GBM GRB Analysis Tutorial

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What we want to accomplish

- Obtain GBM data (RSPs, TTE,)
- Load RMFIT with data
- Bin data in time and energy
- Select background regions
- Spectroscopy
- Post spectroscopy analysis.

Tools

- Full functioning human brain
- RMFIT (IDL… sigh)
- Python
- Some custom magical tools

Acquiring Data

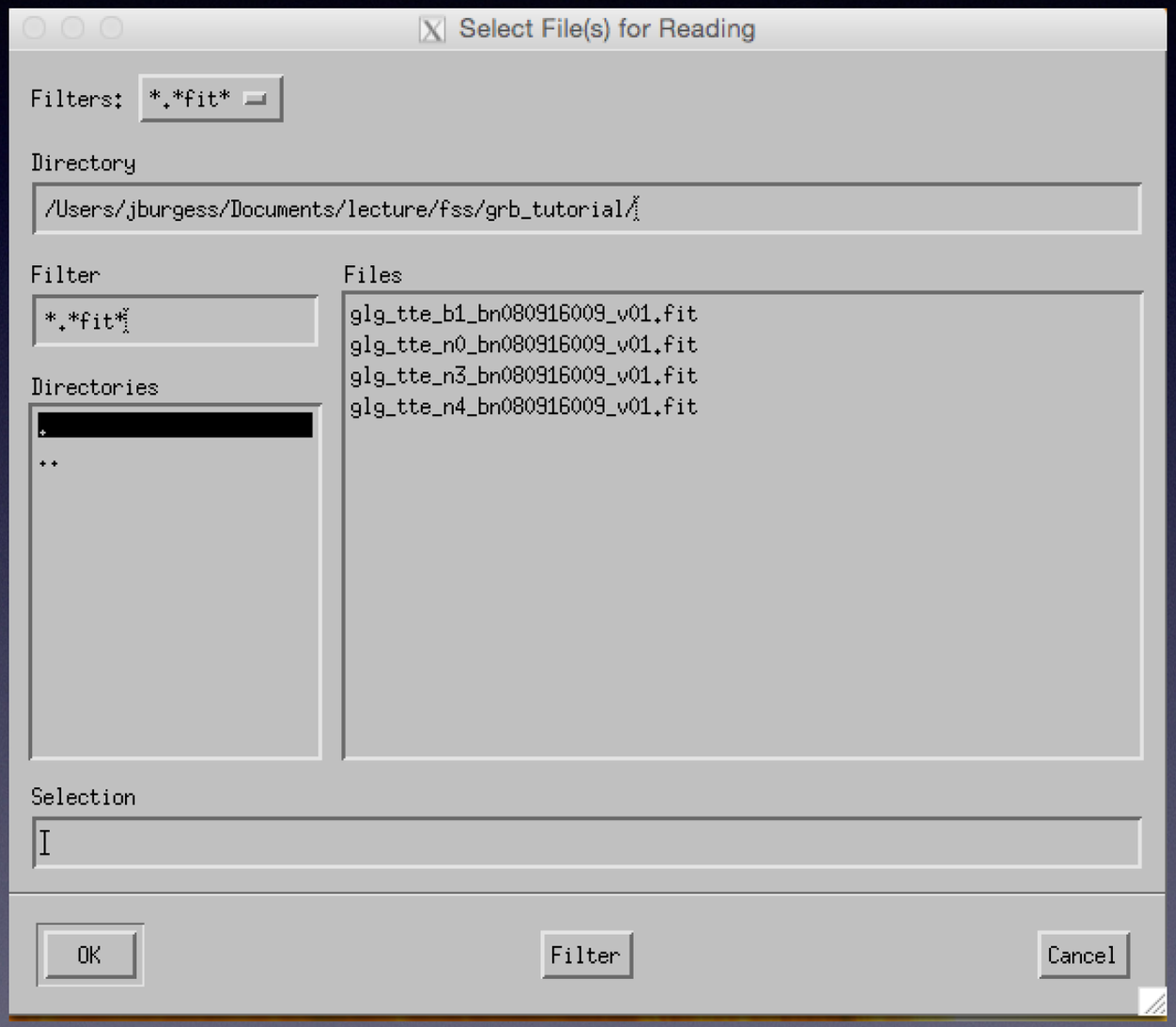
Indicates you want burst data

The type of data you want

The specific detectors required

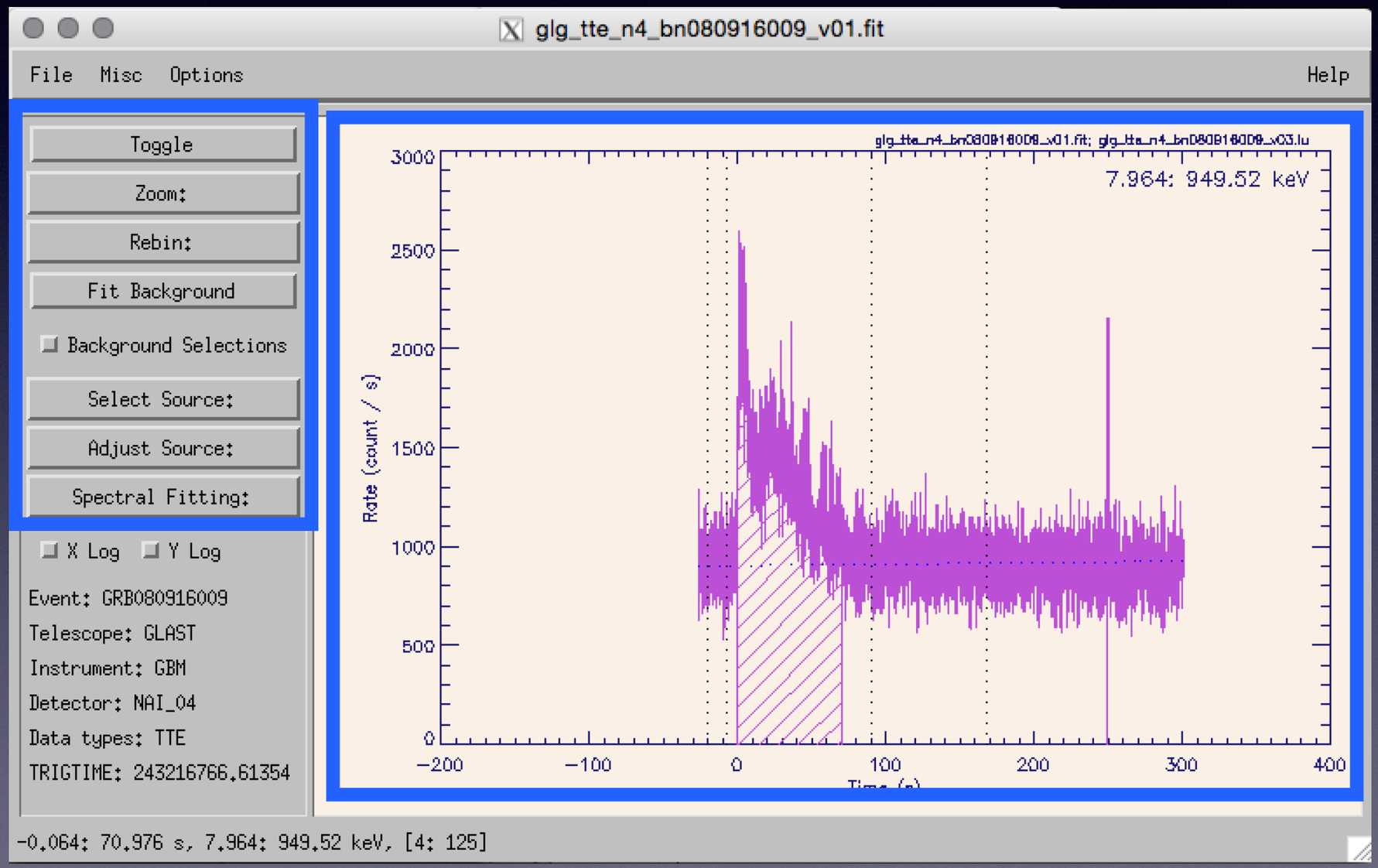
```
$> getGBMdata bn 080916009 --data tte rsp --nai 0 3 4 --bgo 0

$> getGBMdata –help
   usage: getGBMdata [-h] [-v] {bn,date} ...

   Tool for retrieving GBM data from the FSSC

    positional arguments:
    {bn,date}   sub-command help
     bn         Triggered data mode
     date       Daily data mode

optional arguments:
  -h, --help  show this help message and exit
  -v          show program's version number and exit

To access help for the different data modes enter [mode] -h ,--
help
```

Loading Data



Loading Data

Options for binning, viewing, etc.

