Adding the GLAST Burst Monitor to the 3rd Interplanetary Network

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Abstract. The addition of the GLAST Burst Monitor to the interplanetary network is discussed. The IPN can detect about 32% of the GBM events, and reduce the sizes of their error boxes substantially. These error boxes have a wide variety of uses.

Keywords: gamma-rays: bursts, GLAST GBM, Interplanetary Network

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INTRODUCTION

The GLAST Burst Monitor (GBM) is expected to detect approximately 200 bursts/year. Its threshold sensitivity should be 0.35 photons cm^{-2} s^{-1} for untriggered bursts, which can be compared to the BATSE threshold of about 0.1 photons cm^{-2} s^{-1}. The localization accuracy depends on time: 8^{o} accuracies should be available onboard, in real time, 5^{o} in near real time, and 3^{o} accuracy should be achieved after manual intervention. By bringing the GBM into the interplanetary network, many of these bursts can be localized to arcminute precision with delays longer than near real time, but possibly less than those associated with manual intervention.

PREDICTING THE IPN PERFORMANCE

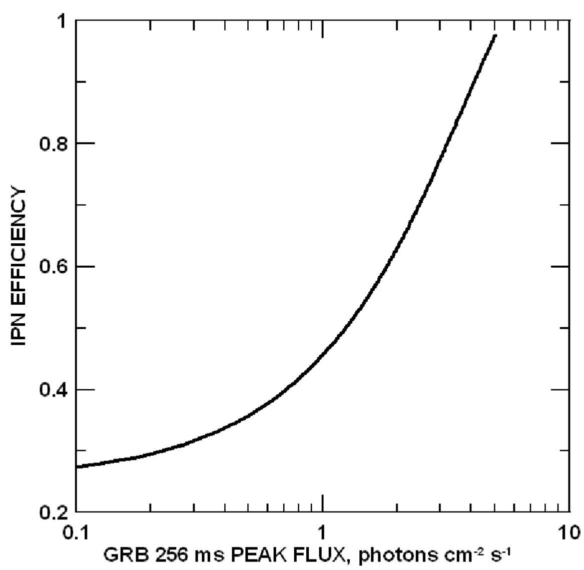

FIGURE 1. The IPN efficiency as a function of flux for detecting BATSE bursts. This is the probability of detecting a burst of a given flux or greater.

The IPN performance with the GBM can be predicted by considering the BATSE results. 919 BATSE GRBs were observed and localized by the IPN, as well as many SGR bursts. The IPN efficiency for detecting bursts of a given flux is shown in fig. 1. The resulting IPN annulus widths are shown in fig. 2. When BATSE and a single, distant IPN spacecraft observed a GRB, the result was a single annulus of location which usually intersected the BATSE 1σ error circle and reduced its area by 1.5 – 2 orders of magnitude. When two or more distant spacecraft observed the burst, the annuli intersected to form an error box and reduce the area by up to four orders of magnitude (fig. 3). The IPN-BATSE results were published in four catalogs [1,2,3,4]. They were also used by the BATSE team to refine the BATSE localization uncertainties [5].

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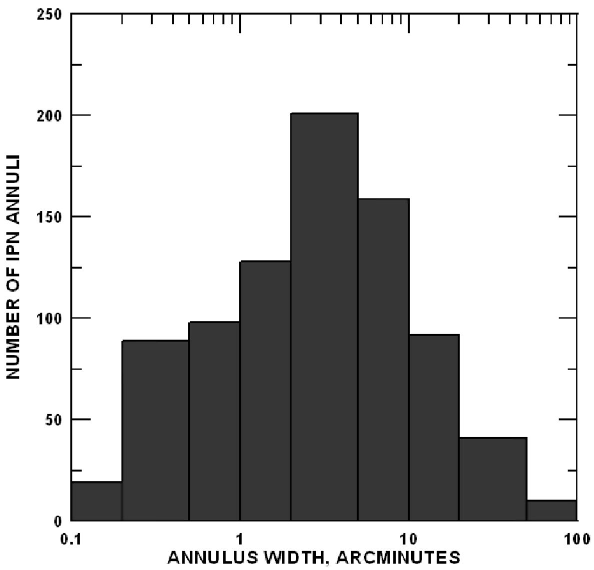

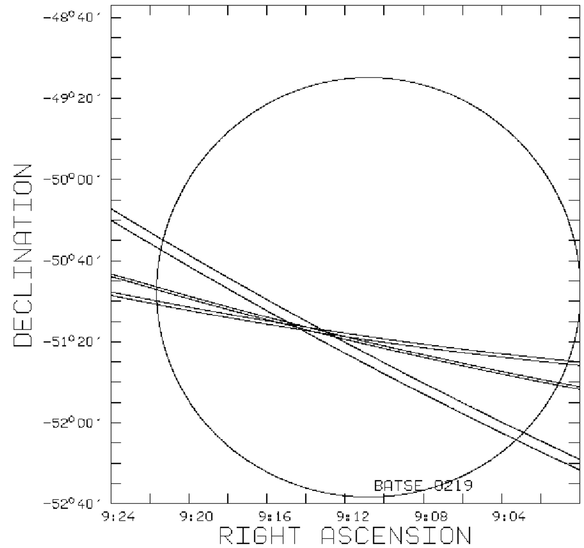

FIGURE 2. Distribution of the widths of IPN-BATSE annuli.

