

# Example\_Reading\_Results

March 8, 2022

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[1]: import numpy as np
from astropy.io import fits
from astropy.table import Table, vstack
from astropy.wcs import WCS
import os
import time
import matplotlib.pyplot as plt
from matplotlib.colors import LogNorm
from matplotlib import cm
import pandas as pd
pd.options.display.max_columns = 250
pd.options.display.max_rows = 250
import healpy as hp
from copy import copy, deepcopy
import logging, traceback
import sys
#logging.basicConfig(stream=sys.stdout, level=logging.DEBUG)

[2]: # cd to code directory
%cd /Users/tparsota/Documents/BAT_SCRIPTS/NITRATES/NITRATES/

/Users/tparsota/Documents/BAT_SCRIPTS/NITRATES/NITRATES

[3]: from event2dpi_funcs import det2dpris, mask_detxy
from flux_models import Cutoff_Plaw_Flux, Plaw_Flux, get_eflux_from_model
from sqlite_funcs import get_conn
from dbread_funcs import get_info_tab
from do_manage2 import im_dist, get_rate_res_fnames, get_peak_res_fnames, \
    ↪get_out_res_fnames, \
        get_merged_csv_df, get_merged_csv_df_wpos
from hp_funcs import ang_sep
from coord_conv_funcs import theta_phi2imxy, imxy2theta_phi, \
    ↪convert_imxy2radec, \
        convert_radec2thetaphi, convert_radec2imxy
from do_llh_inFoV4realtime2 import parse_bkg_csv
from LLH import LLH_webins
from minimizers import NLLH_ScipyMinimize_Wjacob
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[4]: ebins0 = np.array([15.0, 24.0, 35.0, 48.0, 64.0])
      ebins0 = np.append(ebins0, np.logspace(np.log10(84.0), np.log10(500.0), 5+1))[:
      ↪-1]
      ebins0 = np.round(ebins0, decimals=1)[: -1]
      ebins1 = np.append(ebins0[1:], [350.0])
      nebins = len(ebins0)
      print("Number of ebins: ", nebins)

      # directory with results
      work_dir = '/Users/tparsota/Documents/BAT_SCRIPTS/NITRATES/NITRATES/F646018360/
      ↪' #'/storage/work/j/jjd330/local/bat_data/realtime_workdir/F646018360/'

      conn = get_conn(os.path.join(work_dir, 'results.db'))
      info_tab = get_info_tab(conn)
      # trigger time stored in results.db (sqlite DB)
      # not much else stored there (results used to be stored there but not anymore)
      trigger_time = info_tab['trigtimeMET'][0]
      print("trigger time: ", trigger_time)

      # default file names made by do_data_setup.py
      evfname = os.path.join(work_dir, 'filter_evdata.fits')
      ev_data = fits.open(evfname)[1].data
      # GTI extensions added to event fits file by do_data_setup.py
      GTI_PNT = Table.read(evfname, hdu='GTI_POINTING') # when the analysis can be
      ↪run (good data time and pointing)
      GTI_SLEW = Table.read(evfname, hdu='GTI_SLEW') # slewing times
      # the final set of detectors to mask (disabled dets, hot/cold dets, and dets
      ↪with glitches)
      dmask = fits.open(os.path.join(work_dir, 'detmask.fits'))[0].data
      attfile = fits.open(os.path.join(work_dir, 'attitude.fits'))[1].data

      # number of detectors being used
      ndets = np.sum(dmask==0)
      print "Ndets: ", np.sum(dmask==0)

      t_end = trigger_time + 1e3
      t_start = trigger_time - 1e3
      mask_vals = mask_detxy(dmask, ev_data)
      bl_dmask = (dmask==0.)

      # get rid of events:
      # far away from trigger time
      # from bad dets
      # with bad event flags
      bl_ev = (ev_data['EVENT_FLAGS']<1)&\
              (ev_data['ENERGY']<=500.)&(ev_data['ENERGY']>=14.)&\

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(mask_vals==0.)&(ev_data['TIME']<=t_end)&\
(ev_data['TIME']>=t_start)

print("Number of events passing cuts: ", np.sum(bl_ev))
ev_data0 = ev_data[bl_ev]

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('Number of ebins: ', 9)
('trigger time: ', 646018383.1787)
Ndets: 14932
('Number of events passing cuts: ', 1367885)

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[5]: print GTI_PNT
      print
      for row in GTI_PNT:
          print row['START'] - trigger_time, row['STOP'] - trigger_time

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      START          STOP
      s              s
-----
646018333.0 646018533.0953

-50.17869997024536 149.91659998893738

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[6]: bkg_fname = os.path.join(work_dir, 'bkg_estimation.csv')
      bkg_df = pd.read_csv(bkg_fname)

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[7]: bkg_df.head()

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[7]: 4U 1700-377_imx  4U 1700-377_imy  4U 1700-377_rate_0  4U 1700-377_rate_1  \
0      -0.098149      -0.474208          0.012283          0.006913
1      -0.098149      -0.474208          0.012347          0.006780
2      -0.098149      -0.474208          0.012429          0.006578
3      -0.098149      -0.474208          0.012180          0.007136
4      -0.098149      -0.474208          0.012154          0.007424

      4U 1700-377_rate_2  4U 1700-377_rate_3  4U 1700-377_rate_4  \
0          0.003712          0.001373          0.001463
1          0.003702          0.001231          0.001346
2          0.003800          0.001107          0.001207
3          0.004107          0.001041          0.001015
4          0.004079          0.000995          0.001283

      4U 1700-377_rate_5  4U 1700-377_rate_6  4U 1700-377_rate_7  \
0          0.001246          5.000000e-08          4.405373e-04
1          0.001129          5.000000e-08          1.926993e-04
2          0.001223          7.676589e-05          1.201284e-04
3          0.001170          1.520669e-04          5.000000e-08
4          0.001383          7.547491e-05          5.000000e-08

```

	4U 1700-377_rate_8	Background_bkg_rate_0	Background_bkg_rate_1	\
0	5.000000e-08	0.091252	0.066992	
1	5.000000e-08	0.091379	0.066867	
2	5.000000e-08	0.091715	0.066808	
3	5.000000e-08	0.091637	0.066603	
4	5.000000e-08	0.091601	0.066640	

	Background_bkg_rate_2	Background_bkg_rate_3	Background_bkg_rate_4	\
0	0.040157	0.040028	0.035199	
1	0.040137	0.040081	0.035169	
2	0.040104	0.040058	0.035117	
3	0.040075	0.040122	0.035168	
4	0.040147	0.040183	0.035179	

	Background_bkg_rate_5	Background_bkg_rate_6	Background_bkg_rate_7	\
0	0.035563	0.033557	0.025227	
1	0.035658	0.033654	0.025244	
2	0.035700	0.033540	0.025284	
3	0.035781	0.033512	0.025289	
4	0.035717	0.033533	0.025242	

	Background_bkg_rate_8	Background_flat_0	Background_flat_1	\
0	0.018104	0.0	0.0	
1	0.018061	0.0	0.0	
2	0.018039	0.0	0.0	
3	0.018023	0.0	0.0	
4	0.018054	0.0	0.0	

	Background_flat_2	Background_flat_3	Background_flat_4	Background_flat_5	\
0	0.185963	0.076634	0.302086	0.761151	
1	0.185963	0.076634	0.302086	0.761151	
2	0.185963	0.076634	0.302086	0.761151	
3	0.185963	0.076634	0.302086	0.761151	
4	0.185963	0.076634	0.302086	0.761151	

	Background_flat_6	Background_flat_7	Background_flat_8	GR0 J1655-40_imx	\
0	0.809143	1.0	1.0	-0.113416	
1	0.809143	1.0	1.0	-0.113416	
2	0.809143	1.0	1.0	-0.113416	
3	0.809143	1.0	1.0	-0.113416	
4	0.809143	1.0	1.0	-0.113416	

	GR0 J1655-40_imy	GR0 J1655-40_rate_0	GR0 J1655-40_rate_1	\
0	-0.535975	0.005951	0.001267	
1	-0.535975	0.005820	0.001430	
2	-0.535975	0.005816	0.001594	

3	-0.535975	0.006061	0.001409			
4	-0.535975	0.006266	0.001341			
	GR0 J1655-40_rate_2	GR0 J1655-40_rate_3	GR0 J1655-40_rate_4	\		
0	0.001034	0.002560	0.000482			
1	0.000759	0.002518	0.000663			
2	0.000743	0.002582	0.000534			
3	0.000713	0.002482	0.000623			
4	0.000779	0.002457	0.000404			
	GR0 J1655-40_rate_5	GR0 J1655-40_rate_6	GR0 J1655-40_rate_7	\		
0	5.810178e-04	0.001362	0.000960			
1	5.450543e-04	0.001158	0.000979			
2	2.236838e-04	0.001229	0.000992			
3	1.446681e-04	0.001357	0.000989			
4	5.000000e-08	0.001165	0.001027			
	GR0 J1655-40_rate_8	GX 339-4_imx	GX 339-4_imy	GX 339-4_rate_0	\	
0	5.000000e-08	0.008729	-0.694793	0.001315		
1	5.000000e-08	0.008729	-0.694793	0.001541		
2	5.000000e-08	0.008729	-0.694793	0.001466		
3	5.000000e-08	0.008729	-0.694793	0.001639		
4	5.000000e-08	0.008729	-0.694793	0.001054		
	GX 339-4_rate_1	GX 339-4_rate_2	GX 339-4_rate_3	GX 339-4_rate_4	\	
0	0.003580	0.002313	0.001110	0.001396		
1	0.003928	0.002525	0.001094	0.001409		
2	0.004626	0.002726	0.001433	0.001273		
3	0.004308	0.002802	0.001413	0.001128		
4	0.004296	0.002432	0.001725	0.001019		
	GX 339-4_rate_5	GX 339-4_rate_6	GX 339-4_rate_7	GX 339-4_rate_8	\	
0	0.002405	0.001058	0.001856	0.000440		
1	0.002327	0.001109	0.001880	0.000491		
2	0.002053	0.001404	0.001892	0.000466		
3	0.001979	0.001014	0.002041	0.000681		
4	0.001753	0.001182	0.001861	0.000581		
	Sco X-1_imx	Sco X-1_imy	Sco X-1_rate_0	Sco X-1_rate_1	Sco X-1_rate_2	\
0	-0.480179	-0.200157	0.050901	0.005911	0.000726	
1	-0.480179	-0.200157	0.050764	0.005968	0.000776	
2	-0.480179	-0.200157	0.050114	0.006215	0.000897	
3	-0.480179	-0.200157	0.050125	0.006322	0.000705	
4	-0.480179	-0.200157	0.050201	0.005968	0.000689	
	Sco X-1_rate_3	Sco X-1_rate_4	Sco X-1_rate_5	Sco X-1_rate_6	\	
0	5.000000e-08	0.000153	5.000000e-08	5.000000e-08		

1	5.000000e-08	0.000095	5.000000e-08	5.000000e-08
2	5.000000e-08	0.000230	5.000000e-08	5.000000e-08
3	5.000000e-08	0.000190	5.000000e-08	5.000000e-08
4	5.000000e-08	0.000099	5.000000e-08	5.000000e-08

	Sco X-1_rate_7	Sco X-1_rate_8 \
0	5.000000e-08	5.000000e-08
1	5.000000e-08	5.000000e-08
2	5.000000e-08	5.000000e-08
3	5.000000e-08	5.000000e-08
4	5.000000e-08	5.000000e-08

	corr_4U 1700-377_rate_0_GRO J1655-40_rate_0 \
0	-0.307400
1	-0.306465
2	-0.306480
3	-0.306448
4	-0.305521

	corr_4U 1700-377_rate_0_GX 339-4_rate_0 \
0	-0.157821
1	-0.158010
2	-0.157311
3	-0.157688
4	-0.157040

	corr_4U 1700-377_rate_1_GRO J1655-40_rate_1 \
0	-0.305291
1	-0.304834
2	-0.305492
3	-0.306694
4	-0.306484

	corr_4U 1700-377_rate_1_GX 339-4_rate_1 \
0	-0.156358
1	-0.156392
2	-0.156634
3	-0.156276
4	-0.157106

	corr_4U 1700-377_rate_2_GRO J1655-40_rate_2 \
0	-0.308877
1	-0.309741
2	-0.310756
3	-0.308068
4	-0.306766

```
corr_4U 1700-377_rate_2_GX 339-4_rate_2 \
0 -0.155719
1 -0.157482
2 -0.157231
3 -0.157145
4 -0.155967
```

```
corr_4U 1700-377_rate_3_GRO J1655-40_rate_3 \
0 -0.295721
1 -0.295932
2 -0.294252
3 -0.294994
4 -0.294322
```

```
corr_4U 1700-377_rate_3_GX 339-4_rate_3 \
0 -0.167028
1 -0.167068
2 -0.166494
3 -0.165264
4 -0.164455
```

```
corr_4U 1700-377_rate_4_GRO J1655-40_rate_4 \
0 -0.285878
1 -0.286307
2 -0.286683
3 -0.286064
4 -0.286773
```

```
corr_4U 1700-377_rate_4_GX 339-4_rate_4 \
0 -0.166209
1 -0.167772
2 -0.166858
3 -0.167757
4 -0.167261
```

```
corr_4U 1700-377_rate_5_GRO J1655-40_rate_5 \
0 -0.306634
1 -0.307173
2 -0.306579
3 -0.306509
4 -0.309981
```

