

GammaLib - Bug #3472

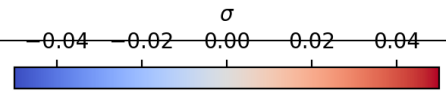
Investigate why high-latitudes have positive residuals

12/01/2020 12:24 PM - Knödseder Jürgen

Status:	Closed	Start date:	12/01/2020
Priority:	Normal	Due date:	
Assigned To:	Knödseder Jürgen	% Done:	100%
Category:		Estimated time:	0.00 hour
Target version:	1.7.3		

Description

As shown in the Gaussian correlated residuals plot below, there are negative residuals in the Galactic plane and positive residuals at high galactic latitudes. The origin of this bias should be investigated.



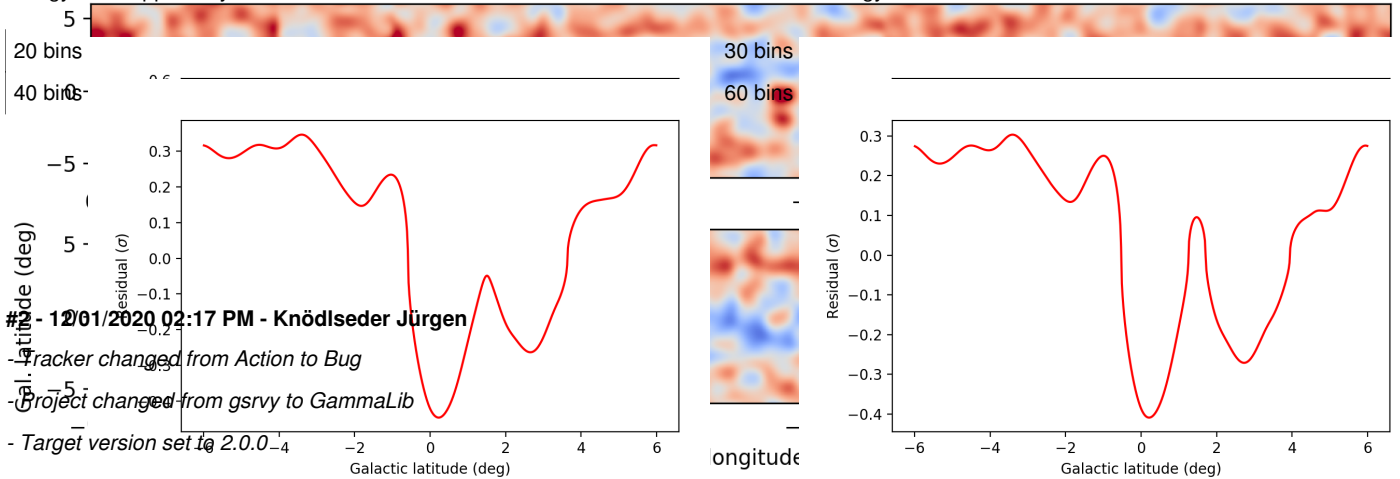
History

#1 - 12/01/2020 12:27 PM - Knödseder Jürgen

- File `gps_anticentre_ebins20.png` added
- File `gps_anticentre_ebins30.png` added
- File `gps_anticentre_ebins40.png` added
- File `gps_anticentre_ebins60.png` added

- Status changed from *New* to *In Progress*
- Assigned To set to Knödseder Jürgen
- % Done changed from 0 to 10

I checked whether the residuals change with a changed number of energy bins. The figures below show the latitude residuals for 20, 30, 40 and 60 energy bins. Apparently the residuals do not reduce with an increase in the number of energy bins.



