

FSSC documentation for v9r27p1 release

Here are FSSC pages that will need updates based on the information in the [Science Tools Development Notes](#). Missing information will be listed in **ALL CAPS**.

Likelihood Updates

- New ScaleFactor class: This is a decorator class that layers an additional overall scale factor to the spectral model function, in addition to the usual normalization parameter. To use, prepend the qualifier "ScaleFactor" to the function name in the xml definition and add a ScaleFactor parameter, e.g.,

```
<spectrum type="ScaleFactor::PowerLaw2">  
<parameter free="1" max="1000.0" min="1e-05" name="Integral" scale="1e-06" value="1.0"/>  
<parameter free="1" max="-1.0" min="-5.0" name="Index" scale="1.0" value="-2.0"/>  
<parameter free="0" max="200000.0" min="20.0" name="LowerLimit" scale="1.0" value="20.0"/>  
<parameter free="0" max="1000000.0" min="20.0" name="UpperLimit" scale="1.0" value="1e6"/>  
<parameter free="1" max="10" min="0." name="ScaleFactor" scale="1.0" value="1"/>  
</spectrum>
```

 - **NEED MODEL DEFINITION EQUATION**
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/source_models.html
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/xml_model_defs.html
- Added ExpCutoffSEDPeak model function and SmoothDoubleBrokenPowerLaw. SmoothDoubleBrokenPowerLaw does not pass derivative tests and so should be used with caution. SmoothDoubleBrokenPowerLaw has been validated. (17-21-06, Jan 19)
 - **NEED XML EXAMPLES**
 - **NEED MODEL DEFINITION EQUATIONS**
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/source_models.html
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/xml_model_defs.html
- Implemented changes to allow use of unbinned analysis with extended source templates
 - Enabled map-based integration for Npred using the source map pixels in unbinned analysis. This will circumvent the normal integration, which uses the exposure map pixels, only for map-based sources.
 - Enabled the map-based diffuse response calculation. This will circumvent the theta-phi integral only for map-based diffuse sources.
 - Enabled map-based Npred and diffuse response integrals to be specified in the xml definition for a source via the "map_based_integral" attribute:

```
<source name="W44_mapIntegral" type="DiffuseSource">  
<spectrum type="PowerLaw2">  
<parameter free="1" max="1000.0" min="0.0" name="Integral" scale="1e-5" value="1.0"/>  
<parameter free="1" max="-1.0" min="-5.0" name="Index" scale="1.0" value="-2.1"/>  
<parameter free="0" max="200000.0" min="20.0" name="LowerLimit" scale="1.0" value="20.0"/>  
<parameter free="0" max="600000.0" min="20.0" name="UpperLimit" scale="1.0" value="600000.0"/>  
</spectrum>  
<spatialModel file="W44.fits" type="SpatialMap" map_based_integral="true">  
<parameter free="0" max="1000.0" min="0.001" name="Prefactor" scale="1.0" value="1.0"/>  
</spatialModel>  
</source>
```

The environment variable mechanism from Likelihood-17-21-04 still works, but this method allows the map-based integration to be activated on a source-by-source basis.
To avoid the map-based integration, simply omit the attribute:

```
<source name="W44" type="DiffuseSource">  
<spectrum type="PowerLaw2">  
<parameter free="1" max="1000.0" min="0.0" name="Integral" scale="1e-5" value="1.0"/>  
<parameter free="1" max="-1.0" min="-5.0" name="Index" scale="1.0" value="-2.1"/>  
<parameter free="0" max="200000.0" min="20.0" name="LowerLimit" scale="1.0" value="20.0"/>  
<parameter free="0" max="600000.0" min="20.0" name="UpperLimit" scale="1.0" value="600000.0"/>  
</spectrum>  
<spatialModel file="W44.fits" type="SpatialMap">  
<parameter free="0" max="1000.0" min="0.001" name="Prefactor" scale="1.0" value="1.0"/>  
</spatialModel>  
</source>
```