```
corr_4U 1700-377_rate_5_GX 339-4_rate_5 \
0 -0.156080
1 -0.158629
2 -0.158157
3 -0.156749
```

4	-0.156018
corr_4U 1700-377_rate_6_GRO J1655-40_rate_6 \	
0	-0.282360
1	-0.281759
2	-0.283375
3	-0.282886
4	-0.284688
corr_4U 1700-377_rate_6_GX 339-4_rate_6 \	
0	-0.158684
1	-0.158478
2	-0.157846
3	-0.157402
4	-0.156748
corr_4U 1700-377_rate_7_GRO J1655-40_rate_7 \	
0	-0.294169
1	-0.297439
2	-0.298370
3	-0.302226
4	-0.302023
corr_4U 1700-377_rate_7_GX 339-4_rate_7 \	
0	-0.158156
1	-0.157836
2	-0.154133
3	-0.154498
4	-0.154595
corr_4U 1700-377_rate_8_GRO J1655-40_rate_8 \	
0	-0.301966
1	-0.301246
2	-0.302546
3	-0.302445
4	-0.301675
corr_4U 1700-377_rate_8_GX 339-4_rate_8 \	
0	-0.153359
1	-0.155041
2	-0.157091
3	-0.156757
4	-0.154922
corr_Background_bkg_rate_0_4U 1700-377_rate_0 \	
0	-0.269181
1	-0.269462



2	-0.269688
3	-0.269547
4	-0.269840
corr_Background_bkg_rate_0_GRO J1655-40_rate_0 \	
0	-0.175101
1	-0.175559
2	-0.175237
3	-0.175795
4	-0.174972
corr_Background_bkg_rate_0_GX 339-4_rate_0 \	
0	-0.081679
1	-0.081116
2	-0.080897
3	-0.080770
4	-0.081785
corr_Background_bkg_rate_0_Sco X-1_rate_0 \	
0	-0.517906
1	-0.518001
2	-0.518716
3	-0.518699
4	-0.518268
corr_Background_bkg_rate_1_4U 1700-377_rate_1 \	
0	-0.259445
1	-0.259981
2	-0.259270
3	-0.258758
4	-0.258410
corr_Background_bkg_rate_1_GRO J1655-40_rate_1 \	
0	-0.178472
1	-0.177888
2	-0.178106
3	-0.178473
4	-0.179505
corr_Background_bkg_rate_1_GX 339-4_rate_1 \	
0	-0.079952
1	-0.080178
2	-0.079329
3	-0.079368
4	-0.079406
corr_Background_bkg_rate_1_Sco X-1_rate_1 \	

0	-0.558391
1	-0.558385
2	-0.557598
3	-0.558076
4	-0.559285
corr_Background_bkg_rate_2_4U 1700-377_rate_2 \	
0	-0.262969
1	-0.262930
2	-0.262459
3	-0.261467
4	-0.261759
corr_Background_bkg_rate_2_GRO J1655-40_rate_2 \	
0	-0.172946
1	-0.174257
2	-0.173499
3	-0.174649
4	-0.174622
corr_Background_bkg_rate_2_GX 339-4_rate_2 \	
0	-0.082878
1	-0.081694
2	-0.082309
3	-0.081731
4	-0.082329
corr_Background_bkg_rate_2_Sco X-1_rate_2 \	
0	-0.570545
1	-0.570749
2	-0.570348
3	-0.570348
4	-0.569753
corr_Background_bkg_rate_3_4U 1700-377_rate_3 \	
0	-0.262986
1	-0.264231
2	-0.265669
3	-0.265968
4	-0.266352
corr_Background_bkg_rate_3_GRO J1655-40_rate_3 \	
0	-0.181972
1	-0.181767
2	-0.181737
3	-0.181520
4	-0.181038

	corr_Background_bkg_rate_3_GX 339-4_rate_3 \
0	-0.079831
1	-0.079405
2	-0.078773
3	-0.078689
4	-0.079885
	corr_Background_bkg_rate_3_Sco X-1_rate_3 \
0	-0.565326
1	-0.565425
2	-0.565593
3	-0.565872
4	-0.566133
	corr_Background_bkg_rate_4_4U 1700-377_rate_4 \
0	-0.269010
1	-0.268953
2	-0.269247
3	-0.269465
4	-0.268539
	corr_Background_bkg_rate_4_GRO J1655-40_rate_4 \
0	-0.176318
1	-0.174185
2	-0.174381
3	-0.174005
4	-0.175225
	corr_Background_bkg_rate_4_GX 339-4_rate_4 \
0	-0.082854
1	-0.082730
2	-0.082378
3	-0.082435
4	-0.080756
	corr_Background_bkg_rate_4_Sco X-1_rate_4 \
0	-0.565746
1	-0.565537
2	-0.564553
3	-0.564511
4	-0.564209
	corr_Background_bkg_rate_5_4U 1700-377_rate_5 \
0	-0.258306
1	-0.257487
2	-0.258526

3	-0.260547
4	-0.259736
corr_Background_bkg_rate_5_GRO J1655-40_rate_5 \	
0	-0.177077
1	-0.177816
2	-0.178547
3	-0.176912
4	-0.177045
corr_Background_bkg_rate_5_GX 339-4_rate_5 \	
0	-0.083484
1	-0.082604
2	-0.081883
3	-0.081368
4	-0.081605
corr_Background_bkg_rate_5_Sco X-1_rate_5 \	
0	-0.564370
1	-0.565327
2	-0.565846
3	-0.564826
4	-0.565115
corr_Background_bkg_rate_6_4U 1700-377_rate_6 \	
0	-0.268479
1	-0.268641
2	-0.268727
3	-0.269437
4	-0.269567
corr_Background_bkg_rate_6_GRO J1655-40_rate_6 \	
0	-0.177517
1	-0.177049
2	-0.175878
3	-0.176505
4	-0.175474
corr_Background_bkg_rate_6_GX 339-4_rate_6 \	
0	-0.085036
1	-0.086423
2	-0.086075
3	-0.087458
4	-0.089064
corr_Background_bkg_rate_6_Sco X-1_rate_6 \	
0	-0.558384

1	-0.558006
2	-0.559615
3	-0.558729
4	-0.558900
corr_Background_bkg_rate_7_4U 1700-377_rate_7 \	
0	-0.258486
1	-0.259436
2	-0.260824
3	-0.259727
4	-0.260532
corr_Background_bkg_rate_7_GRO J1655-40_rate_7 \	
0	-0.173624
1	-0.171754
2	-0.172574
3	-0.170856
4	-0.170590
corr_Background_bkg_rate_7_GX 339-4_rate_7 \	
0	-0.085728
1	-0.085669
2	-0.086243
3	-0.086962
4	-0.086488
corr_Background_bkg_rate_7_Sco X-1_rate_7 \	
0	-0.554043
1	-0.553946
2	-0.553877
3	-0.554847
4	-0.554753
corr_Background_bkg_rate_8_4U 1700-377_rate_8 \	
0	-0.258227
1	-0.259348
2	-0.259106
3	-0.262023
4	-0.262988
corr_Background_bkg_rate_8_GRO J1655-40_rate_8 \	
0	-0.171413
1	-0.171338
2	-0.173254
3	-0.171913
4	-0.171898

```
corr_Background_bkg_rate_8_GX 339-4_rate_8 \
0 -0.093856
1 -0.094018
2 -0.093755
3 -0.091884
4 -0.090964
```

```
corr_Background_bkg_rate_8_Sco X-1_rate_8 \
0 -0.549823
1 -0.551218
2 -0.551217
3 -0.550599
4 -0.549263
```

```
corr_GRO J1655-40_rate_0_GX 339-4_rate_0 \
0 -0.286884
1 -0.287483
2 -0.287878
3 -0.286517
4 -0.287618
```

```
corr_GRO J1655-40_rate_1_GX 339-4_rate_1 \
0 -0.278956
1 -0.279682
2 -0.278866
3 -0.279048
4 -0.278083
```

```
corr_GRO J1655-40_rate_2_GX 339-4_rate_2 \
0 -0.283080
1 -0.280583
2 -0.280174
3 -0.280831
4 -0.282292
```

```
corr_GRO J1655-40_rate_3_GX 339-4_rate_3 \
0 -0.281136
1 -0.280958
2 -0.279262
3 -0.279563
4 -0.279371
```

```
corr_GRO J1655-40_rate_4_GX 339-4_rate_4 \
0 -0.284086
1 -0.284283
2 -0.283980
3 -0.284438
```

4		-0.283810
	corr_GRO J1655-40_rate_5_GX 339-4_rate_5 \	
0		-0.283279
1		-0.280571
2		-0.283016
3		-0.283527
4		-0.282526
	corr_GRO J1655-40_rate_6_GX 339-4_rate_6 \	
0		-0.283494
1		-0.285443
2		-0.287743
3		-0.288653
4		-0.286779
	corr_GRO J1655-40_rate_7_GX 339-4_rate_7 \	
0		-0.277543
1		-0.275391
2		-0.278001
3		-0.277755
4		-0.278745
	corr_GRO J1655-40_rate_8_GX 339-4_rate_8 \	
0		-0.271455
1		-0.270632
2		-0.266967
3		-0.268125
4		-0.269135
	corr_Sco X-1_rate_0_4U 1700-377_rate_0 \	
0		-0.100206
1		-0.100104
2		-0.099554
3		-0.100188
4		-0.100639
	corr_Sco X-1_rate_0_GRO J1655-40_rate_0 \	
0		-0.109050
1		-0.108911
2		-0.109109
3		-0.108227
4		-0.109345
	corr_Sco X-1_rate_0_GX 339-4_rate_0 \	
0		-0.045890
1		-0.046048

2	-0.046656
3	-0.047181
4	-0.046057

corr_Sco X-1_rate_1_4U 1700-377_rate_1 \	
0	-0.101971
1	-0.101636
2	-0.103285
3	-0.102467
4	-0.101791

corr_Sco X-1_rate_1_GRO J1655-40_rate_1 \	
0	-0.100361
1	-0.101127
2	-0.100485
3	-0.099289
4	-0.097952

corr_Sco X-1_rate_1_GX 339-4_rate_1 \	
0	-0.042978
1	-0.041588
2	-0.042361
3	-0.042834
4	-0.042781

corr_Sco X-1_rate_2_4U 1700-377_rate_2 \	
0	-0.089231
1	-0.088256
2	-0.088947
3	-0.090455
4	-0.091925

corr_Sco X-1_rate_2_GRO J1655-40_rate_2 \	
0	-0.100263
1	-0.099395
2	-0.100366
3	-0.100286
4	-0.100125

corr_Sco X-1_rate_2_GX 339-4_rate_2 \	
0	-0.037002
1	-0.038385
2	-0.037034
3	-0.037557
4	-0.037215

corr_Sco X-1_rate_3_4U 1700-377_rate_3 \	
--	--



0	-0.103343
1	-0.101703
2	-0.100700
3	-0.100563
4	-0.100826

corr_Sco X-1_rate_3_GRO J1655-40_rate_3 \	
0	-0.092279
1	-0.092903
2	-0.093609
3	-0.093762
4	-0.094226

corr_Sco X-1_rate_3_GX 339-4_rate_3 \	
0	-0.035664
1	-0.035902
2	-0.037982
3	-0.038265
4	-0.036878

corr_Sco X-1_rate_4_4U 1700-377_rate_4 \	
0	-0.098309
1	-0.098123
2	-0.098059
3	-0.098489
4	-0.098810

corr_Sco X-1_rate_4_GRO J1655-40_rate_4 \	
0	-0.106096
1	-0.109014
2	-0.109961
3	-0.110508
4	-0.109156

corr_Sco X-1_rate_4_GX 339-4_rate_4 \	
0	-0.031574
1	-0.030490
2	-0.031909
3	-0.031144
4	-0.034886

corr_Sco X-1_rate_5_4U 1700-377_rate_5 \	
0	-0.105922
1	-0.105630
2	-0.103893
3	-0.101789
4	-0.101308

```
corr_Sco X-1_rate_5_GRO J1655-40_rate_5 \
0 -0.095471
1 -0.094843
2 -0.094424
3 -0.097327
4 -0.095477
```

```
corr_Sco X-1_rate_5_GX 339-4_rate_5 \
0 -0.036337
1 -0.037240
2 -0.037335
3 -0.038895
4 -0.040000
```

```
corr_Sco X-1_rate_6_4U 1700-377_rate_6 \
0 -0.107506
1 -0.108005
2 -0.106459
3 -0.105739
4 -0.105295
```

```
corr_Sco X-1_rate_6_GRO J1655-40_rate_6 \
0 -0.105102
1 -0.107028
2 -0.106138
3 -0.105435
4 -0.106730
```

```
corr_Sco X-1_rate_6_GX 339-4_rate_6 \
0 -0.037341
1 -0.033304
2 -0.032242
3 -0.031604
4 -0.030134
```

```
corr_Sco X-1_rate_7_4U 1700-377_rate_7 \
0 -0.118062
1 -0.116806
2 -0.116404
3 -0.115655
4 -0.114664
```

```
corr_Sco X-1_rate_7_GRO J1655-40_rate_7 \
0 -0.105467
1 -0.106476
2 -0.103507
```

3 -0.104242  
 4 -0.103894

corr\_Sco X-1\_rate\_7\_GX 339-4\_rate\_7 \  
 0 -0.040132  
 1 -0.041395  
 2 -0.041457  
 3 -0.039254  
 4 -0.040365

corr\_Sco X-1\_rate\_8\_4U 1700-377\_rate\_8 \  
 0 -0.116710  
 1 -0.115349  
 2 -0.116796  
 3 -0.114413  
 4 -0.113940

corr\_Sco X-1\_rate\_8\_GRO J1655-40\_rate\_8 \  
 0 -0.111292  
 1 -0.109787  
 2 -0.107271  
 3 -0.109015  
 4 -0.110575

corr\_Sco X-1\_rate\_8\_GX 339-4\_rate\_8 dt err\_4U 1700-377\_rate\_0 \  
 0 -0.037853 -20.480 0.001207  
 1 -0.037059 -19.456 0.001196  
 2 -0.037225 -18.432 0.001186  
 3 -0.038376 -17.408 0.001175  
 4 -0.040941 -16.384 0.001164

err\_4U 1700-377\_rate\_1 err\_4U 1700-377\_rate\_2 err\_4U 1700-377\_rate\_3 \  
 0 0.000951 0.000723 0.000710  
 1 0.000941 0.000717 0.000703  
 2 0.000934 0.000712 0.000696  
 3 0.000926 0.000705 0.000690  
 4 0.000919 0.000699 0.000685

err\_4U 1700-377\_rate\_4 err\_4U 1700-377\_rate\_5 err\_4U 1700-377\_rate\_6 \  
 0 0.000661 0.000665 0.000634  
 1 0.000655 0.000659 0.000628  
 2 0.000648 0.000652 0.000622  
 3 0.000642 0.000646 0.000616  
 4 0.000637 0.000641 0.000611

err\_4U 1700-377\_rate\_7 err\_4U 1700-377\_rate\_8 err\_Background\_bkg\_rate\_0 \  
 0 0.000556 0.000466 0.000585

1	0.000550	0.000461	0.000580
2	0.000545	0.000456	0.000576
3	0.000541	0.000452	0.000570
4	0.000535	0.000448	0.000565

	err_Background_bkg_rate_1	err_Background_bkg_rate_2	\
0	0.000487	0.000376	
1	0.000482	0.000373	
2	0.000478	0.000370	
3	0.000473	0.000366	
4	0.000470	0.000363	

	err_Background_bkg_rate_3	err_Background_bkg_rate_4	\
0	0.000373	0.000350	
1	0.000370	0.000346	
2	0.000366	0.000343	
3	0.000364	0.000340	
4	0.000361	0.000337	

	err_Background_bkg_rate_5	err_Background_bkg_rate_6	\
0	0.000350	0.000338	
1	0.000347	0.000336	
2	0.000344	0.000332	
3	0.000341	0.000329	
4	0.000338	0.000326	

	err_Background_bkg_rate_7	err_Background_bkg_rate_8	\
0	0.000292	0.000245	
1	0.000289	0.000243	
2	0.000287	0.000241	
3	0.000284	0.000238	
4	0.000281	0.000236	

	err_GRO J1655-40_rate_0	err_GRO J1655-40_rate_1	err_GRO J1655-40_rate_2	\
0	0.001320	0.001032	0.000788	
1	0.001308	0.001022	0.000780	
2	0.001297	0.001014	0.000774	
3	0.001285	0.001005	0.000767	
4	0.001274	0.000995	0.000760	

	err_GRO J1655-40_rate_3	err_GRO J1655-40_rate_4	err_GRO J1655-40_rate_5	\
0	0.000779	0.000717	0.000726	
1	0.000772	0.000712	0.000720	
2	0.000764	0.000705	0.000712	
3	0.000758	0.000699	0.000705	
4	0.000751	0.000691	0.000699	

	err_GRO J1655-40_rate_6	err_GRO J1655-40_rate_7	err_GRO J1655-40_rate_8	\
0	0.000695	0.000607	0.000511	
1	0.000689	0.000601	0.000505	
2	0.000684	0.000596	0.000500	
3	0.000678	0.000591	0.000496	
4	0.000671	0.000585	0.000492	

	err_GX 339-4_rate_0	err_GX 339-4_rate_1	err_GX 339-4_rate_2	\
0	0.001641	0.001290	0.000990	
1	0.001627	0.001279	0.000981	
2	0.001614	0.001271	0.000974	
3	0.001599	0.001258	0.000965	
4	0.001583	0.001247	0.000955	

	err_GX 339-4_rate_3	err_GX 339-4_rate_4	err_GX 339-4_rate_5	\
0	0.000970	0.000909	0.000919	
1	0.000960	0.000901	0.000910	
2	0.000953	0.000891	0.000899	
3	0.000944	0.000882	0.000890	
4	0.000938	0.000874	0.000880	

	err_GX 339-4_rate_6	err_GX 339-4_rate_7	err_GX 339-4_rate_8	\
0	0.000879	0.000777	0.000635	
1	0.000871	0.000768	0.000629	
2	0.000866	0.000762	0.000622	
3	0.000857	0.000756	0.000620	
4	0.000849	0.000748	0.000614	

	err_Sco X-1_rate_0	err_Sco X-1_rate_1	err_Sco X-1_rate_2	\
0	0.001092	0.000848	0.000644	
1	0.001083	0.000840	0.000638	
2	0.001073	0.000833	0.000633	
3	0.001064	0.000825	0.000627	
4	0.001054	0.000817	0.000621	

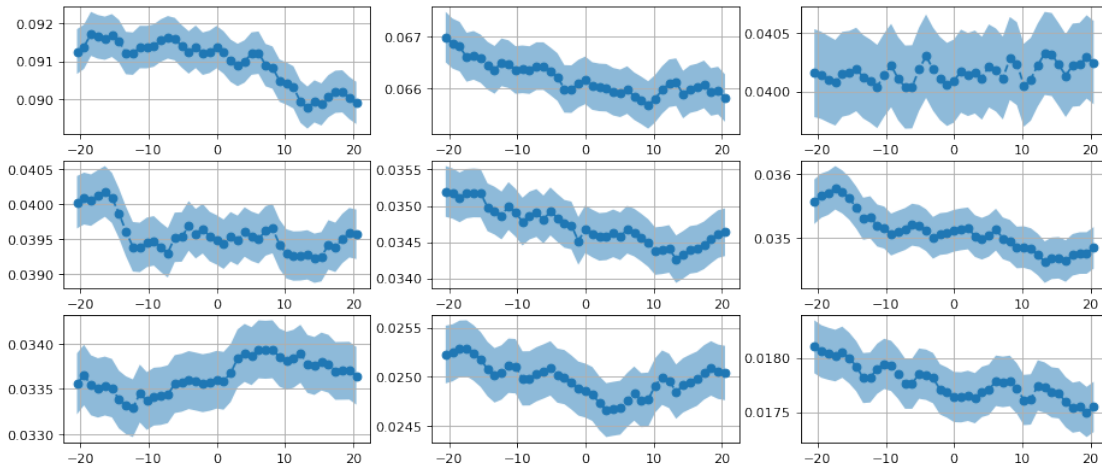
	err_Sco X-1_rate_3	err_Sco X-1_rate_4	err_Sco X-1_rate_5	\
0	0.000635	0.000595	0.000596	
1	0.000629	0.000590	0.000591	
2	0.000624	0.000584	0.000585	
3	0.000618	0.000579	0.000580	
4	0.000613	0.000574	0.000574	

	err_Sco X-1_rate_6	err_Sco X-1_rate_7	err_Sco X-1_rate_8	exp	\
0	0.000575	0.000500	0.000418	55.2987	
1	0.000570	0.000495	0.000414	56.3227	
2	0.000564	0.000491	0.000409	57.3467	
3	0.000560	0.000486	0.000406	58.3707	

4                    0.000555                    0.000481                    0.000404    59.3947

	nllh	time
0	238693.942965	6.460184e+08
1	240133.897390	6.460184e+08
2	241552.567034	6.460184e+08
3	242880.079254	6.460184e+08
4	244131.759490	6.460184e+08