#2 - 12/01/2020 02:17 PM - Knödseder Jürgen

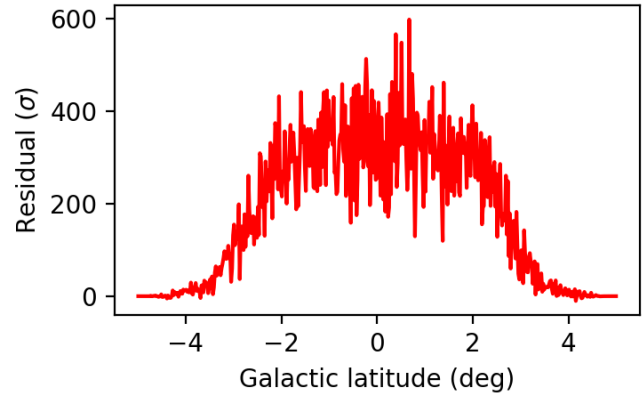
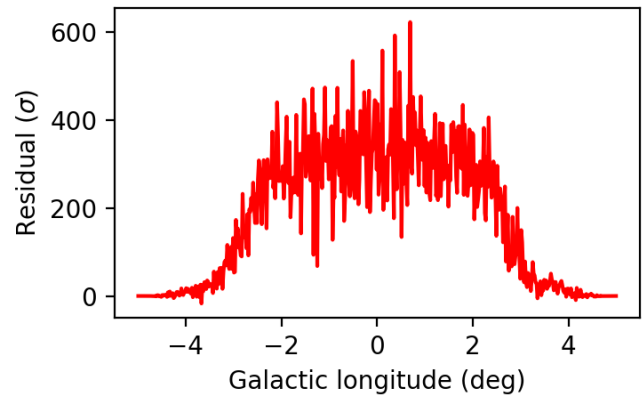
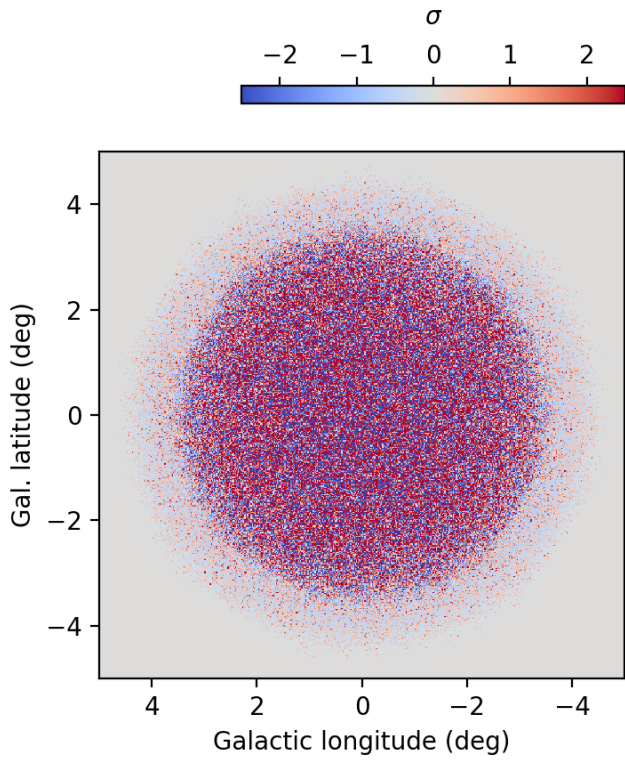
- Tracker changed from *Action* to *Bug*
- Project changed from *gsrv* to *GammaLib*
- Target version set to 2.0.0

#3 - 12/01/2020 02:24 PM - Knödseder Jürgen

- File `residual.png` added

I did a single simulation of 50h of background only on the Galactic centre, generated response and background cubes, computed a model cube and displayed the residual between data and model. I selected an energy range of 70 GeV - 199 TeV and used the prod3b-v2 IRF South_z20_50h. I used 20 energy bins.

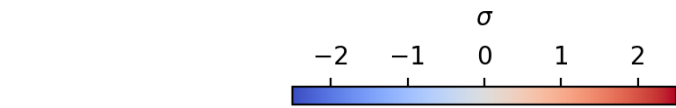
Below the residuals counts cube - model cube for the first energy bin (70-104.2 GeV). There is obviously an excess in the residuals that is not expected.



#4 - 12/01/2020 02:28 PM - Knödseder Jürgen

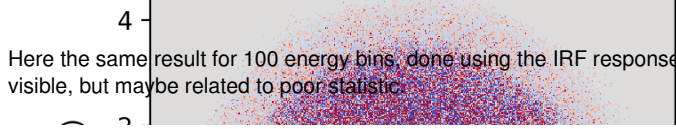
- File residual_irf.png added

For comparison the residual that is obtained when the IRF response instead of the stacked response is used. This looks better, but is not perfect.

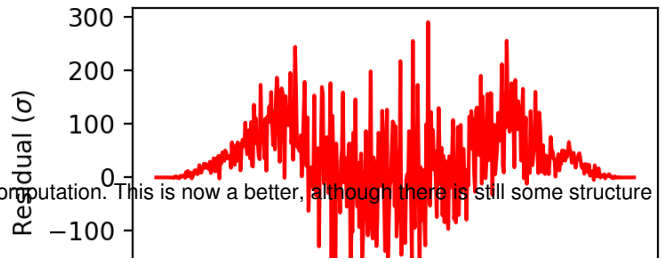


#5 - 12/01/2020 03:08 PM - Knödseder Jürgen

- File residual_irf100.png added



Here the same result for 100 energy bins, done using the IRF response computation. This is now a better, although there is still some structure visible, but may be related to poor statistic.



