



The ZTF Cosmo DR2 sample & Astrophysical biases in standardisation

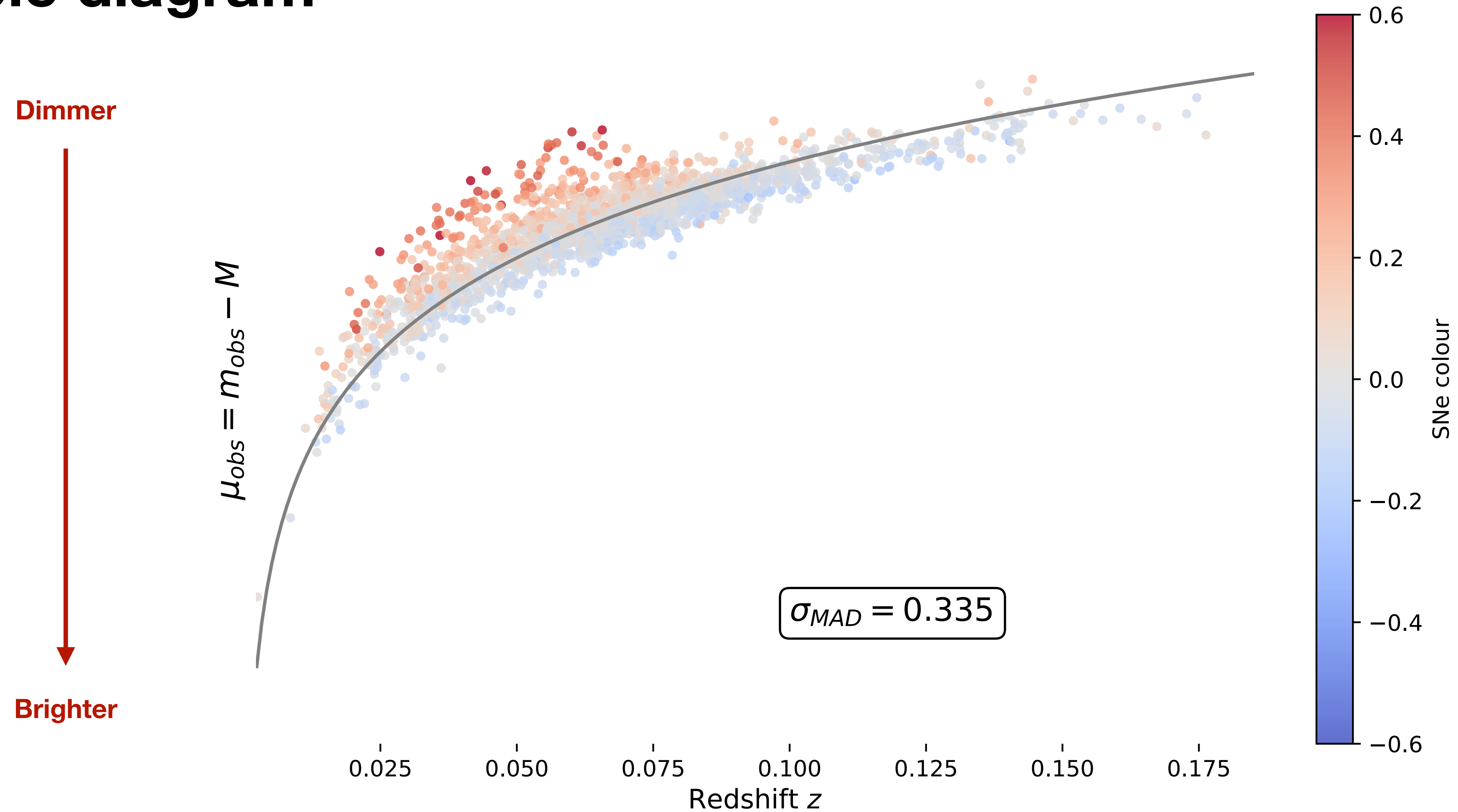
Supervisors: Mickaël Rigault, Mat Smith

Madeleine GINOLIN - 8th June 2023



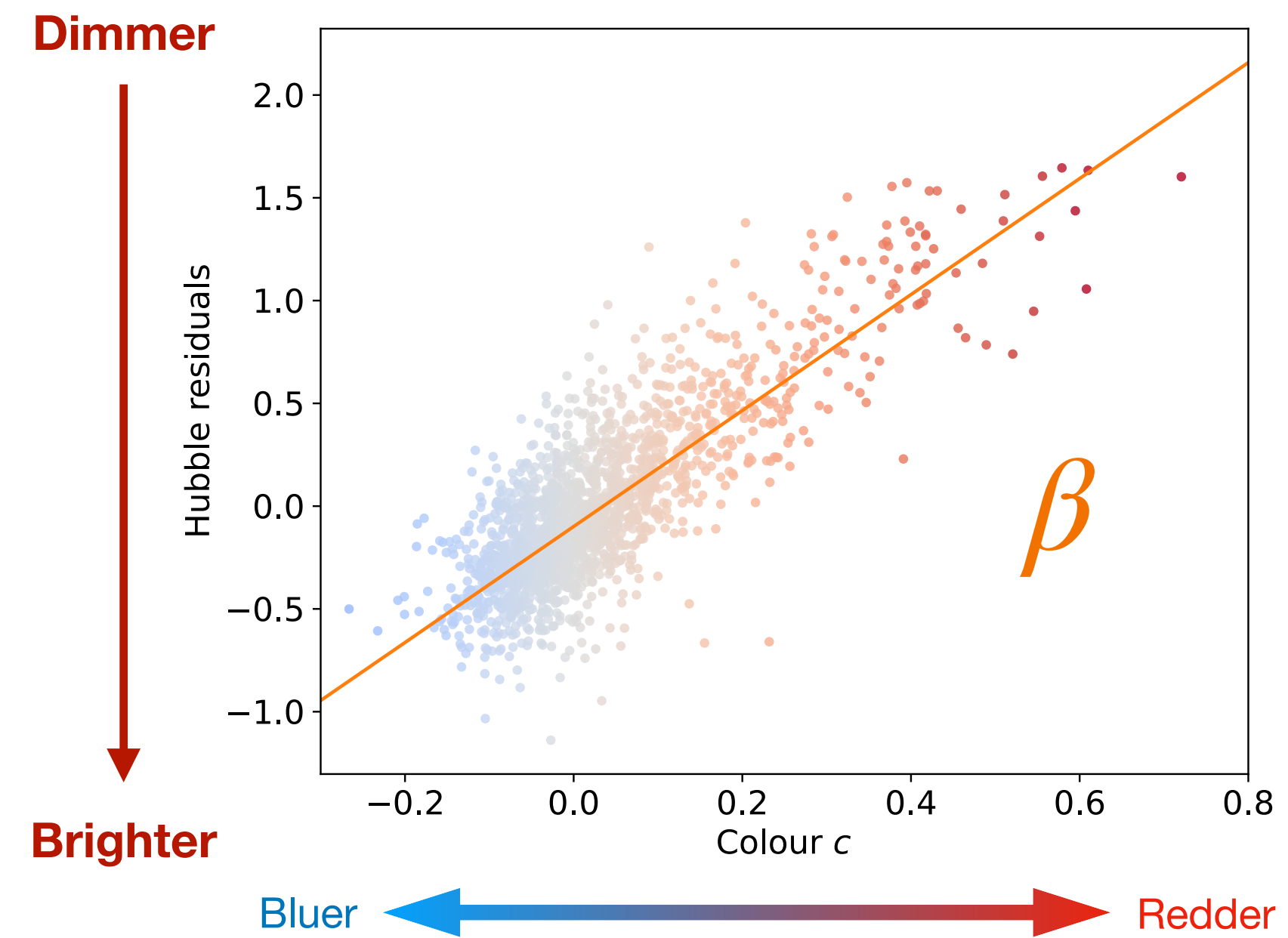
Cosmology with SNe

Hubble diagram



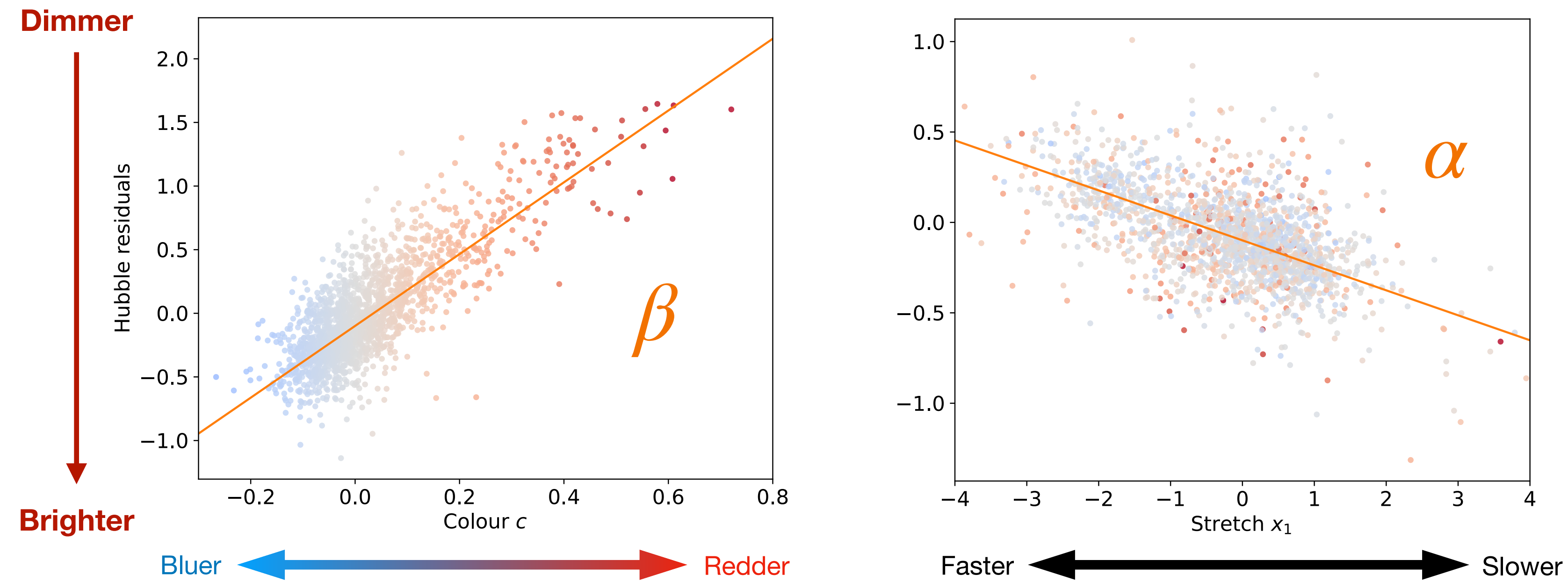
Cosmology with SNe

Standardisation



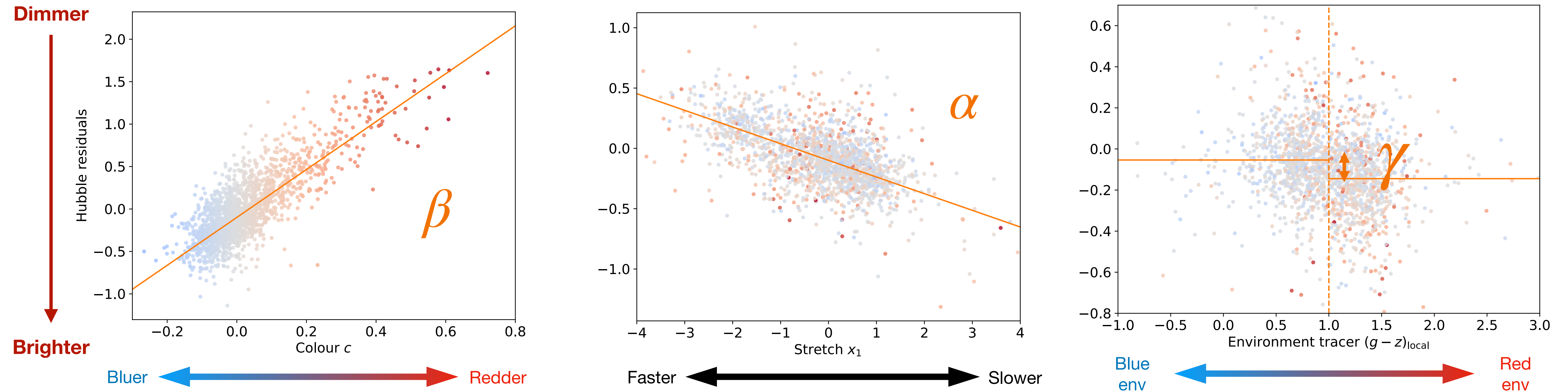
