ZTF simulations of Goldstein et al 2018: template 1 and rescaled crossing coefficients. **System no.=31999299**

1 The model: Template 1 + Crossing Statistics

We consider the intrinsic light curve as a template multiplied by crossing statistics (now the coefficients are readjusted):

$$f(t) = g(t) \times C_0 \left[1.0 + C_1 t_s + C_2(2t_s^2 - 1) + C_3(4t_s^3 - 3t_s) + C_4(8t_s^4 - 8t_s^2 + 1) + ...\right] , \quad (1)$$

where the coefficients $C_0, C_1, C_2, C_3...$, describe the crossing statistics. In this report we test different setups with the above scaling. In this exercise we define

- $t_s \equiv t/t_{max} - 1 \in (-1, 0)$,

so that at higher t (at tails of the light curves), crossing terms have lesser contributions. t_{max} is the largest time of observation after the explosion.

In this report we use the template

$$g(t) = \frac{1}{2\sigma\sqrt{\pi}t} \exp\left[-\frac{(\ln t - m)^2}{2\sigma^2}\right] \qquad (\mathrm{log-normal}) , \quad (2)$$

which we call ‘Template 1’.

Here we are studying system no = 31999299 in compilation of ZTF simulations in Goldstein et al 2018. We used the following priors on various parameters.

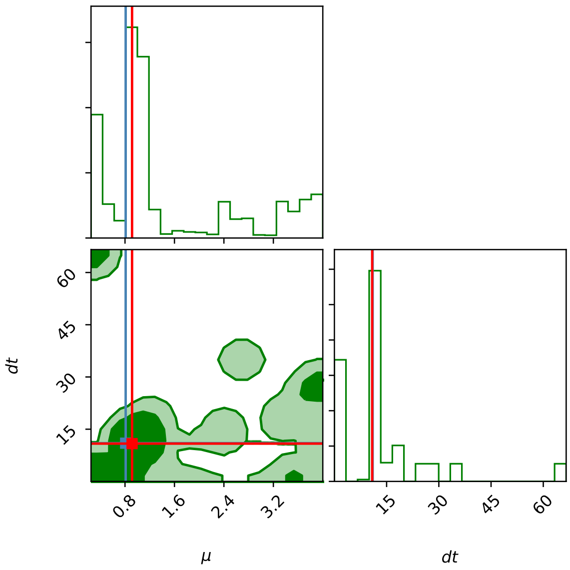
- $0.25 \le \mu \le 4.0$ (I may tighten this prior a little bit)
- $0 \le dt \le 75$.
- For all the bands: $0.1 \le \sigma \le 3.5$ and $1 \le m \le 16$ in the log-normal expression.

Other details can be found in **‘Danny_ztf_template1_newCs.pdf’**.

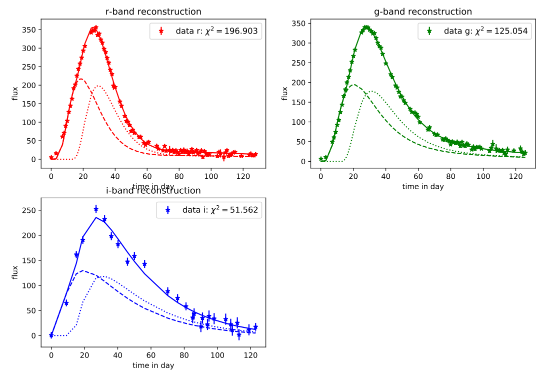
1. **npC3**=No priors on C’s. $t_s \in (-1, 0)$
2. **pC4**=Priors on C’s: $C_1,\ C_2,\ C_3, ... \in \{-10, 10\}$, no prior on C_0. $t_s \in (-1, 0)$

In the confidence level plots of the crossing coefficients (C_i’s) we consider the coefficients of the r and g bands only leaving out the parameters of the i-band which already does not have sufficient good quality data points[1]. This is to avoid clumsy figures. Also I included the template parameters m and σ of the r and g bands. the red dots in all the confidence level plots show the best-fit point whereas the blue dot in the $\mu - dt$ plot represent the true solution.

