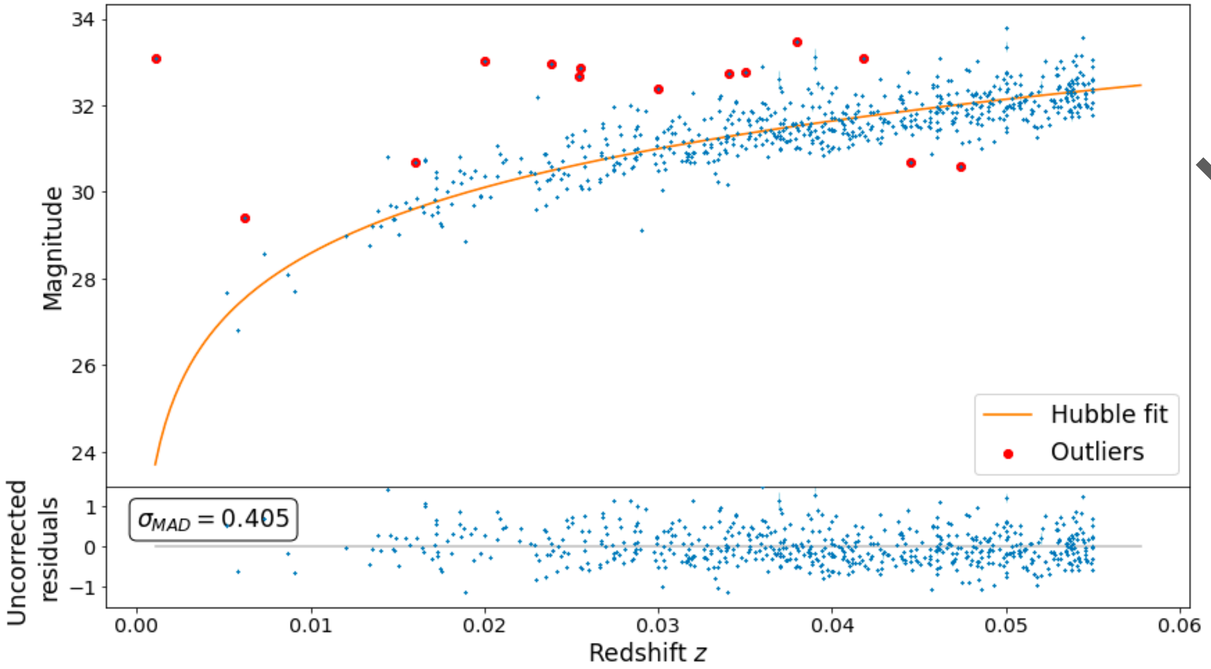
The ZTF Type Ia Supernovae volume limited sample

