January 16th 2024

Gammapy meeting

-Time dependent Li&Ma -

Steps

Steps :

→ Create new IRF

→ Simulate DL3 with new IRFs

→ Evaluate the time dependent Li&Ma for different source parameters (no background time dependent at first)

→ Compare with the Li&Ma standard method

IRF

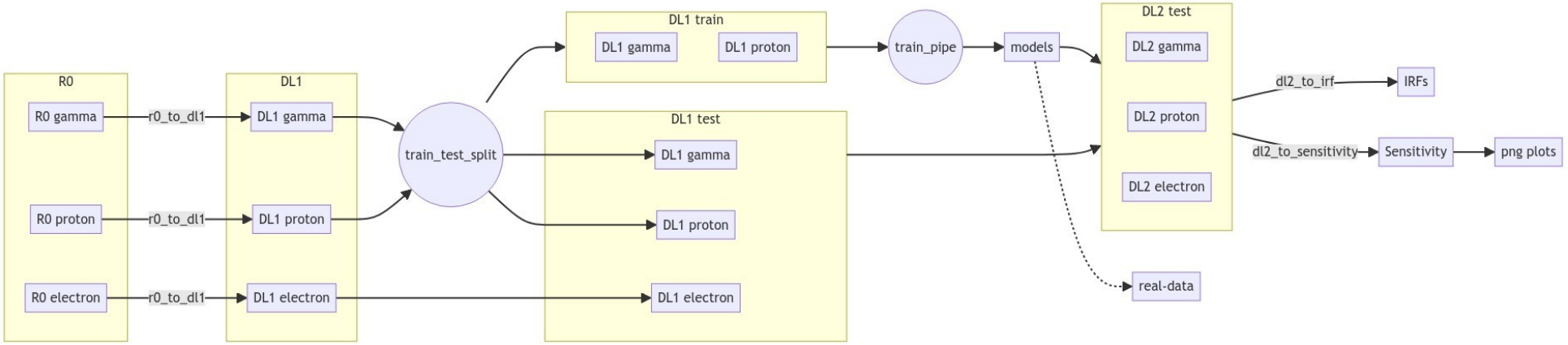
Production : 20200629_prod5_trans80 (old MC !)

→ gamma diffuse

→ background with protons and electrons

} Full enclosure

No existing IRFs with lstchain v0.10.4

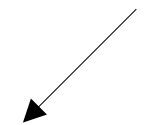


https://cta-observatory.github.io/lstmcpipe/pipeline.html#prod3-prod5-pipelines

DL3 production

DL3

1. Edit config file with parameters (or parameter spaces) for : source analysis
2. Generate observations to create : 1 observation table & 1 run table



Definition of the source

Definition of runs for each observation

3. Make simulation : create DL3 files with the observation and run tables and the config file

Method

Method : - divide the ON source observation T_{ON} into N bins of equal length Δt

- likelihood function : $$L=\left(\frac{\prod_{t_i=(\Delta t,\ldots,N\Delta t)}\left(\Delta t\left(b+s(t_i)\right)\right)^{\{0,1\}}}{\{0,1\}}\right)\left(\frac{\left(bT_{OFF}\right)^{N_{OFF}}}{N_{OFF}!}e^{-bT_{OFF}}\right)$$

product of the probability mass function for each T_{ON} bin (0 or 1 event, for a large N)

probability mass function for OFF observations

Method

Method : - for the null hypothesis : s(t) = 0 and b = b_0

- likelihood function : $\log(L_0) = (N_{ON} + N_{OFF}) \log(b_0)$

- background rate maximized by : $b_0 = \frac{N_{ON} + N_{OFF}}{T_{ON} + T_{OFF}}$

Method

Method : - define t_{ON} : arrival time of ON source counts

- 1 free parameter (amplitude) in the signal time profile $s(t)=\theta f(t)$
- assumption f(t) ~ 1/t
- likelihood function : $\log(L)=N_{OFF}\log b+\sum_{t_i\in\{t_{ON}\}}\log(b+s(t_i))$
- background rate maximized by :

$$b=\frac{N_{ON}+N_{OFF}-\int_0^{T_{ON}}dt\,s(t)}{T_{ON}+T_{OFF}}$$

Method

Method : - ratio likelihood test $TS = -2\log\left(\frac{L_0}{L}\right)$

- Li&Ma time dependent significance $\sigma = \sqrt{TS}$