```
[8]: # plotting the rate per detector in each energy bin for the diffuse models
nr = 3
nc = 3
nplt = 1
fig = plt.figure(dpi=80, figsize=(14,6))
for j in range(9):
    ax = fig.add_subplot(nr,nc,nplt)
    nplt+=1
    try:
        rate_name = 'bkg_rate_' + str(j)
        rate = bkg_df[rate_name]
    except:
        rate_name = 'Background_bkg_rate_' + str(j)
        rate = bkg_df[rate_name]
    err0 = rate - bkg_df['err_'+rate_name]
    err1 = rate + bkg_df['err_'+rate_name]
    plt.fill_between(bkg_df['dt'], err0, err1, alpha=.5)
    plt.plot(bkg_df['dt'], rate, 'o--')
    plt.grid(True)
```



```

[9]: # plotting time hist of event data
tbins = np.arange(-40*1.024, 40*1.024, 0.064*4*4*1) # tbins with multiples of
↳ 64ms (64ms * 4 * 4 = 1.024s)
dt = tbins[1] - tbins[0]
tax = (tbins[1:] + tbins[:-1])/2.
ntbins = len(tax)
# choosing which tbins to estimate a flat bkg from for the plot
# bkg_bl = (np.abs(tax)>8.0)
bkg_bl = ((tax)<-10.0)&(tax>-40.0)

nc = 1
nr = 1
nplt = 1

fig = plt.figure(dpi=100, figsize=(8,3*nr))
ax = fig.add_subplot(nr,nc,nplt)
nplt += 1

h=plt.hist(ev_data0['TIME'] - trigger_time, bins=tbins,\
           histtype='step', label='data')[0]

bkg_mean = np.mean(h[bkg_bl])
bkg_std = np.std(h[bkg_bl])

print("time with min counts, max counts")
print (tbins[np.argmin(h)], tbins[np.argmax(h)])
print("counts at min time, max time")
print(np.min(h), np.max(h))
print("bkg mean, bkg std")
print(bkg_mean, bkg_std)

plt.axhline(bkg_mean)
plt.grid(True)
plt.xlim(-22, 26)
# plt.xlim(-4, 4.)
plt.ylim(np.around(.95*np.min(h[(h>0)]), decimals=-1),\
         np.round(1.01*np.max(h), decimals=-1))
plt.xlabel('t - trig_time (s)')
plt.ylabel('Counts 15-350 keV')
plt.legend(loc='lower left')

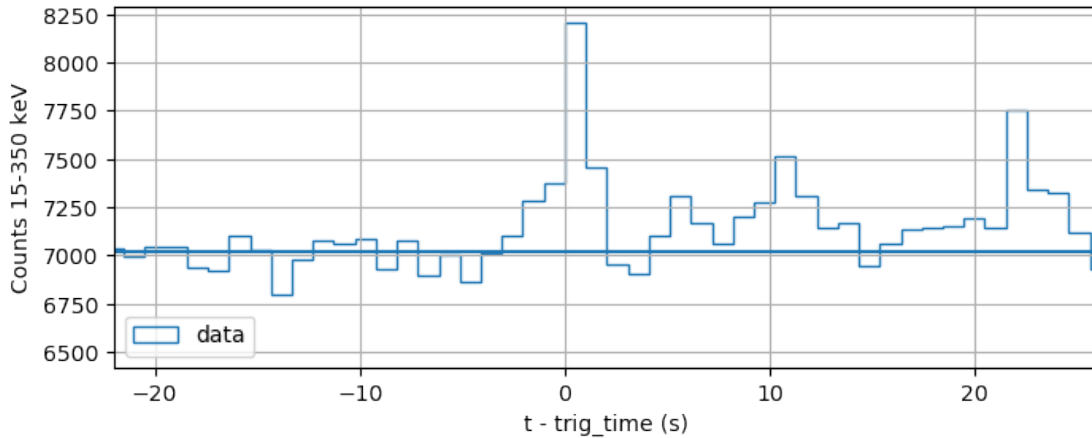
```

```

time with min counts, max counts
(32.768000000000065, 3.552713678800501e-14)
counts at min time, max time
(6760.0, 8209.0)
bkg mean, bkg std
(7023.0, 81.7038385963555)

```

[9]: <matplotlib.legend.Legend at 0x7f98a0db2590>



```
[10]: # plotting time hist with same bins as last cell but for each Ebin
nc = 1
nr = nebins
nplt = 1
fig = plt.figure(dpi=100, figsize=(8,3.5*nr))

for ei in xrange(nebins):
    ax = fig.add_subplot(nr,nc,nplt)
    nplt += 1
    ebl = (ev_data0['ENERGY']>=ebins0[ei])&\
          (ev_data0['ENERGY']<ebins1[ei])
    h=plt.hist(ev_data0[ebl]['TIME'] - trigger_time, bins=tbins,\
              histtype='step')[0]
    bkg_mean = np.mean(h[bkg_bl])
    bkg_std = np.std(h[bkg_bl])
    ttl = '%.1f - %.1f keV' %(ebins0[ei],ebins1[ei])
    print(ttl)
    print("time with min counts, max counts")
    print (tbins[np.argmin(h)], tbins[np.argmax(h)])
    print("counts at min time, max time")
    print(np.min(h), np.max(h))
    print("bkg mean, bkg std")
    print(bkg_mean, bkg_std)
    print
    plt.axhline(bkg_mean)
    plt.title(ttl)
    plt.grid(True)
#     plt.xlim(-2, 2)
plt.xlim(-22, 26)
```



```
plt.ylim(np.around(.9*np.min(h[(h>0)]), decimals=-1),\
         np.round(1.1*np.max(h), decimals=-1))
```

15.0 - 24.0 keV

```
time with min counts, max counts
(-5.119999999999969, 21.504000000000055)
counts at min time, max time
(1686.0, 1884.0)
bkg mean, bkg std
(1774.7586206896551, 28.503666034526997)
```

24.0 - 35.0 keV

```
time with min counts, max counts
(-14.335999999999977, 26.624000000000006)
counts at min time, max time
(1009.0, 1197.0)
bkg mean, bkg std
(1086.2413793103449, 26.90167944047718)
```

35.0 - 48.0 keV

```
time with min counts, max counts
(-5.119999999999969, 3.552713678800501e-14)
counts at min time, max time
(578.0, 746.0)
bkg mean, bkg std
(627.7586206896551, 24.485963850412542)
```

48.0 - 64.0 keV

```
time with min counts, max counts
(-40.96, 3.552713678800501e-14)
counts at min time, max time
(564.0, 774.0)
bkg mean, bkg std
(614.8620689655172, 25.893314458570494)
```

64.0 - 84.0 keV

```
time with min counts, max counts
(32.768000000000065, 3.552713678800501e-14)
counts at min time, max time
(482.0, 675.0)
bkg mean, bkg std
(534.5172413793103, 22.40938948783742)
```

84.0 - 120.0 keV

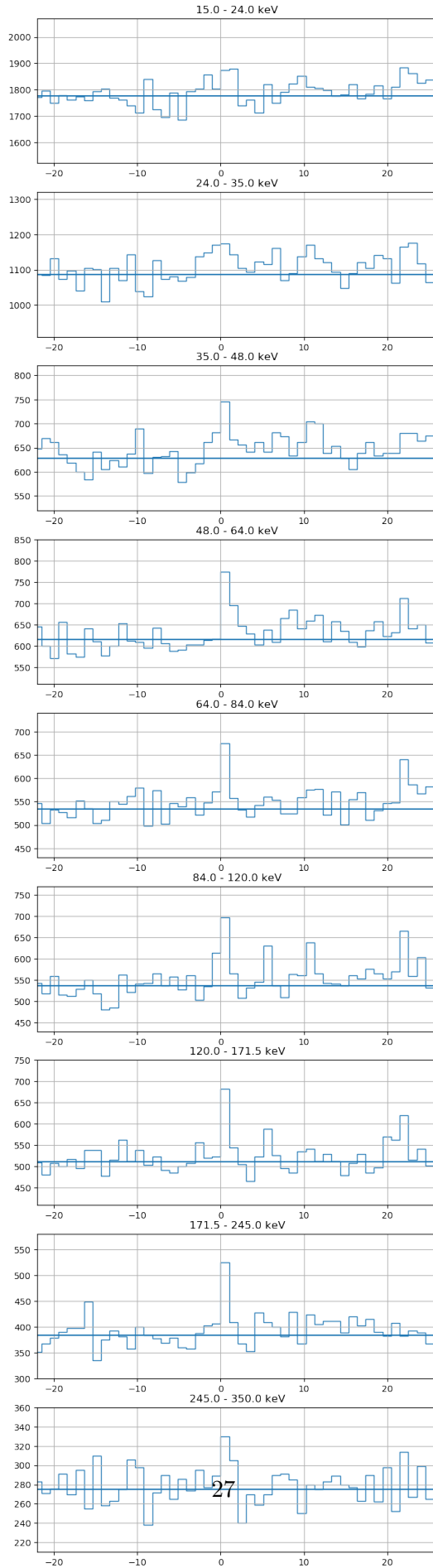
```
time with min counts, max counts
(-14.335999999999977, 3.552713678800501e-14)
counts at min time, max time
(481.0, 698.0)
```

bkg mean, bkg std  
(536.3103448275862, 22.945367571353966)

120.0 - 171.5 keV  
time with min counts, max counts  
(32.768000000000065, 3.552713678800501e-14)  
counts at min time, max time  
(461.0, 683.0)  
bkg mean, bkg std  
(511.3103448275862, 20.82621598598476)

171.5 - 245.0 keV  
time with min counts, max counts  
(-15.359999999999978, 3.552713678800501e-14)  
counts at min time, max time  
(335.0, 525.0)  
bkg mean, bkg std  
(383.1034482758621, 20.780204153499497)

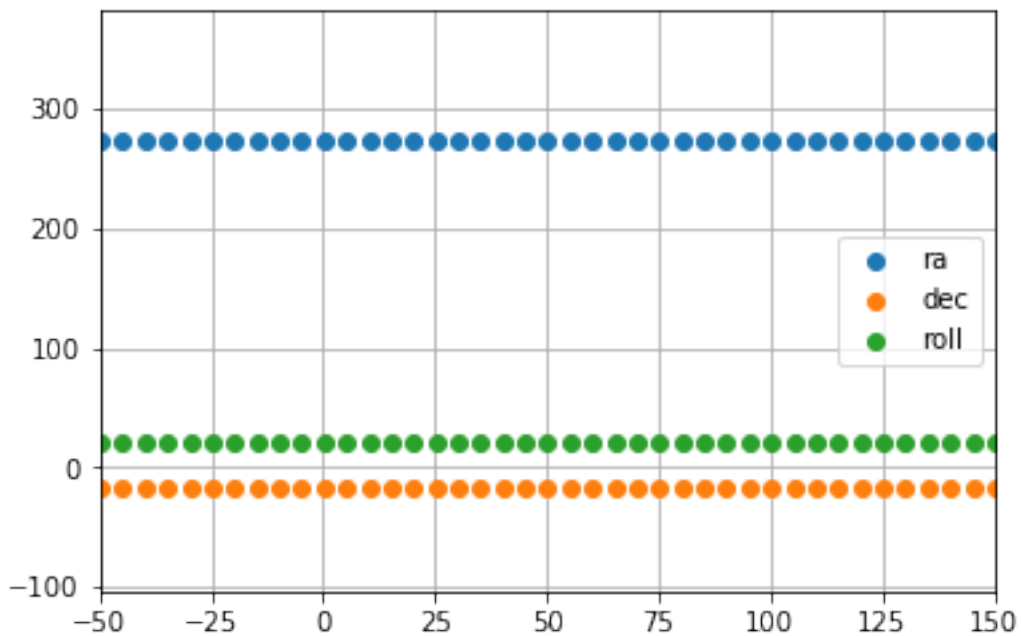
245.0 - 350.0 keV  
time with min counts, max counts  
(32.768000000000065, 3.552713678800501e-14)  
counts at min time, max time  
(235.0, 330.0)  
bkg mean, bkg std  
(274.86206896551727, 14.50736825376733)