FIGURE 3. Error circle of BATSE 0219, and IPN annuli.

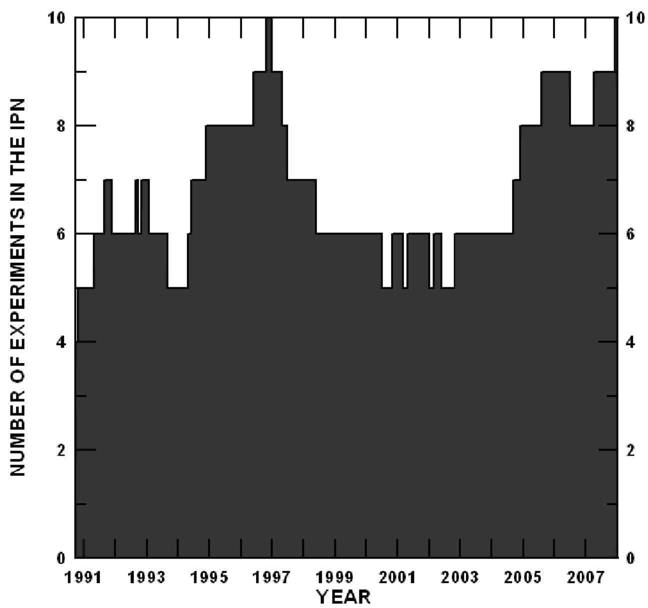

FIGURE 4. The number of the spacecraft in the IPN since 1990.

After GLAST is launched at the end of 2007, the IPN will include Ulysses, Mars Odyssey, and MESSENGER, in interplanetary space, Wind and INTEGRAL at distances up to 5 light-seconds from Earth, and Swift, RHESSI, and Suzaku, in low Earth orbit. AGILE will probably have been added too, and GLAST will bring the total number to 10 (fig. 4). This is the largest number of missions that the IPN has had since its inception in 1990. The addition of an 11^{th} experiment currently aboard the Space Station is under discussion (I. Mitrofanov, private communication).

GLAST AND THE IPN

The GLAST Burst Monitor will be the 28th experiment to join the 3rd IPN since it was formed in 1990. Based on the BATSE results, in particular figure 1, which indicates that the IPN efficiency should be about 32% for bursts above the GBM threshold, we can predict that GBM error boxes will be substantially improved for about 70 bursts/year. Even though these localizations will not be done in real time, they will have a wide range of uses. First, they can be used to refine the GBM localization uncertainty. Second, they will be useful for analyzing LAT observations of GBM error boxes. Here, even a single IPN annulus can be useful, just as it was for GRB940217 (fig. 5). Delayed localizations can be used by the AMANDA, Ice Cube, RICE, and ANITA groups for neutrino searches, by the Milagro group for VHE gamma-ray emission searches, and by the LIGO group for gravitational radiation searches. Finally, they can be used to declare Swift ToO observations of interesting events.

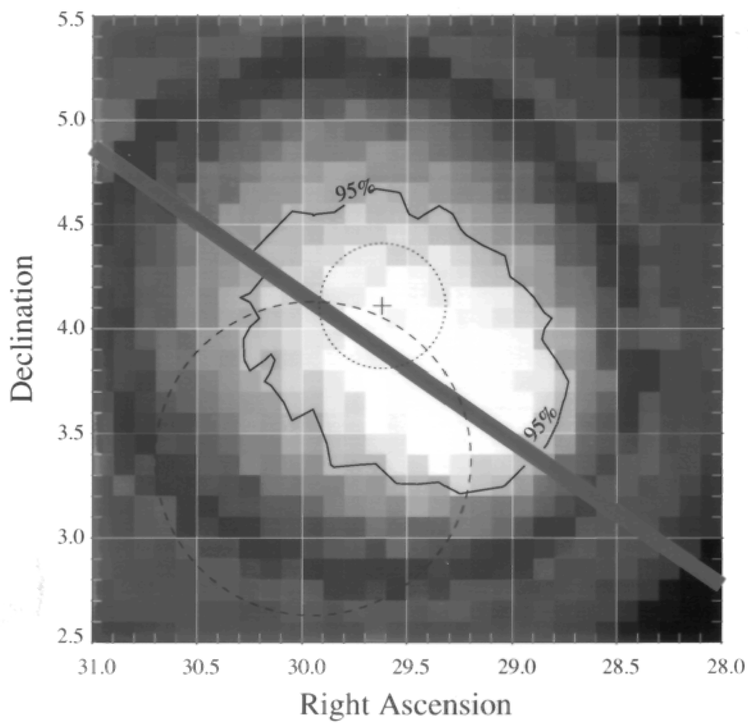

FIGURE 5. EGRET, COMPTEL, and IPN localizations of GRB940217 [6]. The EGRET localization of the main burst is shown with the 95% contour; the localization of the 18 GeV photon is shown with the dotted circle. The COMPTEL localization of the main burst is shown with the dashed circle. The IPN annulus intersects all of them.

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