Redshift evolution of the SN stretch distribution

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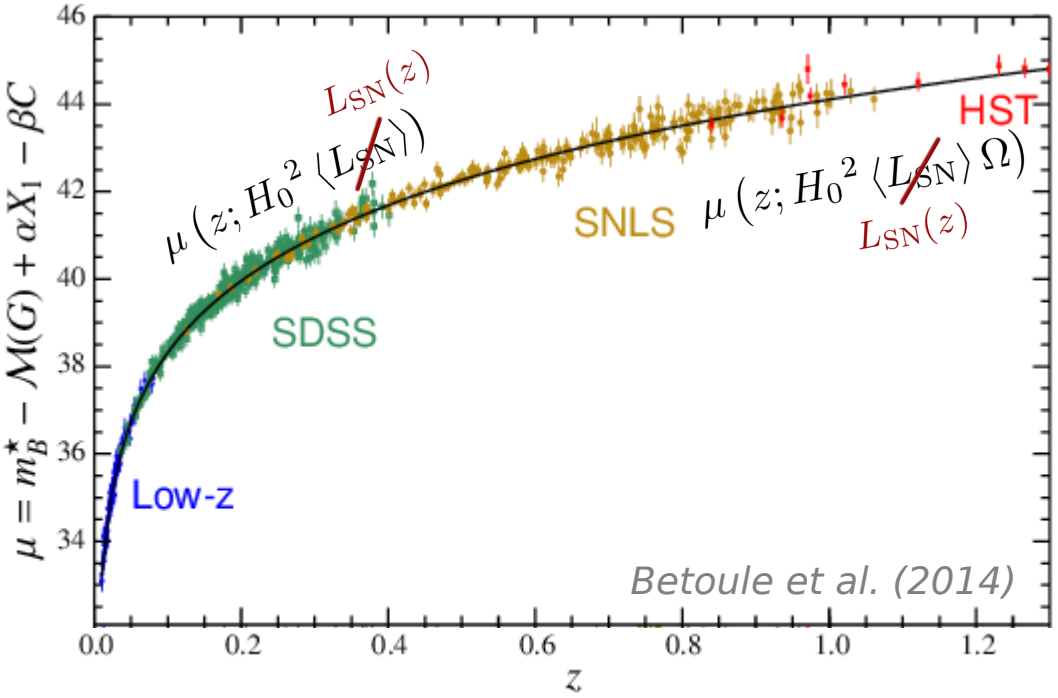
LSST France Conference

Systematic errors

Two sources of variation:

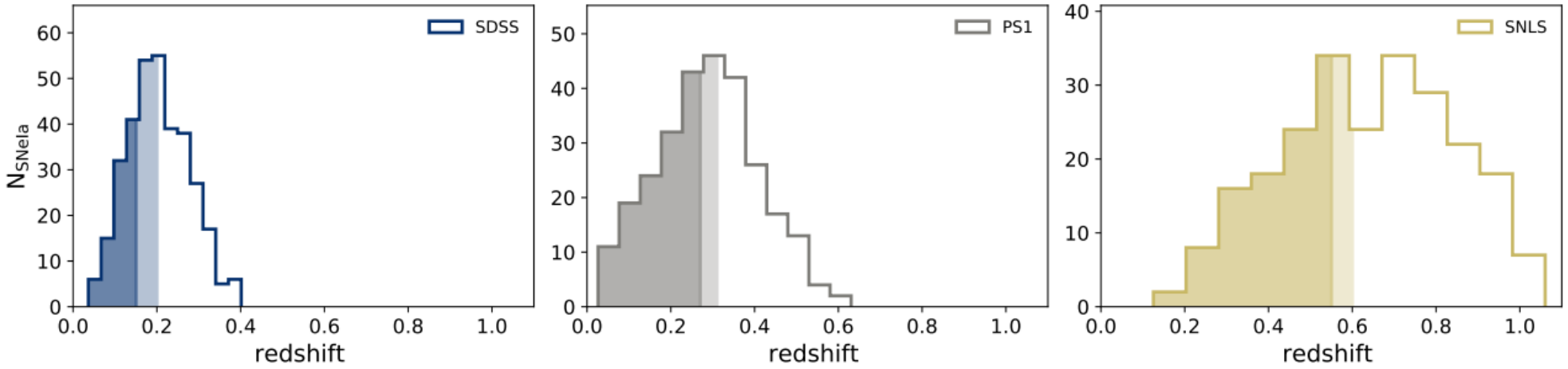
Calibration, human limit

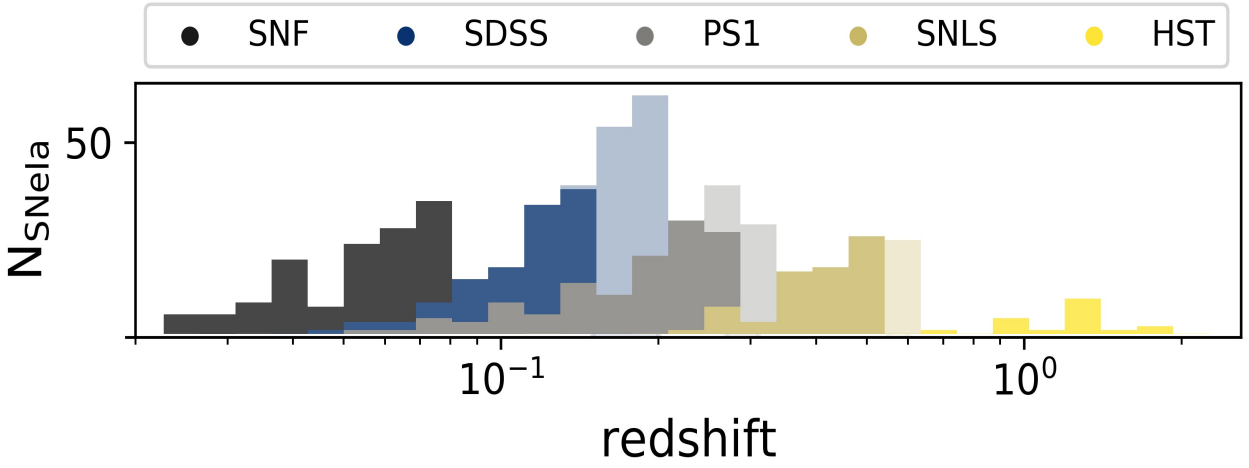


Lack of knowledge, astrophysical limit

Complete sample
free from selection effects

Nicolas et al. (2020)





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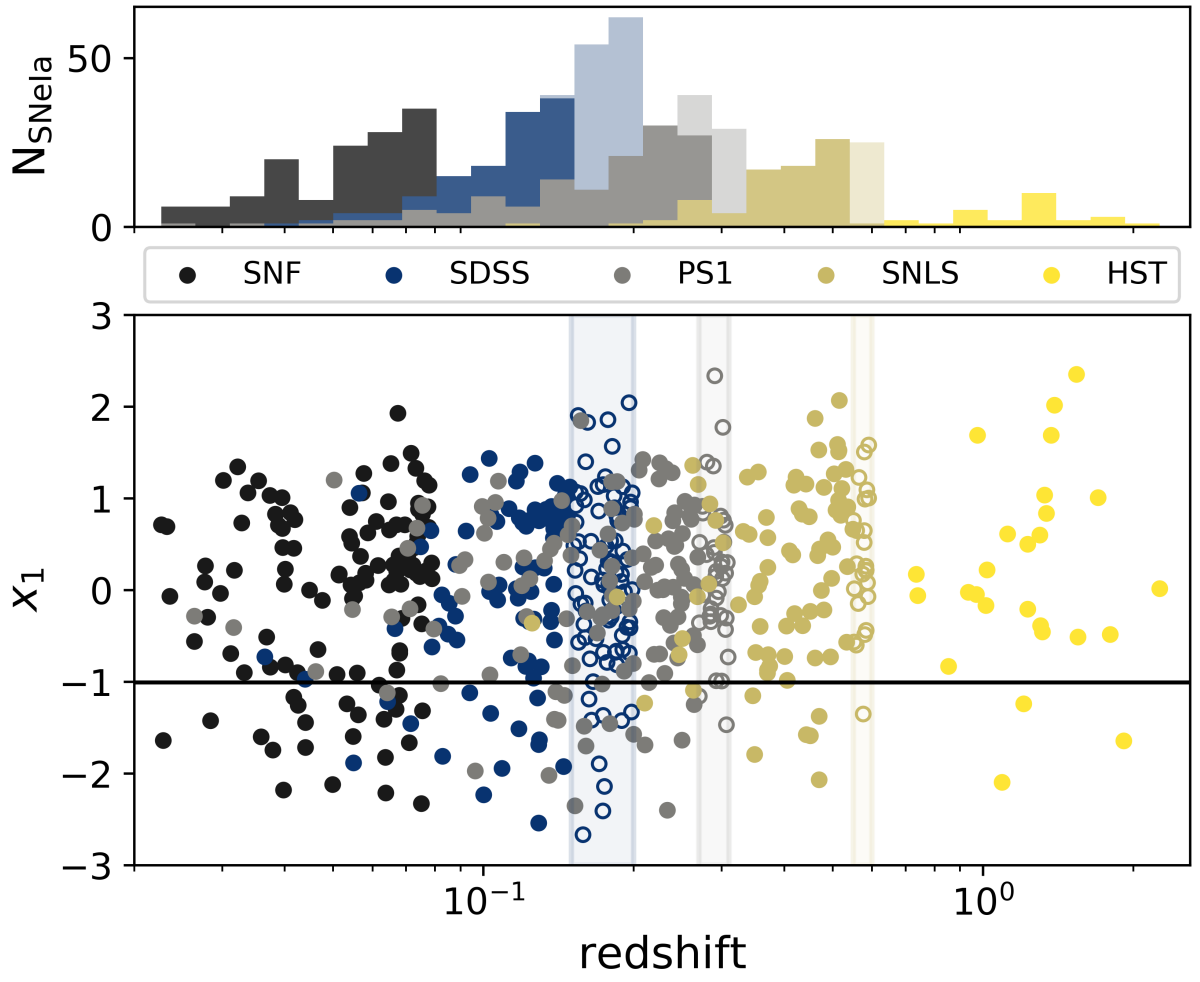
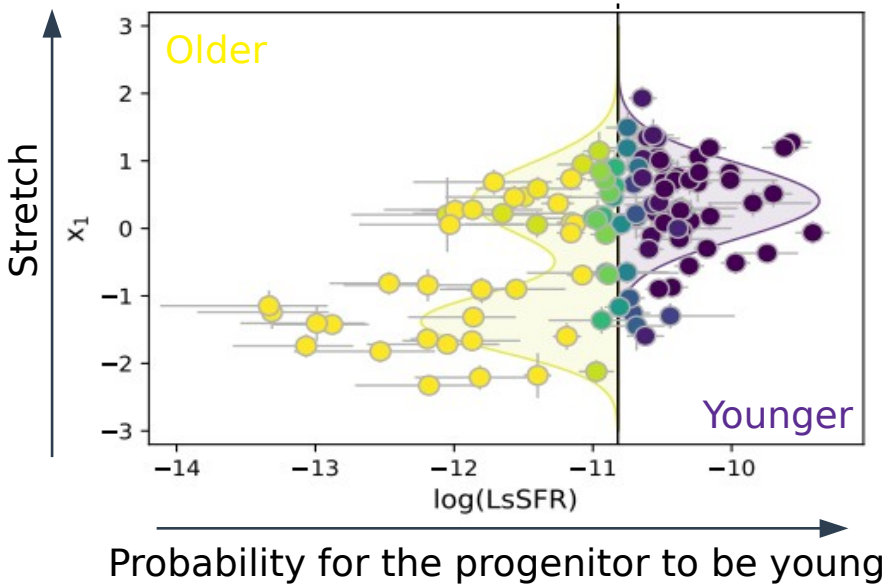
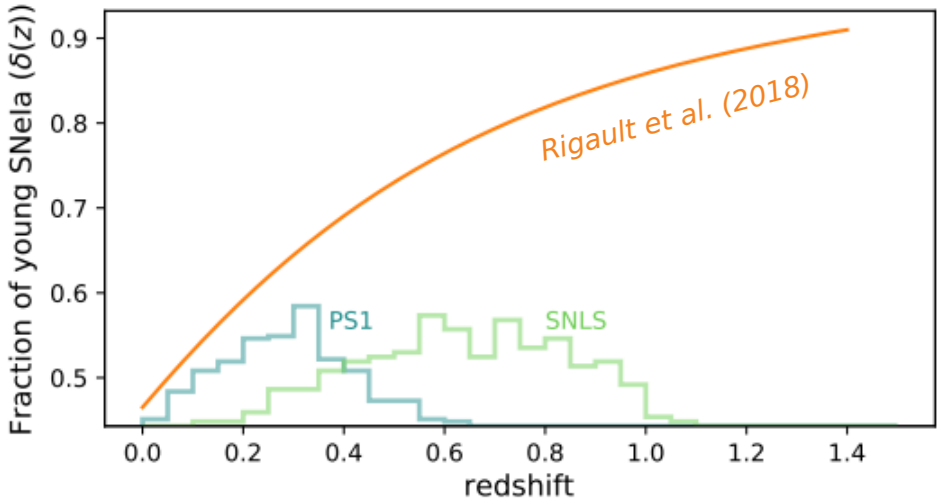