#6 - 12/01/2020 10:58 PM - Knödseder Jürgen

- File deleted (residual_irf.png)

#7 - 12/01/2020 11:00 PM - Knödseder Jürgen

- File deleted (residual.png)

#8 - 12/01/2020 11:01 PM - Knödseder Jürgen

- File deleted (residual_irf100.png)

#9 - 12/01/2020 11:01 PM - Knödseder Jürgen

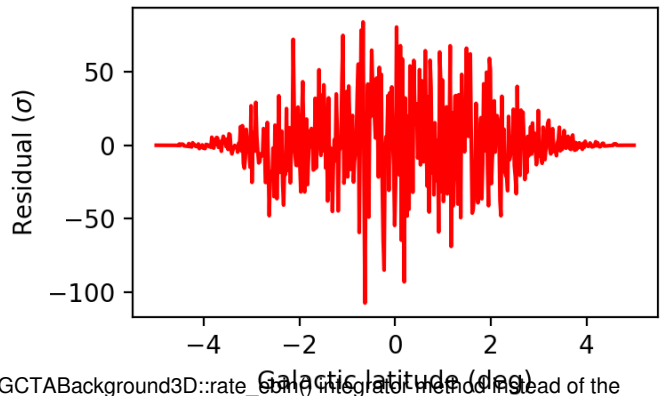
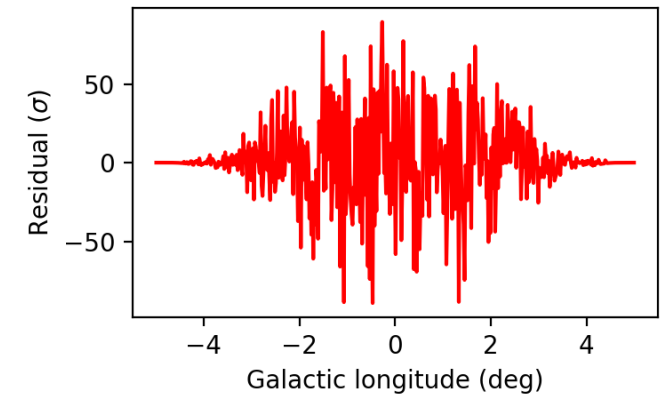
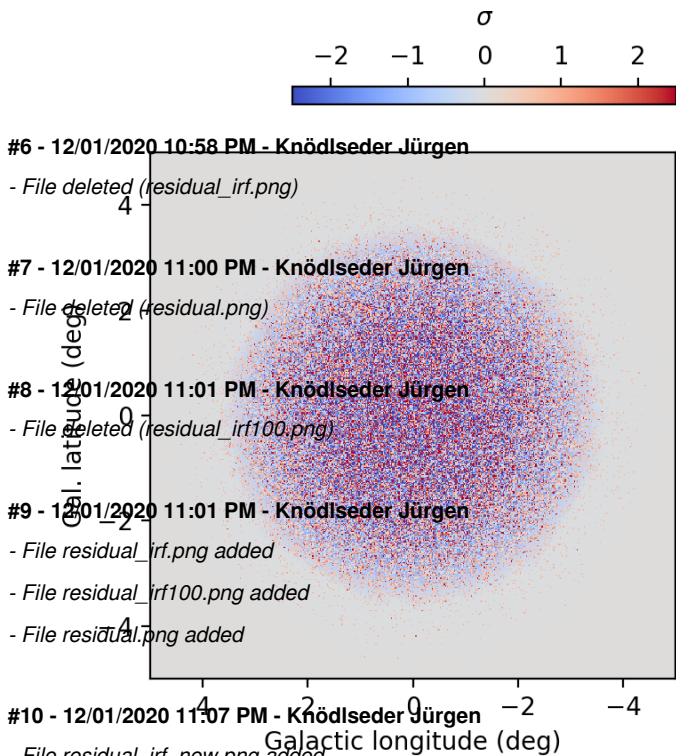
- File residual_irf.png added

