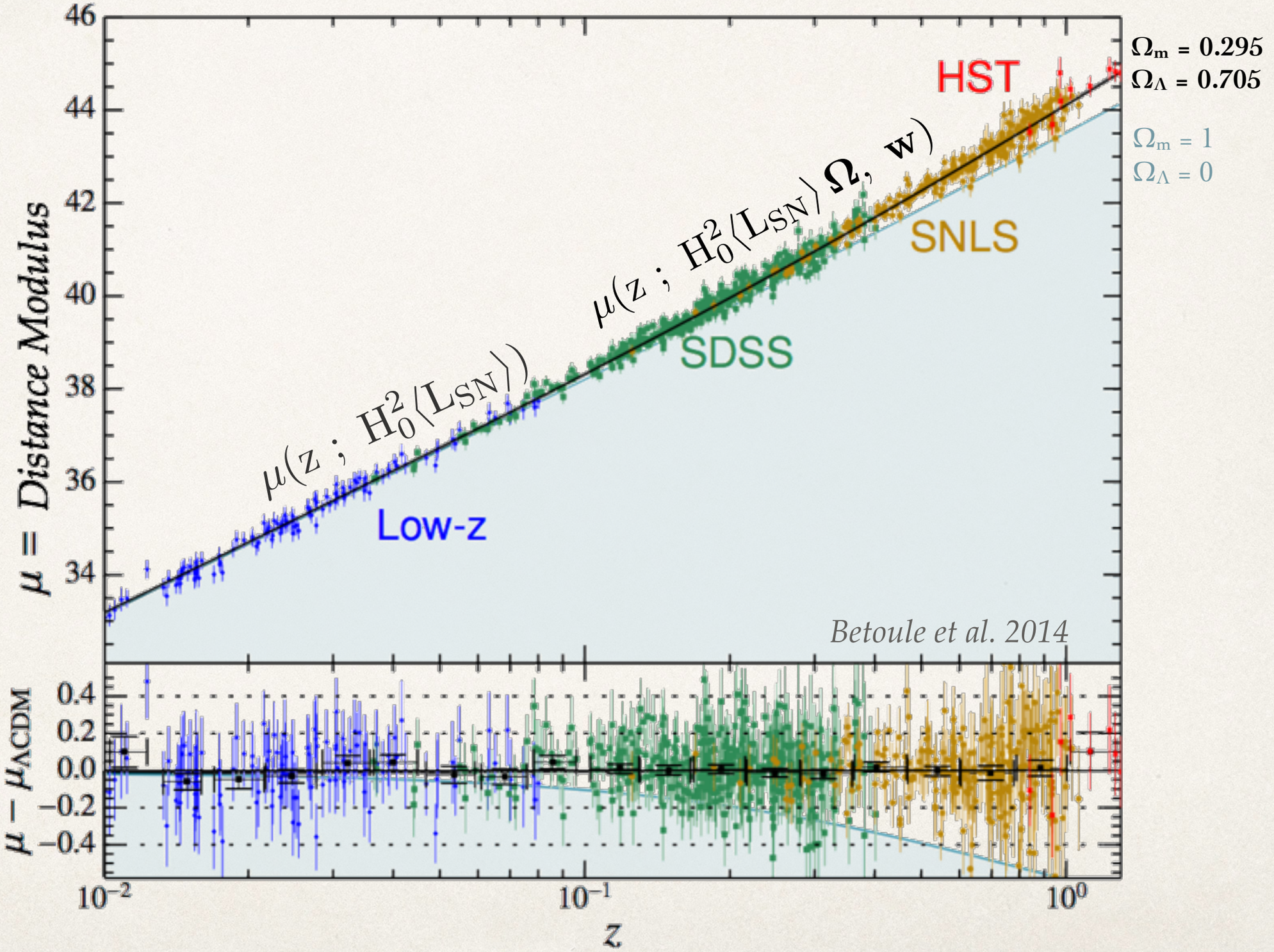
Results from the Nearby Supernova Factory

