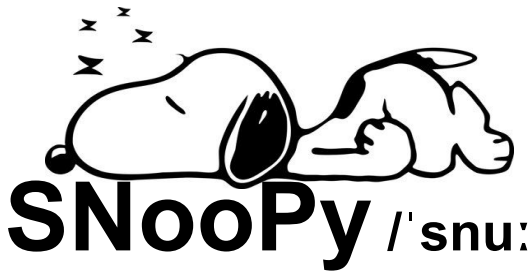
SN-Ia LC-fitting
SN parameters correlations
SN and host galaxy correlations

Nataliya Ramos Chernenko



def., **SuperNovae in Object Oriented Python**

(python package) **a collection of tools useful to build your own fitter in order to analyze the Type Ia supernovae.**

1. **EBV_model.** Only work with Δm_{15}- based template.
2. **EBV_model2.** Δm_{15} & s_{BV} - based templates
3. **Max_model.** Δm_{15} & s_{BV} - based templates
4. **Color_model.** Only work with 'color-stretch' s_{BV} parameter

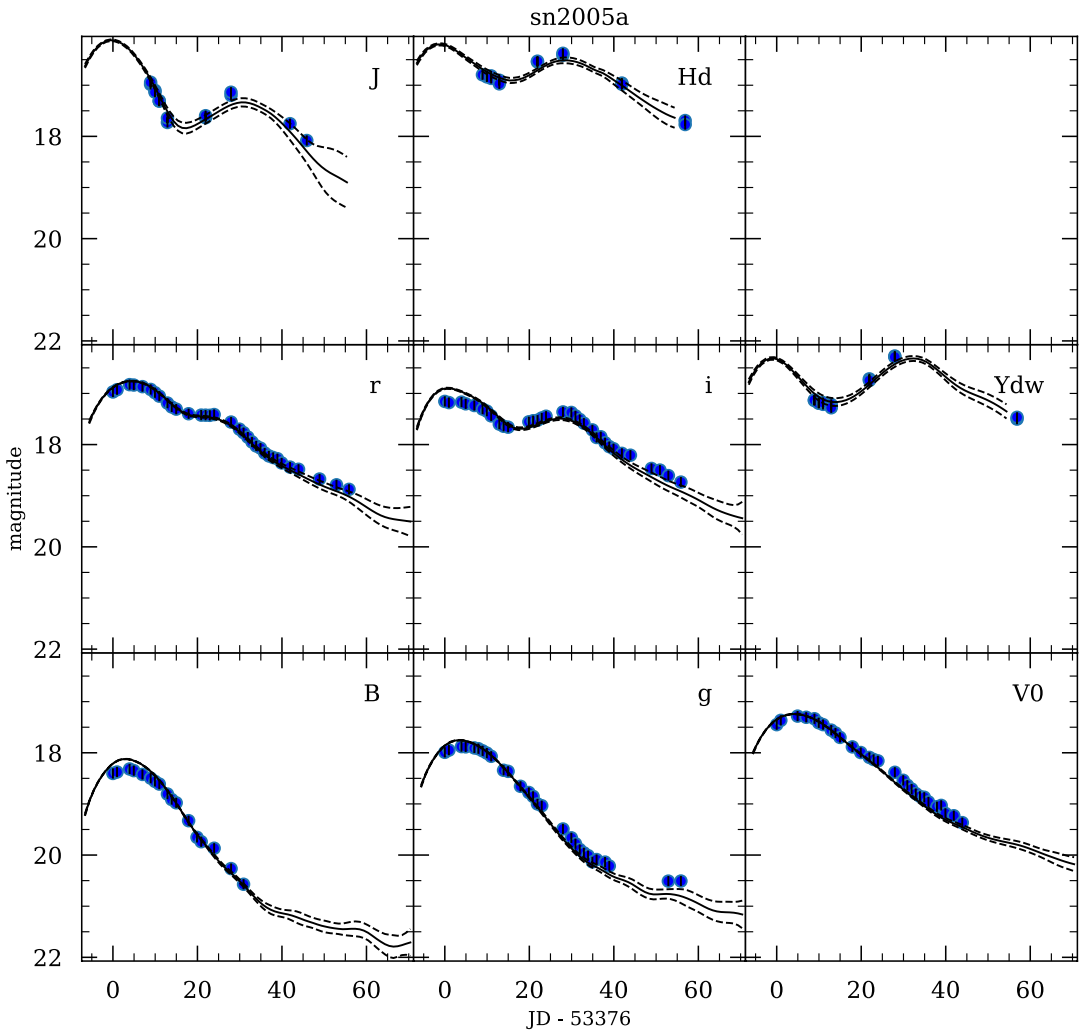
Two fitters: **non-linear least-square Levenberg-Marquart** algorithm and **Markov Chain Monte Carlo** fitter.

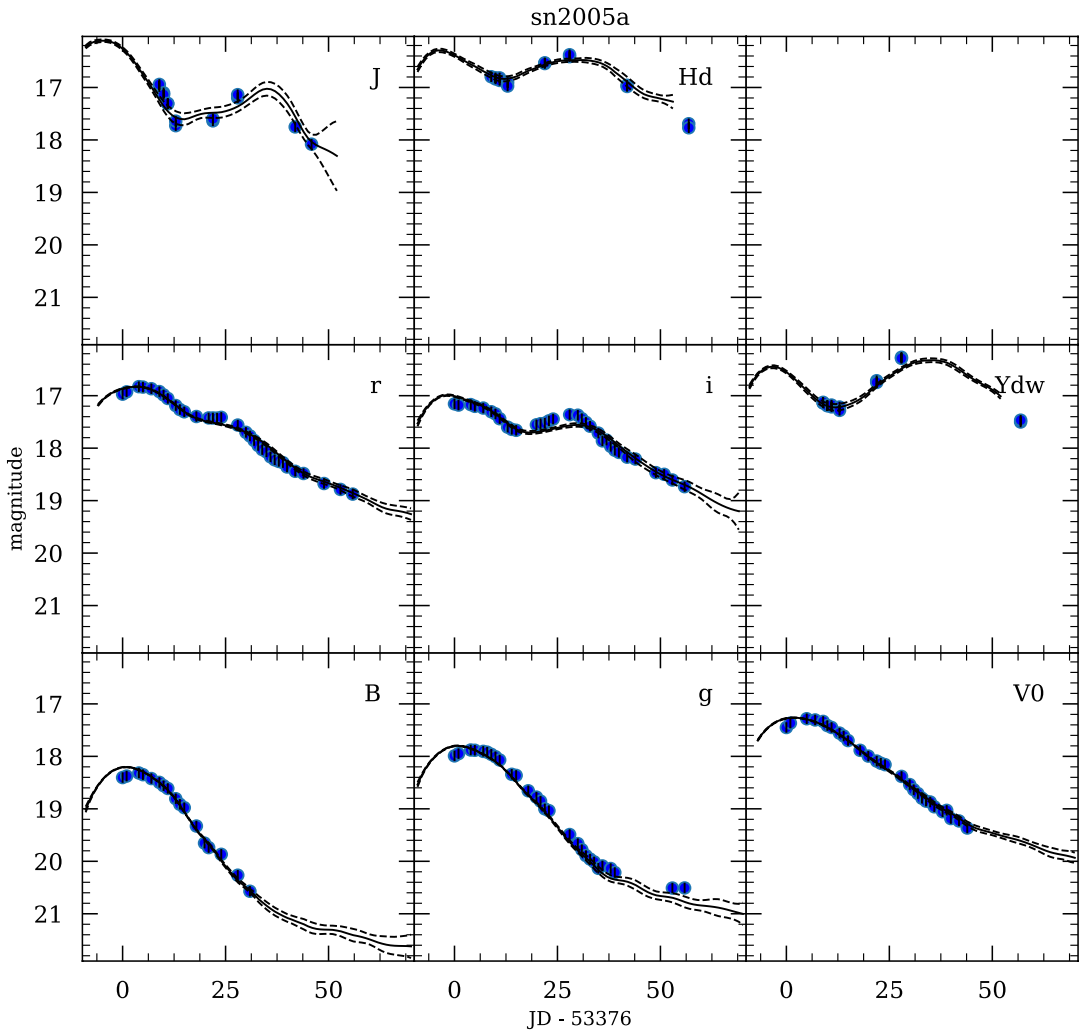
1. EBV_model2. Δm_{15} & s_{BV} - based templates

$$m_X(t) = T_Y(t', stype) + M_Y(stype) + \mu + R_X E(B-V)_{gal} + R_Y E(B-V)_{host} + K_{XY}$$

- $\boldsymbol{m_X(t)}$: observed magnitude in t, time relative to $B_{\max}$.
- $\boldsymbol{E(B-V)_{gal}}$ and $\boldsymbol{E(B-V)_{host}}$**:** reddening due to galactic foreground and host galaxy, respectively.
- $\boldsymbol{R_X}$ and $\boldsymbol{R_Y}$: total-to-selective absorptions for filters X and Y, respectively.
- $\boldsymbol{t'}$ is the de-redshifted time relative to $B_{\max}$.

This model fits **4 parameters**: $T_{\max}$, $\Delta\, m_{15}$ or s_{BV}, EBV_{host}, and DM.


