Lab 9 Worksheet

You are required to hand this worksheet in at the end of the lab.

Name:____________________ User Name:____________________

- The places you need to put your answer in this worksheet are marked by "__________".

Use the following wget command to download the data folder `00769177000/` and result folder `00769177000-results/` for GRB170823A from the BAT GRB catalog website `https://swift.gsfc.nasa.gov/results/batgrbcat/`:

wget -nH –cut-dirs=4 -r -l3 -c -N -np -R 'index*' -R '*gif' -erobots=off –retr-symlinks `https://swift.gsfc.nasa.gov/results/batgrbcat/GRB170823A/data_product/00769177000/`

wget -nH –cut-dirs=4 -r -l3 -c -N -np -R 'index*' -R '*gif' -erobots=off –retr-symlinks `https://swift.gsfc.nasa.gov/results/batgrbcat/GRB170823A/data_product/00769177000-results/`

(If it takes too long to download, copy the folders from `/n/ursa/A288C/alien/lab09_test`.)

Use these data to do the following questions:

1. **Mask-weighted counts**

   (a) Create a **mask-weighted** light curve with 1-s bin for 15-350 keV. Write down the command you used (no need to write down the full path, just the command name).

   ____

   (b) Find the highest count and the corresponding error in this mask-weighted light curve. Write down the command you used and the highest mask-weighted count rate.

   Command: ________________________.

   Highest mask-weighted count rate R_{max}: ________________________.

   (c) Find the number of enabled detectors in the header of the event file `00769177000-results/events/sw00769177000b_all.evt` (use the ftlist with option K).

   Number of enabled detectors: ________________________.

   (d) Find the number of enabled detectors that would be illuminated for an on-axis source.

   Number of illuminated detectors for on-axis source = (Number of enabled detectors)/2.0 = ________________________.

   (e) What is the partial coding fraction for this burst? You can find this information either on the burst web page or the report.txt in the `00769177000-results` folder.

   Partial coding fraction (pcode) = ________________________.

(f) From the partial coding fraction and the number of enabled detectors, estimate the number of illuminated detectors.

Number of illuminated detectors $N_{\text{lum}} \sim$ ____________________.

(g) From the file `00769177000/tdrss/sw00769177000msbce.fits.gz`, find the burst incident angle (BATTHETA).

The incident angle $\theta =$ __________ deg = __________ radian.

(h) Estimate the raw count rate (i.e., non-mask-weighted count rate) that corresponds to this highest mask-weighted count by doing the following:

i. Uncorrect the "per total number of enable detector", that is,

$R_{\text{max}} \times N_{\text{lum}} =$ ____________________.

ii. Uncorrect the "fully illuminated detectors". Here we assume that detectors are either fully illuminated or not illuminated, so this factor is simply one.

iii. Uncorrect the cos(θ) effect (i.e., the flatfield effect):

$R_{\text{max}} \times N_{\text{lum}} \times cos(\theta) =$ ____________________.

(i) From webpage of GRB170823A, find the the raw light curve and estimate the average background count rate (note that the raw light curve is plotted with 1.6 s bin size), the peak count rate, and the net peak count rate from the burst.

Average background count rate = ____________________.

Peak count rate = ____________________.

Net peak count rate from the burst = ____________________.

2. For the same burst, GRB,170823A, do the following analyses of the burst durations and the peak time intervals:

(a) Use batbinevt to create the mask-weighted light curve with 1-s bin and in 15-150 keV.

(b) Use battblocks to find T_{100}, T_{90}, T_{50}, and 1-s peak time for the 15-150 keV light curve.

$T_{100} =$ __________, $T_{90} =$ __________, $T_{50} =$ __________

The start of 1-s peak time relevent to T0 = __________.

(c) Using this light curve, calculate the total count in T_{100}, T_{90}, and T_{50}.

Total count in $T_{100} =$ __________ $\pm$ __________.

Total count in $T_{90} =$ __________ $\pm$ __________.

Total count in $T_{50} =$ __________ $\pm$ __________.

(d) Calculate the following fractions:

$$\frac{\text{Count in T}_{90}}{\text{Count in T}_{100}} = \underline{\hspace{3cm}}.$$

$$\frac{\text{Count in T}_{50}}{\text{Count in T}_{100}} = \underline{\hspace{3cm}}.$$

(e) Modify the setting of battblocks to find the 64-ms peak time.

The start time of the 64 ms peak (relative to T0) is __________.

The end time of the 64 ms peak (relative to T0) is __________.

(f) (Optional) Write a code to

i. Calculate the accumulated counts from the beginning of the light curve to the start time of T_{100}.
The accumulated count C_{T100}^{start} is __________.

ii. Calculate the accumulated counts from the beginning of the light curve to the end time of T_{100}.
The accumulated count C_{T100}^{end} is __________.

iii. Calculate the accumulated counts from the beginning of the light curve to the start time of T_{90}.
The accumulated count is C_{T90}^{start} __________.
The fraction $C_{T90}^{\text{start}}/C_{T100}^{\text{end}}$ is __________.

iv. Calculate the accumulated counts from the beginning of the light curve to the end time of T_{90}.
The accumulated count is C_{T90}^{end} __________.
The fraction $C_{T90}^{\text{end}}/C_{T100}^{\text{end}}$ is __________.