- File residual_irf100.png added

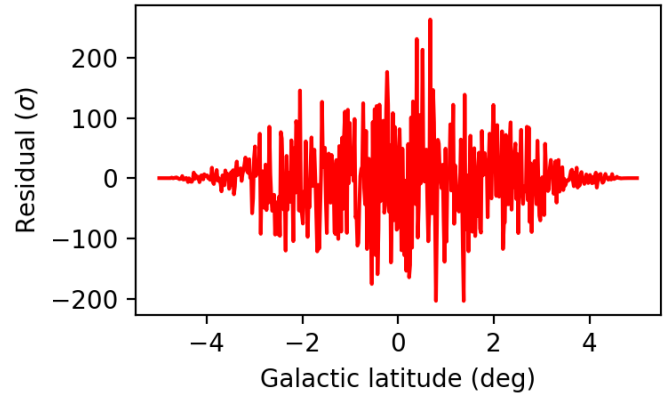
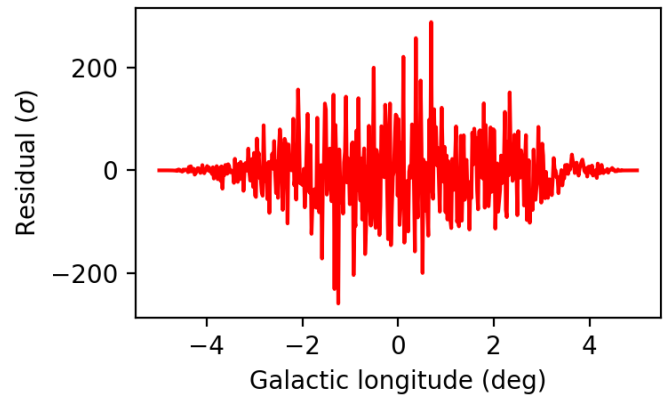
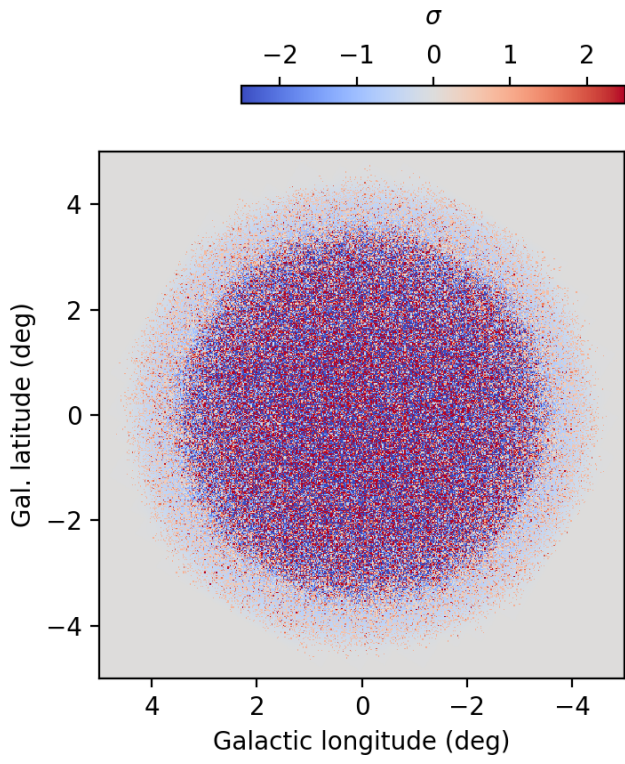
- File residual.png added