Cosmology with SNe

Standardisation



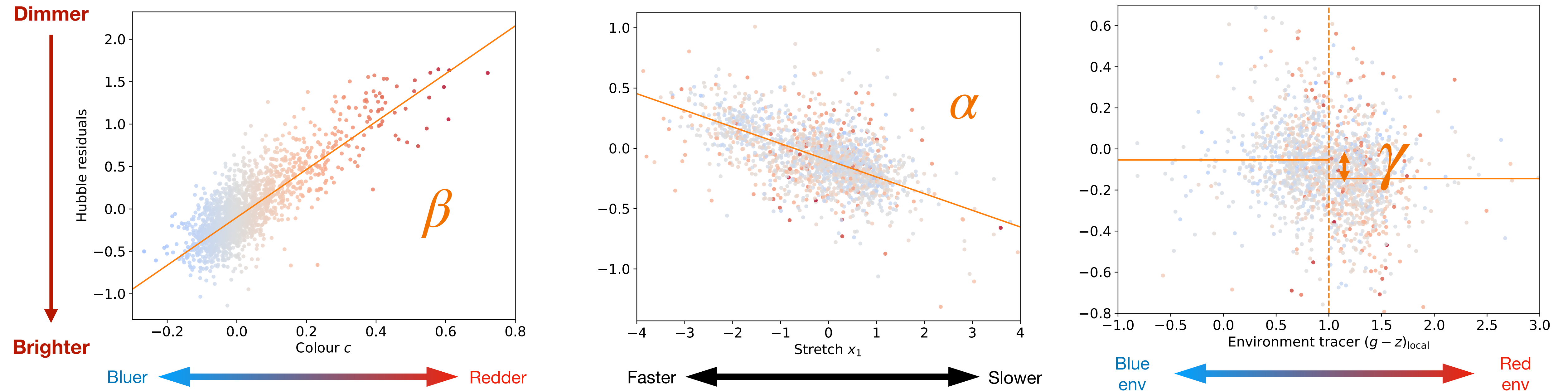
Cosmology with SNe

Standardisation



Cosmology with SNe

Standardisation

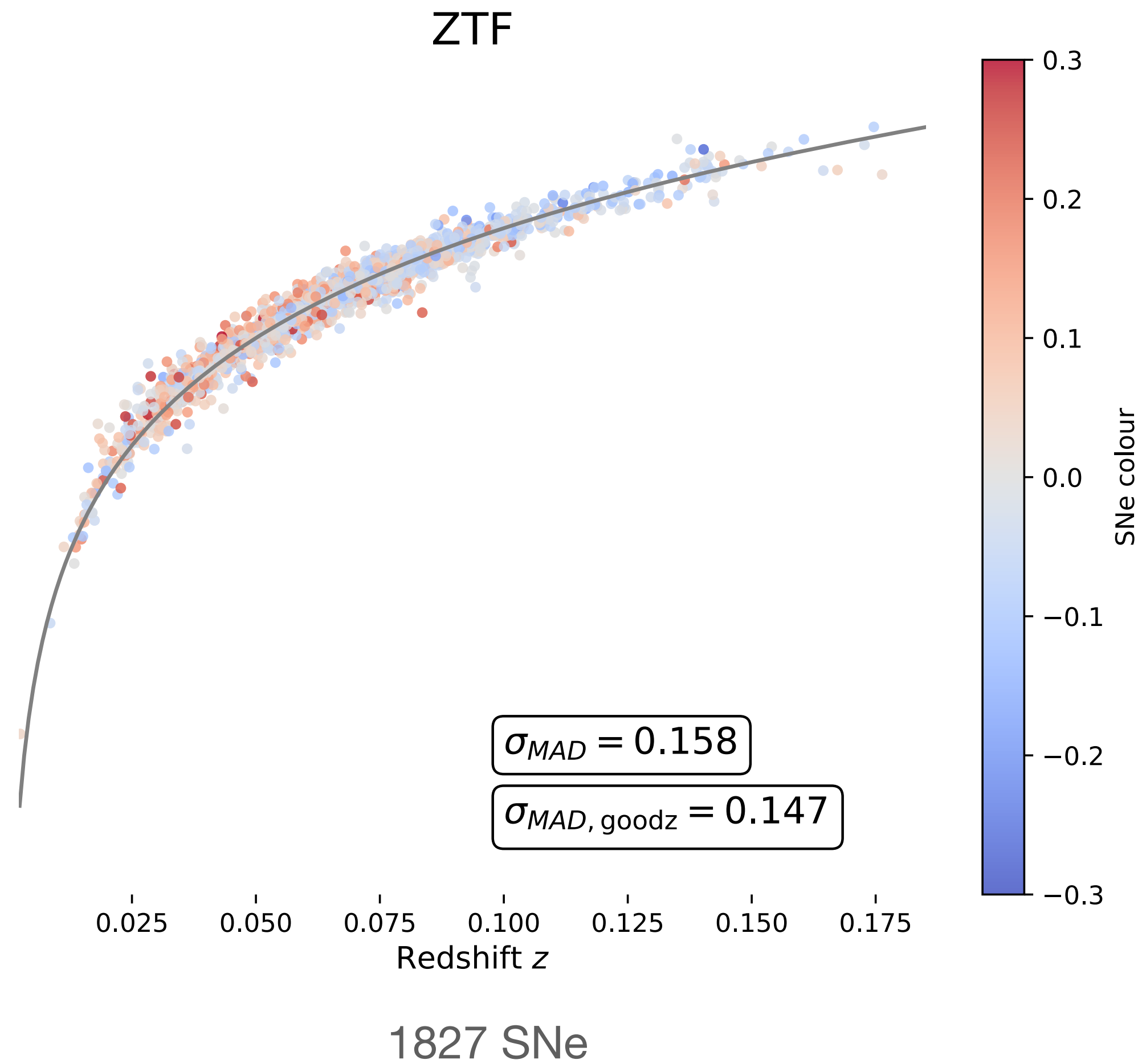


$$\mu_{\text{model}} + M = m_{\text{obs}} - \beta c + \alpha x_1 + p\gamma$$

(Tripp 1998)

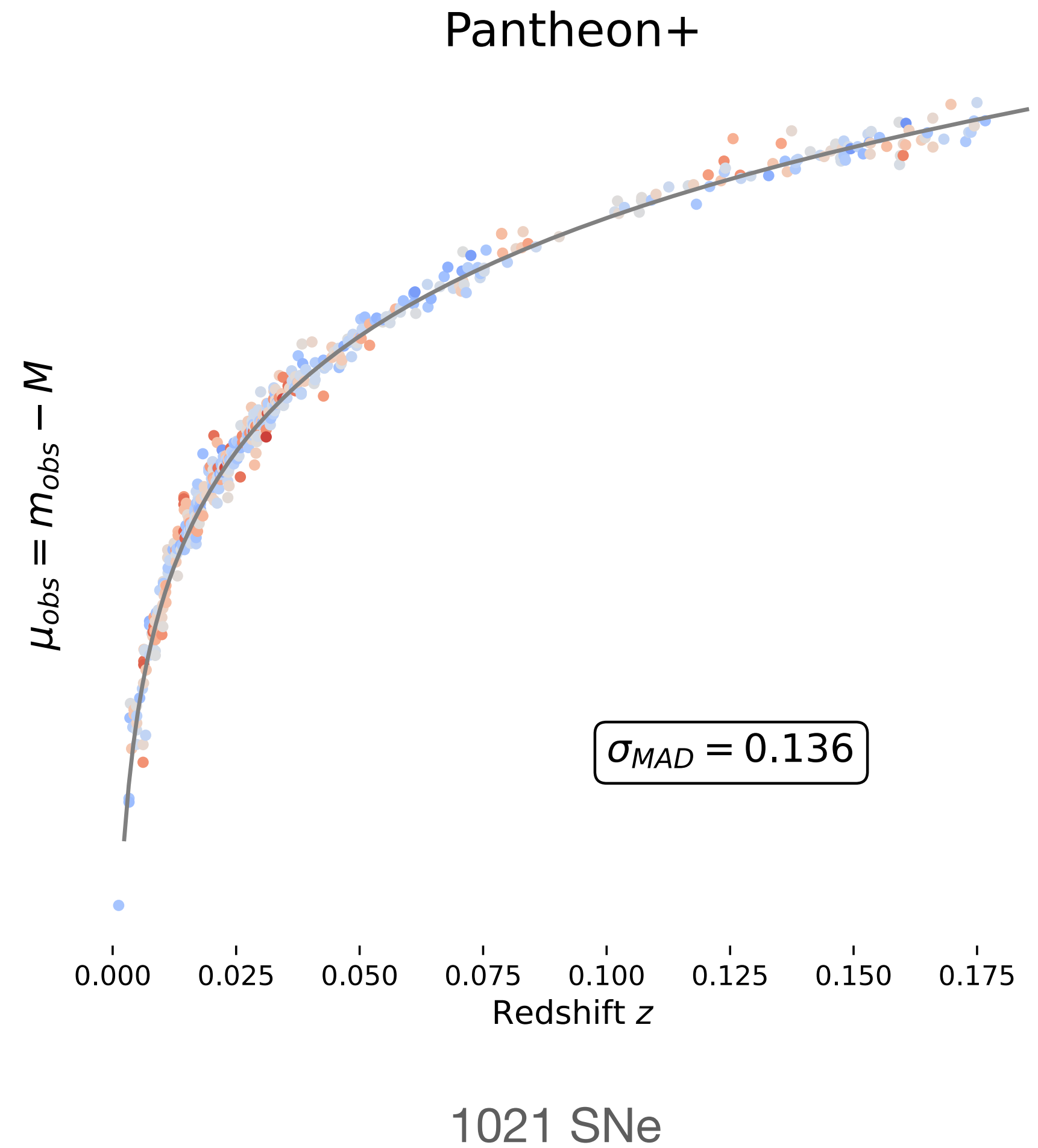
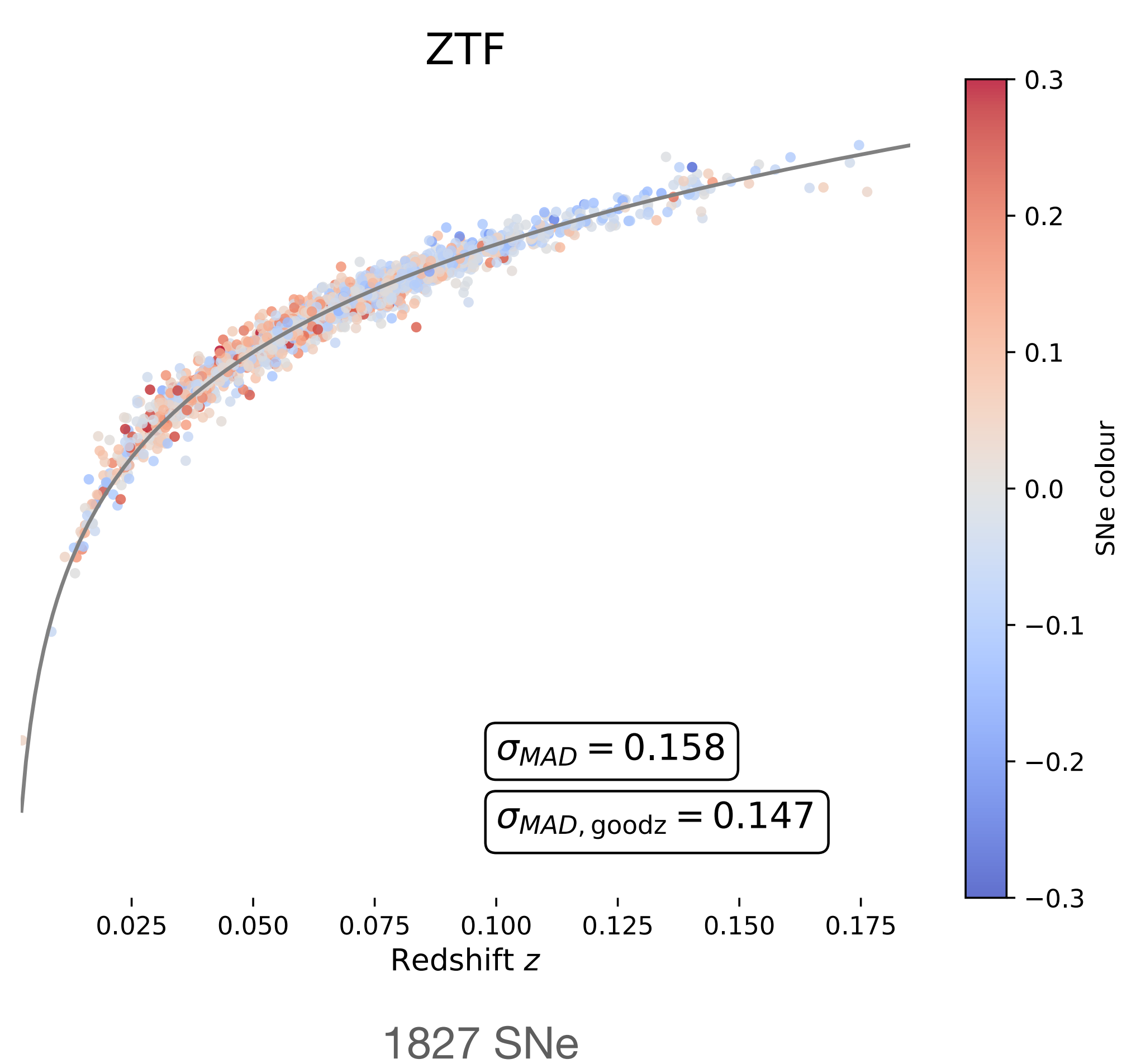
Cosmology with SNe