```
[11]: # getting attitude information at trigger time
att_ind = np.argmin(np.abs(attfile['TIME'] - trigger_time))
att_quat = attfile['QPARAM'][att_ind]
print("QUATERNION: ", att_quat)
pnt_ra, pnt_dec = attfile['POINTING'][att_ind,:2]
print("Pointing RA, Dec")
print(pnt_ra, pnt_dec)
plt.plot(attfile['TIME']-trigger_time, attfile['POINTING'], 'o')
plt.grid(True)
plt.xlim(-50,150)
plt.legend(['ra', 'dec', 'roll'])
```

```
('QUATERNION: ', array([-0.03597053,  0.2345147 , -0.64420835,  0.72712074]))
Pointing RA, Dec
(273.5996900829163, -17.13930771538036)
```

```
[11]: <matplotlib.legend.Legend at 0x7f988021af50>
```



```
[12]: # if you have some ra, dec of interest (like a gbm localization or something)
# here's how to do conversions into detector coordinates (theta, phi) and (imx,
→imy)
ra_interest, dec_interest = 233.117, -26.213
print("RA of interest, Dec of interest")
```

```

print(ra_interest, dec_interest)
theta_interest, phi_interest = convert_radec2thetaphi(ra_interest,
↳dec_interest, att_quat)
print("theta, phi")
print theta_interest, phi_interest
# imx, imy only valid at theta < 90 deg
imx_interest, imy_interest = convert_radec2imxy(ra_interest, dec_interest,
↳att_quat)
print("imx, imy")
print imx_interest, imy_interest

```

```

RA of interest, Dec of interest
(233.117, -26.213)
theta, phi
38.54132137017975 137.65241966813443
imx, imy
-0.5887551341212709 -0.5366203642198198

```

```

[13]: %%time
# getting split rate analysis results

# get the file names
res_rate_fnames = get_rate_res_fnames(work_dir)
print("%d split rate result files"%(len(res_rate_fnames)))
# read files and merge into one Pandas Dataframe
res_rate_tab = get_merged_csv_df(res_rate_fnames, work_dir, ignore_index=True)
print("Merged split rate results table has %d rows"%(len(res_rate_tab)))
res_rate_tab['dt'] = res_rate_tab['time'] - trigger_time

```

```

24 split rate result files
Merged split rate results table has 53244 rows
CPU times: user 463 ms, sys: 46.7 ms, total: 510 ms
Wall time: 313 ms

```

```

do_manage2.py:177: FutureWarning: Sorting because non-concatenation axis is not
aligned. A future version
of pandas will change to not sort by default.

```

To accept the future behavior, pass 'sort=False'.

To retain the current behavior and silence the warning, pass 'sort=True'.

```
df = pd.concat(dfs, ignore_index=ignore_index)
```

```
[14]: res_rate_tab.sort_values('TS', ascending=False).head(64)
```

```

[14]:          4U 1700-377_rt_sum          A          Epeak  GRO J1655-40_rt_sum  \
32553          3308.140625  0.005131  1000.000000          3096.148438

```

51729	3463.363281	0.005100	1000.000000	3397.006836
17797	3897.023438	0.004559	1000.000000	3526.900879
25481	3542.836670	0.004821	1000.000000	3238.922852
35545	2914.345215	0.005365	1000.000000	2866.721680
33233	3276.141602	0.004996	1000.000000	3046.996094
13853	3683.522461	0.004740	1000.000000	3367.135742
33981	4073.167236	0.004355	1000.000000	3558.800049
37109	2534.849609	0.005568	1000.000000	2437.718750
26637	2739.820312	0.005432	1000.000000	2669.706787
29153	3470.923828	0.004983	1000.000000	3340.487793
41597	1886.661133	0.005897	1000.000000	1814.812012
8005	2713.097656	0.005400	1000.000000	2653.986328
23169	3243.520752	0.005023	1000.000000	3031.834473
25685	2881.511475	0.005229	1000.000000	2714.913086
47649	3918.523926	0.004790	1000.000000	3527.067139
4877	1505.411133	0.006461	1000.000000	1471.464478
40237	2462.552979	0.005550	1000.000000	2407.239746
51593	1017.414062	0.006999	959.083011	994.486877
22081	1947.792847	0.005942	1000.000000	1907.100830
37041	2753.189697	0.004712	1000.000000	2459.577637
4741	2199.801758	0.005673	1000.000000	2124.904053
23985	4107.039062	0.004076	1000.000000	3570.471680
25209	2405.287598	0.005503	1000.000000	2310.139160
51933	4121.427734	0.004193	1000.000000	3591.343750
15961	3655.563232	0.004539	1000.000000	3268.968750
1477	3668.826172	0.004194	1000.000000	3253.004883
17321	2685.166504	0.004738	1000.000000	2389.010986
33165	2507.041016	0.005407	1000.000000	2277.100586
22217	3774.344238	0.004532	1000.000000	3415.608154
30513	3816.281738	0.004601	1000.000000	3560.845947
44317	1881.994751	0.005842	1000.000000	1848.421631
27657	2104.311035	0.005960	1000.000000	1946.665649
28949	3165.252441	0.005047	1000.000000	3122.190918
7665	3081.803711	0.004506	1000.000000	2764.121094
28677	3501.917969	0.004224	1000.000000	3058.488770
24801	3028.078125	0.004972	1000.000000	2892.982910
36157	4083.491699	0.004029	1000.000000	3534.917236
16437	2842.733398	0.004888	1000.000000	2577.583496
38265	3946.049316	0.004495	1000.000000	3466.200439
7257	3412.234375	0.004785	1000.000000	3210.553711
15145	2710.343750	0.005156	1000.000000	2482.383057
34729	1780.812500	0.005960	1000.000000	1724.580078
41257	965.057190	0.006993	1000.000000	948.012634
26977	2237.168457	0.005449	1000.000000	2059.248047
1205	1939.652466	0.005700	1000.000000	1870.283325
24733	1813.830566	0.005892	1000.000000	1768.229004
48329	4200.161133	0.003892	1000.000000	3609.397461

31805	2313.709961	0.005413	1000.000000	2174.935059
6101	2683.888184	0.004839	1000.000000	2378.468018
17117	2508.821045	0.006008	1000.000000	2259.522461
19769	2491.762695	0.006517	1000.000000	2214.603271
39353	1715.598755	0.006058	1000.000000	1655.157471
46561	2779.682861	0.004633	1000.000000	2475.367188
48737	4095.593262	0.004375	1000.000000	3661.303223
44725	4075.302246	0.004431	1000.000000	3661.524658
46289	2103.817139	0.005523	1000.000000	2032.961426
48125	4249.120117	0.004328	1000.000000	3673.657227
30309	3152.370605	0.004720	1000.000000	2859.478027
39285	2680.879395	0.004916	1000.000000	2374.585449
6169	2840.694580	0.004729	1000.000000	2513.717529
27997	3494.626953	0.004229	1000.000000	3057.437500
23781	1965.577637	0.006059	1000.000000	1798.108154
20177	2520.865723	0.005652	1000.000000	2284.188721

	GX 339-4_rt_sum	Sco X-1_rt_sum	TS	bkg_nllh	dur \
32553	1976.254395	3396.428711	18.524986	261.024004	2.048
51729	1976.254395	3573.353271	18.497463	264.219452	2.048
17797	1976.254395	4468.304688	18.450624	253.554914	2.048
25481	1971.113525	4008.572021	18.420209	257.861285	2.048
35545	1936.077148	2952.979980	18.413330	262.882505	2.048
33233	1964.611084	3501.029297	18.410200	255.301063	2.048
13853	1976.254272	3998.754883	18.405803	256.258841	2.048
33981	1976.254395	4918.258301	18.351019	251.132652	2.048
37109	1814.178589	2535.038818	18.343302	260.442375	2.048
26637	1966.270020	2753.237061	18.331746	262.678926	2.048
29153	1976.254395	3580.875244	18.322459	258.669331	2.048
41597	1312.075195	1917.067505	18.314090	257.152223	2.048
8005	1880.681030	2747.229492	18.299154	260.097320	2.048
23169	1976.254272	3343.482910	18.298146	256.627926	2.048
25685	1951.660767	3018.865723	18.295390	257.892325	2.048
47649	1976.254517	4172.052734	18.289312	256.511275	2.048
4877	1125.064209	1572.357056	18.284830	249.926011	2.048
40237	1514.136597	2547.925293	18.247805	257.447438	2.048
51593	797.742188	1038.338501	18.243742	249.135156	2.048
22081	1392.755371	1985.979248	18.237637	254.744852	2.048
37041	1444.139160	3177.625488	18.229300	252.944955	2.048
4741	1564.200195	2220.031250	18.219148	254.924940	2.048
23985	1974.977295	5269.171875	18.217772	244.126894	2.048
25209	1744.542236	2435.586426	18.214678	258.913684	2.048
51933	1976.254517	5141.248535	18.206815	245.950329	2.048
15961	1947.484253	4342.060547	18.206334	252.381302	2.048
1477	1924.742676	4712.764648	18.182078	247.388922	2.048
17321	1362.743896	3185.188965	18.171312	250.401905	2.048
33165	1362.743774	2608.147949	18.170393	253.240113	2.048

22217	1976.254395	4090.545410	18.165880	253.089205	2.048
30513	1969.224365	4537.526367	18.161823	250.504306	2.048
44317	1342.747925	1912.569824	18.157626	256.550392	2.048
27657	1358.400635	2128.535400	18.152787	251.482833	2.048
28949	1962.699829	3342.292725	18.151209	258.108637	2.048
7665	1692.700439	3731.791992	18.150145	252.854852	2.048
28677	1816.656738	4645.451660	18.147156	246.362954	2.048
24801	1821.203613	3374.447266	18.143219	253.103534	2.048
36157	1975.845947	5343.960938	18.136199	242.737454	2.048
16437	1557.007812	3042.379883	18.135317	252.989949	2.048
38265	1976.254395	4157.835938	18.135317	253.778904	2.048
7257	1864.876099	3956.516113	18.135072	251.663972	2.048
15145	1491.677979	3012.959717	18.134069	250.539884	2.048
34729	1350.577148	1808.736084	18.132614	252.499132	2.048
41257	762.935059	995.778320	18.129666	251.010514	2.048
26977	1362.743896	2266.817871	18.122737	253.681545	2.048
1205	1144.328857	2024.383789	18.119548	249.199357	2.048
24733	1447.160889	1813.195312	18.118070	255.057392	2.048
48329	1976.254395	5795.178711	18.117878	241.108590	2.048
31805	1378.567749	2404.594238	18.116202	255.204969	2.048
6101	1362.743774	2874.830566	18.115809	253.582571	2.048
17117	1362.743896	2613.297607	18.113562	253.219444	2.048
19769	1362.743774	2587.534180	18.105695	251.255891	2.048
39353	1289.455566	1728.163330	18.100077	252.572281	2.048
46561	1454.382446	3223.416016	18.098224	251.342381	2.048
48737	1976.254395	4683.235352	18.098101	248.120990	2.048
44725	1976.254395	4810.178223	18.096897	250.216333	2.048
46289	1439.491943	2237.812500	18.092639	251.527682	2.048
48125	1976.254395	4823.883789	18.091712	250.324098	2.048
30309	1820.359985	3562.348633	18.082302	251.684418	2.048
39285	1362.743896	2801.054688	18.082098	251.490503	2.048
6169	1494.172974	3106.783203	18.081893	252.147944	2.048
27997	1721.652466	4880.694336	18.081588	243.258063	2.048
23781	1347.153931	1975.702393	18.080856	250.019392	2.048
20177	1362.022827	2628.216064	18.080445	252.778563	2.048

	gamma	hp_ind	imx	imy	ndets	nllh	phi	solid_angle	\
32553	0.236981	NaN	0.08	-0.56	7147	89.436460	NaN	7206.133604	
51729	0.240639	NaN	-0.16	-0.56	7314	93.141376	NaN	7397.469045	
17797	0.187357	NaN	0.32	-0.40	9925	83.342152	NaN	10084.993057	
25481	0.221658	NaN	0.44	-0.40	8567	88.209233	NaN	8726.558695	
35545	0.264898	NaN	-0.10	-0.64	6090	93.357147	NaN	6129.661822	
33233	0.250540	NaN	0.38	-0.48	7545	85.833324	NaN	7671.704471	
13853	0.169867	NaN	0.26	-0.48	8639	86.872050	NaN	8773.869983	
33981	0.134831	NaN	0.38	-0.32	10908	82.752700	NaN	11082.322131	
37109	0.300736	NaN	0.14	-0.64	5263	92.204018	NaN	5257.262112	
26637	0.271188	NaN	0.02	-0.64	5709	94.652475	NaN	5735.294086	



29153	0.185320	NaN	-0.04	-0.56	7311	90.813072	NaN	7382.974082
41597	0.490524	NaN	0.74	-0.64	3946	89.449277	NaN	3986.597603
8005	0.272560	NaN	-0.22	-0.64	5648	92.667793	NaN	5685.659383
23169	0.190247	NaN	0.20	-0.56	7054	89.216846	NaN	7124.424778
25685	0.274180	NaN	0.32	-0.56	6373	90.531672	NaN	6450.090479
47649	0.187407	NaN	-0.22	-0.48	8530	89.261814	NaN	8641.441958
4877	0.555561	NaN	0.44	-0.72	3180	82.758499	NaN	3214.638126
40237	0.380419	NaN	0.56	-0.56	5192	90.956246	NaN	5297.506630
51593	0.582146	NaN	0.38	-0.80	2111	82.718096	NaN	2113.037923
22081	0.430519	NaN	0.50	-0.64	4075	88.439151	NaN	4147.153126
37041	0.295909	NaN	0.80	-0.24	8064	86.791265	NaN	8155.978360
4741	0.342291	NaN	0.38	-0.64	4591	88.956266	NaN	4635.248662
23985	0.157124	NaN	0.50	-0.16	12560	78.183285	NaN	12703.488009
25209	0.264820	NaN	0.26	-0.64	5002	93.026438	NaN	5012.044131
51933	0.166602	NaN	0.44	-0.24	11890	80.206267	NaN	12049.703933
15961	0.150785	NaN	0.50	-0.32	9492	86.646010	NaN	9679.081439
1477	0.181883	NaN	0.62	-0.16	11456	82.094936	NaN	11600.051013
17321	0.285248	NaN	0.92	-0.08	8232	85.303609	NaN	8337.988478
33165	0.430195	NaN	1.04	-0.24	6538	88.158515	NaN	6593.119204
22217	0.083165	NaN	0.14	-0.48	8831	88.089600	NaN	8945.558085
30513	0.166920	NaN	-0.40	-0.40	9266	85.578399	NaN	9435.296848
44317	0.425905	NaN	0.62	-0.64	3948	91.700706	NaN	4017.016461
27657	0.514049	NaN	0.98	-0.48	4820	86.720995	NaN	4862.921186
28949	0.199517	NaN	-0.28	-0.56	6818	93.375436	NaN	6903.165450
7665	0.230586	NaN	0.68	-0.24	9195	88.140976	NaN	9327.993301
28677	0.179300	NaN	0.68	-0.08	11410	81.703326	NaN	11556.453924
24801	0.192983	NaN	-0.46	-0.48	6889	88.515338	NaN	7020.268860
36157	0.166141	NaN	0.56	-0.08	12890	78.276594	NaN	13012.668668
16437	0.272336	NaN	0.68	-0.40	6941	88.545081	NaN	7068.049379
38265	0.054448	NaN	0.02	-0.48	8866	89.334037	NaN	8973.680247
7257	0.218383	NaN	-0.52	-0.40	8060	87.223556	NaN	8232.203004
15145	0.284163	NaN	-0.58	-0.48	6083	86.117658	NaN	6214.818794
34729	0.403527	NaN	-0.28	-0.72	3731	88.103279	NaN	3745.886486
41257	0.607855	NaN	-0.34	-0.80	2019	86.668119	NaN	2010.270796
26977	0.392090	NaN	0.80	-0.56	4796	89.464754	NaN	4862.511384
1205	0.386856	NaN	-0.64	-0.56	4093	85.040344	NaN	4147.487978
24733	0.343597	NaN	0.20	-0.72	3748	90.925163	NaN	3713.096495
48329	0.106962	NaN	0.56	0.08	13961	76.979845	NaN	14041.239576
31805	0.360549	NaN	0.68	-0.56	4953	91.106588	NaN	5041.274865
6101	0.318259	NaN	0.98	-0.16	7369	89.491303	NaN	7446.879721
17117	0.526919	NaN	1.16	-0.08	6873	89.168875	NaN	6906.546674
19769	0.579662	NaN	1.22	0.00	6837	87.347796	NaN	6863.519861
39353	0.437892	NaN	0.32	-0.72	3560	88.765882	NaN	3565.876808
46561	0.246618	NaN	0.86	-0.16	8249	87.569517	NaN	8349.331950
48737	0.125877	NaN	0.20	-0.40	10463	84.350356	NaN	10610.889882
44725	0.114713	NaN	-0.28	-0.40	9902	86.467496	NaN	10053.744025
46289	0.302071	NaN	-0.52	-0.56	4594	87.855890	NaN	4673.808627

48125	0.078904	NaN	-0.16	-0.40	10217	86.669082	NaN	10354.238425
30309	0.186419	NaN	0.56	-0.40	7630	88.199601	NaN	7789.151804
39285	0.312368	NaN	0.86	-0.32	6920	88.009362	NaN	7016.125618
6169	0.235436	NaN	0.74	-0.32	7593	88.670524	NaN	7716.479179
27997	0.131274	NaN	0.74	0.16	11951	79.786150	NaN	12102.506175
23781	0.521396	NaN	0.92	-0.56	4232	86.560712	NaN	4264.853318
20177	0.461808	NaN	1.10	-0.16	6772	89.327320	NaN	6819.014533

	theta	time	timeID	dt
32553	NaN	6.460184e+08	-5122048	-0.512
51729	NaN	6.460184e+08	-5122048	-0.512
17797	NaN	6.460184e+08	-5122048	-0.512
25481	NaN	6.460184e+08	-5122048	-0.512
35545	NaN	6.460184e+08	-5122048	-0.512
33233	NaN	6.460184e+08	-5122048	-0.512
13853	NaN	6.460184e+08	-5122048	-0.512
33981	NaN	6.460184e+08	-5122048	-0.512
37109	NaN	6.460184e+08	-5122048	-0.512
26637	NaN	6.460184e+08	-5122048	-0.512
29153	NaN	6.460184e+08	-5122048	-0.512
41597	NaN	6.460184e+08	-5122048	-0.512
8005	NaN	6.460184e+08	-5122048	-0.512
23169	NaN	6.460184e+08	-5122048	-0.512
25685	NaN	6.460184e+08	-5122048	-0.512
47649	NaN	6.460184e+08	-5122048	-0.512
4877	NaN	6.460184e+08	-5122048	-0.512
40237	NaN	6.460184e+08	-5122048	-0.512
51593	NaN	6.460184e+08	-5122048	-0.512
22081	NaN	6.460184e+08	-5122048	-0.512
37041	NaN	6.460184e+08	-5122048	-0.512
4741	NaN	6.460184e+08	-5122048	-0.512
23985	NaN	6.460184e+08	-5122048	-0.512
25209	NaN	6.460184e+08	-5122048	-0.512
51933	NaN	6.460184e+08	-5122048	-0.512
15961	NaN	6.460184e+08	-5122048	-0.512
1477	NaN	6.460184e+08	-5122048	-0.512
17321	NaN	6.460184e+08	-5122048	-0.512
33165	NaN	6.460184e+08	-5122048	-0.512
22217	NaN	6.460184e+08	-5122048	-0.512
30513	NaN	6.460184e+08	-5122048	-0.512
44317	NaN	6.460184e+08	-5122048	-0.512
27657	NaN	6.460184e+08	-5122048	-0.512
28949	NaN	6.460184e+08	-5122048	-0.512
7665	NaN	6.460184e+08	-5122048	-0.512
28677	NaN	6.460184e+08	-5122048	-0.512
24801	NaN	6.460184e+08	-5122048	-0.512
36157	NaN	6.460184e+08	-5122048	-0.512