28th rencontres de Blois 2016

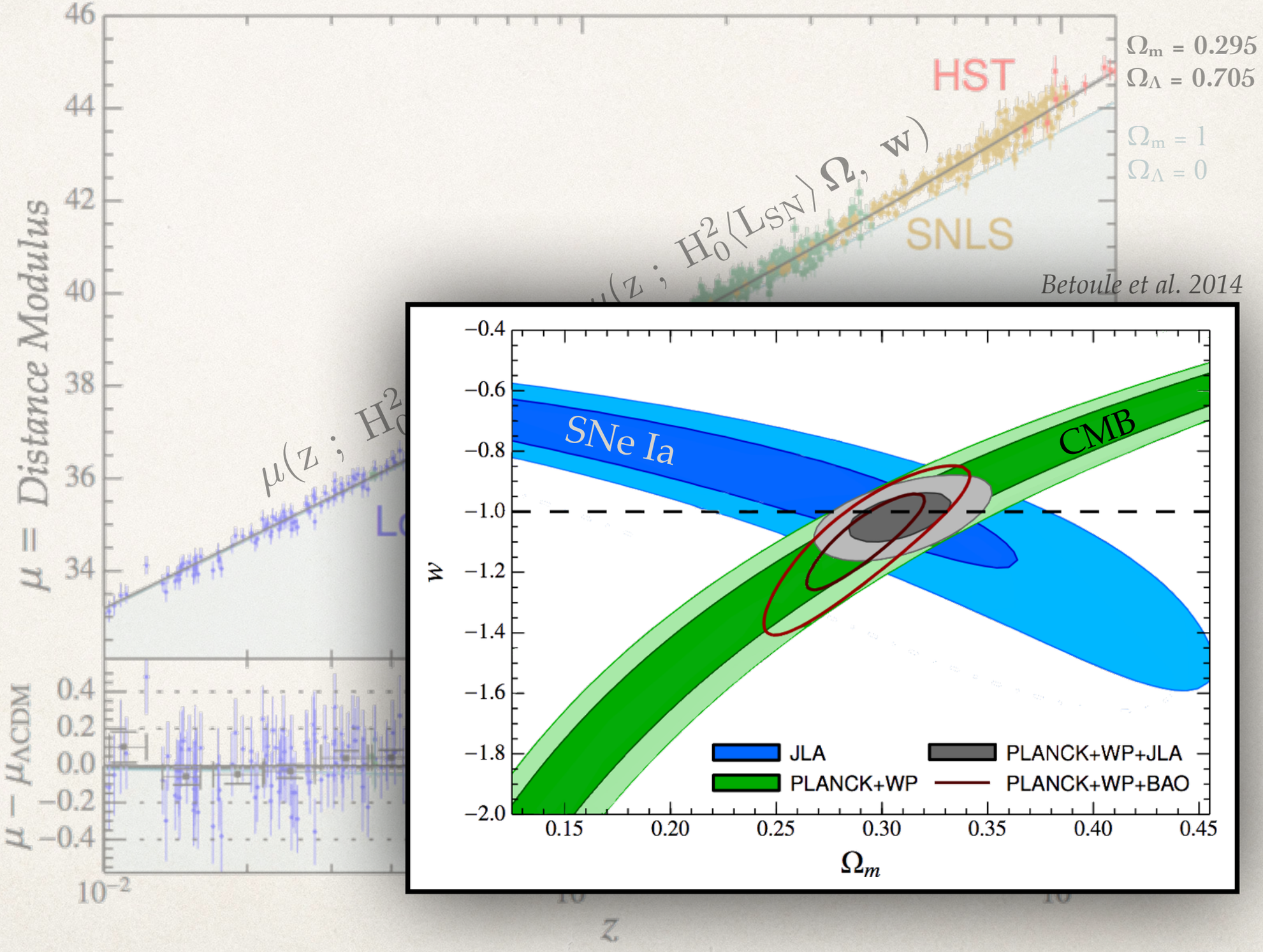
June 2016

Mickael RIGAULT
ON THE BEHALF OF SNFACTORY

Cosmology using Type Ia Supernovae

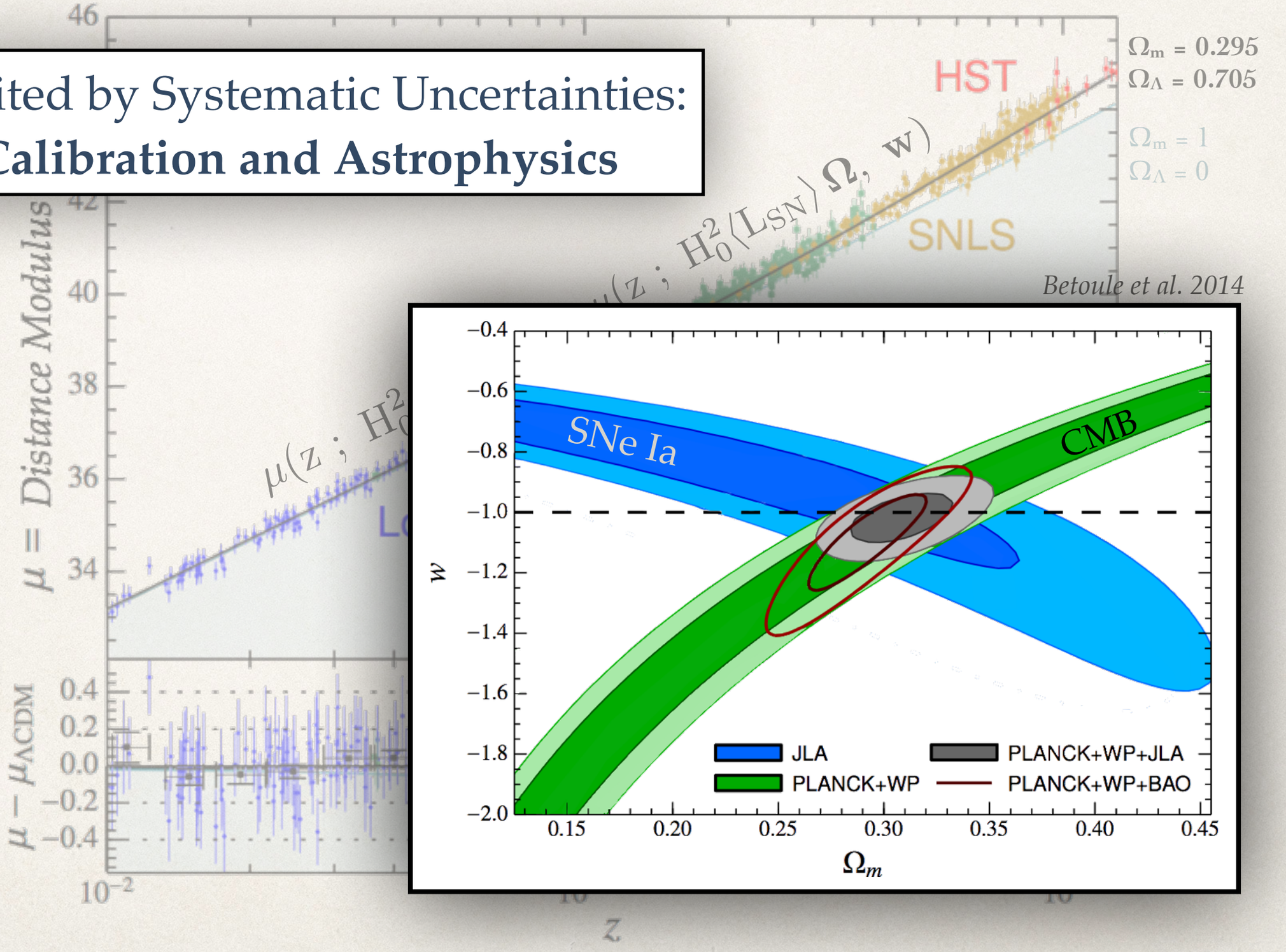


Cosmology using Type Ia Supernovae



Cosmology using Type Ia Supernovae

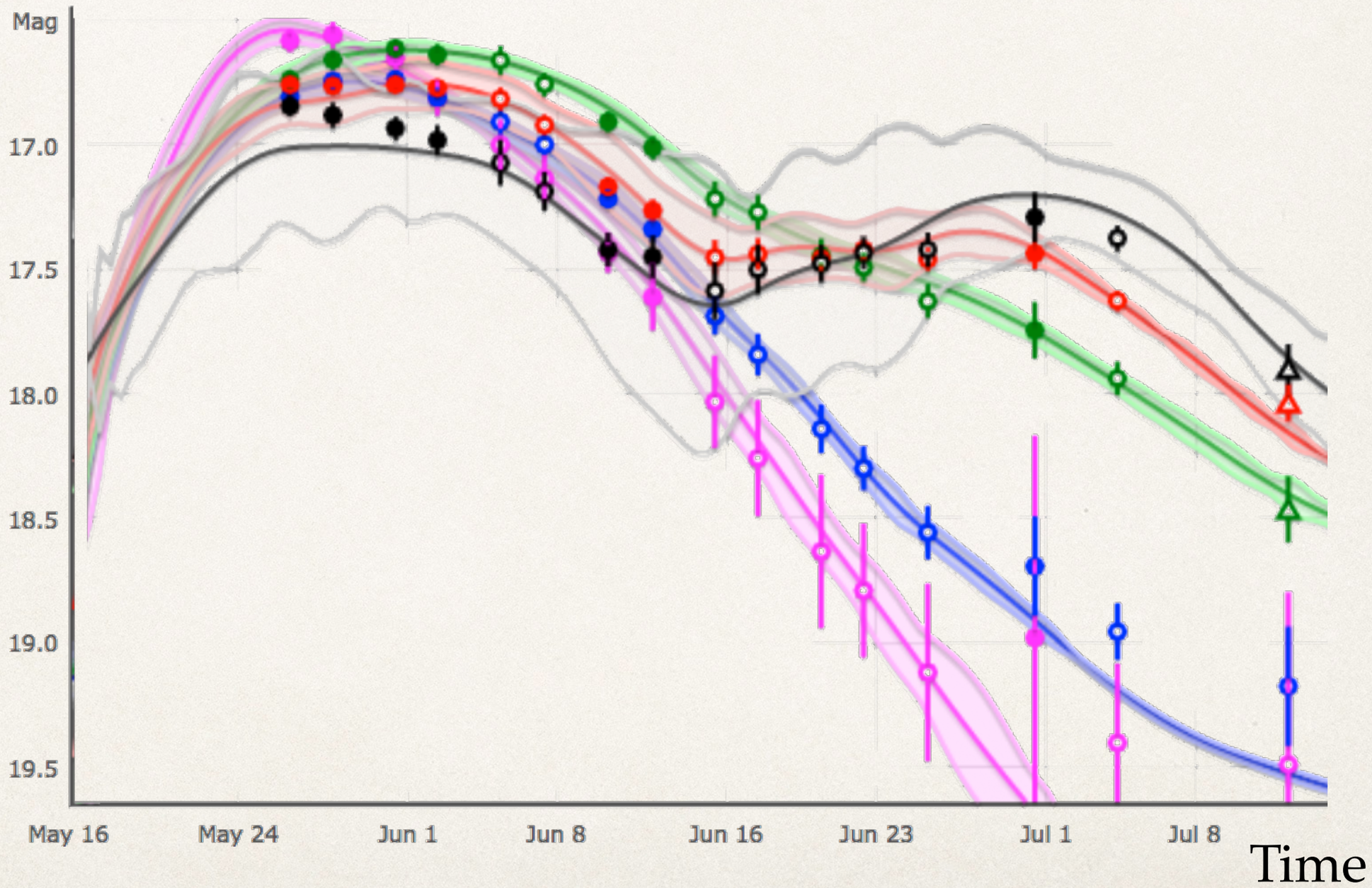
Limited by Systematic Uncertainties:
Calibration and Astrophysics



Betoule et al. 2014

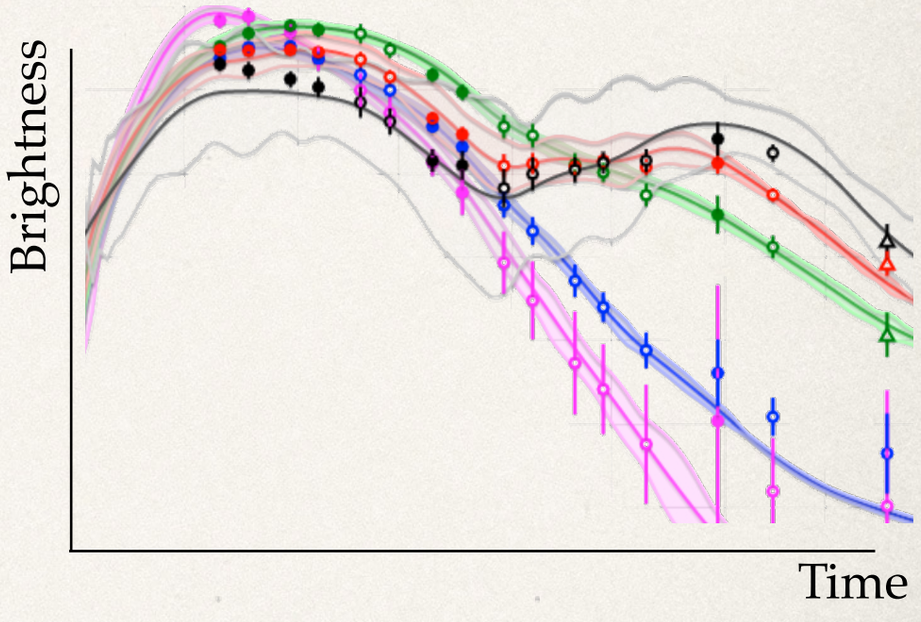
SNe Ia data for Cosmology — *Light Curves*

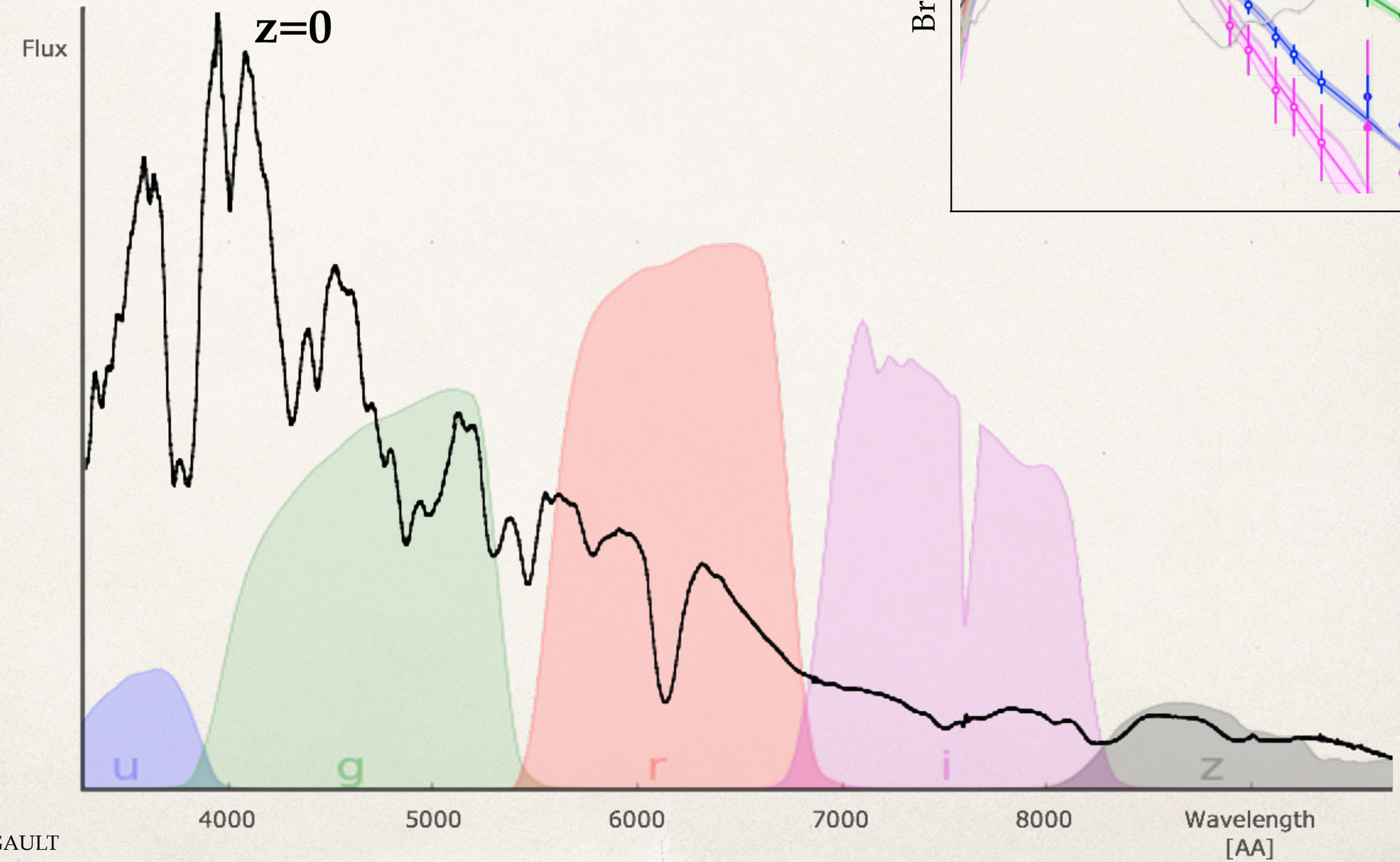
Brightness



Time

Photometric issue 1 — *K-correction*





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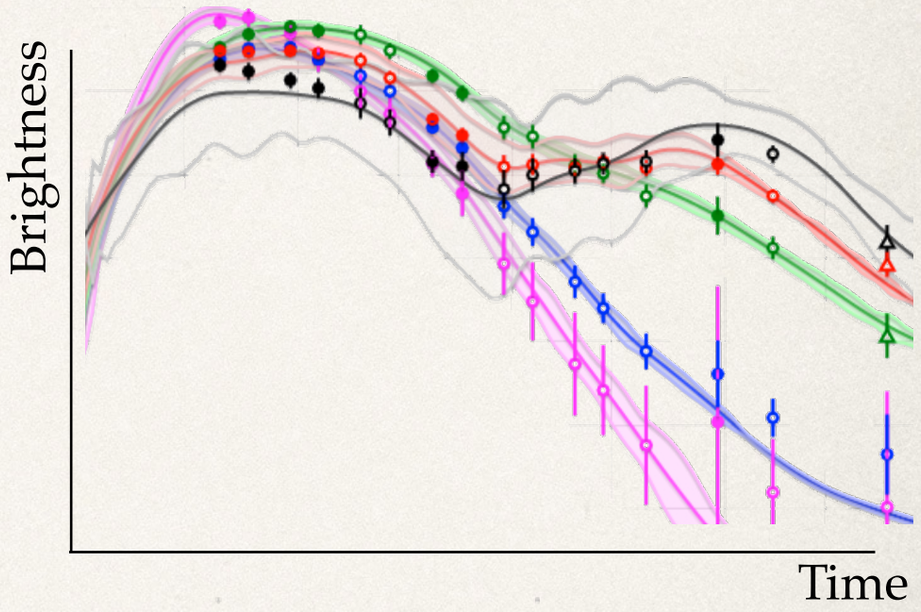

