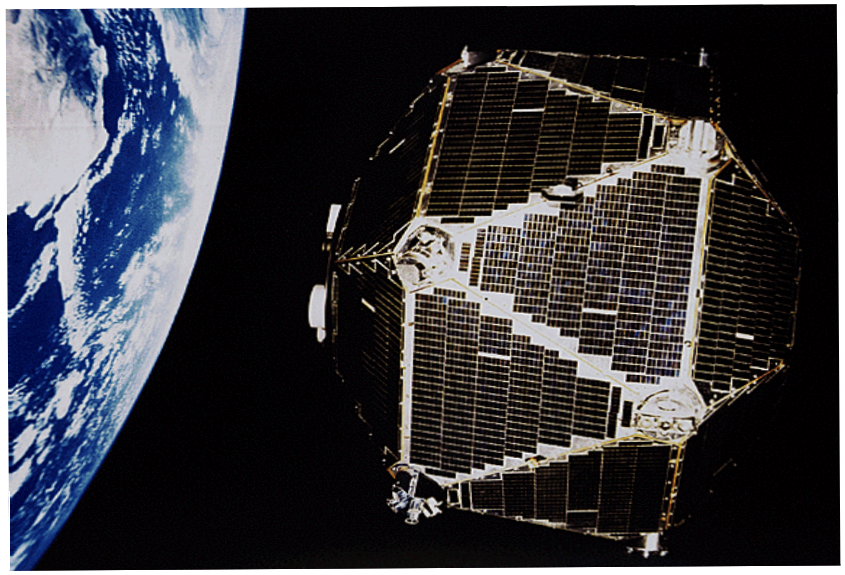
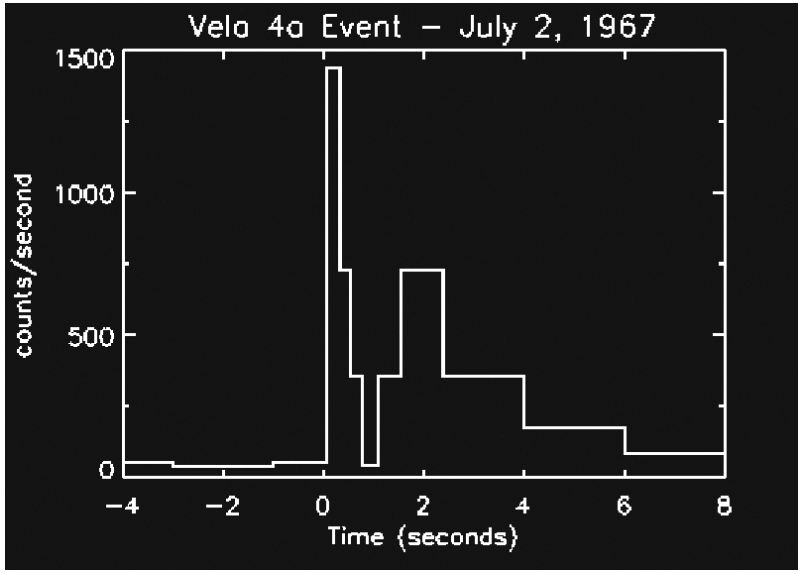
Hunting GRBs and other Transients with MAGIC.

L.A. Antonelli

INAF-OAR & ASI-SSDC

Gamma Ray Bursts





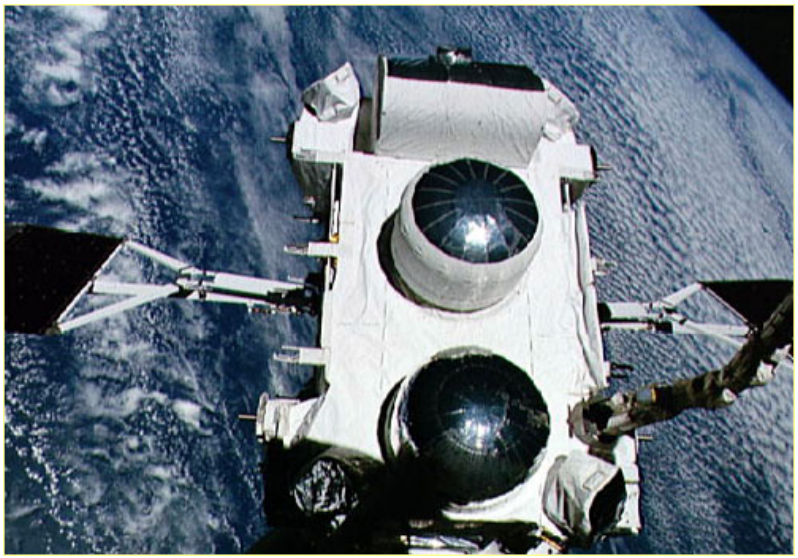
THE ASTROPHYSICAL JOURNAL, 182:L85–L88, 1973 June 1

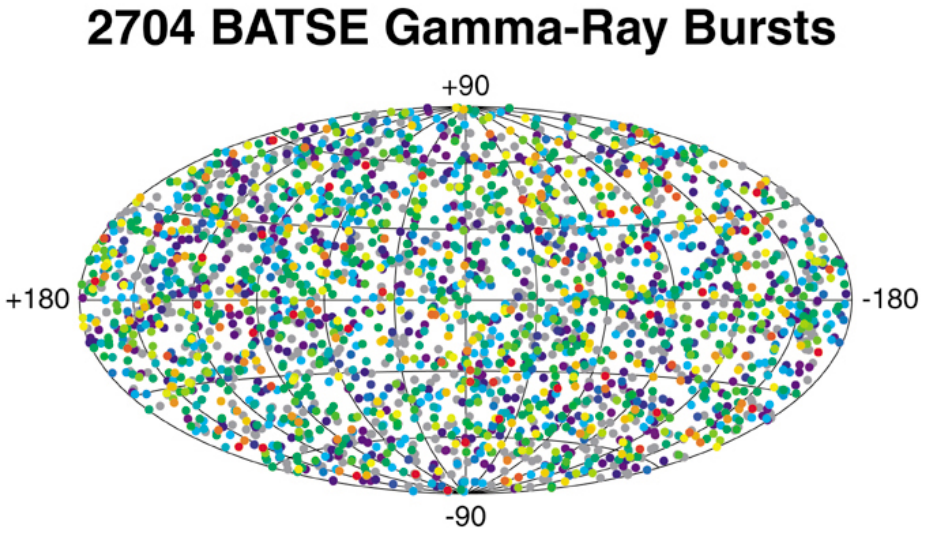
OBSERVATIONS OF GAMMA-RAY BURSTS OF COSMIC ORIGIN

RAY W. KLEBESADEL, IAN B. STRONG, AND ROY A. OLSON

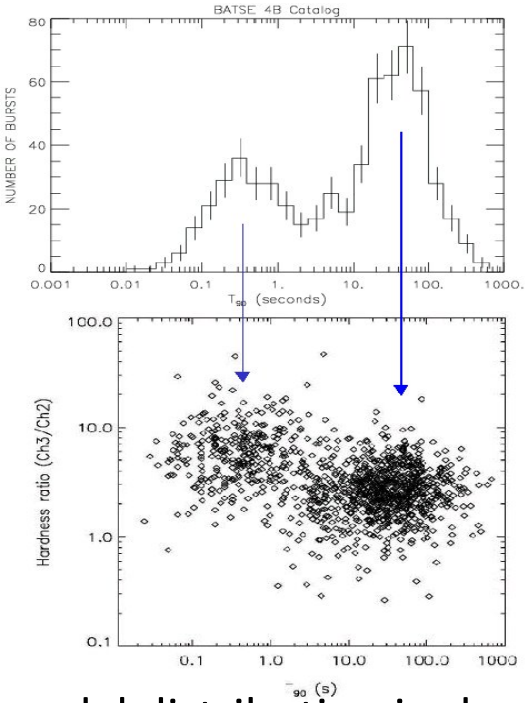
University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico
Received 1973 March 16; revised 1973 April 2

