GammaLib - Feature #3606

Add spectral bin function

04/13/2021 12:04 PM - Knödlseder Jürgen

Status:	Closed	**Start date:**	04/13/2021
Priority:	Normal	**Due date:**	
Assigned To:	Knödlseder Jürgen	**% Done:**	100%
Category:		**Estimated time:**	0.00 hour
Target version:	2.0.0		

Description

Creating a spectrum in the COMPTEL standard energy bands excluding the 26Al band (1.7-1.9 MeV) the spectral node functions gives unreliable flux and error estimates. For spectral analysis it seems more appropriate to have a spectral bin function that defines a constant intensity within a given energy band.

A class GModelSpectralBins should be added to implement this functionality. The formal of the model definition XML file should be as follows:

```
<spectrum type="BinFunction">
   <bin>
      <parameter scale="1.0"   name="LowerLimit" min="0.1"   max="1.0e20" value="0.75" free="0"/>
      <parameter scale="1.0"   name="UpperLimit" min="0.1"   max="1.0e20" value="1.0"  free="0"/>
      <parameter scale="1e-07" name="Intensity"  min="1e-07" max="1000.0" value="1.0"  free="1"/>
   </bin>
   <bin>
      <parameter scale="1.0"   name="LowerLimit" min="0.1"   max="1.0e20" value="1.0"  free="0"/>
      <parameter scale="1.0"   name="UpperLimit" min="0.1"   max="1.0e20" value="3.0"  free="0"/>
      <parameter scale="1e-07" name="Intensity"  min="1e-07" max="1000.0" value="0.1"  free="1"/>
   </bin>
</spectrum>
```

History

#1 - 04/13/2021 05:03 PM - Knödlseder Jürgen

- Status changed from New to Pull request

- % Done changed from 0 to 90

I implemented the GModelSpectralBins class, modelled on the GModelSpectralNodes class, but now with statistically independent spectral bins. Within a bin, the spectrum follows a power law, with a spectral index that is the same for all bins. The value of the spectral index is added as an additional parameter to the XML file, as shown below:

```
<spectrum type="BinFunction">
   <parameter name="Index" scale="-1" value="2.48" min="0.0" max="+5.0" free="0"/>
   <bin>
      <parameter scale="1.0"   name="LowerLimit" min="0.1"   max="1.0e20" value="0.75" free="0"/>
      <parameter scale="1.0"   name="UpperLimit" min="0.1"   max="1.0e20" value="1.0"  free="0"/>
      <parameter scale="1e-07" name="Intensity"  min="1e-07" max="1000.0" value="1.0"  free="1"/>
   </bin>
   <bin>
      <parameter scale="1.0"   name="LowerLimit" min="0.1"   max="1.0e20" value="1.0"  free="0"/>
      <parameter scale="1.0"   name="UpperLimit" min="0.1"   max="1.0e20" value="3.0"  free="0"/>
      <parameter scale="1e-07" name="Intensity"  min="1e-07" max="1000.0" value="0.1"  free="1"/>
   </bin>
</spectrum>
```

I added unit tests to test the check the validity of the class.

#2 - 04/13/2021 05:35 PM - Knödlseder Jürgen

I also added GModelSpectralNodes::error(int&) and GModelSpectralBins::error(int&) method so that the intensity error can be accessed directly.

#3 - 04/13/2021 10:01 PM - Knödlseder Jürgen

- Status changed from Pull request to Closed

- % Done changed from 90 to 100

Merged into devel.