Hubble diagram



Cosmology with SNe

Hubble diagram



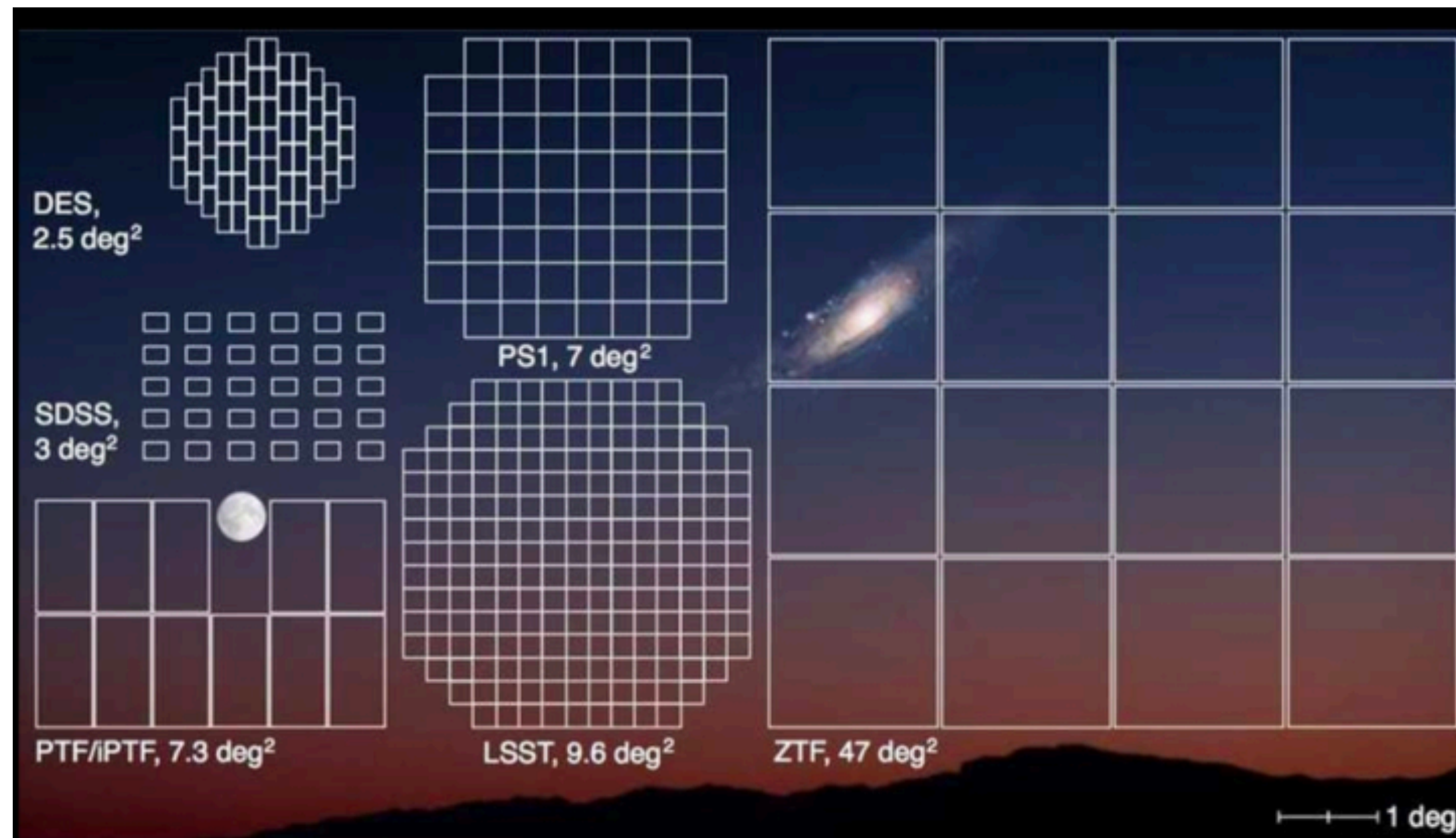
ZTF DR2

ZTF Overview



ZTF DR2

ZTF Overview

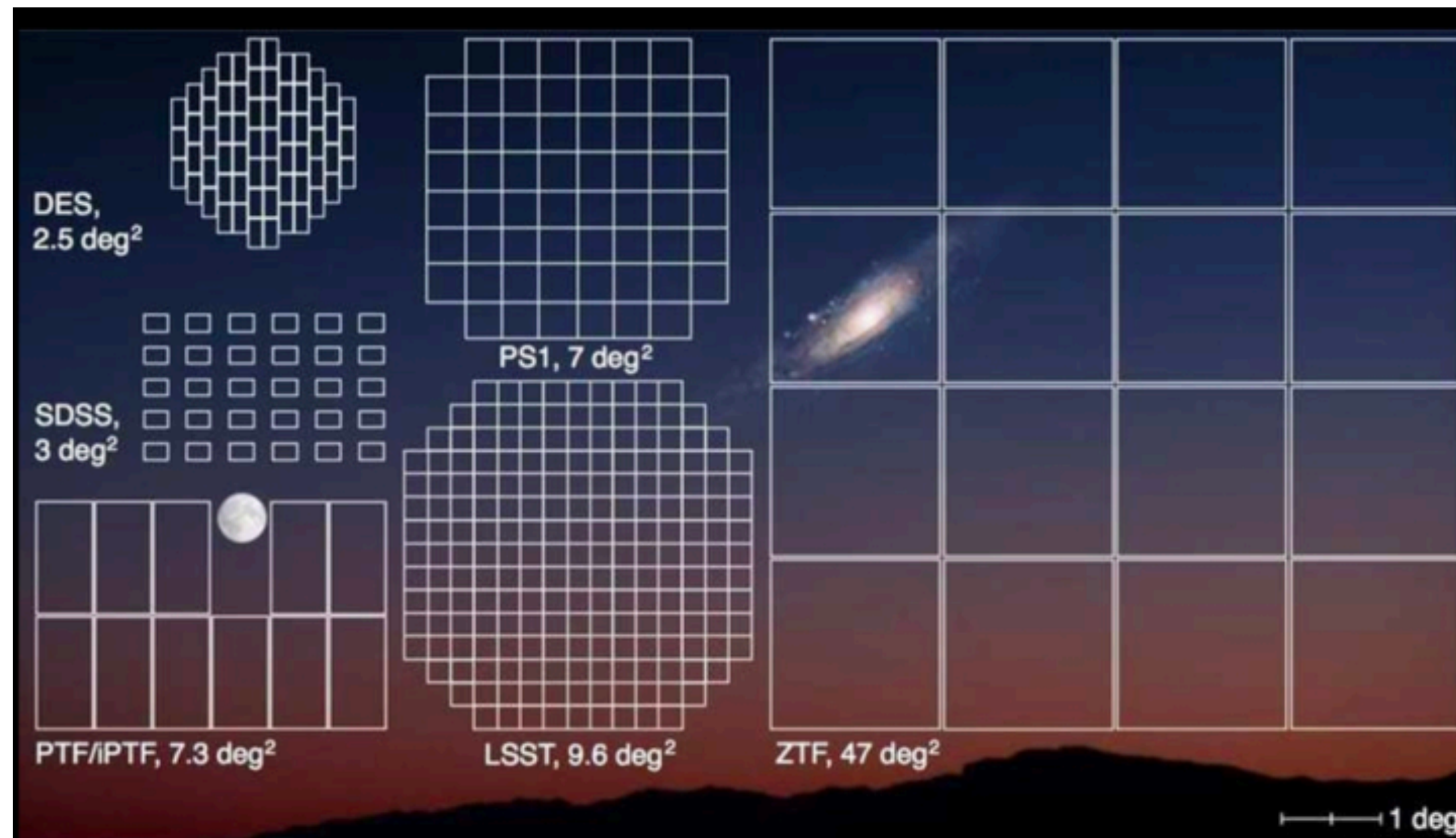


Zwicky Transient Facility (P48)

- High FoV
- Short (30s) exposures
- 3 bands (g, r, i)
- Median depth in r band at ~ 20.4 mag (z=0.1)

ZTF DR2

ZTF Overview



Zwicky Transient Facility (P48)

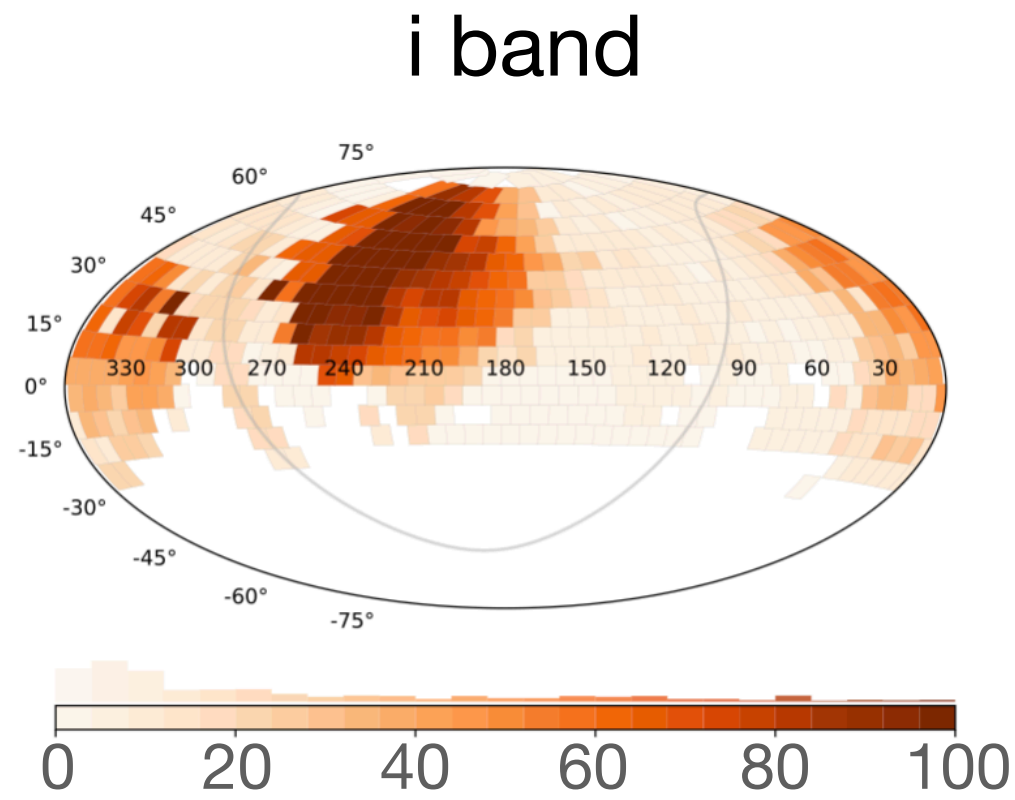
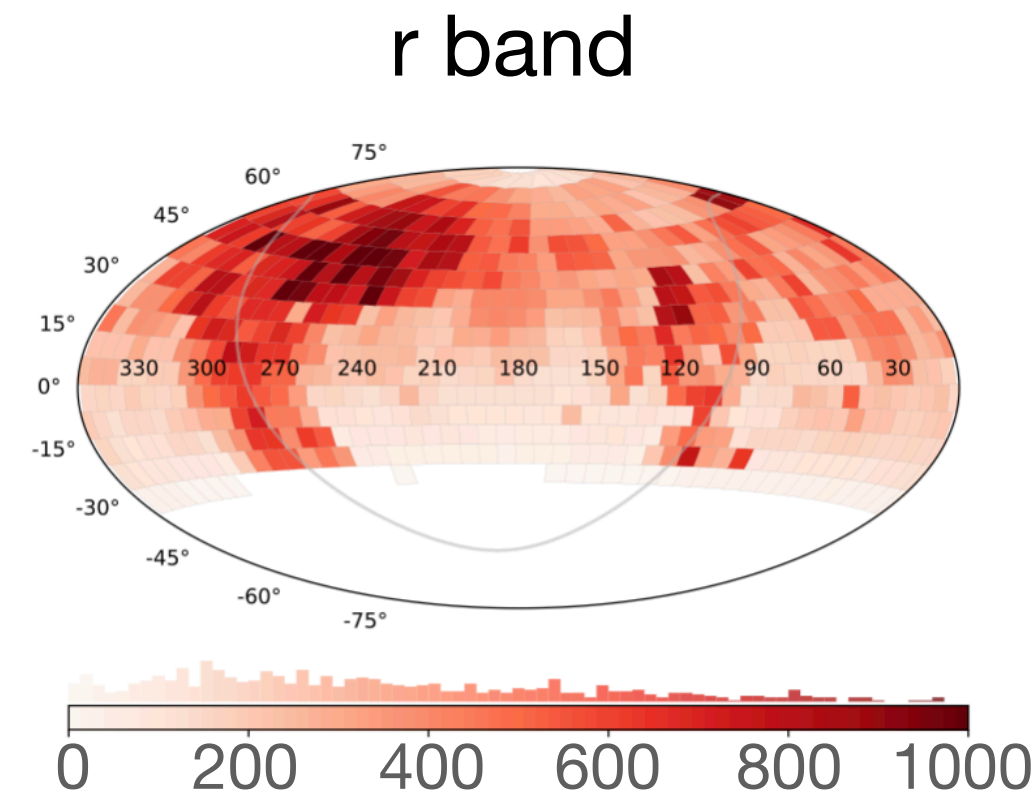
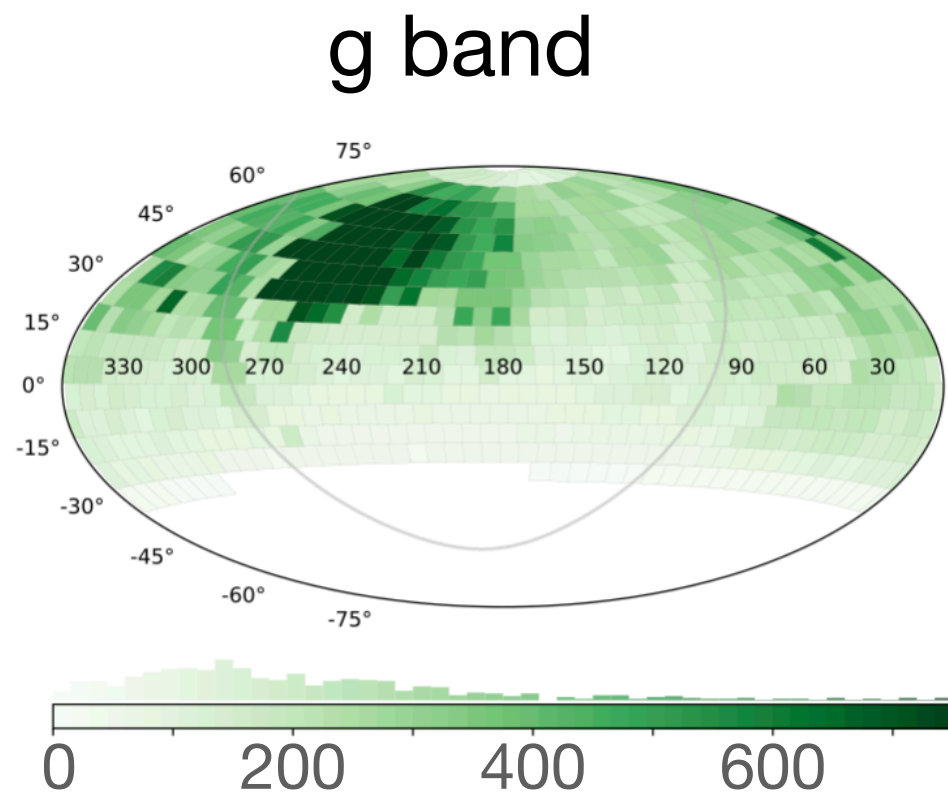
- High FoV
- Short (30s) exposures
- 3 bands (g, r, i)
- Median depth in r band at ~ 20.4 mag (z=0.1)