Why do we expect a stretch evolution?

Nicolas et al. (2020)

$$a \times \mathcal{N}(\mu_1, \sigma_1) + (1-a) \times \mathcal{N}(\mu_2, \sigma_2) \quad | \quad \mathcal{N}(\mu_1, \sigma_1)$$





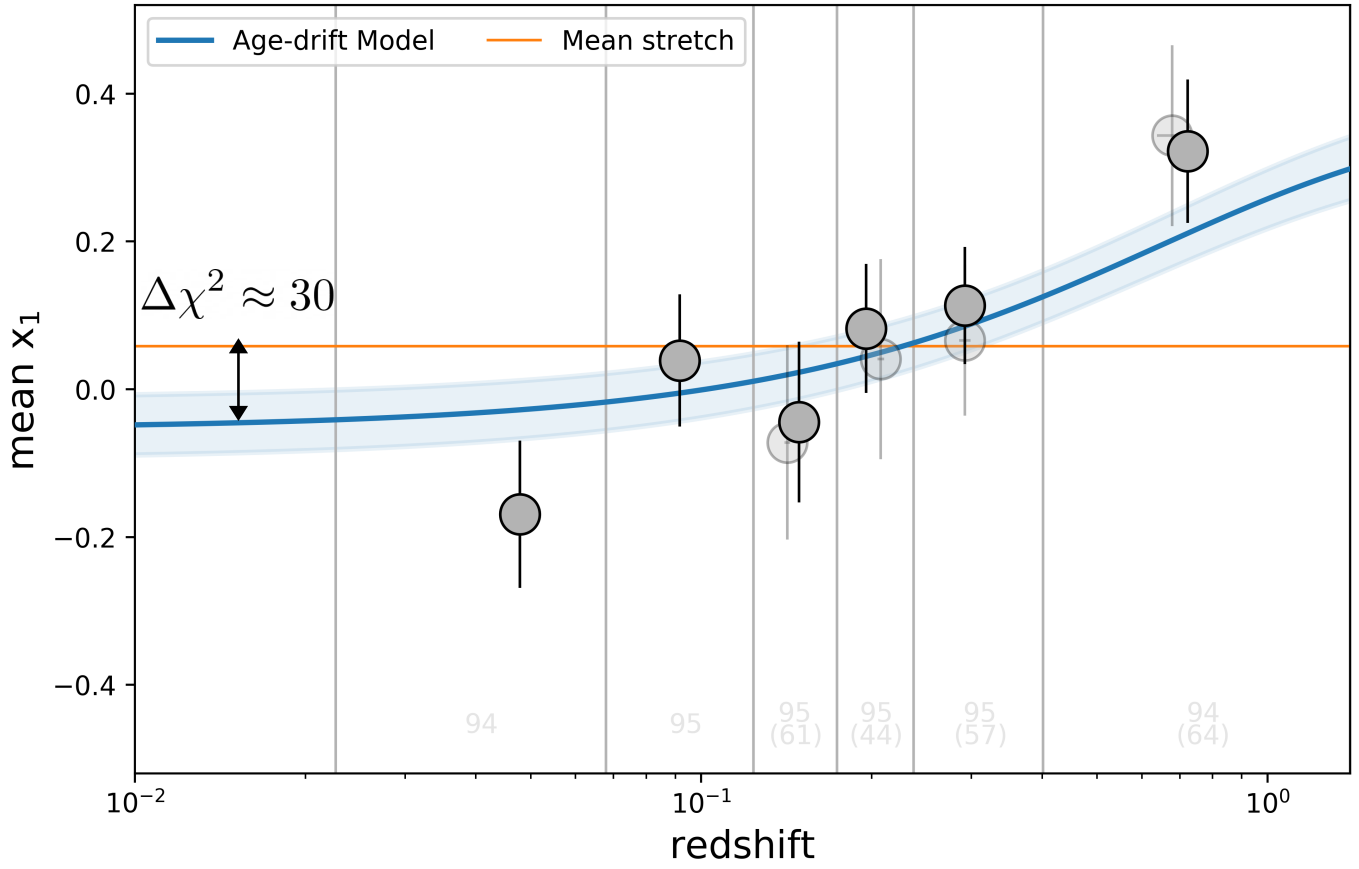
$$\delta(z) = \left(K^{-1} \times (1+z)^{-\phi} + 1\right)^{-1}$$