Rubin-LSST France @ LAPP

Madeleine GINOLIN - 17th May 2022

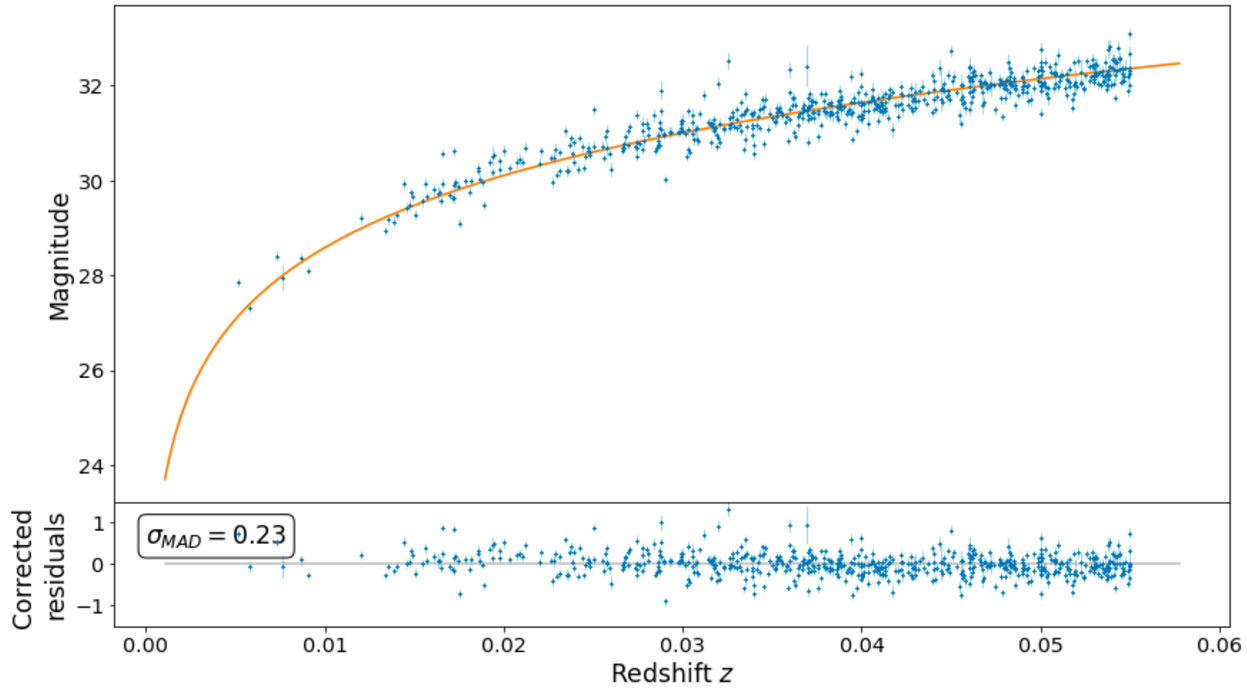
Hubble diagram

Standard correction



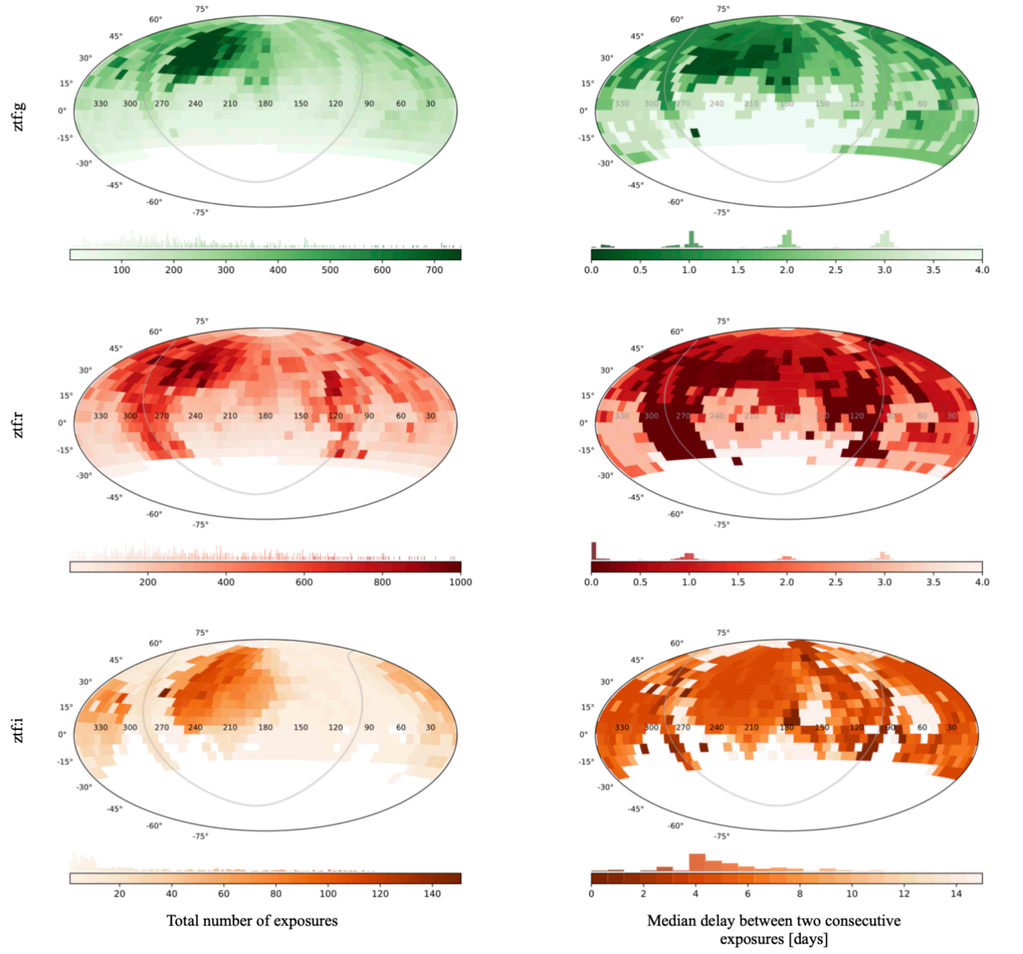
$$\Delta m = \beta c + \alpha x_1 + M$$

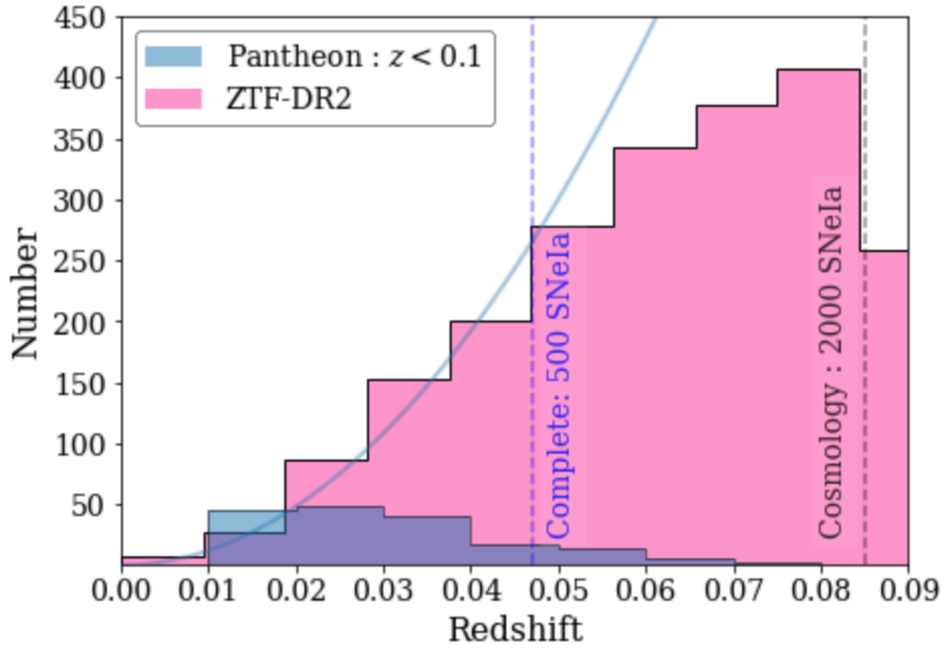
(Tripp 1998)



All results are preliminary

DR2 sample





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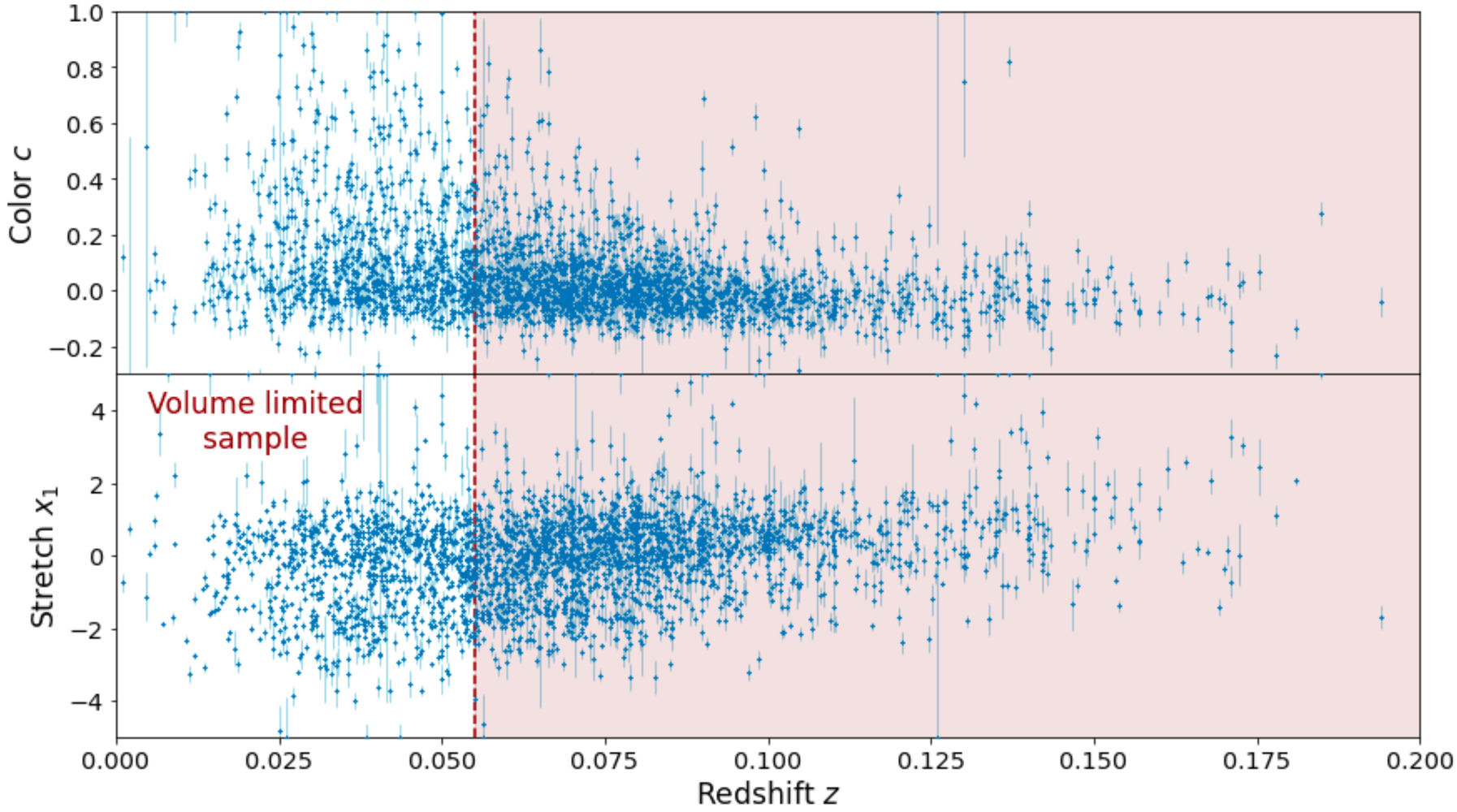
DR2 sample