```

16437    NaN    6.460184e+08 -5122048 -0.512
38265    NaN    6.460184e+08 -5122048 -0.512
7257     NaN    6.460184e+08 -5122048 -0.512
15145    NaN    6.460184e+08 -5122048 -0.512
34729    NaN    6.460184e+08 -5122048 -0.512
41257    NaN    6.460184e+08 -5122048 -0.512
26977    NaN    6.460184e+08 -5122048 -0.512
1205     NaN    6.460184e+08 -5122048 -0.512
24733    NaN    6.460184e+08 -5122048 -0.512
48329    NaN    6.460184e+08 -5122048 -0.512
31805    NaN    6.460184e+08 -5122048 -0.512
6101     NaN    6.460184e+08 -5122048 -0.512
17117    NaN    6.460184e+08 -5122048 -0.512
19769    NaN    6.460184e+08 -5122048 -0.512
39353    NaN    6.460184e+08 -5122048 -0.512
46561    NaN    6.460184e+08 -5122048 -0.512
48737    NaN    6.460184e+08 -5122048 -0.512
44725    NaN    6.460184e+08 -5122048 -0.512
46289    NaN    6.460184e+08 -5122048 -0.512
48125    NaN    6.460184e+08 -5122048 -0.512
30309    NaN    6.460184e+08 -5122048 -0.512
39285    NaN    6.460184e+08 -5122048 -0.512
6169     NaN    6.460184e+08 -5122048 -0.512
27997    NaN    6.460184e+08 -5122048 -0.512
23781    NaN    6.460184e+08 -5122048 -0.512
20177    NaN    6.460184e+08 -5122048 -0.512

```

```

[15]: %%time
# getting out of FoV analysis results

res_out_fnames = get_out_res_fnames(work_dir)
print("%d out of FoV result files"%(len(res_out_fnames)))

res_out_tab = get_merged_csv_df_wpos(res_out_fnames, attfile, direc=work_dir,
↳ ignore_index=True)
print("Merged out of FoV results table has %d rows"%(len(res_out_tab)))
res_out_tab['dt'] = res_out_tab['time'] - trigger_time

```

```

2509 out of FoV result files
Merged out of FoV results table has 341224 rows
CPU times: user 16.4 s, sys: 1.32 s, total: 17.7 s
Wall time: 18.6 s

```

```

[16]: %%time
# getting in FoV analysis results

res_peak_fnames = get_peak_res_fnames(work_dir)

```

```

print("%d in FoV peaks result files"%(len(res_peak_fnames)))
# read files and merge in single dataframe, also convert detector coords into
↳RA, Dec
res_peak_tab = get_merged_csv_df_wpos(res_peak_fnames, attfile, direc=work_dir,
↳ignore_index=True)
print("Merged in FoV peaks results table has %d rows"%(len(res_peak_tab)))
res_peak_tab['dt'] = res_peak_tab['time'] - trigger_time

```

1052 in FoV peaks result files  
Merged in FoV peaks results table has 1282878 rows  
CPU times: user 9.83 s, sys: 816 ms, total: 10.6 s  
Wall time: 11.3 s

```

[17]: # getting the max TS for each square/time seed combo
idx = res_peak_tab.groupby(['squareID', 'timeID'])['TS'].transform(max) ==
↳res_peak_tab['TS']
res_peak_maxSq_tab = res_peak_tab[idx]
print(len(res_peak_maxSq_tab))

```

2664

```

[18]: # initing flux model to calculate flux/fluences
flux_params = {'A':1.0, 'gamma':0.5, 'Epeak':1e2}
flux_mod = Cutoff_Plaw_Flux(E0=100.0)

```

```

[19]: %%time
# calculating fluence for each row based on the best fit spectral parameters
fluncs = np.zeros(len(res_peak_maxSq_tab))
flux_pars = {'A':1.0, 'Epeak':1e2, 'gamma':0.5}
i = 0
for ind, row in res_peak_maxSq_tab.iterrows():
    flux_pars['A'] = row['A']
    flux_pars['gamma'] = row['gamma']
    flux_pars['Epeak'] = row['Epeak']
    fluncs[i] = get_eflux_from_model(flux_mod, flux_pars, 1e1, 1e3)*row['dur']
↳# fluence from 10keV to 1MeV
    i+=1
# res_peak_maxSq_tab.loc[ind]['fluence'] = get_eflux_from_model(flux_mod,
↳flux_pars, 1e1, 1e3)*row['dur']
res_peak_maxSq_tab['fluence'] = fluncs

```

CPU times: user 1.1 s, sys: 3.2 ms, total: 1.11 s  
Wall time: 1.1 s

/Users/tparsota/opt/anaconda3/envs/test\_py2/lib/python2.7/site-  
packages/ipykernel\_launcher.py:12: SettingWithCopyWarning:  
A value is trying to be set on a copy of a slice from a DataFrame.  
Try using .loc[row\_indexer,col\_indexer] = value instead

See the caveats in the documentation: <http://pandas.pydata.org/pandas-docs/stable/indexing.html#indexing-view-versus-copy>

```
if sys.path[0] == '':
```

```
[20]: # max TS peak result
print np.max(res_peak_maxSq_tab['TS'])
idx = res_peak_maxSq_tab['TS'].idxmax()
row = res_peak_maxSq_tab.loc[idx]
max_TS_timeID = row['timeID']
row
```

18.88998837595465

```
[20]: Unnamed: 0    1.430000e+02
      A          5.439460e-03
      Epeak     9.189738e+02
      TS        1.888999e+01
      bkg_nllh  4.603944e+04
      dur       2.048000e+00
      gamma    2.000000e-01
      imx      -5.890000e-01
      imy      -5.350000e-01
      nllh     4.586102e+04
      phi      1.377505e+02
      theta    3.850943e+01
      time     6.460184e+08
      timeID   -5.122048e+06
      squareID 1.761000e+03
      ra       2.331463e+02
      dec      -2.614926e+01
      dt       -5.119998e-01
      fluence  2.006761e-06
      Name: 847079, dtype: float64
```

