GammaLib - Feature #1916

Add GModelTemporalPhaseCurve class

01/27/2017 09:58 AM - Knödlseder Jürgen

Status:	Closed	**Start date:**	01/27/2017
Priority:	Normal	**Due date:**	
Assigned To:	Knödlseder Jürgen	**% Done:**	100%
Category:		**Estimated time:**	0.00 hour
Target version:	1.2.0		

Description

The GModelTemporalPhase class should implement a regular variation, specified by a phase file function (relative amplitude as function of phase in the interval [0,1]). The class can be used to simulate pulsars and gamma-ray binaries. Parameters of the model component are:

- the relative normalization
- the origin of time (t0)
- the period at time t0 (p0)
- the first period derivative at time t0 (p1)
- the second period derivative at time t0 (p2)
- the phase at the origin of time at time t0 (phi0)

The phase is the computed using

{{latex($\Phi(t) = \Phi_0+f(t-t_0) + \frac{1}{2}\dot{f} (t-t_0)^2 +\frac{1}{6}\ddot{f} (t-t_0)^3$)}}

where

- {{latex($f = \frac{1}{P}$)}}
- {{latex($\dot{f} = - \frac{\dot{P}}{P^2}$)}}
- {{latex($\ddot{f} = \frac{\dot{P}^2}{P^3} - \frac{\ddot{P}}{P^2}$)}}

History

#1 - 01/27/2017 10:43 PM - Knödlseder Jürgen

- File phasecurve.png added

- Subject changed from Add GModelTemporalPhase class to Add GModelTemporalPhaseCurve class

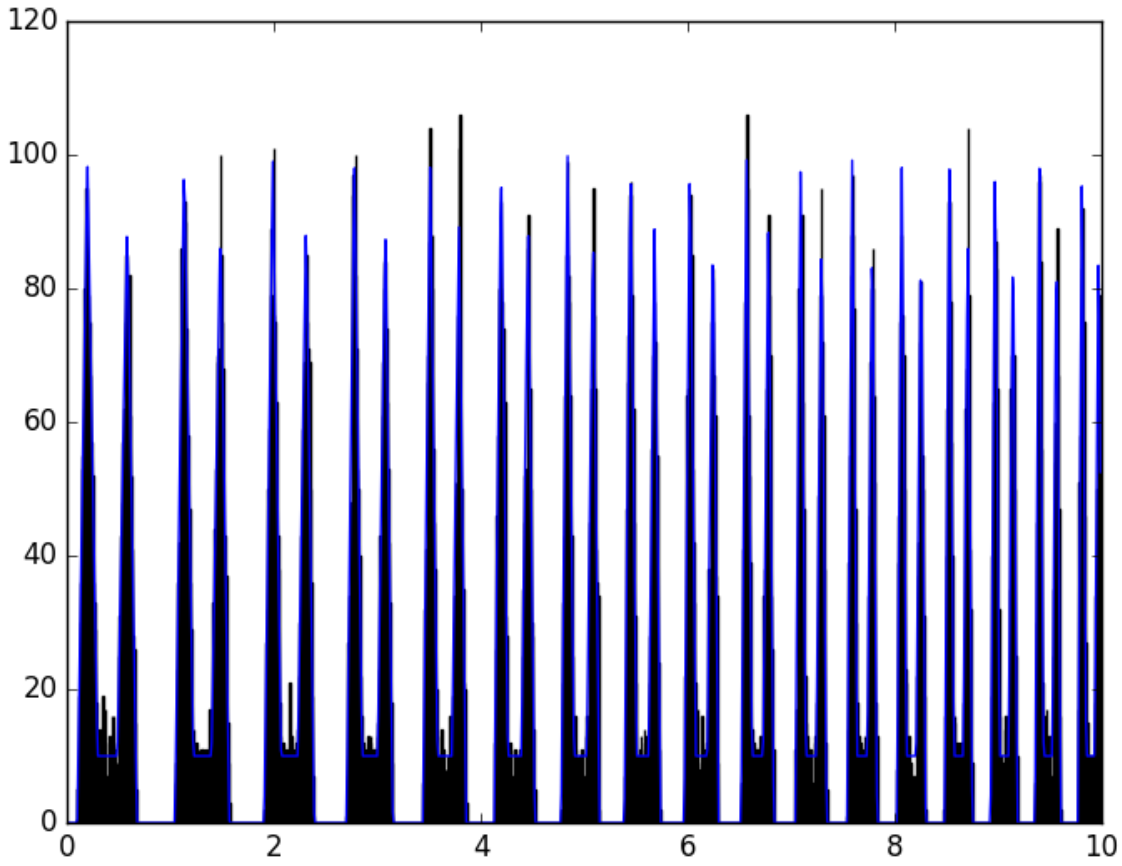
- Status changed from New to In Progress

