Status and results of the search for gamma-ray bursts above 1 TeV with the HEGRA experiment

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Overview:

1.- Motivation.

2.- The HEGRA experiment.

- **Cherenkov telescopes.**
- **AIROBICC array.**
- **Scintillator array.**

3.- Search for GRB counterparts.

- **Cherenkov telescopes search.**
- **HEGRA arrays search.**

4.- All-sky survey.

Motivation

* Theoretical models.

  - Blast-wave models.

  - Evaporating primordial black holes.

* Experimental support.

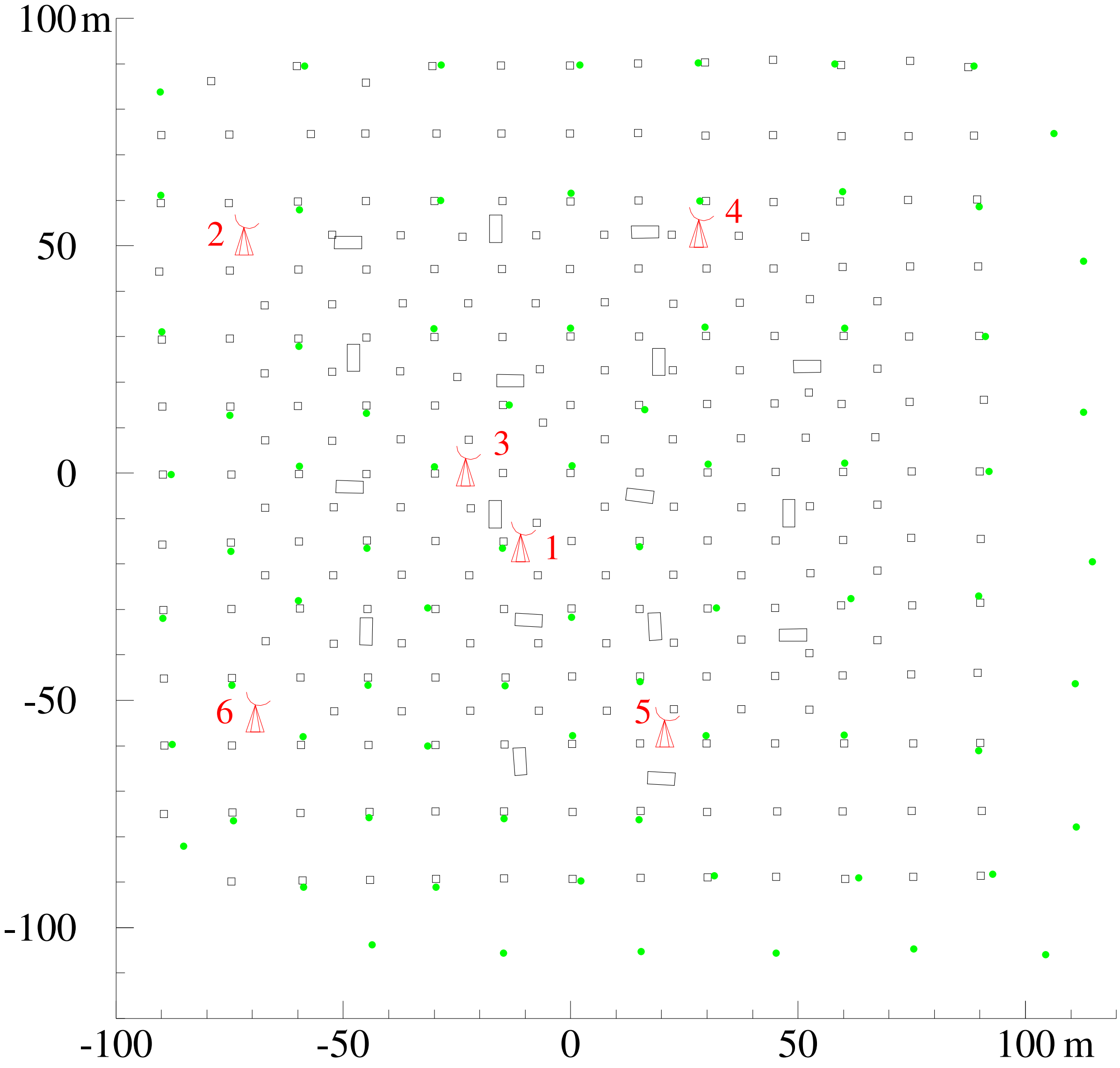
  - EGRET detection up to 18 GeV.