sn2005a
J
Hd
r
i
Ydw
B
g
V0
magnitude
JD - 53376

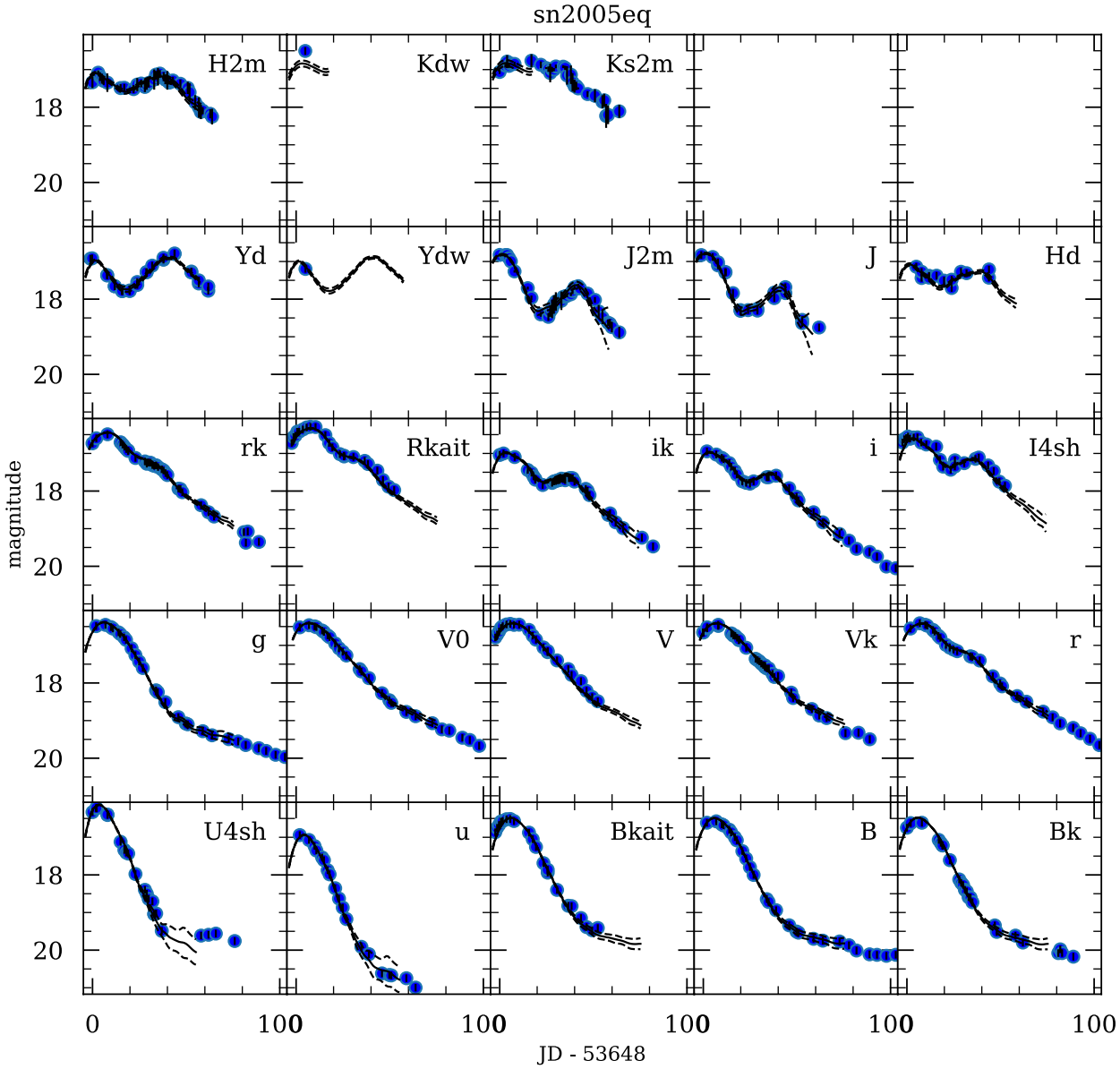

sn2005a
J
Hd
r
i
Ydw
B
g
V0
magnitude
JD - 53376

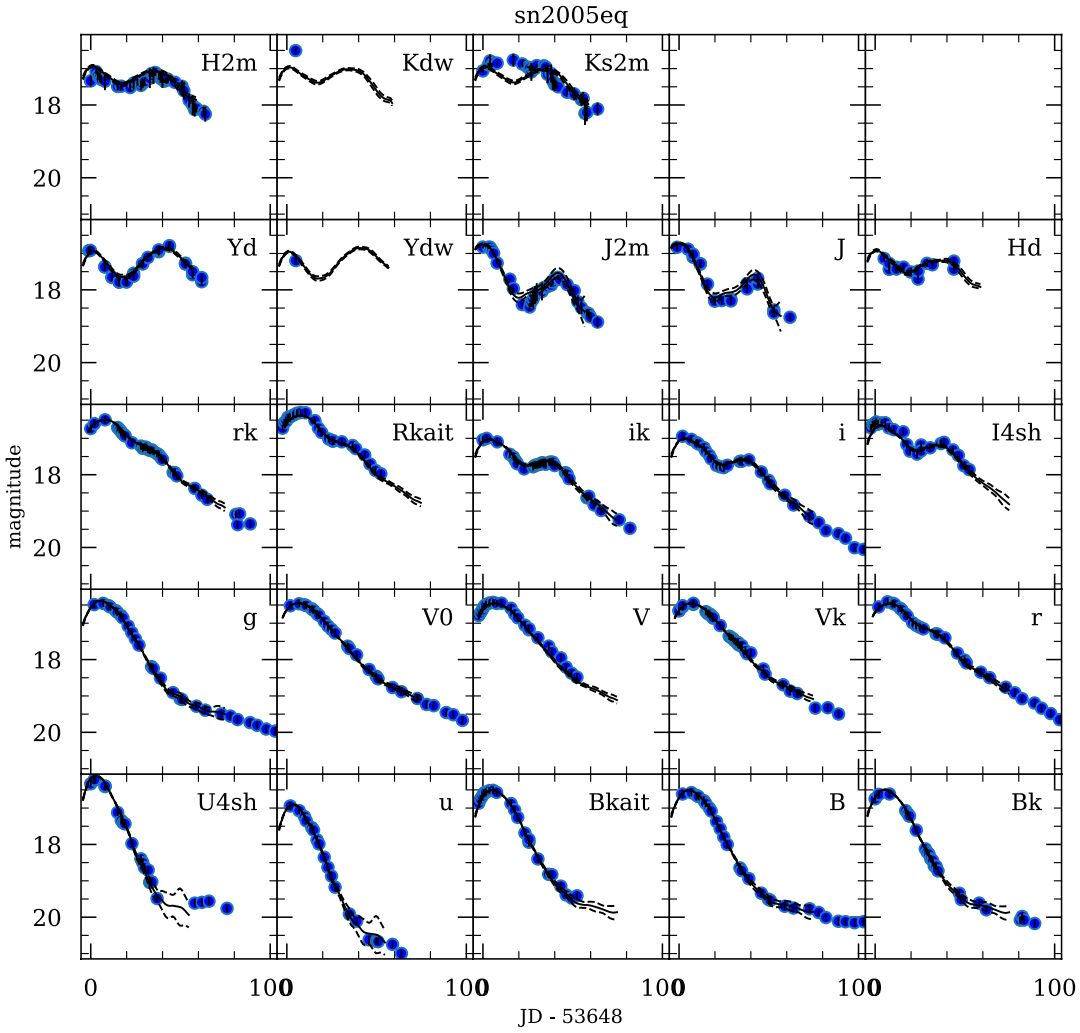
2. Max_model. Δm_{15} & s_{BV} - *based templates.*

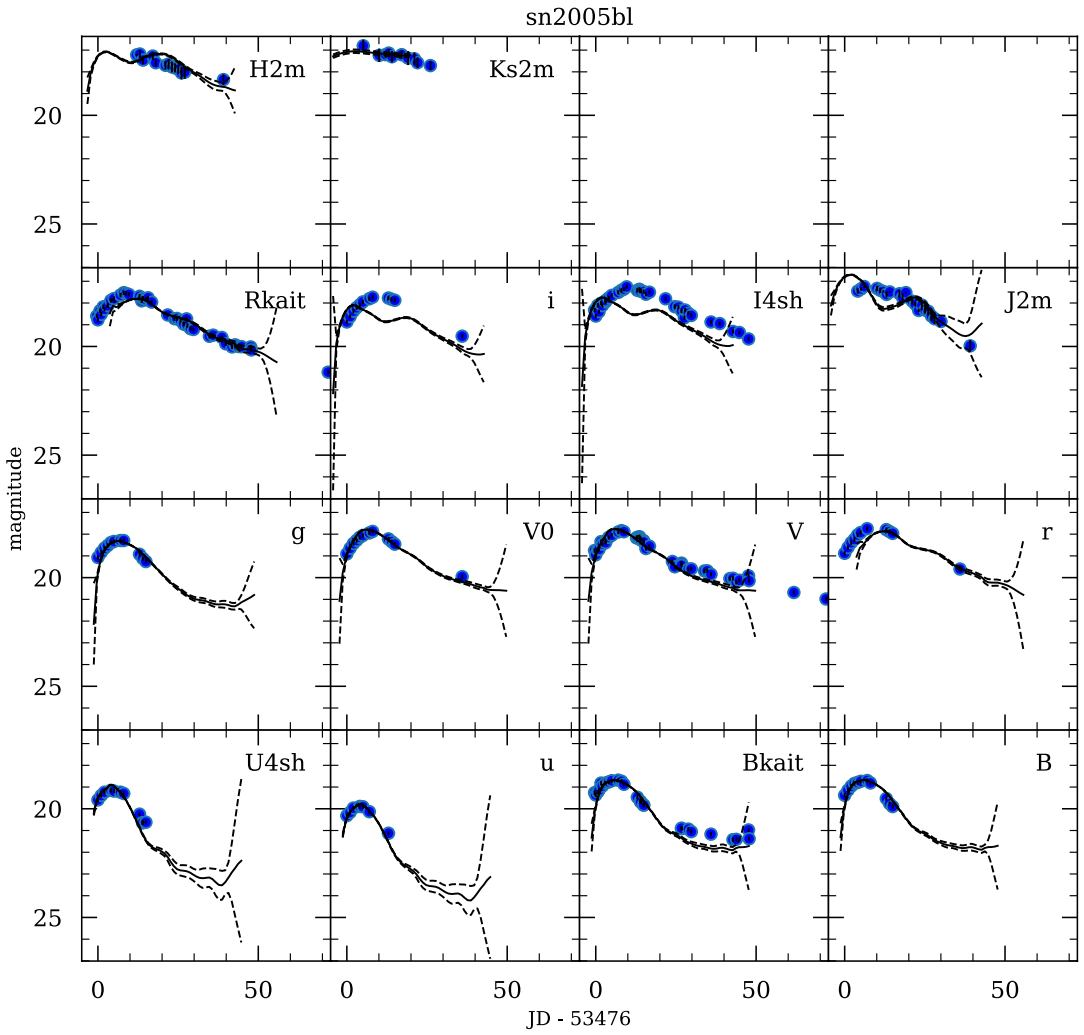
$$m_X(t) = T_Y(t', stype) + m_Y + R_X\, E(B-V)_{gal} + K_{XY}$$

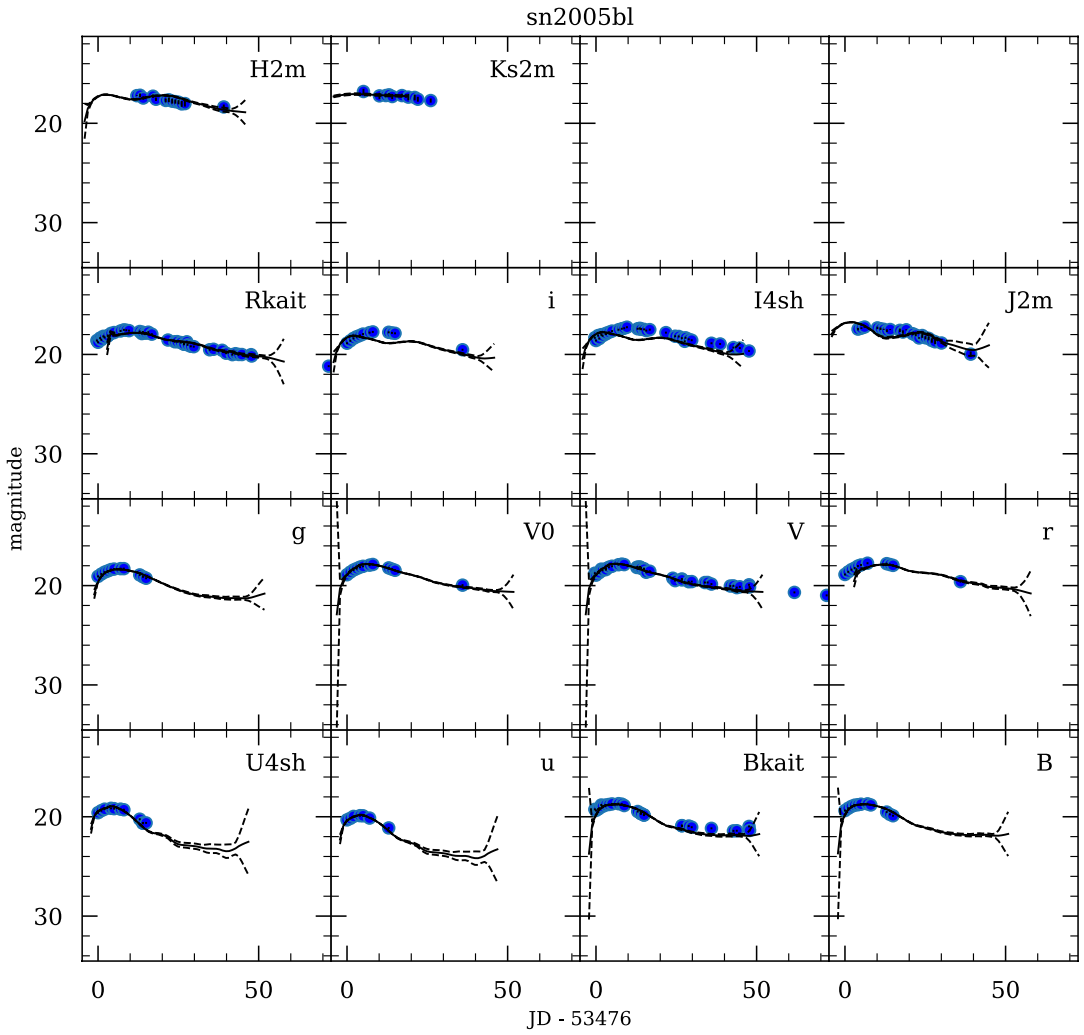
- m_Y is the peak magnitude in filter Y
- K_{XY} the cross-band k-correction from rest-frame X to observed filter Y.
- $stype = \Delta m_{15}\ \ or\ \ s_{BV}$.

