GammaLib - Action #3548

Implement TOF flux correction factors

02/19/2021 04:05 PM - Knödlseder Jürgen

Status:	Closed	**Start date:**	02/19/2021
Priority:	Normal	**Due date:**	
Assigned To:	Knödlseder Jürgen	**% Done:**	100%
Category:		**Estimated time:**	0.00 hour
Target version:	2.0.0		

Description

According to a study of Rob van Dijk the TOF selection implies flux dependent correction factors. These are given in the following document:
attachment:com-rp-rol-drg-057.pdf

The correction should be implemented at the GCOMResponse level so that a joint-fit with COMPTEL data can be performed.

History

#1 - 02/20/2021 01:16 AM - Knödlseder Jürgen

The ToF correction factor should be implemented as function of the ToF selection criteria. The correction should be implemented at the level of the GCOMResponse class so that the correction will be directly applied in the response computation.

The ToF selection is stored in the DRE. The best thing is to store the ToF correction factor with the DRE since:

- the DRE is energy dependent, hence a single ToF applies to a given DRE
- the ToF selection criteria are available when computing the DRE

The ToF correction factor should therefore be computed when GCOMDri::compute_dre() is called. The factor should also be written in a DRE FITS file and read back from that file for reference. Selection parameters and minimum Earth horizon angle should also be written into the FITS file and read back. For that purpose, methods GCOMSelection::write(GFitsHDU& hdu) and GCOMSelection::read(const GFitsHDU& hdu) should be implemented that write and read the selection keywords from an HDU. These methods should then be called by the GCOMDri::write_attributes() and GCOMDri::read_attributes() methods. In that way the selection parameters will also be available (this is not strictly needed, yet is desirable).

A method GCOMDri::tof_correction() needs to be added to access the pre-computed ToF correction by reference. If no pre-computation was done the value should be 1.0.

GCOMEventBin needs to store a pointer to the ToF correction value that will be set in GCOMEventCube::init_bin(). In that way the ToF correction is also available for an individual event. A GCOMEventBin::tof_correction() method needs to be added so that the value can be access in the response computation and multiplied to the IRF.

Specifically, this needs to be done in GCOMResponse::irf_ptsrc() (best by changing the IAQ normalisation iaq_norm) and in GCOMResponse::irf() (best as additional multiplier after deadtime correction).

#2 - 02/21/2021 12:45 AM - Knödlseder Jürgen

- Status changed from New to Pull request

- % Done changed from 0 to 90

I implemented the formula from table 1 of COM-RP-ROL-DRG-057.

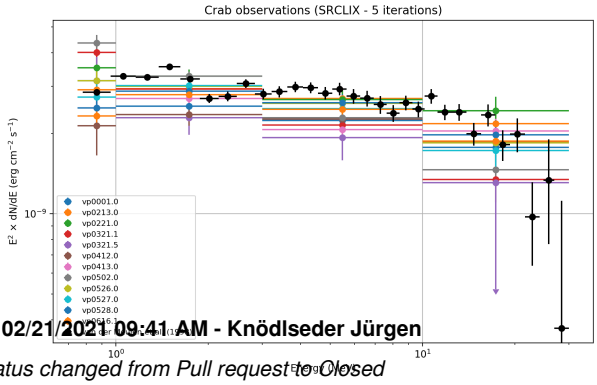
#3 - 02/21/2021 09:39 AM - Knödlseder Jürgen

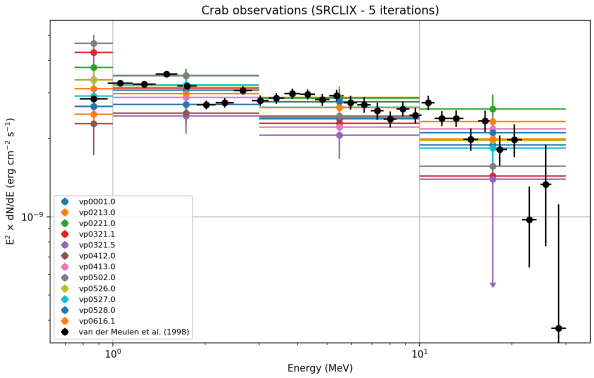
- File spectrum-by-vp.png added

- File spectrum-by-vp-multby1.07.png added

Here a comparison of the resulting Crab spectra for all Crab viewing periods. The SRCLIX method was used, where the data were fitted in the four standard energy bins using a power law spectrum. The resulting background models were then used for a spectral analysis. The source position was left free. Five SRCLIX iterations were performed. For comparison, the Crab spectrum obtained by van der Meulen et al. (1998) is shown.

Overall the results are close to the ones of van der Meulen et al. (1998), yet there seems still to be a small underestimation of the published results. Note that Rob van Dijk mentioned in his thesis an underestimation of SRCLIX fluxes by 7%, which goes in the same direction as the differences shown. Multiplying the results by 1.07 brings the data in relatively good agreement. The left plot shows the uncorrected spectrum, the right one the spectrum that was multipled by 1.07.





#4 - 02/21/2021 09:41 AM - Knödlseder Jürgen

- Status changed from Pull request to Closed

- % Done changed from 90 to 100

Files

com-rp-rol-drg-057.pdf	403 KB	02/19/2021	Knödlseder Jürgen
spectrum-by-vp.png	116 KB	02/21/2021	Knödlseder Jürgen
spectrum-by-vp-multby1.07.png	117 KB	02/21/2021	Knödlseder Jürgen