GRB: status of the art at the end of ‘90

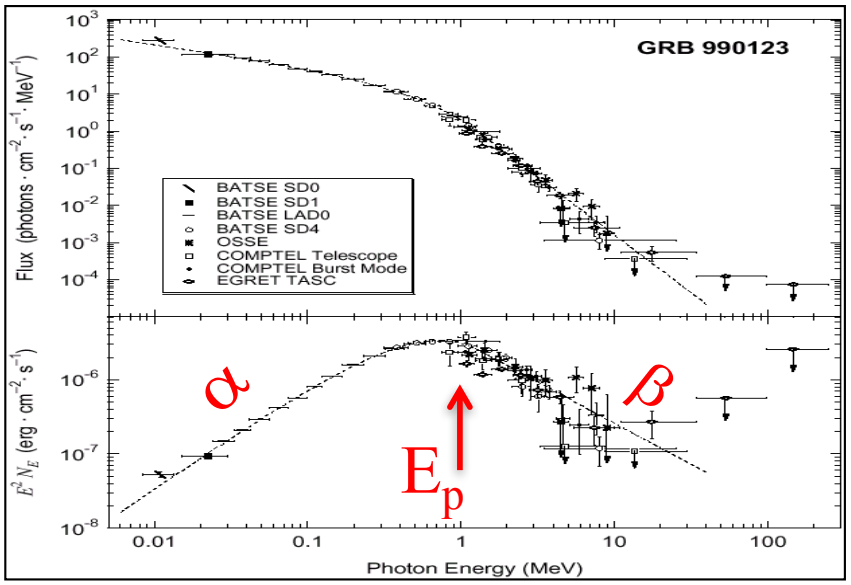




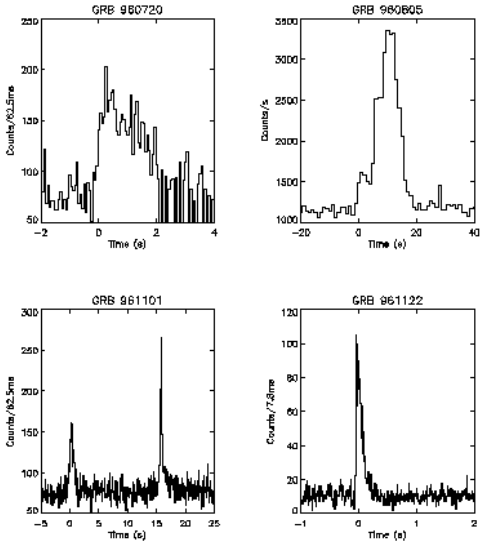
isotropic distribution



bimodal distribution in duration

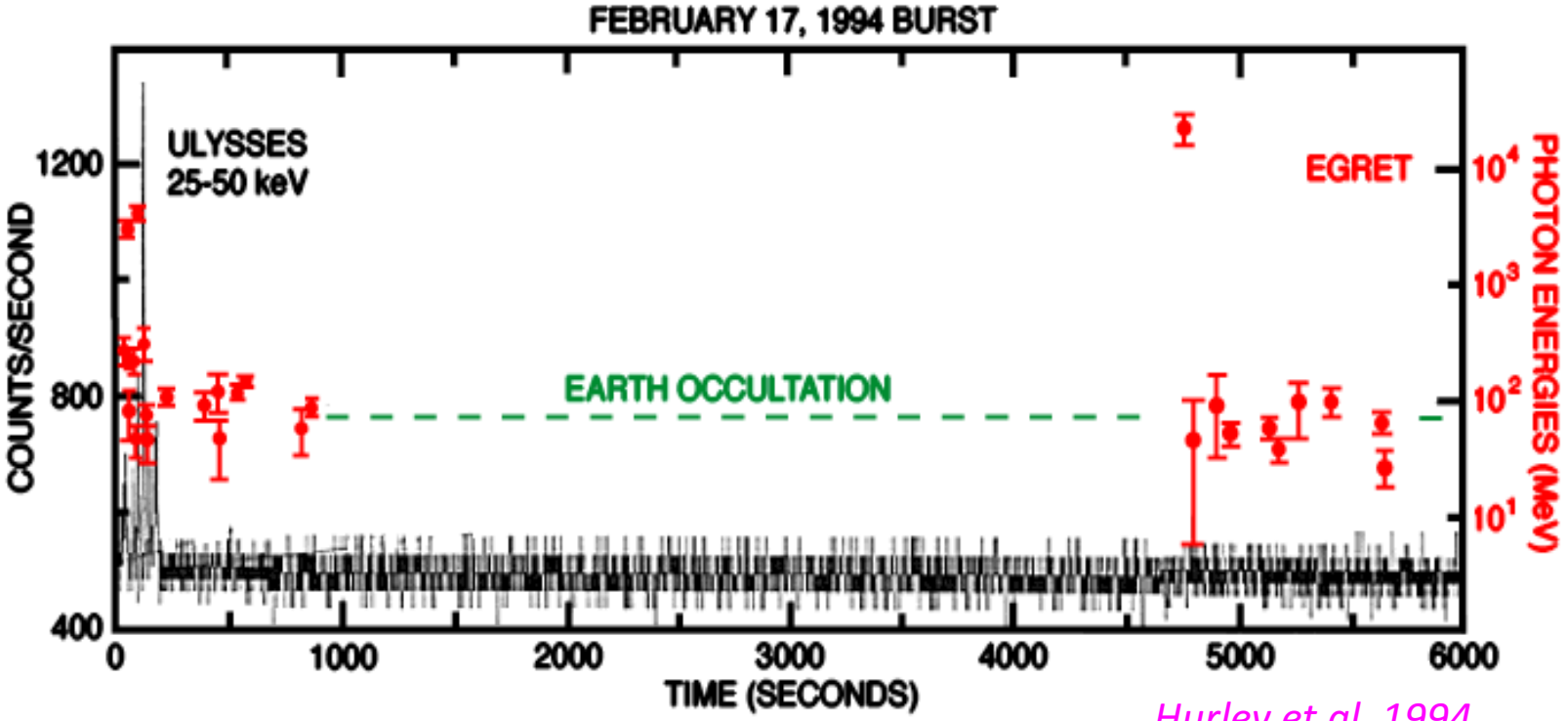


SED described by Band law



very different LCs

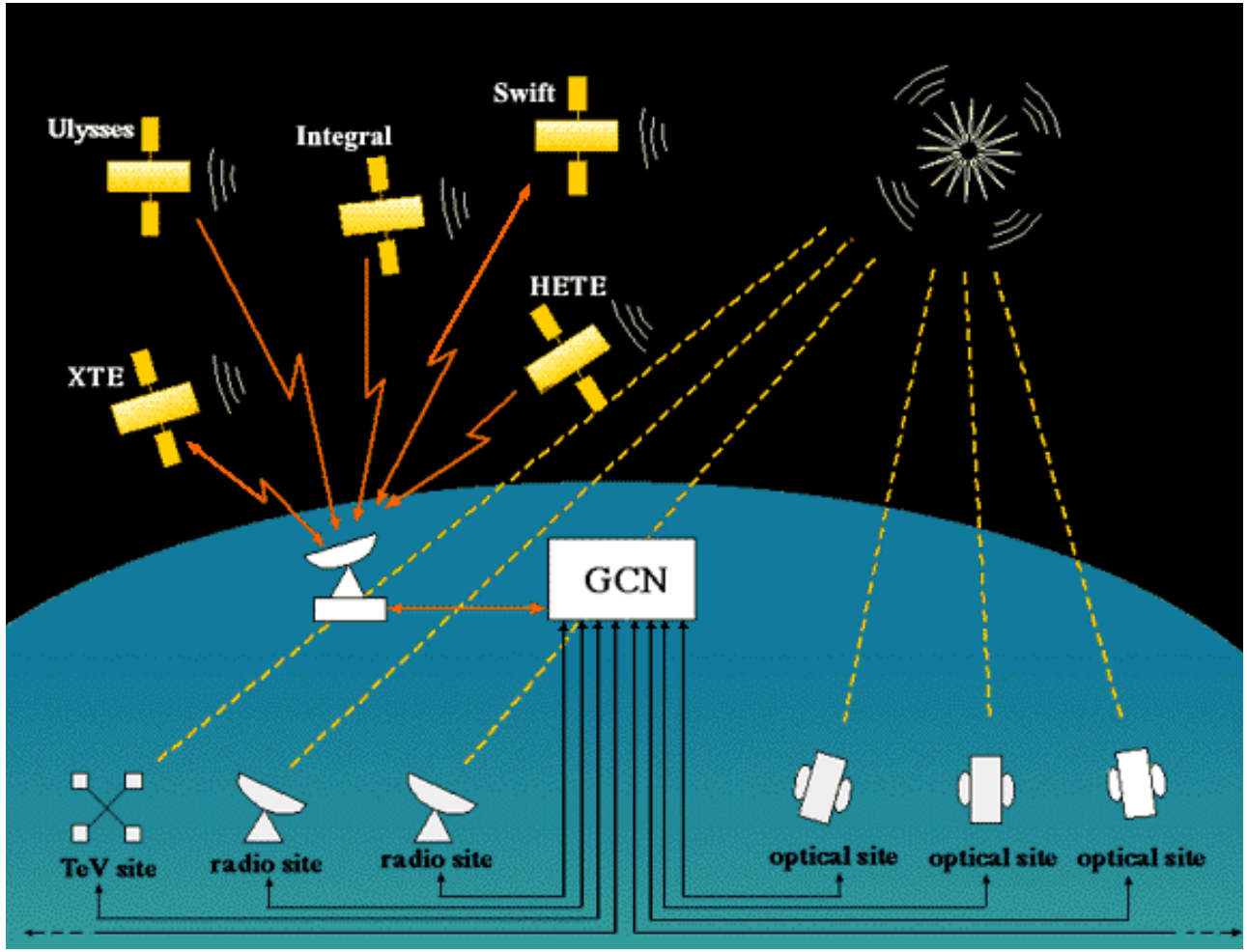
VHE Properties of GRBs



Hurley et al. 1994

- A 18 GeV photon observed by EGRET 90 minutes after the start of the GRB
- Evidence for second component