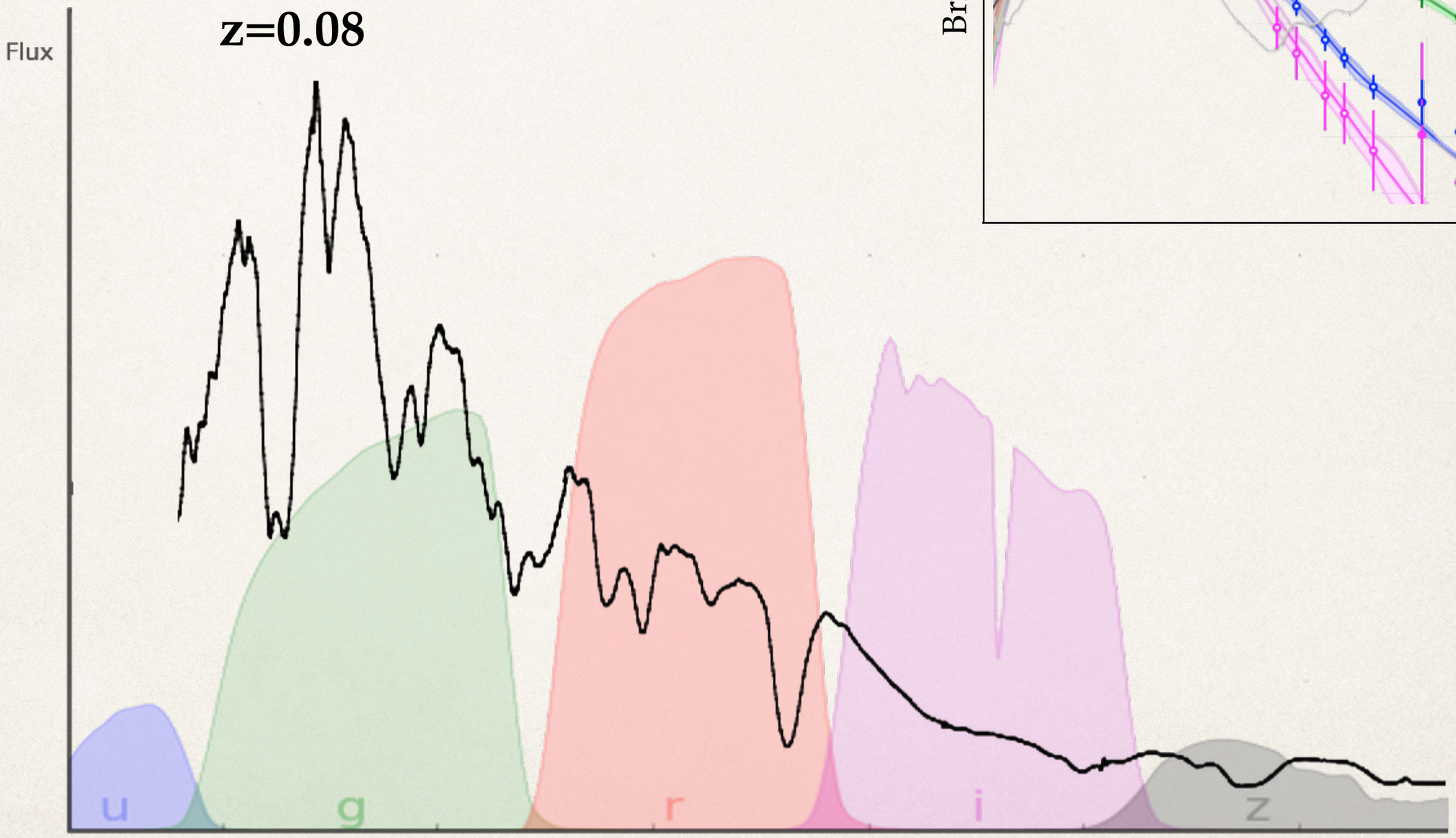

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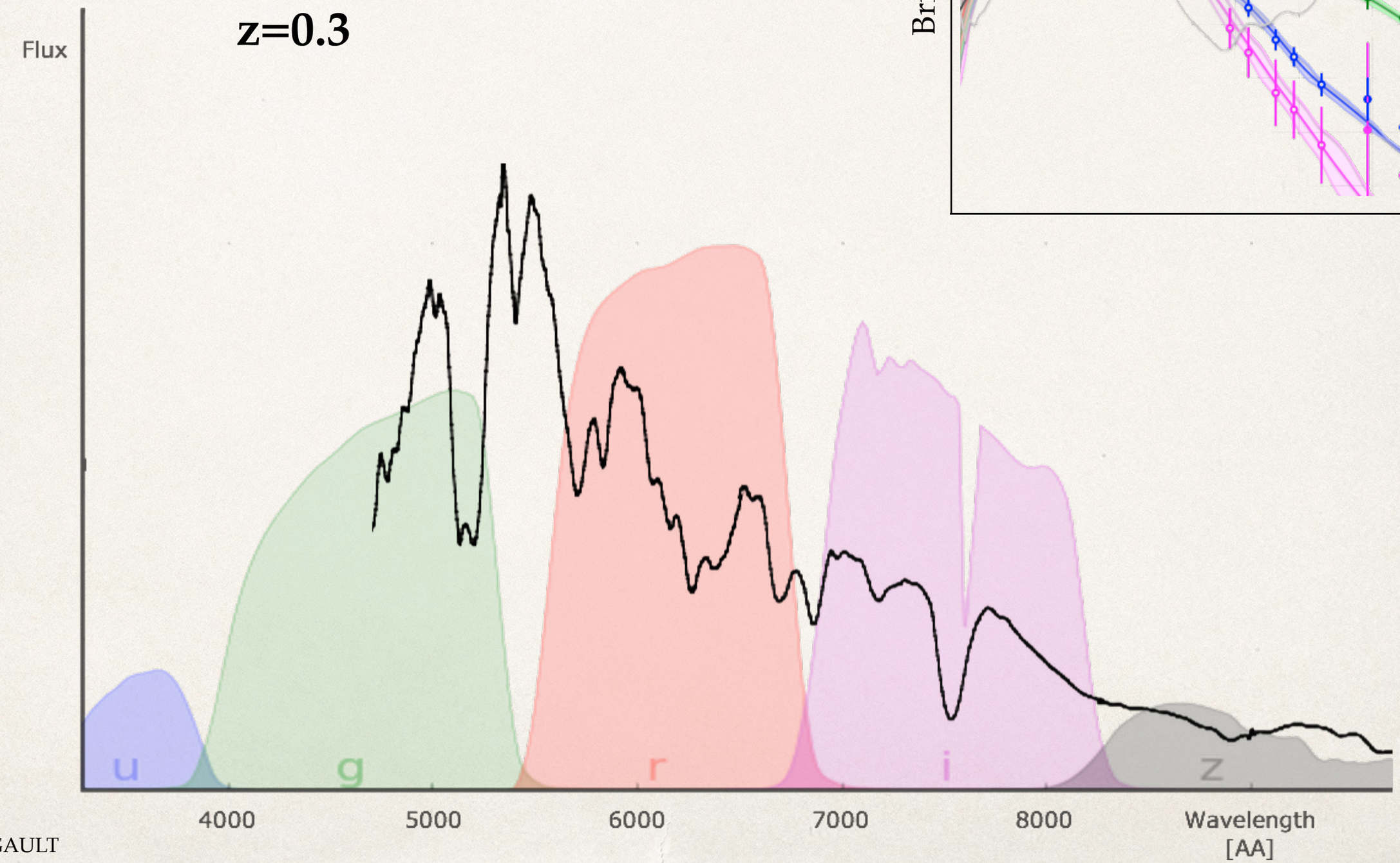
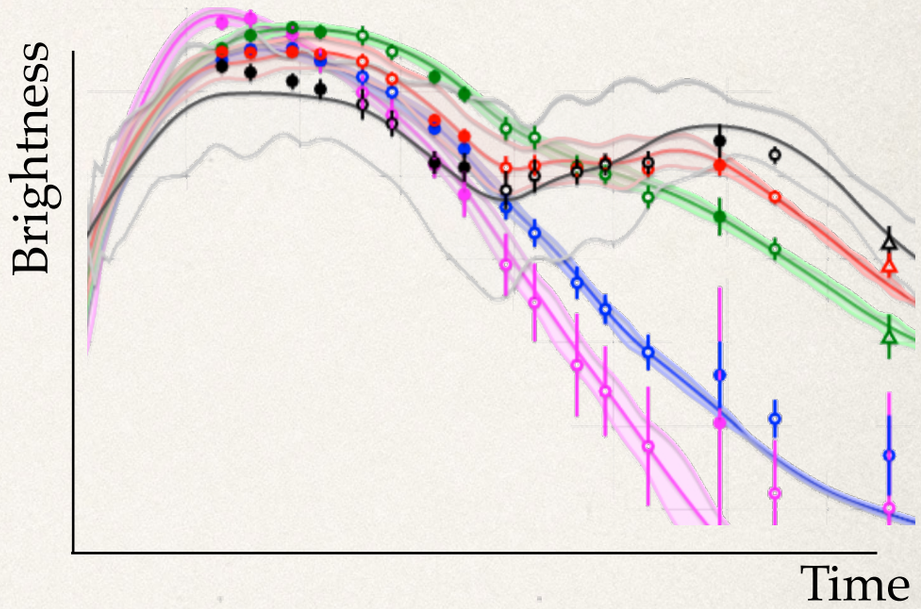
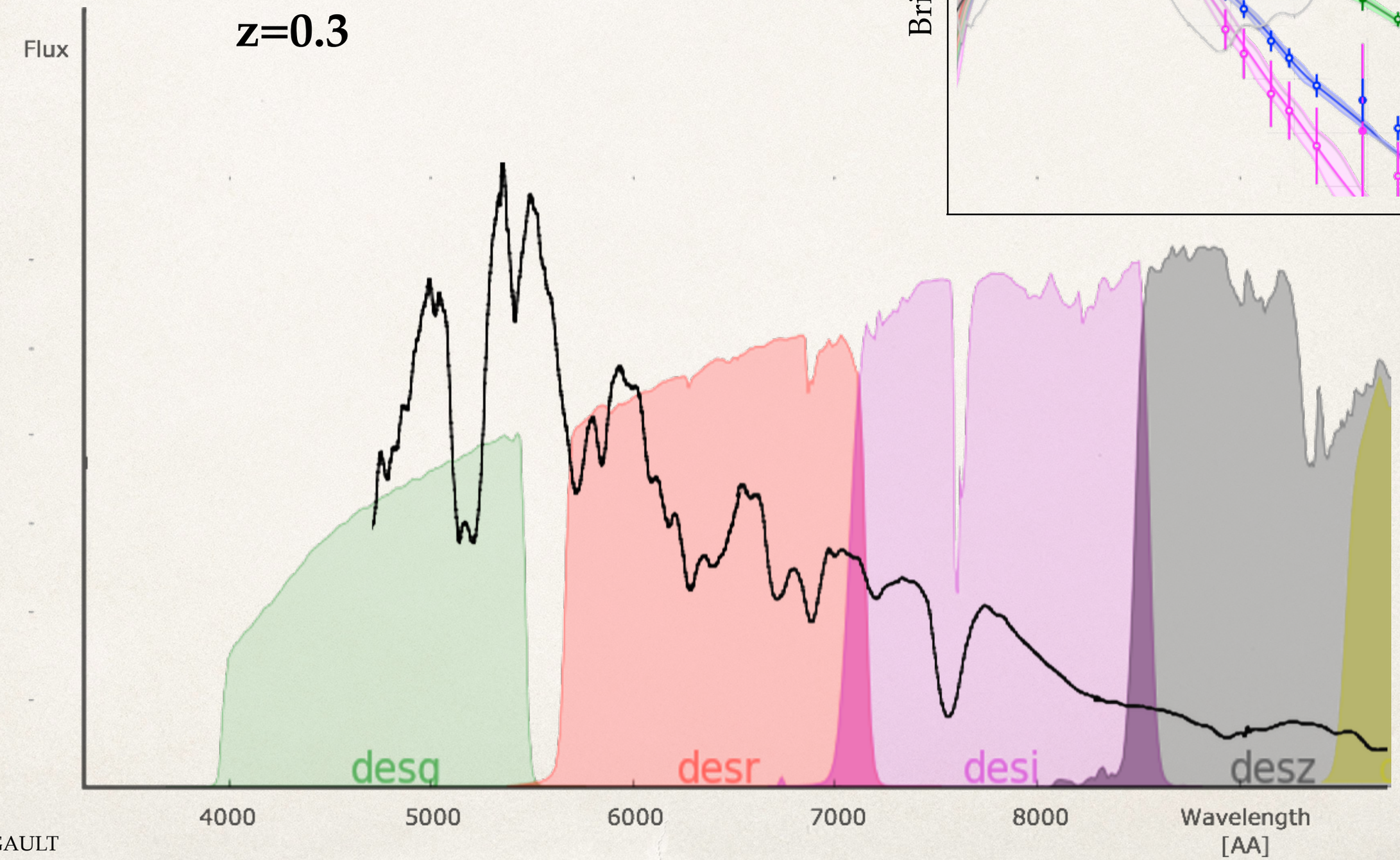
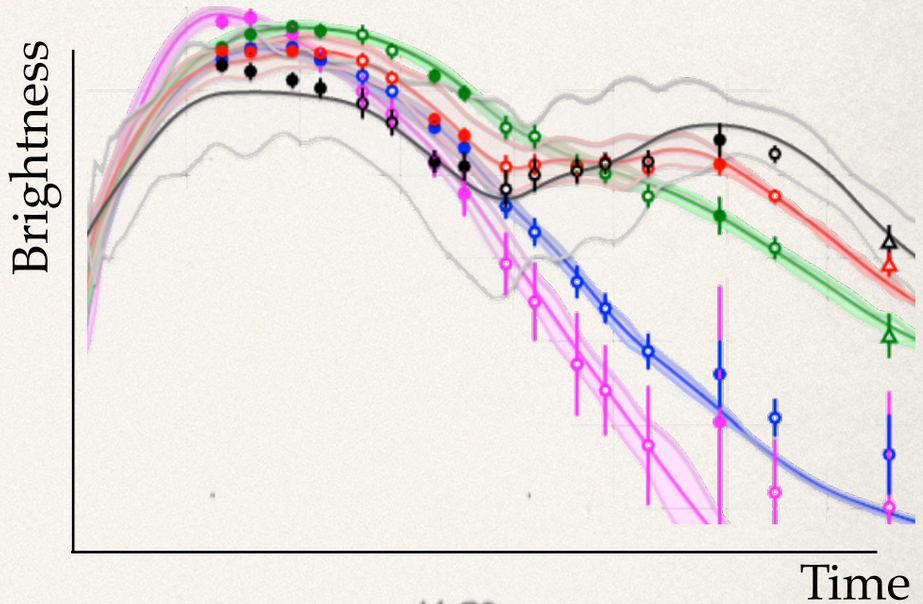