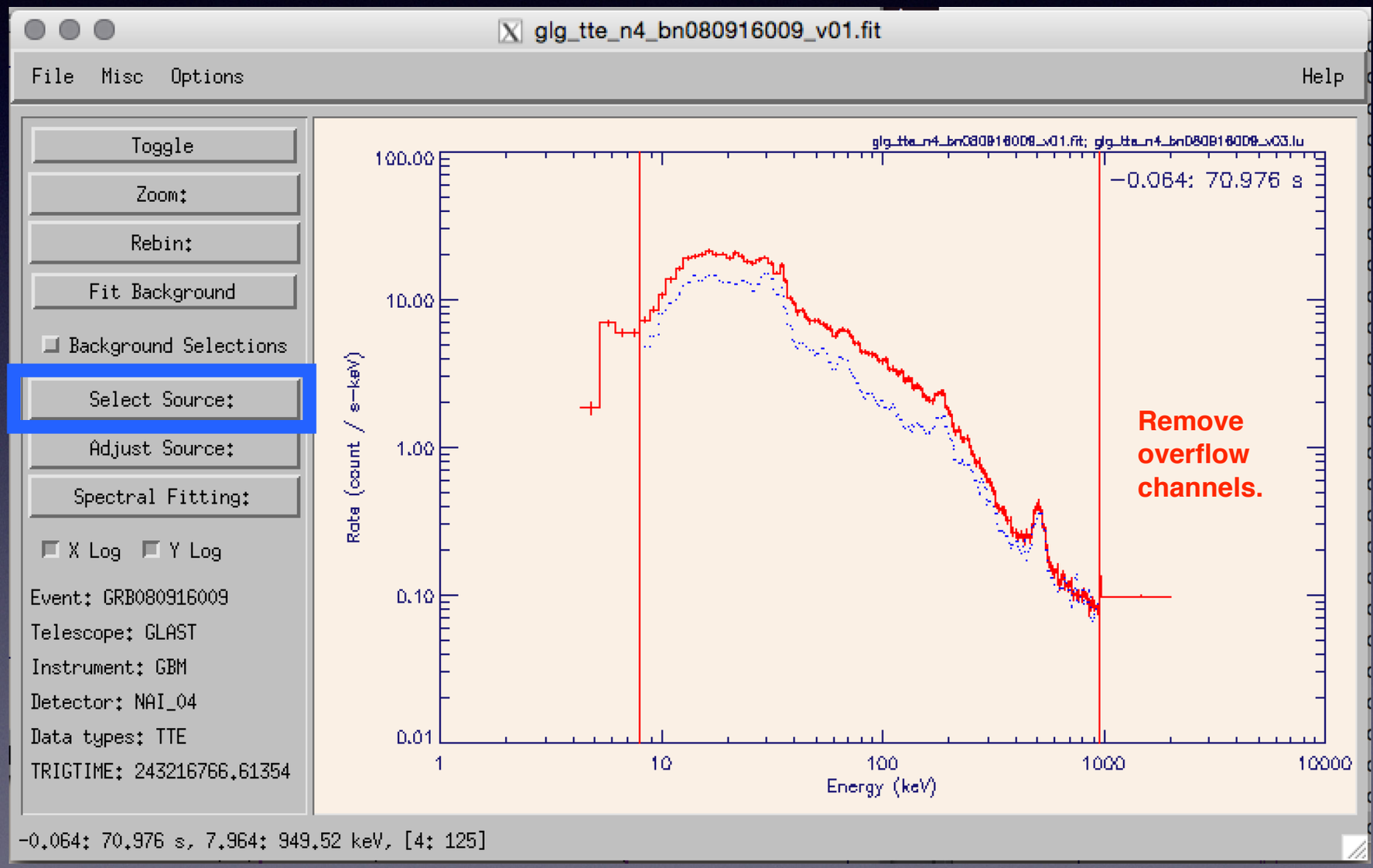


Light curve display

Energy Selection

Nominal GBM energy selections:

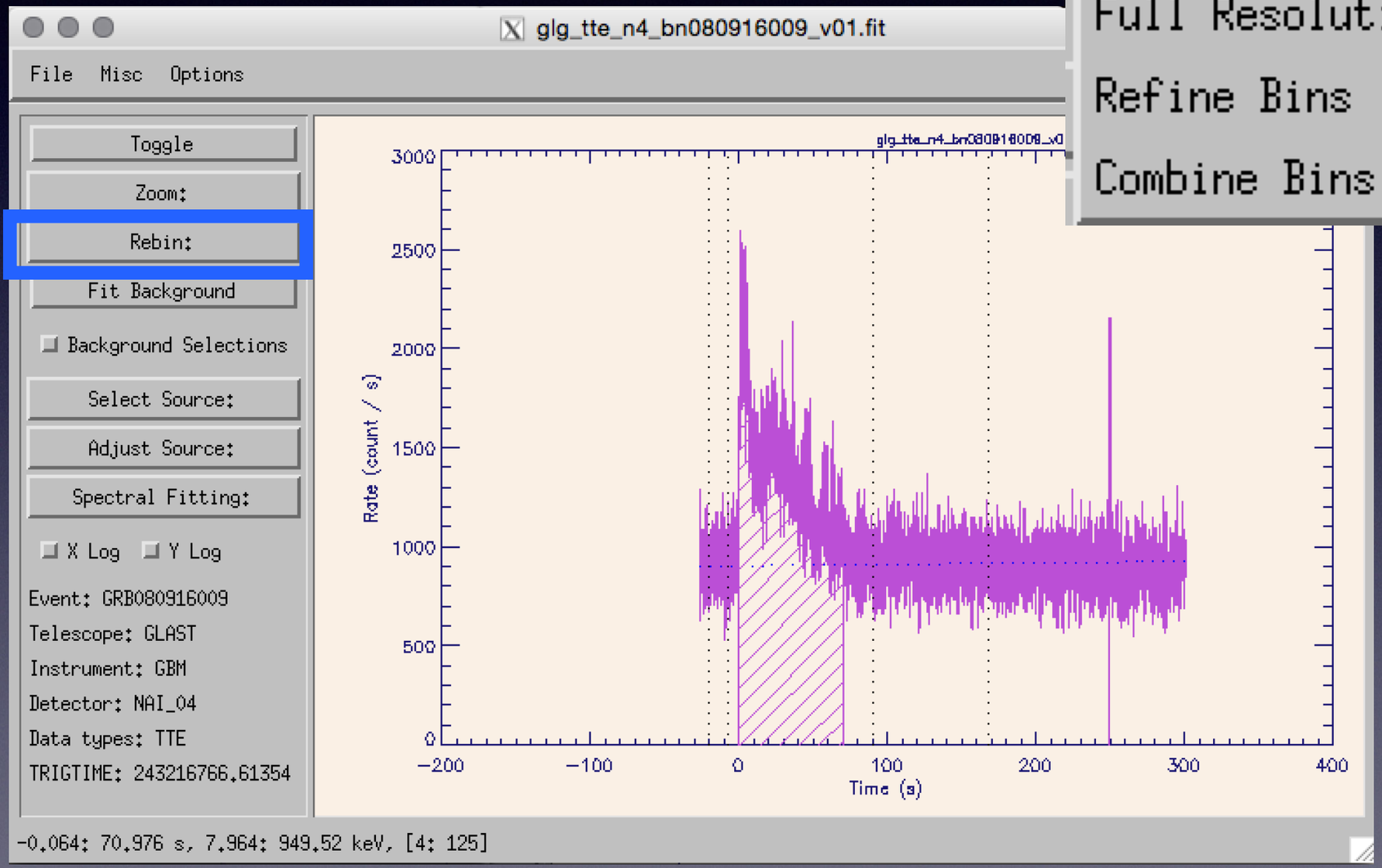
NaI: 8-900 keV
BGO: 250-38000 keV



Light curve display

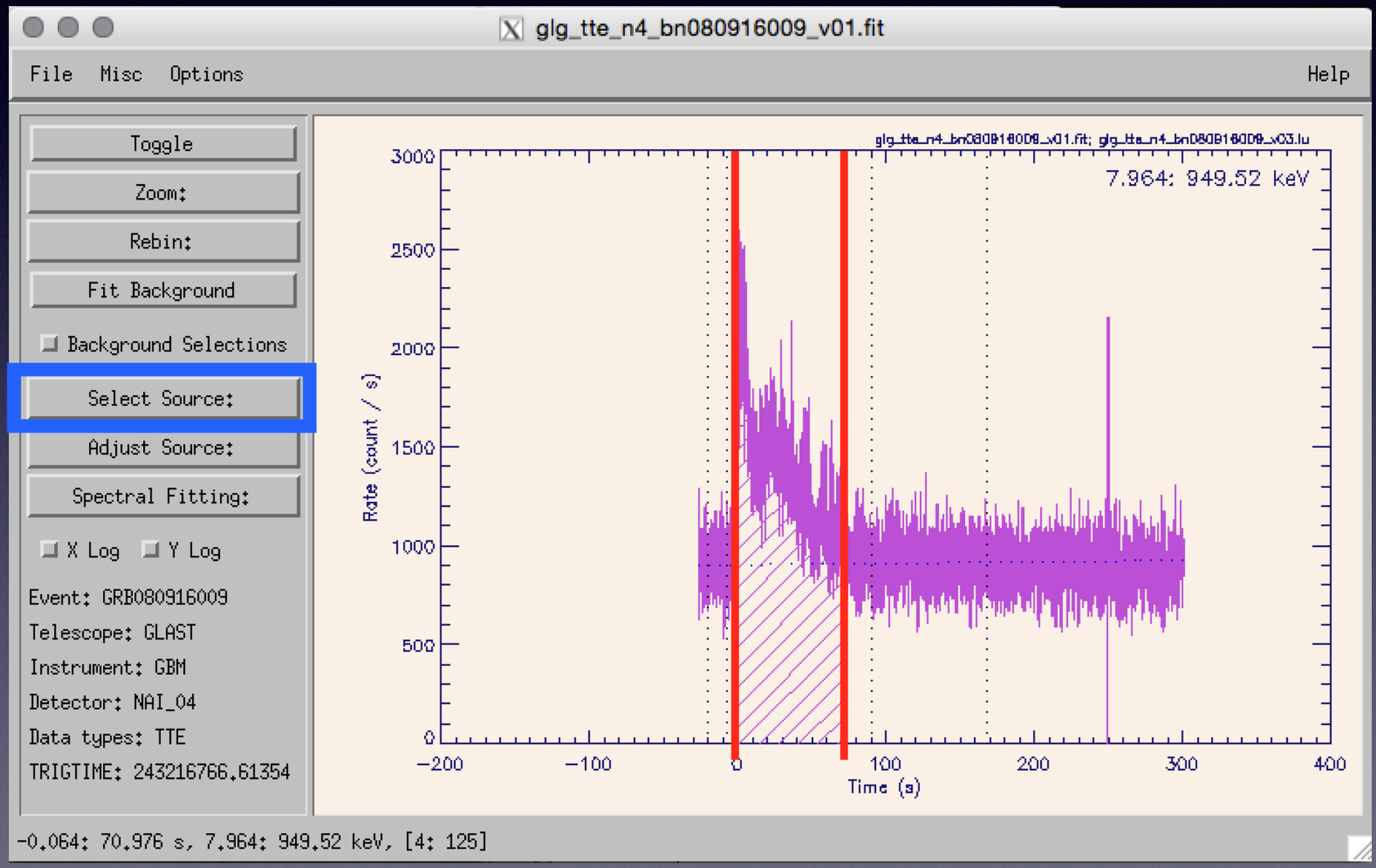
Binning

Choose the binning method you prefer. Custom binning methods must be made offline. We will discuss this later.