SEDmachine (P60)

- Low resolution ($\frac{\lambda}{\Delta\lambda} \sim 100$)
- ~ 1h exposure
- Limiting magnitude at ~ 19.5 mag

ZTF DR2 Numbers

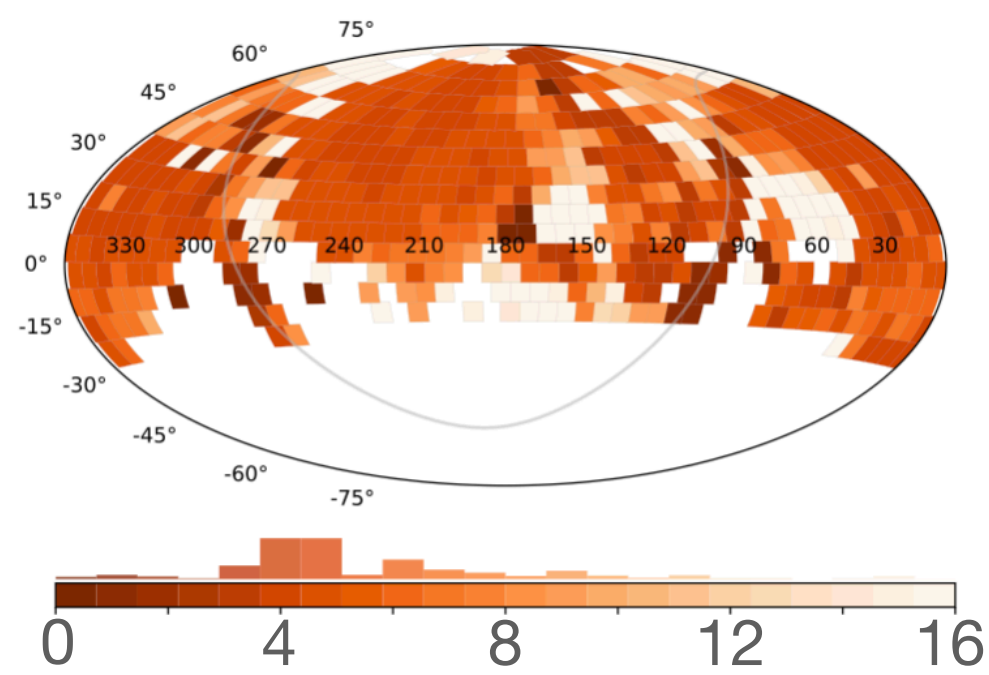
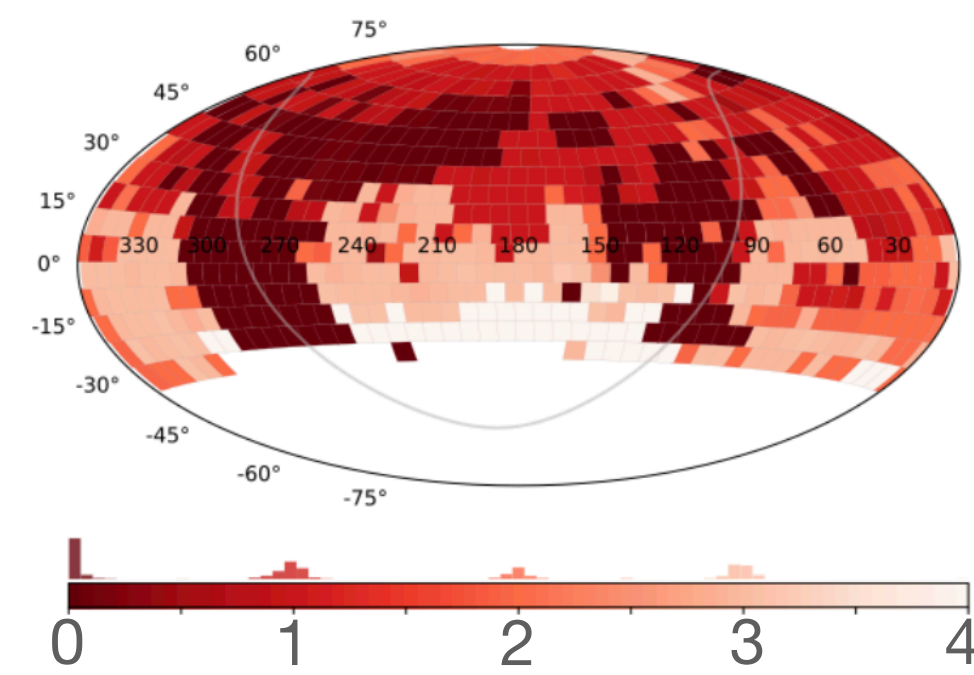
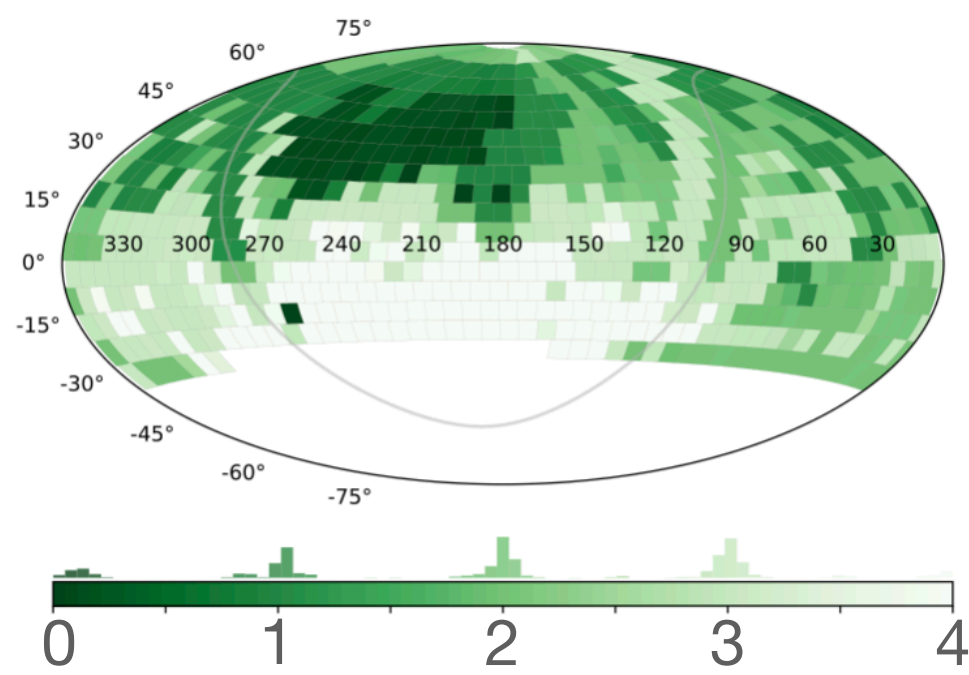
Total number of exposures



➔ 3627 spectroscopically confirmed SNe Ia

➔ 2930 with a good light curve

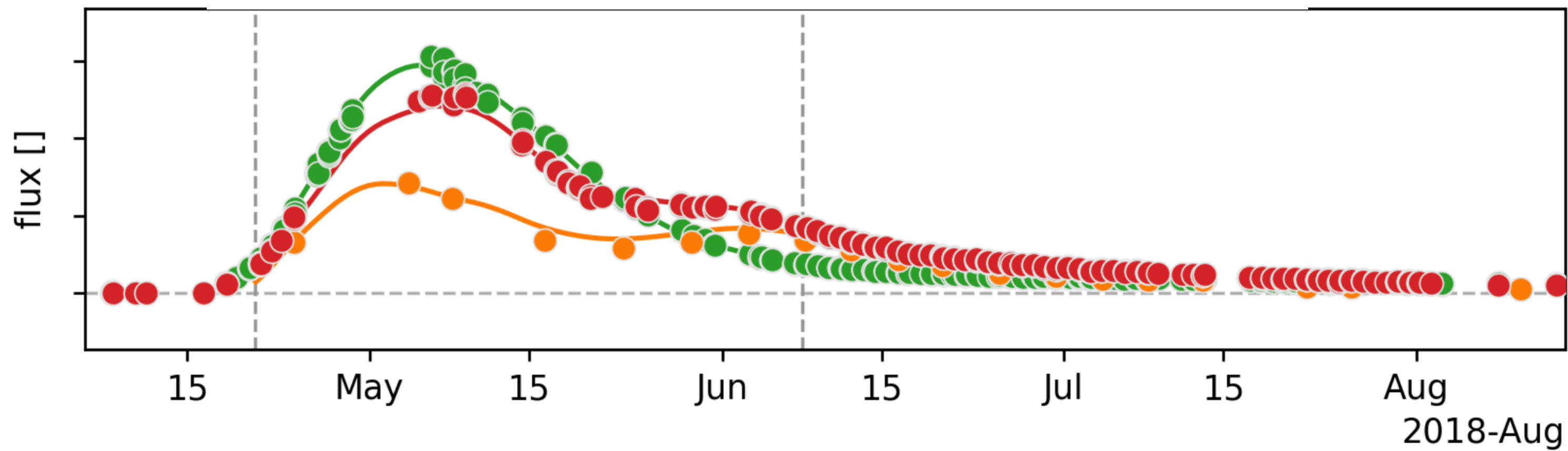
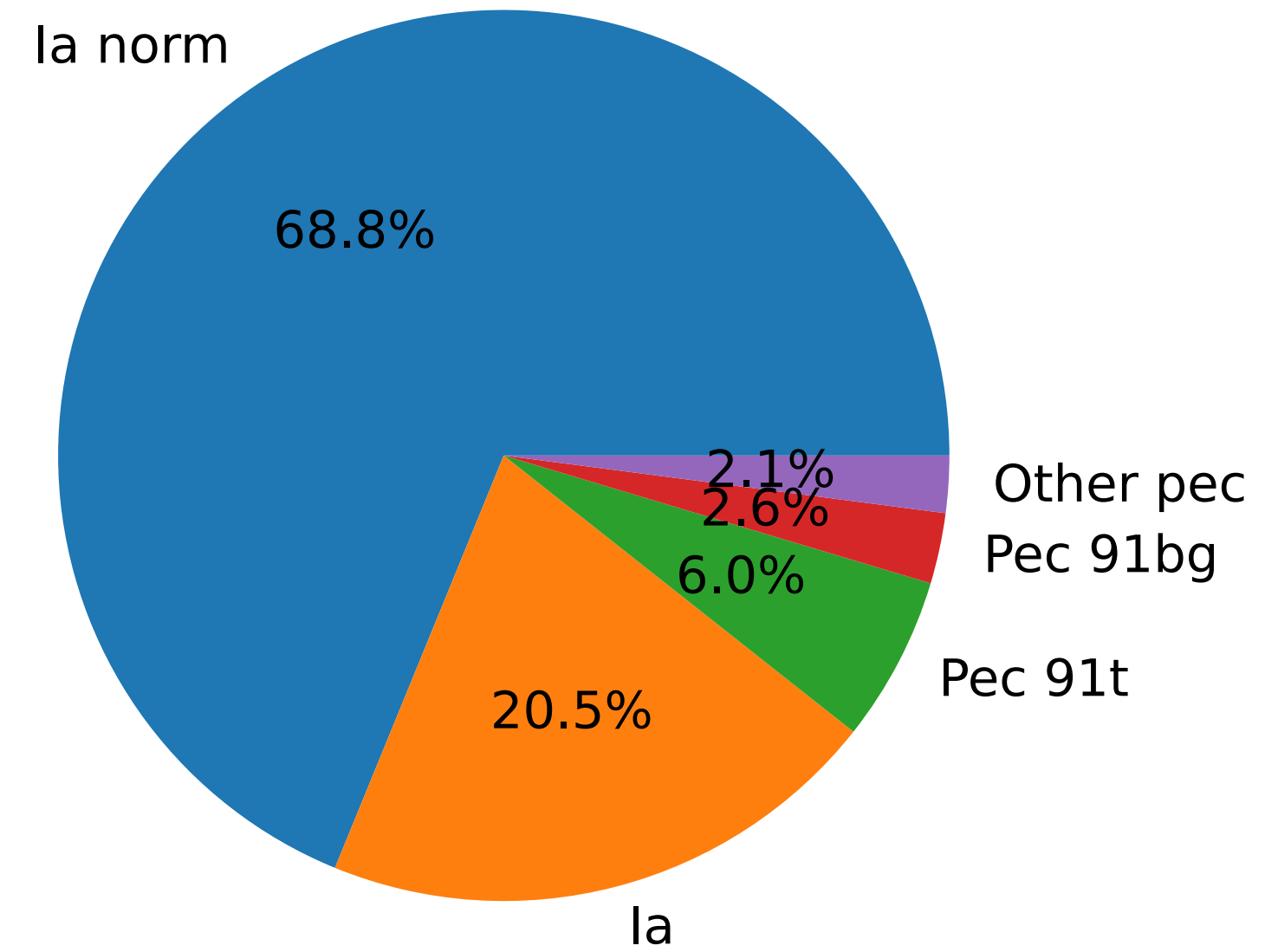
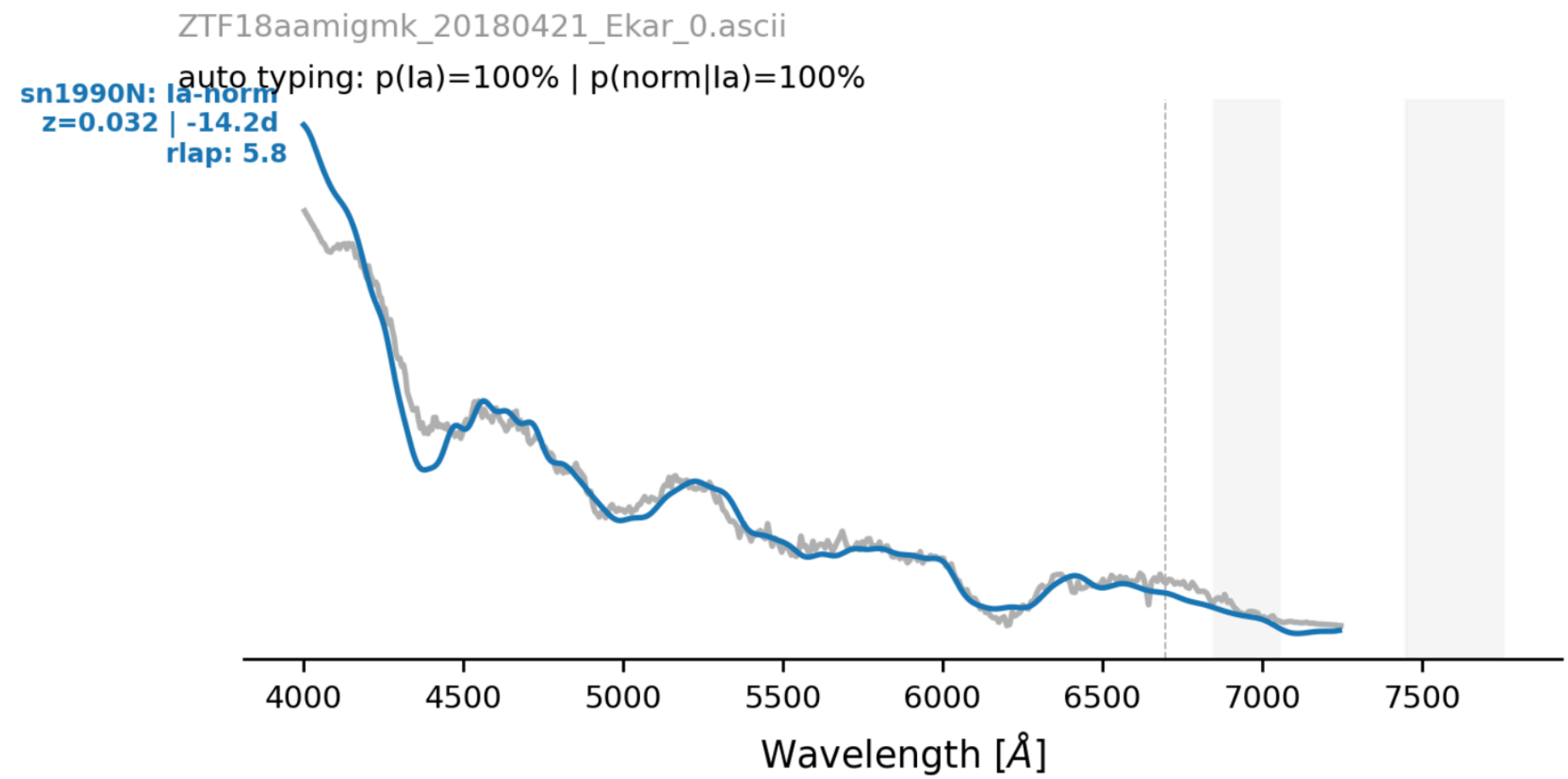
Median delay between two consecutive exposures (in days)