For **N filters**, this model fit **N+2 parameters**: $T_{\max}$, $\Delta\, m_{15}$ or s_{BV} and $Nf_{\max}$.


sn2005eq
H2m
Kdw
Ks2m
Yd
Ydw
J2m
J
Hd
rk
Rkait
ik
i
I4sh
g
V0
V
Vk
r
U4sh
u
Bkait
B
Bk
magnitude
18
20
0
100
JD - 53648


sn2005eq
H2m
Kdw
Ks2m
Yd
Ydw
J2m
J
Hd
rk
Rkait
ik
i
I4sh
g
V0
V
Vk
r
U4sh
u
Bkait
B
Bk
magnitude
18
20
0
100
JD - 53648


sn2005bl
H2m
Ks2m
Rkait
i
I4sh
J2m
g
V0
V
r
U4sh
u
Bkait
B
magnitude
JD - 53476

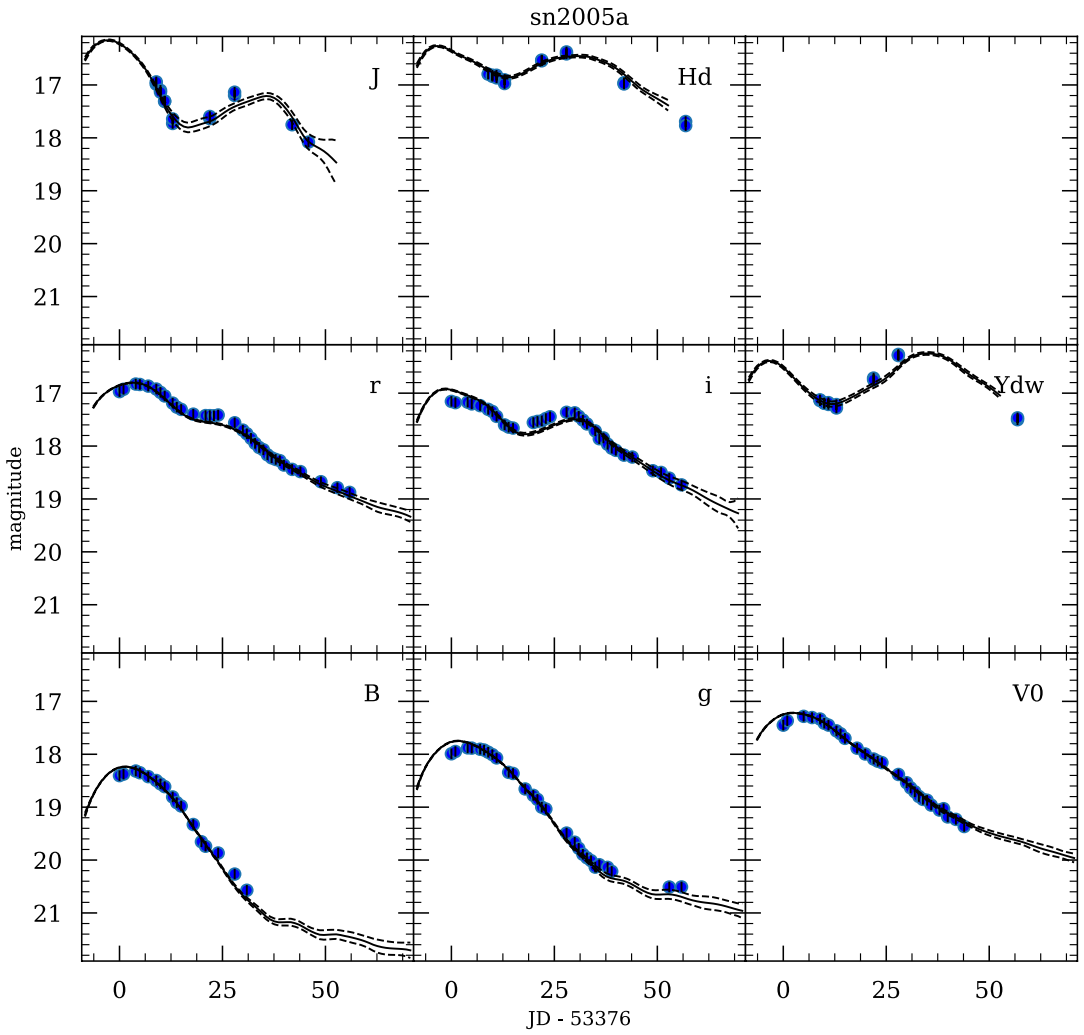

sn2005bl
H2m
Ks2m
Rkait
i
I4sh
J2m
g
V0
V
r
U4sh
u
Bkait
B
magnitude
JD - 53476

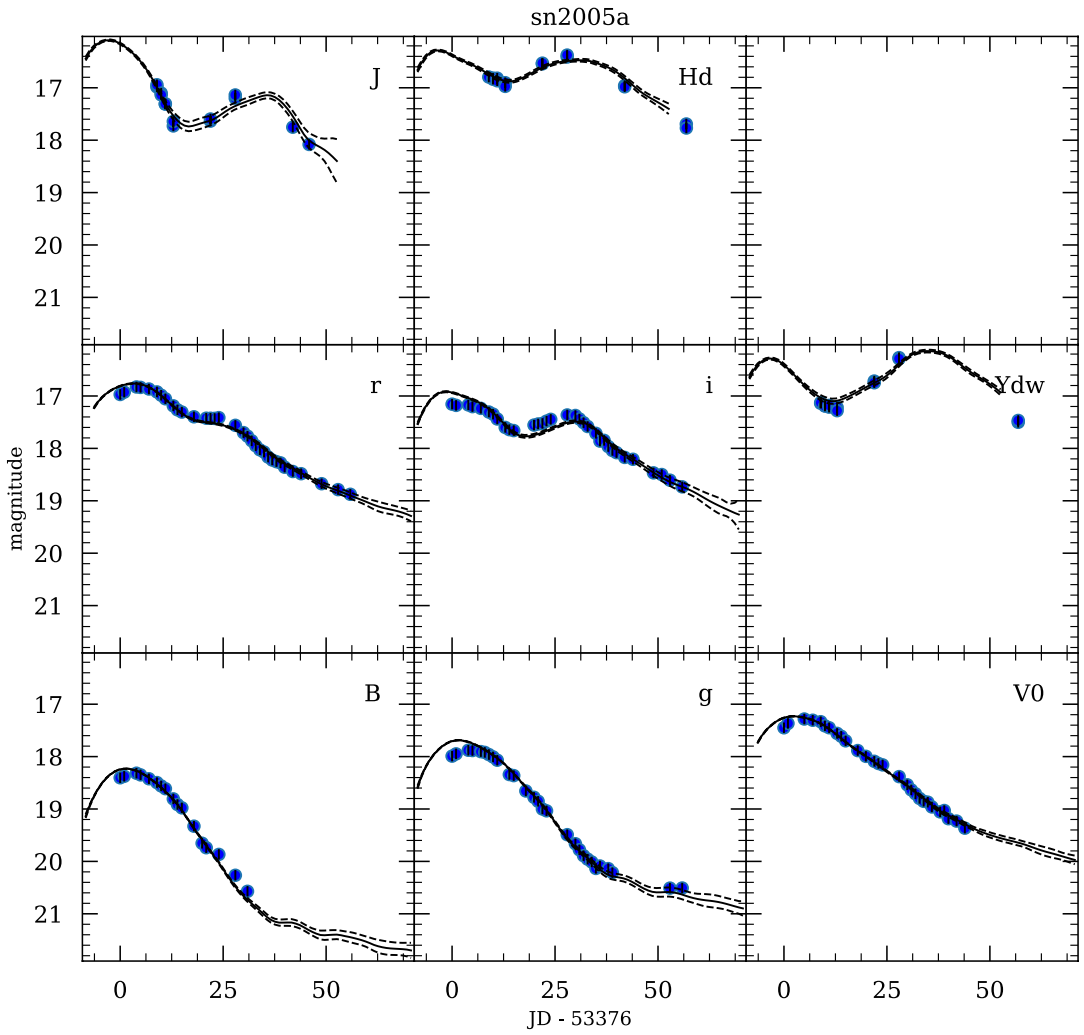
3. Color_model. *Only work with 'color-stretch' s_{BV} parameter*

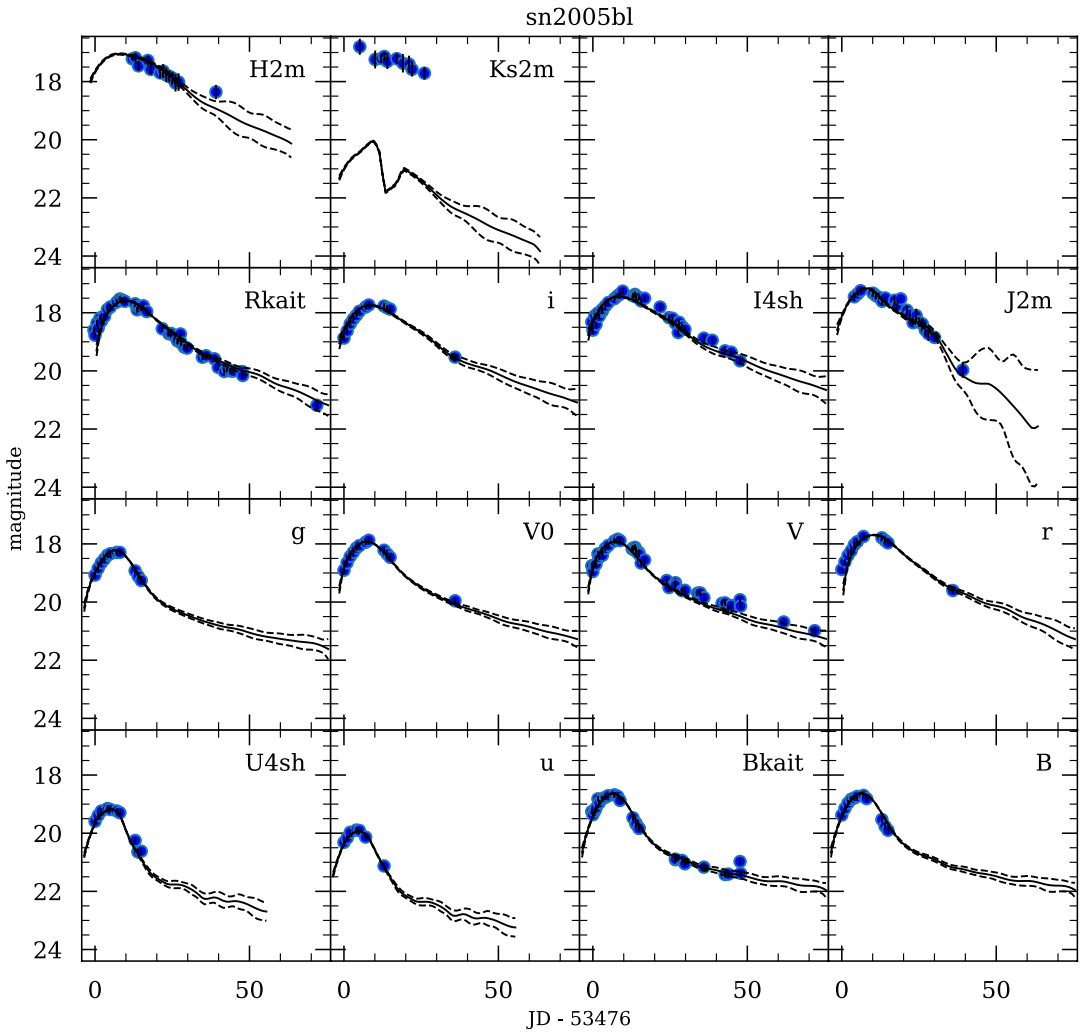
$$m_X(t) = T_Y(t', s_{BV}) + B_{max} + (X - B)(s_{BV}) + R_X \cdot E(B - V)_{gal} + R_Y(R_V) \cdot E(B - V)_{host} + K_{XY}$$

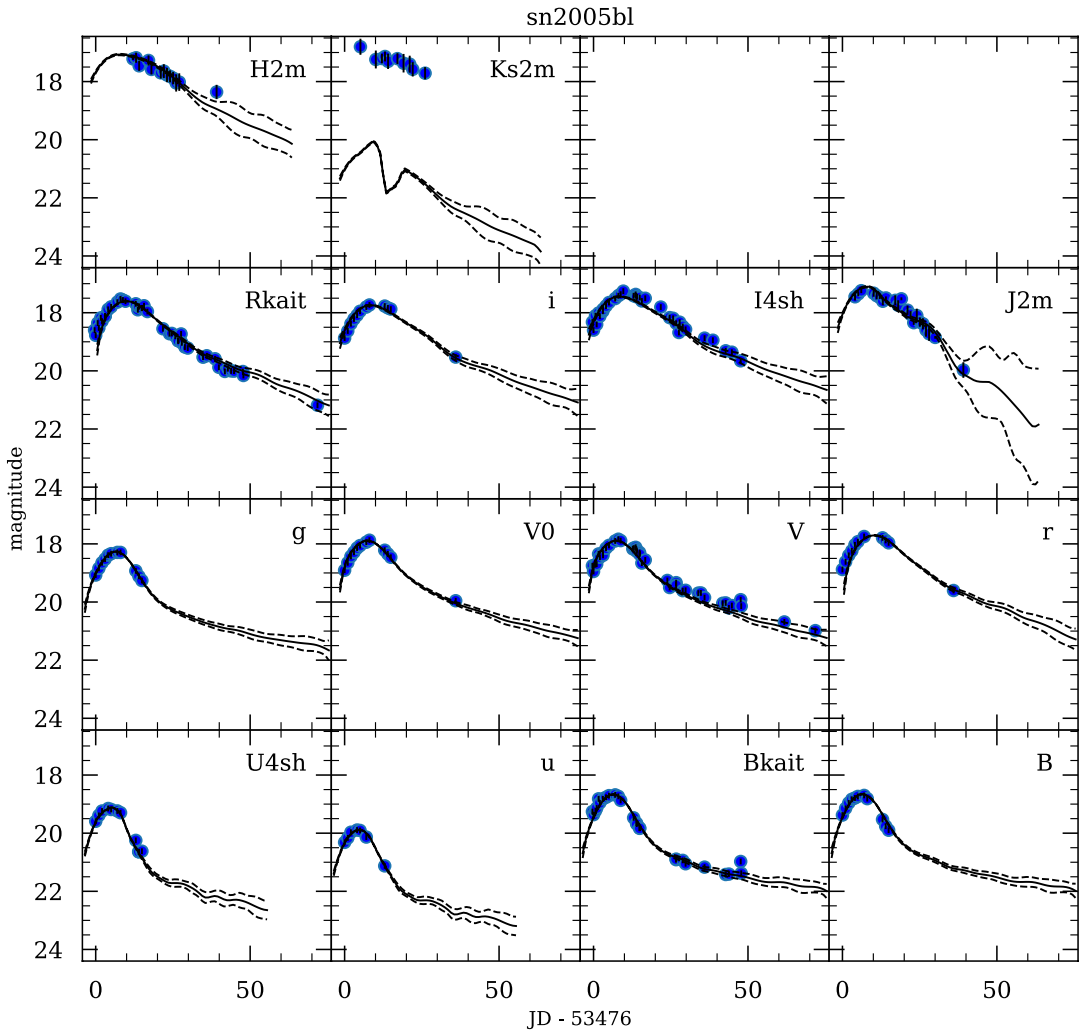
- B_{max} is the de-reddened and K-corrected B maximum
- $(\mathrm{X} - \mathrm{B})(s_{BV})$ is the intrinsic X-B color, which is a function of s_{BV}.