Photometric issue 2 — *Cross Calibration*





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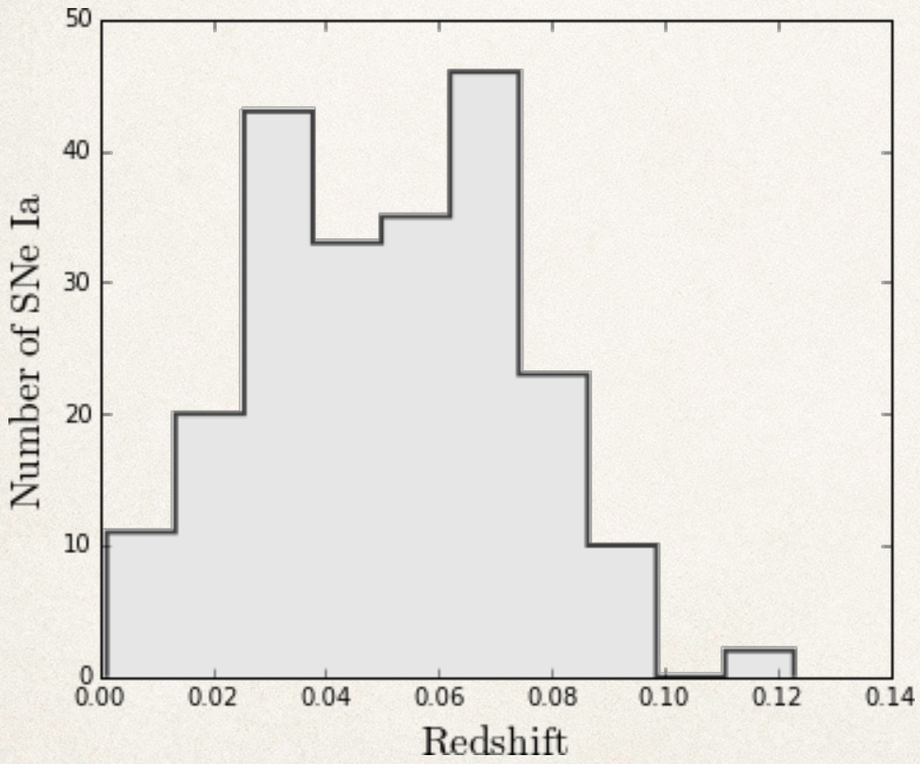
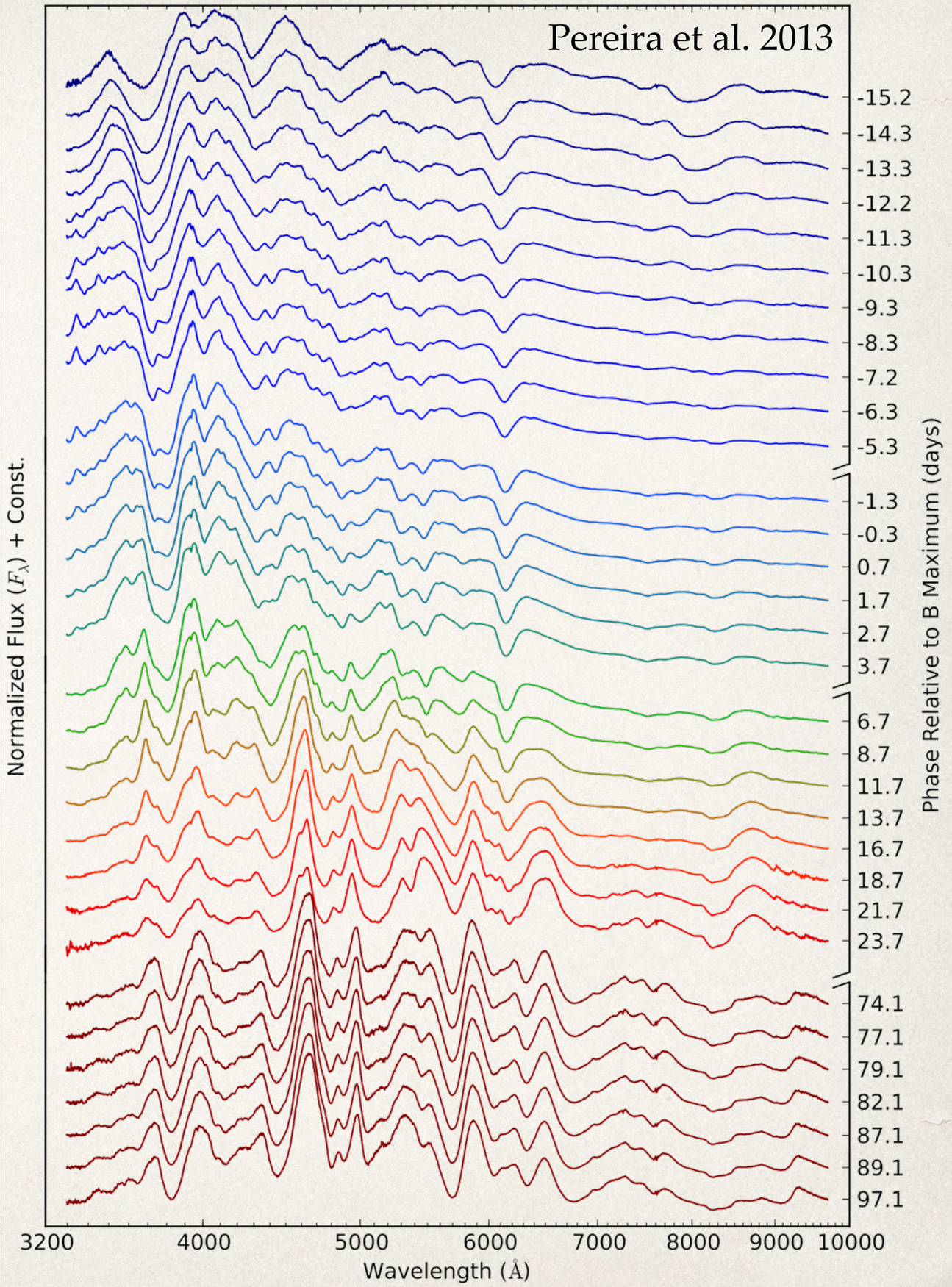
Time Series of Type Ia Supernovae

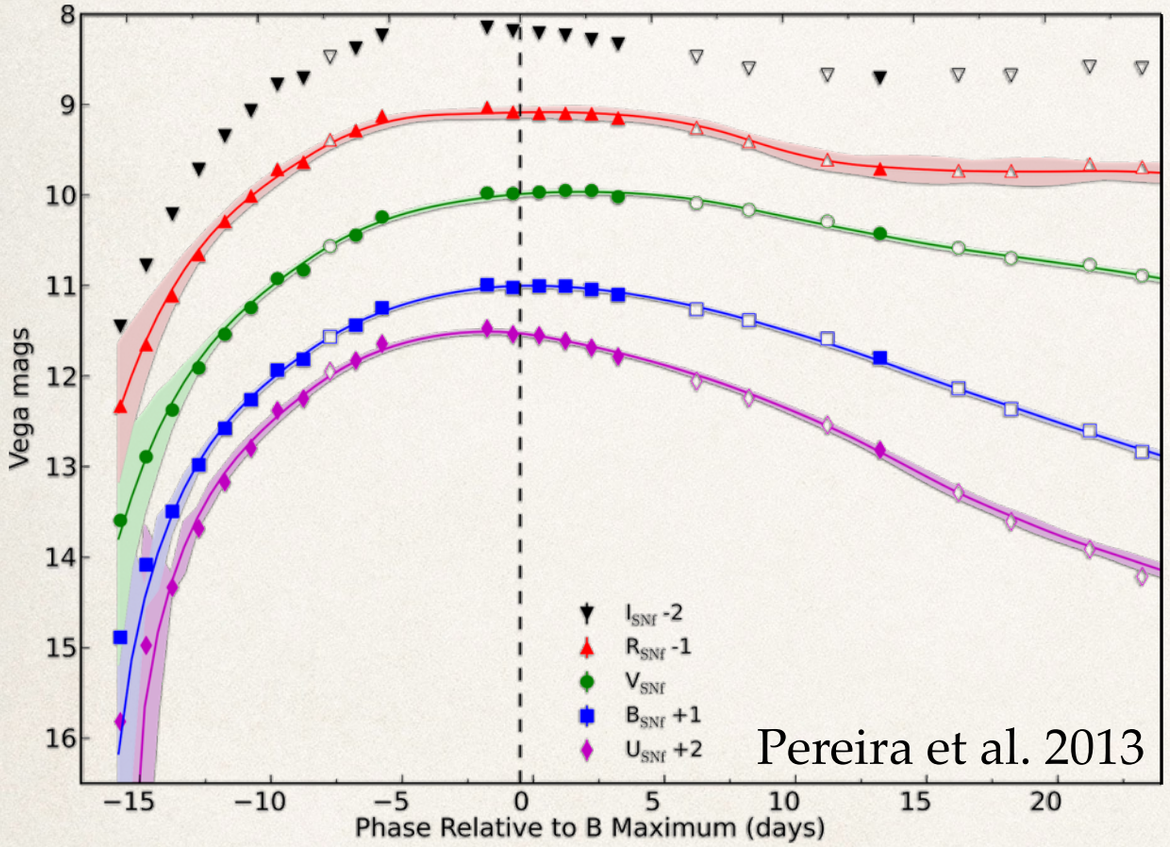
- ~200 SNe *for classic cosmology*
- ~ redshift [0.03 ; 0.08]
- ~15 spectra per SNe
- median first phase -4.6 days