- Assigned To set to Knödlseder Jürgen

- Target version set to 1.2.0

- % Done changed from 0 to 80

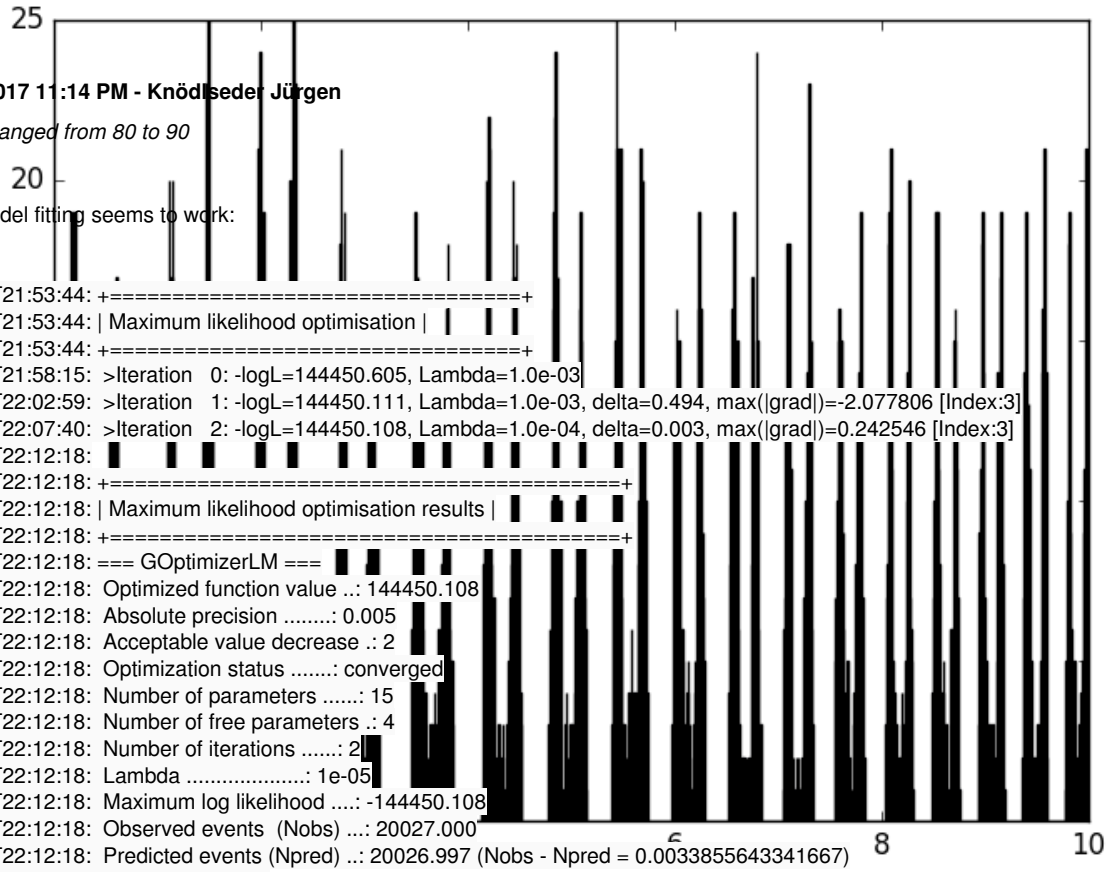
The class is now correctly implemented (see plot below).


120
100
80
60
40
20
0
0
2
4
6
8
10

#2 - 01/27/2017 10:51 PM - Knödlseder Jürgen

- File ctobssim.png added

And here the output of ctobssim.