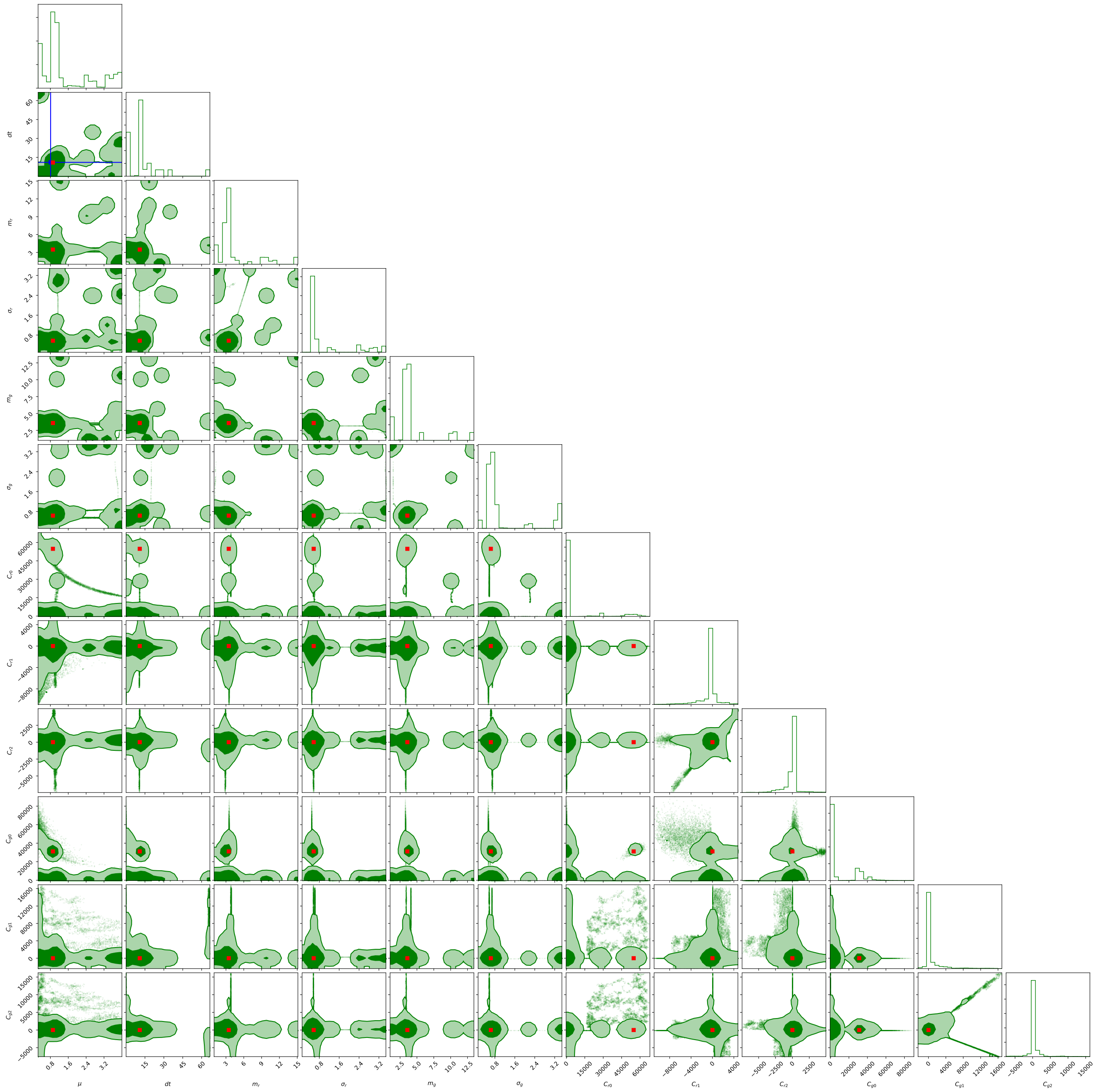
[1]We fit the i-band data too, but do not plot the confidence levels of its coefficients. Also I think that the i-band data points do not contribute much to a good accurate fit.



