Impact of SUGAR in the cosmological analysis

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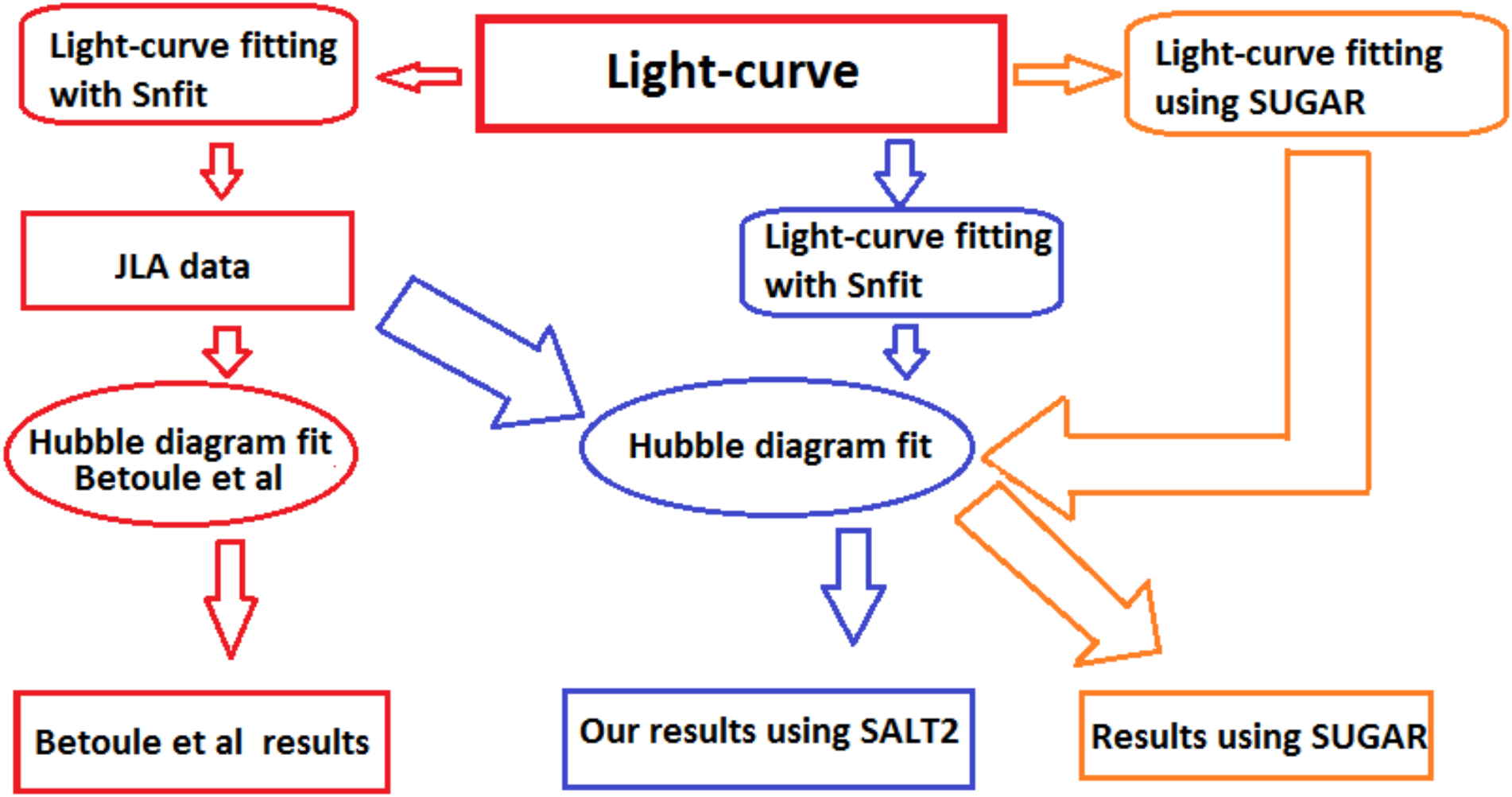
Supernova Useful Generator And Reconstructor (SUGAR)