#10 - 12/01/2020 11:07 PM - Knödseder Jürgen

- File residual_irf_new.png added



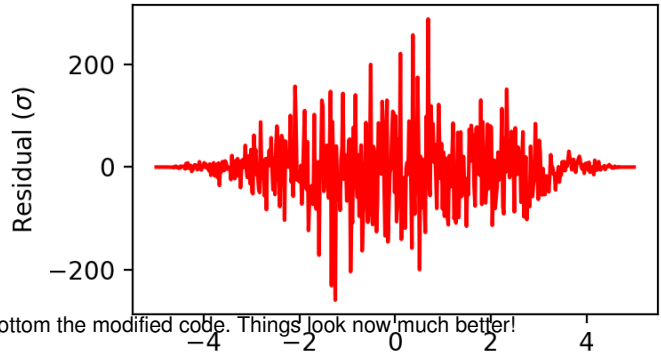
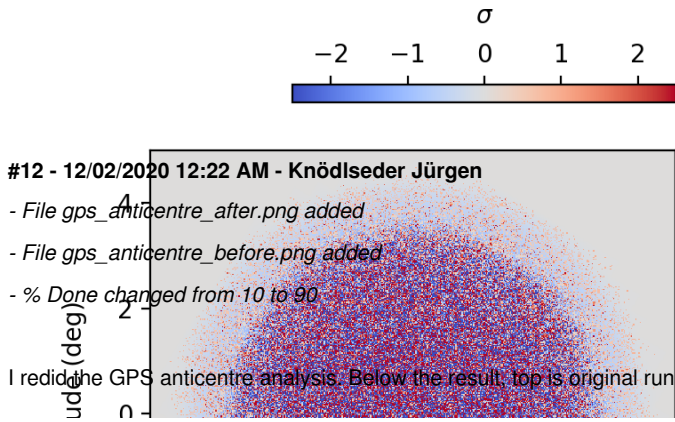
I made a modification in GCTAModIrfBackground::eval() using now the GCTABackground3D::rate_sum() integral method instead of the GCTABackground3D::operator() operator. This takes a bit more time (ctmodel takes 4.9 seconds instead of 3.6 seconds before, which is actually not so bad). The residuals are now clean.



#11 - 12/01/2020 11:22 PM - Knödlseider Jürgen

- File residual_new.png added

I simplified the GCTACubeBackground::fill() method, removing the power law integration, and using directly the GCTAModellrfBackground::eval() method which is now exact. Recomputing the background cube using ctbgcube and then computing a model using the stacked response using ctmodel produced the following plot. It looks perfect, and actually identical to the plot generated using the IRF response.

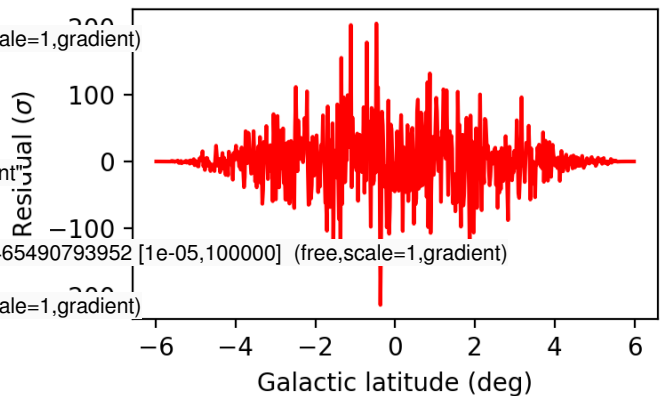
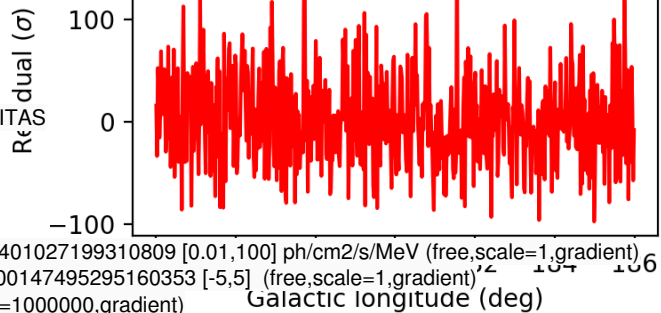


Also note that the background model fit parameters are now much closer to nominal. The normalisation of the IEM is also impacted, not being consistent with the nominal value of 1.

Before:

```

6 |
2020-11-30T16:23:18: === GCTAModelCubeBackground ===
2020-11-30T16:23:18: Name .....: BackgroundModel
2020-11-30T16:23:18: Instruments .....: CTA, HESS, MAGIC, VERITAS
2020-11-30T16:23:18: Observation identifiers ....: all
2020-11-30T16:23:18: Model type .....: "PowerLaw" * "Constant"
2020-11-30T16:23:18: Number of parameters .....: 4
2020-11-30T16:23:18: Number of spectral par's ...: 3
2020-11-30T16:23:18: Prefactor .....: 0.95425308484162 +/- 0.00401027199310809 [0.01,100] ph/cm2/s/MeV (free,scale=1,gradient)
2020-11-30T16:23:18: Index .....: -0.0242787890275514 +/- 0.00147495295160353 [-5,5] (free,scale=1,gradient)
2020-11-30T16:23:18: PivotEnergy .....: 1000000 MeV (fixed,scale=1000000,gradient)
2020-11-30T16:23:18: Number of temporal par's ..: 1
2020-11-30T16:23:18: Normalization .....: 1 (relative value) (fixed,scale=1,gradient)
2020-11-30T16:23:18: === GCTAModelSkyCube ===
2020-11-30T16:23:18: Name .....: IEM
2020-11-30T16:23:18: Instruments .....: all
2020-11-30T16:23:18: Observation identifiers ....: all
2020-11-30T16:23:18: Model type .....: "ConstantValue" * "Constant"
2020-11-30T16:23:18: Number of parameters .....: 3
2020-11-30T16:23:18: Number of spectral par's ...: 1
2020-11-30T16:23:18: Value .....: 16.6818659128961 +/- 1.41465490793952 [1e-05,100000] (free,scale=1,gradient)
2020-11-30T16:23:18: Number of temporal par's ..: 1
2020-11-30T16:23:18: Normalization .....: 1 (relative value) (fixed,scale=1,gradient)
    
```