GRB & Alert Systems

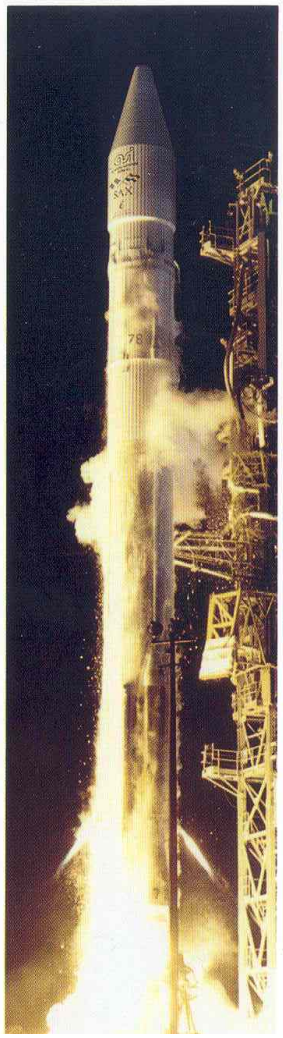


BACODINE: BAtse COordinates DIstribution NEtwork

GCN: Gamma-ray Coordinates Network

GCN/TAN: GCN/Transient Astronomy Network

BeppoSAX and the new era for GRBs

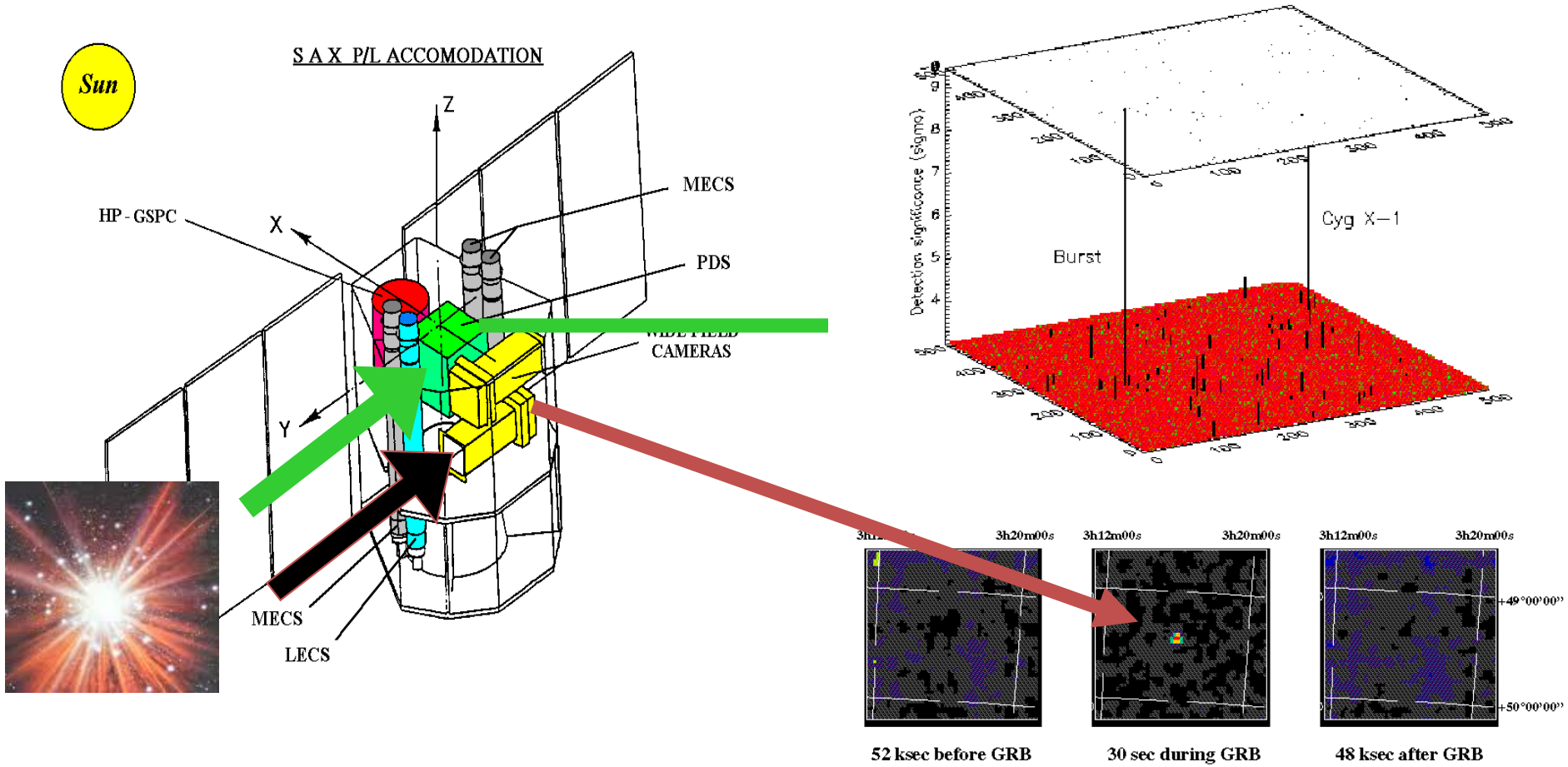


Italian-Dutch Satellite for X-ray Astronomy:

- Launched: on April 30, 1996
- Switched-off: on April 30, 2002,
- De-orbited: on April 30, 2003
- First and last observation of a GRB on July 20, 1996 and on April 30, 2002

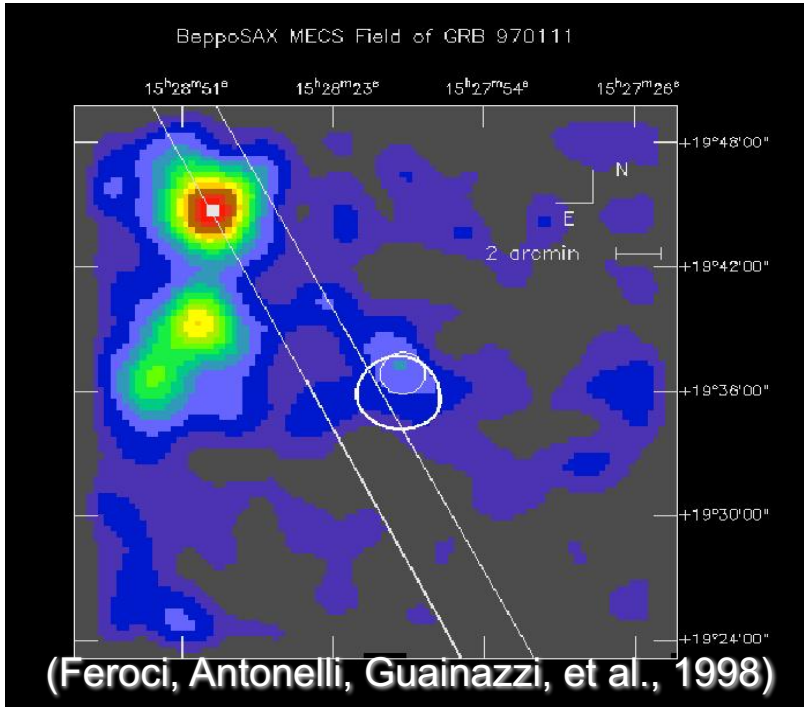
Many instruments working at different energies and with different field-of-view: a sort of “Christmas Tree” (cit.)

BeppoSAX & GRBs

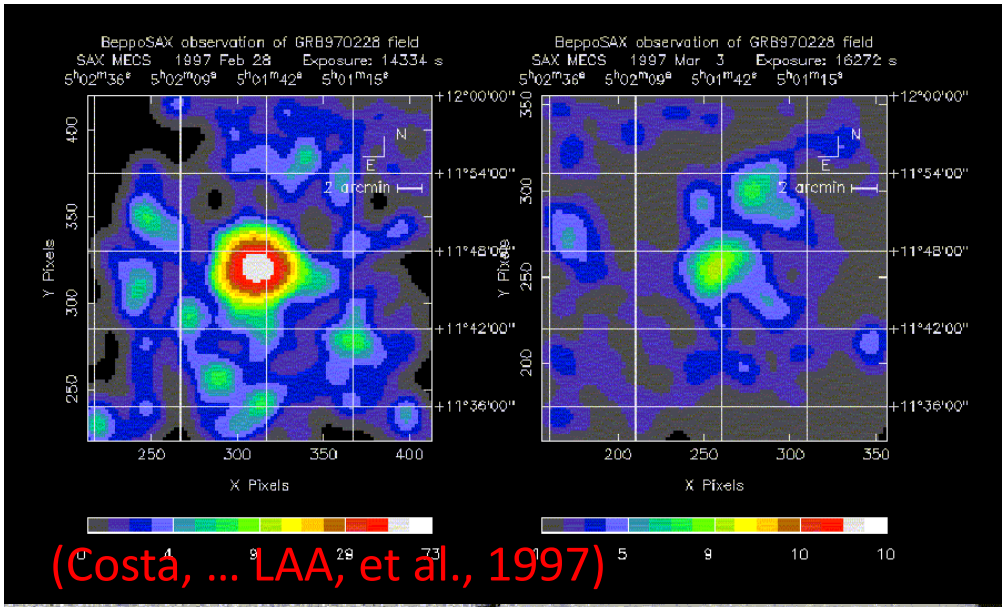


GRB960720: the 1st GRB the field was observed with NFI on october…

GRB afterglows

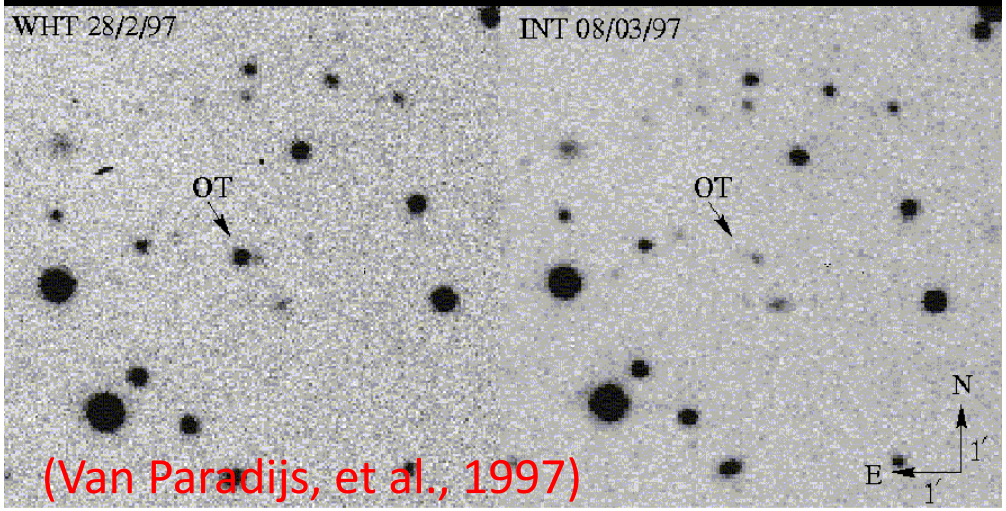


GRB970111: Triggered by GRBM and localized by the WFC of BeppoSAX fast follow-up (16 hrs after the GRB) by the NFI.