Source Selection

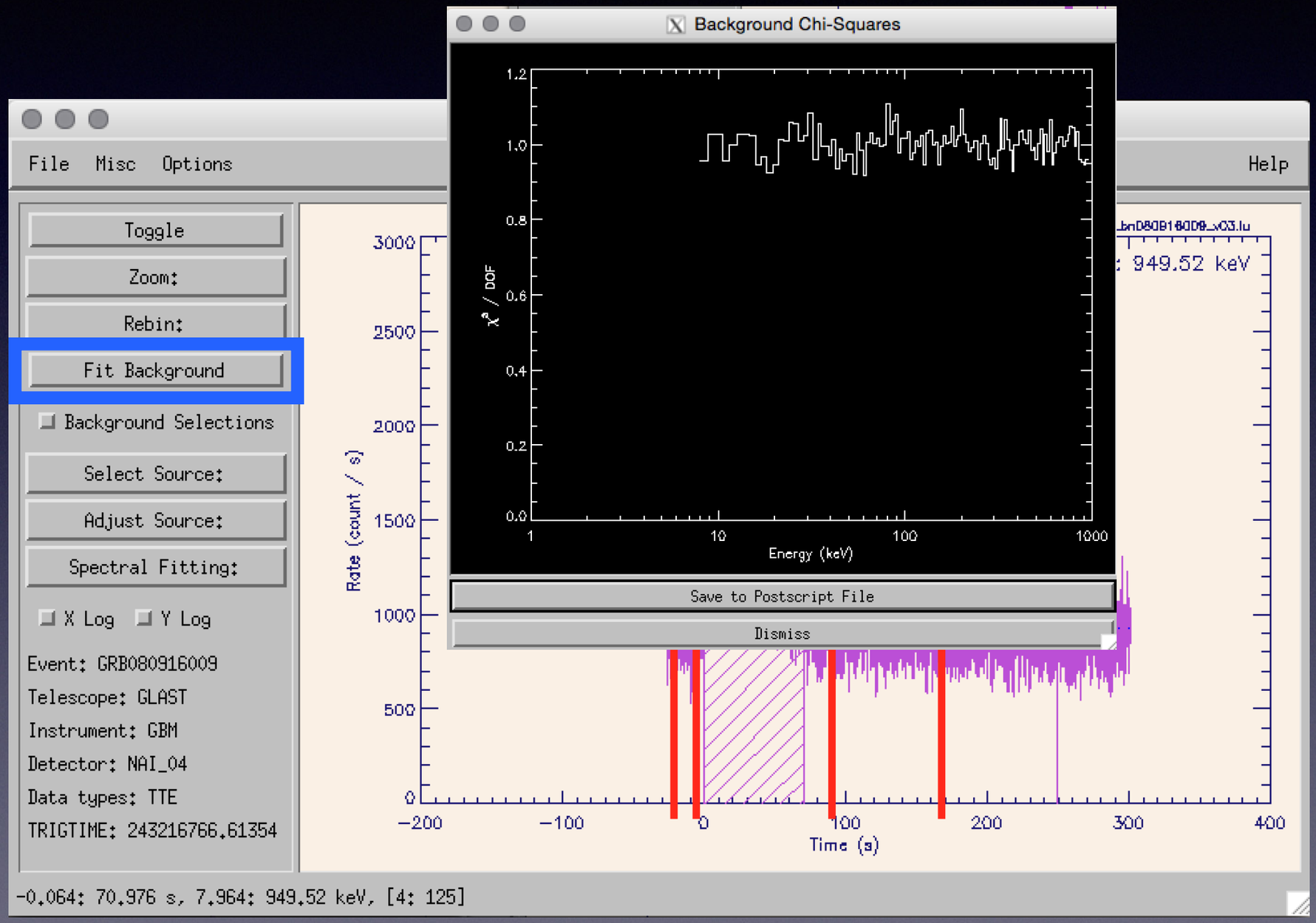
Hit the Select Source button or ‘i’ on the keyboard



Select the region(s) you would like to fit.

Background Fitting

We want as flat of a line around 1 as possible, however, it is often require to do a spectral fit and redo background until