Smith, Rigault et al (in prep)

ZTF DR2

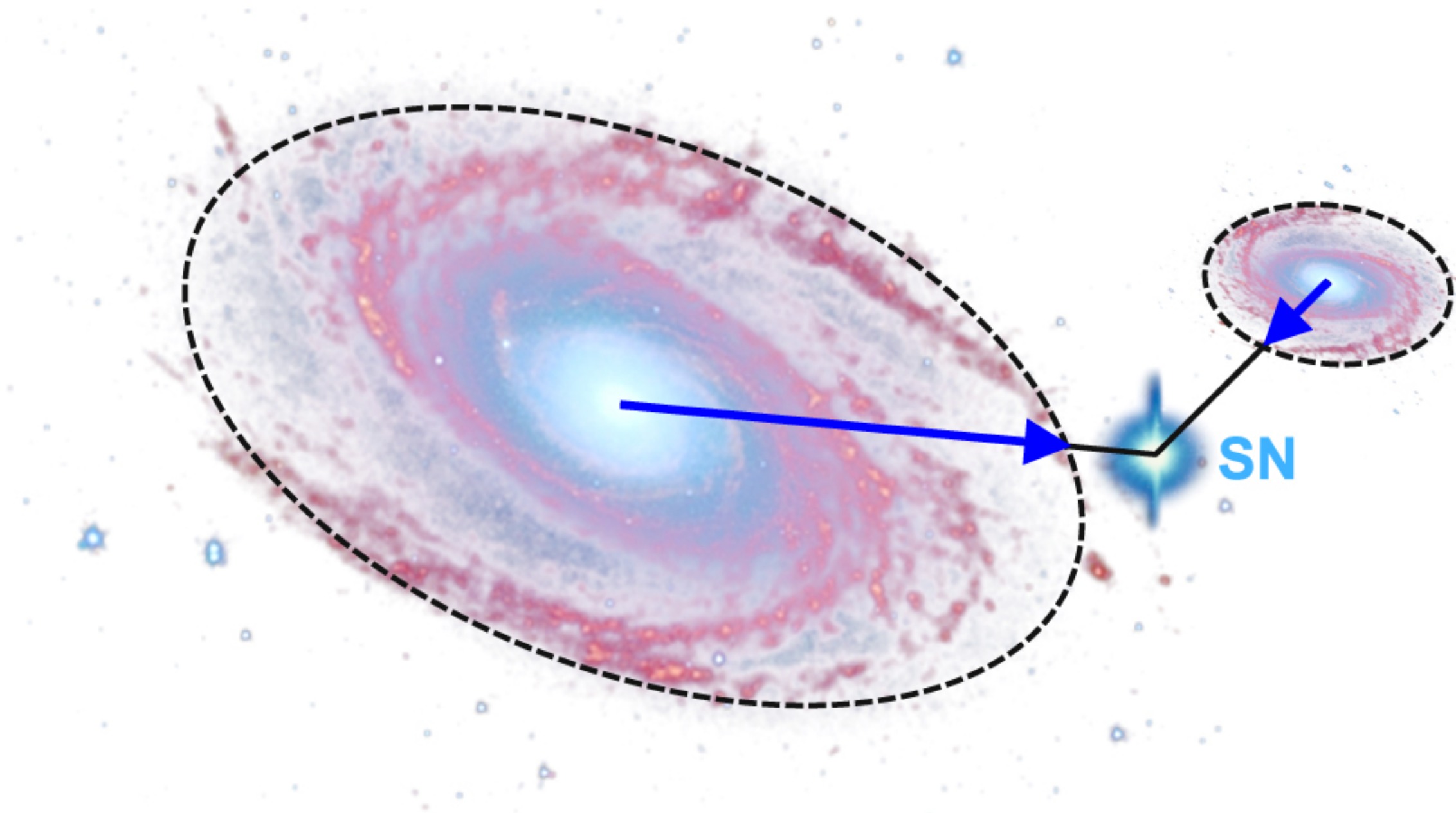
Typing + fitting



SALT2.4 fitting

ZTF DR2

Host association - Redshifts



- ➔ 38% SNe with host redshift ($\sigma_z = 10^{-5}$)
- ➔ 16% SNe with emission lines ($\sigma_z = 10^{-4}$)
- ➔ 46 % SNe features ($\sigma_z = 10^{-3}$)

54% SNe with good quality redshift

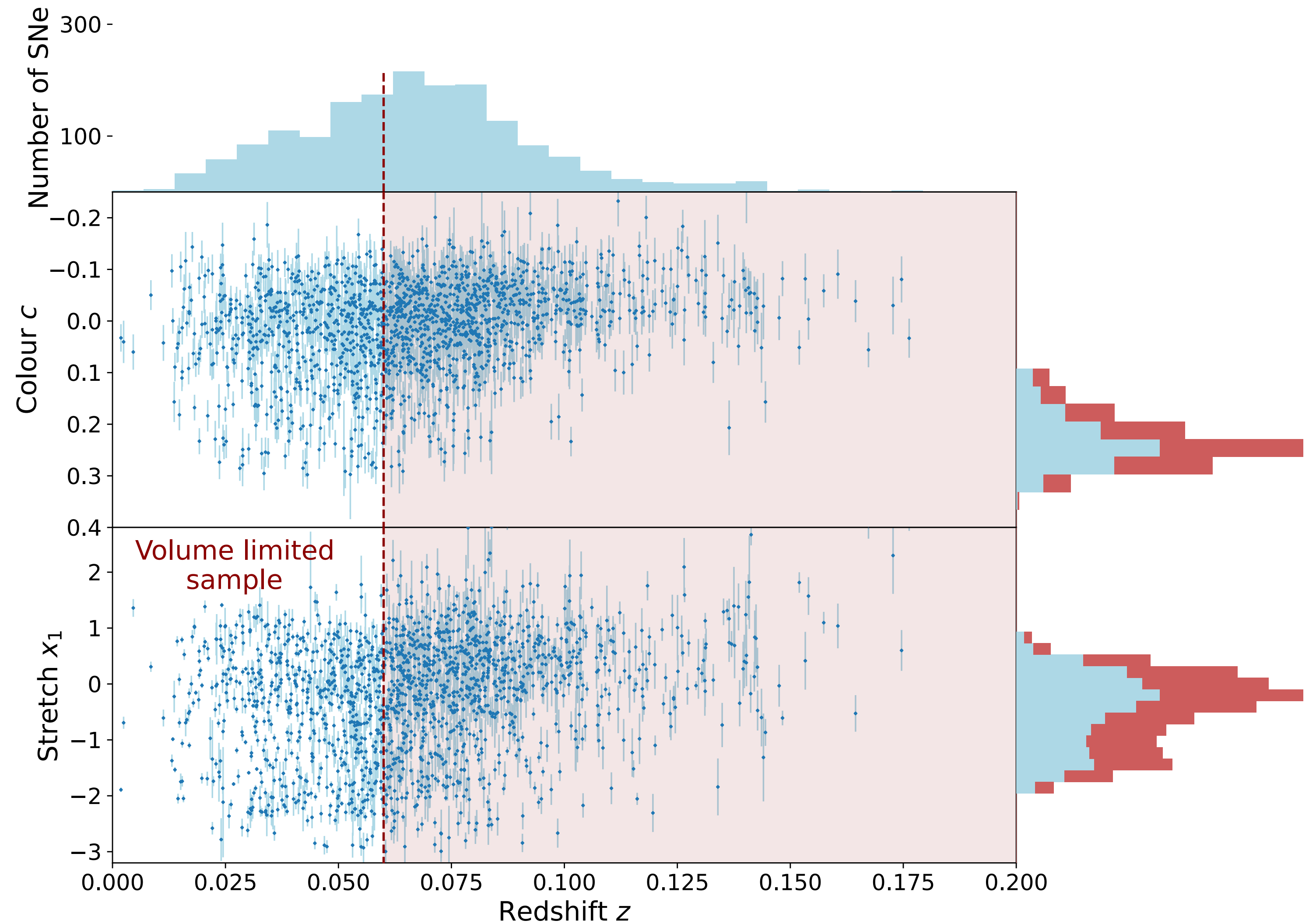
DLR technique (Sullivan et al 2006, Gupta et al 2016)

ZTF DR2

Volume limited sample

- Redshift cut: no selection effects
- Additional cuts:
 - (x_1, x_1^{err})
 - (c, c^{err})
 - t_0^{err}
 - Normal SNe Ias
 - SALT fit probability