After:

```

2020-12-01T23:09:55: === GCTAModelCubeBackground ===
2020-12-01T23:09:55: Name .....: BackgroundModel
2020-12-01T23:09:55: Instruments .....: CTA, HESS, MAGIC, VERITAS
2020-12-01T23:09:55: Observation identifiers ....: all
2020-12-01T23:09:55: Model type .....: "PowerLaw" * "Constant"
2020-12-01T23:09:55: Number of parameters .....: 4
2020-12-01T23:09:55: Number of spectral par's ...: 3
2020-12-01T23:09:55: Prefactor .....: 0.998666663749527 +/- 0.00463828188617879 [0.01,100] ph/cm2/s/MeV (free,scale=1,gradient)
2020-12-01T23:09:55: Index .....: -0.000905912390236462 +/- 0.00158187474876209 [-5,5] (free,scale=1,gradient)
2020-12-01T23:09:55: PivotEnergy .....: 1000000 MeV (fixed,scale=1000000,gradient)
2020-12-01T23:09:55: Number of temporal par's ..: 1
2020-12-01T23:09:55: Normalization .....: 1 (relative value) (fixed,scale=1,gradient)
2020-12-01T23:09:55: === GCTAModelSkyCube ===
2020-12-01T23:09:55: Name .....: IEM
    
```

2020-12-01T23:09:55: Instruments: all
 2020-12-01T23:09:55: Observation identifiers: all
 2020-12-01T23:09:55: Model type: "ConstantValue" * "Constant"
 2020-12-01T23:09:55: Number of parameters: 3
 2020-12-01T23:09:55: Number of spectral par's ...: 1
 2020-12-01T23:09:55: Value: 1.83811471079993 +/- 1.65034103271708 [1e-05,100000] (free,scale=1,gradient)
 2020-12-01T23:09:55: Number of temporal par's ...: 1
 2020-12-01T23:09:55: Normalization: 1 (relative value) (fixed,scale=1,gradient)

#13 - 12/02/2020 08:41 AM - Knödseder Jürgen

- Target version changed from 2.0.0 to 1.7.3

I moved the issue to the bugfix-1.7.3 release.

Note that I had also added GCTAEventBin::emin() and GCTAEventBin::emax() methods to compute the event boundaries for an event bin from the log mean energy and energy bin width. I kept these methods in release 2.0.0 but removed them from release 1.7.3 since a bugfix release should have no interface change.

#14 - 12/02/2020 02:32 PM - Knödseder Jürgen

- Status changed from In Progress to Feedback

- % Done changed from 90 to 100

#15 - 12/02/2020 02:32 PM - Knödseder Jürgen

- Status changed from Feedback to Closed

Files

residuals_none_20201109_gauss05.png	1.97 MB	12/01/2020	Knödseder Jürgen
gps_anticentre_ebins20.png	49 KB	12/01/2020	Knödseder Jürgen
gps_anticentre_ebins30.png	47.2 KB	12/01/2020	Knödseder Jürgen
gps_anticentre_ebins40.png	52.3 KB	12/01/2020	Knödseder Jürgen
gps_anticentre_ebins60.png	54.3 KB	12/01/2020	Knödseder Jürgen
residual_irf100.png	442 KB	12/01/2020	Knödseder Jürgen
residual_irf.png	549 KB	12/01/2020	Knödseder Jürgen
residual.png	545 KB	12/01/2020	Knödseder Jürgen
residual_irf_new.png	552 KB	12/01/2020	Knödseder Jürgen
residual_new.png	552 KB	12/01/2020	Knödseder Jürgen
gps_anticentre_before.png	774 KB	12/01/2020	Knödseder Jürgen
gps_anticentre_after.png	781 KB	12/01/2020	Knödseder Jürgen