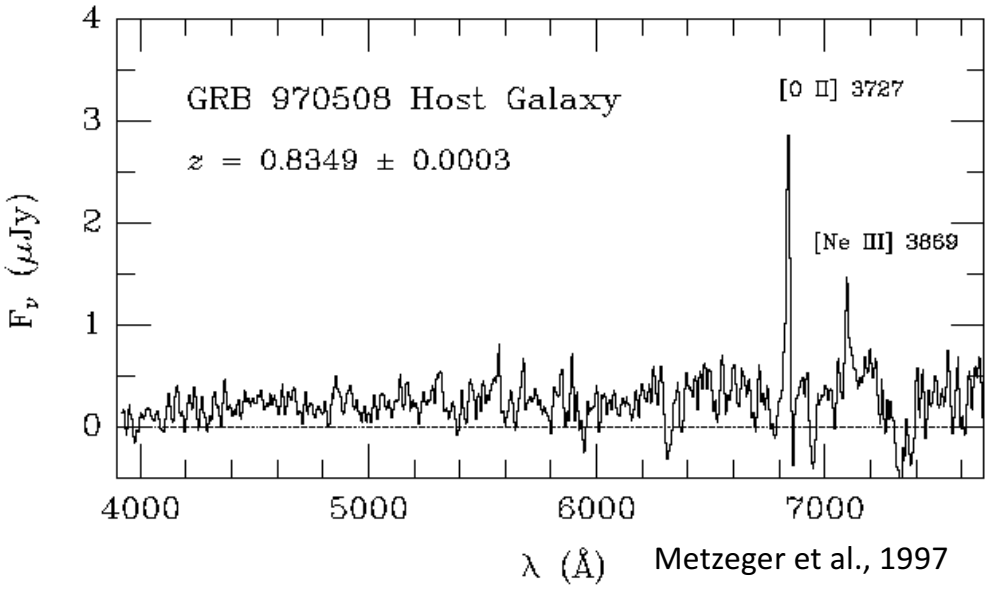


GRB970228: Fast follow up (8hr) led to discover a bright unknown X-ray source in NFI. A second pointing 3 days after showed the source faded.

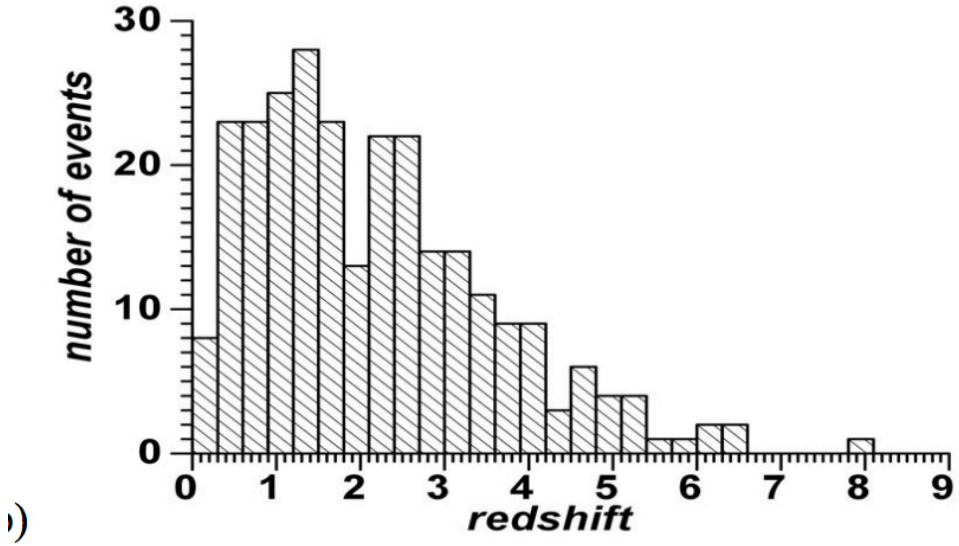
Thanks to the good X-ray position an optical fading source could be observed.

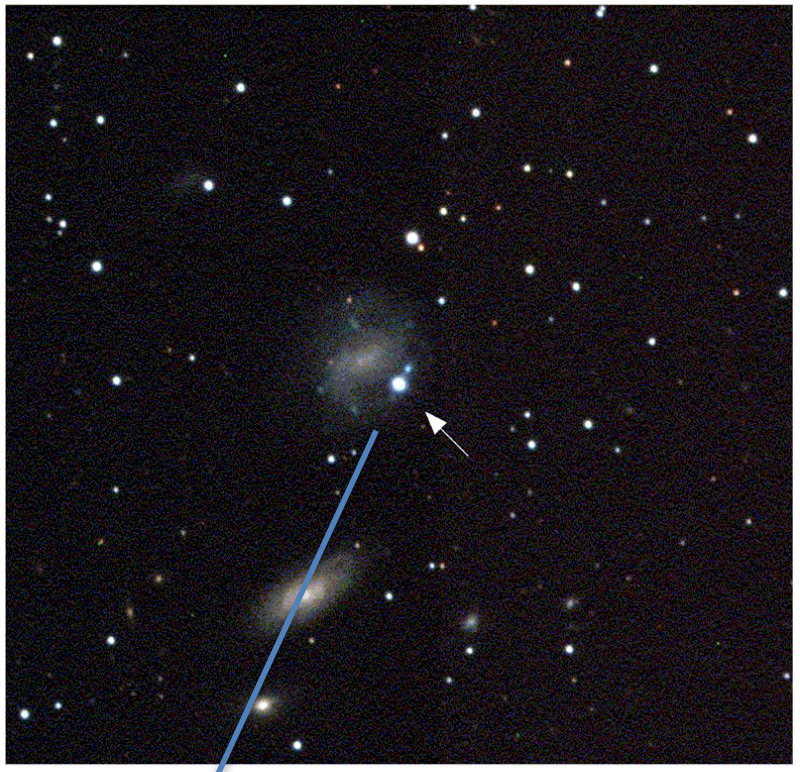


GRBs as Extragalctic Sources

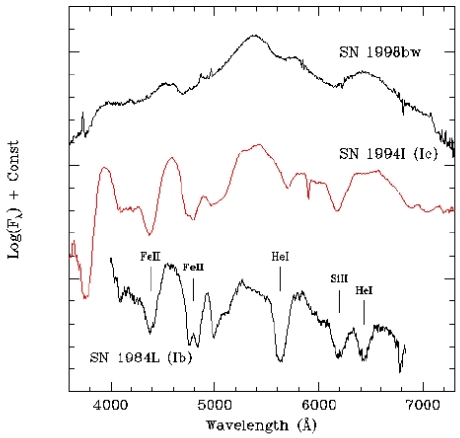


Metzeger et al., 1997



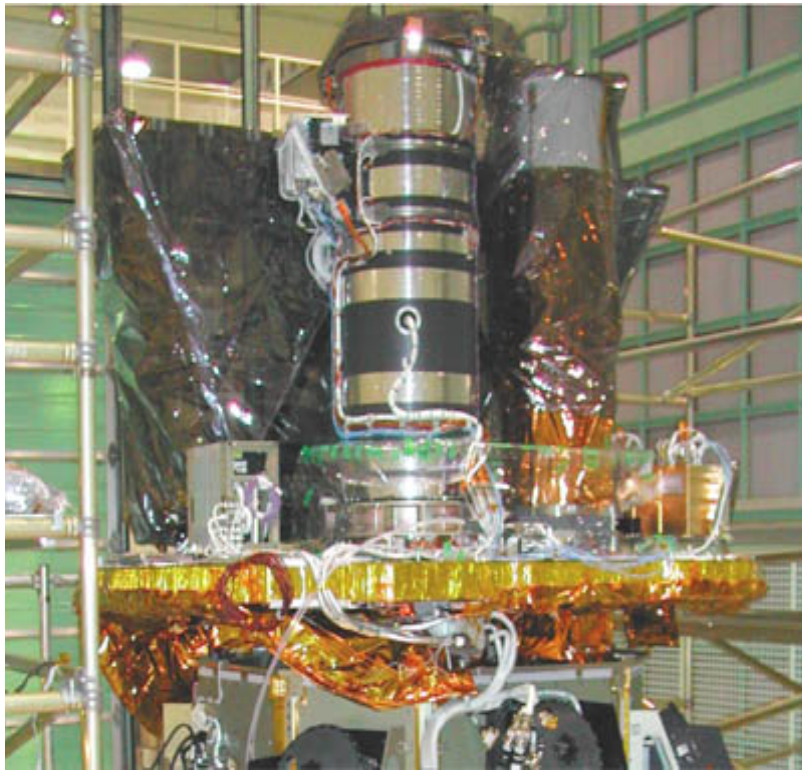


SN 1998bw in Spiral Galaxy ESO184-G82



SWIFT

- NASA MIDEX Mission selected in **1999**
- Primary science is to study gamma-ray bursts throughout the Universe
- International hardware participation from UK and Italy
- Launched on November 20, **2004**



Autonomous re-pointing, 70 - 120 sec

MAGIC & GRBs

ASTRONOMY & ASTROPHYSICS
SUPPLEMENT SERIES

Astron. Astrophys. Suppl. Ser. **138**, 601–602 (1999)

SEPTEMBER **1999**, PAGE 601

The MAGIC Telescope - prospects for GRB research

D. Petry[1] **for the MAGIC Telescope Collaboration**⋆

Institut de Física d'Altes Energies, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain
e-mail: petry@ifae.es

Received December 29, 1998; accepted March 15, 1999

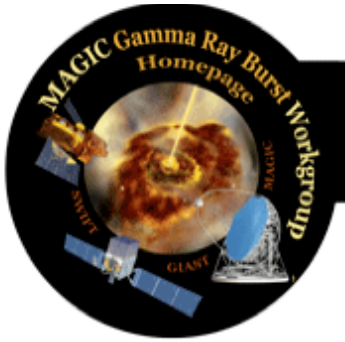
Abstract. The Major Atmospheric Gamma-ray Imaging Cherenkov (MAGIC) Telescope collaboration is constructing a large Cherenkov telescope (17 m diameter) for the exploration of the gamma-ray energy regime above 10 GeV with high sensitivity. One of the highlights in the science program of this future observatory are the plans for fast follow-up observations of of GRBs. By "fast" we mean delays of less than 30 s between notification and the beginning of observations. The expected gamma counting rates are of the order of 100 Hz for a EGRET counting telescope for ground-based γ-ray observations above 10 GeV. Details of its design, the scientific motivation, the feasibility of the project, and other issues have been described elsewhere (Barrio et al. 1998). The telescope is expected to become operational by the middle of 2001.