The model has **5 free parameters**: $T_{\max}$, $\Delta\, m_{15}$ or s_{BV}, EBV_{host} and R_V.

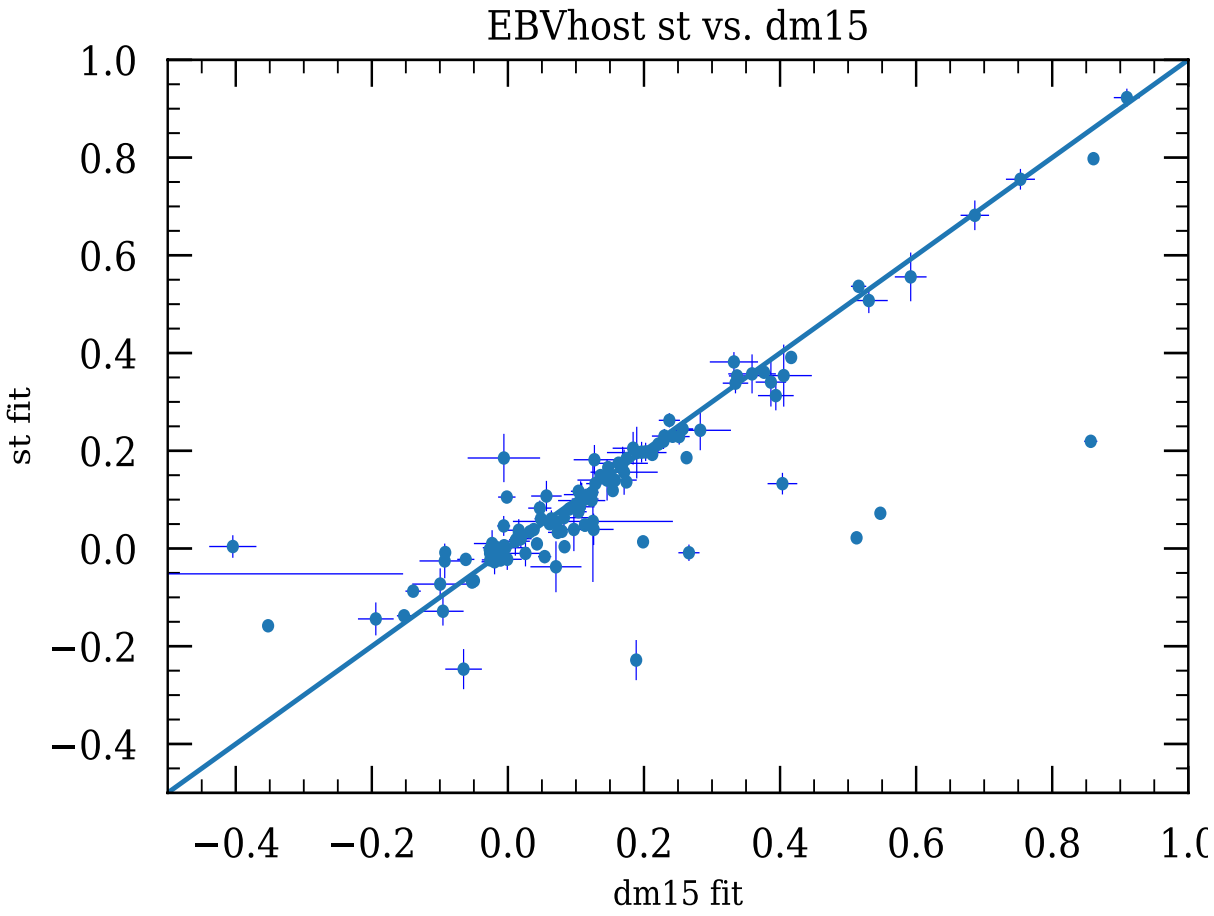

sn2005a
J
Hd
r
i
Ydw
B
g
V0
magnitude
JD - 53376

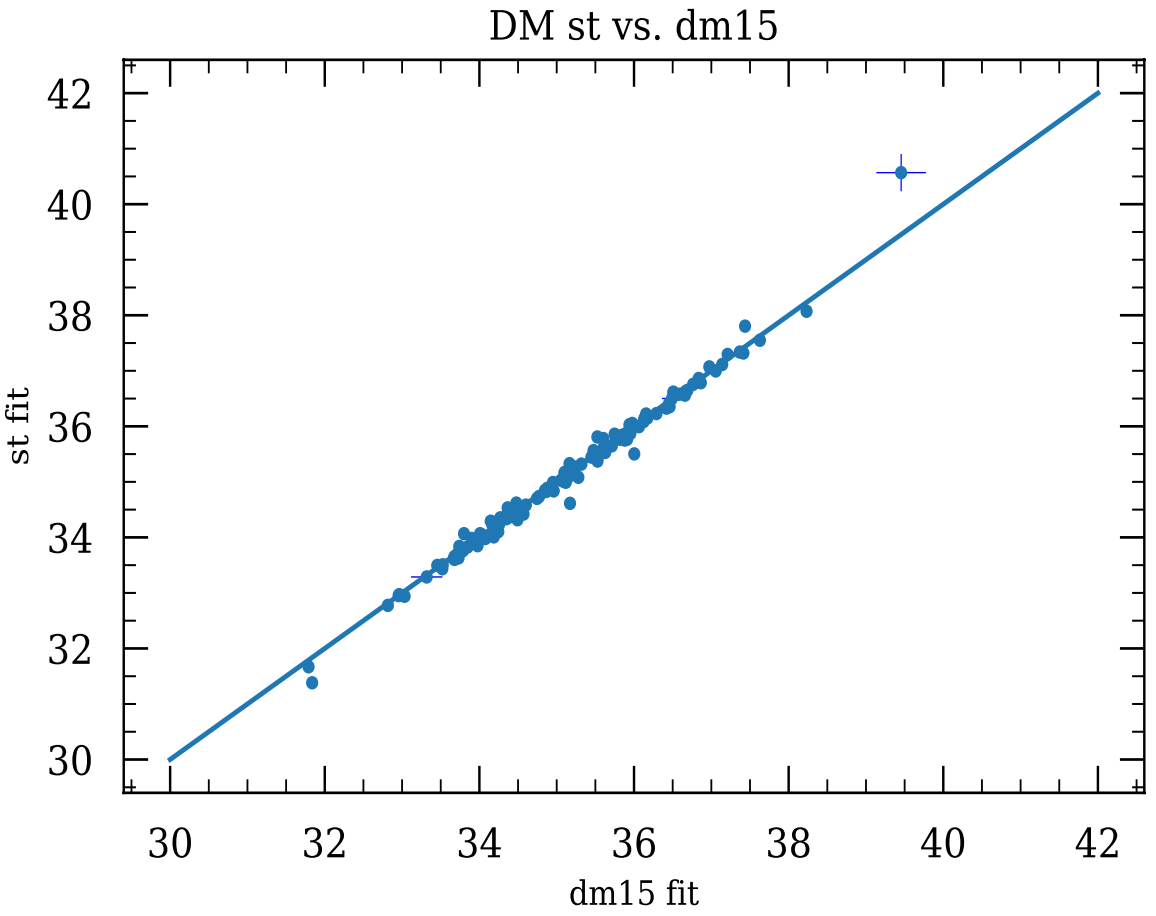

sn2005a
J
Hd
r
i
Ydw
B
g
V0
magnitude
JD - 53376

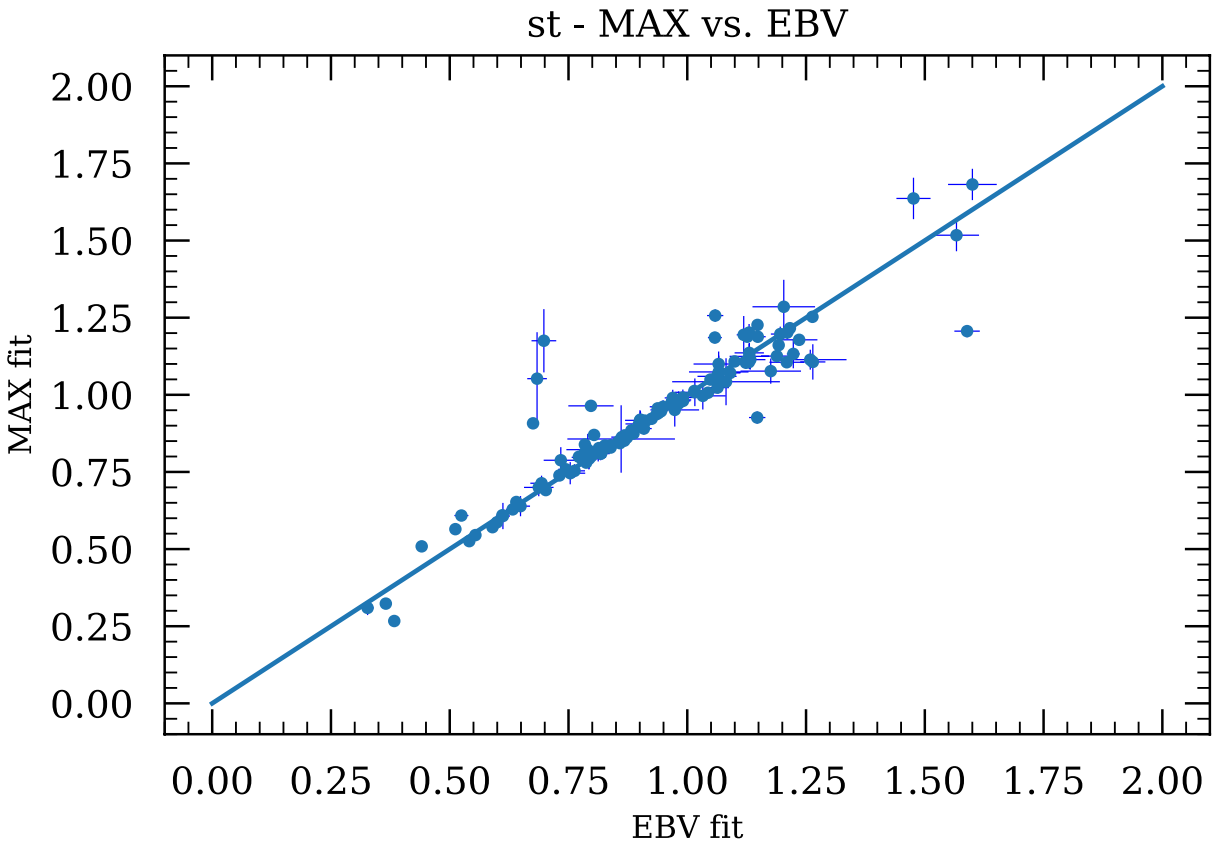

sn2005bl
H2m
Ks2m
Rkait
i
I4sh
J2m
g
V0
V
r
U4sh
u
Bkait
B
magnitude
JD - 53476

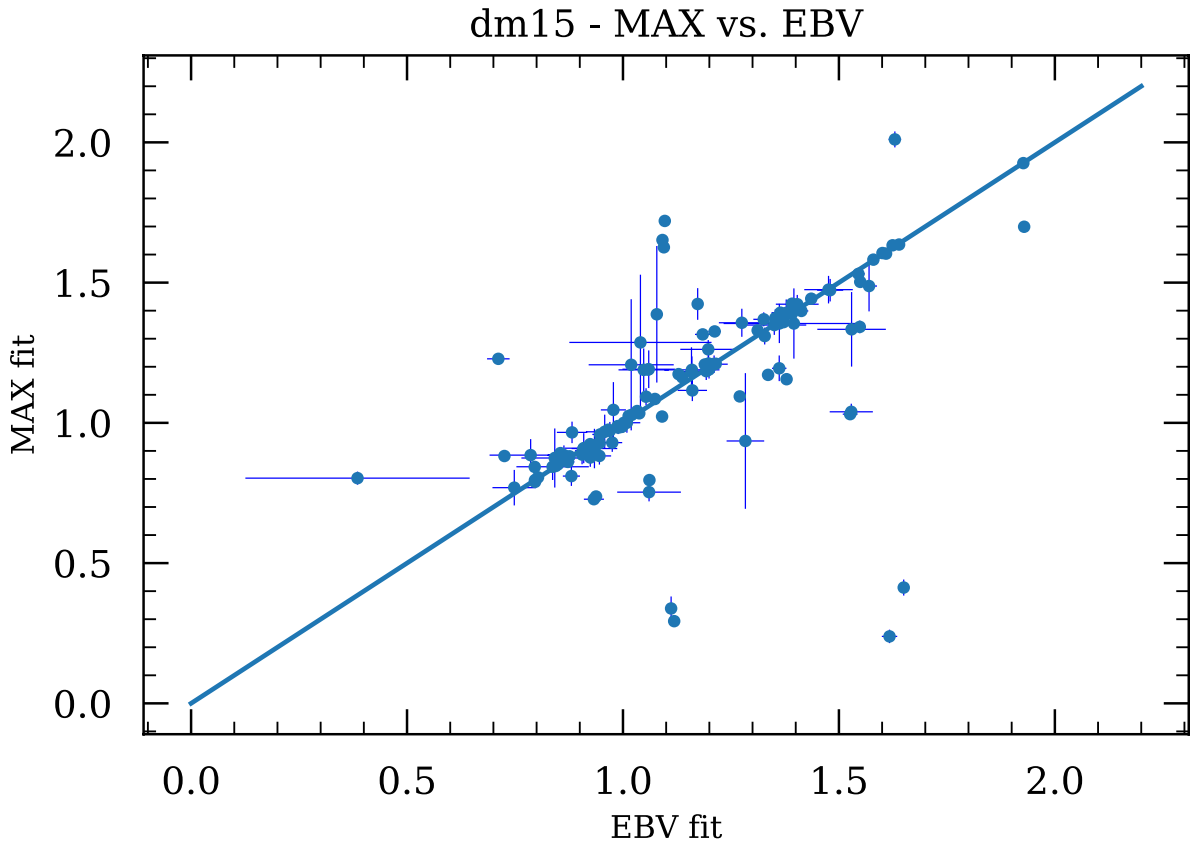