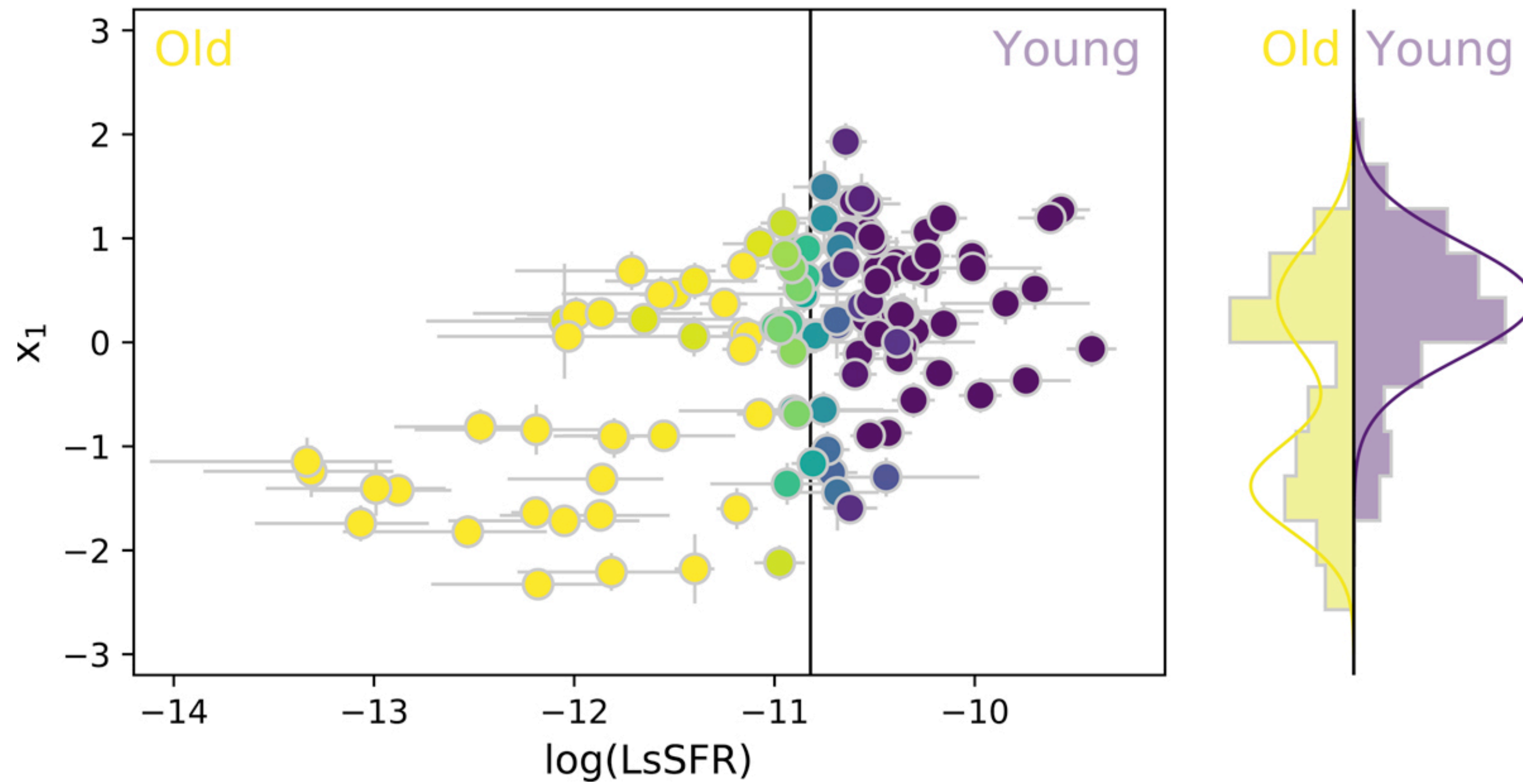
➔ **670 SNe** in the final sample



Ginolin et al (in prep)

Standardisation

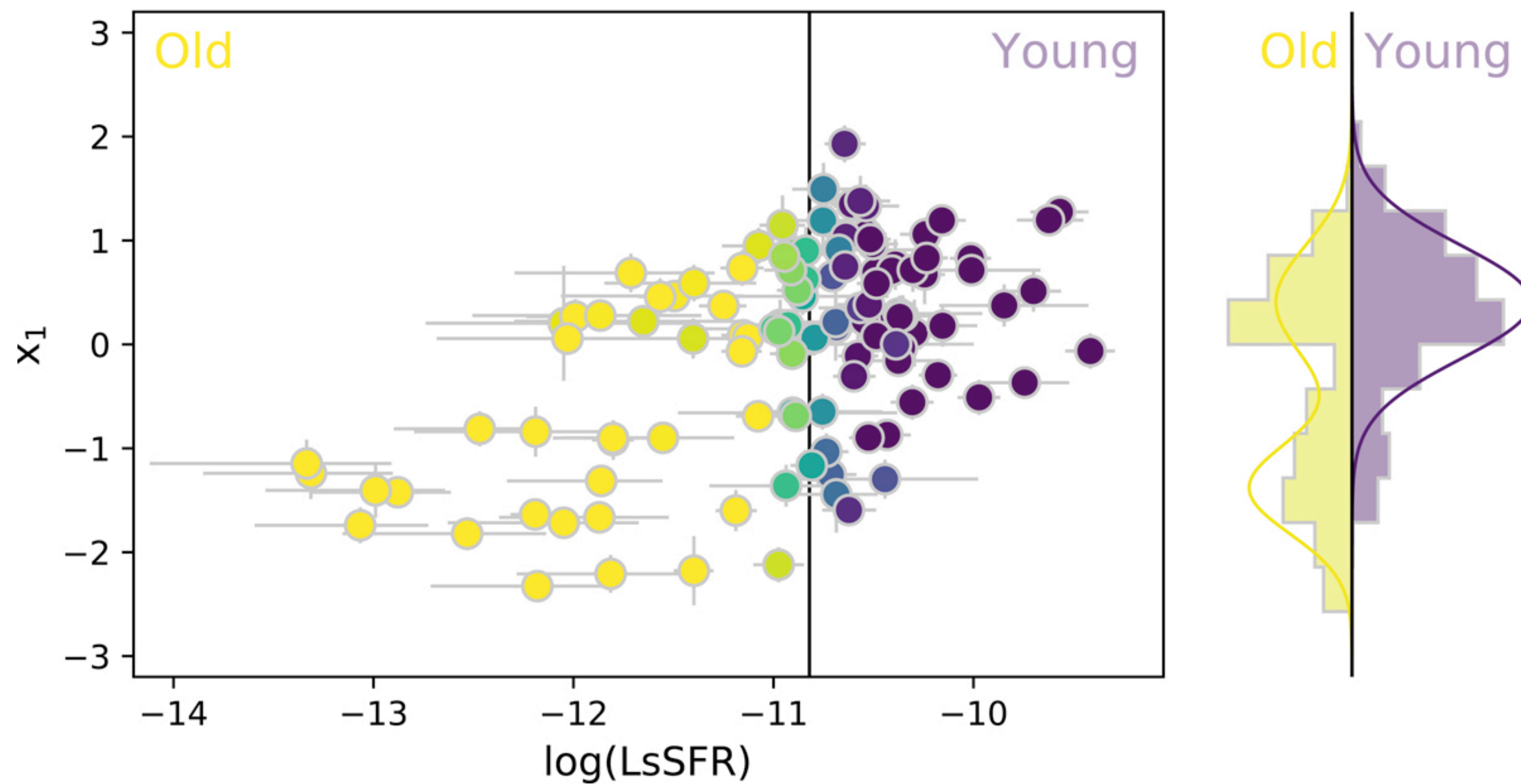
Stretch distribution



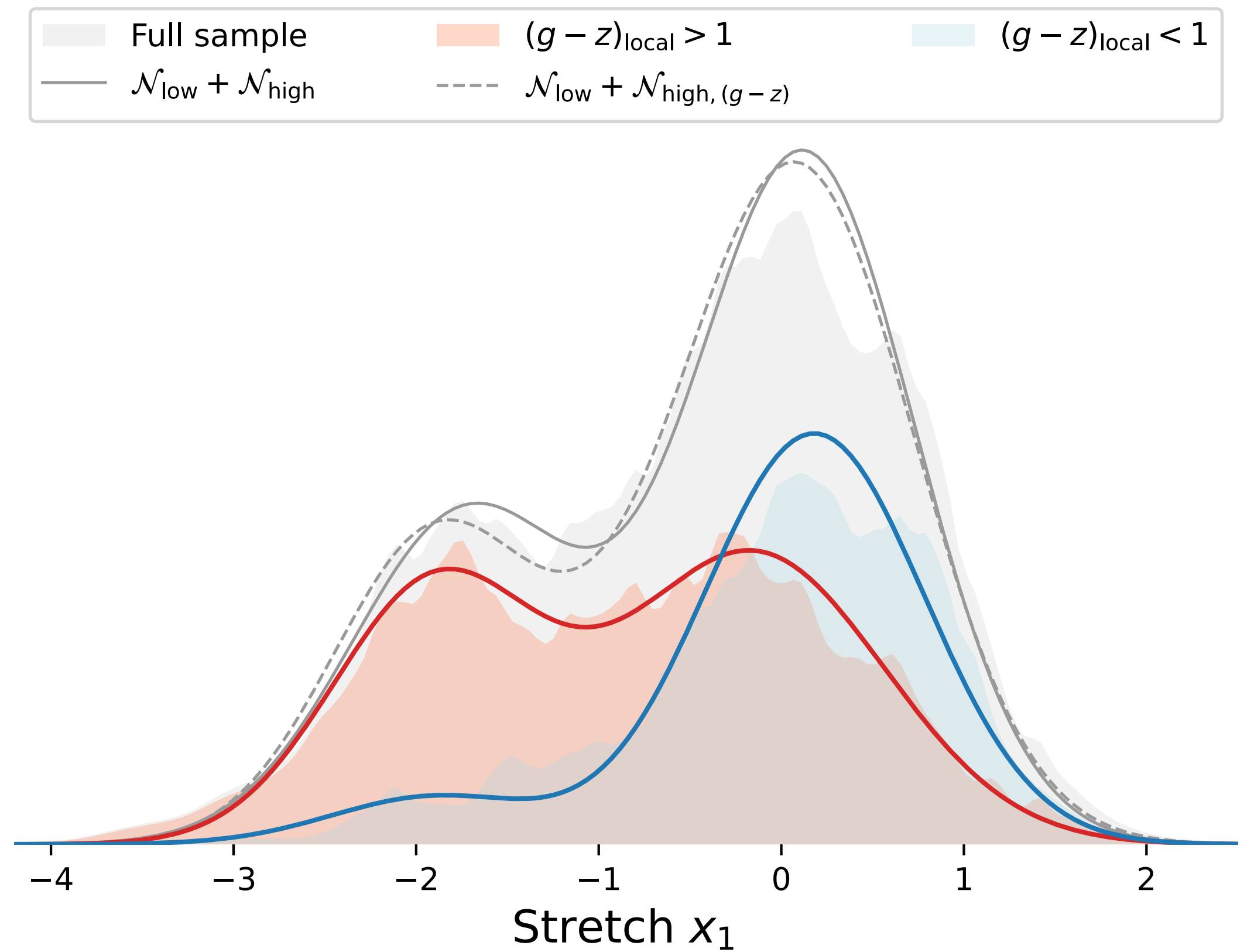
Nicolas et al (2021)
SNF - 114 SNe

Standardisation

Stretch distribution



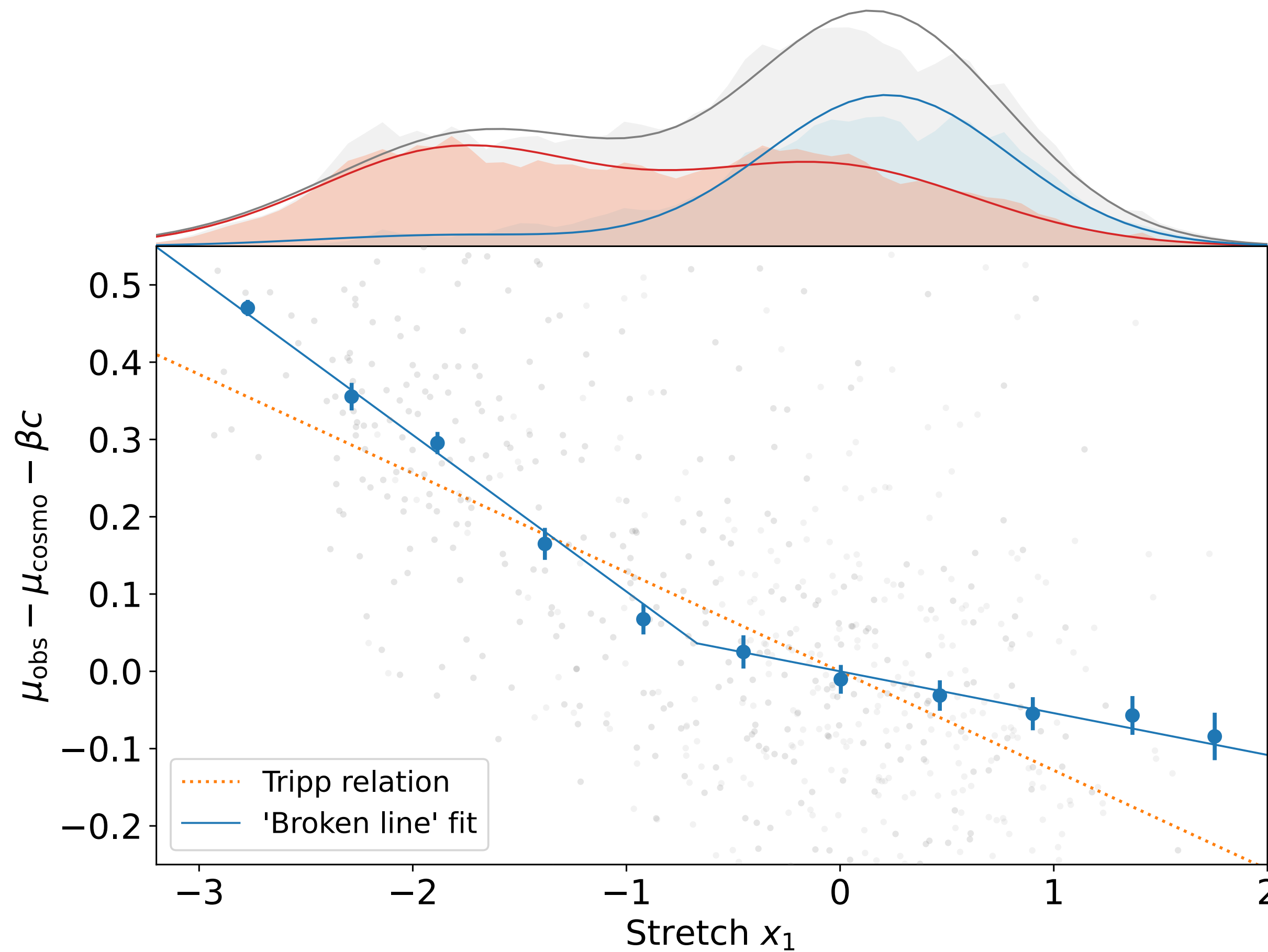
Nicolas et al (2021)
SNF - 114 SNe



Ginolin et al (in prep)

