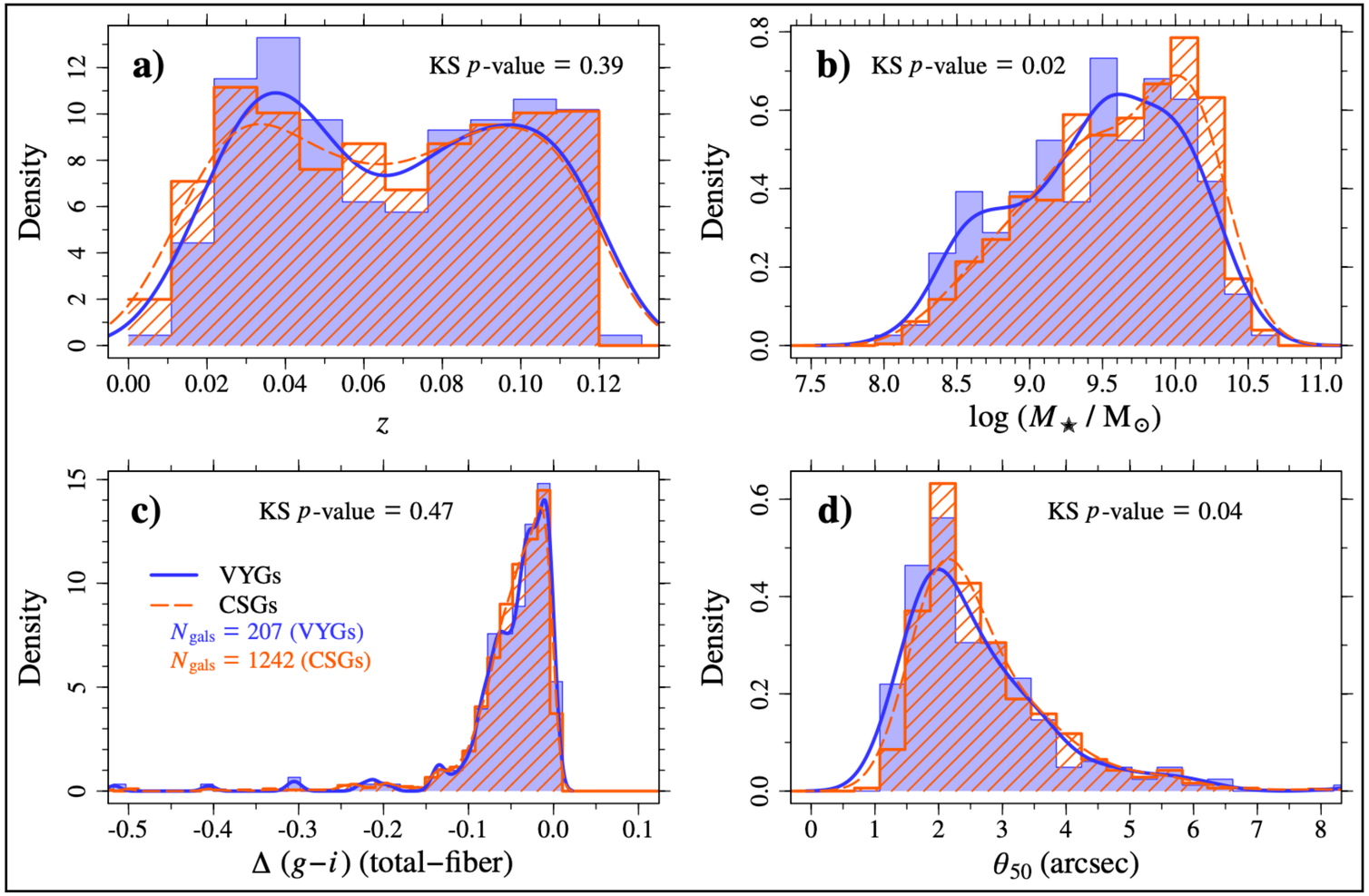
(radii with 50% petrosian r-band

flux) are different

✤ **VYGs tend to lie at higher**

redshifts compared to the CSGs

in SDSS



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Trevisan+2020 results

- ✤ VYGs tend to have higher surface brightness and to be more compact, dusty, asymmetric and clumpy relative to CSGs
- ✤ HI detections reveal that VYGs are more gas-rich than CSGs
- ✤ VYGs tend to reside more in the inner parts of low-mass groups
- ✤ VYGs twice as likely to be interacting with a neighbour galaxy than CSGs
- ✤ VYGs and CSGs have similar gas metallicities and large scale environments (relative to filaments and voids)
- ✤ For lowest mass VYGs subsets, starbursts may arise from a mixture of mergers and gas infall
- ✤ For the rest, gas-rich interactions and mergers are the main mechanisms

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Thank you for you time...

Questions?