(a) C2=2nd order Crossing

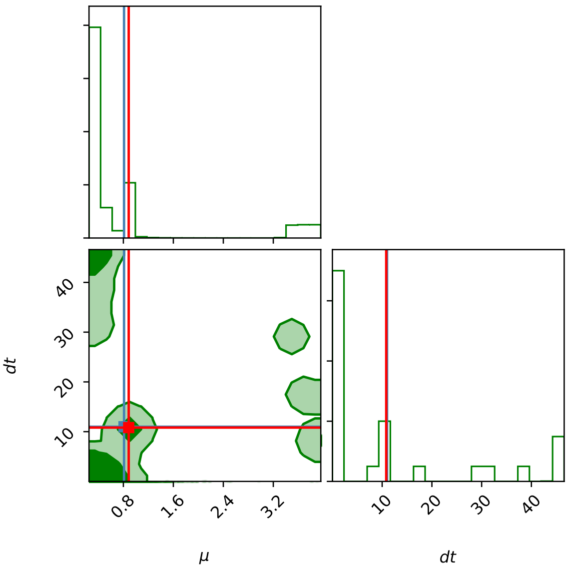


(b) C2=2nd order Crossing

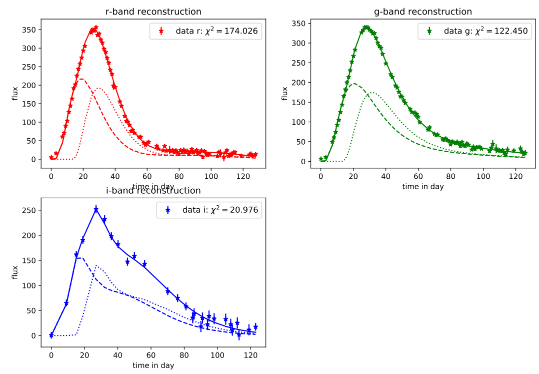


(c) C2=2nd order Crossing

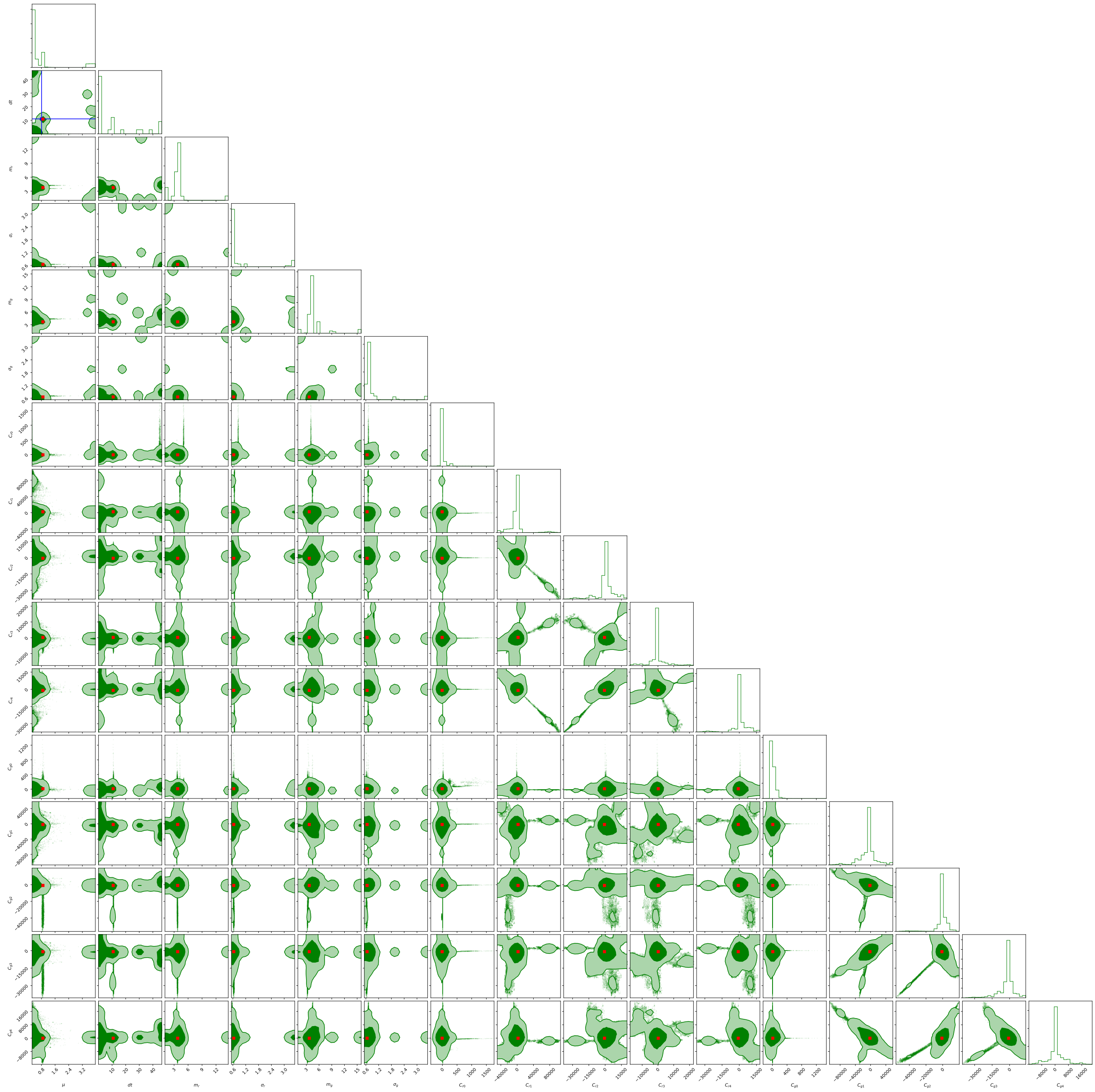
Figure 1: C2: System number=31999299. Method=npC3: No priors on C's. $t_s \in (-1, 0)$.