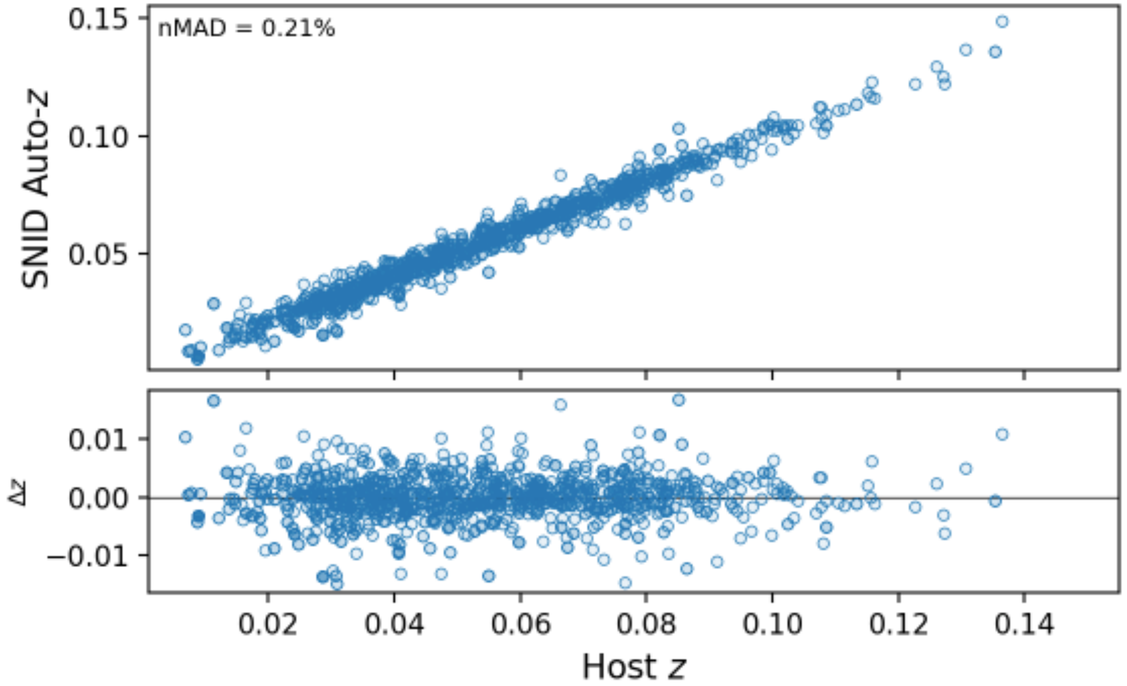
Volume limited sample



All results are preliminary

DR2 volume-limited sample

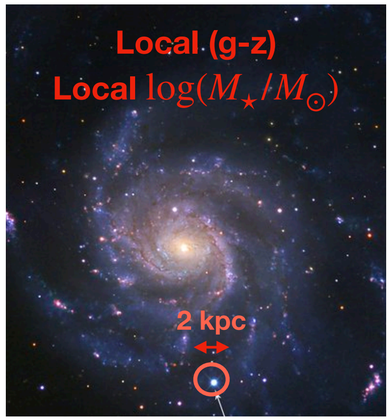
Sample	Size
SNe classified as Ia	3793
Good light curve	2975
Redshift cut	972
SALT fit probability	825
Color cut (values and errors)	664
Stretch cut (values and errors)	647
Host redshift	332

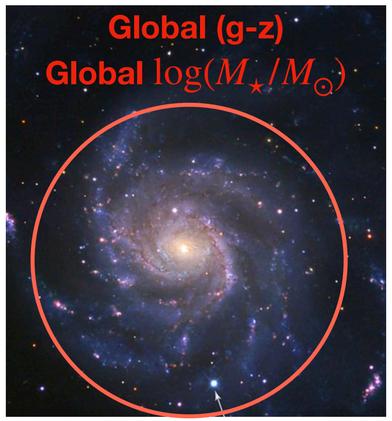


All results are preliminary

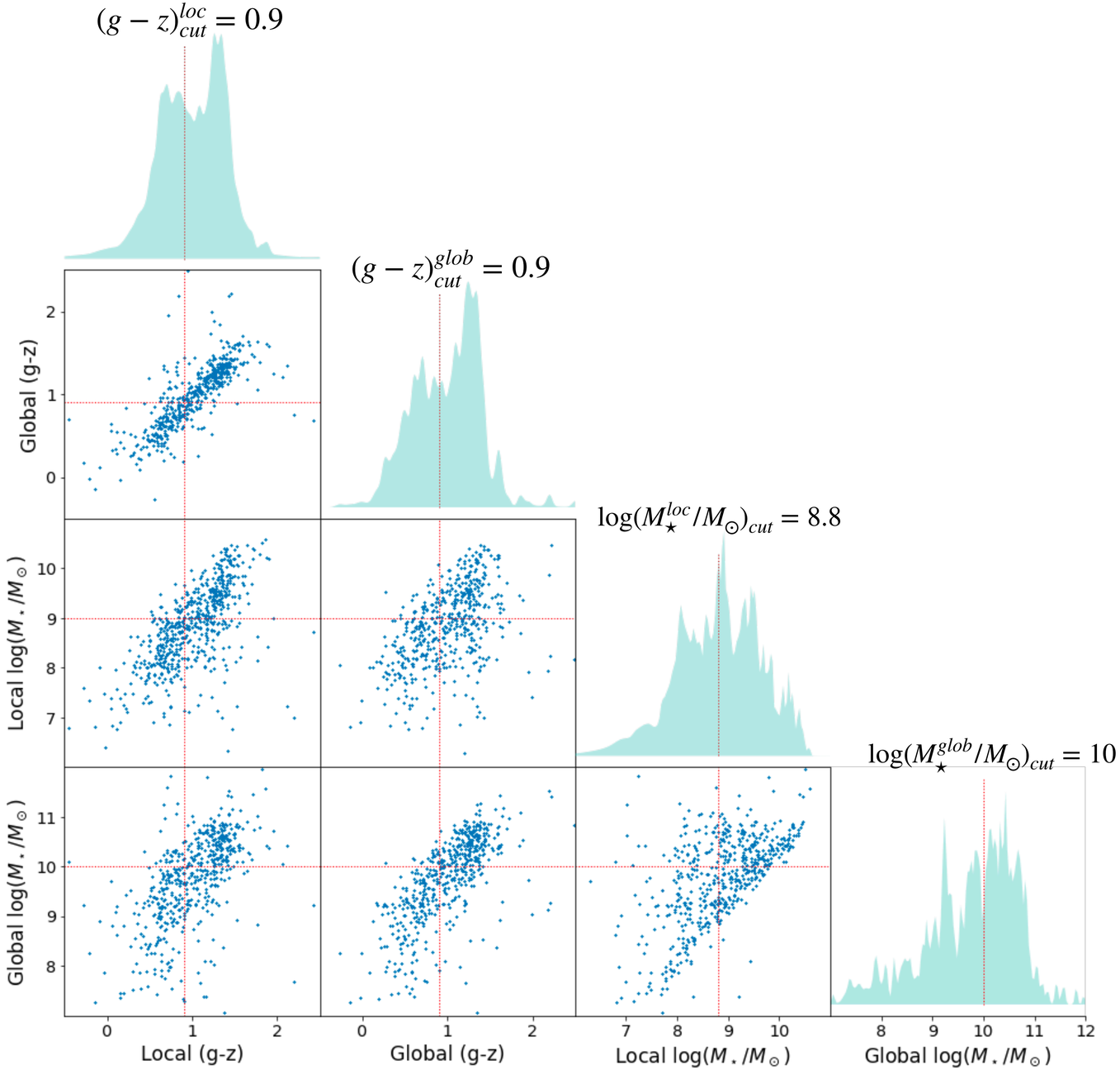
Hubble residuals

Environment properties





Credits: B.J. Fulton/
LCOGT/Caltech



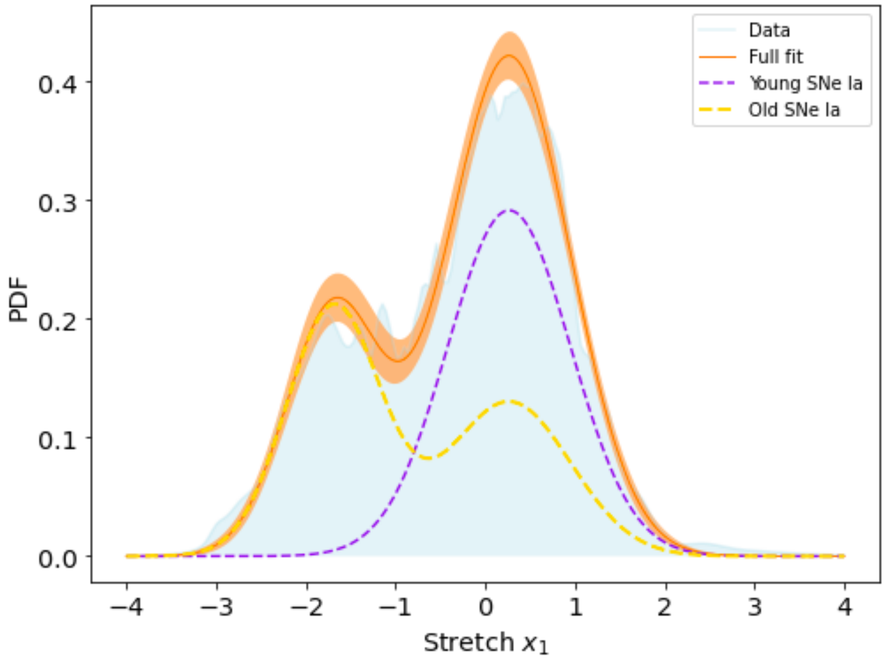
(Masses derived with the formula from Taylor et al. 2011)

