Characterizing SNela lightcurve : analysis of second bump with ZTF

Collaborative work w/
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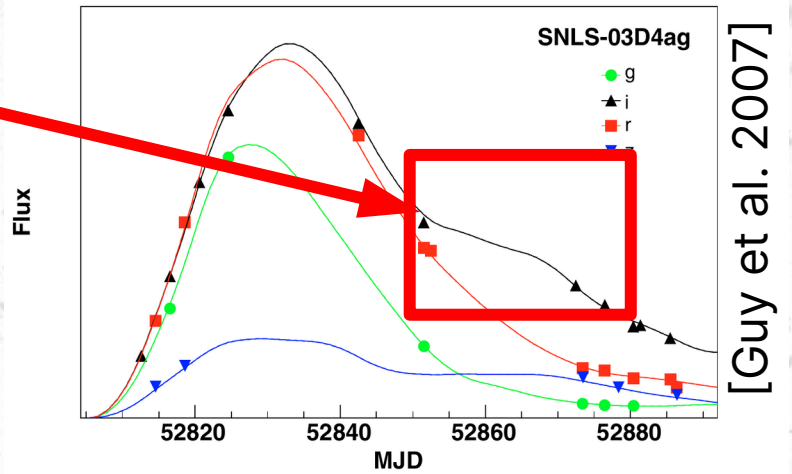
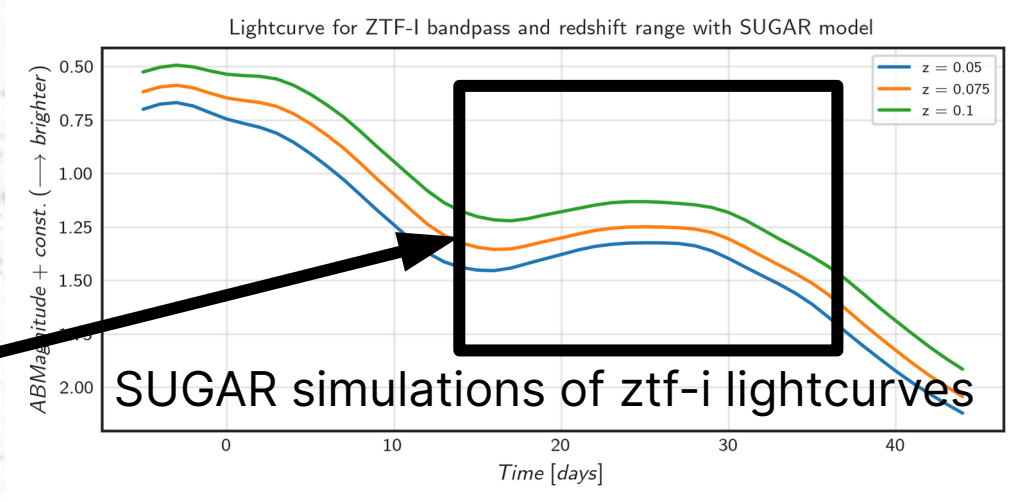
Quick reminder

- Second ump occuring in time range ~ $[t_0+15, t_0+40]$
- Integrated into current models :
  → SALT2 [Guy et al. 2007]
  → SUGAR [Léget et al. 2018]
- No explanation so far on the physical origin of the second bump :
  → host effect ?
  → chemical properties ?
- Cadence of ZTF + i-band = perfect cocktail for this study !





Until now...