Select multiple regions off source

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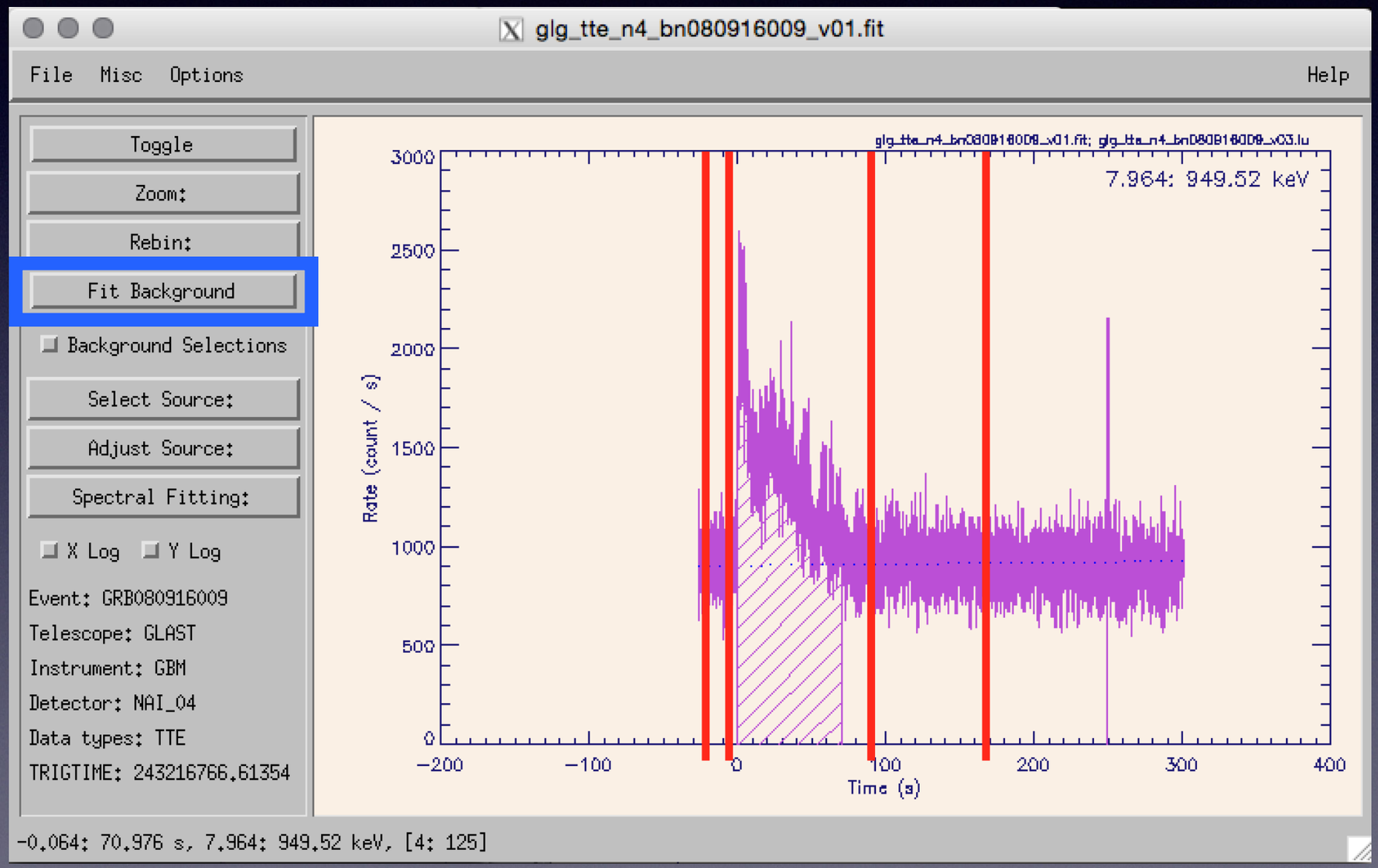
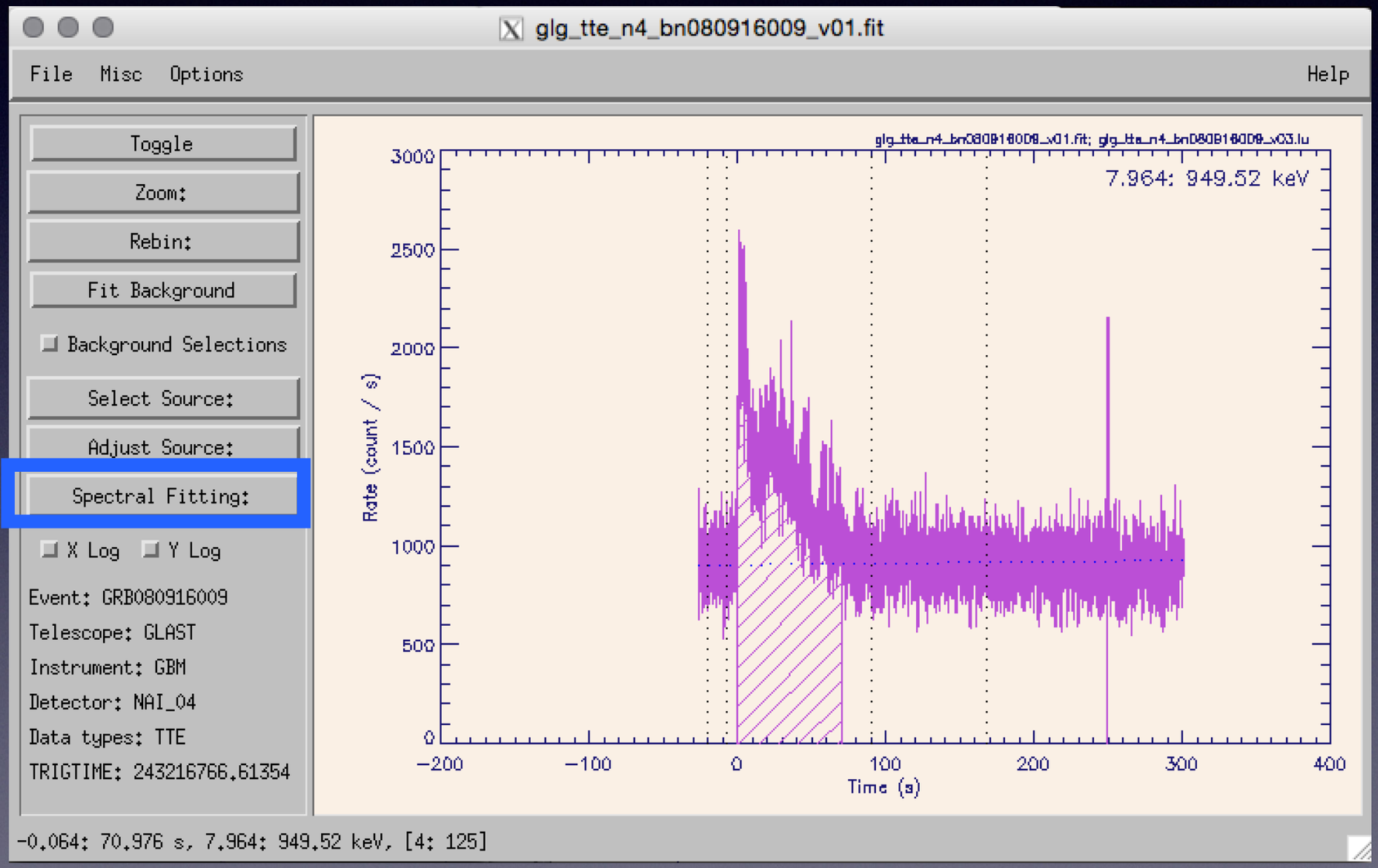
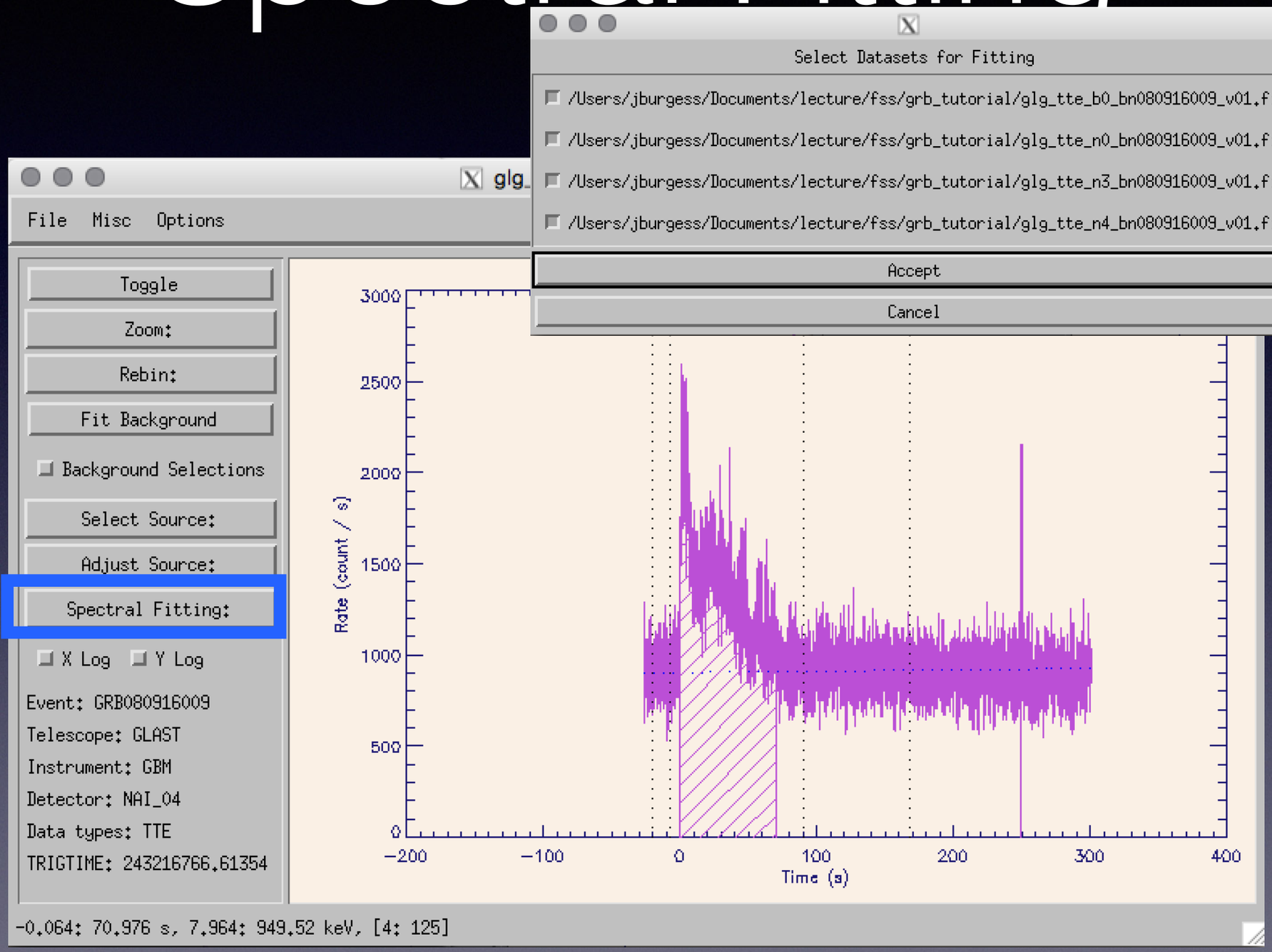


Select multiple regions off source

Spectral Fitting



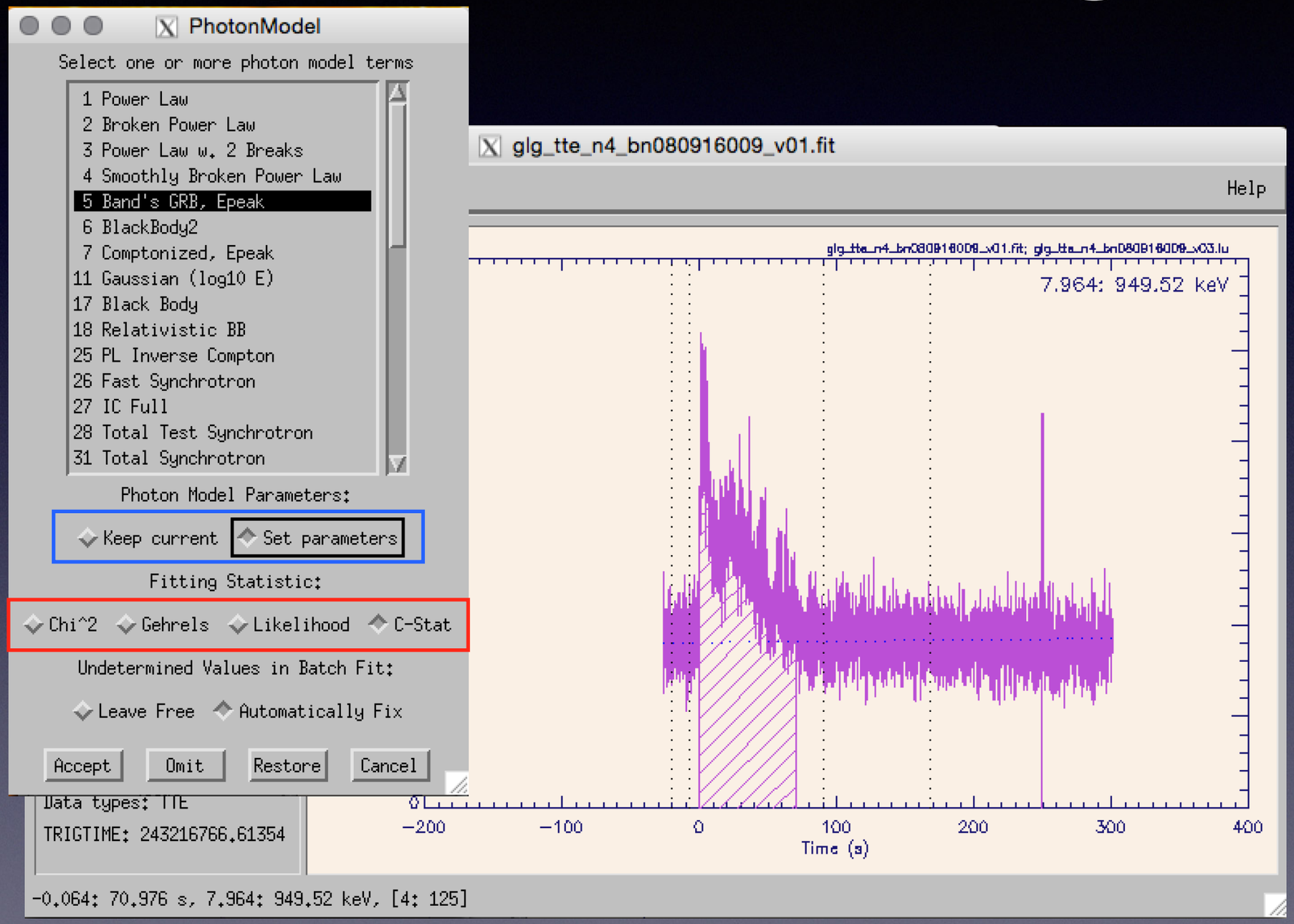
Spectral Fitting



Select or deselect the detectors you need. Deselecting detectors will show how “bad” a detector is by including it’s data in the plot.