#3 - 01/27/2017 11:14 PM - Knödlseder Jürgen

- % Done changed from 80 to 90

Even the model fitting seems to work:

```
2017-01-27T21:53:44: +==================================+
2017-01-27T21:53:44: | Maximum likelihood optimisation |
2017-01-27T21:53:44: +==================================+
2017-01-27T21:58:15:  >Iteration   0: -logL=144450.605, Lambda=1.0e-03
2017-01-27T22:02:59:  >Iteration   1: -logL=144450.111, Lambda=1.0e-03, delta=0.494, max(|grad|)=-2.077806 [Index:3]
2017-01-27T22:07:40:  >Iteration   2: -logL=144450.108, Lambda=1.0e-04, delta=0.003, max(|grad|)=0.242546 [Index:3]
2017-01-27T22:12:18:
2017-01-27T22:12:18: +========================================+
2017-01-27T22:12:18: | Maximum likelihood optimisation results |
2017-01-27T22:12:18: +========================================+
2017-01-27T22:12:18: === GOptimizerLM ===
2017-01-27T22:12:18:  Optimized function value ..: 144450.108
2017-01-27T22:12:18:  Absolute precision .........: 0.005
2017-01-27T22:12:18:  Acceptable value decrease .: 2
2017-01-27T22:12:18:  Optimization status .......: converged
2017-01-27T22:12:18:  Number of parameters ......: 15
2017-01-27T22:12:18:  Number of free parameters .: 4
2017-01-27T22:12:18:  Number of iterations ......: 2
2017-01-27T22:12:18:  Lambda ....................: 1e-05
2017-01-27T22:12:18:  Maximum log likelihood ....: -144450.108
2017-01-27T22:12:18:  Observed events  (Nobs) ...: 20027.000
2017-01-27T22:12:18:  Predicted events (Npred) ..: 20026.997 (Nobs - Npred = 0.0033855643341667)
2017-01-27T22:12:18: === GModels ===
2017-01-27T22:12:18:  Number of models ..........: 2
2017-01-27T22:12:18:  Number of parameters ......: 15
2017-01-27T22:12:18: === GModelSky ===
2017-01-27T22:12:18:  Name ......................: Crab
2017-01-27T22:12:18:  Instruments ................: all
2017-01-27T22:12:18:  Instrument scale factors ..: unity
2017-01-27T22:12:18:  Observation identifiers ...: all
2017-01-27T22:12:18:  Model type ................: PointSource
2017-01-27T22:12:18:  Model components ..........: "PointSource" * "PowerLaw" * "PhaseCurve"
2017-01-27T22:12:18:  Number of parameters ......: 11
2017-01-27T22:12:18:  Number of spatial par's ...: 2
2017-01-27T22:12:18:   RA ........................: 83.6331 [-360,360] deg (fixed,scale=1)
2017-01-27T22:12:18:   DEC .......................: 22.0145 [-90,90] deg (fixed,scale=1)
2017-01-27T22:12:18:  Number of spectral par's ..: 3
2017-01-27T22:12:18:   Prefactor .................: 5.68398824584615e-16 +/- 2.2420159576827e-17 [1e-23,1e-13] ph/cm2/s/MeV
 (free,scale=1e-16,gradient)
2017-01-27T22:12:18:   Index .....................: -2.44945511369705 +/- 0.0342651451272744 [-0,-5]  (free,scale=-1,gradient)
2017-01-27T22:12:18:   PivotEnergy ...............: 300000 [10000,1000000000] MeV (fixed,scale=1000000,gradient)
2017-01-27T22:12:18:  Number of temporal par's ..: 6
2017-01-27T22:12:18:   Normalization ............: 1 [0,1000] (relative value) (fixed,scale=1,gradient)
2017-01-27T22:12:18:   MJD .......................: 51544.5 [0,100000] days (fixed,scale=1)
2017-01-27T22:12:18:   Phase .....................: 0 [0,1]  (fixed,scale=1)
2017-01-27T22:12:18:   F0 ........................: 1 [0,1000] Hz (fixed,scale=1)
2017-01-27T22:12:18:   F1 ........................: 0.1 [0,1000] s^-2 (fixed,scale=1)
2017-01-27T22:12:18:   F2 ........................: 0.01 [0,1000] s^-3 (fixed,scale=1)
2017-01-27T22:12:18: === GCTAModelIrfBackground ===
2017-01-27T22:12:18:  Name ......................: CTABackgroundModel
2017-01-27T22:12:18:  Instruments ................: CTA
2017-01-27T22:12:18:  Instrument scale factors ..: unity
2017-01-27T22:12:18:  Observation identifiers ...: all
2017-01-27T22:12:18:  Model type ................: "PowerLaw" * "Constant"
2017-01-27T22:12:18:  Number of parameters ......: 4
```