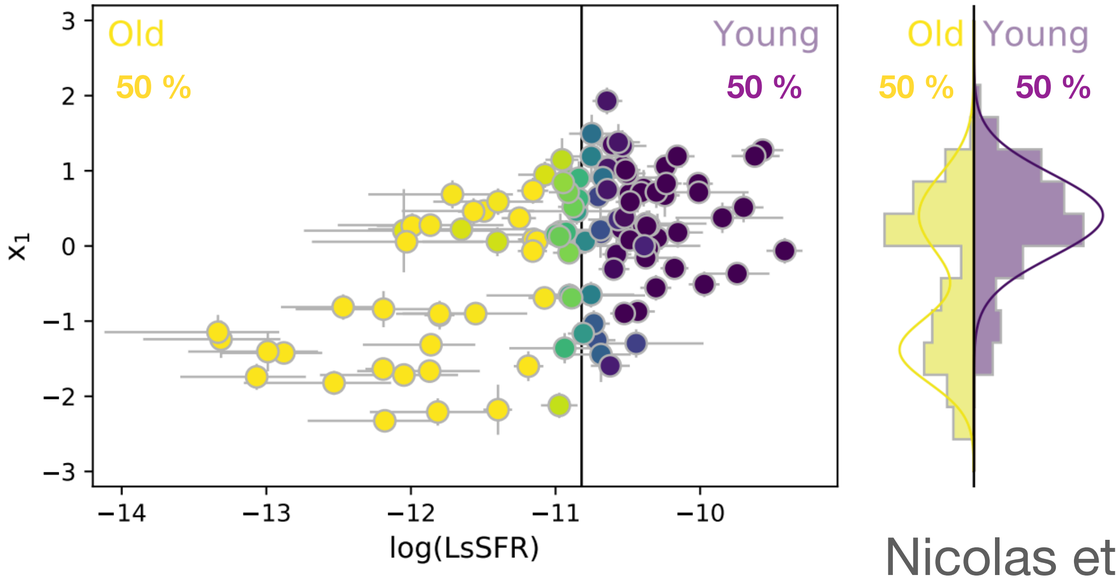
All results are preliminary

Stretch distribution

Two population model

$$\Delta m = \beta c + \alpha x_1 + M$$





Nicolas et al. (2021)

	μ_1	σ_1	μ_2	σ_2	Ratio
This work	0.27 ± 0.06	0.68 ± 0.04	-1.69 ± 0.09	0.52 ± 0.06	0.722 ± 0.034
Fiducial sample from Nicolas et al 2021	0.37 ± 0.05	0.61 ± 0.04	-1.22 ± 0.16	0.56 ± 0.10	0.76 ± 0.05
Difference (in sigmas)	1.28	1.24	2.56	0.34	0.63