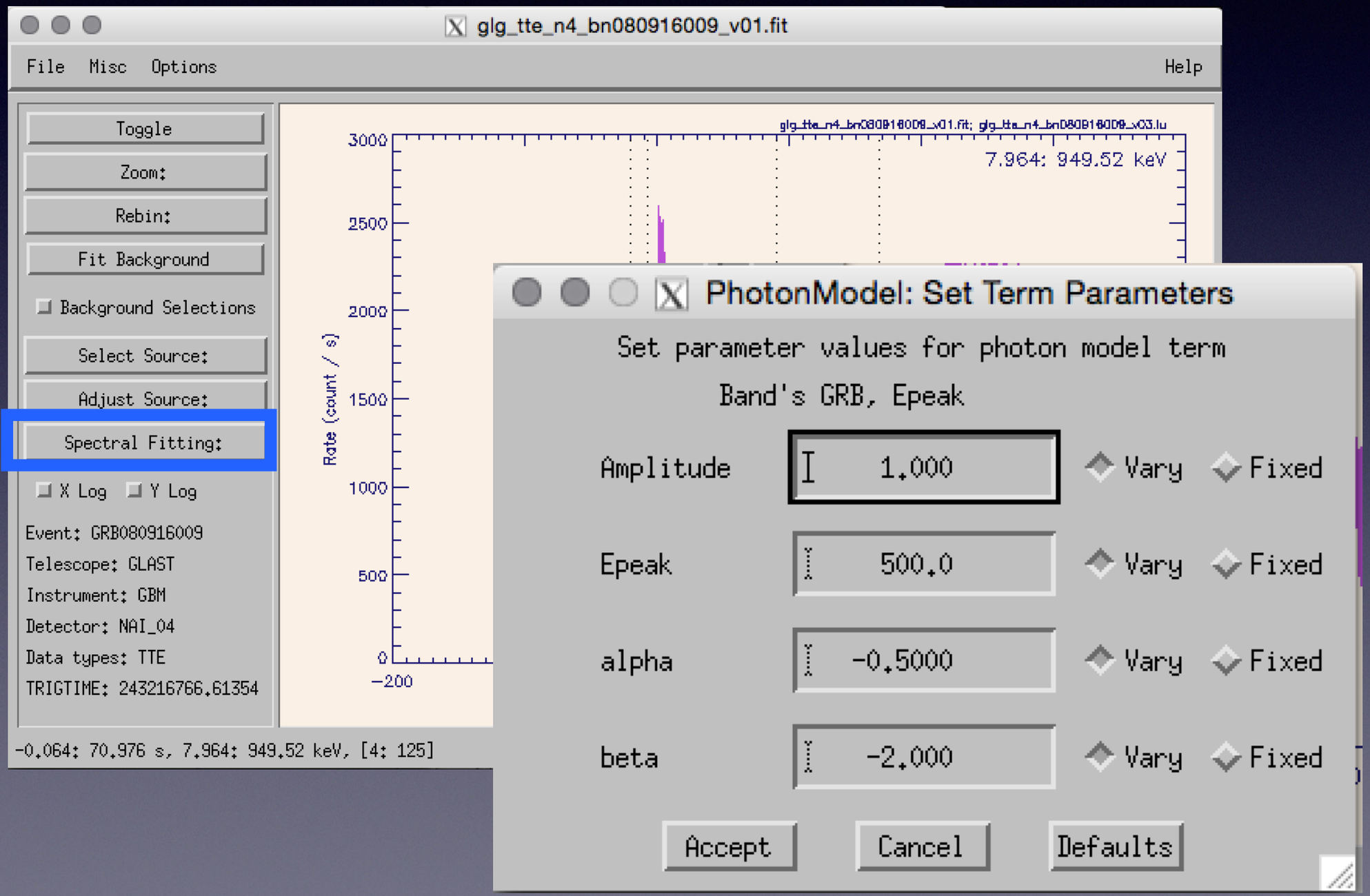
Spectral Fitting

Select your model or combination of models.