sn2005bl
H2m
Ks2m
Rkait
i
I4sh
J2m
g
V0
V
r
U4sh
u
Bkait
B
magnitude
JD - 53476

Are the estimated values independent of the selected LC-shape-parameter template within the same model?



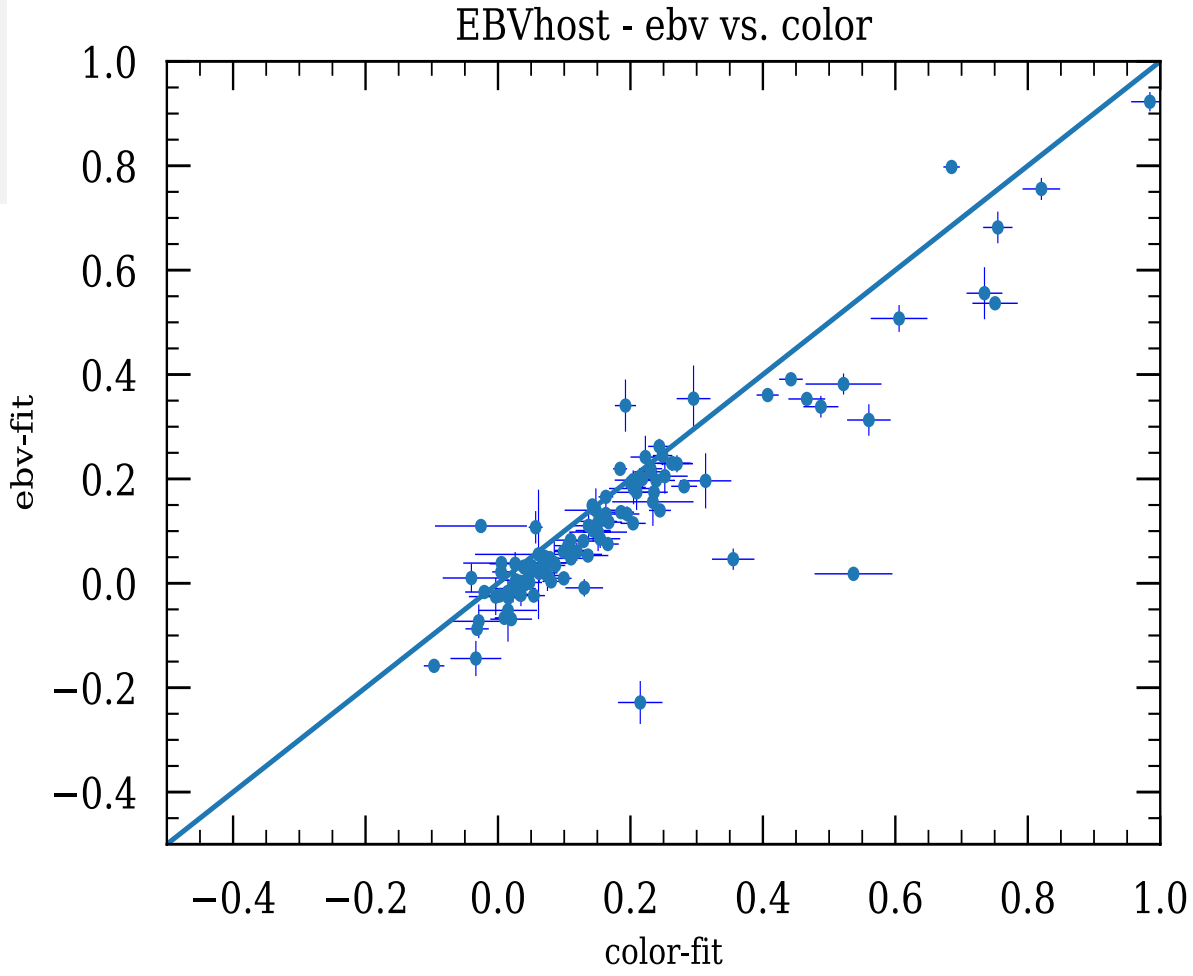


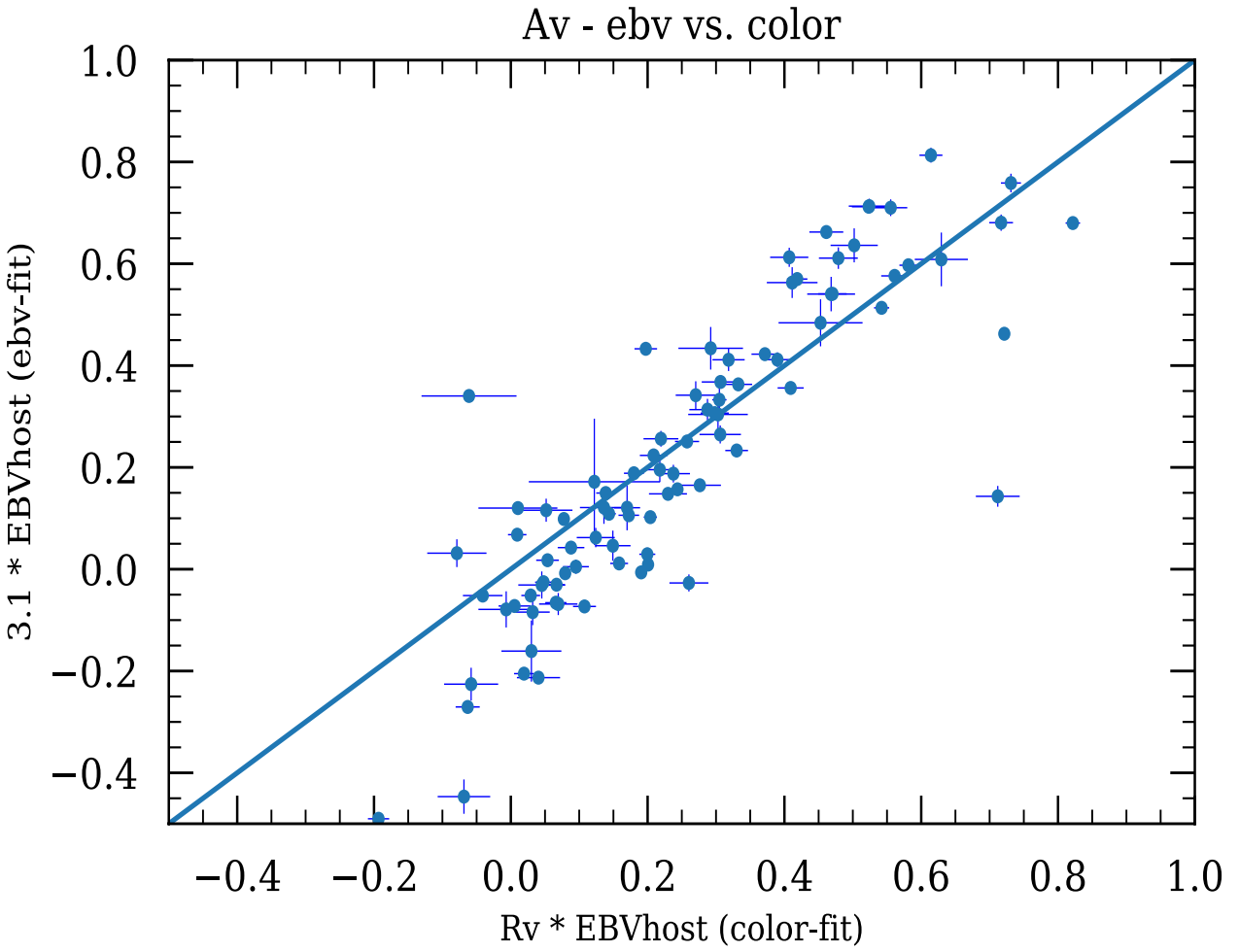


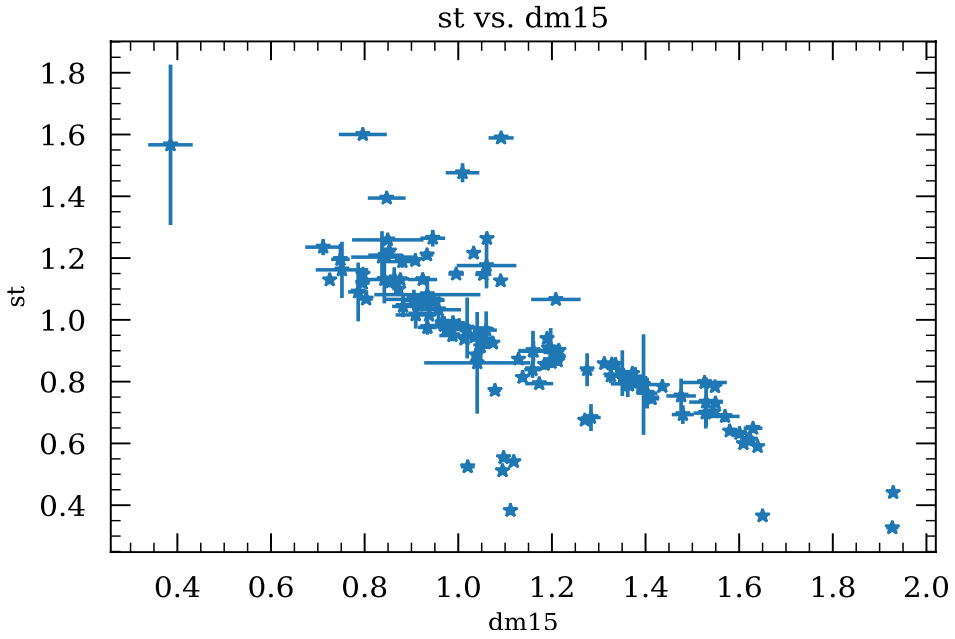


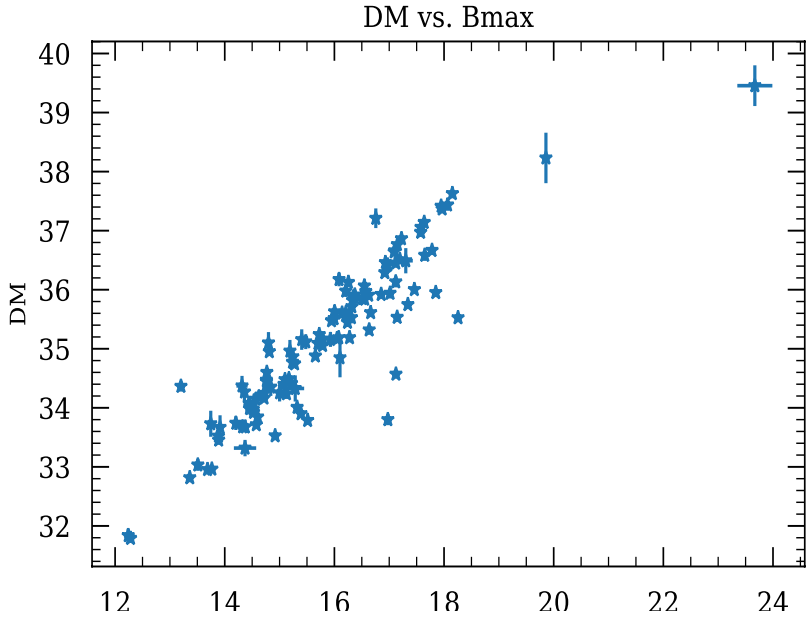
Is the estimated LC-shape-parameter independent of the selected model?