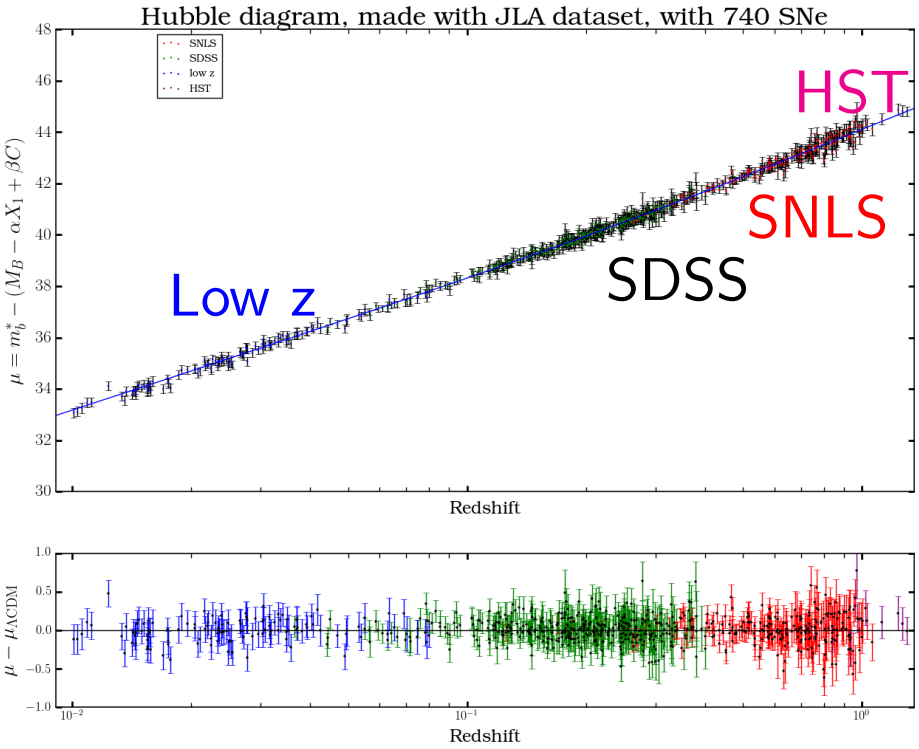
- SED model making by Pierre-François Leget during this PHD in 2016 based on spectral indicators.
- Sugar model:

$$M_{t,\lambda} = M_{t,\lambda,0} + \sum_{i=1}^{3} q_i \alpha_{t,\lambda,i} + A_V \left(\alpha_\lambda + \frac{1}{R_V} \beta_\lambda \right) + \Delta M_{grey}$$

- stretch and color + 2 new parameters correlated with spectral indicators
- Will this model allow to decrease the dispersion in the Hubble diagram fit?


Light-curve
Light-curve fitting with Snfit
Light-curve fitting using SUGAR
JLA data
Light-curve fitting with Snfit
Hubble diagram fit Betoule et al
Hubble diagram fit
Betoule et al results
Our results using SALT2
Results using SUGAR

Results obtained with the full JLA samples



- ΛCDM model:

$$d_l = \frac{(1+z)\ c}{H_0} \int_0^z \frac{\mathrm{d}z'}{H(z')/H_0}$$

$$\frac{H(z)}{H_0} = \sqrt{\Omega_m (1+z)^3 + \Omega_\Lambda}$$

$$\Omega_\Lambda = 1 - \Omega_m$$

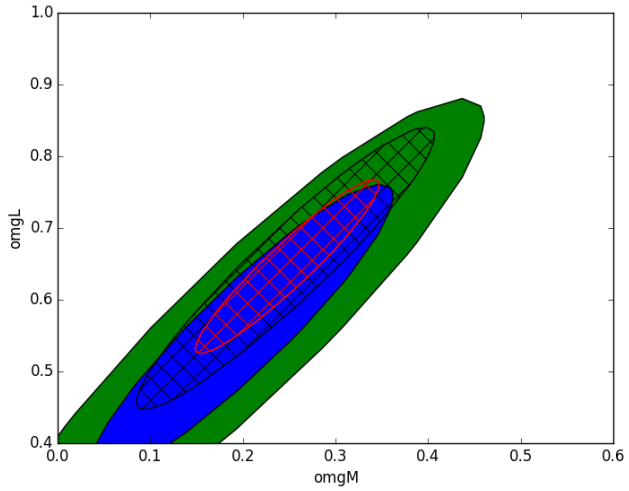
	Our Results	Results Betoule & al.
χ^2 / d.o.f	0.93	0.93
χ^2	682.89	682.9
Ω_M	0.295 $\pm$ 0.033	0.295 $\pm$ 0.34
α	0.141 $\pm$ 0.007	0.141 $\pm$ 0.006
β	3.101 $\pm$ 0.081	3.101 $\pm$ 0.075
Mb	-19.05 $\pm$ 0.02	-19.05 $\pm$ 0.02
ΔM	-0.070 $\pm$ 0.022	-0.70 $\pm$ 0.023

Results using only statistical covariance matrix

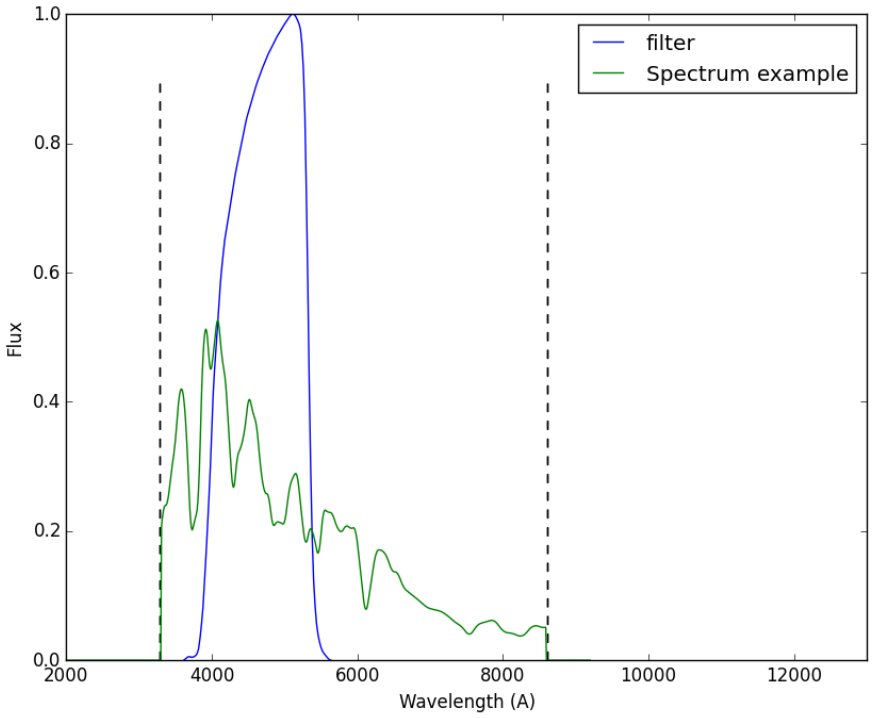
- Results for ΛCDM:

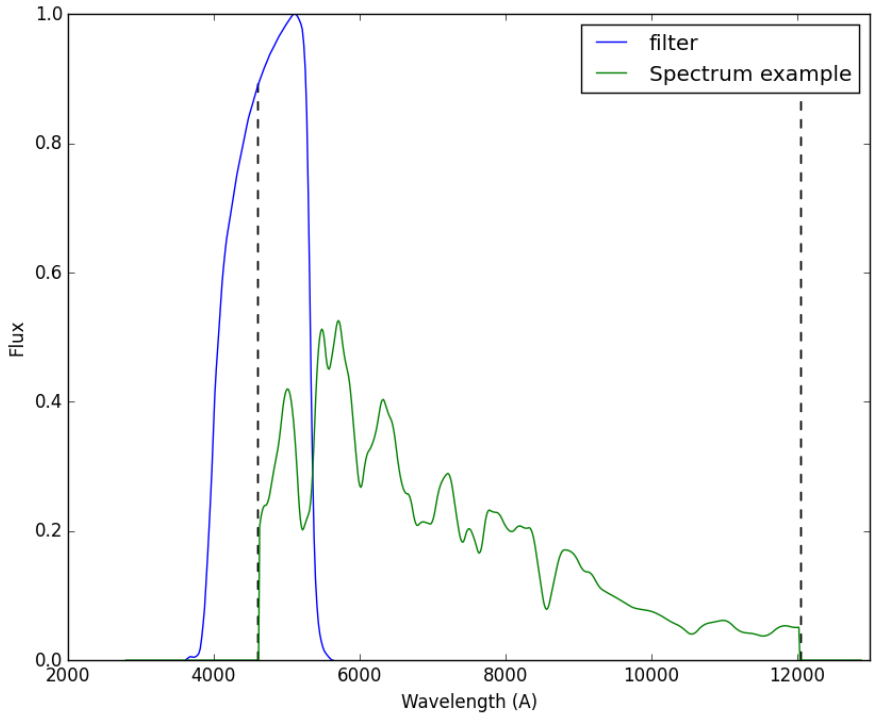
	$C_{stat+sys}$ Betoule & al.	C_{stat} Betoule & al.
$\chi^2/\mathrm{d.o.f}$	0.93	0.98
χ^2	682.89	717.29
Ω_M	0.295 $\pm$ 0.033	0.288 $\pm$ 0.018
α	0.141 $\pm$ 0.007	0.140 $\pm$ 0.006
β	3.101 $\pm$ 0.081	3.139 $\pm$ 0.077
Mb	-19.05 $\pm$ 0.02	-19.044 $\pm$ 0.013
ΔM	-0.070 $\pm$ 0.022	-0.060 $\pm$ 0.012

- Confidence contour:



Problem of SUGAR wavelength coverage





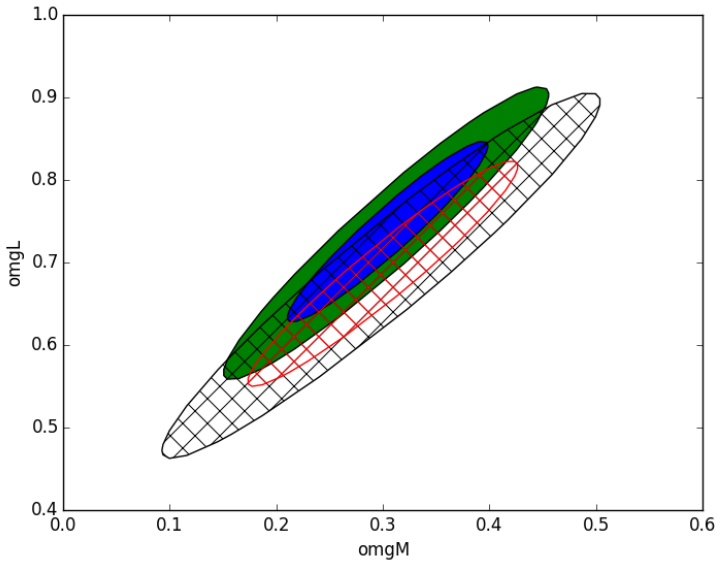
- If 10% of the integrated transmission are outside SUGAR wavelenght coverage we don't select the filter.

Impact of the selection

- Results for ΛCDM:

	Snfit output data without bands selections	Snfit output data with bands selections
$\chi^2/\mathrm{d.o.f}$	0.99	1.00
χ^2	724.68	734.74
Mean of the residuals	-0.00069	0.01088
rms	0.1702	0.2841
Ω_M	0.288 $\pm$ 0.018	0.306$\pm$ 0.022
α	0.140 $\pm$ 0.006	0.147 $\pm$ 0.006
β	3.146 $\pm$ 0.077	3.125$\pm$ 0.084
Mb	-19.046 $\pm$ 0.012	-19.038 $\pm$ 0.013
ΔM	-0.061 $\pm$ 0.012	-0.075 $\pm$ 0.012

- Confidence contour:



Conclusion

- We have reproduced the results of Betoule et al. (2014)
- We have established a point of comparison to study the use of SUGAR
- The next step is to replace the SALT2 fit by the SUGAR fit to study the impact of the new model
- We must take into account the total covariance matrix
- It will be necessary to extrapolate the model in the ultraviolet