Fermi

Gamma-ray Space Telescope

Users Group Meeting
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LAT Onboard GRB Search

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LAT Onboard GRB Search

- **Select events, onboard recon**
  - **Filter for gamma-like events**
    - **currently all events passing gamma-filter, but would like to look for additional background rejection.**
  - **Reconstruct onboard tracks**
    - **Combine 2-D projections to find 3-D tracks, select "best" track.**
- **Tier 1 - Pretrigger**
  - **Search through sliding windows of fixed number of events for clusters in space and time.**
  - **Pass into tier 2 if cluster prob exceeds a predefined threshold**
- **Tier 2 - Trigger (get here from Tier 1, or from GBM seed location)**
  - **Compile event list within Tier 1 or GBM seed location radius.**
  - **Declare a GRB if probability exceeds a predefined threshol**
- **Burst refinement**
  - **Localization obtained by iteratively calculated weighted mean location**
  - **Recalculate location at sequence of configurable count thresholds.**
  - **Alert notices sent out at fixed time intervals: 1, 2, 4, 8,16, 32, 600 seconds**

LAT GRB Search - GBM Seeded Search

- **GBM sends trigger location to LAT at 2 5 10 20 30 60 90 and 150s**
- **Ra, Dec from GBM trigger is used as the seed location for search (LAT search commences when GBM message arrives)**
- **Current config**
  - **Onboard threshold is TS>0, so always trigger immediately on detection of first LAT event within 10 deg of GBM location.**
  - **We apply a filter of TS>120 on the ground before sending GCN notice.**
- **Two reasons to change this**
  - **Enabling a delayed search, by not triggering on the first GBM message, we allow the possibility of triggering on later ones.**
  - **Allowing the LAT-only search to run without hindrance**
    - **Long LAT searches will not trigger if the GBM seeded window has already generated a spurious trigger and put the LAT in GRB mode.**
- **Optimize and test updated config using existing LAT-detected bursts**
  - **Now complete, new configuration will be uploaded within the next two weeks**
  - **Localizations range from 0.1 to 0.5 deg typically.**

LAT GRB Search

Potential detections with new configuration:

GRB	2s	5s	10s	20s	30s	60s	90s	150s
080825	n	n	n	n	n	n	n	n
080916C	n	y						
081024B	y							
090227	n	n	n	n	n	n	n	n
090323	n	n	n	n	n	n	n	n
090328	n	n	n	n	n	n	n	n
090510*	y							
090626	n	n	n	n	n	n	n	n
090902	n	n	y	y				
090926	n	y						
091003	n	n	n	n	n	n	n	n
091031	n	n	n	n	n	n	n	n
100116*	n	n	n	n	n	n	n	n

Questions?

Test Statistics and Search Method

$$P_S = \sum_{i=1}^{M} |\log_{10}(p_{s_i})| = \sum_{i=1}^{M} \left| \log_{10}\left(\frac{1-\cos(\theta_i)}{1-\cos(\theta_m)} \right) \right| .$$

$$P_T = \sum_{i=1}^{M} |\log_{10}(p_{t_i})| = \sum_{i=1}^{M} \left| \log_{10}(1 - e^{-r_t \Delta T_i}) \right| .$$

- **Tier 1**
  - **Consider n events from entire sky (n = 40 or 80)**
  - **For each event calculate P_S and P_T using all events within a 17 deg radius using the ra, dec of the first event as a seed position.**
  - **P_S+P_T is roughly proportional to the number of events -> theta dependence**
  - **If P_S+αP_T > Thres1 pass into Tier 2 (α=1)**
- **Tier 2**
  - **Use the location from Tier 1 as a seed location (or a GBM position)**
  - **Calculate P_S and P_T for N_{prev} events (N_{prev} =200 for LAT and 500 for GBM seeds), add additional events to the P_S, P_T calculation until P_S+αP_T>Thres2, or 1 second has elapsed since entering tier 2 (this means that we can't set Thres2 low to determine the null distribution)**