Standardisation

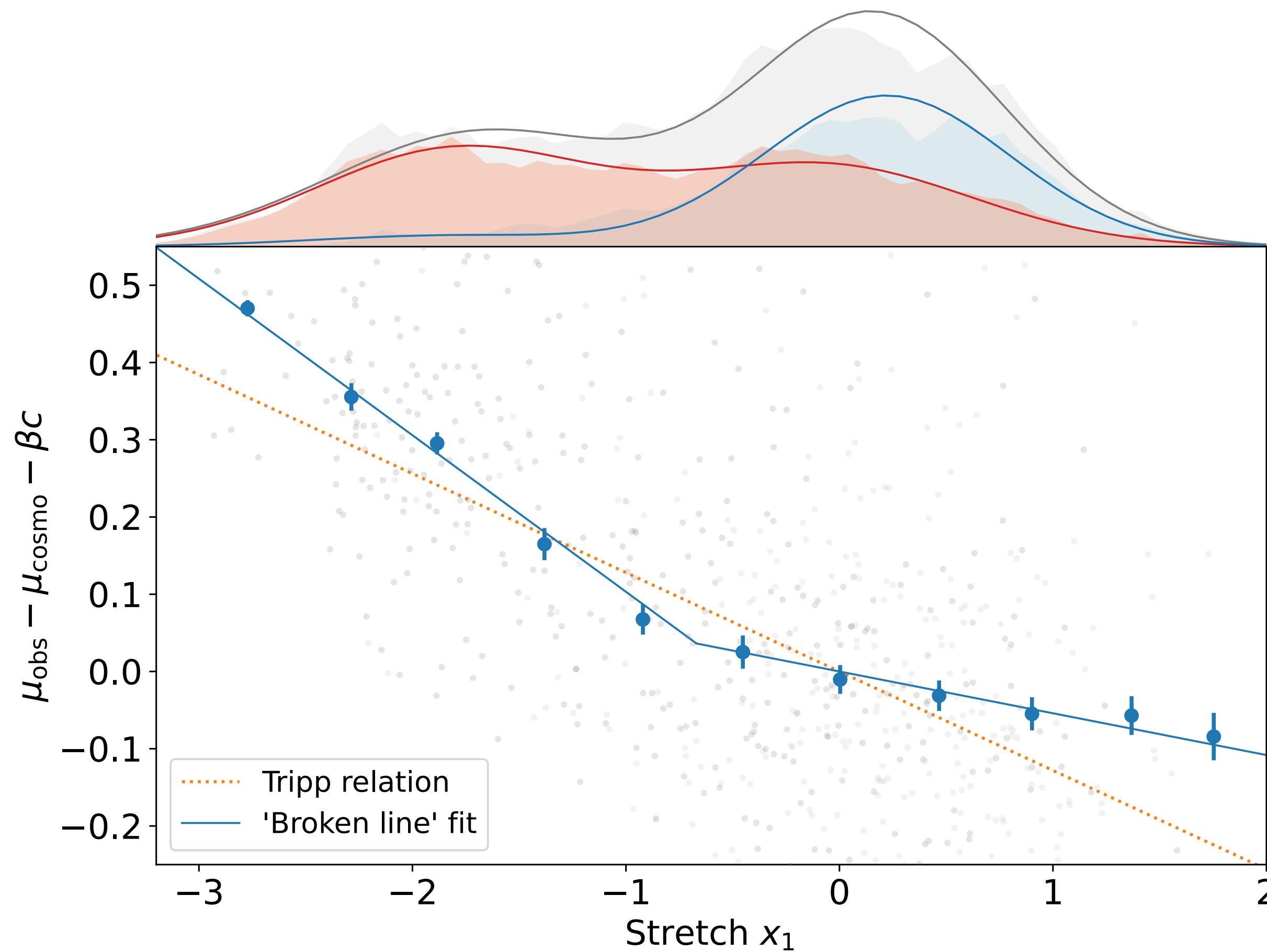
Non linearity of the stretch-residuals relation



Ginolin et al (in prep)

Standardisation

Non linearity of the stretch-residuals relation

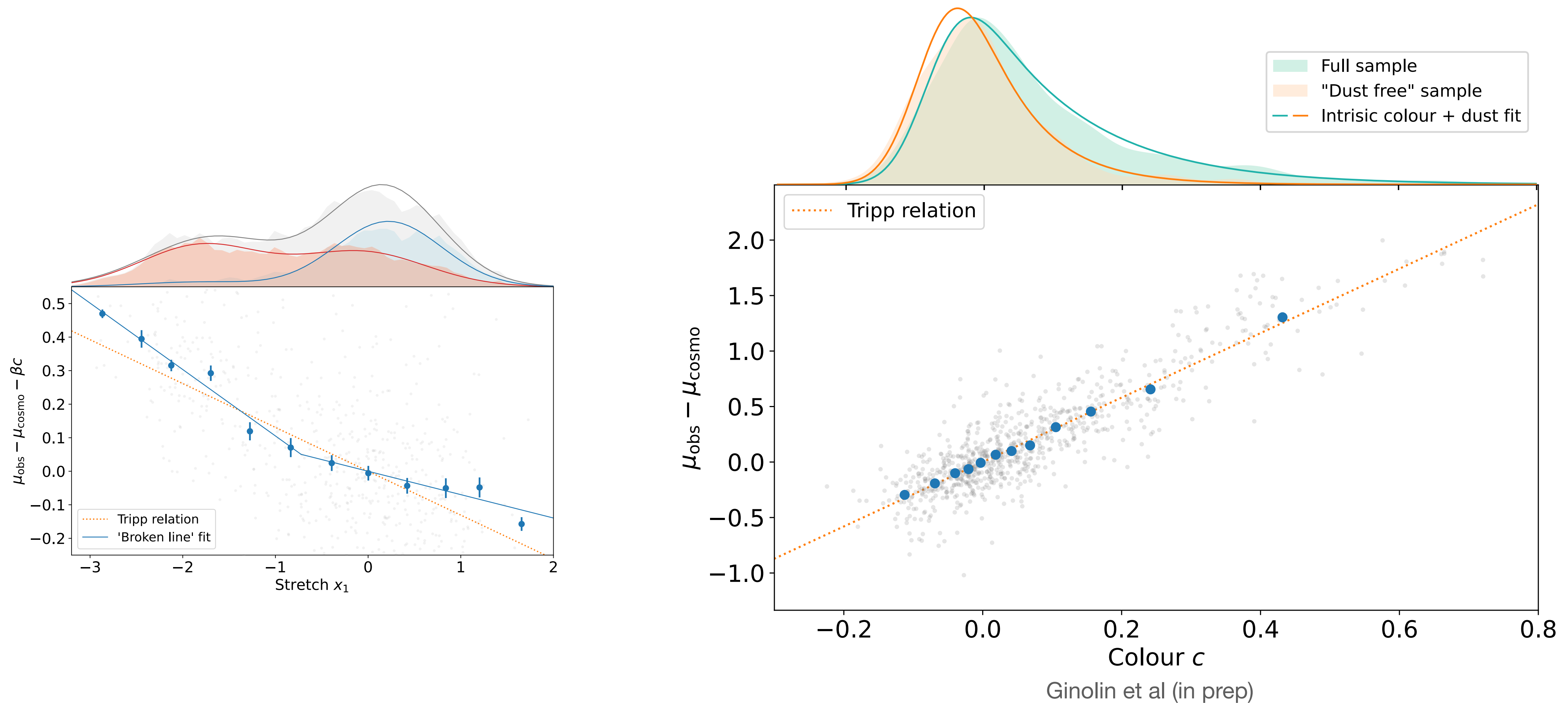


Discovery

Ginolin et al (in prep)

Standardisation

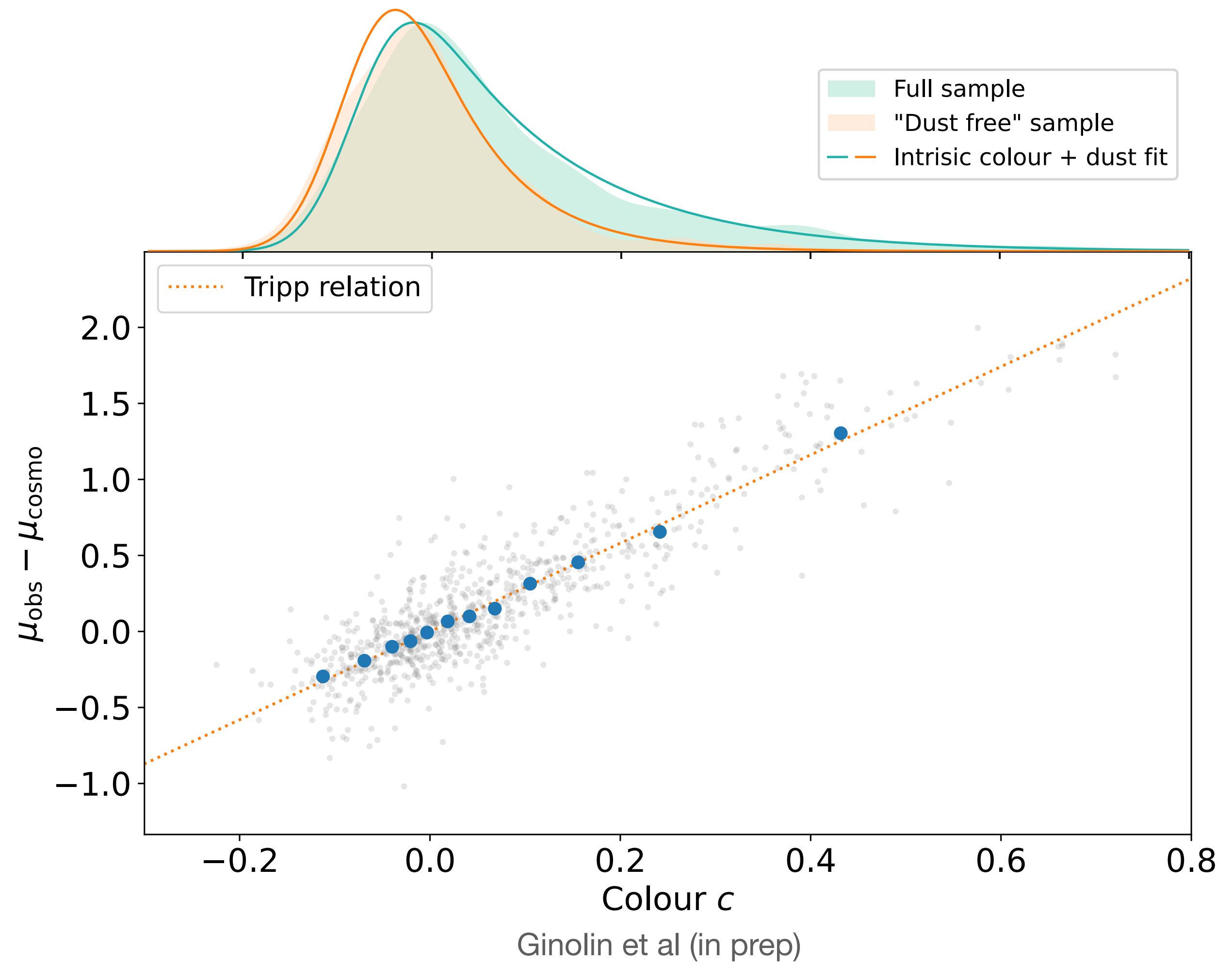
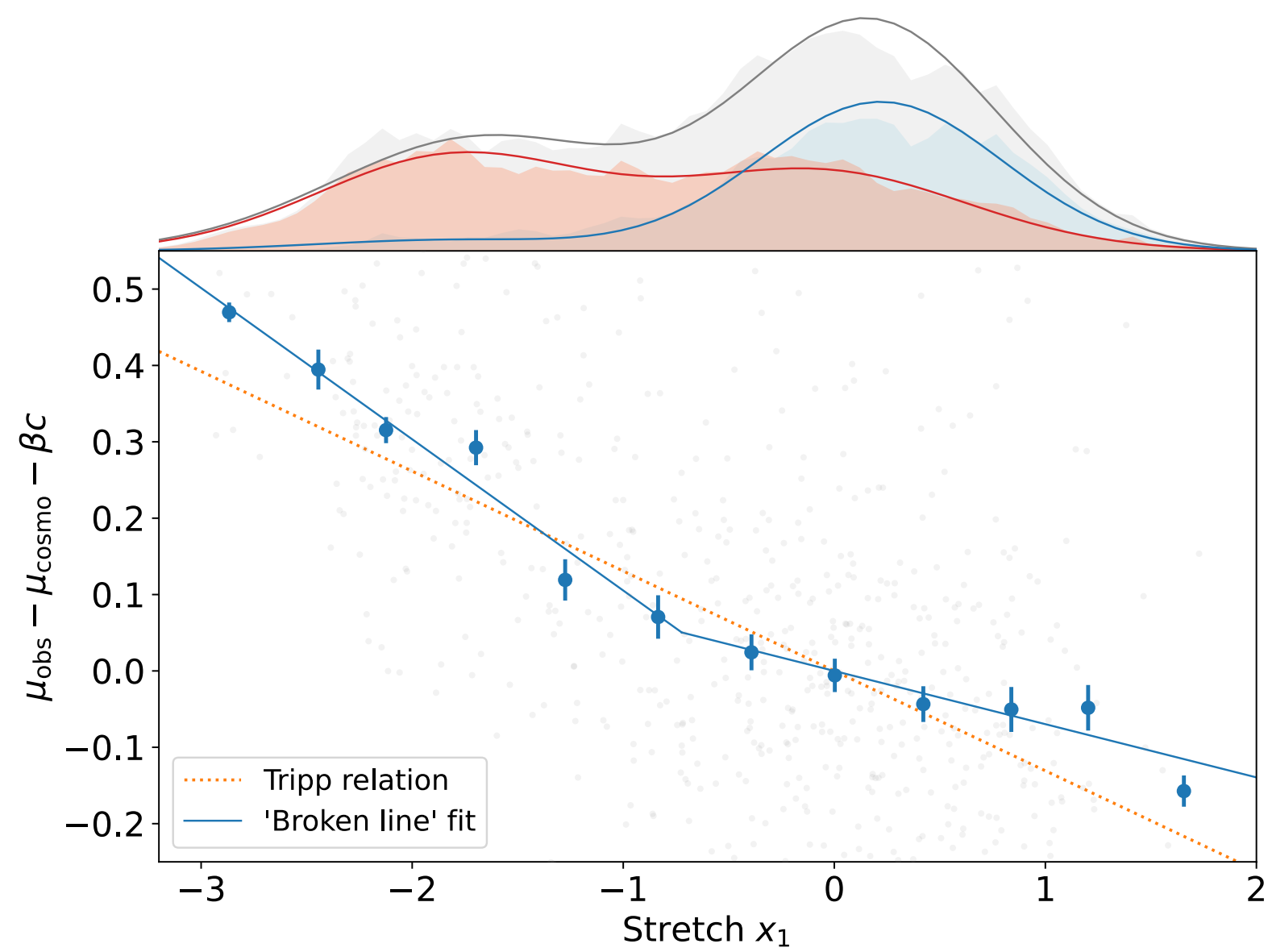
Linearity of the colour-residuals relation