The telescope is optimised to achieve the lowest energy threshold and highest flux sensitivity achievable with present technology. This makes it applicable to a large range of astrophysical research fields:

– Blazars (study of EGRET blazars, possible discovery

MAGIC & GRBs

MAGIC & GRBs

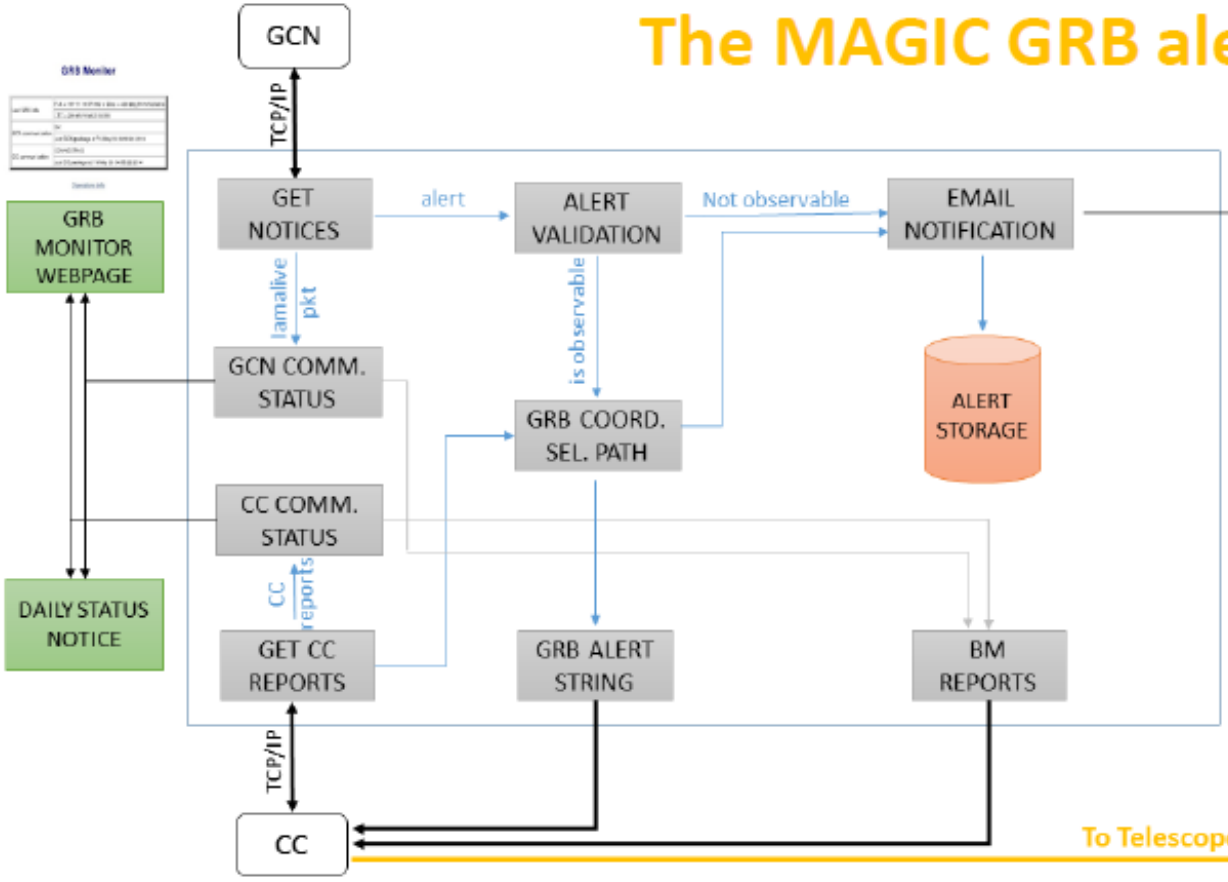


MAGIC Telescope | Group Members | MAGIC GRBs | Meetings | Publications | Burst Advocates | Internal | Links

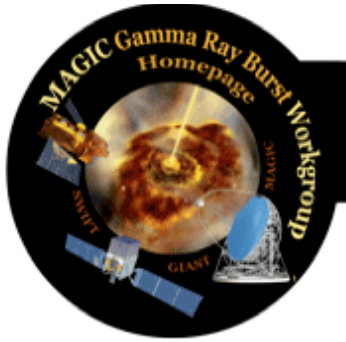
Shifters Guide

- **Dedicated Automatic Alert System**
- **Dedicated data reduction chain**
- **Dedicated group**
- **Burst Advocate Organization**
- **MWL activities**

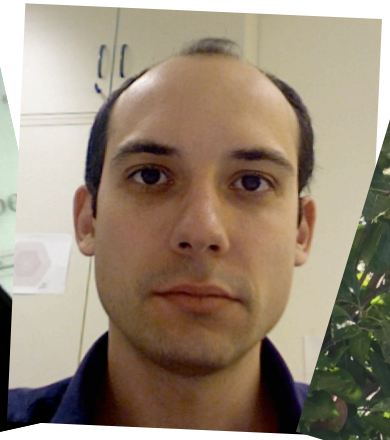
The MAGIC GRB alert system



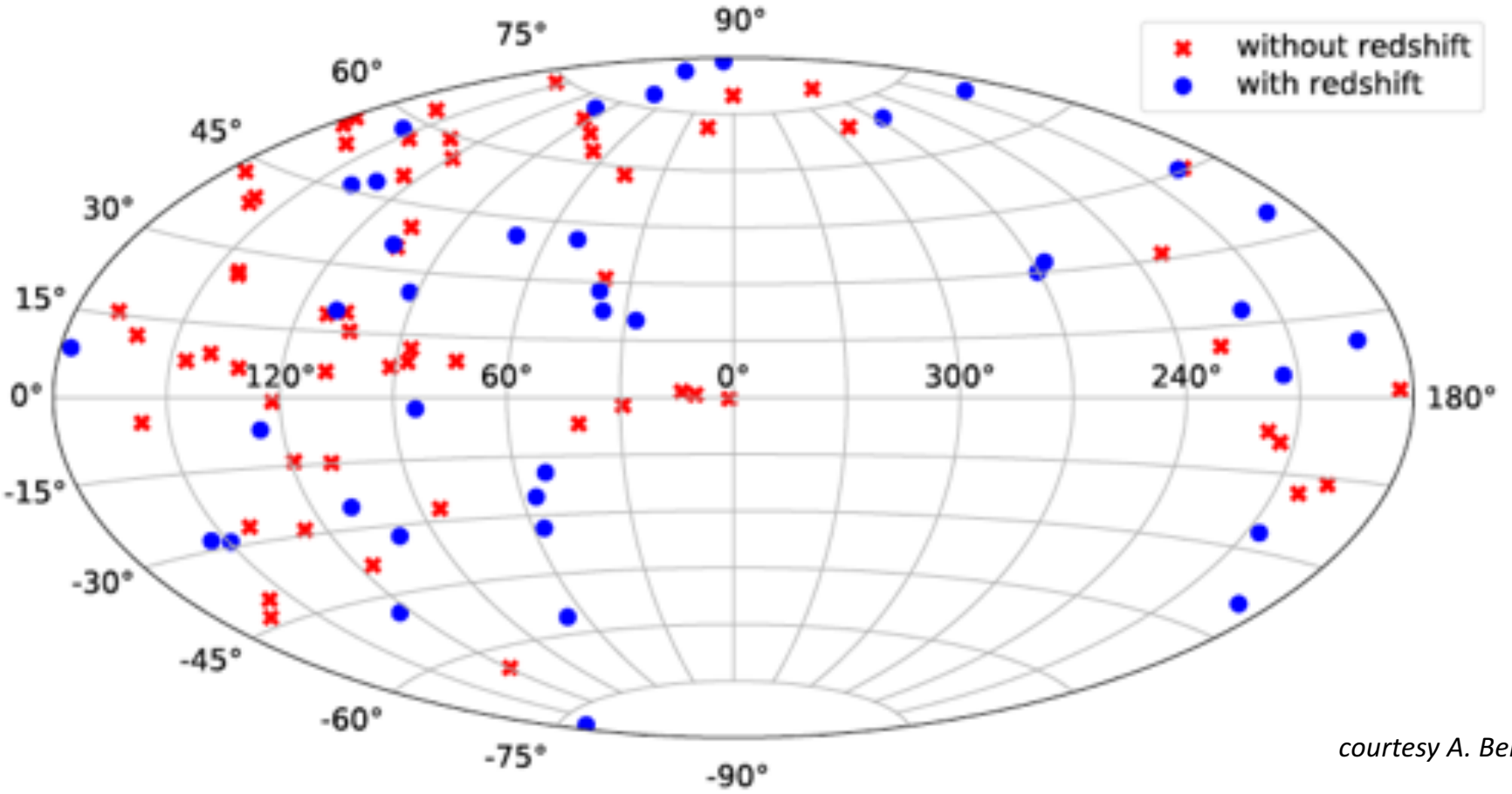
MAGIC & GRBs



MAGIC Telescope | Group Members | MAGIC GRBs | Meetings | Publications | Burst Advocates | Internal | Links



