Title
Stretch-Parameterized Light Curves for High Redshift SN Ia Studies

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Sudies for High-Redshift Survey
Stretch Parameterization Light
Objective

Create a SN Ia lightcurve template optimized to fit hi-z SN magnitudes

- Continuous parametrization
- Simple model for lightcurves
- No biases
- B lightcurve a good magnitude indicator
- Measure host extinction (hmmm...)
- Template uncertainties and covariance
- Confined to B and V lightcurves at early epochs
- Low dispersion on Hubble diagram
Plan

1. Motivate our template model

2. Describe the model

3. The template!

4. Testing the template.

5. Other interesting results
Template Model

\[ x - \text{spline knots} \]

\[ \beta \]

\[ V \]

\[ M_V = -19.475 \]

\[ H_0 = 65 \text{ km/s/Mpc} \]

And for each supernova in the training set:

\[ S_V, t_{\text{max}}, E(B-V) \]

\[ R_b = 4.1 \]

\[ R_V = 3.1 \]
$\Delta t_{\text{max}} = 2.4 \text{ days}$
Result

- Split Hamuy et al. Sample magnitude dispersion from the Hubble diagram

$\sigma = 0.14 \text{ mag}$
The diagram shows a distribution of various galaxy types in the B-V Host plane. The galaxy types include Sab, SBo, SBa, Sbc, SBb, Sbb, E1, E2/S0, E3/S0, Sb, E5/S0, SB0, and SB0/SBa. The B-V Host plane is marked with a red arrow labeled SV.
CFA SNe Ia (Riess et al.)

$M - M_c (H_0 = 65)$

$3 \log \frac{L}{L_c} + 25$

$H_0 = 65 \text{ km s}^{-1} \text{ Mpc}^{-1}$
Conclusions

* Not optimized for low-z Type Ia's
  B and V only
  Early epochs

* Customize training set for the data

* Extinction (hmmm...)

* About as good as you can do with a single parameter
  No biases in residuals

* Easy to use.
  I give you the curves, you stretch them

* $\sigma = 0.14$ mag
Extinction

• Does not work well for $E(B-V) > 0.4$
  - $B-V$ data only

• $R_B, R_v$ depend on epoch + dust
  - High $z$!

• A problem for all template methods

• Biased against in mag-limited high-$z$ searches

• Ridge line