ICRC2015

ICRC
The Astroparticle Physics Conference
34th International Cosmic Ray Conference
July 30 - August 6, 2015
The Hague, The Netherlands

Contribution ID: **1202** Type: **Poster contribution**

A new time-dependent likelihood technique for detection of gamma-ray bursts with IACT arrays

Thursday 30 July 2015 15:30 (1 hour)

In imaging atmospheric Cherenkov telescope arrays (IACTs), the standard method of statistically inferring the existence of a source is based on the maximum likelihood method of Li&Ma (1983). We will present a new statistical approach, also based on maximum likelihood theory, which takes into account a priori knowledge of the source light curve. This approach is especially useful for observations of rapidly decaying gamma-ray bursts (GRBs). Using Monte Carlo simulations, the new maximum likelihood test statistic is evaluated under realistic conditions for GRBs observed by current generation IACT arrays, and a moderate improvement in sensitivity is projected. To calculate the improvement, we conservatively assume that the Li&Ma integration time has been optimally chosen, which isn't possible in reality without prior knowledge of the burst fluence. The sensitivity improvement depends on the decay index of the burst and the observing delay, but is projected to be approximately 30% for a typical observation near the threshold of detection (typical is defined as a burst observed with a 2min delay and that decays as a power law of index -1). An even larger improvement is projected for quickly observed, rapidly decaying GRBs. The method is shown to be relatively resilient to uncertainties in the light curve, as long as it still captures the decaying nature of the GRB flux. We will also discuss results established by using this technique to analyze VERITAS GRB observations.

Collaboration

VERITAS

Registration number following "ICRC2015-I/"

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Session Classification: Poster 1 GA

Track Classification: GA-EX