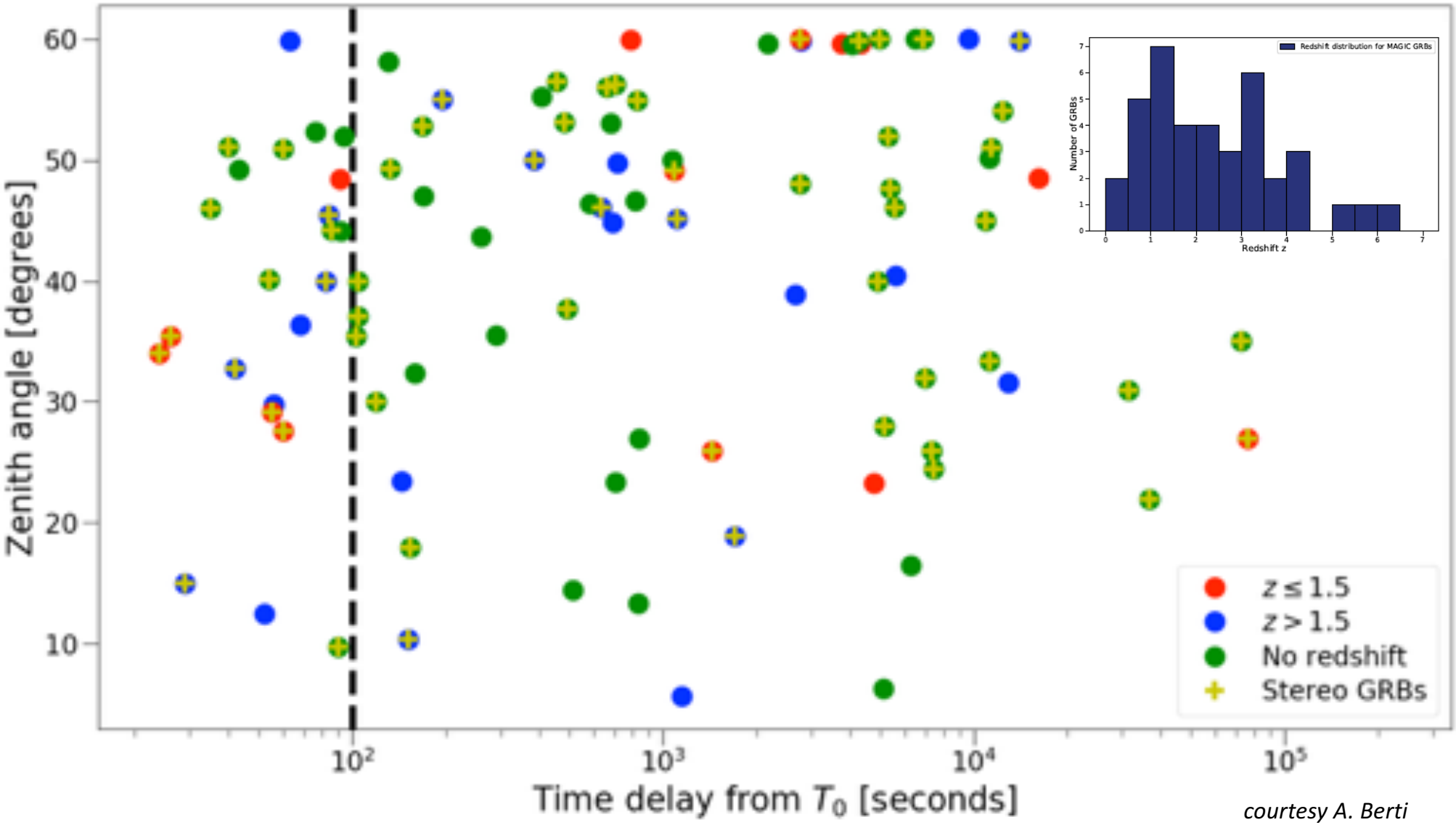
MAGIC GRBs



courtesy A. Berti

101 GRBs followed up 8-10 GRBs/year 39 GRBs with known z

MAGIC GRBs



courtesy A. Berti

24 GRB within 100 s from T_{burst}

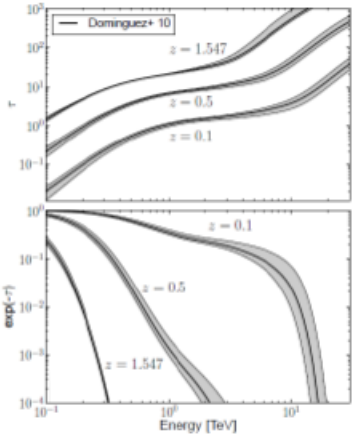
faster f-up 24s from T_{burst}

MAGIC Results on GRB

GRB WITH MAGIC

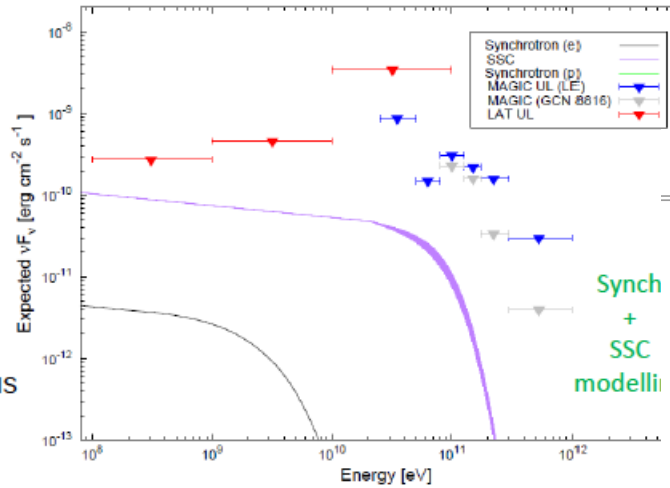
No detection to date although some scientific works have been done

$En_{52} = 4.5$; $T=T_0 + 4$ ks
$\varepsilon_e = 0.1$; $\varepsilon_B = 0.01$
$z= 1.547$; $n = 1\ cm^{-3}$



First GRB with simultaneous MAGIC & Fermi-LAT

GRB 090102

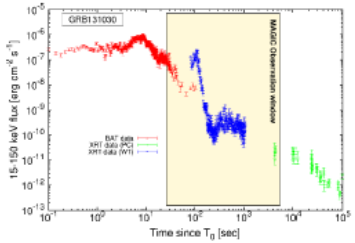


Synch + SSC modelli

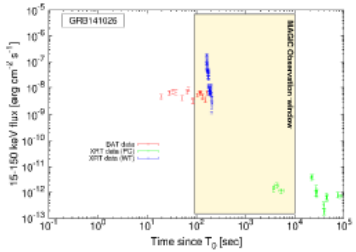
MAGIC upper limits on GRB090102
J. Aleksic et al. (MAGIC Collaboration), 2014, MNRAS, 437, 3103

34th ICRC @ The Hague, Netherlands

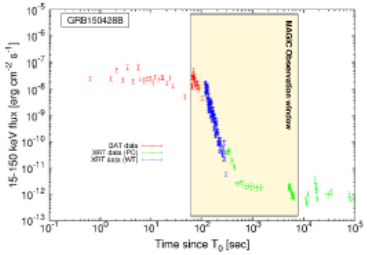
MAGIC



GRB 131030
Trigger: Swift
Redshift: 1.3
Bad weather conditions for first 30 min



GRB 141026
Trigger: Swift
Redshift: 3.35



GRB 150428B
Trigger: Swift
No redshift
Relatively high zenith (50^0)

34th ICRC @ The Hague, Netherlands

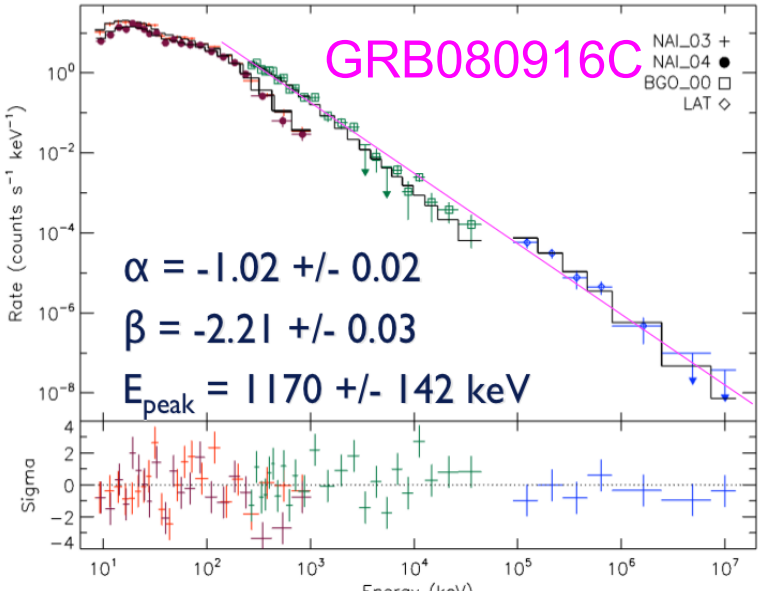
12

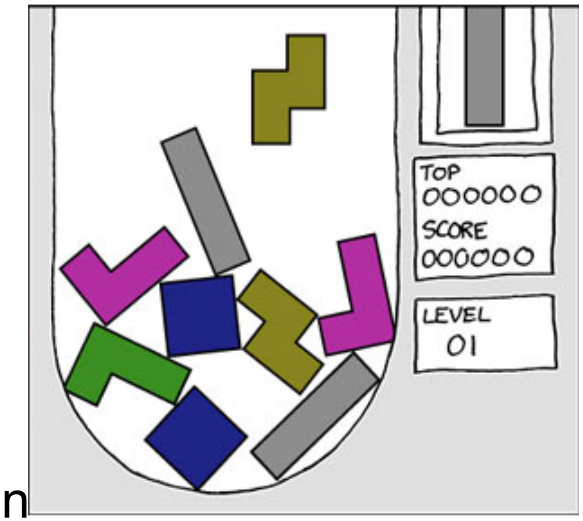
for more see Koji's talk on friday

Courtesy A. Carosi

Why continue to observe with MAGIC?