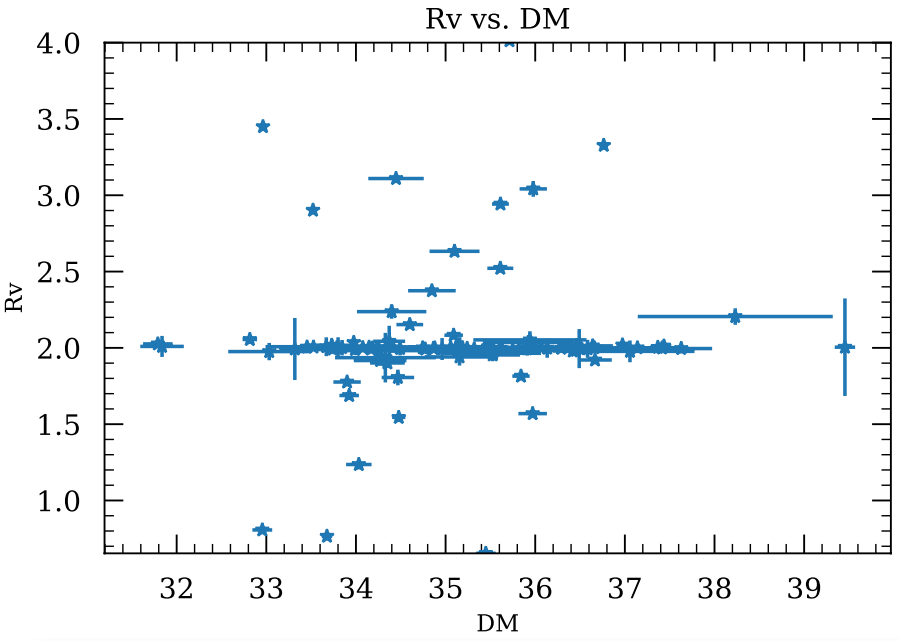
And if some, what kind of dependance ?

