

Abstract

The Flare Advocate/Gamma-ray Sky Watcher (FA-GSW) program, part of the Fermi LAT Science Operations, provides for a prompt review and analysis of the quick-look Automatic Science Processing (ASP) products. The FA-GSW service offers alerts of potentially interesting seeds for LAT science outlooking the gamma-ray sky day by day and communicating news to the external astrophysical community. This is important to increase the rate of multi-frequency observations and follow-ups that could maximize science return. For example during the first 32 months of the Fermi mission, the FA-GSWs discovered many gamma-ray flares from blazars, short and long duty cycles of blazars and other AGNs, unidentified transients near the Galactic plane, flares from Galactic sources (like the Crab nebula), confirmed the gamma-ray emission of the quiet sun and the active sun, compiled more than 130 Astronomical Telegrams, pointed out new gamma-ray sources, and provided starting seeds for several LAT-triggered multifrequency campaigns.

The Flare Advocate Service

Fermi LAT is a all-sky survey monitor and the high-energy sky is often variable and transient, therefore the FA-GSW activity is performed with continuity for all the year through weekly shifts. The FA-GSW points out something potentially interesting and first sends it to the different LAT science groups. Basic summaries about the gamma-ray sky on six and twenty-four hour intervals are communicated along with any relevant news to the external astrophysical community (through the LAT-MW mailing-list, Astronomical Telegrams and the Fermi Sky Blog with weekly digests). This allows us to promote and increase the rate of multi-frequency collaborations and observations, maximizing the scientific return.

The role and activity of the FA-GSW is twofold (Fig.1).

Gamma-ray Flare Advocate task

This is a role similar to the LAT burst-advocate (for GRBs). Sources exceeding 1E-6 photons/cm²/s are always deserving attention. This activity is addressed to release internal fast notes, ATels, ToO triggers for multi-frequency observations, and to start possible ToO multi-frequency campaigns, LAT multi-frequency papers, and papers on single sources in general (with the possibility to be also a friend and contact person for a LAT source).

Gamma-ray Sky Watcher task

All the daily and 6h ASP process results are quickly inspected, looking at the detected LAT sources in the sky (Galactic and extragalactic source candidates), searching for flares and brightness trends, and for possible new candidate gamma-ray sources.

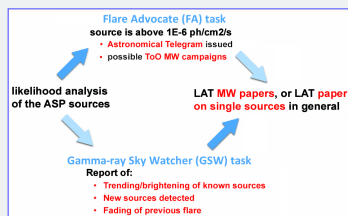


Figure 1: the service routine of the Fermi LAT gamma-ray Flare Advocates (also known as Gamma-ray Sky Watchers).

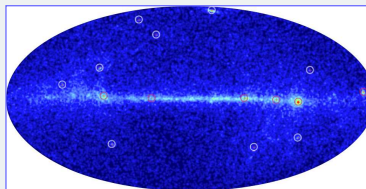


Figure 2: Typical count-map output of the Automatic Science Processing (ASP) task that performs an all sky and quick guess-detection using wavelets, and makes a first rough source association of the directions where gamma-rays are clustered. Flare advocates, among other tasks, perform a quicklook analysis for detection, flux and photon index of each candidate source using the gtlake LAT science tool in the daily and 6h interval all-sky maps.

Some results

For particularly interesting sources and possible new sources a likelihood check of detection, flux and spectral index is performed joined with the inspection of count maps (Fig.2), exposure maps and localization. A short daily internal report is compiled day by day and a short teleconference is performed periodically in the Collaboration. The Fermi sky blog (Fig. 6) is updated with the public weekly summary. Finally software or other technical issues are also reported during the FA shift. FA-GSWs discovered many new gamma-ray blazars and flares from blazars, major outbursts (Fig.3, 4), some galactic plane transients, quiet-sun and flaring-sun emission, peculiar and new findings like gamma-ray flares from the Crab Nebula and the star nova V407 Cygni (Fig. 4) and transients and flares still un-associated or not clearly associated to known sources.