Still a lot of contradictory results from HE observations with FERMI LAT

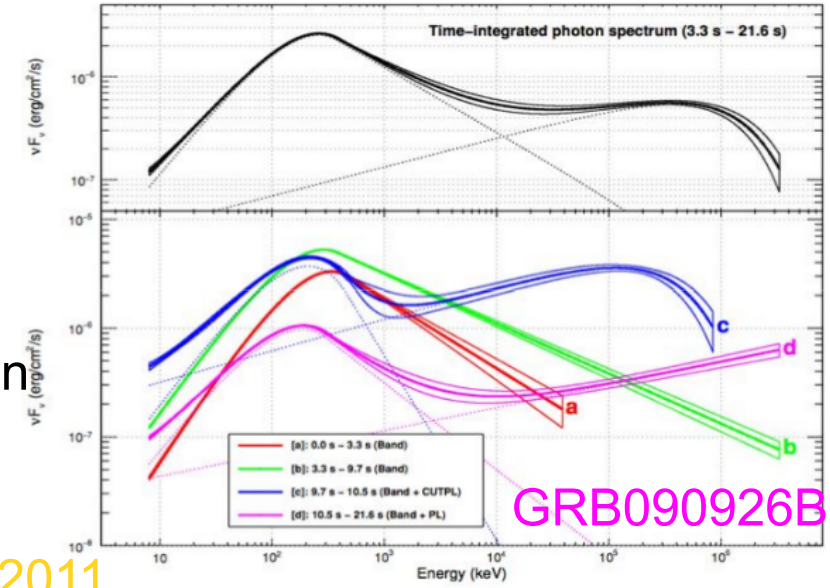




GRB080916C: HE emission Consistent with Band function

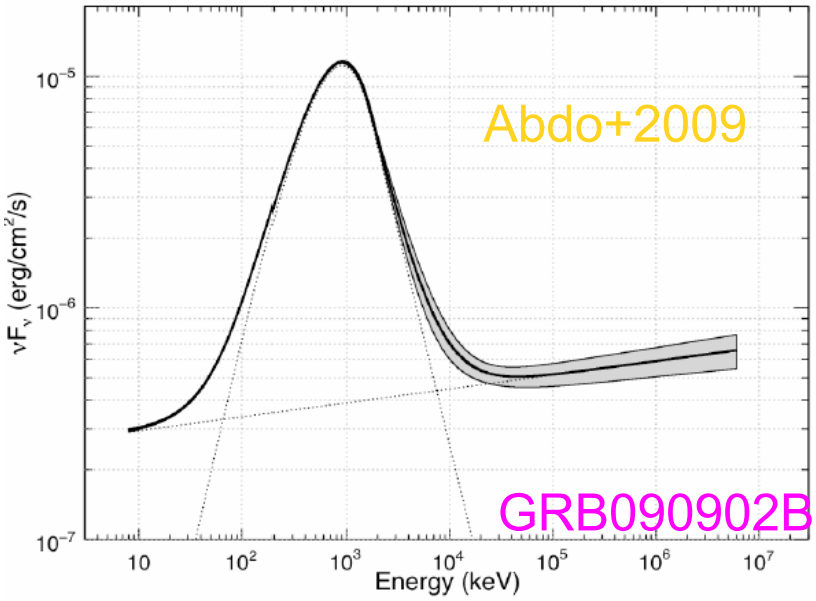
Abdo+2008

Distinct emission components



GRB090926B

Ackerman+2011

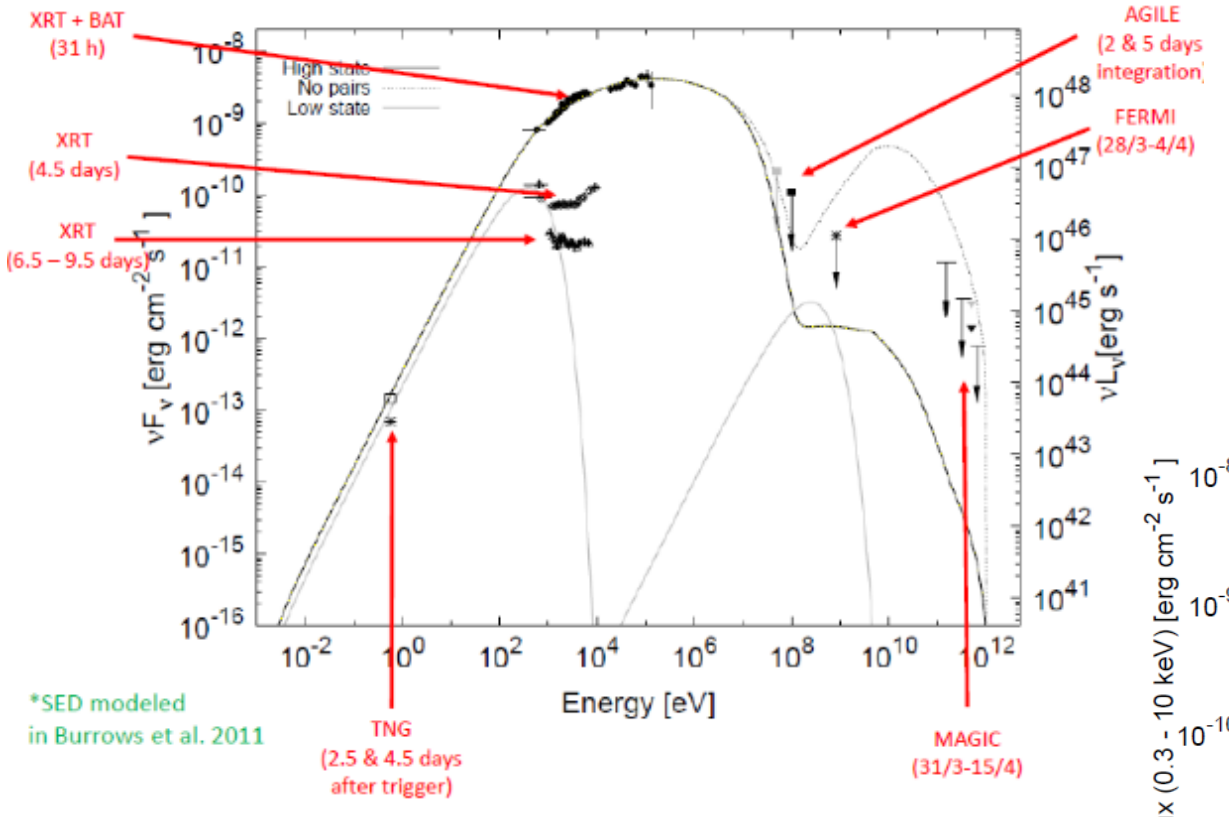


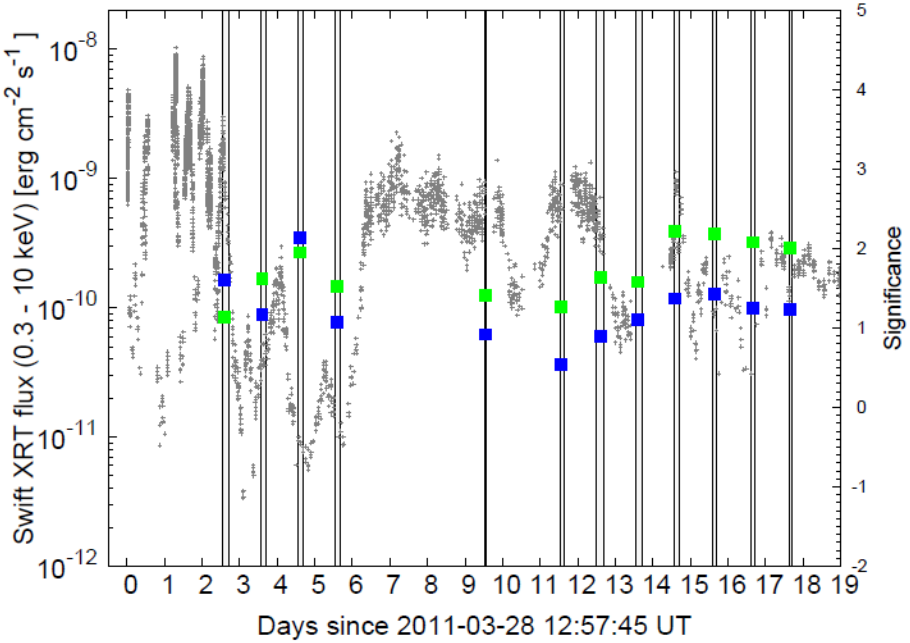
GRB090902B

MAGIC Results

Not GRBs only!