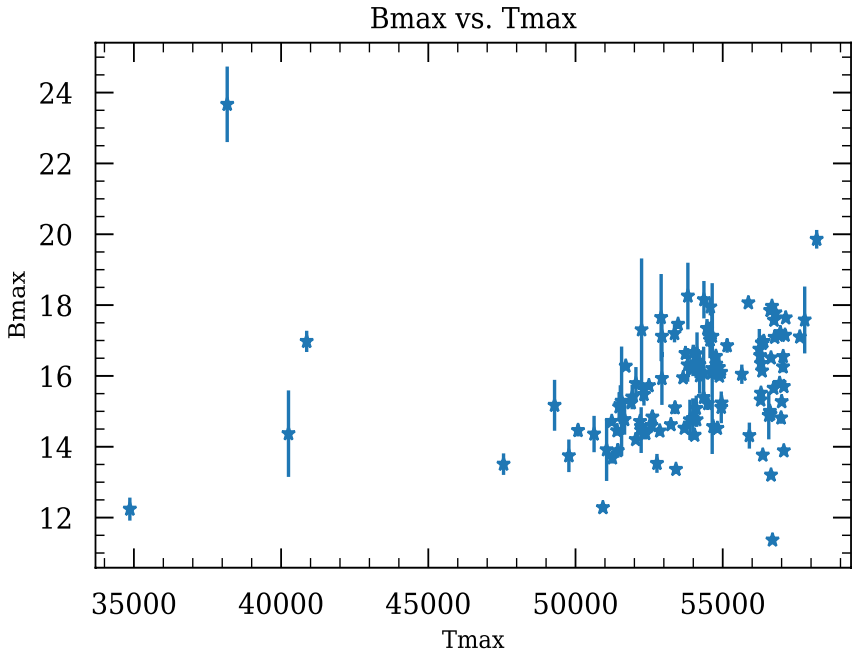






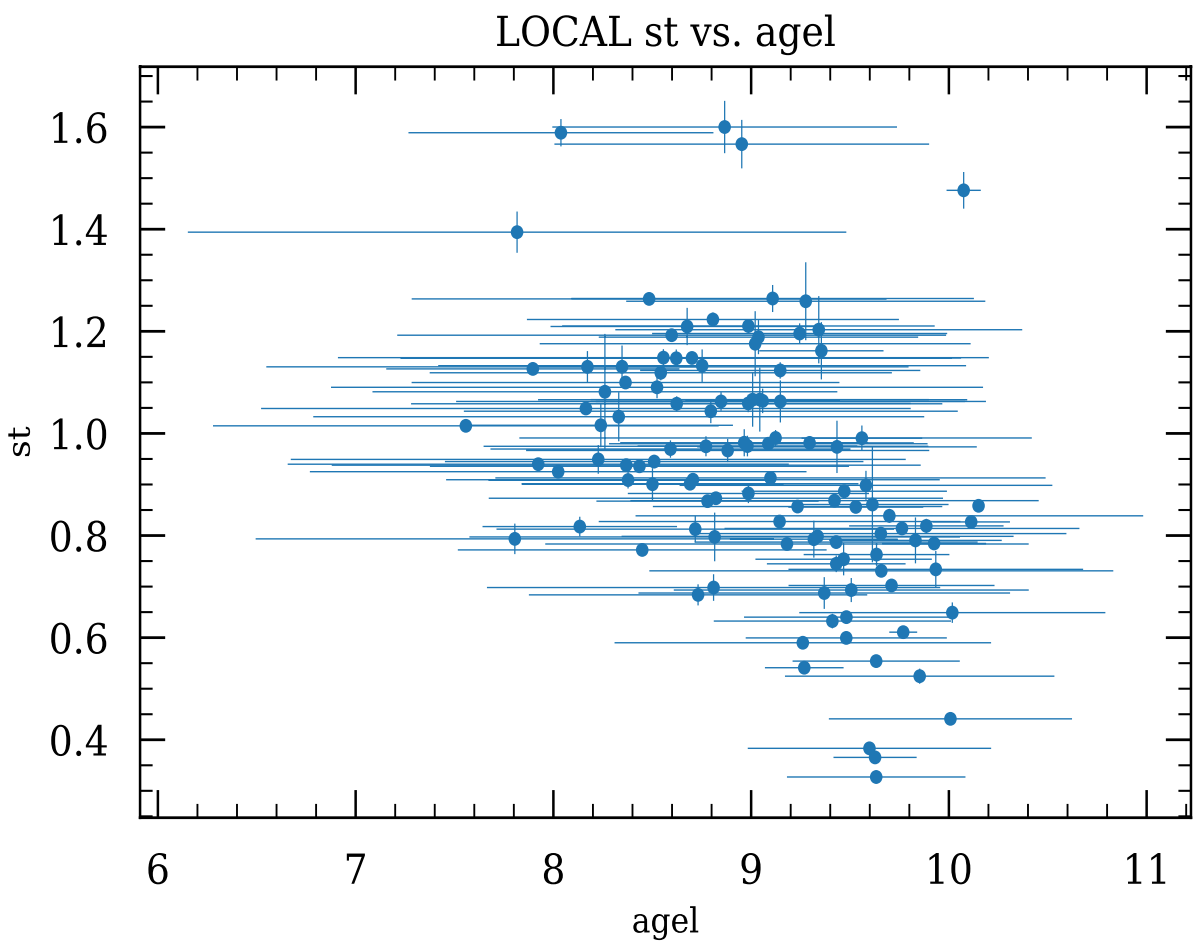


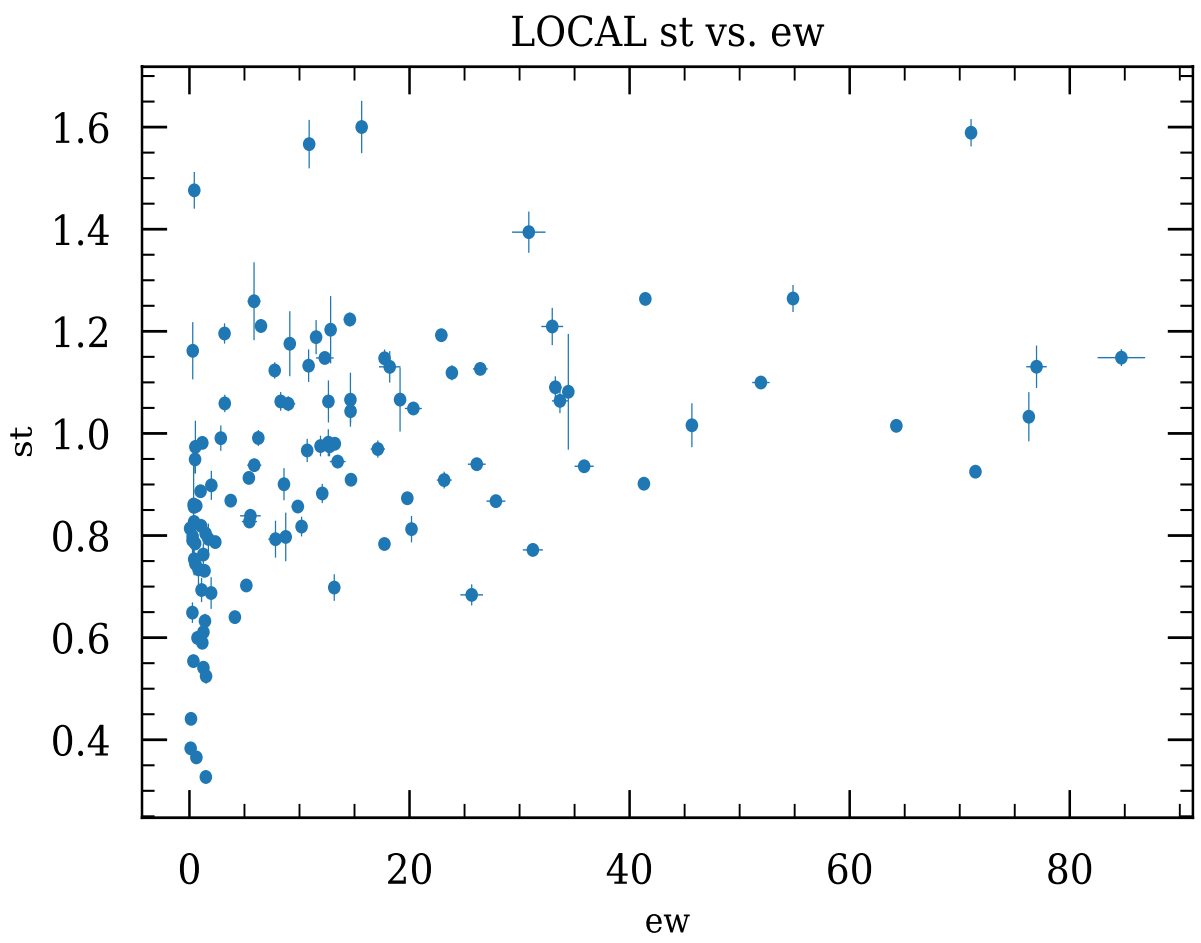


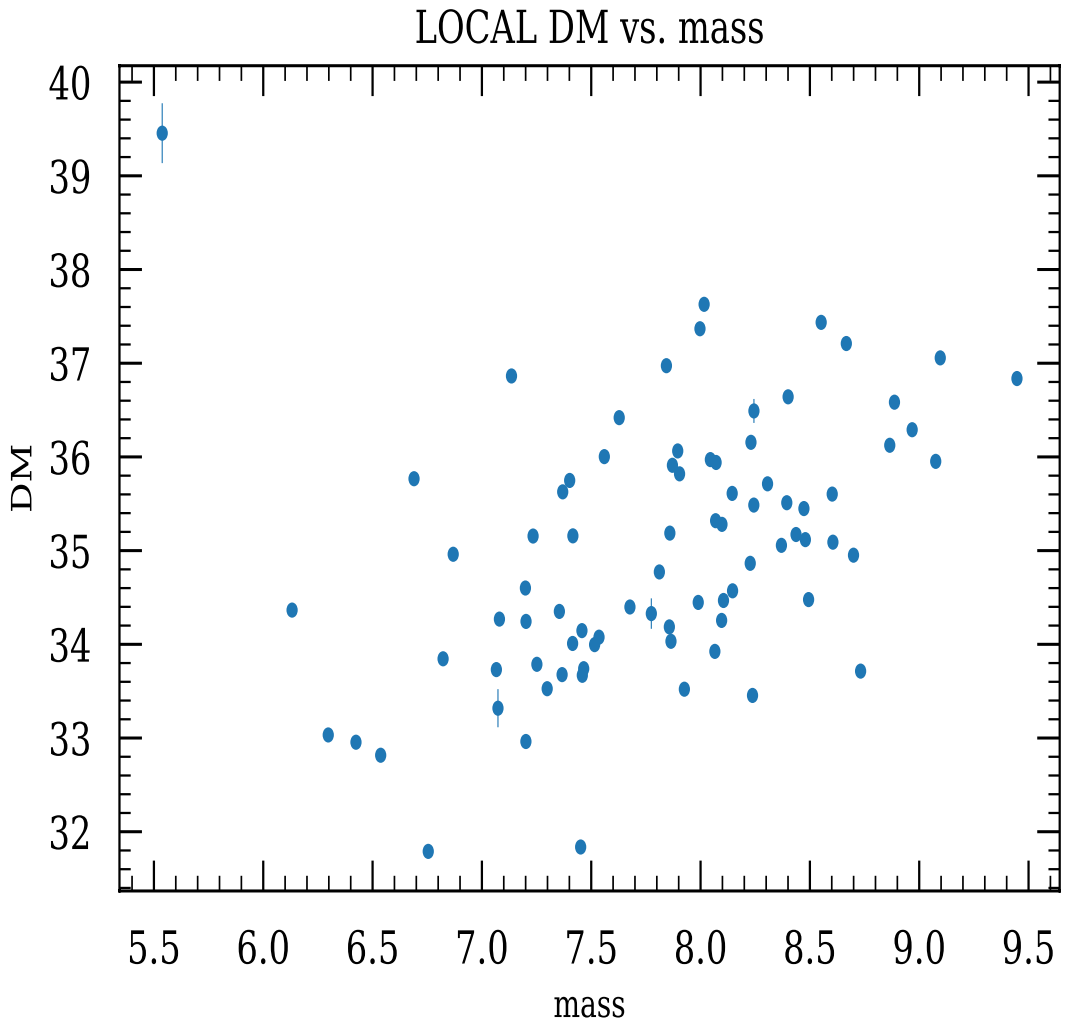


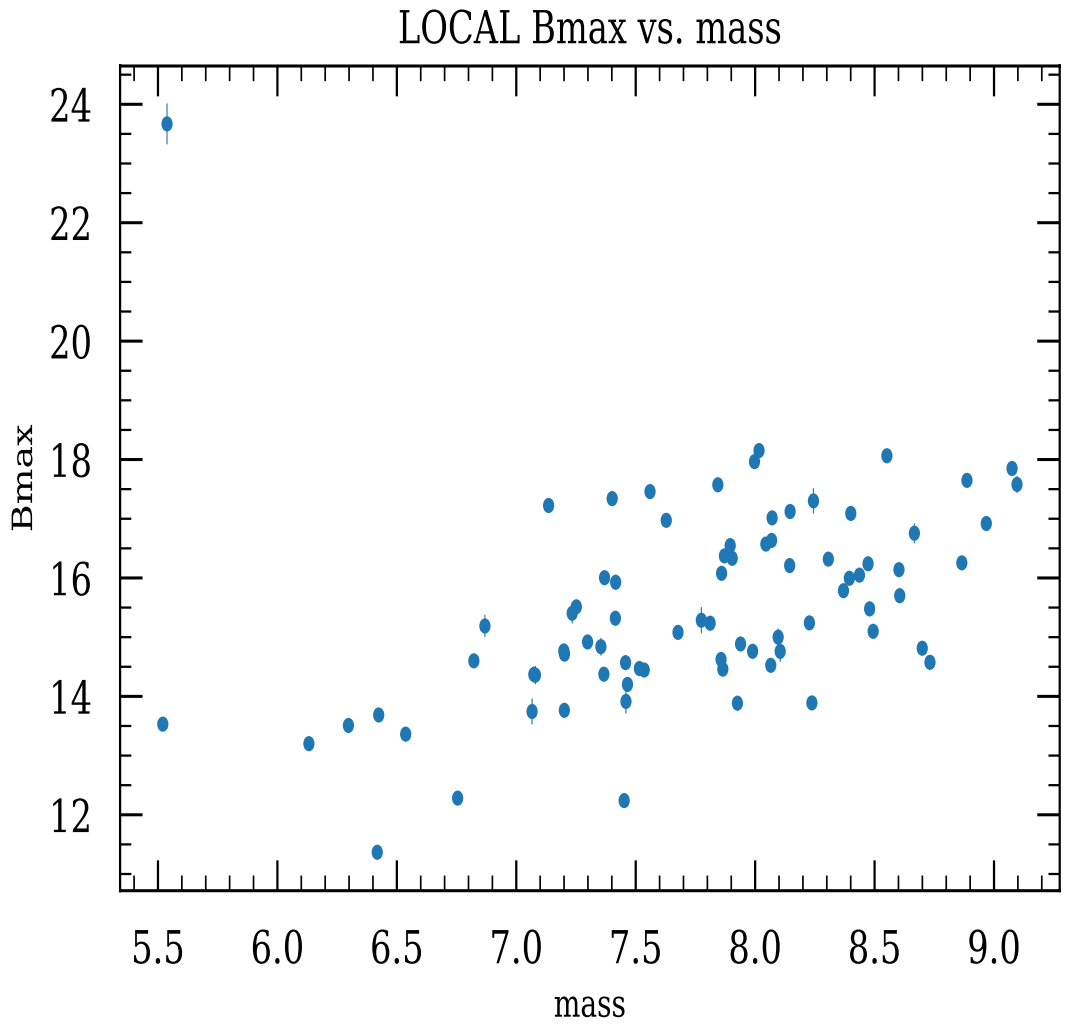
SN parameters correlations

SN parameters – host galaxy local environment correlations

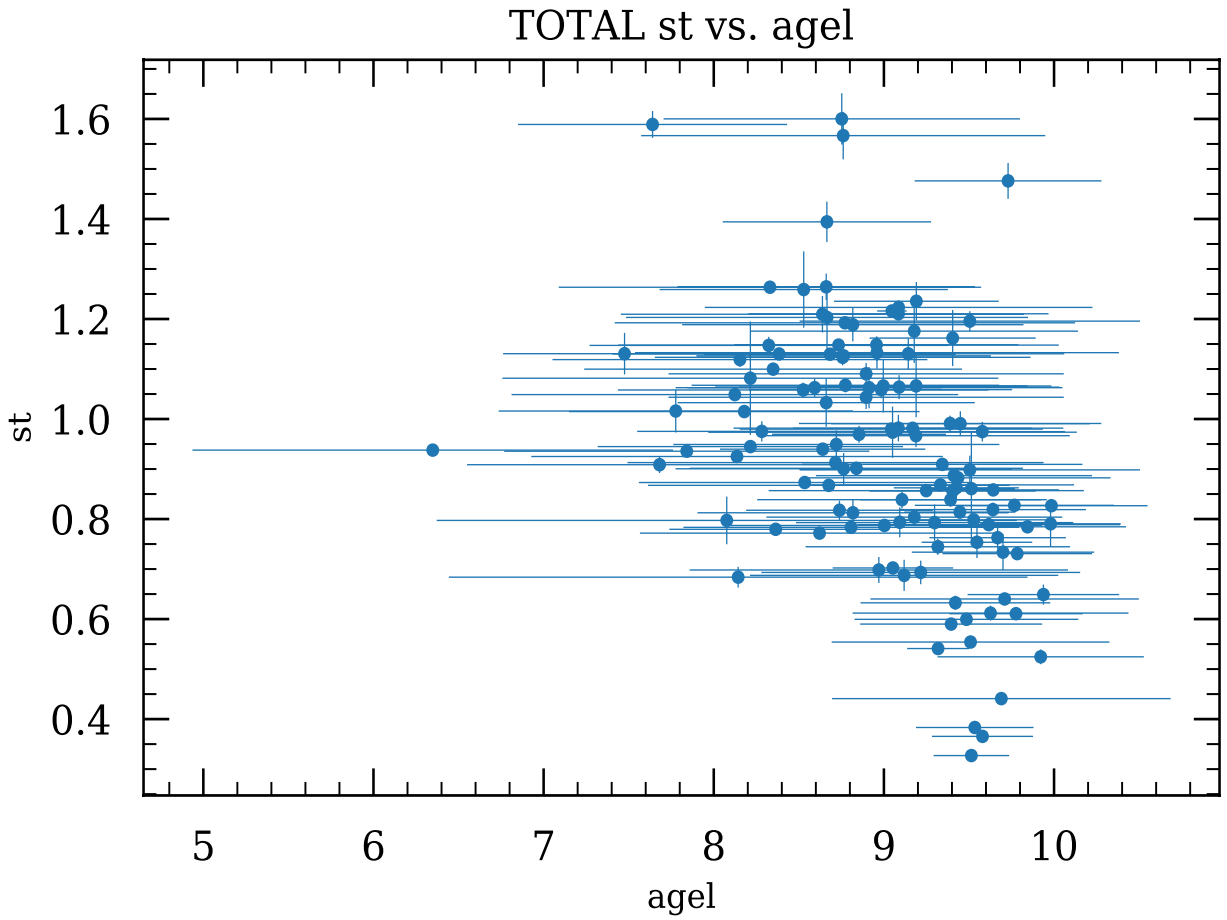


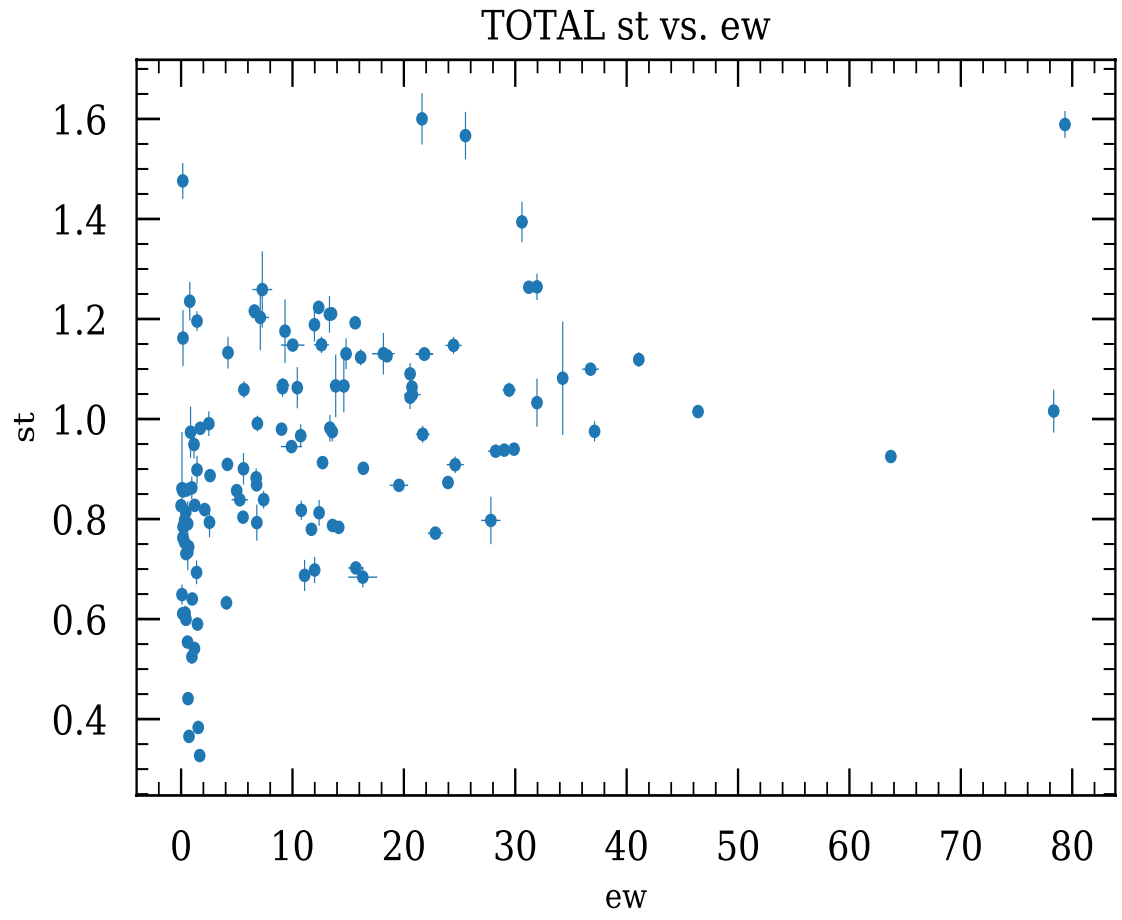


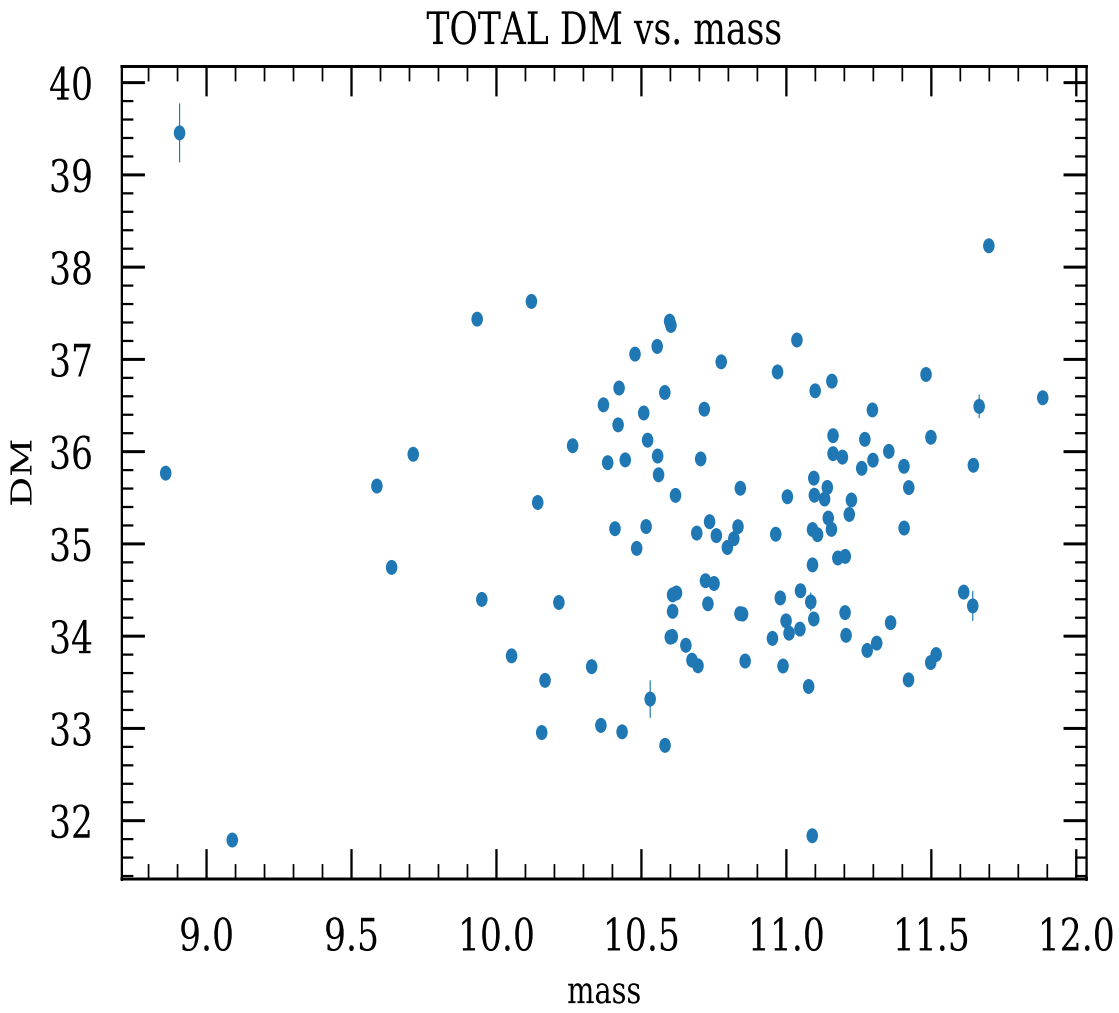

LOCAL DM vs. mass
DM
mass
40
39
38
37
36
35
34
33
32
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5

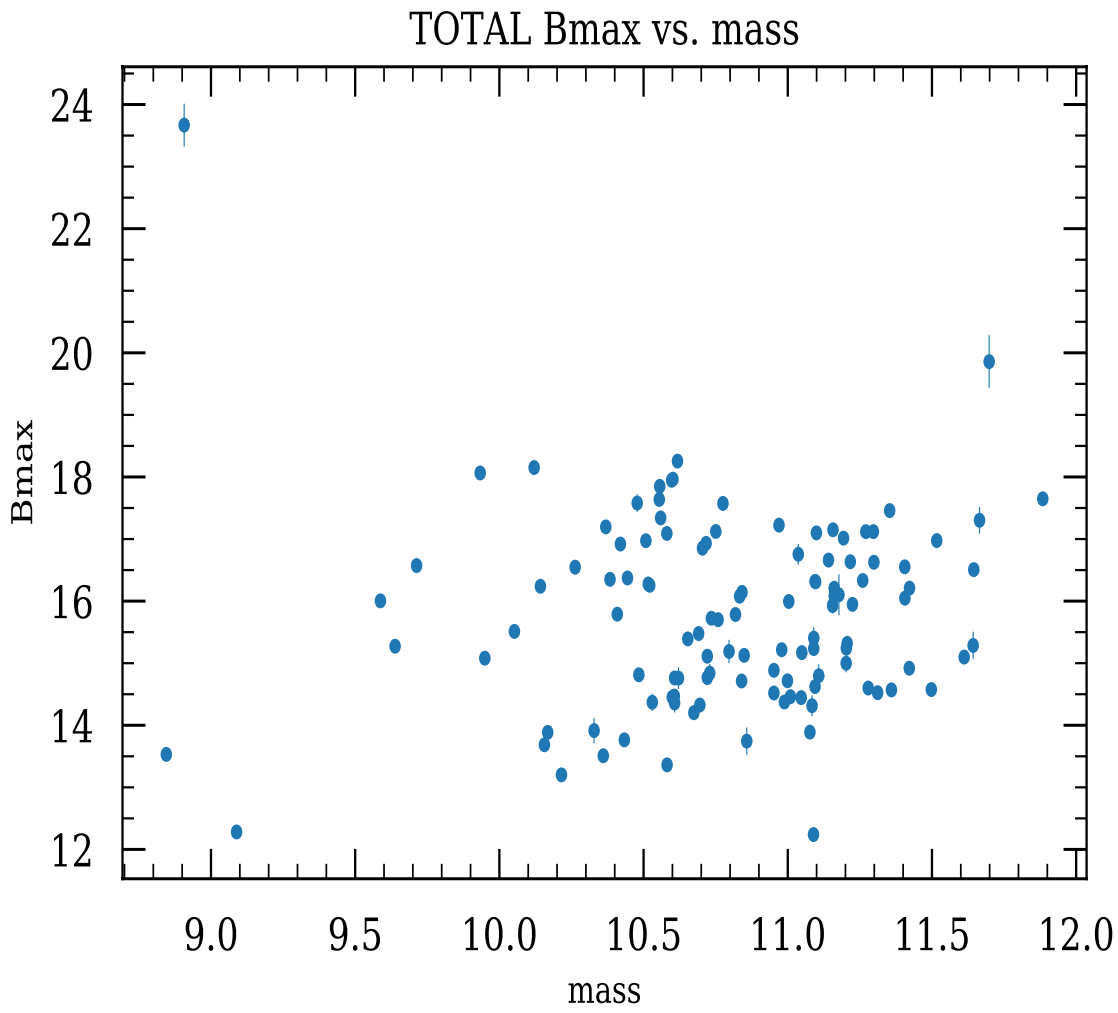

LOCAL Bmax vs. mass
Bmax
mass