```
[21]: res_peak_maxSq_tab.sort_values('TS', ascending=False).head(64)
```

```
[21]:
```

	Unnamed: 0	A	Epeak	TS	bkg_nllh	dur	\
847079	143	0.005439	918.973797	18.889988	46039.440350	2.048	
985696	88	0.003991	918.973797	18.166359	46039.440348	2.048	
115667	161	0.004440	918.973797	18.099210	46039.440348	2.048	
100529	89	0.004446	918.973797	18.095792	46039.440349	2.048	
232424	116	0.004758	918.973797	18.092233	46039.440350	2.048	
1253528	134	0.005309	918.973797	18.080242	46039.440350	2.048	
731240	296	0.005313	918.973797	18.078437	46039.440351	2.048	
608605	133	0.004331	918.973797	18.015078	46039.440349	2.048	
776444	140	0.005651	729.966834	17.972488	46039.440350	2.048	
25900	142	0.004057	918.973797	17.972456	46039.440348	2.048	
45979	133	0.004065	918.973797	17.971801	46039.440348	2.048	

885950	134	0.003869	918.973797	17.959096	46039.440347	2.048
632402	116	0.004599	918.973797	17.958508	46039.440349	2.048
150650	152	0.004554	918.973797	17.935166	46039.440350	2.048
520972	142	0.004412	918.973797	17.926615	46039.440349	2.048
250289	485	0.004585	918.973797	17.923744	46039.440349	2.048
27656	116	0.004589	918.973797	17.923209	46039.440349	2.048
1113406	142	0.005568	918.973797	17.905166	46039.440351	2.048
1233278	134	0.005268	918.973797	17.889136	46039.440351	2.048
789353	89	0.005360	918.973797	17.885479	46039.440351	2.048
1210435	133	0.004404	918.973797	17.876074	46039.440350	2.048
455335	115	0.004101	918.973797	17.869040	46039.440348	2.048
906856	142	0.004167	918.973797	17.867031	46039.440348	2.048
206153	89	0.004829	918.973797	17.857990	46039.440350	2.048
84689	125	0.004697	918.973797	17.857200	46039.440350	2.048
422783	125	0.005340	918.973797	17.856131	46039.440351	2.048
736910	134	0.004867	918.973797	17.855134	46039.440350	2.048
782268	132	0.003485	918.973797	17.845672	46039.440346	2.048
958669	115	0.004203	918.973797	17.844335	46039.440349	2.048
579284	134	0.004681	918.973797	17.835892	46039.440350	2.048
569843	413	0.004711	918.973797	17.834526	46039.440350	2.048
382481	161	0.004240	918.973797	17.830927	46039.440348	2.048
259154	116	0.004494	918.973797	17.830509	46039.440349	2.048
1281554	134	0.004982	918.973797	17.828190	46039.440350	2.048
1099465	133	0.004398	918.973797	17.827079	46039.440350	2.048
87126	132	0.003887	918.973797	17.820989	46039.440348	2.048
304073	323	0.004635	918.973797	17.816279	46039.440350	2.048
1049389	115	0.004379	918.973797	17.814111	46039.440349	2.048
1258404	150	0.003932	918.973797	17.811075	46039.440348	2.048
201156	114	0.003969	918.973797	17.810455	46039.440348	2.048
447767	161	0.004530	918.973797	17.807735	46039.440349	2.048
630179	323	0.004691	918.973797	17.805456	46039.440350	2.048
856007	161	0.004479	918.973797	17.803313	46039.440349	2.048
1101410	134	0.004487	918.973797	17.801161	46039.440349	2.048
739484	116	0.005637	918.973797	17.793374	46039.440351	2.048
1167020	134	0.005308	918.973797	17.792415	46039.440350	2.048
464102	134	0.004839	918.973797	17.789598	46039.440350	2.048
174922	124	0.004382	918.973797	17.788563	46039.440350	2.048
747305	161	0.005344	918.973797	17.787540	46039.440351	2.048
592082	134	0.005346	918.973797	17.786854	46039.440351	2.048
573101	269	0.004727	918.973797	17.783279	46039.440351	2.048
939248	134	0.004247	918.973797	17.782665	46039.440349	2.048
702385	115	0.003718	918.973797	17.777880	46039.440347	2.048
941165	107	0.004624	918.973797	17.770879	46039.440349	2.048
656054	116	0.004582	918.973797	17.770488	46039.440350	2.048
170081	143	0.004586	918.973797	17.768335	46039.440349	2.048
588327	105	0.003988	918.973797	17.768019	46039.440349	2.048
1219688	152	0.004411	918.973797	17.767719	46039.440349	2.048

53261	125	0.004594	918.973797	17.766194	46039.440350	2.048
415500	132	0.003929	918.973797	17.763857	46039.440348	2.048
555955	133	0.003995	918.973797	17.760535	46039.440349	2.048
552698	116	0.004529	918.973797	17.758406	46039.440349	2.048
838483	133	0.003997	918.973797	17.757836	46039.440348	2.048
934071	141	0.003465	918.973797	17.755298	46039.440347	2.048

	gamma	imx	imy	nllh	phi	theta \
847079	2.000000e-01	-0.589	-0.535	45861.024519	137.750529	38.509432
985696	-1.000000e-01	0.285	-0.372	45874.432043	52.543226	25.108943
115667	-2.775558e-17	0.265	-0.483	45875.649640	61.248438	28.851294
100529	-2.775558e-17	0.265	-0.483	45875.711503	61.248438	28.851294
232424	-2.775558e-17	-0.603	-0.491	45875.775909	140.845382	37.869285
1253528	2.000000e-01	-0.667	-0.559	45875.992777	140.034268	41.032075
731240	2.000000e-01	-0.667	-0.559	45876.025403	140.034268	41.032075
608605	-1.000000e-01	0.075	-0.493	45877.168832	81.349928	26.504159
776444	-2.775558e-17	-0.633	-0.537	45877.935185	139.690684	39.695902
25900	-1.000000e-01	0.231	-0.401	45877.935760	60.055483	24.833586
45979	-1.000000e-01	0.231	-0.401	45877.947537	60.055483	24.833586
885950	-2.775558e-17	0.565	-0.143	45878.175787	14.203147	30.234299
632402	-2.775558e-17	-0.585	-0.437	45878.186347	143.239954	36.136969
150650	-2.775558e-17	-0.584	-0.438	45878.605265	143.130102	36.129444
520972	-1.000000e-01	0.029	-0.537	45878.758590	86.908817	28.270585
250289	-2.775558e-17	-0.519	-0.437	45878.810055	139.902492	34.155960
27656	-2.775558e-17	-0.519	-0.437	45878.819634	139.902492	34.155960
1113406	3.000000e-01	-0.615	-0.602	45879.142871	135.612011	40.715223
1233278	2.000000e-01	-0.705	-0.555	45879.429749	141.788975	41.899908
789353	2.000000e-01	-0.617	-0.592	45879.495165	136.184607	40.532920
1210435	-1.000000e-01	-0.459	-0.453	45879.663347	135.376940	32.817781
455335	-1.000000e-01	0.103	-0.434	45879.789055	76.649155	24.039496
906856	-1.000000e-01	0.297	-0.443	45879.824947	56.160958	28.073054
206153	-2.775558e-17	-0.525	-0.537	45879.986451	134.352618	36.906379
84689	-2.775558e-17	-0.600	-0.505	45880.000560	139.913799	38.104795
422783	2.000000e-01	0.642	-0.647	45880.019648	45.222248	42.348155
736910	-2.775558e-17	0.049	-0.641	45880.037442	85.628637	32.735753
782268	-2.000000e-01	0.545	0.089	45880.206337	350.725308	28.908321
958669	-1.000000e-01	0.045	-0.447	45880.230197	84.251337	24.192448
579284	-2.775558e-17	-0.179	-0.603	45880.380820	106.533473	32.170187
569843	-2.775558e-17	-0.643	-0.501	45880.405186	142.075698	39.184786
382481	-2.775558e-17	0.275	-0.435	45880.469364	57.699584	27.231972
259154	-2.775558e-17	0.011	-0.505	45880.476824	88.752170	26.799244
1281554	2.000000e-01	0.731	-0.529	45880.518179	35.891989	42.060929
1099465	-1.000000e-01	0.449	-0.467	45880.537975	46.125755	32.936573
87126	-2.000000e-01	0.283	-0.399	45880.646525	54.652944	26.066621
304073	-2.775558e-17	-0.619	-0.476	45880.730450	142.440356	37.984732
1049389	-1.000000e-01	-0.103	-0.557	45880.769077	100.476742	29.529094
1258404	-2.000000e-01	-0.216	-0.401	45880.823151	118.309276	24.488054

201156	-2.000000e-01	-0.217	-0.401	45880.834188	118.419909	24.510593
447767	-2.775558e-17	0.675	-0.449	45880.882632	33.631262	39.031501
630179	-2.775558e-17	-0.493	-0.497	45880.923216	134.768503	34.993613
856007	-2.775558e-17	0.627	-0.441	45880.961371	35.120609	37.472231
1101410	-2.775558e-17	0.627	-0.441	45880.999690	35.120609	37.472231
739484	2.000000e-01	0.267	-0.745	45881.138279	70.282866	38.358093
1167020	2.000000e-01	-0.539	-0.579	45881.155330	132.950936	38.345801
464102	-2.775558e-17	0.049	-0.639	45881.205448	85.615008	32.654834
174922	-1.000000e-01	-0.452	-0.487	45881.223866	132.865363	33.601428
747305	2.000000e-01	-0.689	-0.599	45881.242066	138.997090	42.395275
592082	2.000000e-01	-0.689	-0.599	45881.254261	138.997090	42.395275
573101	-2.775558e-17	-0.679	-0.511	45881.317852	143.035711	40.357922
939248	-2.775558e-17	0.895	-0.087	45881.328755	5.552090	41.962466
702385	-1.000000e-01	0.617	-0.045	45881.413831	4.171399	31.742544
941165	-2.775558e-17	-0.007	-0.583	45881.538271	90.687909	30.243982
656054	-2.775558e-17	-0.223	-0.561	45881.545220	111.678041	31.119252
170081	-2.775558e-17	-0.223	-0.561	45881.583479	111.678041	31.119252
588327	-2.000000e-01	-0.147	-0.448	45881.589105	108.165957	25.243915
1219688	-2.775558e-17	0.238	-0.503	45881.594425	64.678312	29.094395
53261	-2.775558e-17	0.702	-0.493	45881.621530	35.079570	40.623611
415500	-2.000000e-01	-0.067	-0.407	45881.663042	99.348142	22.415064
555955	-1.000000e-01	0.431	-0.319	45881.722038	36.506595	28.200689
552698	-2.775558e-17	-0.009	-0.545	45881.759854	90.946083	28.593666
838483	-1.000000e-01	0.431	-0.319	45881.769983	36.506595	28.200689
934071	-2.000000e-01	0.343	-0.178	45881.815034	27.427075	21.128341

	time	timeID	squareID	ra	dec	dt \
847079	6.460184e+08	-5122048	1761	233.146251	-26.149265	-0.512
985696	6.460184e+08	-5122048	2865	282.469719	-41.065866	-0.512
115667	6.460184e+08	-5122048	2812	278.561099	-45.698056	-0.512
100529	6.460184e+08	-5122048	2813	278.561099	-45.698056	-0.512
232424	6.460184e+08	-5122048	1712	233.702487	-24.195588	-0.512
1253528	6.460184e+08	-5122048	1661	230.254666	-24.851080	-0.512
731240	6.460184e+08	-5122048	1660	230.254666	-24.851080	-0.512
608605	6.460184e+08	-5122048	2562	265.791234	-42.798293	-0.512
776444	6.460184e+08	-5122048	1711	231.737724	-25.013145	-0.512
25900	6.460184e+08	-5122048	2765	278.302542	-41.648896	-0.512
45979	6.460184e+08	-5122048	2764	278.302542	-41.648896	-0.512
885950	6.460184e+08	-5122048	3221	302.550024	-32.411296	-0.512
632402	6.460184e+08	-5122048	1764	235.524173	-22.684419	-0.512
150650	6.460184e+08	-5122048	1763	235.534538	-22.748926	-0.512
520972	6.460184e+08	-5122048	2511	261.654697	-43.539289	-0.512
250289	6.460184e+08	-5122048	1814	237.811479	-24.478460	-0.512
27656	6.460184e+08	-5122048	1864	237.811479	-24.478460	-0.512
1113406	6.460184e+08	-5122048	1709	230.828678	-27.715997	-0.512
1233278	6.460184e+08	-5122048	1611	229.274462	-23.708838	-0.512
789353	6.460184e+08	-5122048	1710	230.992543	-27.327275	-0.512



1210435	6.460184e+08	-5122048	1913	239.651597	-26.773896	-0.512
455335	6.460184e+08	-5122048	2614	269.189730	-40.879153	-0.512
906856	6.460184e+08	-5122048	2863	281.650892	-44.388299	-0.512
206153	6.460184e+08	-5122048	1811	235.215452	-28.018254	-0.512
84689	6.460184e+08	-5122048	1762	233.480027	-24.781447	-0.512
422783	6.460184e+08	-5122048	3308	300.483774	-54.046874	-0.512
736910	6.460184e+08	-5122048	2558	259.817107	-47.865283	-0.512
782268	6.460184e+08	-5122048	3177	303.976180	-20.882759	-0.512
958669	6.460184e+08	-5122048	2563	265.194294	-40.212961	-0.512
579284	6.460184e+08	-5122048	2259	247.994997	-40.529402	-0.512
569843	6.460184e+08	-5122048	1662	232.233721	-23.479490	-0.512
382481	6.460184e+08	-5122048	2814	280.382054	-43.766717	-0.512
259154	6.460184e+08	-5122048	2512	261.473321	-41.844376	-0.512
1281554	6.460184e+08	-5122048	3411	307.175554	-49.337118	-0.512
1099465	6.460184e+08	-5122048	3063	291.125494	-46.726858	-0.512
87126	6.460184e+08	-5122048	2864	281.736512	-42.268812	-0.512
304073	6.460184e+08	-5122048	1713	233.533869	-23.220620	-0.512
1049389	6.460184e+08	-5122048	2361	253.342345	-40.969232	-0.512
1258404	6.460184e+08	-5122048	2215	251.769158	-31.564728	-0.512
201156	6.460184e+08	-5122048	2214	251.718827	-31.536922	-0.512
447767	6.460184e+08	-5122048	3313	304.960855	-46.316169	-0.512
630179	6.460184e+08	-5122048	1862	237.305995	-27.474866	-0.512
856007	6.460184e+08	-5122048	3264	302.375365	-46.039512	-0.512
1101410	6.460184e+08	-5122048	3263	302.375365	-46.039512	-0.512
739484	6.460184e+08	-5122048	2806	271.575231	-55.470328	-0.512
1167020	6.460184e+08	-5122048	1810	233.748930	-29.088177	-0.512
464102	6.460184e+08	-5122048	2559	259.877782	-47.794978	-0.512
174922	6.460184e+08	-5122048	1912	239.077146	-28.272706	-0.512
747305	6.460184e+08	-5122048	1610	228.778445	-25.593409	-0.512
592082	6.460184e+08	-5122048	1609	228.778445	-25.593409	-0.512
573101	6.460184e+08	-5122048	1612	230.948769	-22.881078	-0.512
939248	6.460184e+08	-5122048	3622	317.404851	-30.699105	-0.512
702385	6.460184e+08	-5122048	3273	306.060304	-27.973737	-0.512
941165	6.460184e+08	-5122048	2460	258.110086	-44.432664	-0.512
656054	6.460184e+08	-5122048	2210	247.006954	-37.737053	-0.512
170081	6.460184e+08	-5122048	2211	247.006954	-37.737053	-0.512
588327	6.460184e+08	-5122048	2313	254.056177	-35.448979	-0.512
1219688	6.460184e+08	-5122048	2762	276.238833	-46.156033	-0.512
53261	6.460184e+08	-5122048	3362	305.963748	-48.027985	-0.512
415500	6.460184e+08	-5122048	2414	259.627620	-35.808247	-0.512
555955	6.460184e+08	-5122048	3016	292.651603	-40.021435	-0.512
552698	6.460184e+08	-5122048	2461	259.107668	-42.942913	-0.512
838483	6.460184e+08	-5122048	3017	292.651603	-40.021435	-0.512
934071	6.460184e+08	-5122048	2920	289.863235	-32.338575	-0.512

fluence  
847079 0.000002

985696	0.000002
115667	0.000002
100529	0.000002
232424	0.000002
1253528	0.000002
731240	0.000002
608605	0.000002
776444	0.000002
25900	0.000002
45979	0.000002
885950	0.000002
632402	0.000002
150650	0.000002
520972	0.000002
250289	0.000002
27656	0.000002
1113406	0.000002
1233278	0.000002
789353	0.000002
1210435	0.000002
455335	0.000002
906856	0.000002
206153	0.000002
84689	0.000002
422783	0.000002
736910	0.000002
782268	0.000002
958669	0.000002
579284	0.000002
569843	0.000002
382481	0.000002
259154	0.000002
1281554	0.000002
1099465	0.000002
87126	0.000002
304073	0.000002
1049389	0.000002
1258404	0.000002
201156	0.000002
447767	0.000002
630179	0.000002
856007	0.000002
1101410	0.000002
739484	0.000002
1167020	0.000002
464102	0.000002
174922	0.000002

```

747305 0.000002
592082 0.000002
573101 0.000002
939248 0.000002
702385 0.000002
941165 0.000002
656054 0.000002
170081 0.000002
588327 0.000002
1219688 0.000002
53261 0.000002
415500 0.000002
555955 0.000002
552698 0.000002
838483 0.000002
934071 0.000002

```

```

[22]: # max TS out result
print np.max(res_out_tab['TS'])
idx = res_out_tab['TS'].idxmax()
row = res_out_tab.loc[idx]
max_TSout_timeID = row['timeID']
row

```

```
17.93049827144411
```

```

[22]: Unnamed: 0    2.600000e+01
      A            2.254872e-02
      Epeak        6.309573e+02
      TS           1.793050e+01
      bkg_nllh     4.603944e+04
      dur          2.048000e+00
      gamma        1.600000e+00
      nllh         4.587869e+04
      phi          1.553214e+02
      theta        7.526322e+01
      time         6.460184e+08
      timeID       -5.122048e+06
      hp_ind       1.611000e+03
      ra           1.968750e+02
      dec          -7.180756e+00
      dt           -5.119998e-01
      Name: 221978, dtype: float64

```