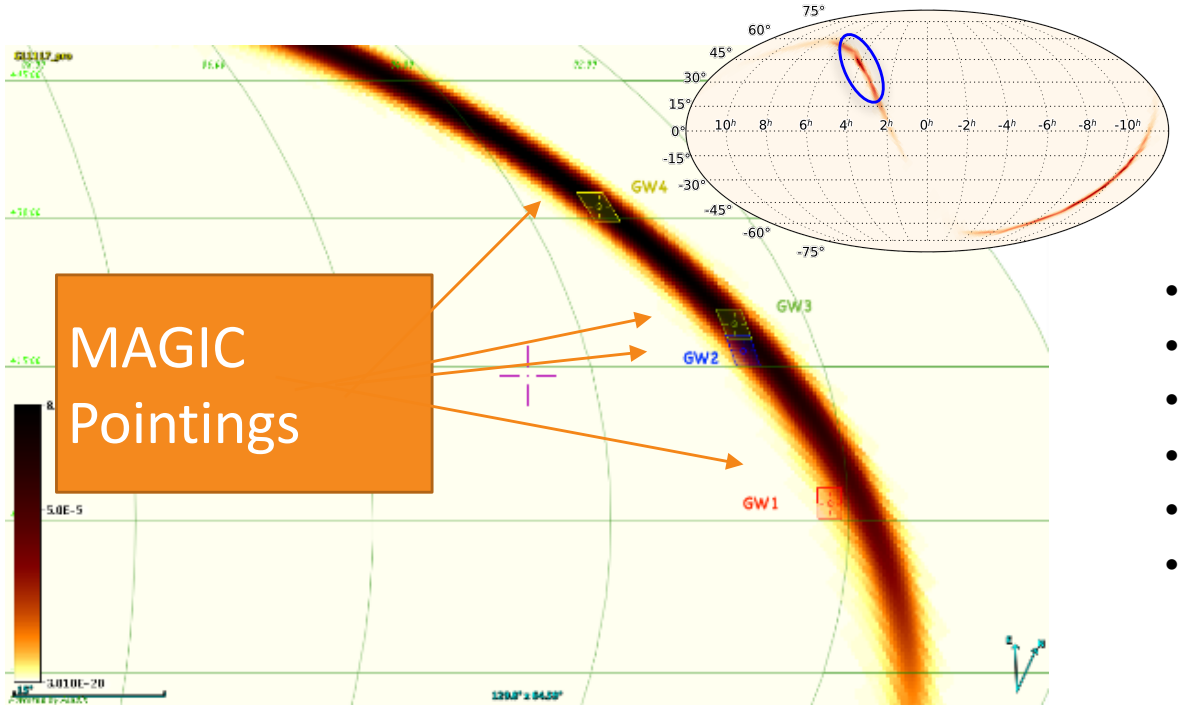
SW J1644+57





MAGIC Coll., A&A, 2013, 55, 112

Surfing Waves: MAGIC follow-ups of GW events



MAGIC follow-up of GW151226

Status after O2

- MAGIC-LVC MoU
- MAGIC observations of 3 events
- Analysis completed for GW151226
- Analisys still on going for other events
- No excesses found
- The observed merger of NS-NS is a strong motivation for this program

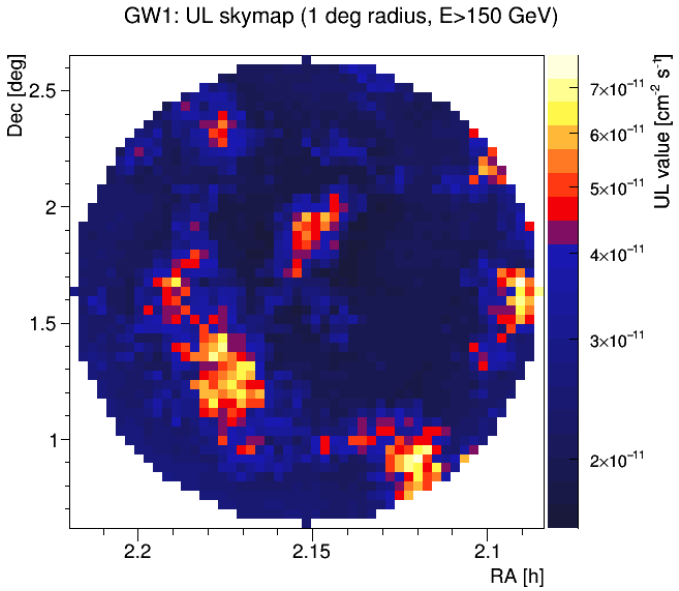
TITLE: GCN CIRCULAR
NUMBER: 18776
SUBJECT: LIGO/Virgo G211117: MAGIC very-high energy gamma-ray observations
DATE: 15/12/30 16:14:44 GMT
FROM: Antonio Stamerra at INAF-OATo/SNS-Pisa <antonio.stamerra@sns.it>

Angelo Antonelli (INAF-OaR), Alessandro Carosi (INAF-OaR), Barbara de Lotto (Univ. Udine), Razmik Mirzoyan (MPI-MÃ¼enchen) and Antonio Stamerra (INAF-OaTo and SNS-Pisa) on behalf of the MAGIC collaboration

The MAGIC system of Cherenkov Telescopes, sensitive to high-energy gamma-ray above ~50 GeV, performed observations of 4 regions in the strip of the bayestar GW map for the trigger G211117.
Observations started on December 28, 21 UT. Each observation covers a region of ~2.5x2.5 deg. Analysis is on-going.
The list of targets is the following:

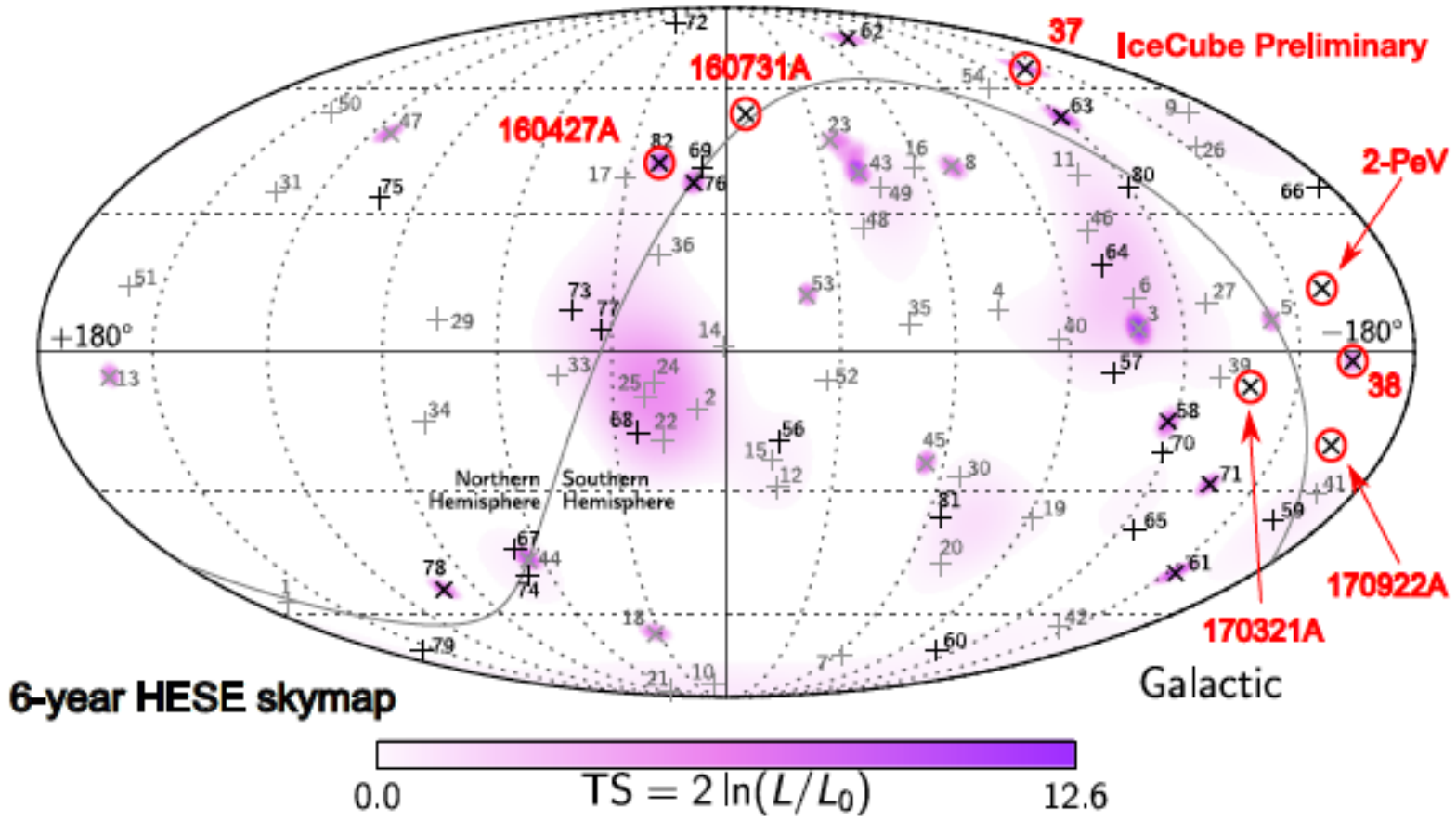
Target 1: PGC1200980 (OT MASTER GCN#18729)
RA,Dec (J2000): 02:09:05.8, +01:38:03.0
Duration: 42 min

GCN #18776



MAGIC follow-ups of neutrino events

- Since 2012 MAGIC is inside the Gamma-ray Follow-Up (GFU)
- HESE+EHE: 4 real-time alerts observed after delivery of AMON GCN Notices
- Archival tracks: 2 HESE (37 and 38) and 2PeV track (Highest Energy Track, HET)
- More than 30 h of observations
- No significant detection to report but one … (see next talks)

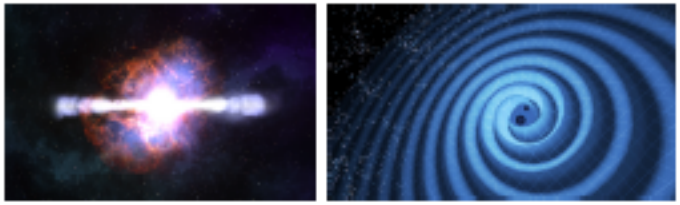


Adapted from Kopper et al., Proc. 35th ICRC 2017

The MAGIC Transient Program

Gamma-Ray Bursts

- 50 h reserved per year
- Automatic (prompt) follow-up
- Late-time observations

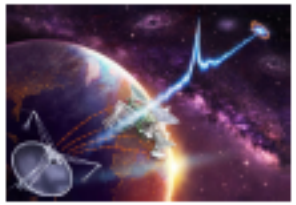


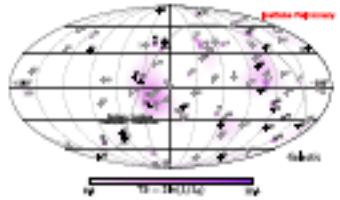
Gravitational Waves Counterparts

- Signed MoU with LIGO/Virgo in 2014
- Follow-up of several alerts
- New strategy implementation

Neutrinos

- Follow-up of alerts from IceCube
- Real-time and archival events
- 60 h per year allocated





Fast Radio Bursts

- Observations of FRB 121102 in VHE and optical
- Coordination with radio observatories
- Multiwavevlength campaign in September 2017

15% of total observation time per year