  - Simple power-law extrapolation of some GRBs above our sensitivity.

* Unknown type of bursters?

* Flares of SNRs, AGNs.

The HEGRA experiment



243 scintillator counters (1 m ^{2})

97 AIROBICC detectors (ϕ 0.4 m)

6 Cherenkov telescopes

17 Geiger towers (18 m ^{2})

* Location: the Canary island La Palma, **2200** m a.s.l.
  lat. = 28.8° N, long. = 17.9° W.
* **6** Cherenkov telescopes.
* **97** AIROBICC counters.
* **243** scintillator counters.

Detectors' characteristics

*** Cherenkov telescopes.**

- Energy threshold: 500 GeV - 1 TeV.
- Field of view: 4° - 5°.
- Duty cycle: 10%.
- Response time: several minutes.

*** AIROBICC array.**

- Energy threshold: 15 TeV.
- Field of view: 60°.
- Angular resolution: 0.3°.
- Duty cycle: 10%.
- Response time: immediate.

*** Scintillator array.**

- Energy threshold: 30 (7) TeV.
- Field of view: 60°.
- Angular resolution: 0.8° (2.7°).
- Duty cycle: 95%.
- Response time: immediate.

Search for GRB counterparts with the Cherenkov telescopes

GRB 950401: final position out of scanned area.

GRB 960425: final position out of scanned area.

GRB 960528: final position out of scanned area.

GRB 970925: scanned 8% of error box, no signal found.

GRB 970926: scanned 9% of error box, no signal found.

GRB 971029: scanned 20% of error box, no signal found.

GRB 980519: analysis in progress.

GRB 980527: analysis in progress.

Search for GRB counterparts with the HEGRA arrays

25 GRBs/year with scintillator array.

3 GRBs/year with AIROBICC array.

More than 130 GRBs (1991 - 1997) searched up to now.

Search in coincidence, preceding and following the trigger.

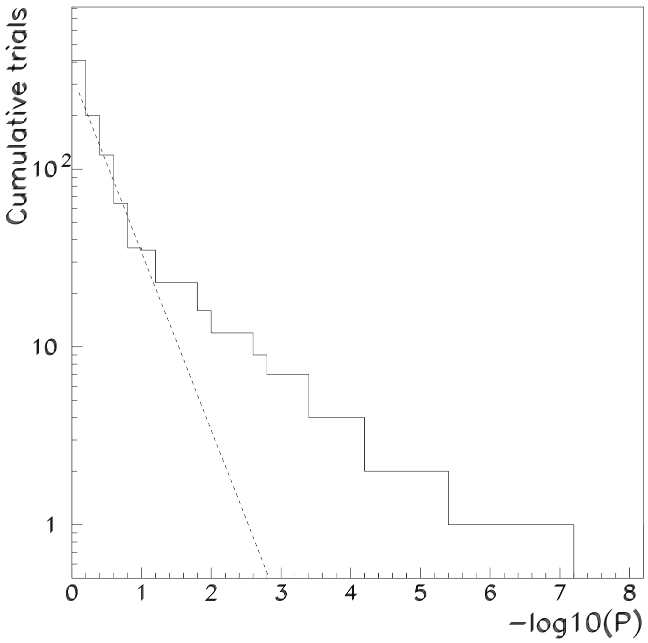
Search on several time scales, from seconds to hours.

No evidence for counterparts at TeV energies.

Integral flux upper limits F(>15 TeV) = 10^{-11} - 10^{-8} cm^{-2} s^{-1}.

Limits for 3 GRBs << simple extrapolation of keV/MeV spectra.

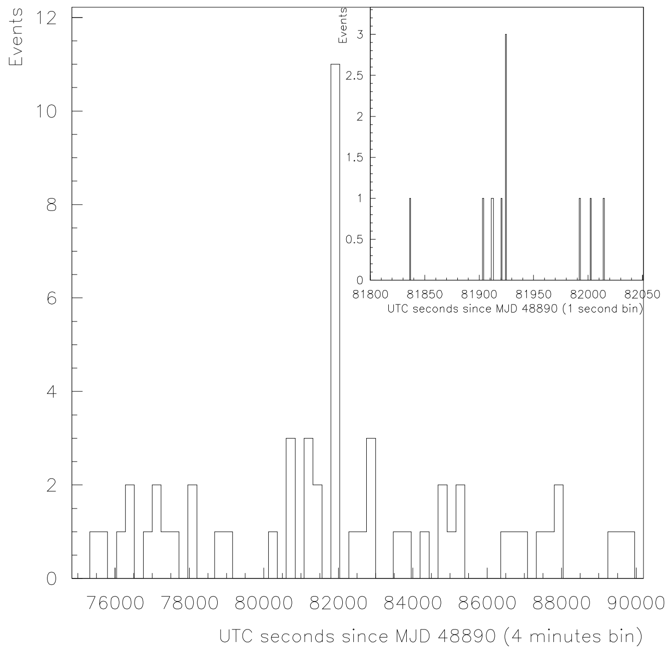
Search for WATCH GRB 920925c counterpart



Solid line represents real data.