```
[23]: res_out_tab.sort_values('TS', ascending=False).head(64)
```

```

[23]:      Unnamed: 0      A      Epeak      TS      bkg_nllh      dur \
221978      26  0.022549  630.957344  17.930498  46039.440354  2.048

```

221985	33	0.022179	1584.893192	17.929094	46039.440354	2.048
221981	29	0.020974	1000.000000	17.929017	46039.440354	2.048
221975	23	0.020974	1000.000000	17.929017	46039.440354	2.048
221982	30	0.022679	1000.000000	17.922284	46039.440354	2.048
221984	32	0.019930	1584.893192	17.921898	46039.440354	2.048
221970	18	0.024943	398.107171	17.915766	46039.440354	2.048
221979	27	0.023441	630.957344	17.909630	46039.440354	2.048
221977	25	0.021301	630.957344	17.895092	46039.440354	2.048
80134	30	0.016178	398.107171	17.894867	46039.440354	2.048
80130	26	0.016241	251.188643	17.888527	46039.440354	2.048
55786	26	0.015754	251.188643	17.866926	46039.440354	2.048
55790	30	0.015665	398.107171	17.866808	46039.440354	2.048
221980	28	0.018944	1000.000000	17.864619	46039.440354	2.048
80133	29	0.018363	398.107171	17.841474	46039.440354	2.048
80123	19	0.018363	398.107171	17.841474	46039.440354	2.048
154936	32	0.024452	1584.893192	17.840089	46039.440354	2.048
221983	31	0.017388	1584.893192	17.830554	46039.440354	2.048
154933	29	0.025794	1000.000000	17.827400	46039.440354	2.048
154927	23	0.025794	1000.000000	17.827400	46039.440354	2.048
221969	17	0.024301	398.107171	17.825994	46039.440354	2.048
80135	31	0.018799	630.957344	17.824023	46039.440354	2.048
80132	28	0.018799	398.107171	17.824023	46039.440354	2.048
80129	25	0.018799	251.188643	17.824023	46039.440354	2.048
154932	28	0.023299	1000.000000	17.822882	46039.440354	2.048
107065	33	0.018177	630.957344	17.821293	46039.440354	2.048
283719	23	0.022506	1000.000000	17.818541	46039.440354	2.048
283725	29	0.022506	1000.000000	17.818541	46039.440354	2.048
283728	32	0.021368	1584.893192	17.817734	46039.440354	2.048
154929	25	0.026335	630.957344	17.815834	46039.440354	2.048
154935	31	0.021280	1584.893192	17.811344	46039.440354	2.048
283722	26	0.024218	630.957344	17.810629	46039.440354	2.048
148545	33	0.018373	630.957344	17.808011	46039.440354	2.048
107062	30	0.019017	398.107171	17.807198	46039.440354	2.048
202400	32	0.022516	1584.893192	17.806689	46039.440354	2.048
80136	32	0.019193	630.957344	17.803787	46039.440354	2.048
202397	29	0.023739	1000.000000	17.803097	46039.440354	2.048
202391	23	0.023739	1000.000000	17.803097	46039.440354	2.048
89514	26	0.015306	251.188643	17.802646	46039.440354	2.048
283729	33	0.023784	1584.893192	17.800929	46039.440354	2.048
148542	30	0.019241	398.107171	17.798685	46039.440354	2.048
154930	26	0.027803	630.957344	17.797873	46039.440354	2.048
89518	30	0.015220	398.107171	17.797357	46039.440354	2.048
55779	19	0.017720	398.107171	17.794977	46039.440354	2.048
55789	29	0.017720	398.107171	17.794977	46039.440354	2.048
283721	25	0.022888	630.957344	17.790750	46039.440354	2.048
283726	30	0.024327	1000.000000	17.790552	46039.440354	2.048
202394	26	0.025575	630.957344	17.787659	46039.440354	2.048

55788	28	0.018182	398.107171	17.787334	46039.440354	2.048
55791	31	0.018182	630.957344	17.787334	46039.440354	2.048
55785	25	0.018182	251.188643	17.787334	46039.440354	2.048
202393	25	0.024184	630.957344	17.786392	46039.440354	2.048
107064	32	0.017480	630.957344	17.784851	46039.440354	2.048
80128	24	0.019659	1000.000000	17.782680	46039.440354	2.048
107050	18	0.019214	398.107171	17.782157	46039.440354	2.048
107061	29	0.019214	398.107171	17.782157	46039.440354	2.048
283714	18	0.026816	398.107171	17.782135	46039.440354	2.048
74560	32	0.013978	1584.893192	17.779294	46039.440353	2.048
107059	27	0.020302	251.188643	17.779119	46039.440354	2.048
107055	23	0.016347	1000.000000	17.778523	46039.440354	2.048
148539	27	0.020572	251.188643	17.777700	46039.440354	2.048
74561	33	0.015153	1584.893192	17.777548	46039.440353	2.048
202396	28	0.021423	1000.000000	17.775878	46039.440354	2.048
74557	29	0.014493	1000.000000	17.774910	46039.440353	2.048

	gamma	nllh	phi	theta	time	timeID	\
221978	1.6	45878.688970	155.321410	75.263221	6.460184e+08	-5122048	
221985	1.8	45878.714140	155.321410	75.263221	6.460184e+08	-5122048	
221981	1.6	45878.715529	155.321410	75.263221	6.460184e+08	-5122048	
221975	1.6	45878.715529	155.321410	75.263221	6.460184e+08	-5122048	
221982	1.8	45878.836218	155.321410	75.263221	6.460184e+08	-5122048	
221984	1.6	45878.843140	155.321410	75.263221	6.460184e+08	-5122048	
221970	1.6	45878.953011	155.321410	75.263221	6.460184e+08	-5122048	
221979	1.8	45879.062929	155.321410	75.263221	6.460184e+08	-5122048	
221977	1.4	45879.323197	155.321410	75.263221	6.460184e+08	-5122048	
80134	2.4	45879.327226	112.677901	64.787443	6.460184e+08	-5122048	
80130	2.2	45879.440648	112.677901	64.787443	6.460184e+08	-5122048	
55786	2.2	45879.826837	66.506182	64.258877	6.460184e+08	-5122048	
55790	2.4	45879.828931	66.506182	64.258877	6.460184e+08	-5122048	
221980	1.4	45879.868050	155.321410	75.263221	6.460184e+08	-5122048	
80133	2.2	45880.281265	112.677901	64.787443	6.460184e+08	-5122048	
80123	2.2	45880.281265	112.677901	64.787443	6.460184e+08	-5122048	
154936	1.6	45880.305961	156.884201	78.620145	6.460184e+08	-5122048	
221983	1.4	45880.476029	155.321410	75.263221	6.460184e+08	-5122048	
154933	1.6	45880.532266	156.884201	78.620145	6.460184e+08	-5122048	
154927	1.6	45880.532266	156.884201	78.620145	6.460184e+08	-5122048	
221969	1.0	45880.557325	155.321410	75.263221	6.460184e+08	-5122048	
80135	2.0	45880.592462	112.677901	64.787443	6.460184e+08	-5122048	
80132	2.0	45880.592462	112.677901	64.787443	6.460184e+08	-5122048	
80129	2.0	45880.592462	112.677901	64.787443	6.460184e+08	-5122048	
154932	1.4	45880.612786	156.884201	78.620145	6.460184e+08	-5122048	
107065	1.8	45880.641119	37.350698	71.161062	6.460184e+08	-5122048	
283719	1.6	45880.690145	160.059037	76.623800	6.460184e+08	-5122048	
283725	1.6	45880.690145	160.059037	76.623800	6.460184e+08	-5122048	
283728	1.6	45880.704523	160.059037	76.623800	6.460184e+08	-5122048	

154929	1.4	45880.738376	156.884201	78.620145	6.460184e+08	-5122048
154935	1.4	45880.818358	156.884201	78.620145	6.460184e+08	-5122048
283722	1.6	45880.831103	160.059037	76.623800	6.460184e+08	-5122048
148545	1.8	45880.877722	40.533213	70.874880	6.460184e+08	-5122048
107062	1.8	45880.892209	37.350698	71.161062	6.460184e+08	-5122048
202400	1.6	45880.901276	152.154065	77.287722	6.460184e+08	-5122048
80136	2.2	45880.952947	112.677901	64.787443	6.460184e+08	-5122048
202397	1.6	45880.965217	152.154065	77.287722	6.460184e+08	-5122048
202391	1.6	45880.965217	152.154065	77.287722	6.460184e+08	-5122048
89514	2.2	45880.973252	76.323252	63.713755	6.460184e+08	-5122048
283729	1.8	45881.003821	160.059037	76.623800	6.460184e+08	-5122048
148542	1.8	45881.043751	40.533213	70.874880	6.460184e+08	-5122048
154930	1.6	45881.058207	156.884201	78.620145	6.460184e+08	-5122048
89518	2.4	45881.067398	76.323252	63.713755	6.460184e+08	-5122048
55779	2.2	45881.109749	66.506182	64.258877	6.460184e+08	-5122048
55789	2.2	45881.109749	66.506182	64.258877	6.460184e+08	-5122048
283721	1.4	45881.184964	160.059037	76.623800	6.460184e+08	-5122048
283726	1.8	45881.188481	160.059037	76.623800	6.460184e+08	-5122048
202394	1.6	45881.239944	152.154065	77.287722	6.460184e+08	-5122048
55788	2.0	45881.245723	66.506182	64.258877	6.460184e+08	-5122048
55791	2.0	45881.245723	66.506182	64.258877	6.460184e+08	-5122048
55785	2.0	45881.245723	66.506182	64.258877	6.460184e+08	-5122048
202393	1.4	45881.262475	152.154065	77.287722	6.460184e+08	-5122048
107064	1.6	45881.289889	37.350698	71.161062	6.460184e+08	-5122048
80128	2.2	45881.328503	112.677901	64.787443	6.460184e+08	-5122048
107050	1.6	45881.337803	37.350698	71.161062	6.460184e+08	-5122048
107061	1.6	45881.337803	37.350698	71.161062	6.460184e+08	-5122048
283714	1.6	45881.338200	160.059037	76.623800	6.460184e+08	-5122048
74560	1.6	45881.388710	98.171415	61.514280	6.460184e+08	-5122048
107059	1.8	45881.391825	37.350698	71.161062	6.460184e+08	-5122048
107055	1.6	45881.402411	37.350698	71.161062	6.460184e+08	-5122048
148539	1.8	45881.417049	40.533213	70.874880	6.460184e+08	-5122048
74561	1.8	45881.419739	98.171415	61.514280	6.460184e+08	-5122048
202396	1.4	45881.449436	152.154065	77.287722	6.460184e+08	-5122048
74557	1.6	45881.466633	98.171415	61.514280	6.460184e+08	-5122048

	hp_ind	ra	dec	dt
221978	1611	196.8750	-7.180756	-0.512
221985	1611	196.8750	-7.180756	-0.512
221981	1611	196.8750	-7.180756	-0.512
221975	1611	196.8750	-7.180756	-0.512
221982	1611	196.8750	-7.180756	-0.512
221984	1611	196.8750	-7.180756	-0.512
221970	1611	196.8750	-7.180756	-0.512
221979	1611	196.8750	-7.180756	-0.512
221977	1611	196.8750	-7.180756	-0.512
80134	2701	202.5000	-48.141208	-0.512

80130	2701	202.5000	-48.141208	-0.512
55786	2824	285.0000	-81.219822	-0.512
55790	2824	285.0000	-81.219822	-0.512
221980	1611	196.8750	-7.180756	-0.512
80133	2701	202.5000	-48.141208	-0.512
80123	2701	202.5000	-48.141208	-0.512
154936	1633	194.0625	-4.780192	-0.512
221983	1611	196.8750	-7.180756	-0.512
154933	1633	194.0625	-4.780192	-0.512
154927	1633	194.0625	-4.780192	-0.512
221969	1611	196.8750	-7.180756	-0.512
80135	2701	202.5000	-48.141208	-0.512
80132	2701	202.5000	-48.141208	-0.512
80129	2701	202.5000	-48.141208	-0.512
154932	1633	194.0625	-4.780192	-0.512
107065	2881	355.5000	-60.434439	-0.512
283719	1636	196.8750	-2.388015	-0.512
283725	1636	196.8750	-2.388015	-0.512
283728	1636	196.8750	-2.388015	-0.512
154929	1633	194.0625	-4.780192	-0.512
154935	1633	194.0625	-4.780192	-0.512
283722	1636	196.8750	-2.388015	-0.512
148545	2880	355.0000	-63.448284	-0.512
107062	2881	355.5000	-60.434439	-0.512
202400	1610	194.0625	-9.594068	-0.512
80136	2701	202.5000	-48.141208	-0.512
202397	1610	194.0625	-9.594068	-0.512
202391	1610	194.0625	-9.594068	-0.512
89514	2566	236.2500	-78.284148	-0.512
283729	1636	196.8750	-2.388015	-0.512
148542	2880	355.0000	-63.448284	-0.512
154930	1633	194.0625	-4.780192	-0.512
89518	2566	236.2500	-78.284148	-0.512
55779	2824	285.0000	-81.219822	-0.512
55789	2824	285.0000	-81.219822	-0.512
283721	1636	196.8750	-2.388015	-0.512
283726	1636	196.8750	-2.388015	-0.512
202394	1610	194.0625	-9.594068	-0.512
55788	2824	285.0000	-81.219822	-0.512
55791	2824	285.0000	-81.219822	-0.512
55785	2824	285.0000	-81.219822	-0.512
202393	1610	194.0625	-9.594068	-0.512
107064	2881	355.5000	-60.434439	-0.512
80128	2701	202.5000	-48.141208	-0.512
107050	2881	355.5000	-60.434439	-0.512
107061	2881	355.5000	-60.434439	-0.512
283714	1636	196.8750	-2.388015	-0.512

```

74560      2605  211.5000 -60.434439 -0.512
107059     2881  355.5000 -60.434439 -0.512
107055     2881  355.5000 -60.434439 -0.512
148539     2880  355.0000 -63.448284 -0.512
74561      2605  211.5000 -60.434439 -0.512
202396     1610  194.0625  -9.594068 -0.512
74557      2605  211.5000 -60.434439 -0.512

```

```

[24]: # get best out of FoV result for each healpix pixel for a certain time bin
bl = np.isclose(res_out_tab['timeID'],max_TSout_timeID)
idx = res_out_tab[bl].groupby(['hp_ind'])['TS'].transform(max) ==
↳res_out_tab[bl]['TS']
res_hpmax_tab = res_out_tab[bl][idx]

```

```

[25]: %%time
# get fluence for each row of res_hpmax_tab
fluncs = np.zeros(len(res_hpmax_tab))
flux_pars = {'A':1.0, 'Epeak':1e2, 'gamma':0.5}
# for i in range(len(res_peak_maxSq_tab)):
i = 0
for ind, row in res_hpmax_tab.iterrows():
    flux_pars['A'] = row['A']
    flux_pars['gamma'] = row['gamma']
    flux_pars['Epeak'] = row['Epeak']
    fluncs[i] = get_eflux_from_model(flux_mod, flux_pars, 1e1, 1e3)*row['dur']
    i+=1
res_hpmax_tab['fluence'] = fluncs

```

CPU times: user 1.08 s, sys: 10.5 ms, total: 1.09 s

Wall time: 1.09 s