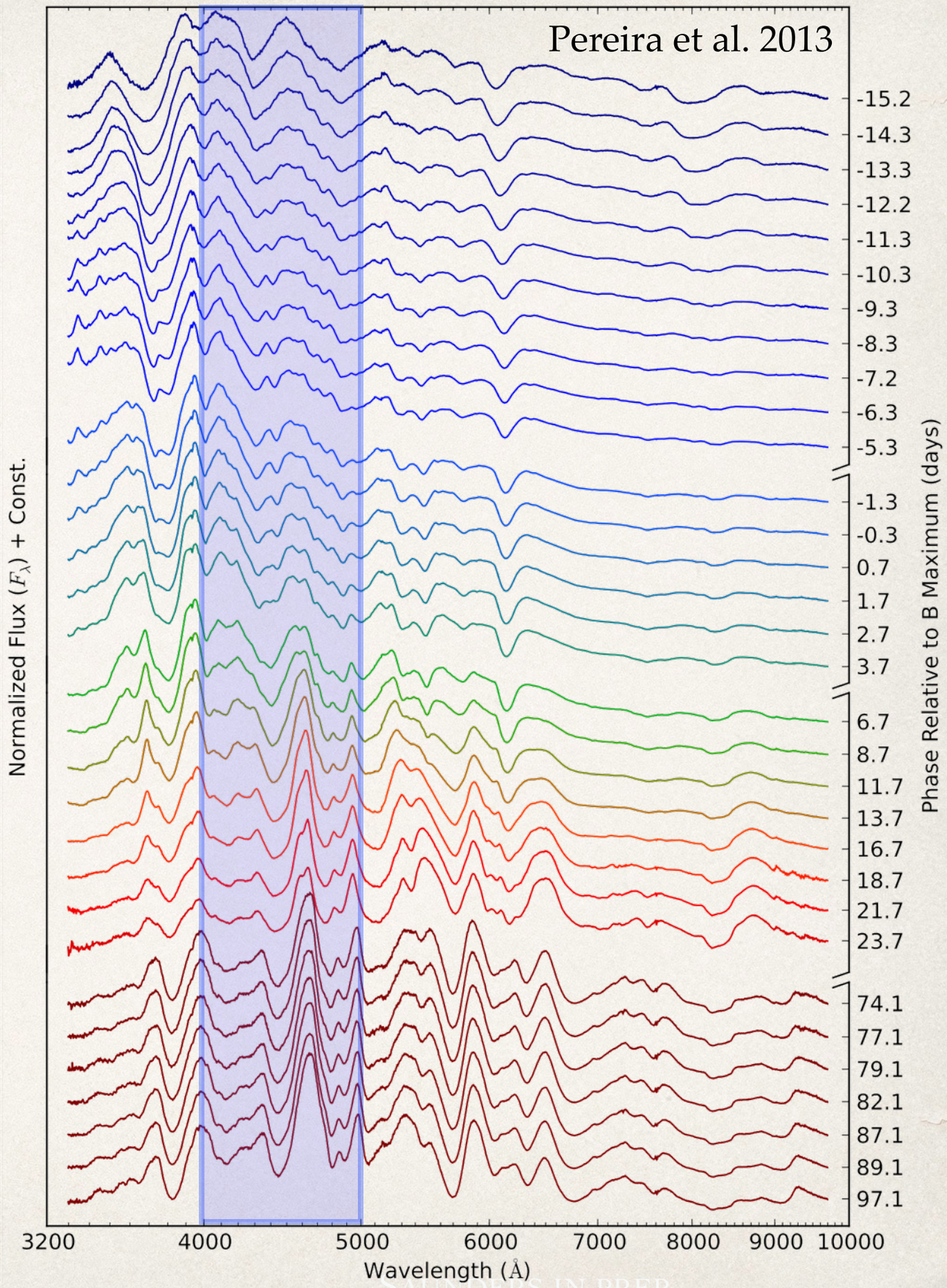




SNfactory

Synthesize Light Curves
in any filter system





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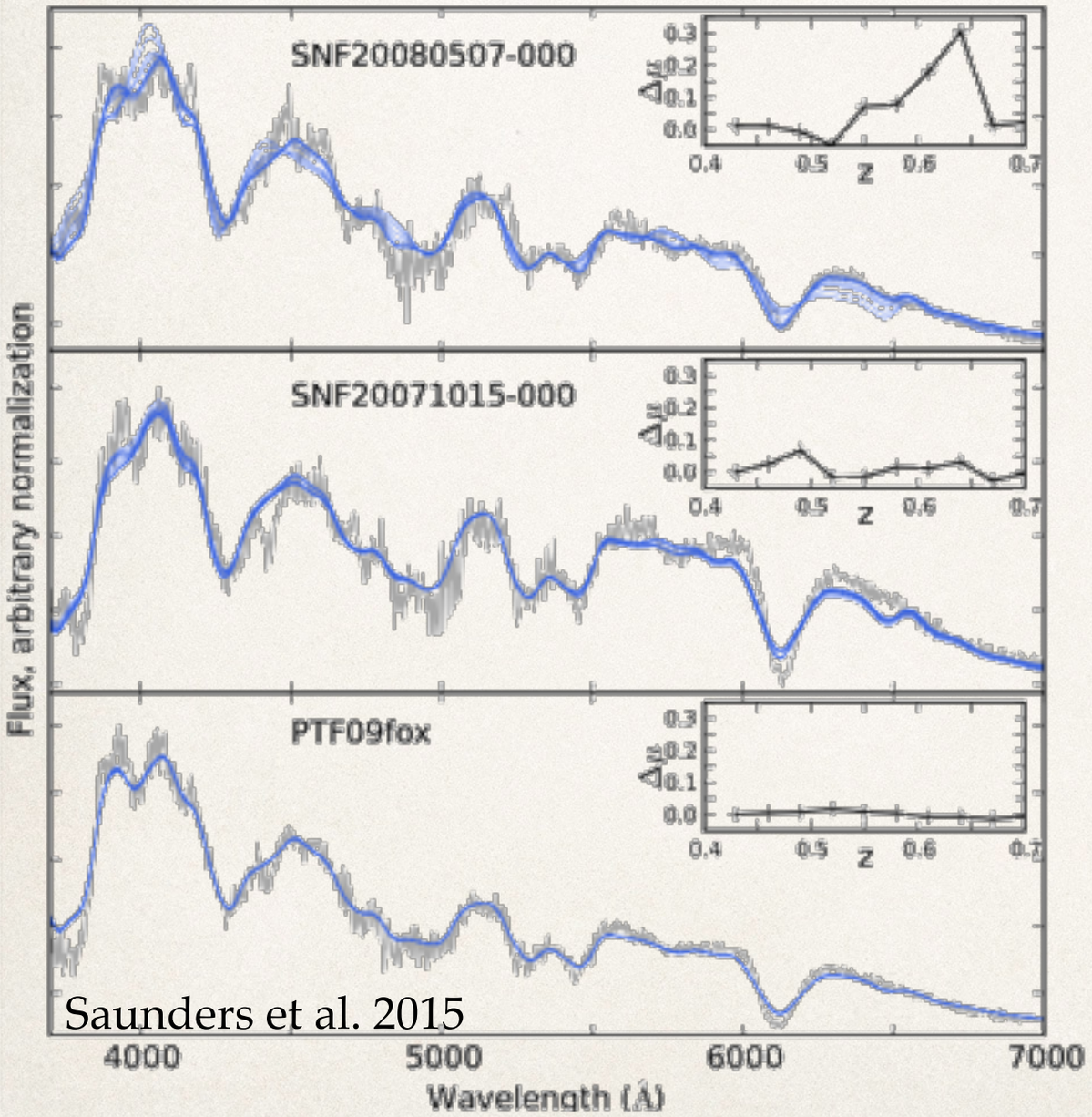
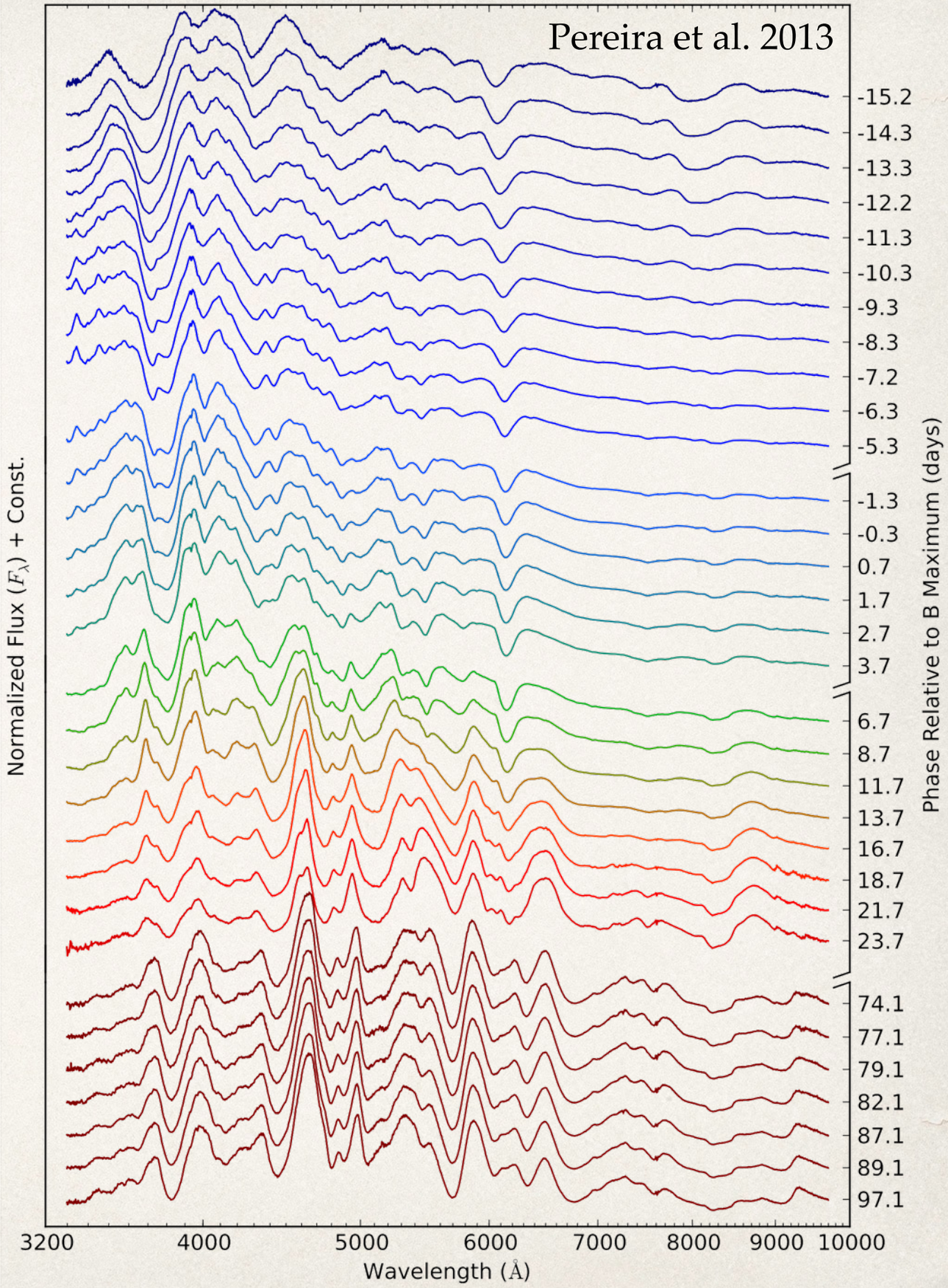
Test the accuracy of current ***K*-corrections** (effect on w~3%)



Saunders et al. 2015



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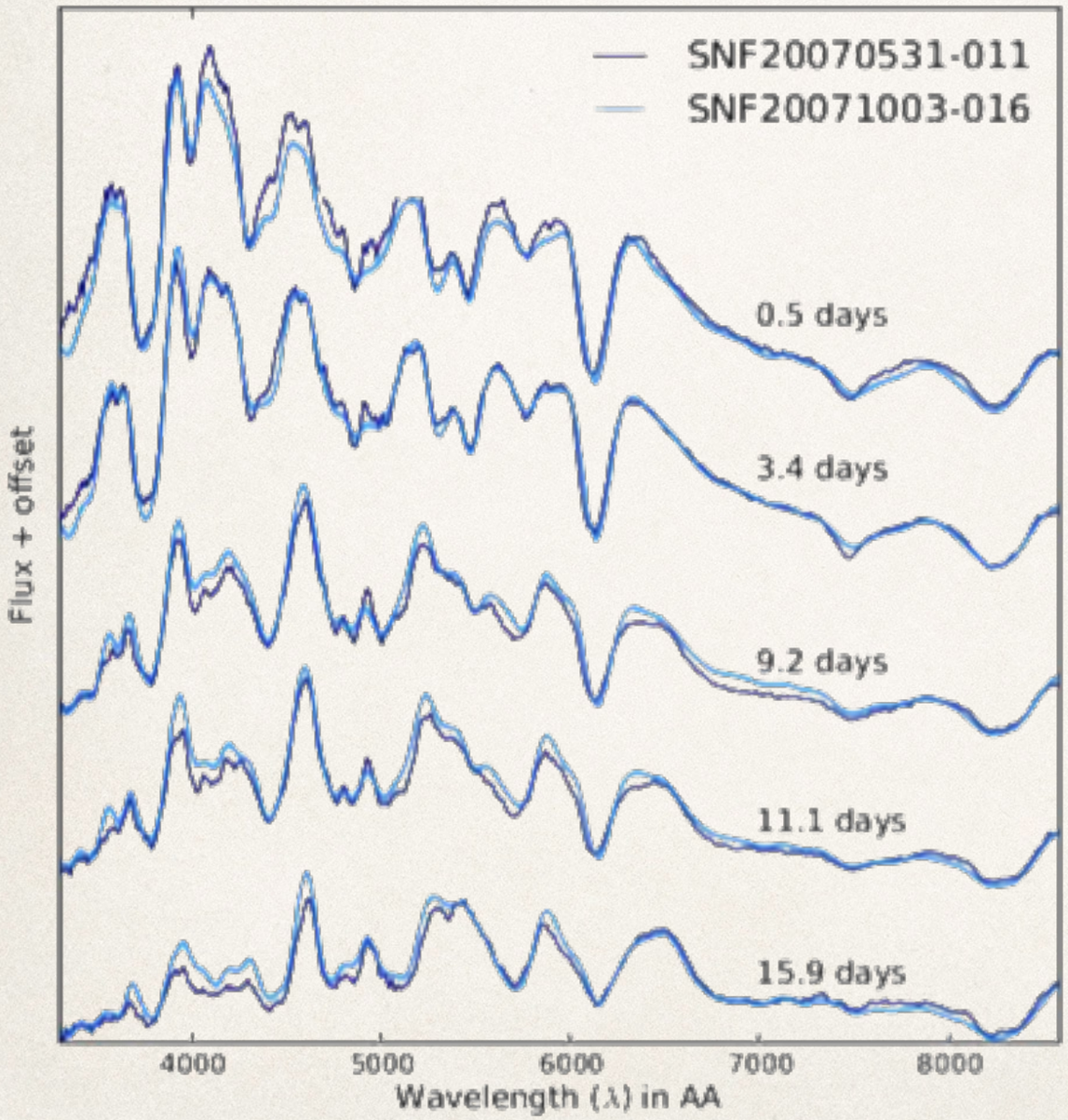
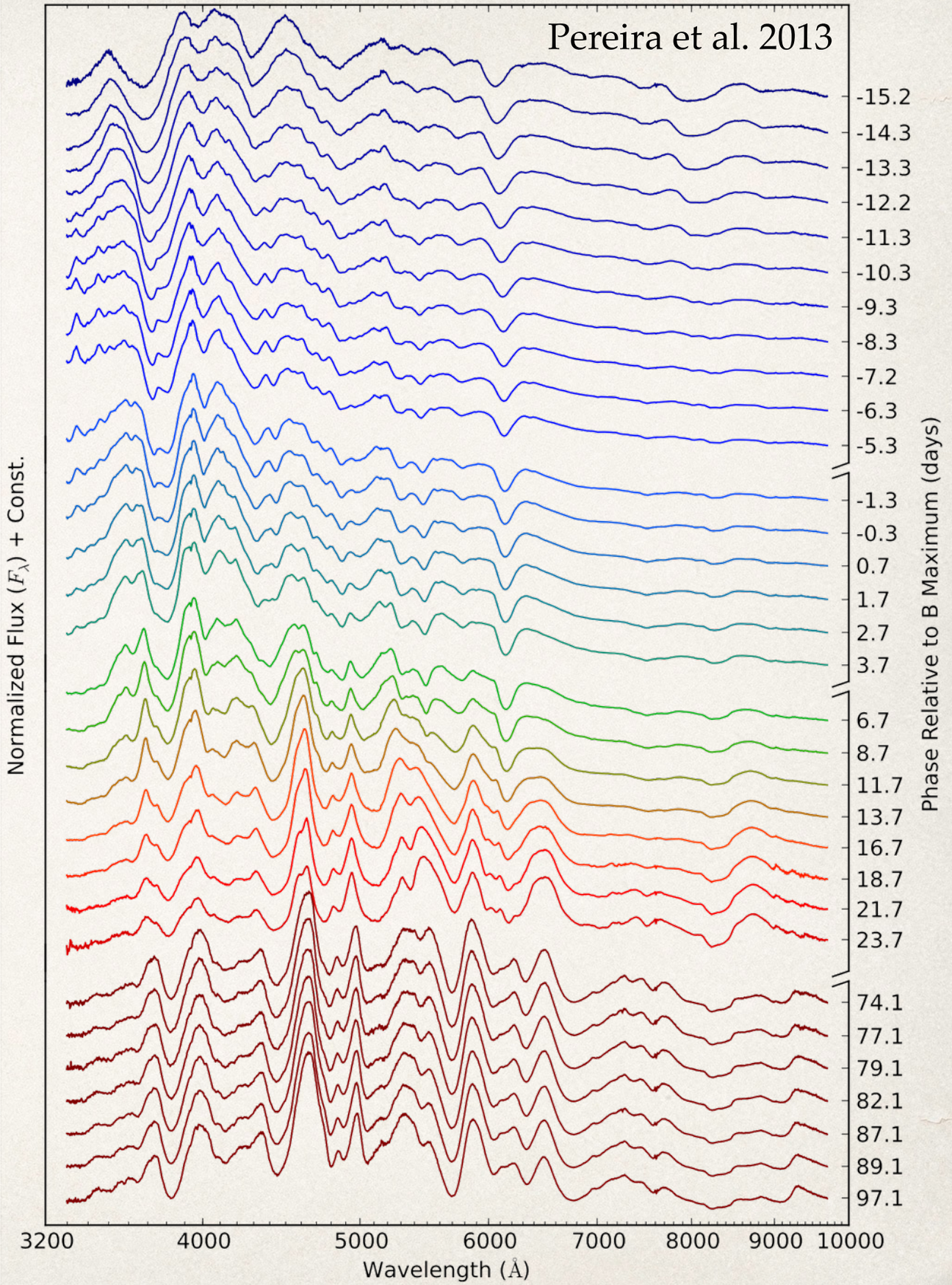
Twinning