(a) C4=4th order Crossing

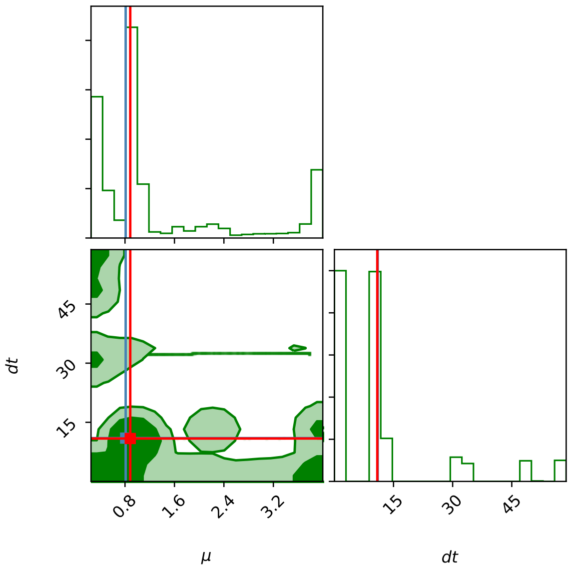


(b) C4=4th order Crossing

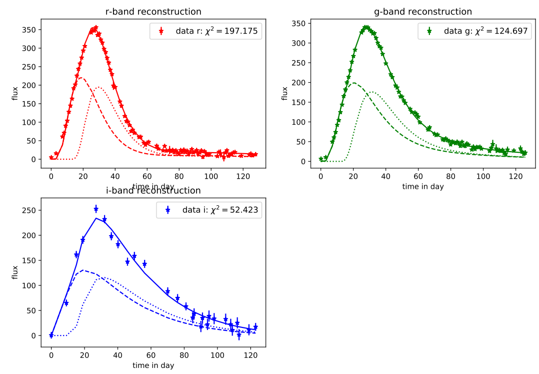


(c) C4=4th order Crossing

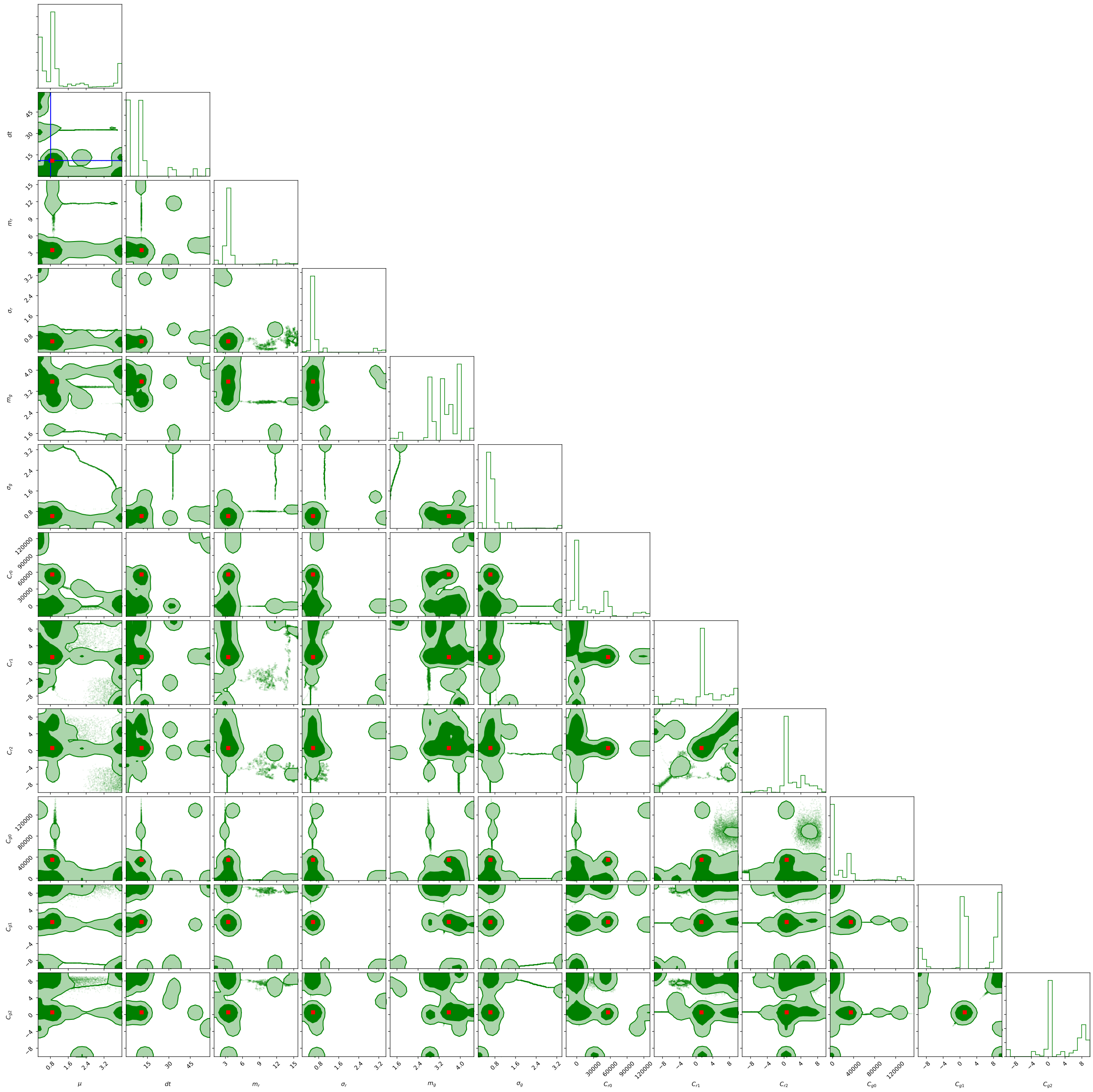
Figure 2: C4: System number=31999299. Method=npC3: No priors on C's. $t_s \in (-1, 0)$.