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2017-01-27T22:12:18:  Number of spectral par's ..: 3
2017-01-27T22:12:18:   Prefactor ................: 0.997595111690758 +/- 0.0118966498258124 [0.001,1000] ph/cm2/s/MeV (free,scale=1,gradient)
2017-01-27T22:12:18:   Index ....................: -0.00052776545878647 +/- 0.00735258326140023 [-5,5]  (free,scale=1,gradient)
2017-01-27T22:12:18:   PivotEnergy ..............: 1000000 [10000,1000000000] MeV (fixed,scale=1000000,gradient)
2017-01-27T22:12:18:  Number of temporal par's ..: 1
2017-01-27T22:12:18:   Normalization ............: 1 (relative value) (fixed,scale=1,gradient)
```

#4 - 01/28/2017 11:03 PM - Knödlseder Jürgen

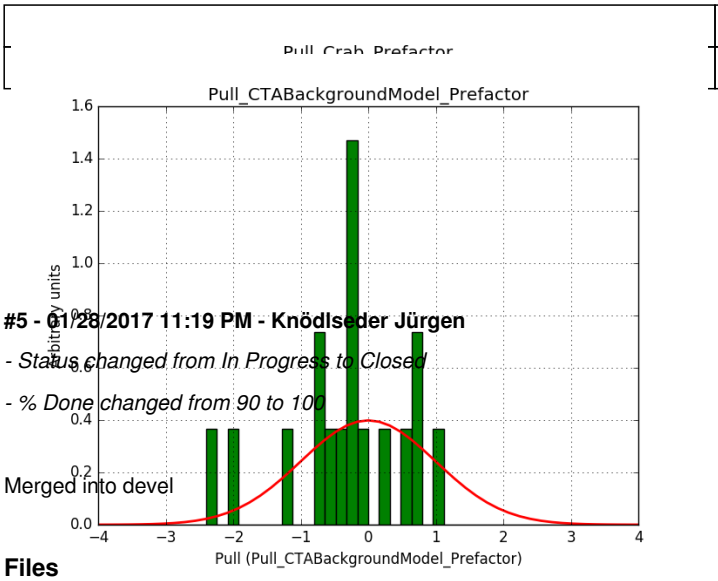
- File bgd_index.png added

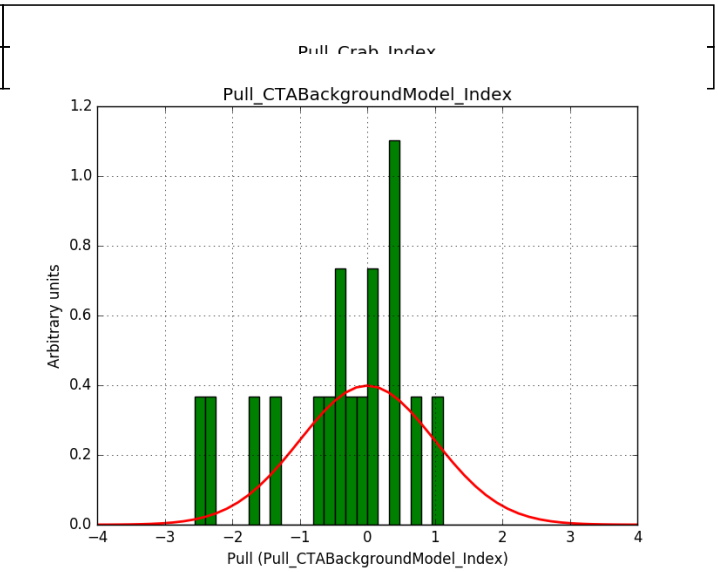
- File bgd_prefactor.png added

- File prefactor.png added

- File index.png added

Here the pull distributions for fitting with fixed phase parameters. Note that fitting the phase parameters leads to warnings and the fit seems not to work properly, but it would have been a surprise if this were possible. This needs some more investigations, an issue has been created for that: #1917.





#5 - 01/28/2017 11:19 PM - Knödlseder Jürgen

- Status changed from In Progress to Closed

- % Done changed from 90 to 100

Merged into devel

Files

phasecurve.png	63 KB	01/27/2017	Knödlseder Jürgen
ctobssim.png	15.8 KB	01/27/2017	Knödlseder Jürgen
bgd_index.png	40.3 KB	01/28/2017	Knödlseder Jürgen
bgd_prefactor.png	42 KB	01/28/2017	Knödlseder Jürgen
prefactor.png	39.6 KB	01/28/2017	Knödlseder Jürgen
index.png	30.4 KB	01/28/2017	Knödlseder Jürgen