All results are preliminary

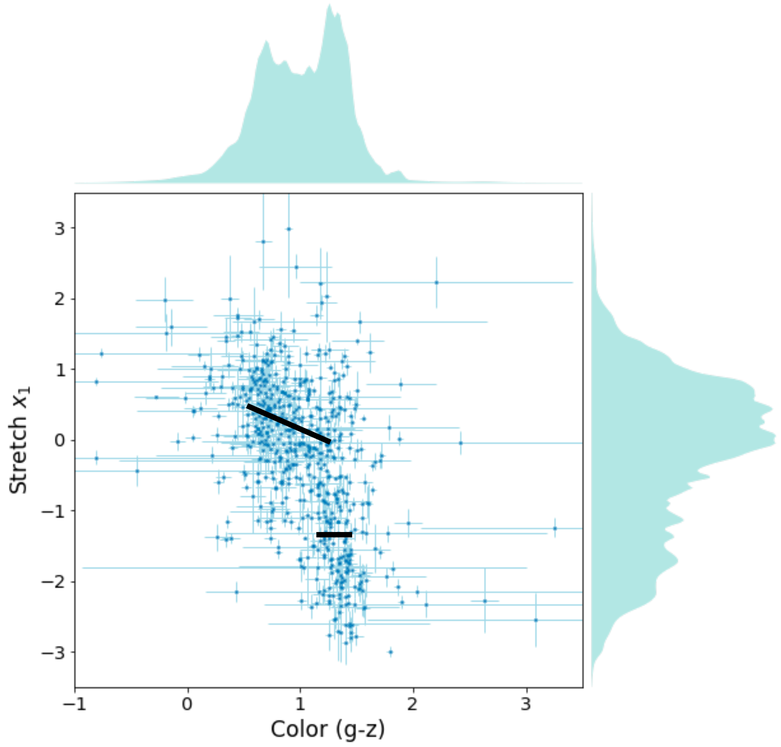
Color-stretch distribution

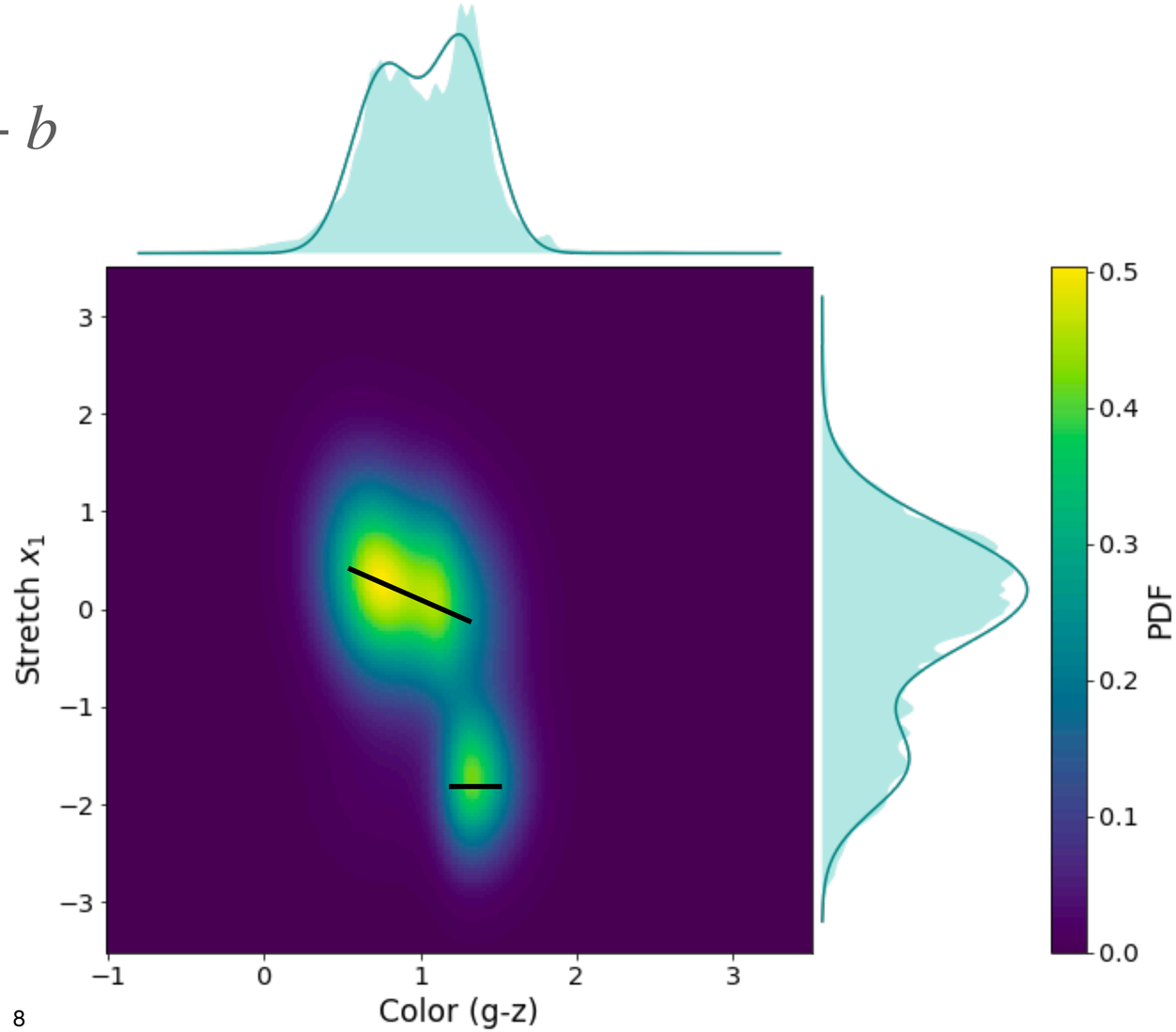
Data vs model

$$\Delta m = \beta c + \alpha x_1 + M$$

$$\mu_{high} = a(g - z) + b$$

$$a = -0.50 \pm 0.13$$



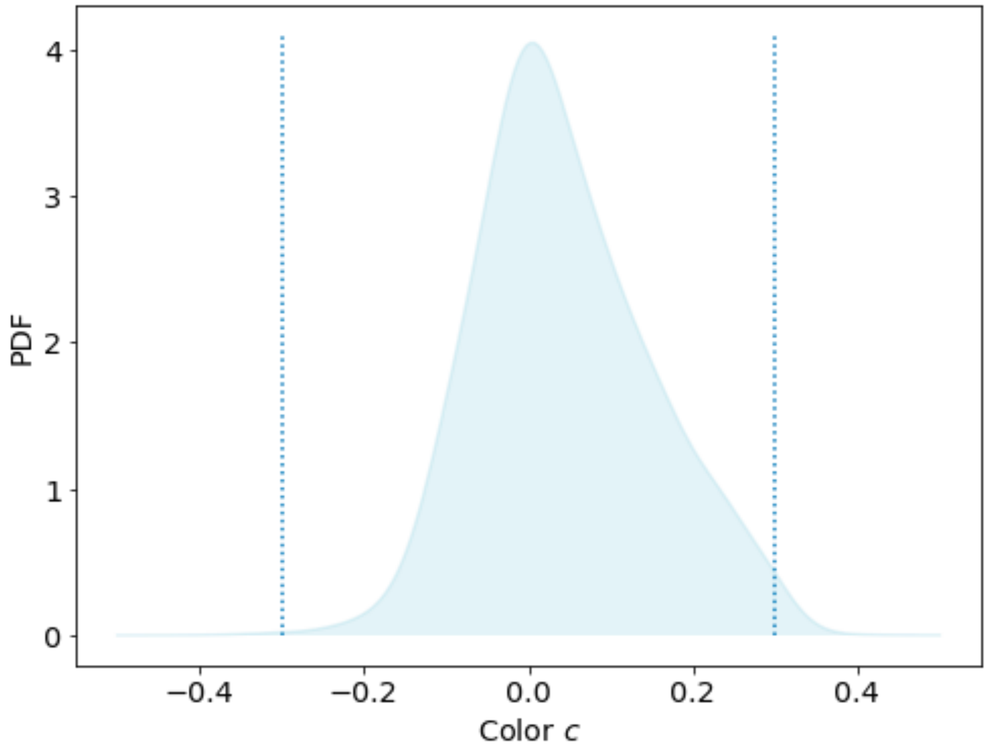


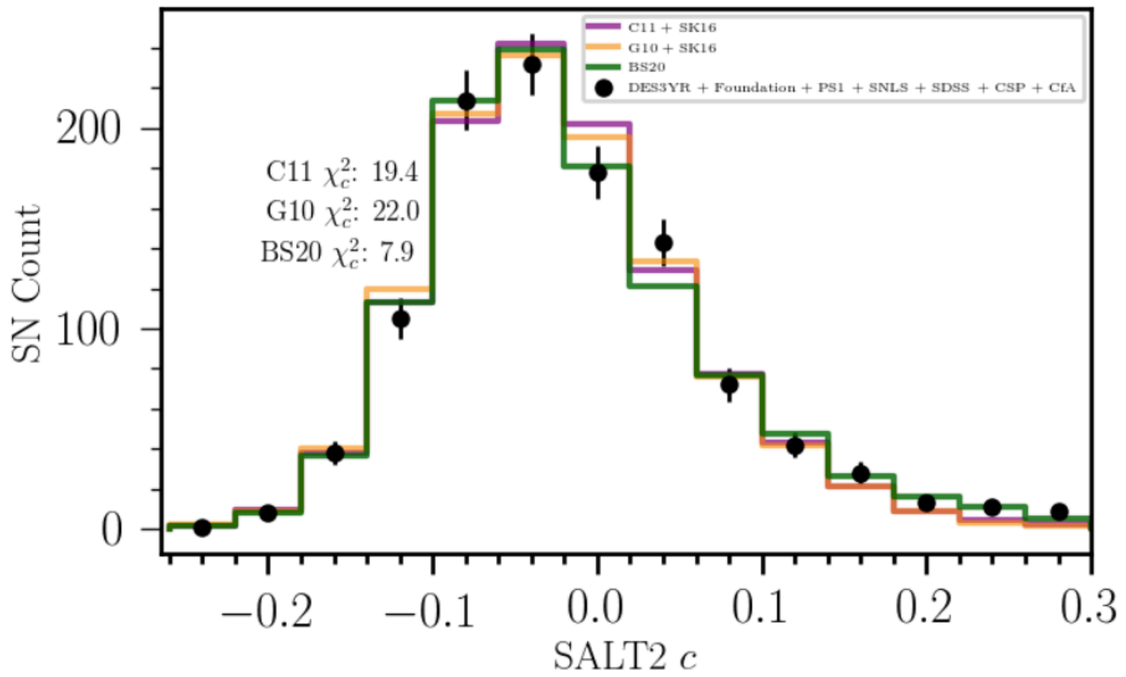
All results are preliminary

Color distribution

Data

$$\Delta m = \beta c + \alpha x_1 + M$$





Brout & Scolnic (2020)

