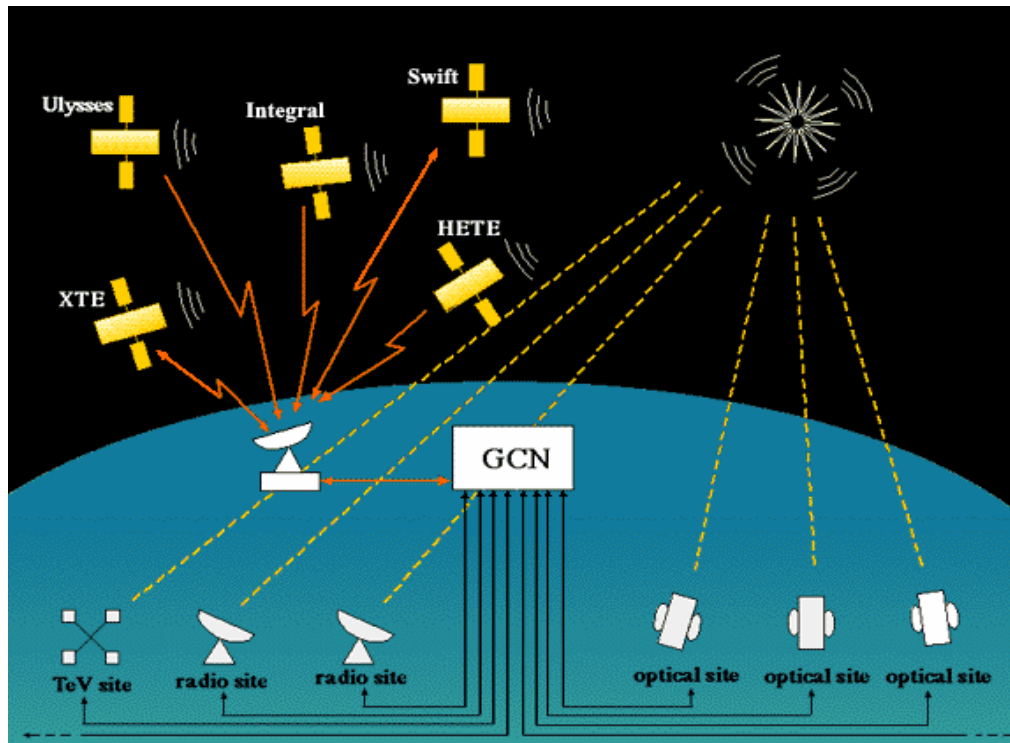


# **GCN : Gamma-ray Burst Coordinates Network**



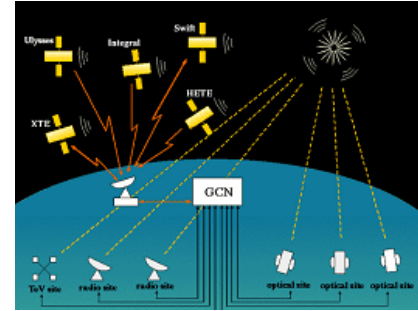
**La physique d'AMS :  
enjeux et perspectives  
scientifiques**

**LAPP Annecy  
9 & 10 mars 2010**

**Claude Zurbach**

**Laboratoire de Physique Théorique et Astroparticules – Montpellier**

# The Gamma-ray bursts Coordinates Network



## The GCN system distributes :

**locations of GRBs (the Notices)** detected by spacecraft  
(most in real-time while the burst is still bursting)

**reports of follow-up observations (the Circulars and the Reports)**  
made by ground-based and space-based optical, radio, X ray, TeV, and other particle observers


In summary, **the GCN assumes** :

- ❑ the real-time (and near real-time) distribution of GRB locations detected by various spacecrafts (Swift, INTEGRAL, IPN, Fermi etc...),
- ❑ the distribution of follow-up observation reports submitted by the GRB community

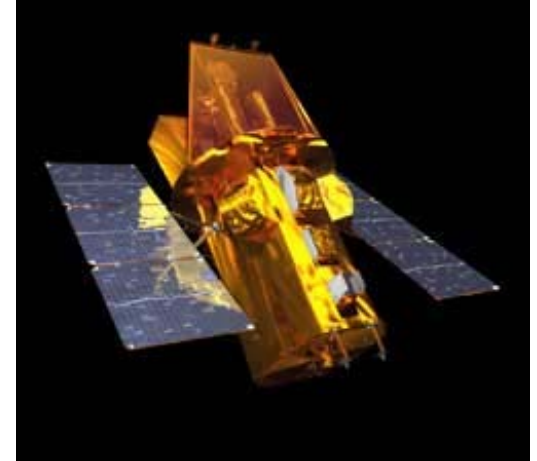
**NASA Web site** : <http://gcn.gsfc.nasa.gov/gcn>  
NASA Goddard Space Flight Center

# The Gamma-ray bursts Coordinates Network

## Overview of experiments involved

ACTIVE	FUTURE	OLD INACTIVE
<a href="#">XTE-PCA</a>	-	<a href="#">CGRO</a>
<a href="#">XTE-ASM</a>	-	<a href="#">BeppoSAX</a>
<a href="#">IPN</a>	-	<a href="#">NEAR</a>
<a href="#">INTEGRAL</a>	-	<a href="#">ALEXIS</a>
<a href="#">Swift</a> 	-	<a href="#">HETE</a>
<a href="#">AGILE</a>	-	<a href="#">MILAGRO</a>
<a href="#">SIMBAD-NED</a>	-	-
<a href="#">Fermi</a>	-	-

The **Swift** Gamma-Ray Burst Mission is the first provider for GCN alerts.



