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Studying gravitational lensing effect using GRB from Fermi mission

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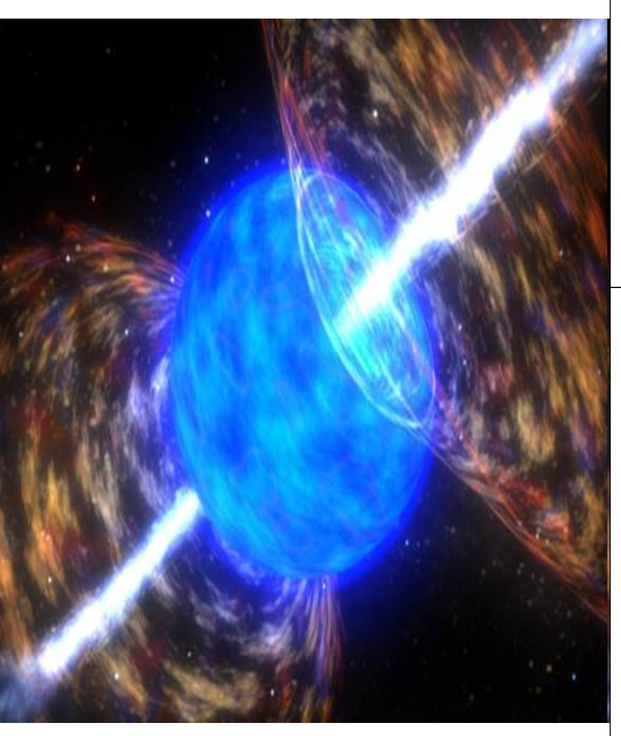
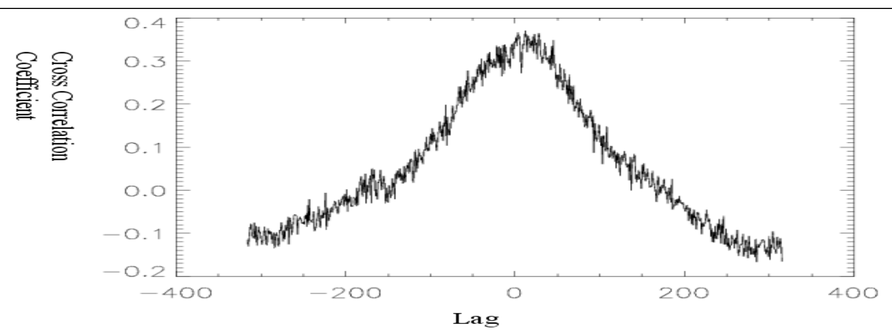
Overview

The gravitational lensing effect can lead to multiple images of a distant target galaxy when a massive galaxy lies between the Earth and the target galaxy. Since gamma-ray bursts often occur with a high-energy value, they are possible candidates for observing the gravitational lensing effect. We report here a search of multiple imaging of gamma-ray bursts due to the gravitational lensing effect. We use data provided by the Fermi Science Support Center and the GRB team. All possible pairs of bursts were put through the following tests: cross-correlation analysis, energy ratios, and certain spectral analyses.

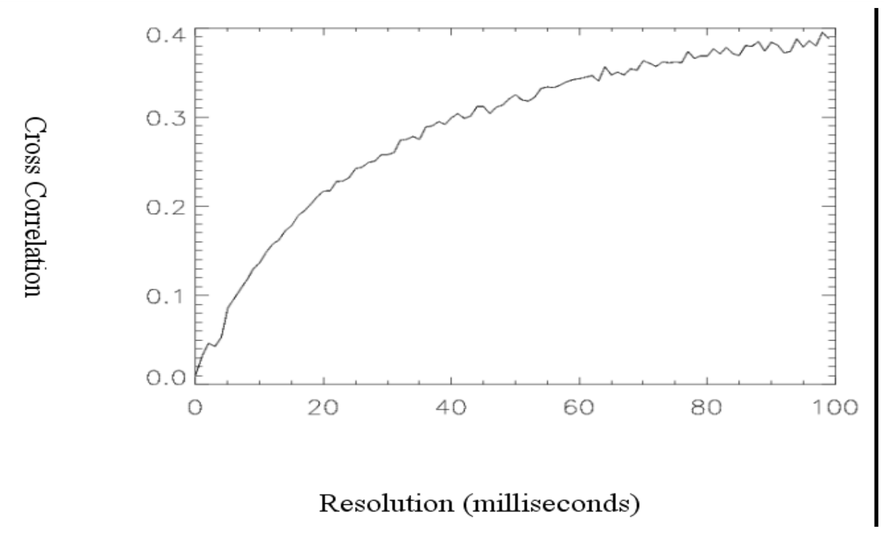


The cross correlation curves created from each pair of burst were observed for symmetry about its center and a peak value near the center.



The relationship between the cross-correlation peak and the resolution of the two bursts was observed for a linear behavior.

These images are of tests correlation tests done on the pairs bn081109293 and bn080804972.



The ratio of one curve to another within a pair was expected to be close to a constant.

Spectral properties such as the E-peak value were expected to be within error of one another within each pair.

Key Findings

After putting every possible pair of gamma ray bursts through this series of tests, a dramatic reduction was found. Using a total 132,000 possible combinations of GRB's, we found three pairs that were interesting candidates for observing gravitational lensing. The results of the best candidate from these three pairs is shown above. With this degree of scrutiny, these tests can reveal gravitational lensing of GRB's should they happen in the future.

Impact

Devising a way detect the occurrence of gravitational lensing with gamma ray bursts gives us yet another method of probing the universe. The energetic properties of these bursts make what information we can gather about them very valuable. The detection of this gravitational lensing will allow us to use these GRB's as distant lights illuminating the previously unobservable, thus expanding our view of the universe.

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