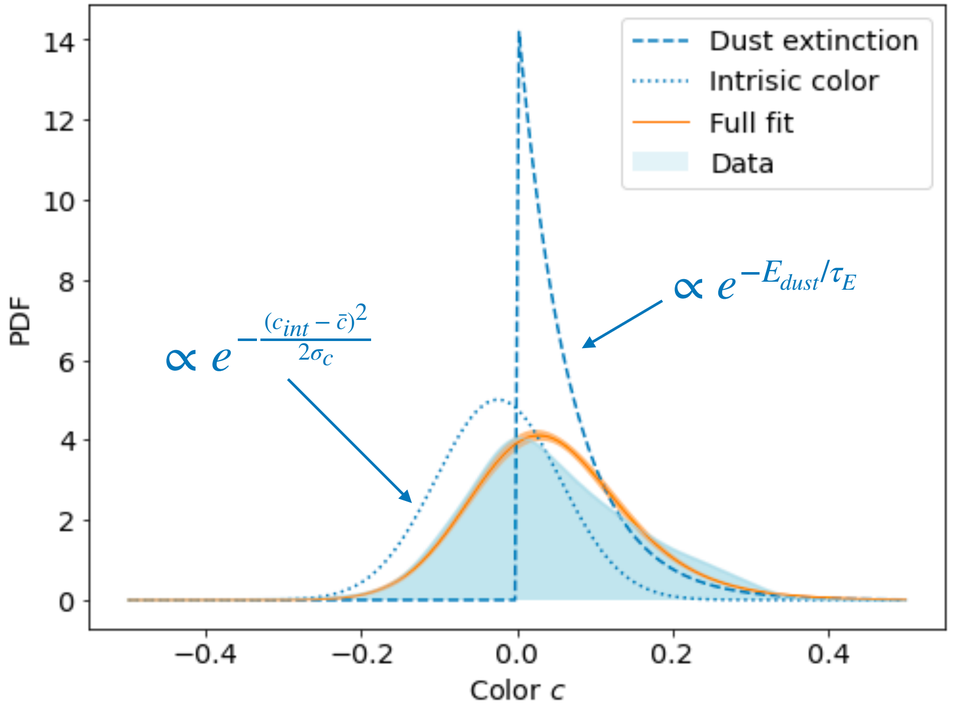
All results are preliminary

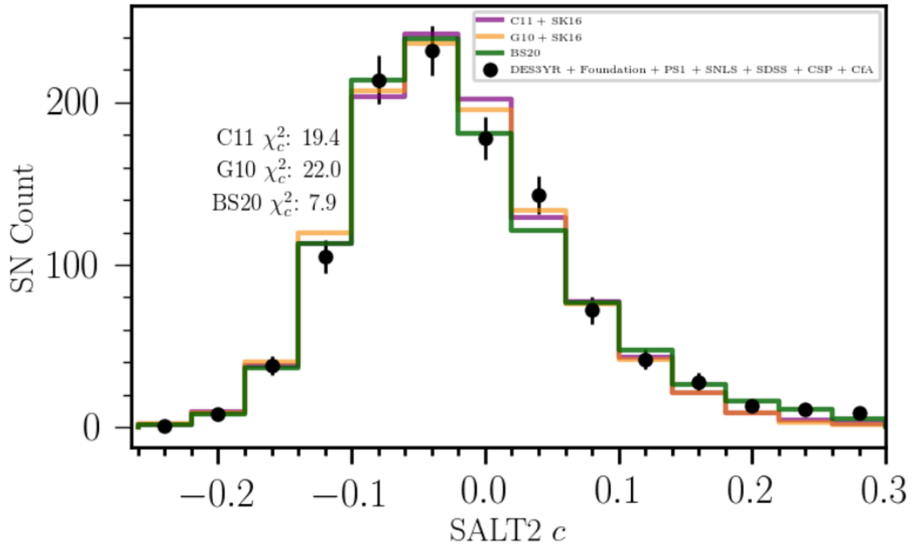
Color distribution

What is dust and what is intrinsic?

$$\Delta m = \beta c + \alpha x_1 + M$$

$$c_{obs} = c_{int} + E_{dust}$$





Brout & Scolnic (2020)

	$\bar{c}$	σ_c	τ_E
Brout & Scolnic 2020	-0.084 ± 0.004	0.042 ± 0.002	0.17 ± 0.04
This work	-0.034 ± 0.009	0.070 ± 0.006	0.078 ± 0.009
Difference (in sigmas)	5.08	4.43	2.24