Rigault et al. (2018), K=0.87, Φ=2.8

Implementation to dataset

Nicolas et al. (2020)

$$\langle X_1(z) \rangle = \delta(z) \times \mu_1 + (1 - \delta(z)) \times (a\mu_1 + (1-a)\mu_2)$$



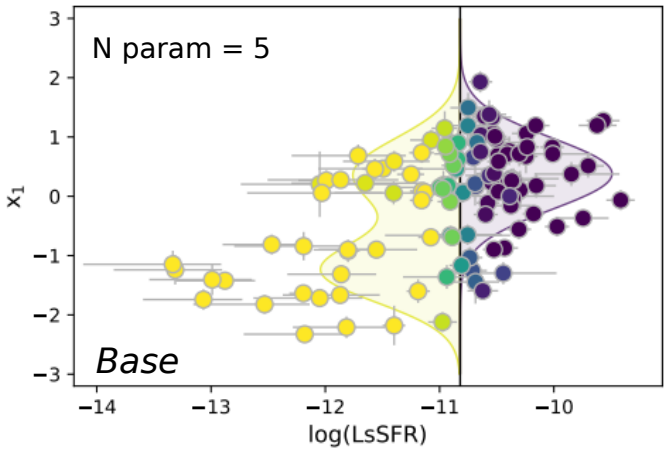
Comparison with all data combined

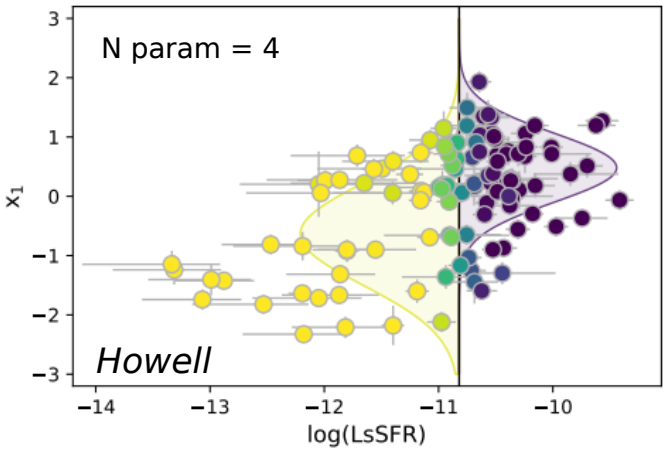
Model fitted on **all** data

Other models

Nicolas et al. (2020)
Cf Howell et al. (2007)