dispersion as low as 0.08 mag

Fahkouri et al. 2015





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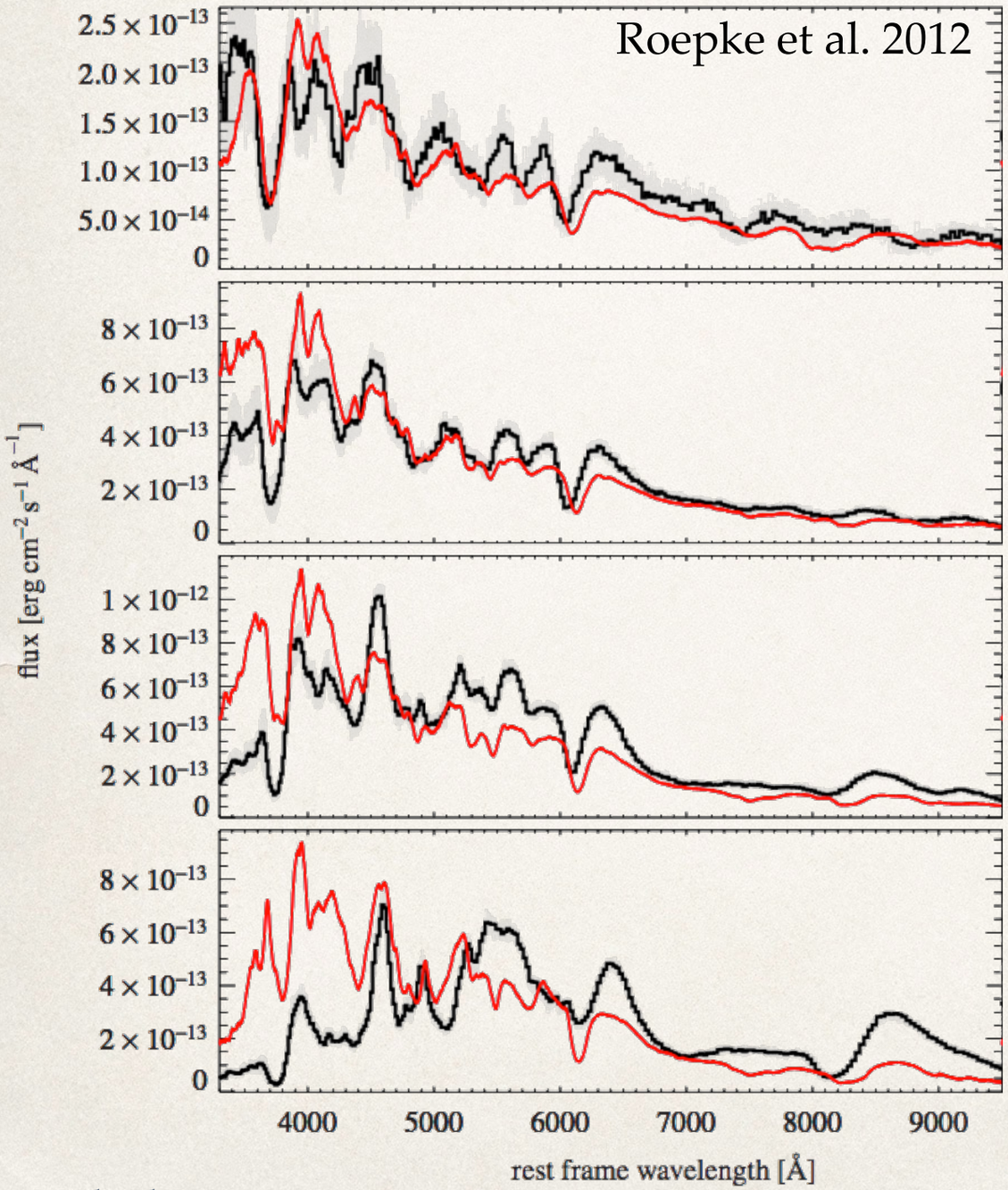
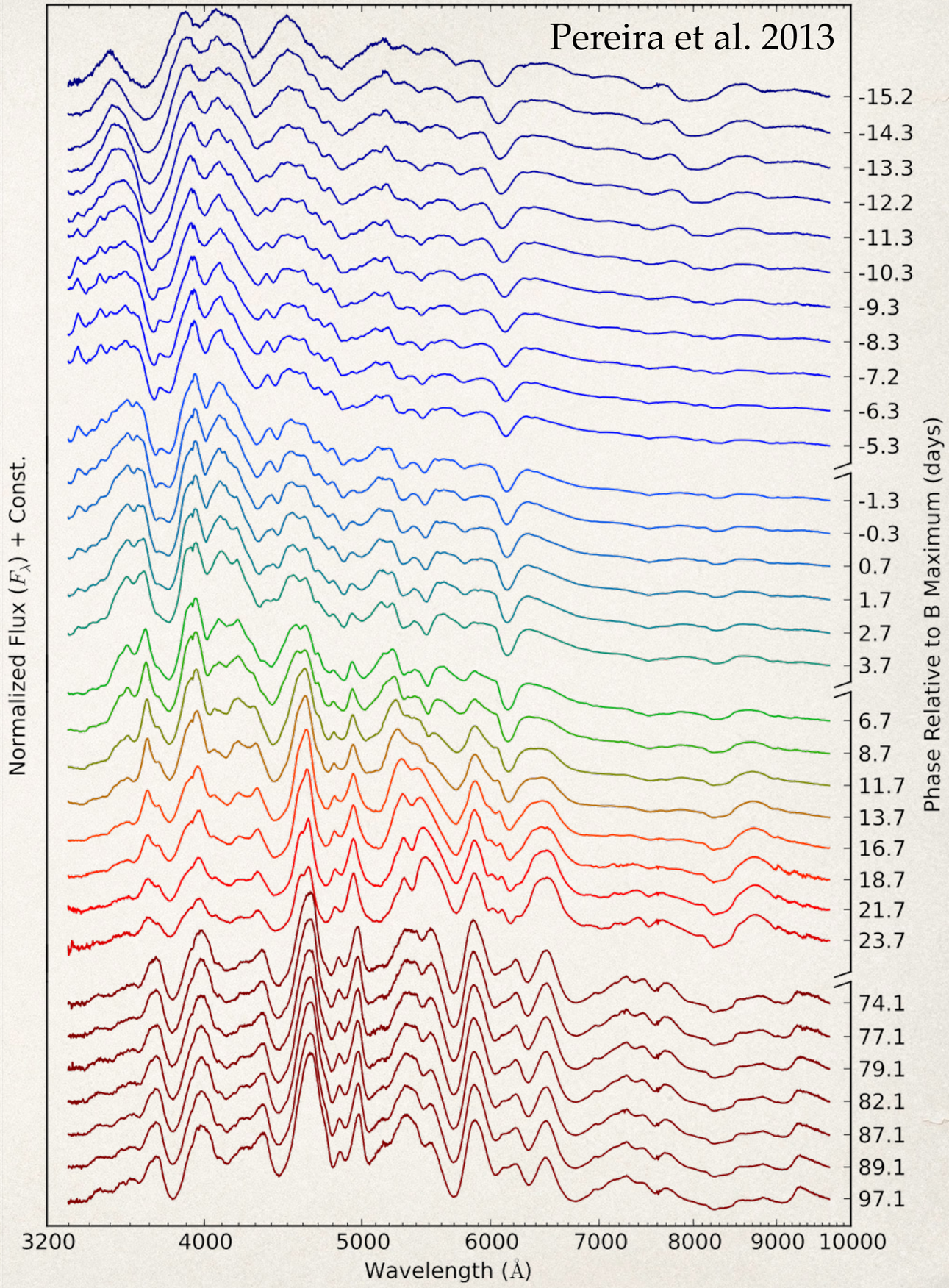
Understand the SN Ia progenitor(s) (*simulations*)

