ASTR 288C

Homework 6

Due: 3:30pm, Oct. 16, 2017

- **In your home directory, create a directory on the ursa machine called** `homework6_yourname`**. Put all your codes in this directory.**.
- **Name your code in this format: question1.py, question2a.py...etc, where the 1 and 2a refer to the question number.**
- **The instructor will test run your code in order to grade it.**
- **In all your code, write brief comments to describe each command/step in your code (similar to the comments in the example codes). This will be part of your grade.**

1. [**5 points**] In the BAT energy range, the spectrum of GRB170519A follows a simple power law function

$$f(E) = 5.25 \times 10^{-4} \left(\frac{E}{50 \text{ keV}} \right)^{-1.948}, \tag{1}$$

where f(E) is the photon flux at energy E, with units of photons cm^{-2} s^{-1} KeV^{-1}. Write a code to calculate f(E) at E=15 keV and E=100 keV, respectively. Have your code print out these two values on the screen, with sufficient print-out information showing which value is for which energy. For example, you can have your code print out a sentence like "At E=15 keV, f(E) = <the value>".

2. Use the summary table from the *Swift*/BAT Gamma-Ray Burst catalog
`https://swift.gsfc.nasa.gov/results/batgrbcat/summary_cflux/summary_general_info/summary_general.txt`
to find out the answers to the following questions **by writing python codes**:

   (a) [**5 points**] How many GRBs are detected by BAT in year 2013? Have your code print out the total number in 2013 on the screen.

   (b) [**10 points**] There is a column in the table called "XRT_detection", which indicates whether the burst is also detected by XRT. Find out the fraction long GRBs ($T_{90} > 2$ s) that have XRT detections, and the fraction of long GRBs that do not have XRT detections. Have your code print out both of these fractions (to the screen), with clear print-out description of which one is which.

3. Download the redshift table from this link `https://swift.gsfc.nasa.gov/results/batgrbcat/summary_cflux/summary_general_info/GRBlist_redshift_BAT.txt`.
This table contains the GRB redshift information. Use this table to find out the answers to the following questions **by writing python codes**.
In the following questions, ignore all the redshifts that are questionable (those with a question mark) and those that are upper or lower limits (those with a $<$ or $>$ symbol):

   (a) [**5 point**] What is the average redshift of BAT-detected GRBs? Have your code print out the average to the screen.

   (b) [**10 points**] What is the GRB with the highest redshift? What is the redshift of this burst? Have your code print out both the GRB name and the redshift of the highest redshift burst (to the screen).

   (c) [**10 points**] The advanced LIGO can detect gravitational waves from binary neutron star mergers out to 440 Mpc, which is equivalent to redshift $z = 0.1$. How many BAT-detected GRBs are within this redshift? Have your code save the GRB name of these nearby GRBs to a file named `nearby_GRBs.txt`.

   (d) [**10 points**] Following question 3c, find the burst duration T_{90} of the nearby GRBs (those within $z = 0.1$). Have your code save the GRB name, redshift, and T_{90} of these nearby GRBs to a file named `nearby_GRBs_T90.txt`. You need to use both the redshift table `GRBlist_redshift_BAT.txt` and the summary table `summary_general.txt` for this question.

   (e) [**5 points**] Following question 3d, are there any reported short GRBs within $z = 0.1$? If so, have your code print out "Nearby short GRB found" to the screen, otherwise have your code print out "No nearby short GRB found" to the screen.