Standardisation

Linearity of the colour-residuals relation

Discovery

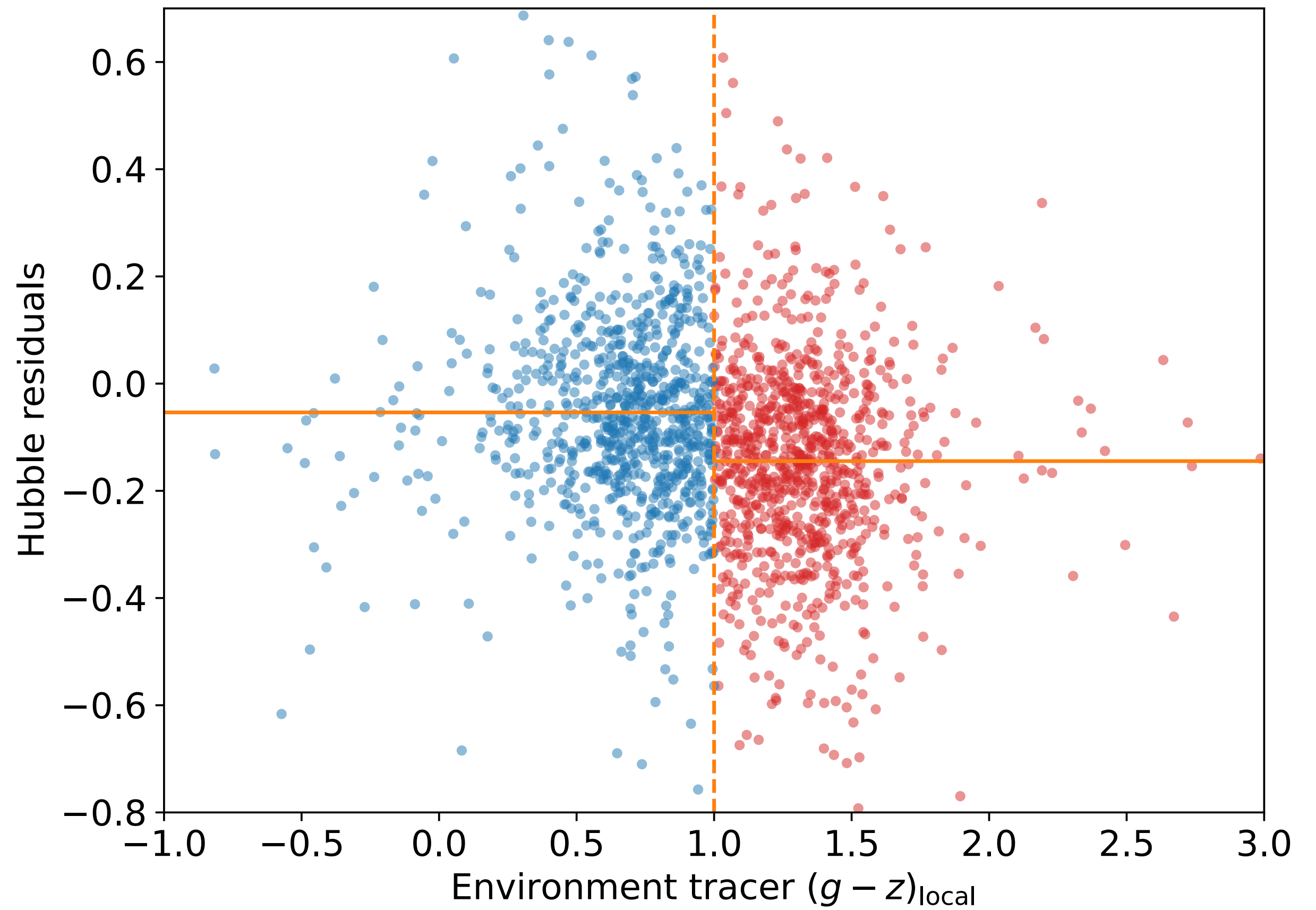
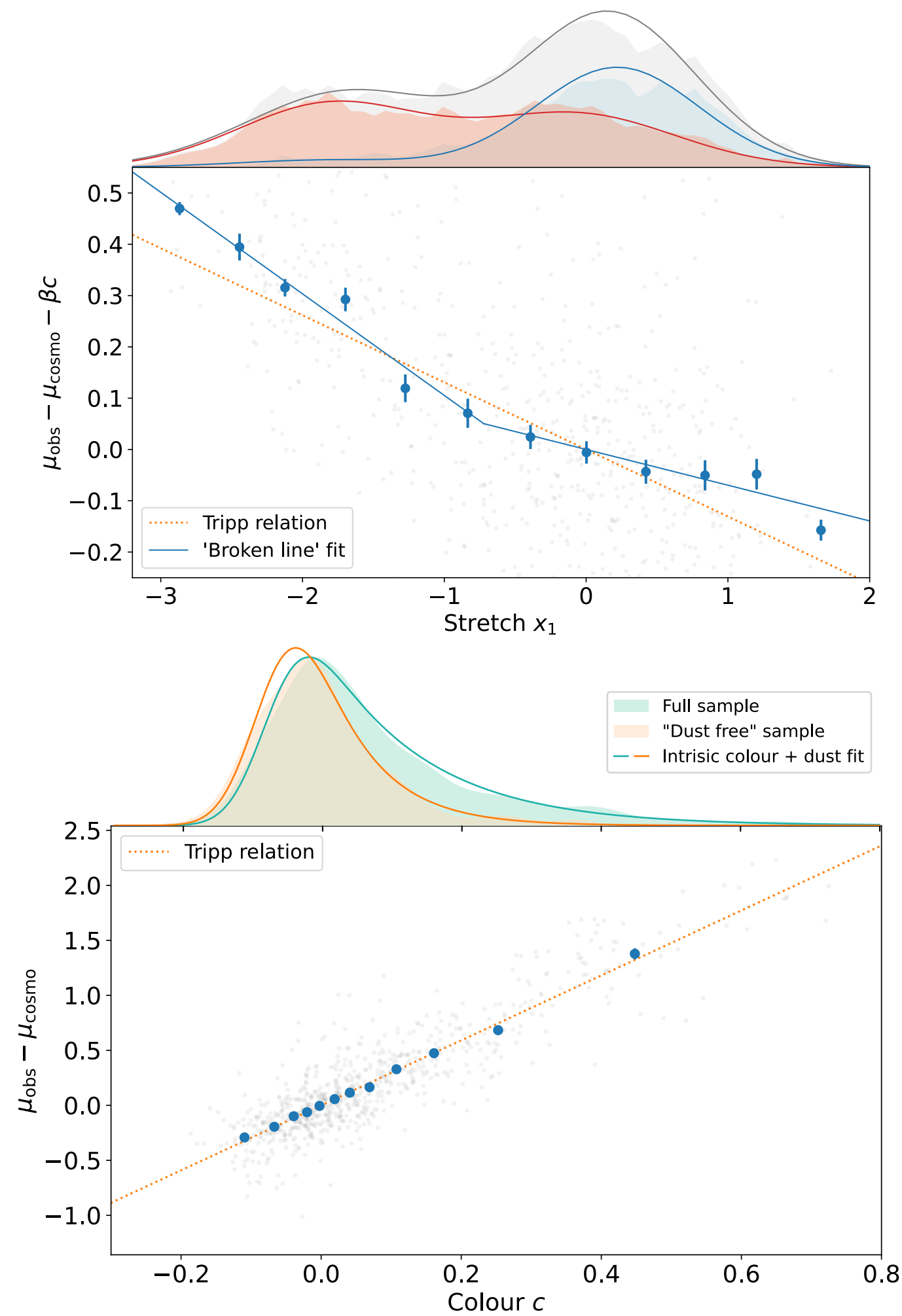


Ginolin et al DR2

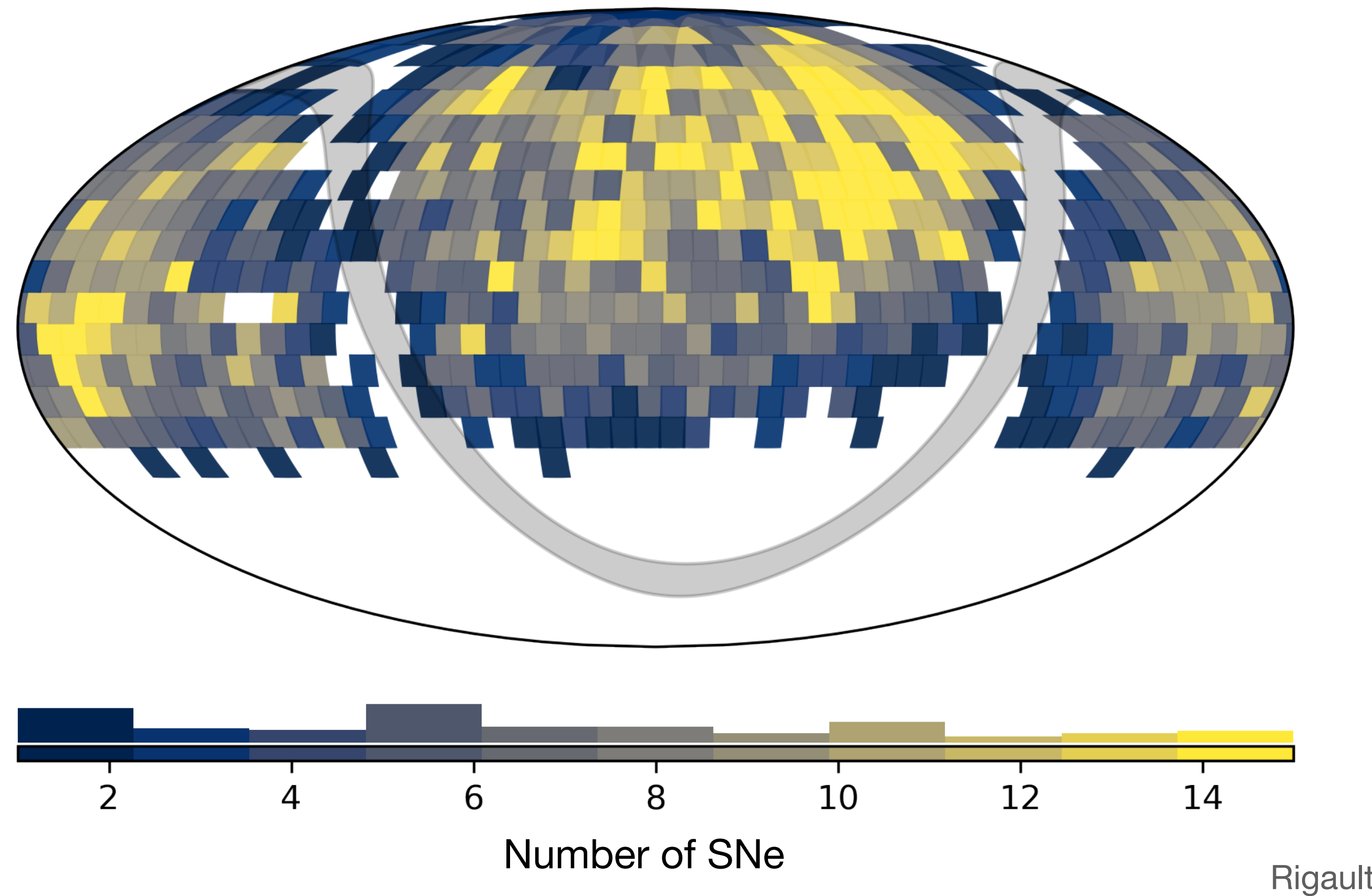
Standardisation - Astrophysical biases

$$\gamma = 0.12 \pm 0.02$$

(with or without the 'broken alpha' law)



Stay tuned!



Papers coming soon

- Photometry (Lacroix+)
- fsigma8 (Rigault+, Carreres+)
- Simulation (Amenouche+)
- SNe in clusters (Ruppin+)
- Astrophysical biases (Ginolin+)
- Photometric diversity (Dimitriadis+)
- Spectral diversity (Burgaz+, Johansson+)
- Early time signature (Harvey+)
- Progenitor signals (Terwel+)
- Photometric SNe (Townsend+)
- Siblings (Dhawan+)
- ...

Steps & contamination - Briday et al (2021)

