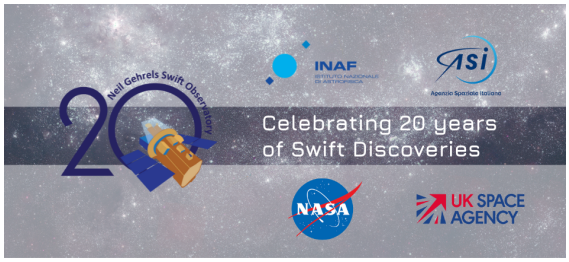

Contribution ID: **170** Type: **Contributed talk**

Teaching an old BAT new tricks: New analysis methods and results with Swift/BAT-GUANO

Tuesday 25 March 2025 17:15 (15 minutes)

In 2017 the detection of the faint GRB 170817A jointly with gravitational waves vaulted us into the era of multi-messenger astronomy, but it also showed us the need for an increased sensitivity to faint GRBs. This motivated efforts to develop sensitive, targeted searches for GRBs that run on the ground. The Gamma-ray Urgent Archiver for Novel Opportunities (GUANO) came online in 2019 to fill the need of having the full resolution Swift/BAT data delivered to the ground on command. With data available, more sensitive analyses were able to be performed. The most sensitive being the Non-Imaging Transient Reconstruction and Temporal Search (NITRATES), a forward-folding, likelihood-based analysis that has improved the detection rate of GRB 170817A-like bursts by a factor of ~3 over the status quo. The combination of GUANO data and the NITRATES analysis has lead to a ~60% increase in the number of short GRBs localized to an arcminute scale by Swift/BAT over the past few years. The functionality of the NITRATES analysis has recently been expanded to perform inference over the whole sky, creating localization skymaps for GRBs that are either too weak to be localized to a single arcminute-scale peak or originate from outside BAT's coded field of view. For optimal orientations, localizations for bursts outside the coded field of view can be as small as ~100 square degrees, rivaling the localization capability of scintillator based instruments. Coded aperture instruments make it possible to resolve gamma-rays and hard x-rays, and the NITRATES analysis is a novel technique that can greatly increases their functionality and sensitivity to transients.

Development is currently underway on a joint, coherent analysis of Swift/BAT and Fermi GBM data. This analysis would merge each instruments' strengths and effective areas while having mostly independent backgrounds, resulting in the most sensitive search possible for weak GRBs. This analysis will hopefully create a framework for analysis of a network of gamma-ray detectors that allows for very different instrument properties. Work is also under way on further analyses that can detect and possibly localize weak GRBs in continuous Swift/BAT data products with limited resolution.

In this talk I will discuss the needs for sensitive gamma-ray transient searches, the basics of the NITRATES analysis, and highlight some results made possible by GUANO and NITRATES, including extensive limits set on prompt GRB emission around gravitational wave events and the detection of "delayed" gamma-rays from the Einstein Probe transient EP240315a. I will end the talk with a discussion of ongoing development on further analyses that will hopefully be able to be applied to the long history of archival Swift data and to future instruments.

Primary author: DELAUNAY, Jimmy (Penn State)

Presenter: DELAUNAY, Jimmy (Penn State)

Session Classification: GRB as probes