Underlying stretch model per age population





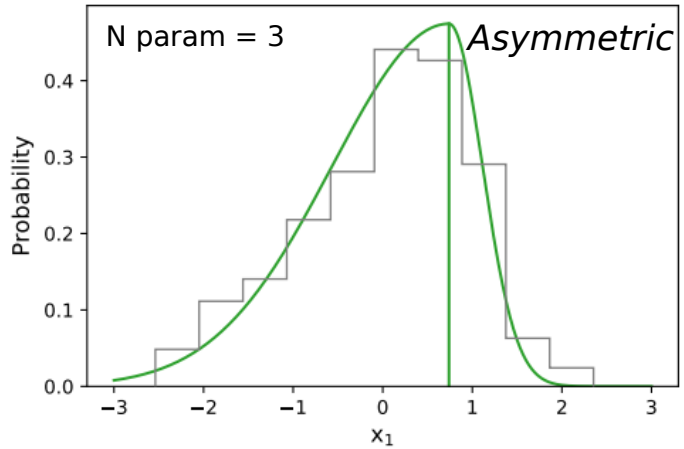
+

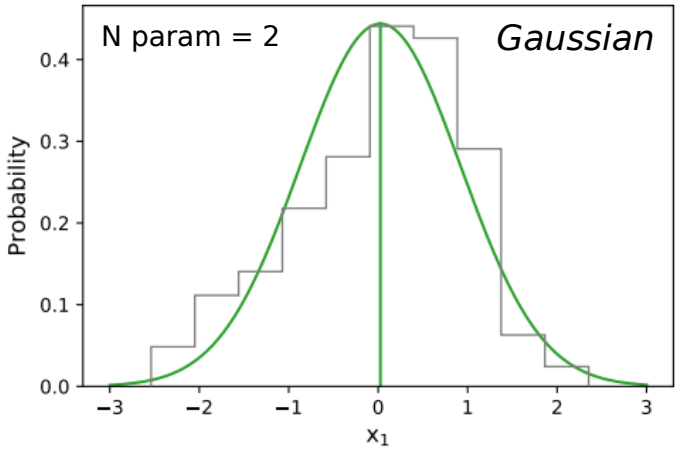
Drift

$$\delta(z) = \left(K^{-1} \times (1+z)^{-\phi} + 1\right)^{-1}$$

Or no drift

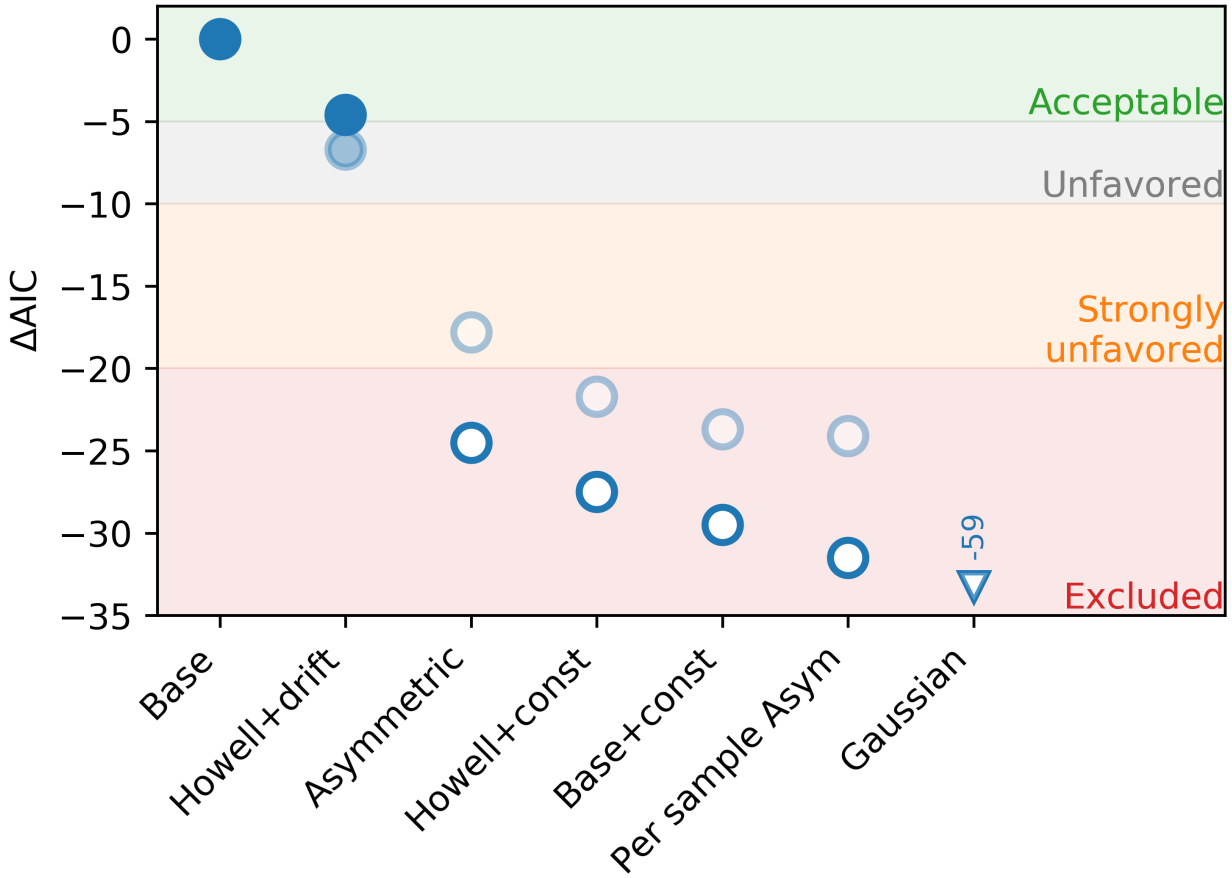
$$\delta(z) = \mathrm{cst}$$





Comparison results

Nicolas et al. (2020)