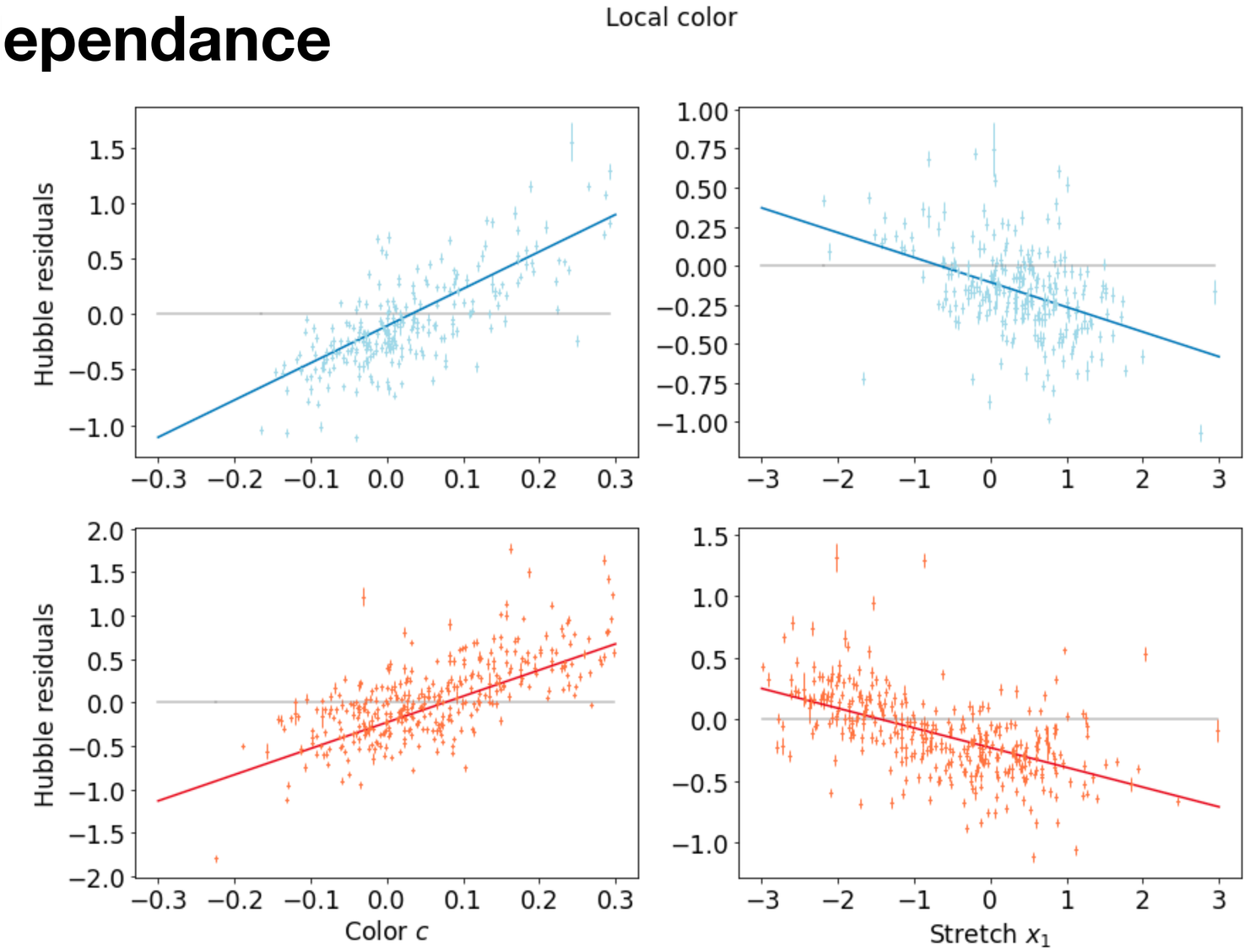
All results are preliminary

Hubble residuals

Environmental dependance

$$\Delta m = \beta c + \alpha x_1 + M$$

➡ Different (β, α, M) for the two populations



$+ \; M_{blue}$

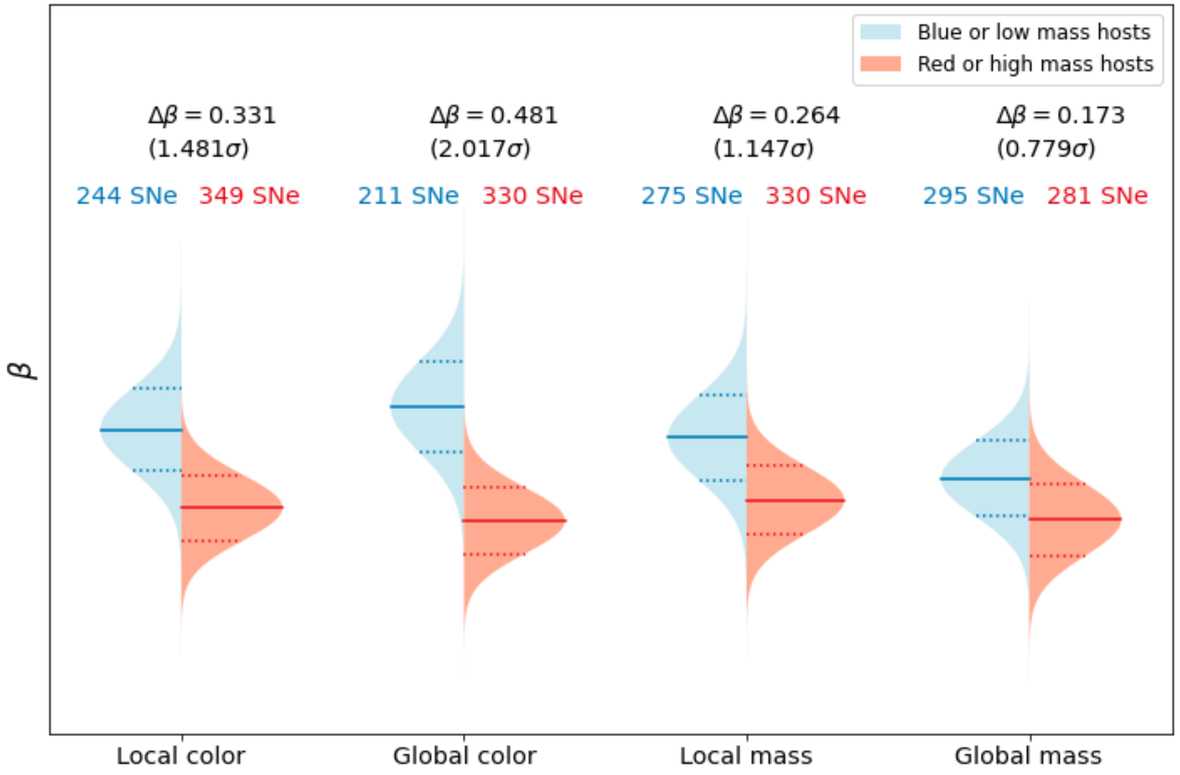
$+ \; M_{red}$

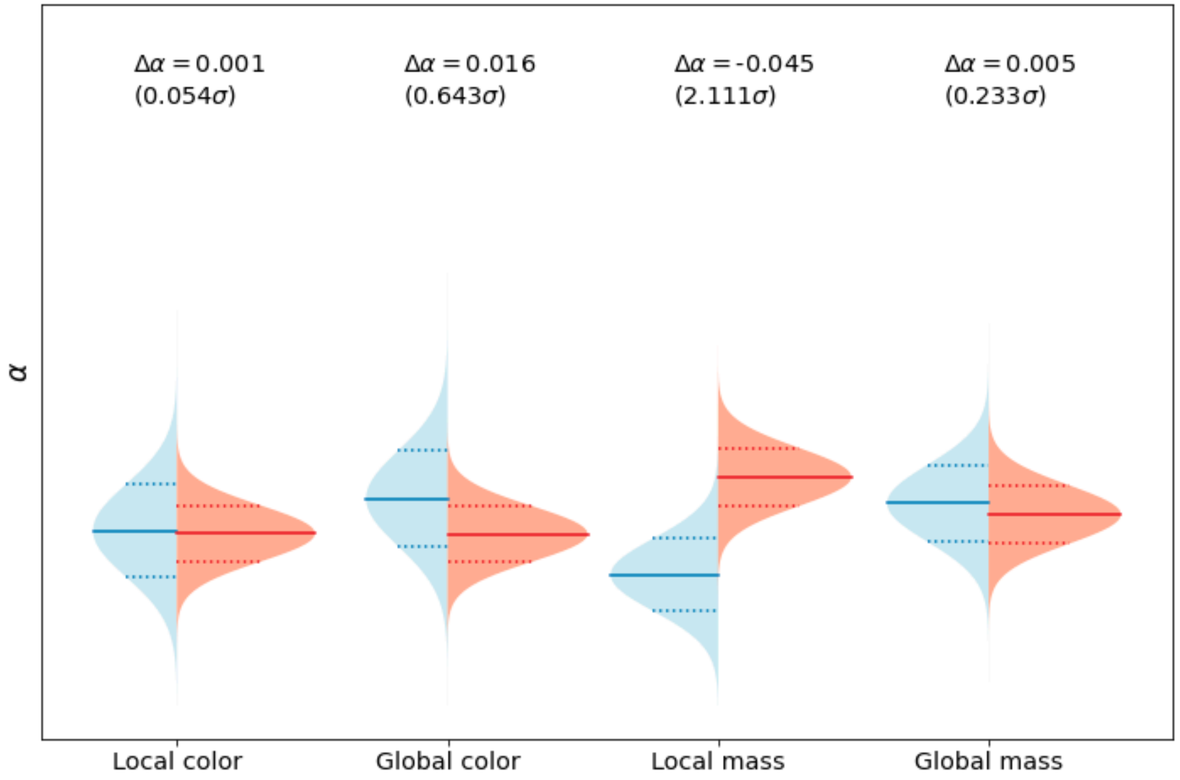
All results are preliminary

Hubble residuals

Environmental dependance

$$\Delta m = \beta c + \alpha x_1 + M$$



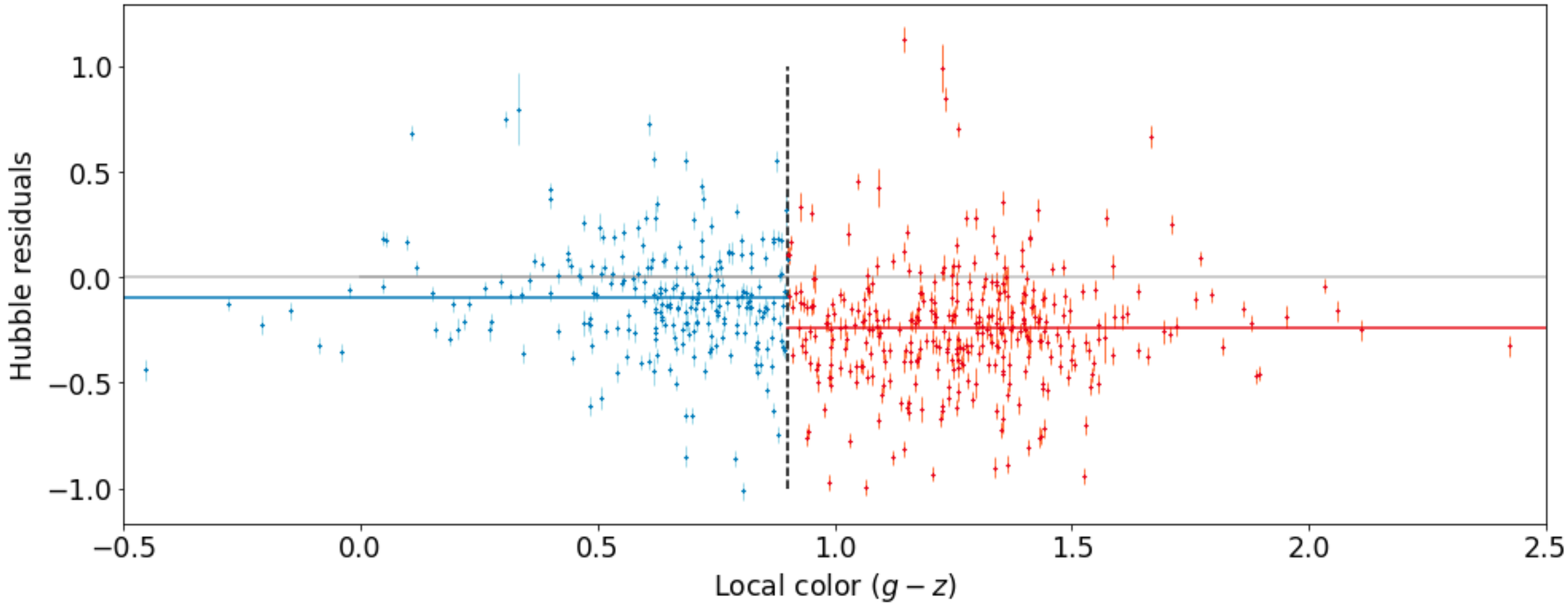