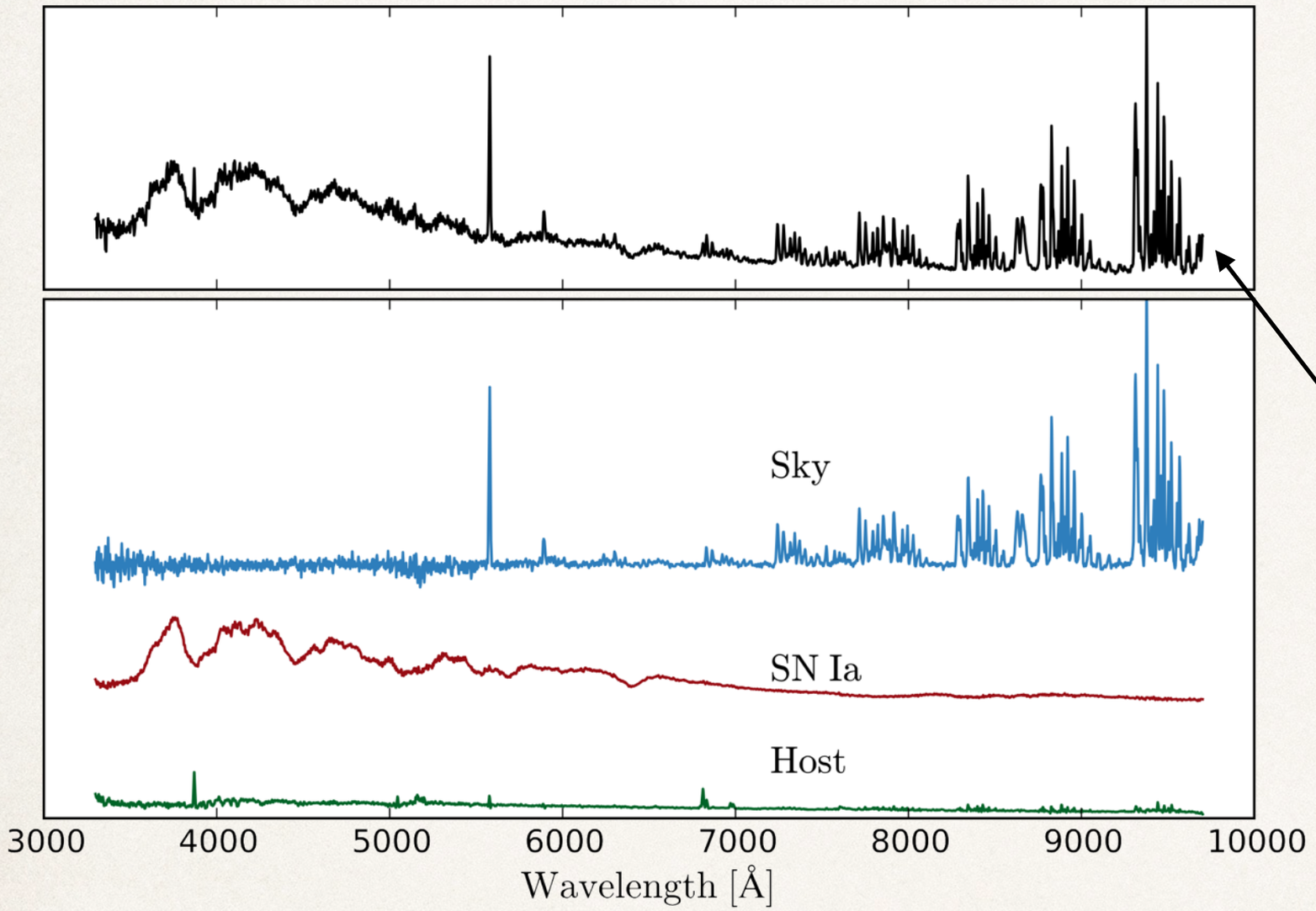


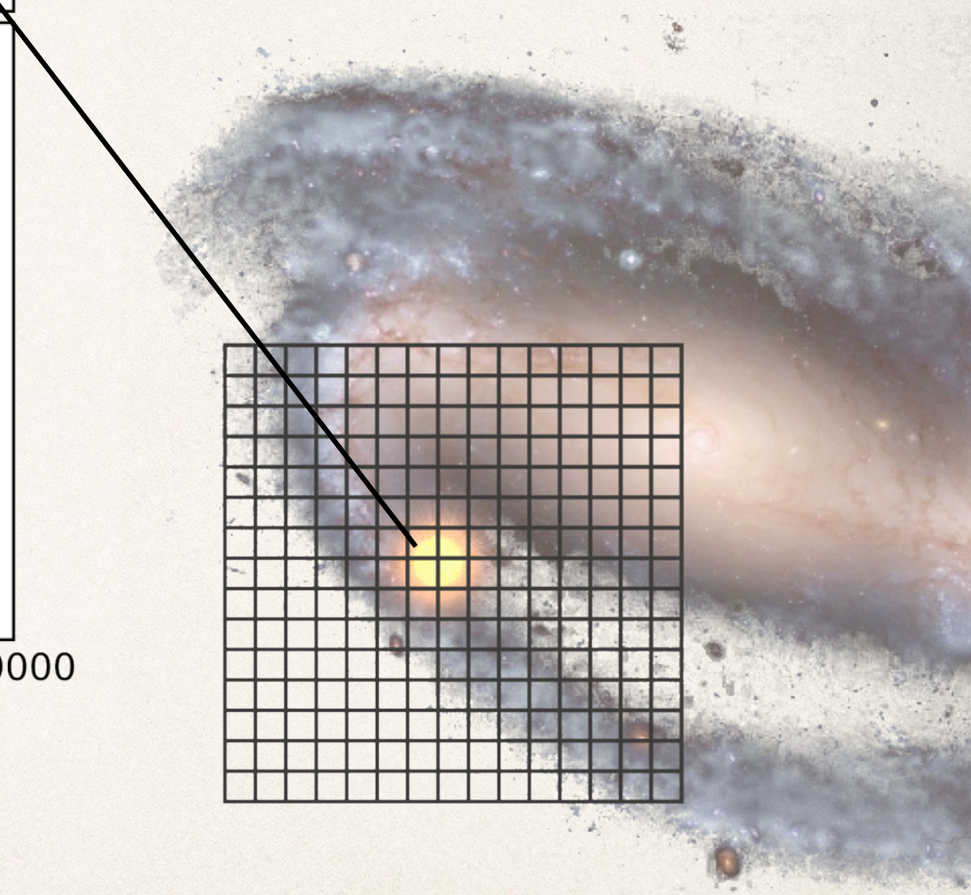


Astrophysical Bias in Cosmology

SN2011fe

SNfactory 3D Spectroscopy





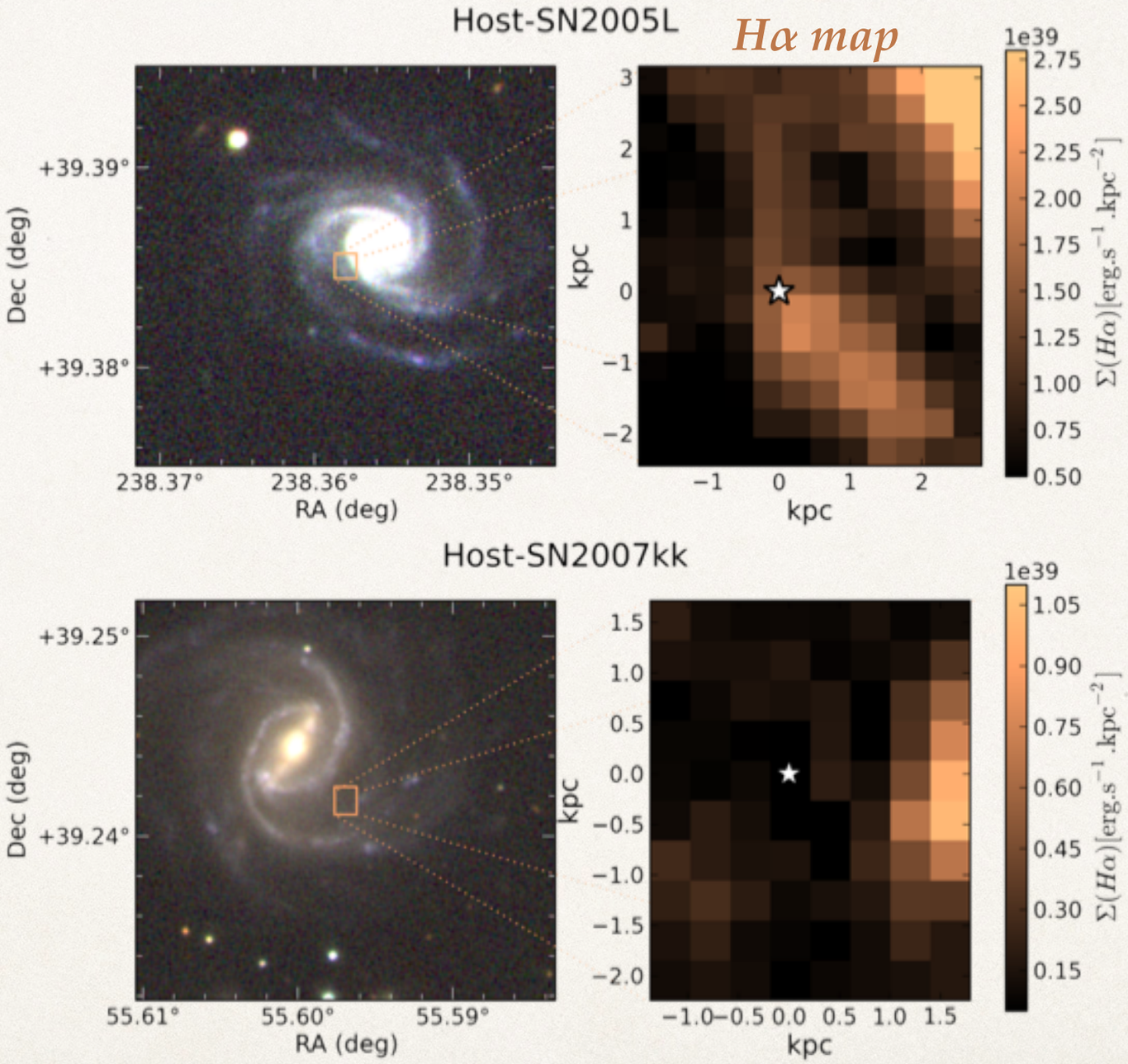
Local Environment and SNe Observed Simultaneously

The Local Perspective

Rigault et al. (2013)

Global

Spiral, Star forming Galaxies



Locale

Star forming Environments

—

Young stars

Passive Environments

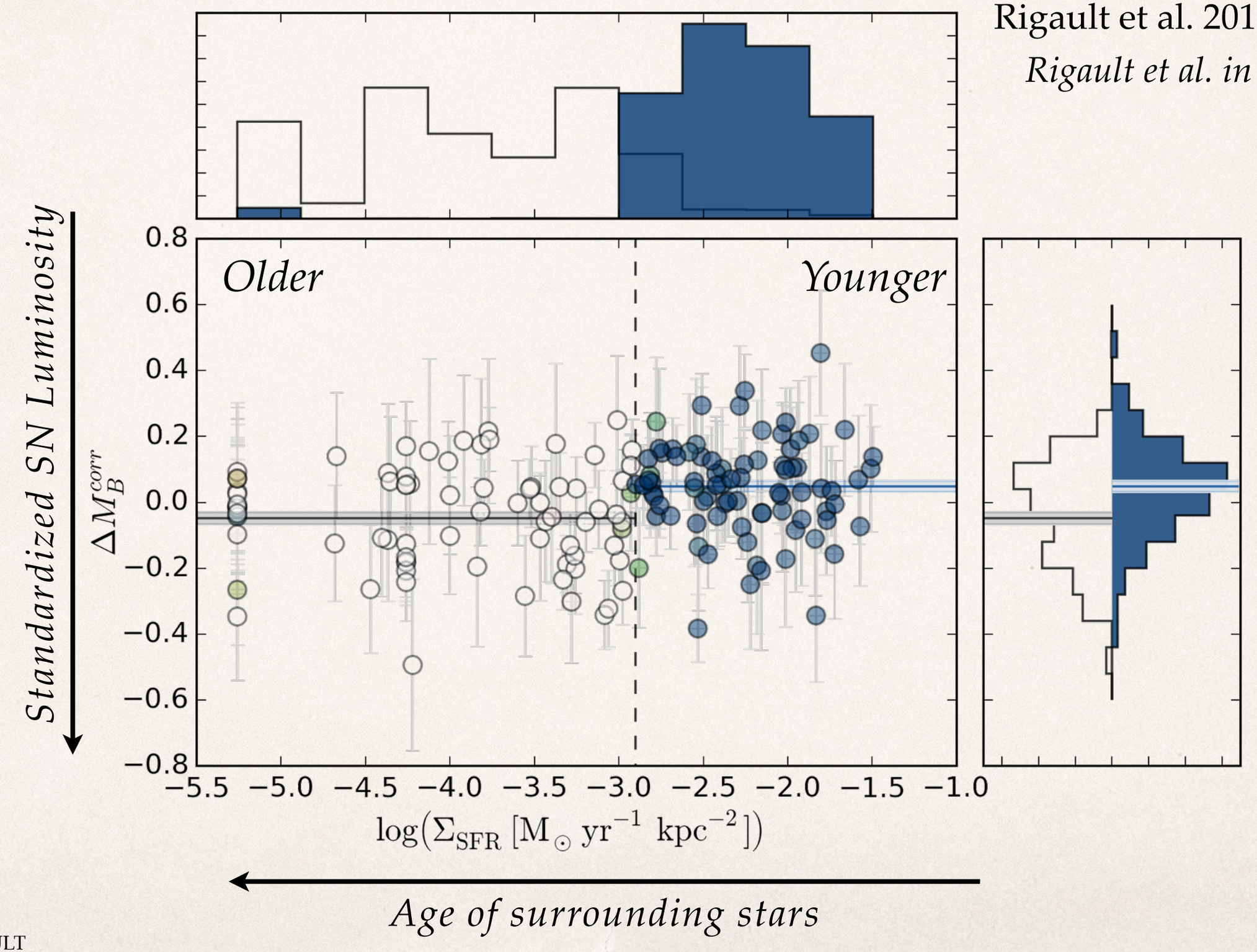
—

Old(er) stars

Astrophysical Bias in Cosmology

Rigault et al. 2013, 2015

Rigault et al. in prep.



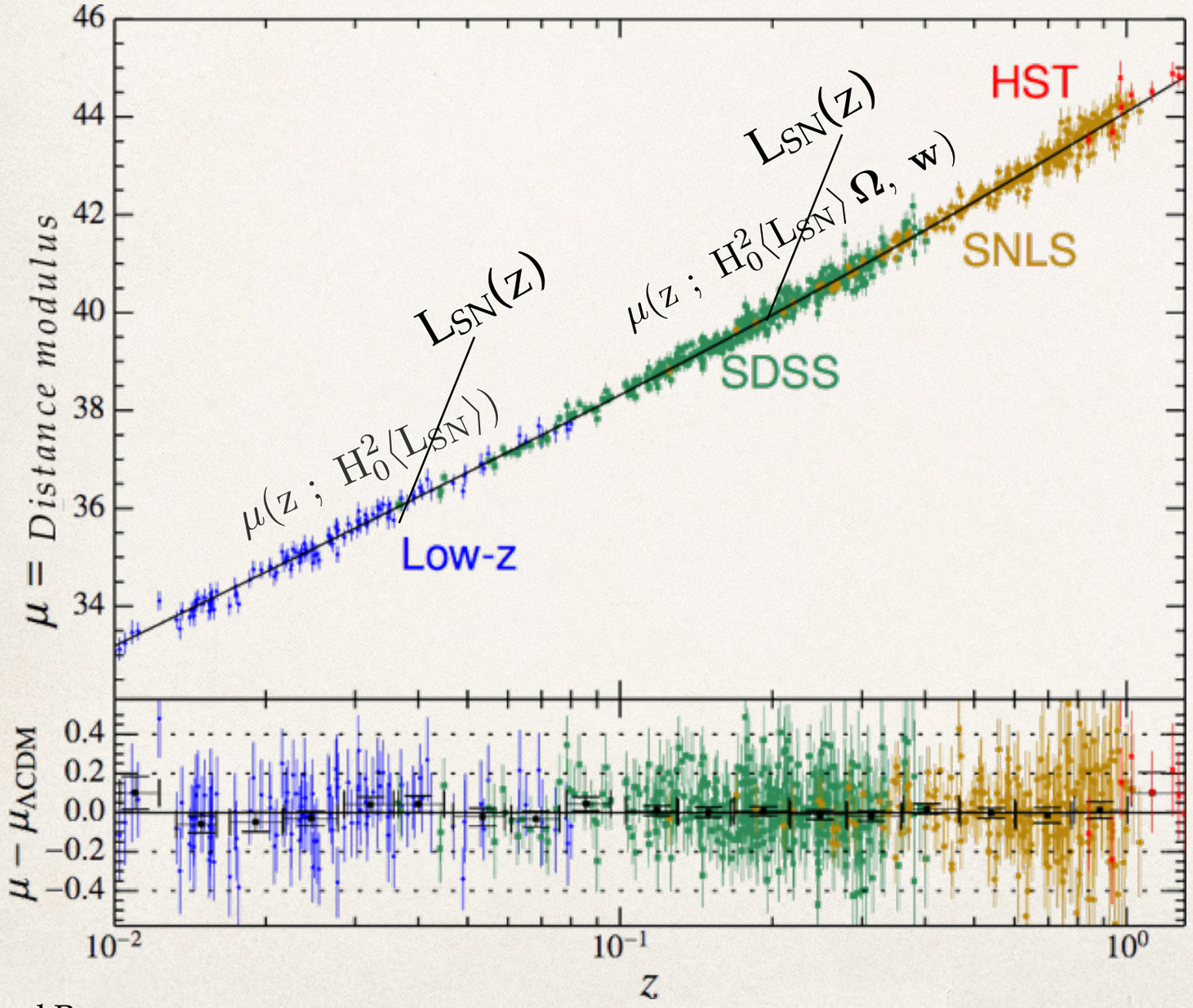
Correct Astrophysics for Accurate Cosmology (*w*)

Rigault et al. (2013)

