

ctools - Support #1877

Fit results differ from MC input for Prod3 IRFs

11/10/2016 10:45 AM - Yang Lili

Status:	In Progress	Start date:	11/10/2016
Priority:	Normal	Due date:	
Assigned To:	Knödseder Jürgen	% Done:	0%
Category:		Estimated time:	0.00 hour
Target version:			
Description			
<p>We are using prod3 baseline and threshold IRFs to run a background simulation. ctobssim RA of pointing (degrees) (0-360) [83.63] 266.364 Dec of pointing (degrees) (-90-90) [22.01] -28.9938 Radius of FOV (degrees) (0-180) [5.0] Start time (MET in s) [0.0] End time (MET in s) [1800.0] 1800000 Lower energy limit (TeV) [0.1] 0.03 Upper energy limit (TeV) [100.0] Calibration database [prod2] prod3 Instrument response function [South_0.5h] Baseline_South_50h Input model XML file [CTOOLS/share/models/crab.xml] bkg.xml Output event data file or observation definition XML file [events.fits] bkg_500h.fits</p> <p>Then we binned the simulated events, with 0.5deg spatial bins and 20 energy bins in the 0.03 -100 TeV energy range. ctbin Input event list or observation definition XML file [events.fits] bkg_500h.fits First coordinate of image center in degrees (RA or galactic l) (0-360) [83.63] 266.364 Second coordinate of image center in degrees (DEC or galactic b) (-90-90) [22.01] -28.9938 Projection method (AIT AZP CAR MER MOL STG TAN) [CAR] Coordinate system (CEL - celestial, GAL - galactic) (CEL GAL) [CEL] Image scale (in degrees/pixel) [0.02] 0.5 Size of the X axis in pixels [200] 10 Size of the Y axis in pixels [200] 10 Algorithm for defining energy bins (FILE LIN LOG) [LOG] Start value for first energy bin in TeV [0.1] 0.03 Stop value for last energy bin in TeV [100.0] Number of energy bins (1-200) [20] Output counts cube file [cntcube.fits] bkg_500h_bin.fits</p> <p>We run a likelihood analysis between a large scale dark matter map (it is not a point source like) and CR simulation maps (CTA1rfBackground) with ctlike. ctlike Input event list, counts cube or observation definition XML file [cr_prod3_bl500h.fits] bkg_500h_bin.fits Calibration database [prod3] Instrument response function [Baseline_South_50h] Input model XML file [2TeVdm_cr.xml] 2TeVdm_bkg.xml Output model XML file [cr_prod3_bl500h_2TeVdm_cr_110.xml] bkg_500h_bin_fit2TeVdm.xml</p> <p>We get unreasonable results for this step (please see bkg_500h_bin_fit2TeVdm.xml and ctlike.log for our results). But with prod2 we obtained reasonable results with this setup.</p> <p>We noticed that prod 3 IRFs have less data points (in terms of energy bins etc) — could that be the problem?</p> <p>Please let us know if you have any advice or have some experience with prod 3 IRFs usage with CTOOLS (other than for standard point source-like analysis).</p>			

History

#1 - 11/10/2016 10:50 AM - Yang Lili

- File 2TeVdm_bkg.xml added

#2 - 11/21/2016 11:51 AM - Knödseder Jürgen

I found a strange thing in your XML file:

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<source_library title="source library">
  <source name="Darkmatter" type="DiffuseSource">
    <spectrum type="ConstantValue">
      <parameter name="Value" value="0.577642" error="0.0829846" scale="1" min="0" max="1e+08" free="1" />
    </spectrum>
    <spatialModel type="MapCubeFunction" file="DM_mapcube_54_WW_2TeV_csth_Ein_mapcubeddb025deg_dr01_lmax359p75bmax89p75">
      <parameter name="Normalization" value="1" error="0" scale="1" min="0.1" max="10" free="1" />
    </spatialModel>
  </source>
  <source name="CTABackgroundModel" type="CTAIfBackground" instrument="CTA">
    <spectrum type="PowerLaw">
      <parameter name="Prefactor" value="0.9916" error="0.000370804" scale="1" min="0.001" max="1000" free="1" />
      <parameter name="Index" value="-0.00453959" error="0.000141207" scale="1" min="-5" max="5" free="1" />
      <parameter name="Scale" value="1" scale="1e+06" min="0.01" max="1000" free="0" />
    </spectrum>
  </source>
</source_library>
```

Both the Value and Normalization are set to free, which leads to degenerate parameters in the model fitting. This explains why ctlike complains as follows:

```
2016-11-10T09:33:16: Parameter "Normalization" has zero curvature. Fix parameter.
2016-11-10T09:33:16: >Iteration 0: -logL=-795146206.405, Lambda=1.0e-03
2016-11-10T09:33:19: >Iteration 1: -logL=-795146942.609, Lambda=1.0e-03, delta=736.205, max(|grad|)=11919.478645 [Index:4]
2016-11-10T09:33:21: >Iteration 2: -logL=-795146943.035, Lambda=1.0e-04, delta=0.426, max(|grad|)=92.767487 [Index:4]
2016-11-10T09:33:23: >Iteration 3: -logL=-795146943.035, Lambda=1.0e-05, delta=0.000, max(|grad|)=1.206720 [Index:4]
2016-11-10T09:33:23: Free parameter "Normalization" after convergence was reached with frozen parameter.
```

You may first set the Normalization to free="0".

Then you also have too few energy bins. According to <http://cta.irap.omp.eu/ctools/users/issues.html#issue-binned> you should at least use 10 bins per spectral decade. You have 3.5 spectral decades from 0.03 - 100 TeV, hence you should use at least 35 bins (and not 20) or even a bit more.

The issue is that the effective area drops quickly when going to lower energies, and you have to make sure that this drop is sufficiently well sampled. So if you want to run an analysis down to 30 GeV you have to increase the number of bins. You can run the analysis for a different number of bins and check the results for each run. With increasing number of bins your result should at some point stabilize (and correspond to the input model within statistics), which is the point where the effective area is sufficiently well sampled.

#3 - 11/21/2016 11:52 AM - Knödseder Jürgen

- Subject changed from prod3 to Fit results differ from MC input for Prod3 IRFs
- Status changed from New to In Progress
- Assigned To set to Knödseder Jürgen

Files

bkg_500h_bin_fit2TeVdm.xml	1 KB	11/10/2016	Yang Lili
ctlike.log	7.06 KB	11/10/2016	Yang Lili
bkg.xml	526 Bytes	11/10/2016	Yang Lili
2TeVdm_bkg.xml	932 Bytes	11/10/2016	Yang Lili