Unfortunately, the likelihoods in RMFIT are wrong…

Spectral Fitting



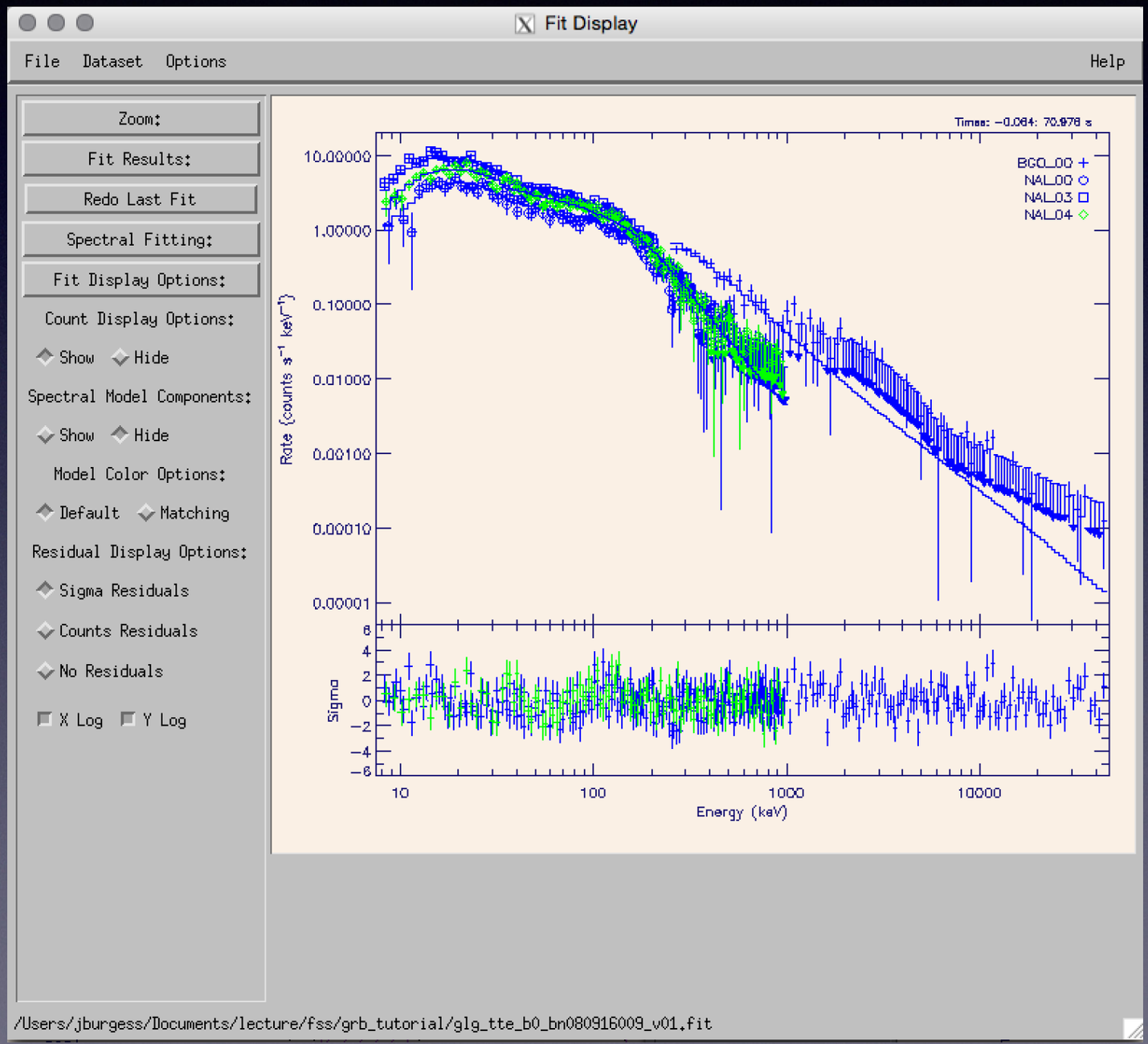
Spectral Fitting

Fit Log

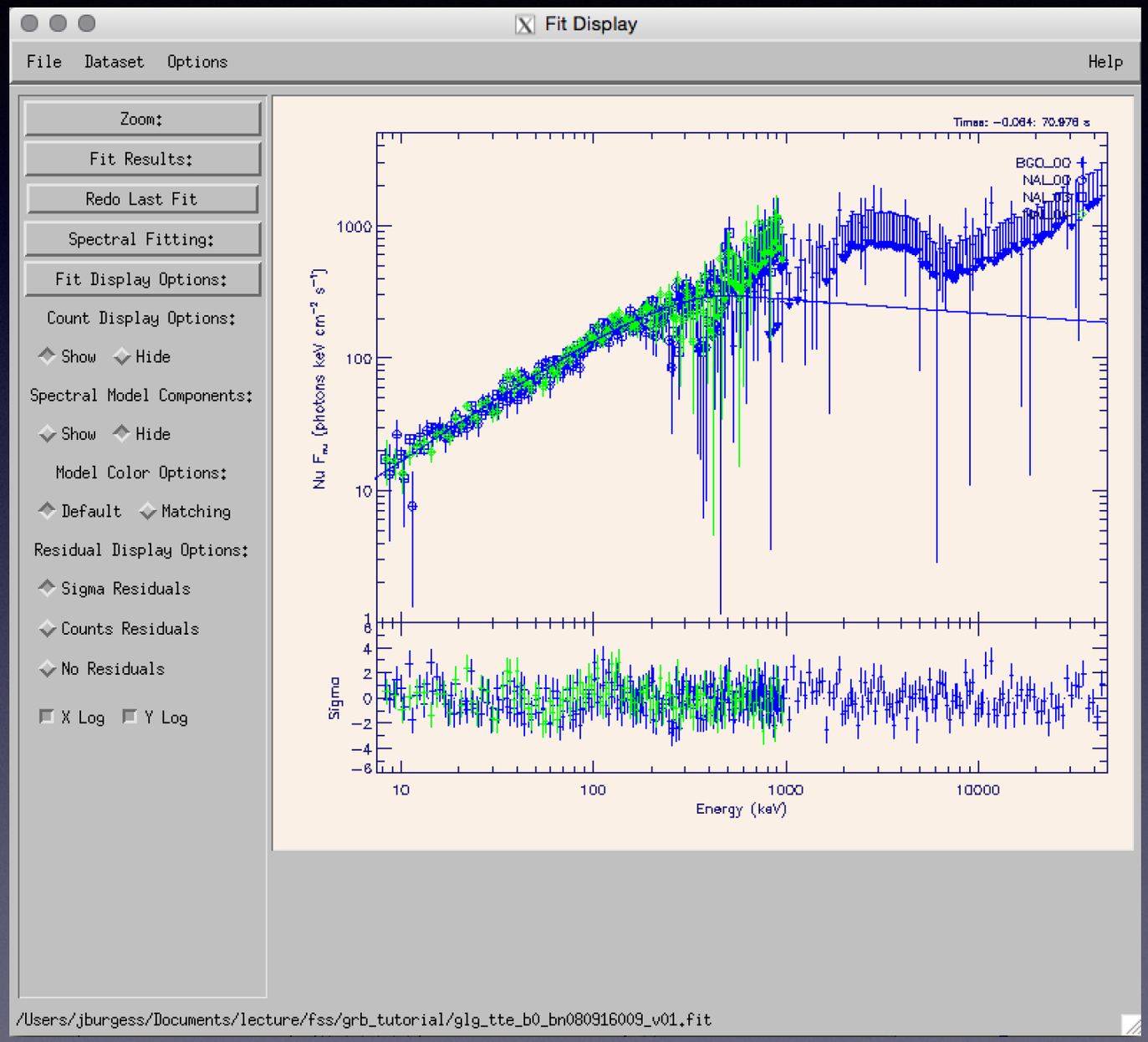
```
==> Dataset      : #3 INCLUDED
==> Data file    : /Users/jburgess/Documents/lecture/fss/grb_tutorial/glg_tte_n4_bn080916009_v01.fit
==> Response file: /Users/jburgess/Documents/lecture/fss/grb_tutorial/glg_cspec_n4_bn080916009_v07.r
==> Fit interval :  -0.064: 70.976 s,  8.036001: 974.7320 keV, channels  4: 125

==> Fitting data...
==> MFIT F95 v1.6 2011 May 16: Fit completed at Sat May 30 18:41:57 2015

TERM: Band's GRB, Epeak

       Amplitude    VARY      0.01622 +/-     0.000334 p/s-cm2-keV
       Epeak        VARY        501.9 +/-         28.1 keV
       alpha        VARY       -1.018 +/-       0.0151
       beta         VARY       -2.104 +/-       0.0615

==> Castor C-STAT = 1266.8, DOF = 488
==> Photon Flux = 5.4463 +/- 0.035 ph/s-cm^2 in the interval: 10.00: 1000.0 keV
==> Energy Flux = 1.1150E-06 +/- 1.4E-08 erg/s-cm^2 in the interval: 10.00: 1000.0 keV

  The Normed Covariance Matrix = Correlation Coefficient Matrix:
 1.000 -0.945  0.899  0.367
-0.945  1.000 -0.848 -0.502
 0.899 -0.848  1.000  0.294
 0.367 -0.502  0.294  1.000

  The global correlation coefficients of the varying parameters are:
 0.966  0.959  0.900  0.604
```

Clear Hide Save Table

Spectral Fitting

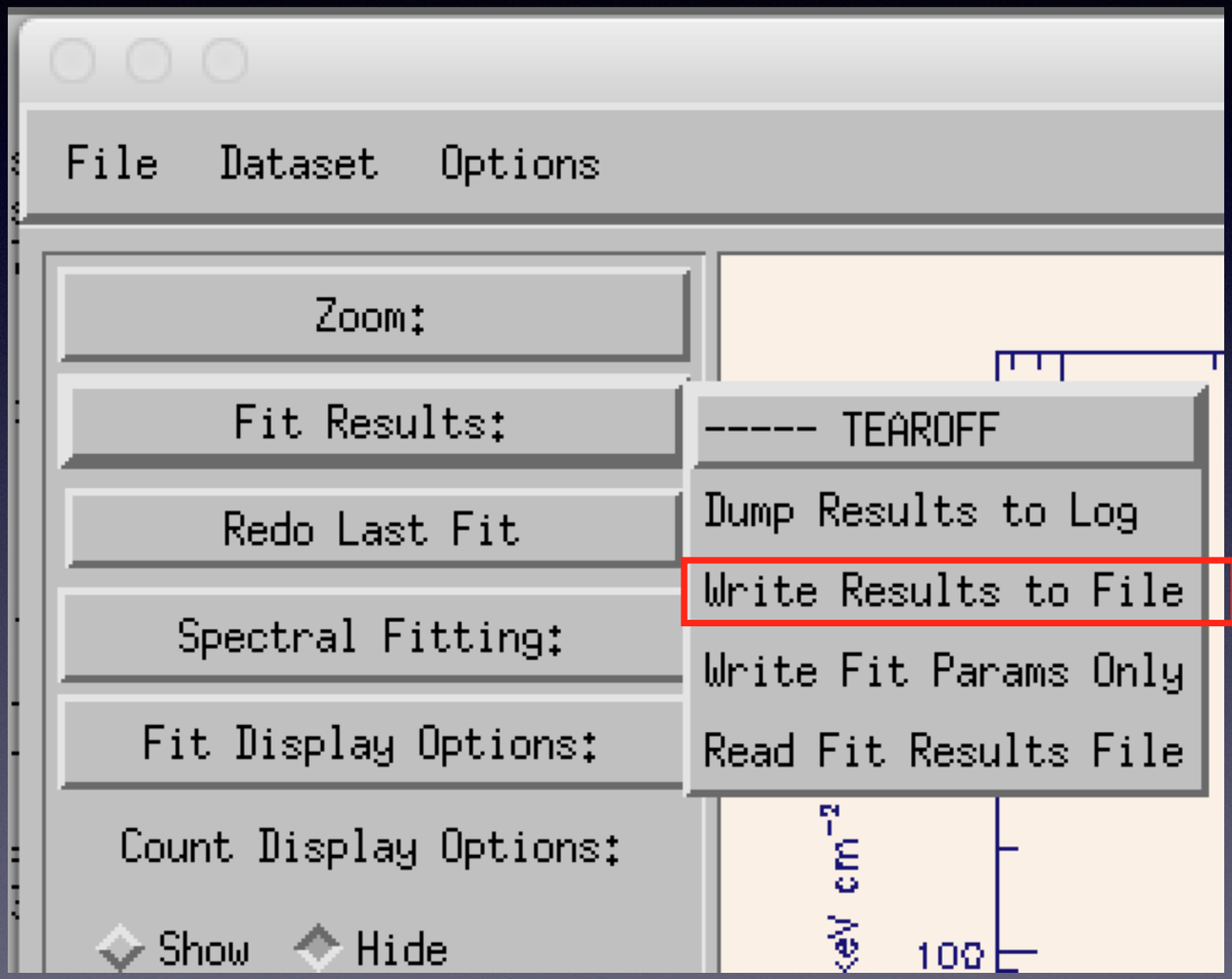


Spectral Fitting



Spectral Fitting

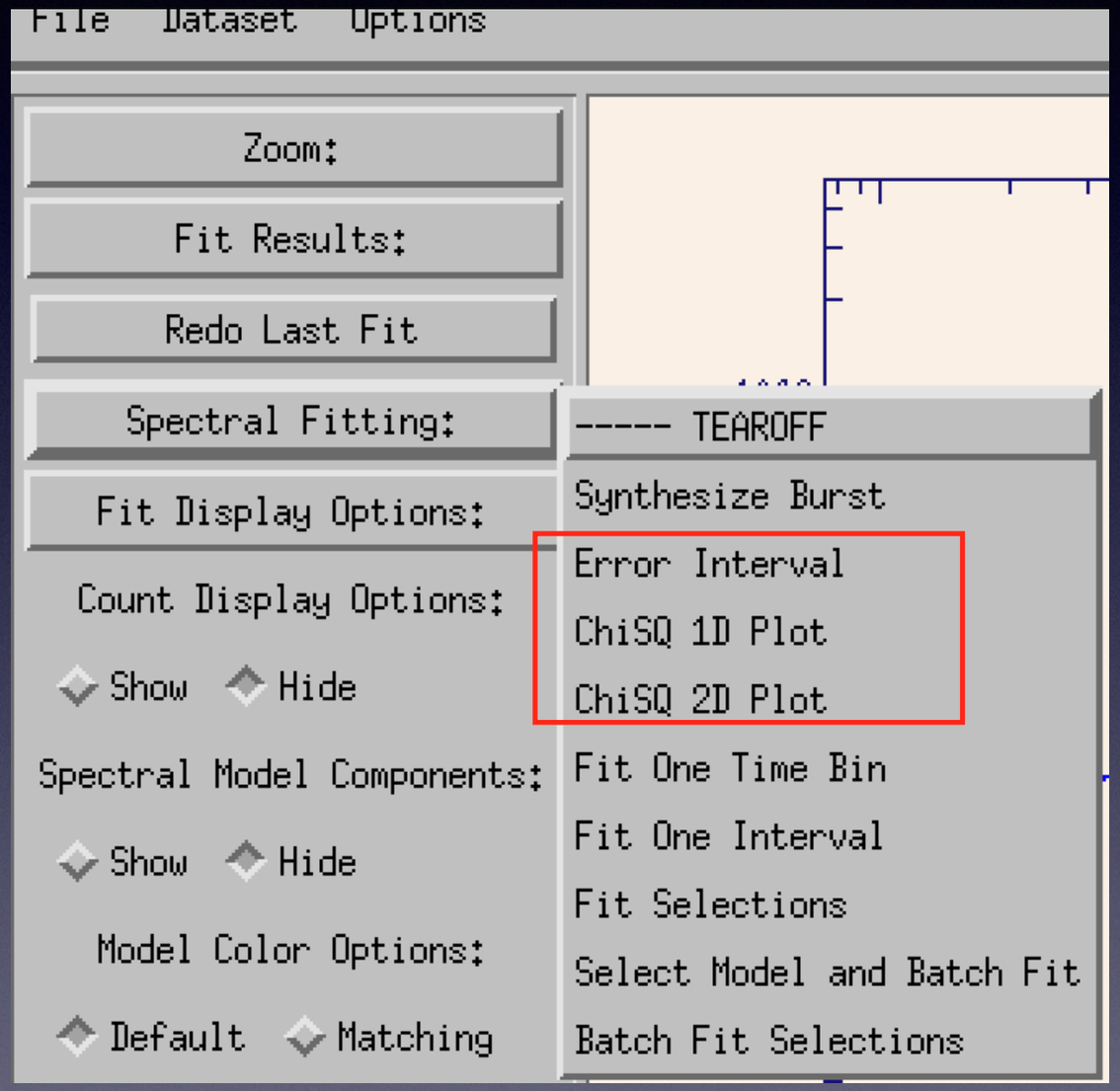
It is important to save the spectral fits to am SCAT file so that they can be used later



Error Analysis

The one sided errors are typically meaningless unless you have a very bright burst.

