CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
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Project Number
S1718

Project Title
The Effects of Interstellar Medium on the X-Ray Spectral Characteristics of Gamma Ray Bursts

Abstract

Objectives/Goals
Gamma Ray Bursts (GRBs) are episodes of intense extra-galactic expulsion of gamma radiation punctuated by a multi-wavelength afterglow. Approximately 25% of gamma ray bursts do not emit an optical wavelength afterglow and this study investigates the potential effect of interstellar medium as an absorber of the optical light.

Methods/Materials
A sample size of 100 GRBs detected by the NASA Swift Telescope was used for this study. 10 GRBs were immediately discarded for having insufficient data for this study's purposes. 90 GRBs were separated into two different categories; those with No Optical Afterglows (NOAs) and those with Optical Afterglows (OAs). Both categories were spectrally analyzed in the x-ray wavelengths for elements present in the interstellar medium (C VI, Ne IX, Fe XVII, O VII, and O VIII). Every possible combination of ion components were statistically compared as potential GRB OA absorbers. GRBs with NOA were additionally analyzed for patterns in their x-ray spectrum data in order to identify the optical afterglow absorption chemical makeup.

Results
No particular indication of interstellar medium appeared in GRBs with no optical afterglows, nor did other combination of ion components. A significantly strong signature of magnesium appeared in 90% of GRBs with NOA while only appearing in approximately 30% of GRBs with OA, creating a meaningful disparity.

Conclusions/Discussion
From the data, it is likely that the currently hypothesized interstellar medium and its components are not the cause of GRBs with NOA. The chemical presence of Mg I is a strong indicator that GRBs with NOA are likely to be found in central star-forming regions of galaxies. Abundances of this element have been found in regions of galaxies where massive stars are located. Gamma Ray Bursts are the most powerful explosions in the universe and studying what very little is known about them is of paramount importance in determining the potential distribution of life in galaxies, learning about stellar mechanics, and proving controversial topics about the laws of our universe.

Summary Statement
This study examined the phenomena of dark gamma ray bursts using x-ray spectroscopy data.

Help Received
None