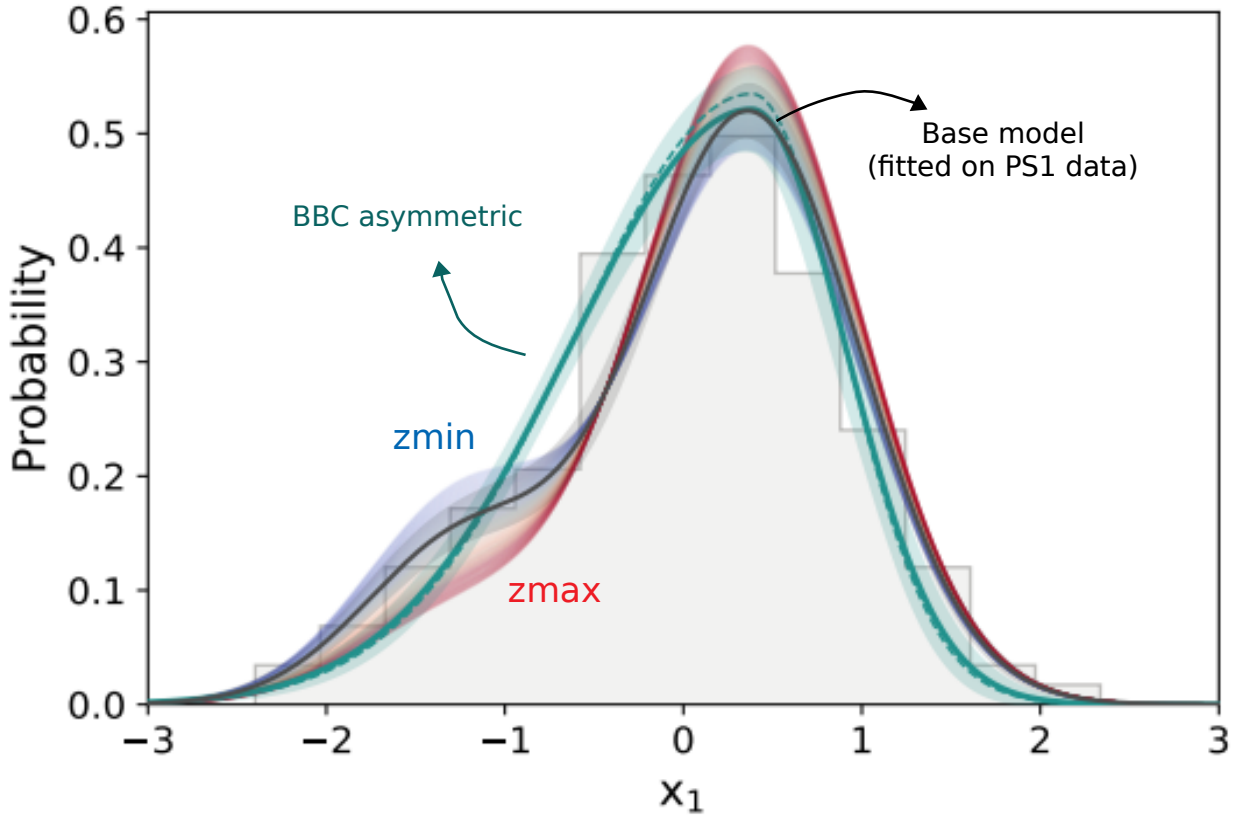


Where does it play a role?

An example with the BBC modeling

Nicolas et al. (2020)

PS1 stretch underlying distribution



Thank you!

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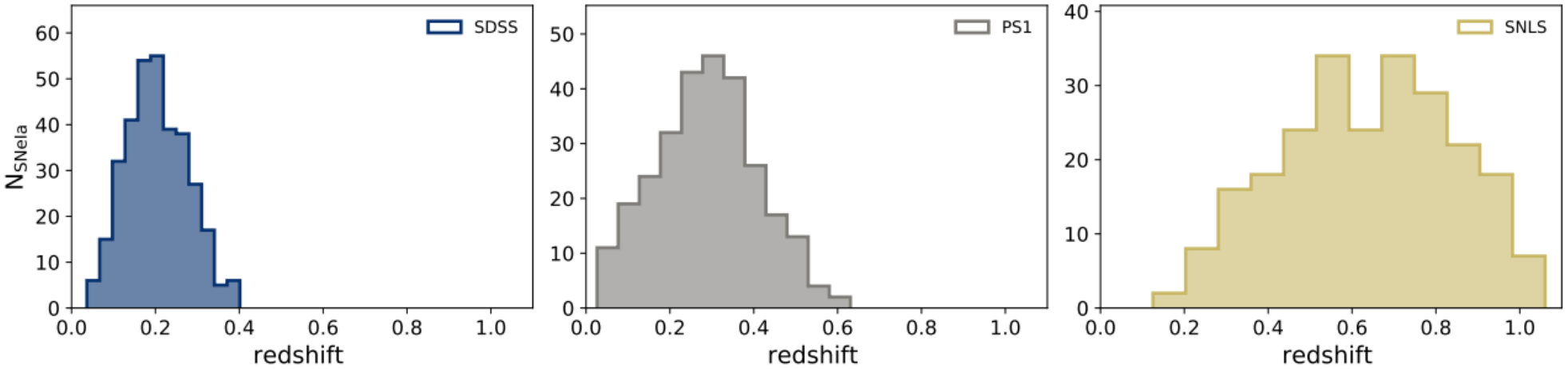
Nicolas et al. (2020)