You must look at the “profile” errors. Note, these are not marginals so the correlation in the other parameters will be removed.



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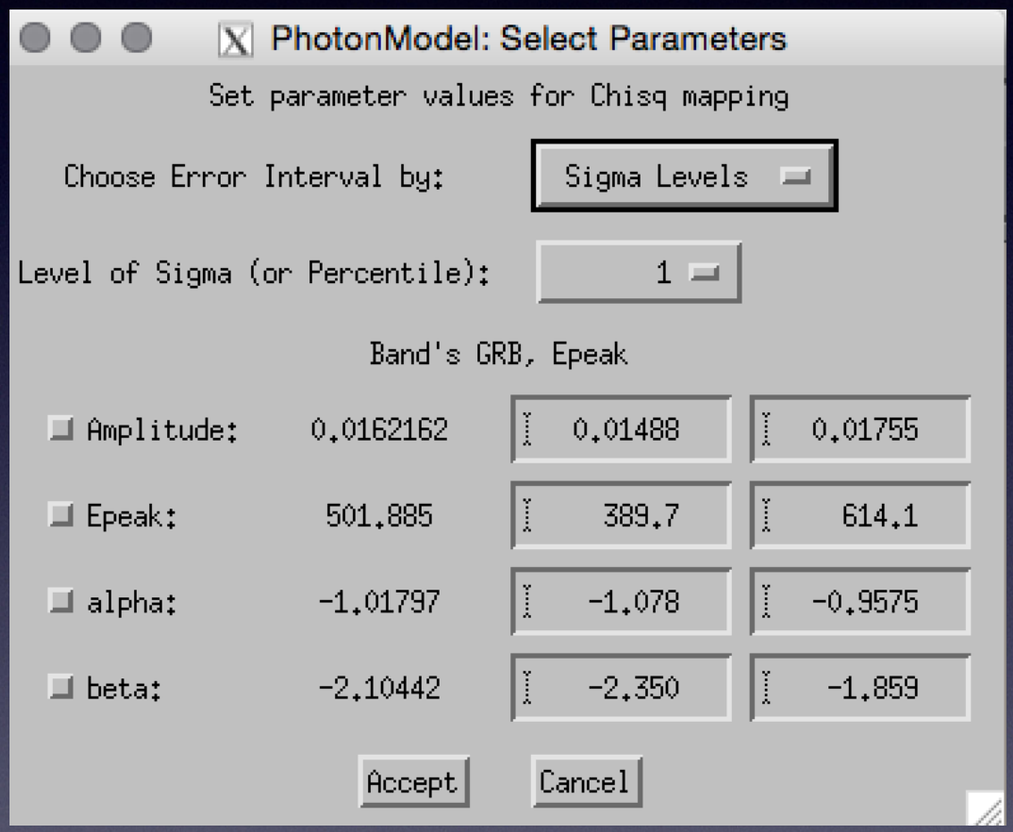

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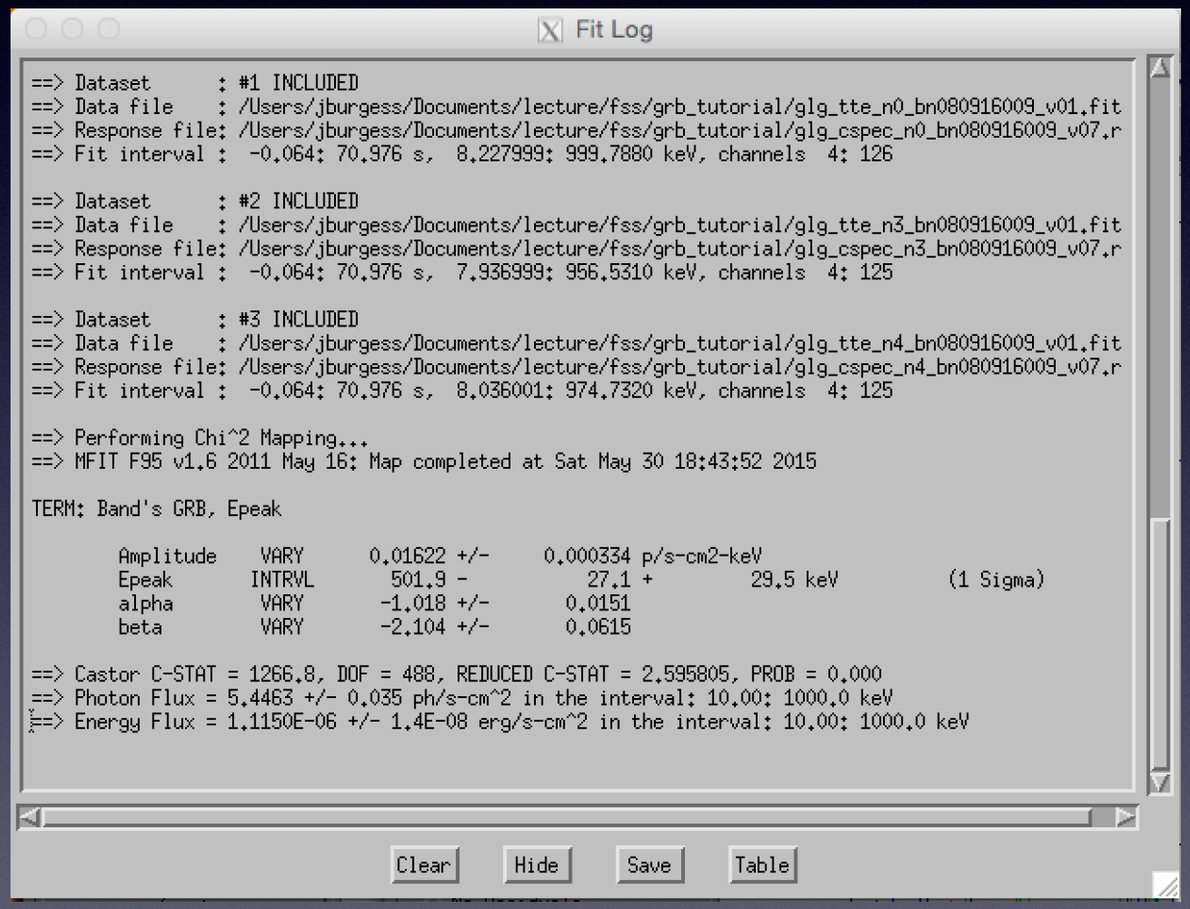

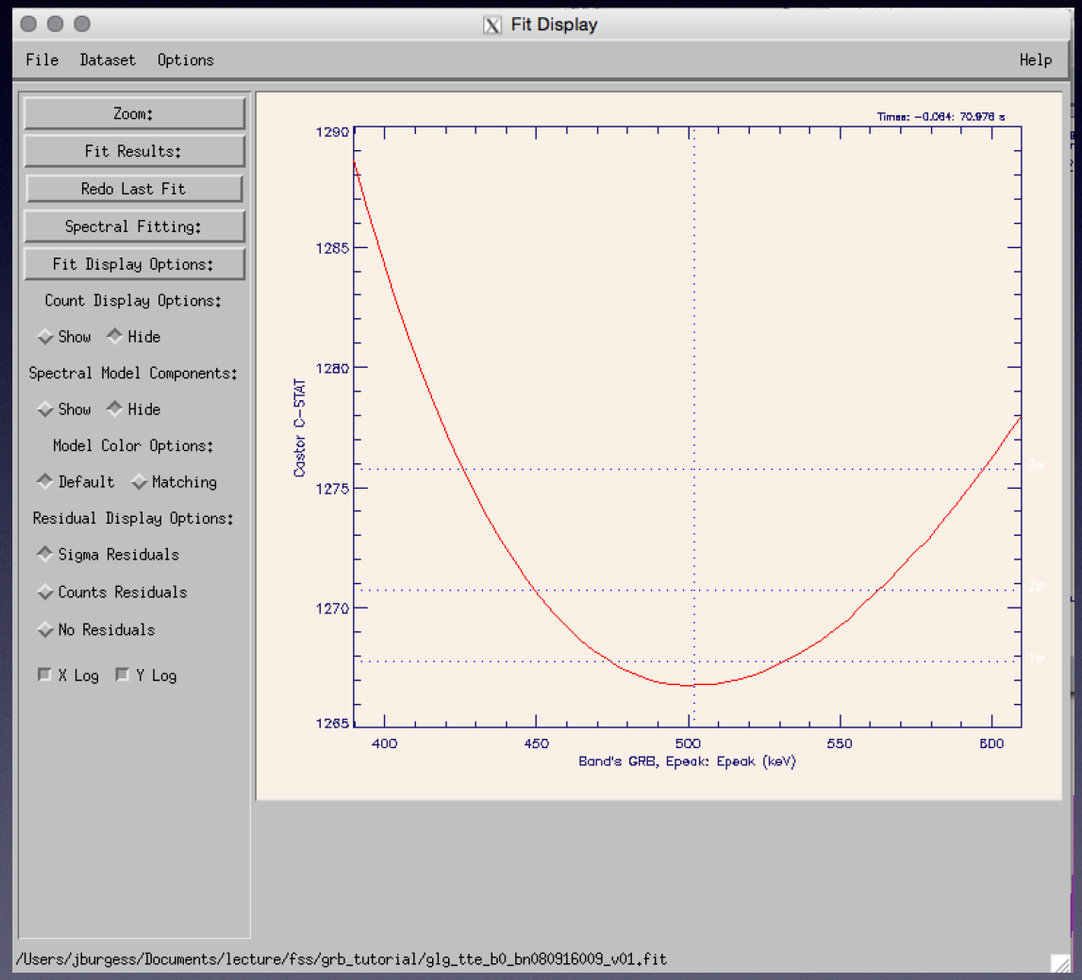

Post Analysis

- Write your own tools to explore the SCAT files.
- Use the included scatReader.py class as a template
- Remember that only symmetric errors can be propagated in classical statistics (Bayesian)

