

GammaLib - Action #2422

Add energy integration methods to GCTAEdisp

03/28/2018 01:34 PM - Knödlseider Jürgen

Status:	Closed	Start date:	03/28/2018
Priority:	Normal	Due date:	
Assigned To:	Knödlseider Jürgen	% Done:	100%
Category:		Estimated time:	0.00 hour
Target version:	1.6.0		

Description

Energy integration methods

```
double prob_etruebin(GEnergy etrue_min, GEnergy etrue_max, GEnergy ereco, double theta);  
double prob_erecobin(GEnergy ereco_min, GEnergy ereco_max, GEnergy etrue, double theta);
```

should be added to GCTAEdisp that integrate the energy dispersion information over a bin in true or reconstructed energy. The prob_erecobin method can then be used in GCTAOnOffObservation::compute_rmf() to speed up the computations of csphagen.

History

#1 - 03/28/2018 02:06 PM - Knödlseider Jürgen

- Status changed from New to In Progress

To have a reference, here a test run on the DC-1 data and Cas A:

\$ csobsselect

```
Input event list or observation definition XML file [obs.xml] $CTADATA/obs/obs_gps_baseline.xml  
Pointing selection region shape (CIRCLE|BOX) [CIRCLE]  
Coordinate system (CEL - celestial, GAL - galactic) (CEL|GAL) [CEL]  
Right Ascension of selection centre (deg) (0-360) [83.63] 350.8524  
Declination of selection centre (deg) (-90-90) [22.01] 58.8159  
Radius of selection circle (deg) (0-180) [5.0] 5.0  
Start time (UTC string, JD, MJD or MET in seconds) [NONE]  
Output observation definition XML file [outobs.xml] obs.xml
```

\$ csphagen

```
Input event list or observation definition XML file [obs.xml]  
Algorithm for defining energy bins (FILE|LIN|LOG) [LOG]  
Start value for first energy bin in TeV [0.1]  
Stop value for last energy bin in TeV [100.0] 50.0  
Number of energy bins [120] 30  
Stack multiple observations into single PHA, ARF and RMF files? [no] yes  
Output observation definition XML file [onoff_obs.xml]  
Method for background estimation (REFLECTED|CUSTOM) [REFLECTED]  
Coordinate system (CEL - celestial, GAL - galactic) (CEL|GAL) [CEL]  
Right Ascension of source region centre (deg) (0-360) [83.63] 350.8524  
Declination of source region centre (deg) (-90-90) [22.01] 58.8159  
Radius of source region circle (deg) (0-180) [0.2]
```

It took 1231.67 second of CPU time to execute.

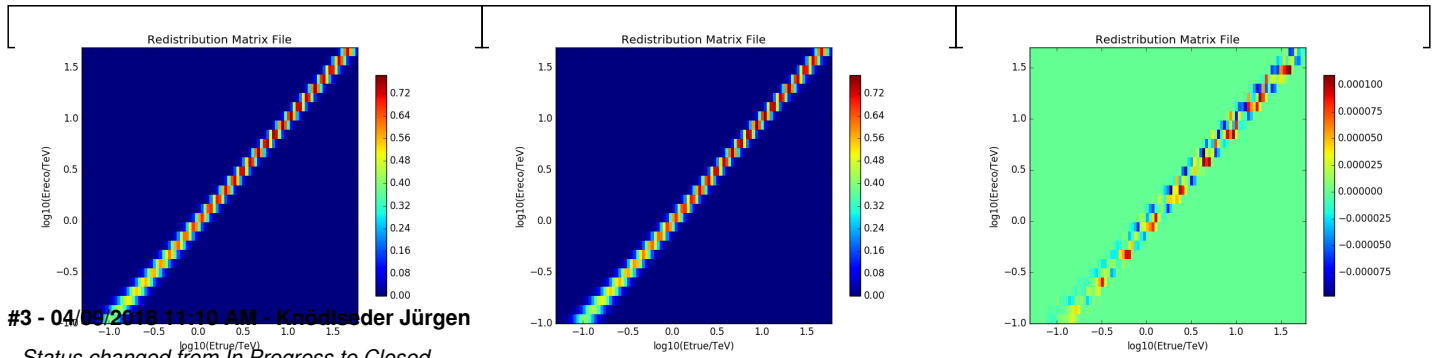
Removing the computation of the RMF, the execution time reduced to 223.4 seconds. This illustrates the potential of replacing the numerical integration by the integration methods in csphagen.

#2 - 03/30/2018 10:35 AM - Knödseder Jürgen

- File `onoff_stacked_rmf_reference.png` added
- File `onoff_stacked_rmf_anaint.png` added
- File `onoff_stacked_rmf_anaint-reference.png` added
- % Done changed from 0 to 50

I implemented the `prob_erecubin()` method for the `GCTAEdisp2D` class. The execution of the `csphagen` script now takes 403 second, hence a factor of 3 increase in computation speed.

The resulting RMF matrix is compared below to the one obtained for the numerical integration. The left panel shows the RMF matrix obtained with numerical integration, the mid panel the one using the `prob_erecubin()` method and the right panel the difference between the `prob_erecubin()` RMF and the numerical integration RMF. The agreement is satisfactory.



#3 - 04/09/2018 11:10 AM - Knödseder Jürgen

- Status changed from *In Progress* to *Closed*
- % Done changed from 50 to 100

The `prob_erecubin` method was added. For the moment a `prob_etruebin` method does not make any sense, since the true energies are convolved with some model spectrum, hence the method will not be implemented.

Merged code into devel.

Files

<code>onoff_stacked_rmf_reference.png</code>	34.4 KB	03/30/2018	Knödseder Jürgen
<code>onoff_stacked_rmf_anaint.png</code>	34.4 KB	03/30/2018	Knödseder Jürgen
<code>onoff_stacked_rmf_anaint-reference.png</code>	36.2 KB	03/30/2018	Knödseder Jürgen