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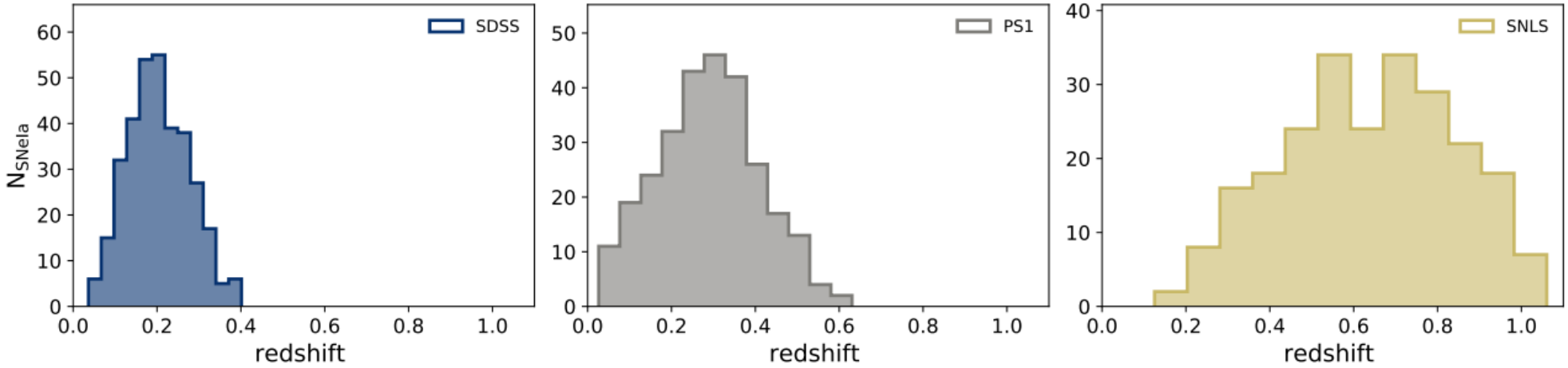

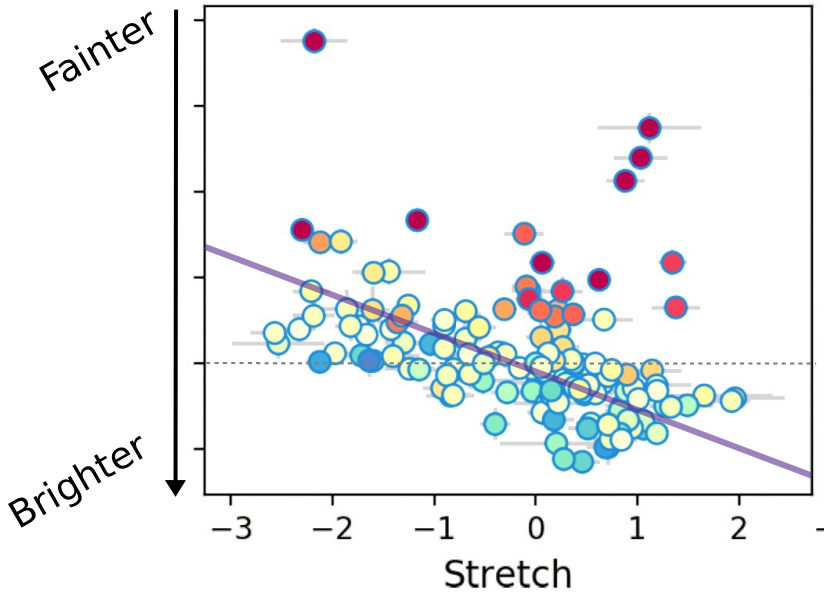

Magnitude-limited surveys from the Pantheon dataset

$$m_{\rm lim} = 24.8\,{\rm mag}$$ (SNLS)