This allows for backwards-compatibility with older XML model definitions.
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/likelihood_tutorial.html
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/python_tutorial.html
 - Page: <http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/extended/extended.html>
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/xml_model_defs.html
 - **WHICH HELPFILES WILL THIS CHANGE?**
- Enabled binned analysis in gttsmap
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/binned_likelihood_tutorial.html
 - Page: <http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/extended/extended.html>
- Use DSS keyword info on the CONVERSION_TYPE selection by gtselect to determine whether front, back (or both) should be used in exposure calculations. This means that the irfs keyword need not be specified with the ::FRONT, ::BACK qualifiers when running gtexpcube2 with ccube=none. In this case, the DSS keyword info is not available from any of the inputs, and the qualifiers must be added, e.g., gtexpcube2 ccube=none irfs=P7SOURCE_V6::FRONT.
 - Elizabeth suggests not modifying the documentation for this change. Using gtexpcube2 in the way we recommend would require entering the IRF name differently than for other tools. However, using the ::FRONT and ::BACK nomenclature elsewhere (hopefully) does not cause issues. Better to be consistent across the tools in the documentation.

- Sources that do not have any free spectral parameters are not included in the model counts map. Fixed.
 - DOES THIS MEAN THEY NOW **ARE** INCLUDED IN THE MODEL MAP?
 - Page: (maybe) http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/binned_likelihood_tutorial.html
- Added GtApp-exposed gtexpcube2 callable to gt_apps.py
 - Page: <http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/extended/extended.html>
- Added SED.py script. See entry at the Likelihood usage notes page.
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/python_tutorial.html
 - Page: <http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/extended/extended.html>

gtobsim

- In gtobsim, make tstart a prompted parameter and startdate a hidden parameter. If tstart=INDEF, then tstart is set to zero if scfile=None or tstart is set to the TSTART value if scfile is set to an existing FT2 file.
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/obssim_tutorial.html
 - Page: <http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/help/gtobsim.txt>

Pulsar Tools

- Three web pages were added to the pulsar tools development web site to cover the new topics introduced in the latest pulsar tools packages (timeSystem-06-05-00, pulsarDb-09-00-00, pulsePhase-09-00-00, and periodSearch-10-08-06). Eventually those web pages should be a part of the FSSC official web site once the related pulsar tools packages are officially released.
 - New documentation: Pulsar Position and Orbital Phase: Explains the new parameters srposition and strict of gtphase, in the style of the pulsar tools tutorials. Once the new gtphase is officially released, it is suggested to append the contents to the tutorial for gtphase, Binary Orbital Phase Calculation.
 - New documentation: Addendum to Pulsar Tools Anatomy: Describes updates and additions to Pulsar Tools Anatomy to cover the changes made in the above listed versions. Once the new pulsar tools are officially released, it is suggested to follow the instructions on the addendum to update the current Pulsar Tools Anatomy.
 - New documentation: Pulsar Ephemeris Data Format: Explains the D4 file format (FITS and text) in detail. Once the pulsar tools with new ephemeris support are officially released, it is suggested to add a new page under Library >> User Support, right next to Pulsar Tools Anatomy.

gtbkg

- Output format change: Use RATE instead of COUNTS for the background spectrum inferred from an unbinned likelihood analysis so that real values (rather than integers) can be used. Also, fill the STAT_ERR column with the model error estimate on the predicted rate.
 - Page: <http://fermi.gsfc.nasa.gov/ssc/data/analysis/scitools/help/gtbkg.txt>

Other

- Added P7SOURCE_V6MC irfs. These contain the Monte Carlo derived psf parameters that have off-axis angle dependence. For use in ST, they should be specified as irfs=P7SOURCE_V6MC.
 - Page: http://fermi.gsfc.nasa.gov/ssc/data/analysis/documentation/Cicerone/Cicerone_LAT_IRFs/IRF_overview.html
 - Page: **ANYTHING ELSE?**
- update with catalogProducts/v1r2
 - Page: <http://fermi.gsfc.nasa.gov/ssc/data/access/lat/BackgroundModels.html>