



The Star Formation Rate of Long Gamma-ray Bursts and the Luminosity Function.



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Abstract:

In this research project the luminosity function of gamma-ray bursts was computed using the Efron-Petrosian method, which allowed us to find such properties a non-parametric way. Data gathered from the Swift and Konus-Wind satellites was added for the first time by Fermi Satellite. The computation showed similar traces and patterns of the luminosity function compared to the ones of presented by Petrosian et al 2015. Further development needs to be performed for the display of the star formation rate.

Methods:

In project, a non-parametric approach for obtaining the luminosity function was used: Efron-Petrosian method. According to Petrosian et al 2015, the luminosity function can be obtain as a function of a single variable (bolometric luminosity), and a constant value (redshift) as shown in the following equation:

$$\Psi(L, z) = \dot{\rho}(z)\psi[L/g(z), \alpha_i]/g(z),$$

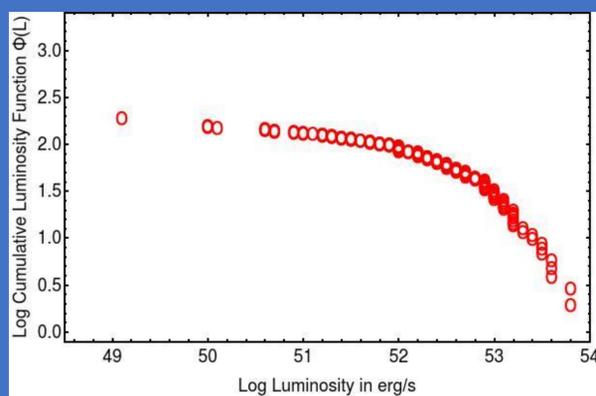
The computations were made in Wolfram Mathematica.

Background:

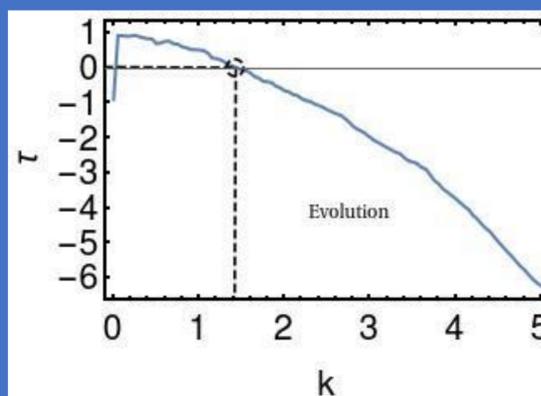
By the time the research program started, star formation rate was first calculated using the Fermi telescope. By the end of the project, star formation rate calculation using Gamma-Ray bursts as standard candles was already done by other group of researchers. However, the uniqueness of this projects lies on the fact that it was indeed the first time in the history of Astrophysics that the calculation of the star formation rate was obtained using *Swift*, *Konus-Wind*, and *Fermi* satellites.

Results:

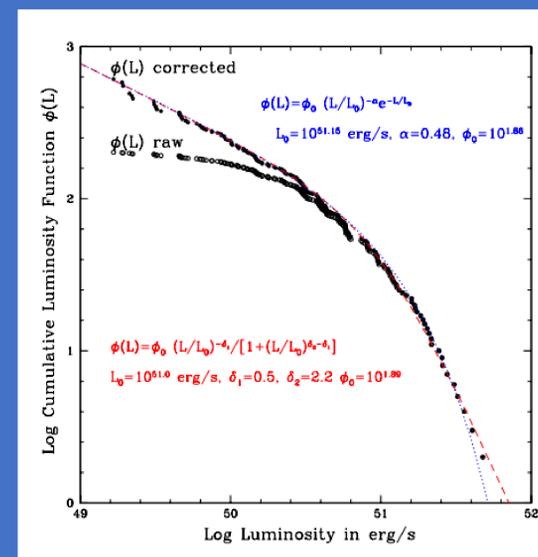
After the data gathering phase, the computation outputted the following graphics:



Luminosity function of Fermi



Evolution Rate of Fermi



Luminosity function of Swift in Petrosian et al. 2015

Conclusion:

My work in this internship was to practically math the results obtained by Petrosian et al. 2015 with a new set of data. The pace of the work was rather slow due to the fact that my mentor and I stumbled upon difficulties in the validity of the data and the effectiveness of the code. The work was successful as the graphics obtained from the Mathematica program had quite similar characteristics as the ones depicted in Petrosian et al. 2015. Star formation rate was a stage that I could not get in this 8-week internship, but my mentor continued the efforts in this project.

References: Petrosian, Vahé, Ellie Kitanidis, and Daniel Kocevski. "Cosmological Evolution of Long Gamma-Ray Bursts and the Star Formation Rate." *The Astrophysical Journal* 806.1 (2015): 44.