24
22
20
18
16
14
12
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0

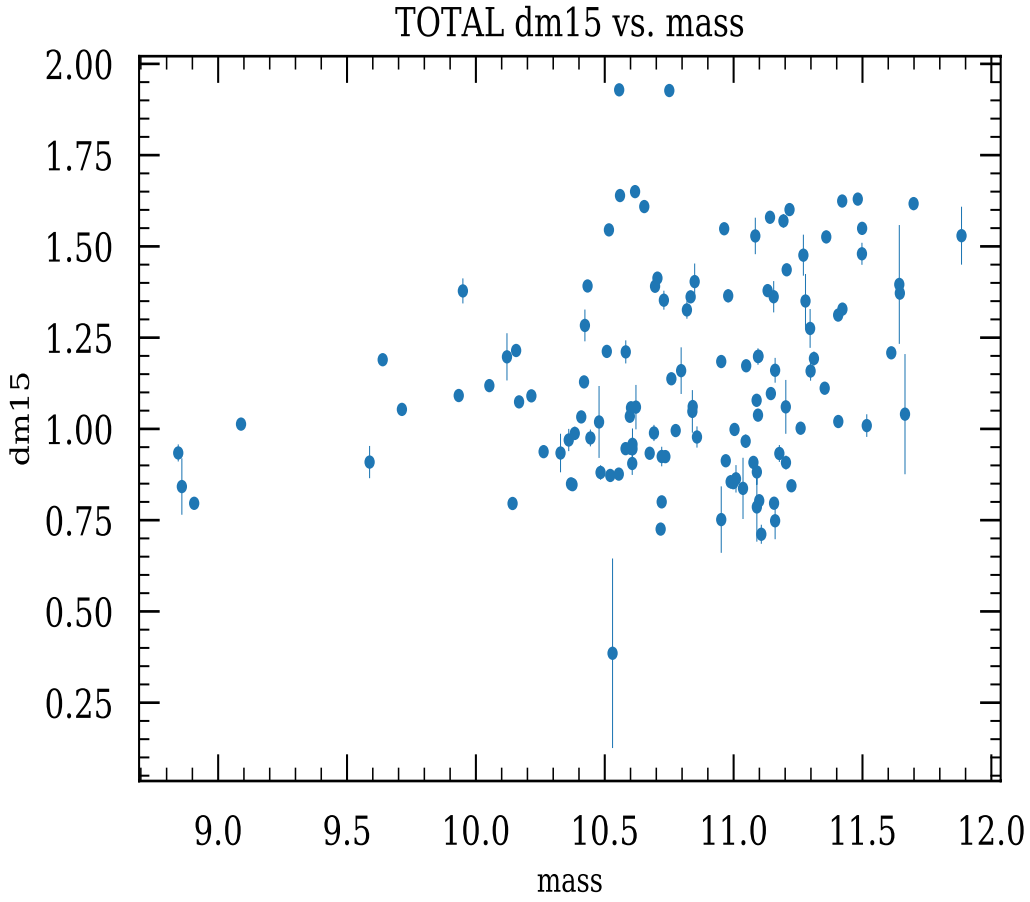
SN parameters – host galaxy TOTAL environment correlations

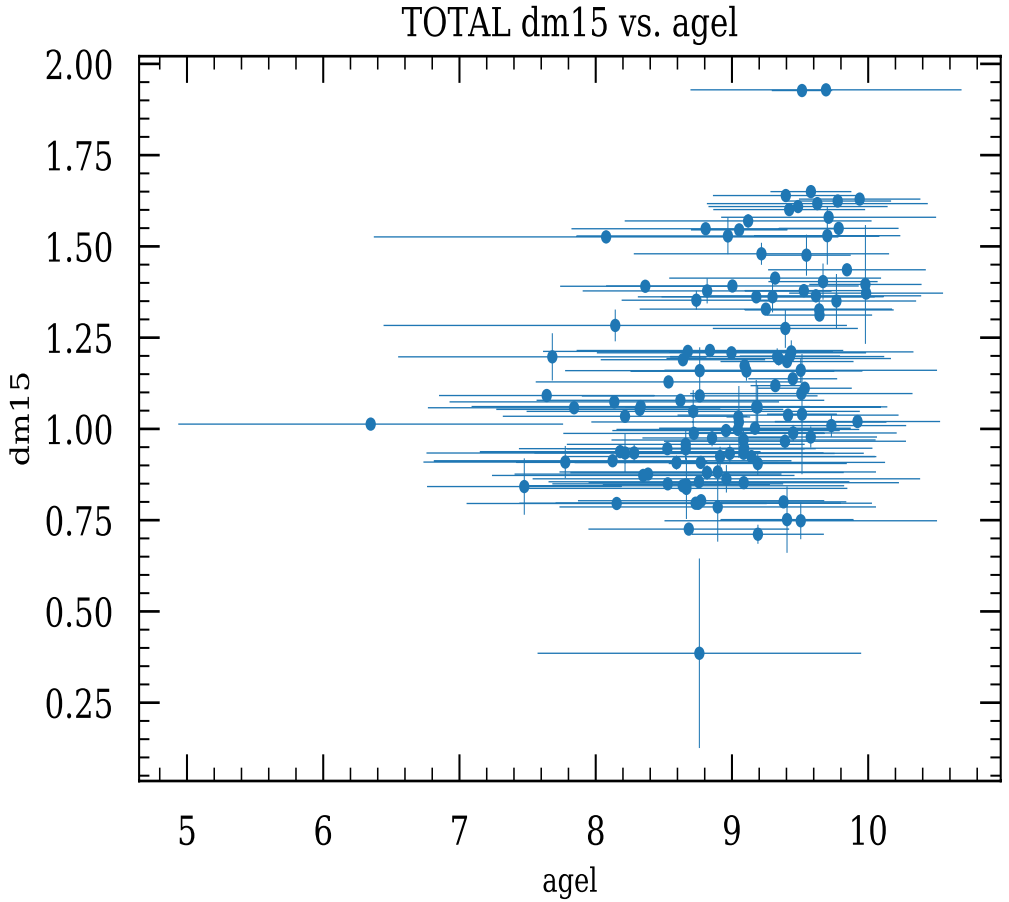





TOTAL DM vs. mass
DM
mass
40
39
38
37
36
35
34
33
32
9.0
9.5
10.0
10.5
11.0
11.5
12.0


TOTAL Bmax vs. mass
Bmax
mass
24
22
20
18
16
14
12
9.0
9.5
10.0
10.5
11.0
11.5
12.0


TOTAL dm15 vs. mass
dm15
mass
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
9.0
9.5
10.0
10.5
11.0
11.5
12.0


TOTAL dm15 vs. agel
dm15
agel
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
5
6
7
8
9
10