(a) C2=2nd order Crossing

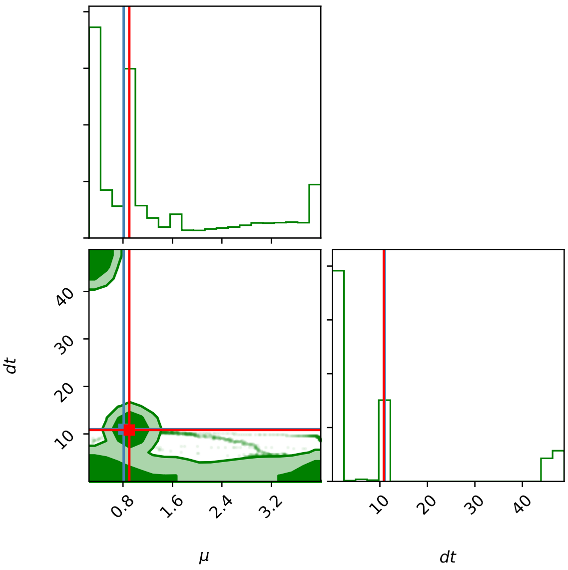


(b) C2=2nd order Crossing

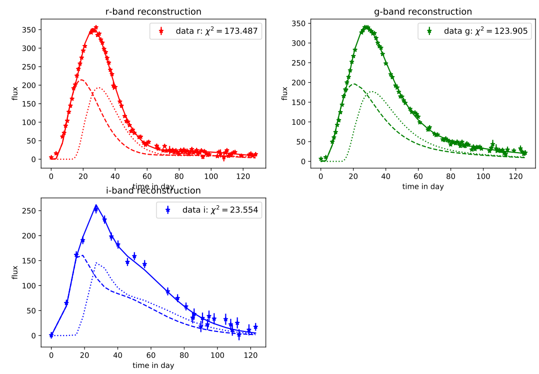


(c) C2=2nd order Crossing

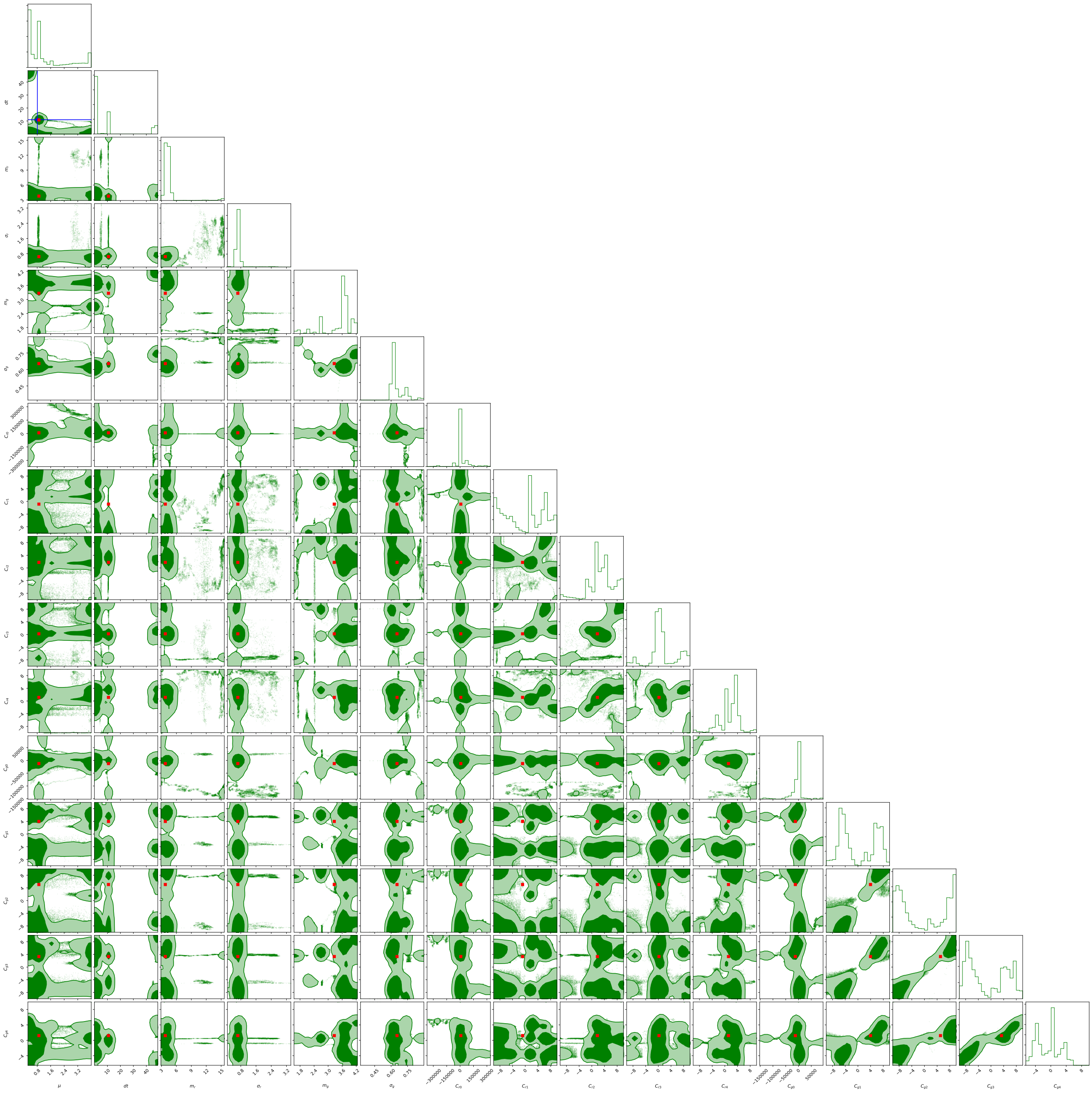
Figure 3: C2: System number=31999299. Method=pC4: No priors on C's. $t_s \in (-1, 0)$.



(a) C4=4th order Crossing



(b) C4=4th order Crossing



(c) C4=4th order Crossing

Figure 4: C4: System number=31999299. Method=pC4: No priors on C's. $t_s \in (-1, 0)$.