```

[26]: res_hpmax_tab.sort_values('TS', ascending=False).head(64)

```

```

[26]:      Unnamed: 0      A      Epeak      TS      bkg_nllh      dur  \
221978      26  0.022549  630.957344  17.930498  46039.440354  2.048
80134      30  0.016178  398.107171  17.894867  46039.440354  2.048
55786      26  0.015754  251.188643  17.866926  46039.440354  2.048
154936      32  0.024452  1584.893192  17.840089  46039.440354  2.048
107065      33  0.018177  630.957344  17.821293  46039.440354  2.048
283719      23  0.022506  1000.000000  17.818541  46039.440354  2.048
283725      29  0.022506  1000.000000  17.818541  46039.440354  2.048
148545      33  0.018373  630.957344  17.808011  46039.440354  2.048
202400      32  0.022516  1584.893192  17.806689  46039.440354  2.048
89514      26  0.015306  251.188643  17.802646  46039.440354  2.048
74560      32  0.013978  1584.893192  17.779294  46039.440353  2.048
88025      33  0.020275  1584.893192  17.771458  46039.440354  2.048
329560      32  0.014263  1584.893192  17.766826  46039.440353  2.048
226473      33  0.016477  1584.893192  17.759180  46039.440354  2.048

```



332553	33	0.015863	1584.893192	17.751229	46039.440353	2.048
171529	33	0.022911	630.957344	17.731983	46039.440354	2.048
14583	31	0.023353	1584.893192	17.724660	46039.440354	2.048
322485	29	0.025648	1000.000000	17.724416	46039.440354	2.048
322479	23	0.025648	1000.000000	17.724416	46039.440354	2.048
29680	32	0.013936	1584.893192	17.724318	46039.440353	2.048
127329	33	0.018722	630.957344	17.722726	46039.440354	2.048
27369	33	0.029638	630.957344	17.721183	46039.440354	2.048
70752	32	0.023188	1584.893192	17.719617	46039.440354	2.048
26138	26	0.013873	251.188643	17.706959	46039.440354	2.048
293786	26	0.013819	251.188643	17.706638	46039.440354	2.048
161458	26	0.016936	251.188643	17.706489	46039.440354	2.048
216137	33	0.021857	1584.893192	17.701959	46039.440354	2.048
232858	26	0.013876	251.188643	17.701618	46039.440354	2.048
277745	33	0.037155	630.957344	17.686706	46039.440355	2.048
246730	26	0.014698	251.188643	17.684729	46039.440354	2.048
209194	26	0.013841	251.188643	17.673480	46039.440354	2.048
304935	23	0.021982	1000.000000	17.672674	46039.440354	2.048
304941	29	0.021982	1000.000000	17.672674	46039.440354	2.048
300321	33	0.034760	251.188643	17.671219	46039.440355	2.048
323978	26	0.016858	251.188643	17.669435	46039.440354	2.048
9144	32	0.016314	1584.893192	17.665182	46039.440354	2.048
271080	32	0.013712	1584.893192	17.664441	46039.440353	2.048
92374	30	0.016788	398.107171	17.661864	46039.440354	2.048
273801	33	0.023881	630.957344	17.660025	46039.440354	2.048
116449	33	0.017807	630.957344	17.657479	46039.440354	2.048
59600	32	0.029812	1584.893192	17.656364	46039.440355	2.048
240208	32	0.013878	1584.893192	17.656032	46039.440353	2.048
296649	33	0.031370	251.188643	17.654681	46039.440355	2.048
75778	26	0.030810	251.188643	17.654131	46039.440355	2.048
168938	26	0.014785	251.188643	17.646472	46039.440354	2.048
72514	26	0.013722	251.188643	17.646428	46039.440354	2.048
136434	26	0.014020	251.188643	17.644468	46039.440354	2.048
183361	33	0.016294	1584.893192	17.642649	46039.440354	2.048
8873	33	0.036885	630.957344	17.639630	46039.440355	2.048
293112	32	0.023176	1584.893192	17.639439	46039.440354	2.048
104338	26	0.014168	251.188643	17.636438	46039.440354	2.048
23010	26	0.013856	251.188643	17.633867	46039.440354	2.048
57015	31	0.021830	1584.893192	17.632867	46039.440354	2.048
340033	33	0.020846	630.957344	17.623075	46039.440354	2.048
186074	26	0.015987	251.188643	17.622763	46039.440354	2.048
306576	32	0.013461	1584.893192	17.622139	46039.440353	2.048
51166	30	0.026343	398.107171	17.621523	46039.440354	2.048
93050	26	0.013896	251.188643	17.617455	46039.440354	2.048
179145	33	0.019670	630.957344	17.605445	46039.440354	2.048
185809	33	0.018188	630.957344	17.604441	46039.440354	2.048
316777	33	0.023869	630.957344	17.604097	46039.440354	2.048

213961	33	0.036630	630.957344	17.595185	46039.440355	2.048
322080	32	0.012494	1584.893192	17.594143	46039.440353	2.048
253401	33	0.018589	1584.893192	17.591670	46039.440354	2.048

	gamma	nllh	phi	theta	time	timeID	\
221978	1.6	45878.688970	155.321410	75.263221	6.460184e+08	-5122048	
80134	2.4	45879.327226	112.677901	64.787443	6.460184e+08	-5122048	
55786	2.2	45879.826837	66.506182	64.258877	6.460184e+08	-5122048	
154936	1.6	45880.305961	156.884201	78.620145	6.460184e+08	-5122048	
107065	1.8	45880.641119	37.350698	71.161062	6.460184e+08	-5122048	
283719	1.6	45880.690145	160.059037	76.623800	6.460184e+08	-5122048	
283725	1.6	45880.690145	160.059037	76.623800	6.460184e+08	-5122048	
148545	1.8	45880.877722	40.533213	70.874880	6.460184e+08	-5122048	
202400	1.6	45880.901276	152.154065	77.287722	6.460184e+08	-5122048	
89514	2.2	45880.973252	76.323252	63.713755	6.460184e+08	-5122048	
74560	1.6	45881.388710	98.171415	61.514280	6.460184e+08	-5122048	
88025	1.8	45881.527989	150.474889	73.987217	6.460184e+08	-5122048	
329560	1.6	45881.610306	101.915002	62.217269	6.460184e+08	-5122048	
226473	1.8	45881.746125	109.151918	63.863046	6.460184e+08	-5122048	
332553	1.8	45881.887294	105.569132	63.003823	6.460184e+08	-5122048	
171529	1.8	45882.228746	142.295774	74.829386	6.460184e+08	-5122048	
14583	1.4	45882.358562	161.536442	80.017266	6.460184e+08	-5122048	
322485	1.6	45882.362892	169.357543	79.590275	6.460184e+08	-5122048	
322479	1.6	45882.362892	169.357543	79.590275	6.460184e+08	-5122048	
29680	1.6	45882.364632	94.314946	60.911427	6.460184e+08	-5122048	
127329	1.8	45882.392838	140.282362	71.712146	6.460184e+08	-5122048	
27369	1.8	45882.420190	173.992294	81.197402	6.460184e+08	-5122048	
70752	1.6	45882.447942	164.725582	78.066307	6.460184e+08	-5122048	
26138	2.2	45882.672161	70.744662	70.936385	6.460184e+08	-5122048	
293786	2.2	45882.677835	74.276369	71.048463	6.460184e+08	-5122048	
161458	2.2	45882.680481	58.249786	66.022607	6.460184e+08	-5122048	
216137	1.8	45882.760686	167.966917	76.164217	6.460184e+08	-5122048	
232858	2.2	45882.766722	66.375519	70.673000	6.460184e+08	-5122048	
277745	1.8	45883.030562	175.399611	84.597367	6.460184e+08	-5122048	
246730	2.2	45883.065531	125.663590	71.774883	6.460184e+08	-5122048	
209194	2.2	45883.264404	77.511839	71.329763	6.460184e+08	-5122048	
304935	1.6	45883.278651	147.306261	76.022581	6.460184e+08	-5122048	
304941	1.6	45883.278651	147.306261	76.022581	6.460184e+08	-5122048	
300321	1.8	45883.304370	178.670475	82.891759	6.460184e+08	-5122048	
323978	2.2	45883.335887	116.159245	65.771661	6.460184e+08	-5122048	
9144	1.6	45883.411018	158.526602	73.245685	6.460184e+08	-5122048	
271080	1.6	45883.424115	90.314292	60.435224	6.460184e+08	-5122048	
92374	2.4	45883.469635	54.619968	65.901105	6.460184e+08	-5122048	
273801	1.8	45883.502115	172.624396	77.772442	6.460184e+08	-5122048	
116449	1.8	45883.547064	134.828516	70.733031	6.460184e+08	-5122048	
59600	1.6	45883.566761	170.756064	83.004100	6.460184e+08	-5122048	
240208	1.6	45883.572628	71.819128	61.564067	6.460184e+08	-5122048	

296649	1.8	45883.596469	182.007510	81.301582	6.460184e+08	-5122048
75778	2.2	45883.606176	180.122614	86.262793	6.460184e+08	-5122048
168938	2.2	45883.741365	2.714378	74.251928	6.460184e+08	-5122048
72514	2.2	45883.742144	102.714102	70.981796	6.460184e+08	-5122048
136434	2.2	45883.776725	105.903057	71.726299	6.460184e+08	-5122048
183361	1.8	45883.808830	80.664535	63.572538	6.460184e+08	-5122048
8873	1.8	45883.862078	183.439075	84.680292	6.460184e+08	-5122048
293112	1.6	45883.865457	144.148070	78.025022	6.460184e+08	-5122048
104338	2.2	45883.918377	119.253196	70.990655	6.460184e+08	-5122048
23010	2.2	45883.963713	8.362066	73.226902	6.460184e+08	-5122048
57015	1.4	45883.981353	149.008366	79.300602	6.460184e+08	-5122048
340033	1.8	45884.153975	137.068590	73.715451	6.460184e+08	-5122048
186074	2.2	45884.159470	71.516185	64.560931	6.460184e+08	-5122048
306576	1.6	45884.170462	86.126710	60.130669	6.460184e+08	-5122048
51166	1.8	45884.181314	177.290341	79.482901	6.460184e+08	-5122048
93050	2.2	45884.252998	80.664002	71.673904	6.460184e+08	-5122048
179145	1.8	45884.464515	122.205606	73.536951	6.460184e+08	-5122048
185809	1.8	45884.482181	43.708362	70.640281	6.460184e+08	-5122048
316777	2.4	45884.488246	99.512328	70.283404	6.460184e+08	-5122048
213961	2.4	45884.645089	273.515344	77.363751	6.460184e+08	-5122048
322080	1.6	45884.663423	72.844240	52.650302	6.460184e+08	-5122048
253401	1.8	45884.706921	145.477965	72.800853	6.460184e+08	-5122048

	hp_ind	ra	dec	dt	fluence
221978	1611	196.875000	-7.180756	-0.512	0.000003
80134	2701	202.500000	-48.141208	-0.512	0.000003
55786	2824	285.000000	-81.219822	-0.512	0.000003
154936	1633	194.062500	-4.780192	-0.512	0.000004
107065	2881	355.500000	-60.434439	-0.512	0.000003
283719	1636	196.875000	-2.388015	-0.512	0.000003
283725	1636	196.875000	-2.388015	-0.512	0.000003
148545	2880	355.000000	-63.448284	-0.512	0.000003
202400	1610	194.062500	-9.594068	-0.512	0.000004
89514	2566	236.250000	-78.284148	-0.512	0.000003
74560	2605	211.500000	-60.434439	-0.512	0.000002
88025	1608	196.875000	-12.024699	-0.512	0.000003
329560	2607	208.636364	-57.399524	-0.512	0.000002
226473	2695	204.230769	-51.255807	-0.512	0.000002
332553	2693	206.250000	-54.340912	-0.512	0.000002
171529	1558	194.062500	-19.471221	-0.512	0.000003
14583	1638	194.062500	0.000000	-0.512	0.000004
322485	1656	196.875000	7.180756	-0.512	0.000004
322479	1656	196.875000	7.180756	-0.512	0.000004
29680	2599	215.000000	-63.448284	-0.512	0.000002
127329	1556	196.875000	-22.024313	-0.512	0.000003
27369	1659	196.875000	12.024699	-0.512	0.000004
70752	1639	196.875000	2.388015	-0.512	0.000004

26138	2560	225.000000	-87.075820	-0.512	0.000003
293786	2562	202.500000	-84.149733	-0.512	0.000003
161458	2822	326.250000	-78.284148	-0.512	0.000003
216137	1650	199.687500	4.780192	-0.512	0.000003
232858	2816	315.000000	-87.075820	-0.512	0.000003
277745	1745	194.062500	14.477512	-0.512	0.000005
246730	2733	194.062500	-35.685335	-0.512	0.000003
209194	2568	195.000000	-81.219822	-0.512	0.000003
304935	1565	194.062500	-14.477512	-0.512	0.000003
304941	1565	194.062500	-14.477512	-0.512	0.000003
300321	1748	196.875000	16.957763	-0.512	0.000004
323978	2703	201.000000	-44.993880	-0.512	0.000003
9144	1614	199.687500	-4.780192	-0.512	0.000003
271080	2597	219.375000	-66.443536	-0.512	0.000002
92374	2823	333.000000	-75.340734	-0.512	0.000003
273801	1657	199.687500	9.594068	-0.512	0.000003
116449	2747	196.875000	-27.279613	-0.512	0.000003
59600	1658	194.062500	9.594068	-0.512	0.000005
240208	2565	258.750000	-78.284148	-0.512	0.000002
296649	1749	199.687500	19.471221	-0.512	0.000004
75778	1750	194.062500	19.471221	-0.512	0.000006
168938	1035	354.375000	-27.279613	-0.512	0.000003
72514	2691	192.272727	-57.399524	-0.512	0.000002
136434	2697	191.250000	-54.340912	-0.512	0.000003
183361	2572	225.000000	-75.340734	-0.512	0.000002
8873	1751	196.875000	22.024313	-0.512	0.000005
293112	1564	191.250000	-16.957763	-0.512	0.000004
104338	2726	194.062500	-41.810315	-0.512	0.000003
23010	1032	354.375000	-32.797168	-0.512	0.000003
57015	1567	191.250000	-12.024699	-0.512	0.000004
340033	1553	194.062500	-24.624318	-0.512	0.000003
186074	2564	255.000000	-81.219822	-0.512	0.000003
306576	2575	225.000000	-69.422546	-0.512	0.000002
51166	1662	199.687500	14.477512	-0.512	0.000004
93050	2570	191.250000	-78.284148	-0.512	0.000003
179145	2732	191.250000	-38.682187	-0.512	0.000003
185809	2837	354.375000	-66.443536	-0.512	0.000003
316777	2689	193.500000	-60.434439	-0.512	0.000005
213961	963	315.000000	51.255807	-0.512	0.000007
322080	2580	263.571429	-69.422546	-0.512	0.000002
253401	1559	196.875000	-16.957763	-0.512	0.000003

```
[27]: def get_dlogl_peak_out(res_peak_tab, res_out_tab):
      '''
      returns DeltaLLH_peak and DeltaLLH_out for the time bin with the max TS
      '''
```

```

idx = res_peak_tab['TS'].idxmax()
row = res_peak_tab.loc[idx]

timeID = row['timeID']
imdists = im_dist(row['imx'], row['imy'], res_peak_tab['imx'],
↳res_peak_tab['imy'])
bld = (imdists>0.012)&(res_peak_tab['timeID']==timeID)

dlogl_peak = np.nanmin(res_peak_tab[bld]['nllh']) - row['nllh']

blo = (res_out_tab['timeID']==timeID)

dlogl_out = np.nanmin(res_out_tab[blo]['nllh']) - row['nllh']

return dlogl_peak, dlogl_out

def get_dlogls_inout(res_tab, res_out_tab):
    '''
    returns DeltaLLH_peak, DeltaLLH_out, timeID for each time bin
    '''

    dlogls = []
    dlogls_in_out = []
    timeIDs = []
    for timeID, df in res_tab.groupby('timeID'):
        idx = df['TS'].idxmax()
        row = df.loc[idx]
        imdists = im_dist(row['imx'], row['imy'], df['imx'], df['imy'])
        bld = (imdists>0.012)
        try:
            dlogls.append(np.nanmin(df[bld]['nllh']) - row['nllh'])
        except Exception as E:
            print(E)
            dlogls.append(np.nan)
        blo = np.isclose(res_out_tab['timeID'],timeID,rtol=1e-9,atol=1e-3)
        dlogls_in_out.append(np.nanmin(res_out_tab[blo]['nllh']) - row['nllh'])
        timeIDs.append(timeID)
    return dlogls, dlogls_in_out, timeIDs

```

```

[28]: dlogl_peak, dlogl_out = get_dlogl_peak_out(res_peak_tab, res_out_tab)
print("\Delta LLH_peak = %.3f"%(dlogl_peak))
print("\Delta LLH_out = %.3f"%(dlogl_out))

```

```

\Delta LLH_peak = 13.408
\Delta LLH_out = 17.664

```

```
[29]: # %%time
dlogls_peak, dlogls_out, list_timeIDs = get_dlogls_inout(res_peak_tab,
↳res_out_tab)
for i in range(len(list_timeIDs)):
    print "timeID = %d"%(list_timeIDs[i])
    print "\Delta LLH_peak = %.3f"%(dlogls_peak[i])
    print "\Delta LLH_out = %.3f"%(dlogls_out[i])
    print
```

```
timeID = -5122048
\Delta LLH_peak = 13.408
\Delta LLH_out = 17.664
```

```
timeID = -2561024
\Delta LLH_peak = 0.842
\Delta LLH_out = 7.147
```

```
timeID = 1024
\Delta LLH_peak = 0.449
\Delta LLH_out = 2.511
```

```
timeID = 2561024
\Delta LLH_peak = 0.341
\Delta LLH_out = 4.529
```

```
[ ]:
```