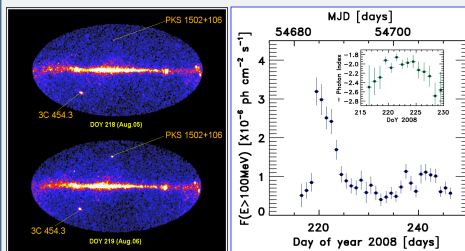


Figure 3: Left panel: ASP all-sky daily count maps showing the fast outburst of a gamma-ray source discovered during the first FA shift and later identified with the flat spectrum radio quasar PKS 1502+106. Right panel: likelihood flux (at E>100MeV) light curve of PKS 1502+106 obtained by Fermi LAT and reported in daily time bins during August 2008 showing the asymmetric outburst (Abdo et al. 2010a).

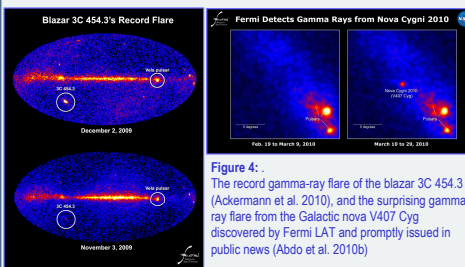


Figure 4: The record gamma-ray flare of the blazar 3C 454.3 (Ackerhann et al. 2010), and the surprising gamma-ray flare from the Galactic nova V407 Cyg discovered by Fermi LAT and promptly issued in public news (Abdo et al. 2010b)

Many ToO were submitted to space observatories (Swift in particular) and radio-optical facilities. The FA-GSW activity is inherently also a multi-frequency job, starting from the quick-look association of daily sources through the exploit of multifrequency databases (like ASDC, NED, CDS, HEASARC, VO, for example) to the work needed to lead a multifrequency campaign.

Flare Advocate activities are important to getting the best science from Fermi LAT as demonstrated in the first 32 months of the Fermi LAT all-sky survey. Productivity and benefits for international scientific cooperation are increasing thanks also to this service. A wide instrumental field of view, a proper scanning mode orbit and relentless cosmic source monitoring activities are all indispensable ingredients of a successful campaign aimed at targeting high-energy flaring sources since the onset of the transient. The FA monitor activity represents the liaison between LAT Collaboration and the external scientific community and is frequently the starting point of multifrequency campaigns and breakthrough articles in the field.

- 128 ATels posted by the LAT collaboration from July 24th, 2008 to March 4th, 2011 (MJD 54671-55624, i.e. 953 days). From ATel #1628 to ATel #3207.
- Most of them following FA activities (new gamma-ray blazar pop-up or bright flares of known gamma-ray blazars), a few following science activities by the galactic or pulsar group independently by the FA service.
- Most of the ATel have AGNs and blazar subject.
- 17 ATels are Swift quicklook results only (from ToO observations after a LAT flare, issued on behalf of the Fermi collaboration).
- 2 ATels are about joined Fermi-Swift results.
- 1 ATel is about joined Fermi-Integral results.
- 1 ATel is about joined Fermi-optical results.
- 1 ATel is about joined Fermi-HESS results.
- 16 ATels are about galactic sources (objectregions: 3EG J0005-3531, Cygnus Region, J1057-6027, J1016+6134, V407 Cyg, J1512-3221, Cygnus X-3, binary system PSR B1259-63, Crab Nebula, PSR B1259-63, Galactic center region).

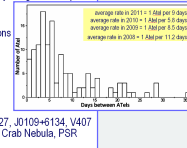


Figure 5: some statistics about the Fermi LAT Astronomical Telegrams (ATels) published till March 4th, 2011.

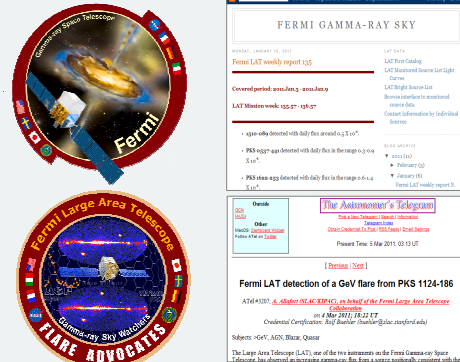


Figure 6: The Fermi gamma-ray sky blog and one example of ATel issued by a Flare Advocate

Acknowledgements. Authors warmly express their gratitude to all the Fermi LAT Flare Advocates (Gamma-ray Sky Watchers) and to people who worked to build and maintain high-level science analysis software, like the LAT Automatic Science Processing.

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