Swift made also best-ever ultraviolet portrait of Andromeda galaxy



# The Gamma-ray bursts Coordinates Network

## The various sources of GRB location : current missions

SOURCE	TIME DELAY	ERROR BOX SIZE	RATE	COMMENTS
IPN_POS	0.5-1.5 days	5-20' dia	3/month	Small FOV telescopes.
INTEGRAL_WAKEUP	60 sec	10'	1/month	Small FOV.
INTEGRAL_REFINED	60-100 sec	5'	1/month	Small FOV.
INTEGRAL_OFFLINE	60-200 sec	3-5'	1/month	Small FOV.
RXTE-ASM	1-2 hours	4'x15-150'	8/year(2)	Small FOV telescopes.
RXTE-PCA	3-5 hours	6-40' dia	6/year(2)	Small FOV telescopes.
Swift-BAT_POS	13-40 sec(1)	1-5' dia	2/week	Fast and Small.
Swift-XRT_POS	30-80 sec(1)	5" dia	2/week	Fast and Small.
Swift-UVOT_POS	0.2-9 hrs(1)	2" dia	1/week	Fast and Small.
SuperAGILE	20-40 sec	20' dia	1/month	Small FOV.
Fermi-GBM	20 sec	4-10 deg dia	15/month	Large FOV telescopes.
Fermi-LAT	100 sec	10-30' dia	1/month	Small FOV telescopes.

\* The **InterPlanetary netGamma-Ray Burst Timing network** (IPN) is a group of spacecraft (Ulysses, Fermi, Agile, Mars Odyssey...) mainly equipped with gamma-ray burst detectors. By timing the arrival of a burst at several spacecraft, precise location is found.

# The Gamma-ray bursts Coordinates Network

## Description of the GCN Notices portion

The Notices are the result of information received by GCN from the various spacecraft in real-time, processed into a standard format and automatically distributed to people wishing to receive specific Notices (based on a variety of filtering conditions). The automation minimizes the time delay between the moment the gamma-rays hit the instrument detectors and when the location information is available to the follow-up observers telescope.

## Description of the GCN Circulars portion

This part allows the GRB community to submit messages to a central queue where they are automatically distributed (e-mail) to the entire GRB community. These are prose-style messages (as opposed to the "TOKEN: value" style of the GCN e-mail messages) (a) from follow-up observers reporting on their results (detections or upper limits) or (b) calls for coordinating with others.

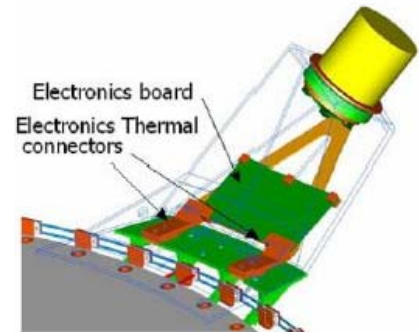
## Description of the GCN Reports portion

Reports are also prose-style write-ups on burst observation, but they are issued at a later time (not quick like the Circulars), allowing the observers to do the full analysis and corrections to the measurements. They are distributed (e-mail) to the entire GRB community.

# The Gamma-ray bursts Coordinates Network

## AMS-02 Star Tracker : detector pointing direction

By installing a **Star Tracker** (which provides an angular resolution of a few arc seconds), AMS will become a sensitive high energy (up to 300 GeV) gamma ray detector. Within AMS, the highest angular precision is provided in the measurement of gamma rays which convert in the upper layers of the detector and the resulting  $e^+ e^-$  pair is then measured in the silicon tracker.



To correlate these sources with phenomena observed in other bands of the electromagnetic spectrum (radio, infrared, visible, UV and X-ray), it is necessary to get the precise direction in which the detector is pointing when the gamma ray arrived.

To avoid any systematic shifts, a pair of small optical telescopes are mounted on each side of the upper silicon tracker which acquire the images of the stars. Then the AMICA on board software selects the camera from which to perform the acquisition, compare these with an on-board **astrometric star catalogue** (derived from the Smithsonian Astrophysical Observatory (SAO) catalog and contains 15 945 stars brighter than magnitude 7).

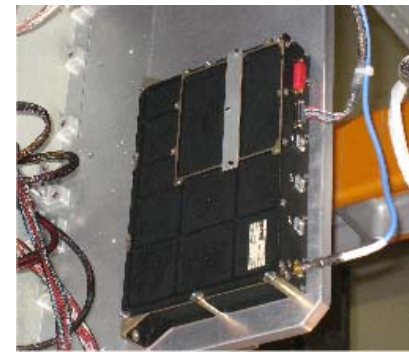
With this information, the attitude of AMS can be determined within an **accuracy of a few arc seconds at rates up to 20 Hz**.

# The Gamma-ray bursts Coordinates Network

## AMS-02 GPS receiver : UTC time

In addition to the directional correlation provided by the Star Tracker, the physics accessible by measuring gamma rays also requires the precise, to a few microseconds, temporal correlation of measurements by AMS-02.

The unit contains a processor and a dedicated ASIC to convert the GPS signals and emit timing pulse (PPS), which is used to reset a local timer within the trigger system.



Interface electronics within the M-Crate then receive the precise time at which the pulse was emitted.

This UTC time is included, along with the value of the local timer, in the event data.