$$\mu(z) = m - M(x_1, c) \Leftrightarrow m = \mu(z) + M(x_1, c)$$

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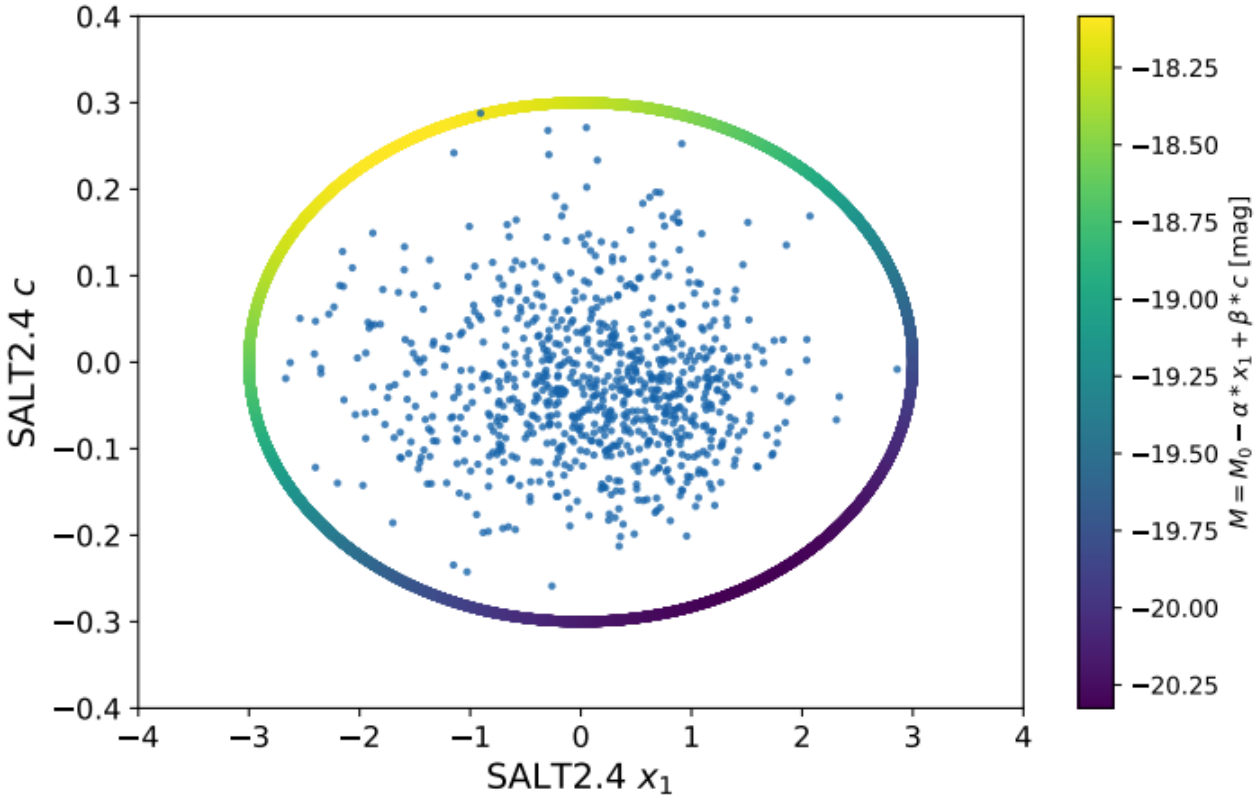

$$M^{t_0-5}_{\rm min,} = -18.00\,{\rm mag}$$
$$x_1 = -1.66$$
$$c = 0.25$$

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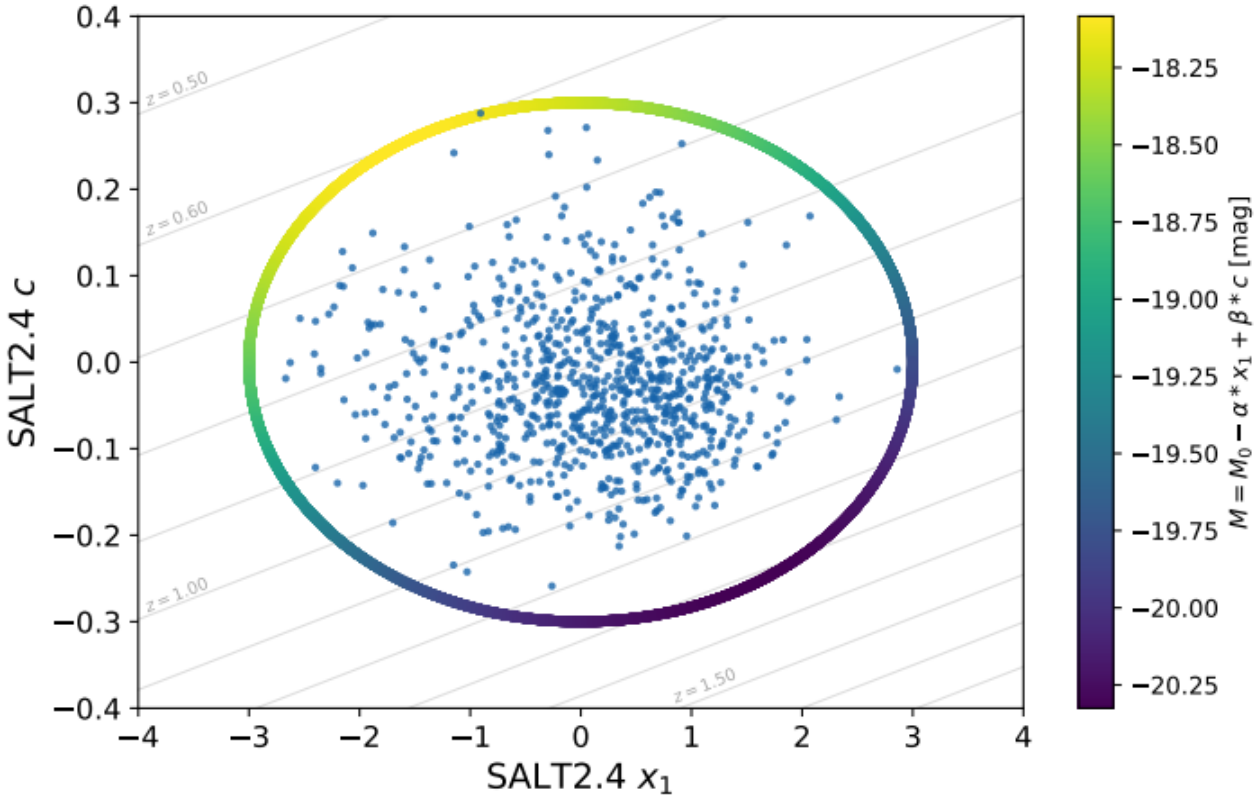

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Complete sample

Testing the construction

Nicolas et al. (2020)