Things not discussed

- Bayesian Analysis
  - Allows for comparison of non-nested models
  - Not sensitive to starting parameters of fits

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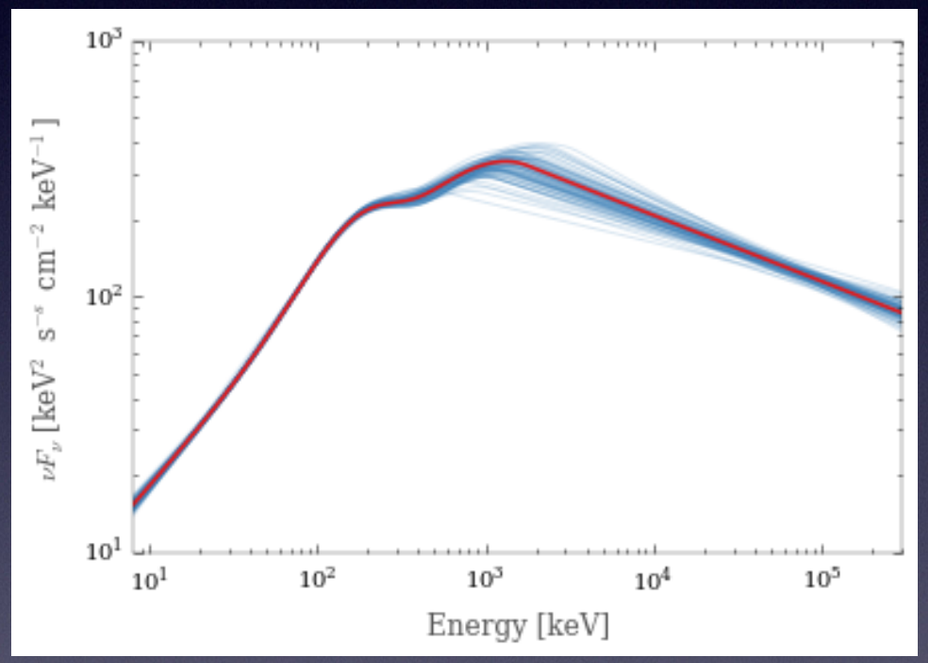
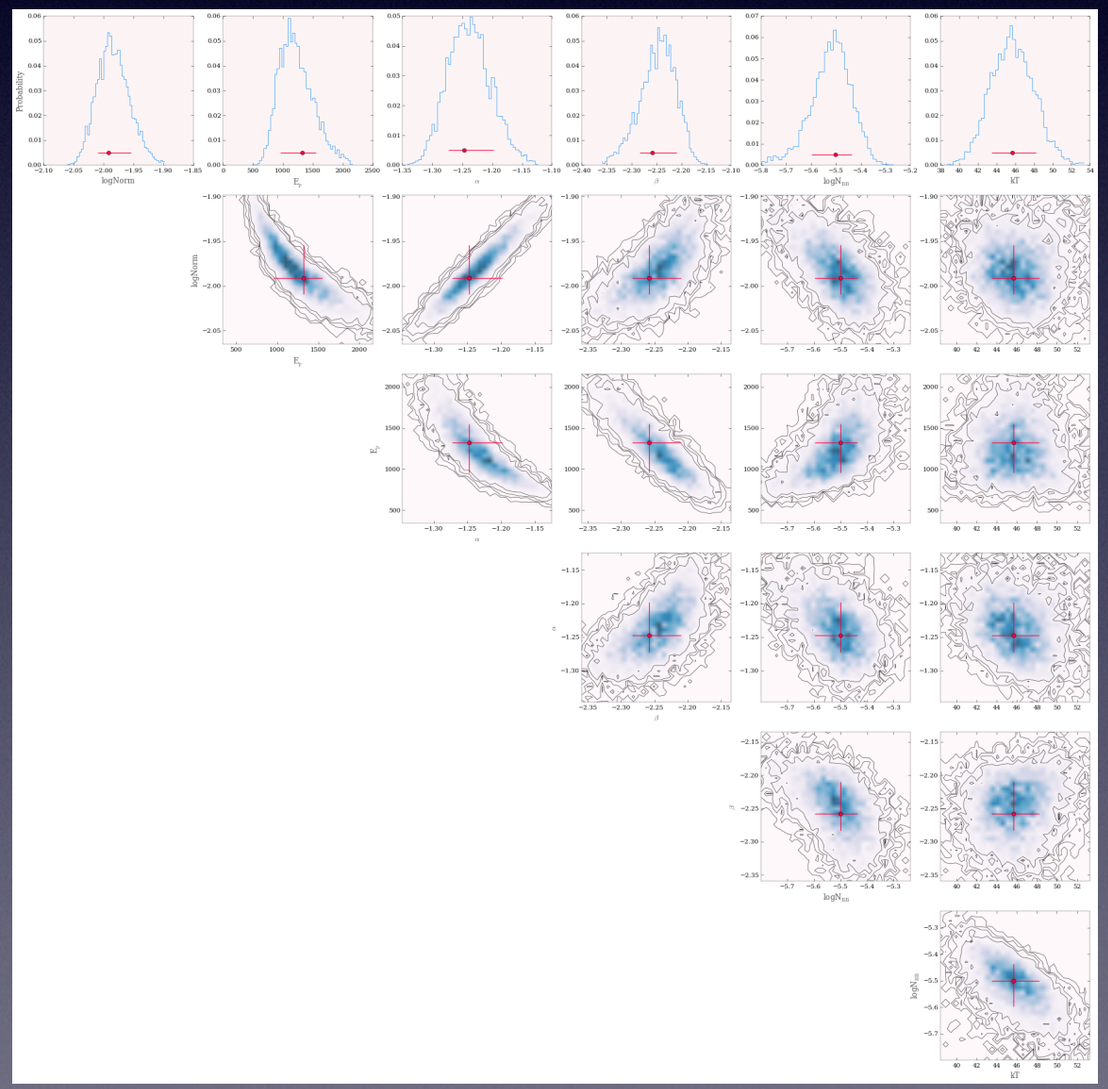
- Bayesian Analysis





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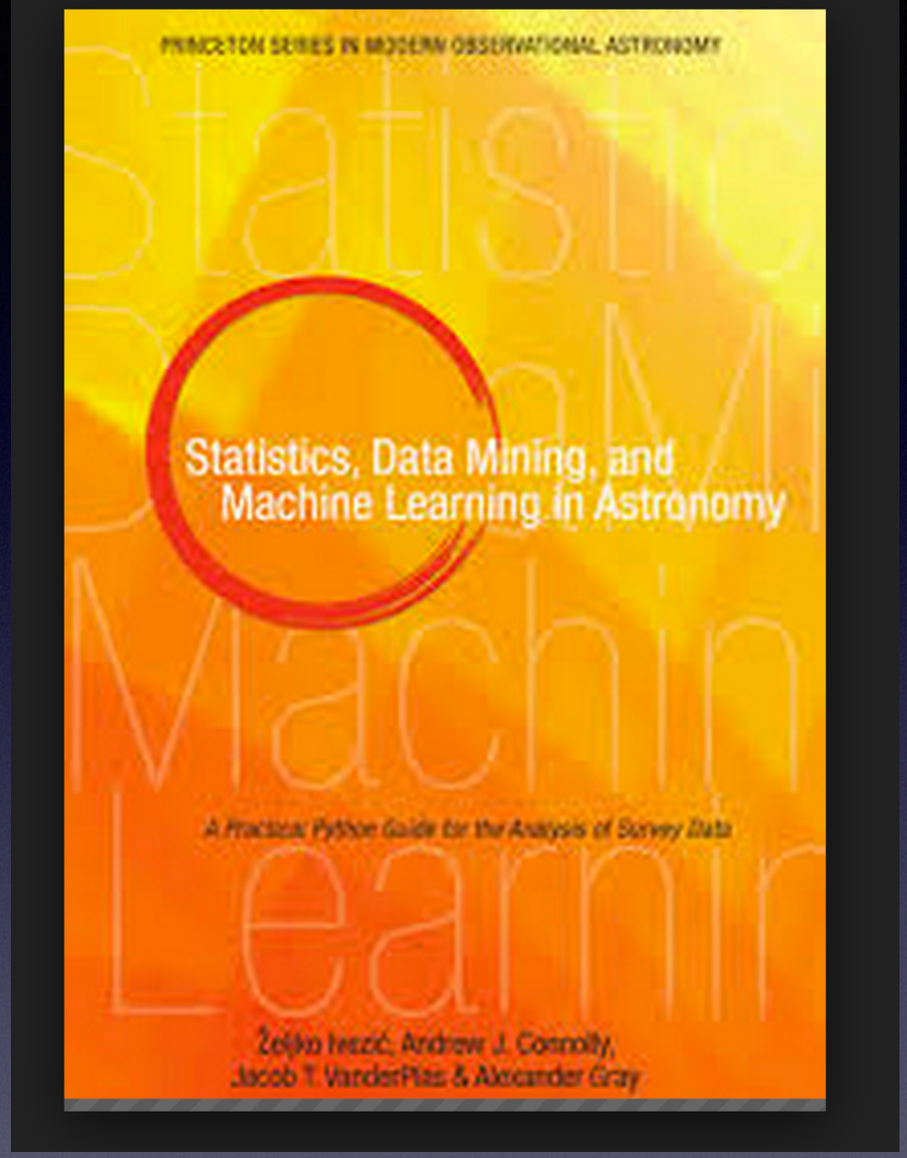
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