50% Young
50% Old

PREDICTION →

90% Young
10% Old

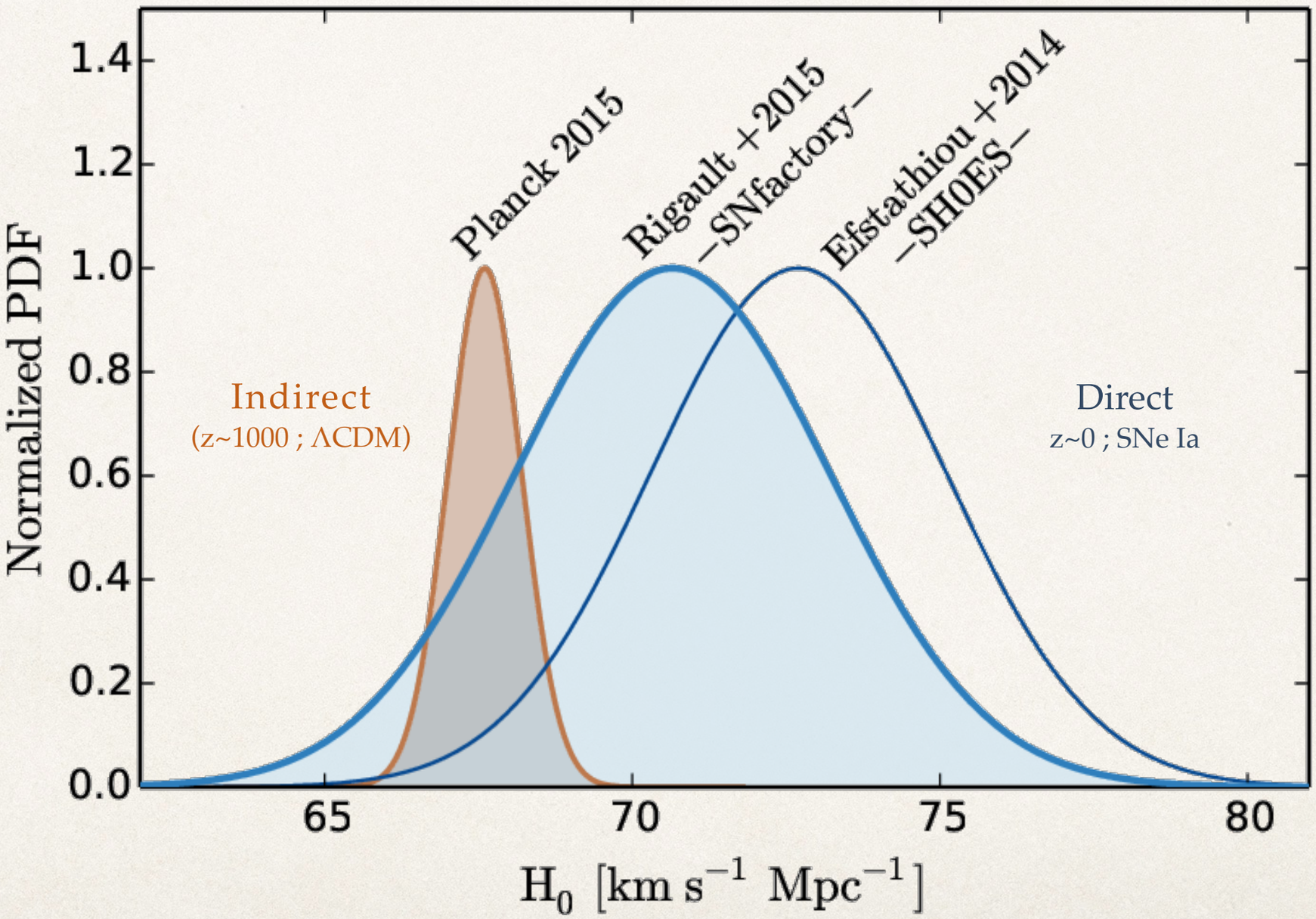


Galaxies are more Star Forming at Higher Redshift

Could impact *w* by a few %

Correct Astrophysics for Accurate Cosmology (H_0)

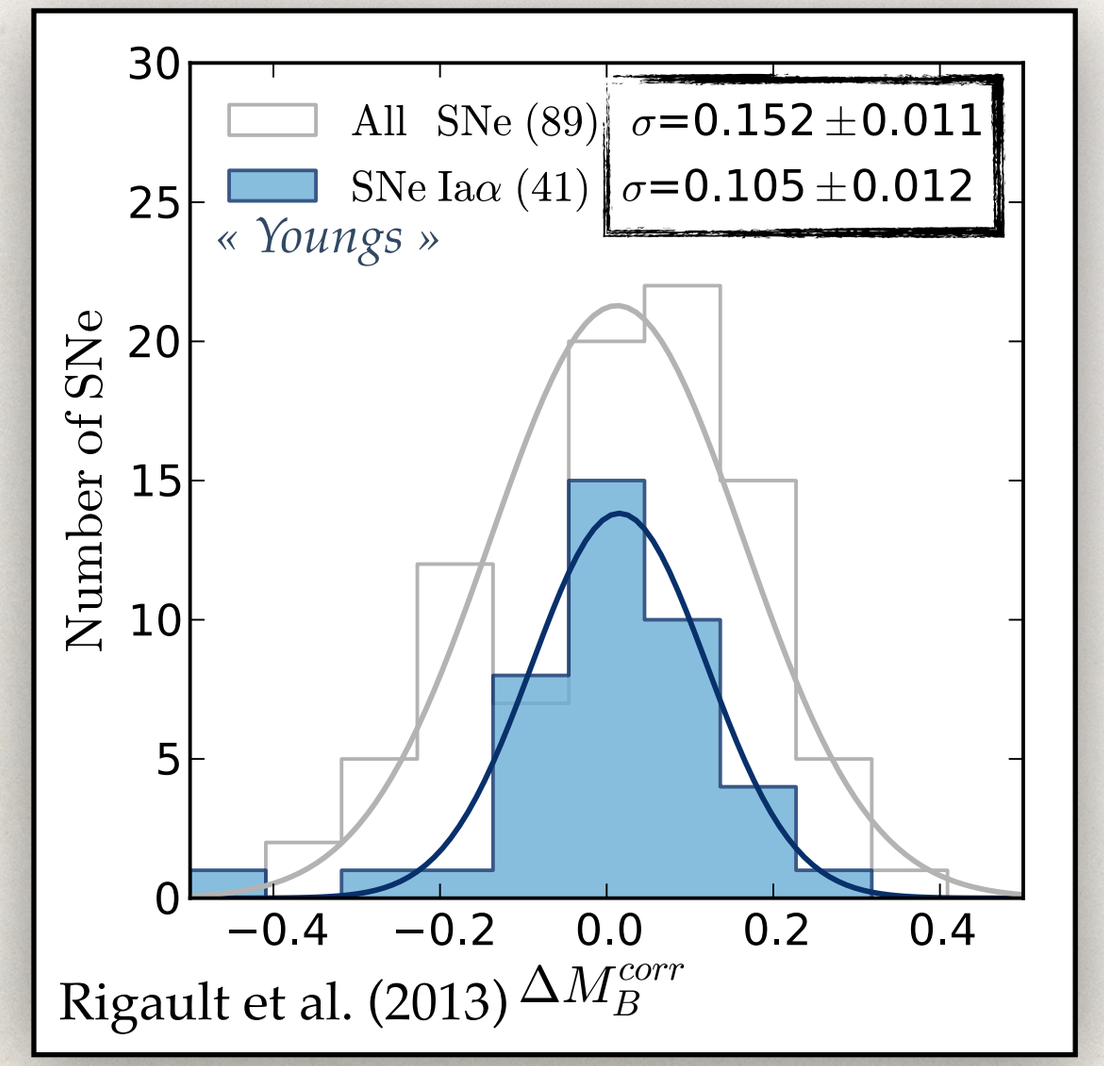
Still debated (Riess et al. 2016 to be checked)



Correct Astrophysics for Accurate Cosmology

Access Better Standard Candles

– Confirmed par Kelly et al. (2014) –



Strong Reduction of the Systematic Uncertainties

Conclusion

The Nearby Supernova Factory has obtained
~200 SNe Ia Time Series

Compare our system to any SN-survey

Test the accuracy of the current techniques

Improve the SN Standardization

The Nearby Supernova Factory has access
to the local SN environment

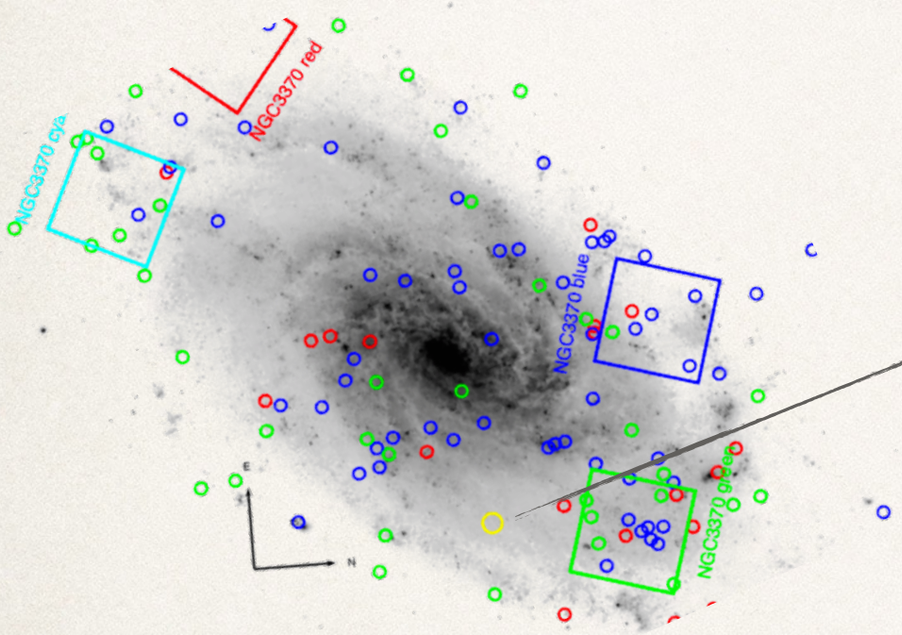
Understand observed environmental effect

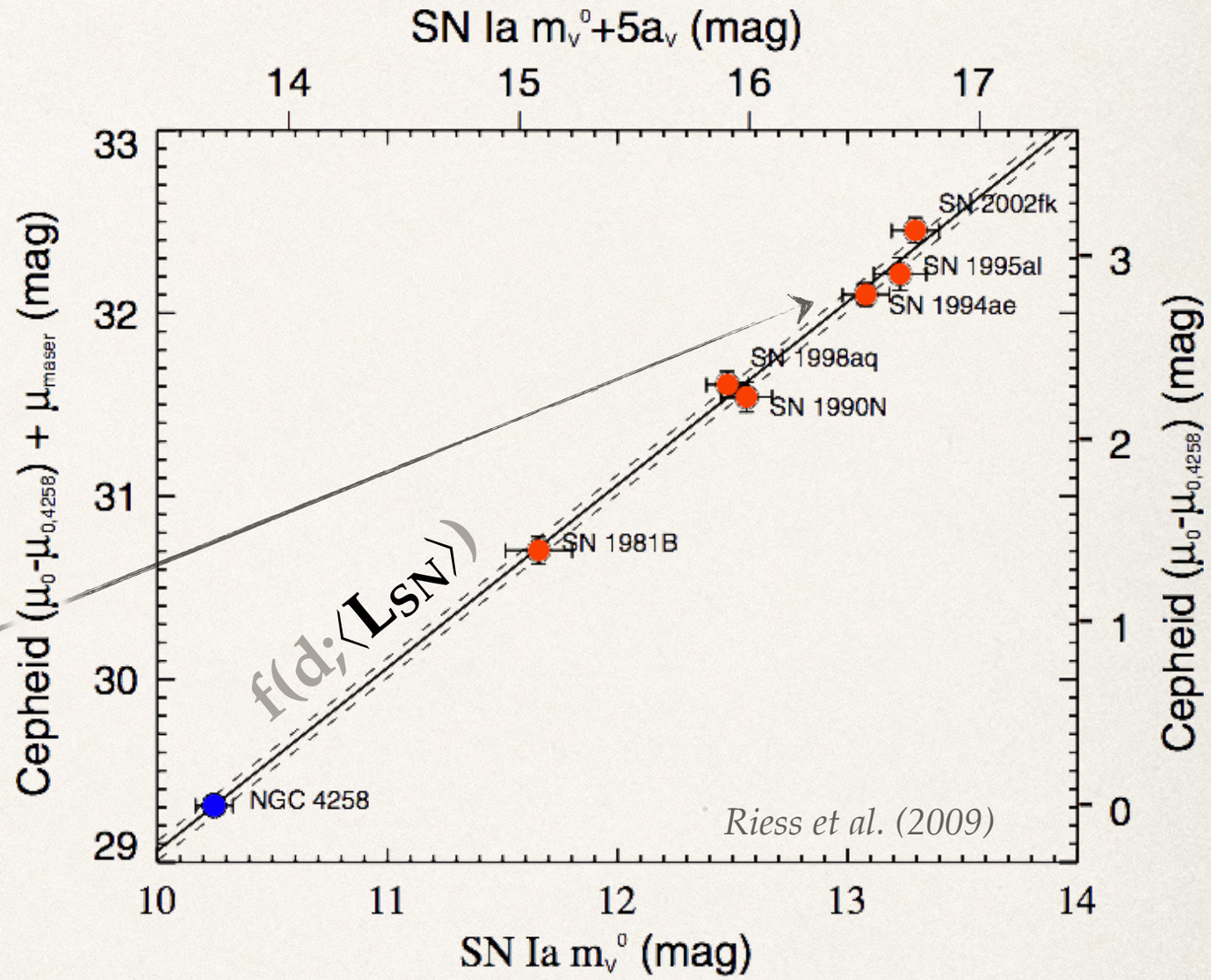
Correct Astrophysical Biaises (w, H_0)

Improve the SN as standard candles

Comprendre l'astrophysiques des sonde…
…Corriger des biais de mesure (H_0)

Céphéides**: jeunes étoiles très brillantes avec une relation **pulsation-luminosité





$H_0 = 72.5 \pm 2.5\ km\ s^{-1}\ Mpc^{-1}$

(3% ; Riess et al 2011; Efstathiou 2014)

ÉCHANTILLON BIAISÉ

SNe Céphéides ~ 100% Jeunes

SNe flot de Hubble ~ 50% Jeunes

***H_0* EST SURESTIMÉ DE ~3%**