- Set objective : **determine if the ZTF i-band lightcurves provide information independent of current models + can it improve standardization of SNela ?**

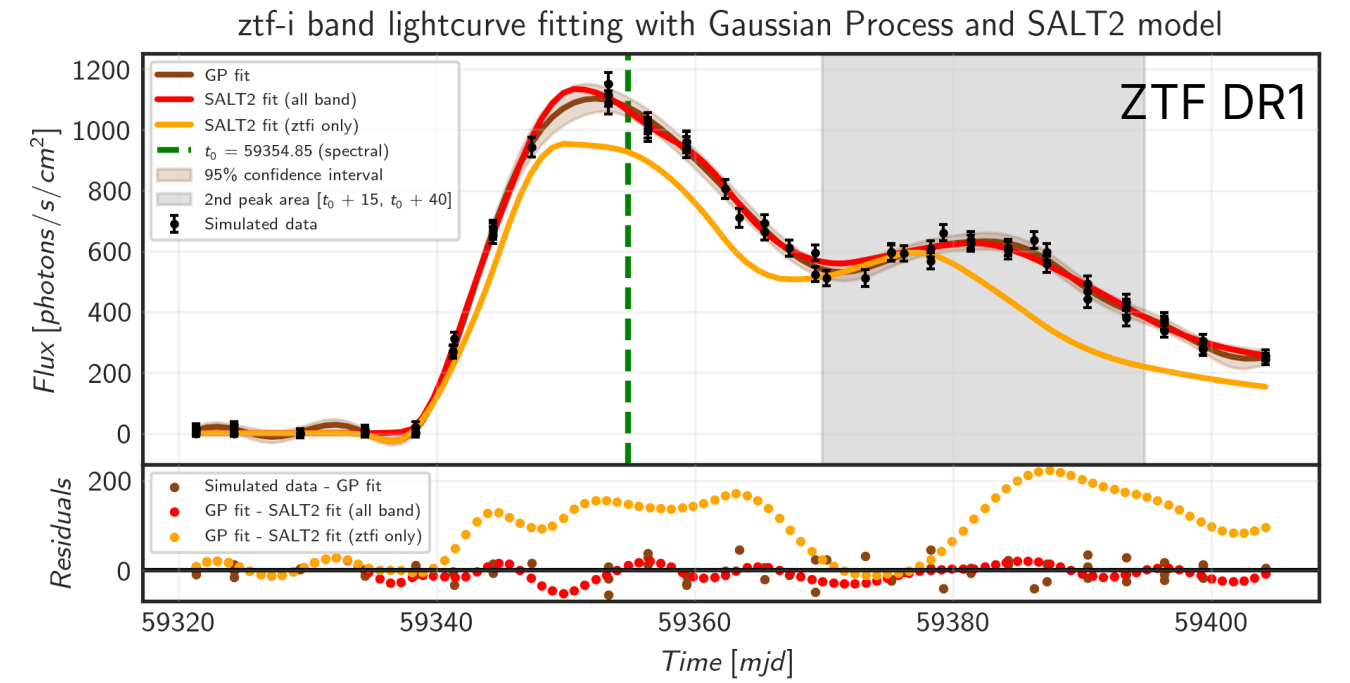
- Get comfortable with SNela cosmology and observation

- Used simulations of lightcurves w/ ***simsurvey + SALT2***:
  → Implemented method
  → Wrote/define pipeline analysis code

- Recently :
  → First analysis of ZTF DR2
  → Define selection criteria for our study (redshift range, min. cadence, time range...)

Gaussian Process to fit ztf-i band

- Data regression/fitting using Bayesian method
- Consists of : mean function (= constant) + kernel (= covariance matrix)
- Look at discrepancies with existing model



Constant component

$$\mathrm{k}(\mathrm{x}_i, x_j) = constant\_value \; \forall \; x_1, x_2$$

+

Matern kernel

$$\mathrm{k}_M(x) = \frac{\sigma^2}{\Gamma(\nu)2^{\nu-1}} \left(\frac{\sqrt{2\nu}x}{l} \right)^{\nu} K_\nu \left(\frac{\sqrt{2\nu}x}{l} \right)$$

or

RBF/"squared exponential" kernel

$$\mathrm{k}(\mathrm{x}_i, x_j) = \exp\left(-\frac{d(x_i, x_j)^2}{2l^2} \right)$$

Upcoming work

- No exact parameter to look for :
  - Colors (R-I, G-I)
  - Residuals between SALT2 fit and Gaussian Process curves
  - Correlation between intensity and t_0-$t_{\text{second bump}}$