All results are preliminary

Hubble residuals

Step function

$$\Delta m = \beta c + \alpha x_1 + M$$



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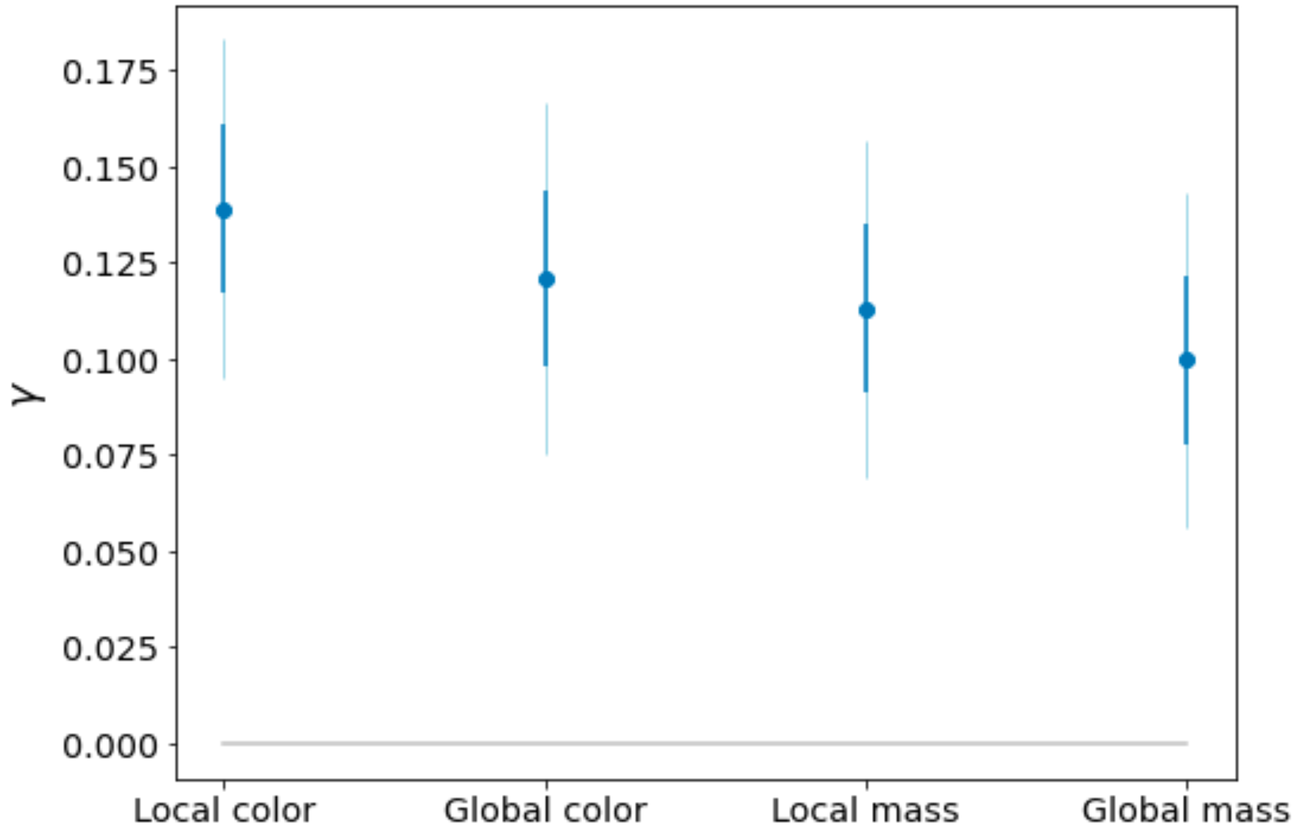
Hubble residuals

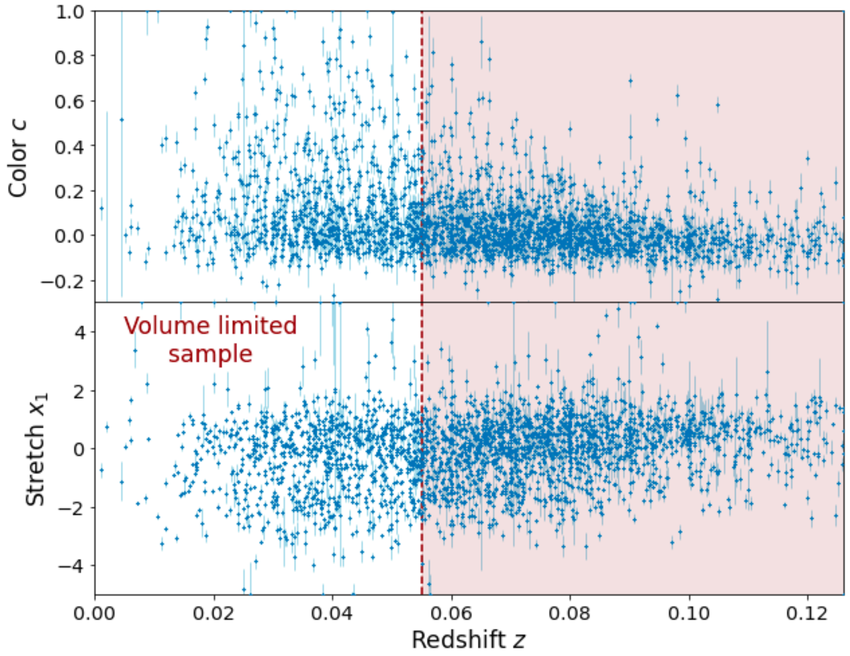
Step function

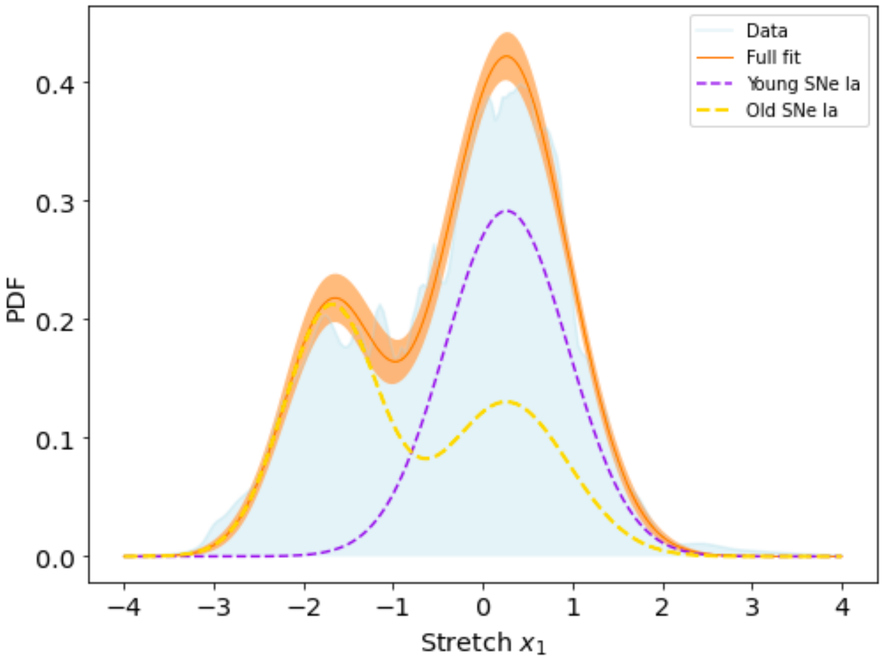
$$\Delta m = \beta c + \alpha x_1 + M$$

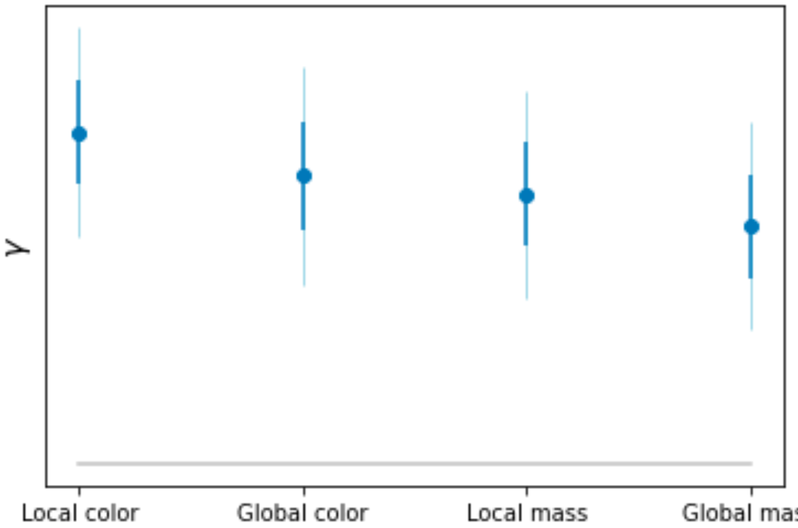


All results are preliminary

Conclusion







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