Dashed line represents expectation.

Deviation with a chance probability $<10^{-4}$.

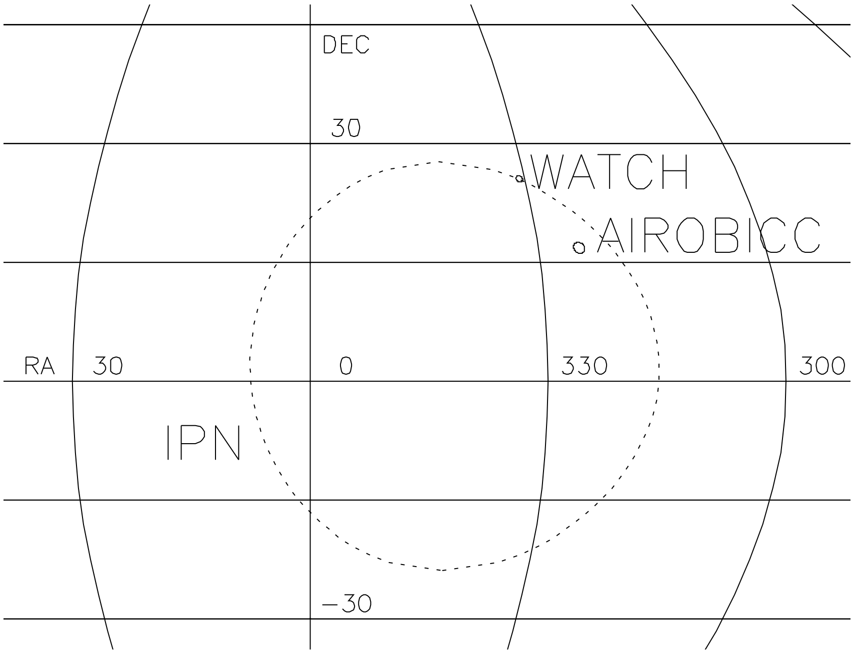


11 events in 4 minutes.

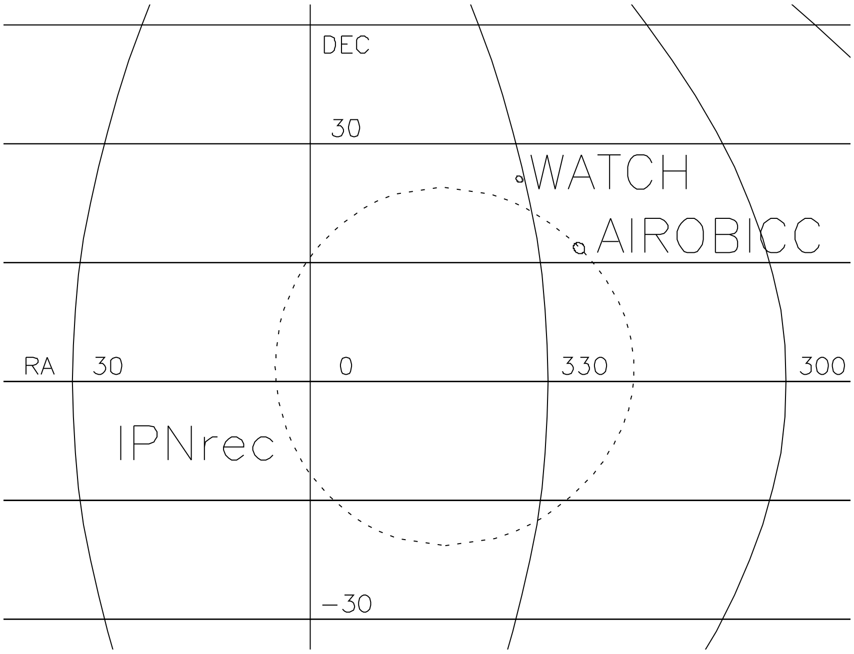
7 of them in 22 seconds.

3 of them in 0.25 seconds.

Search for WATCH GRB 920925c counterpart

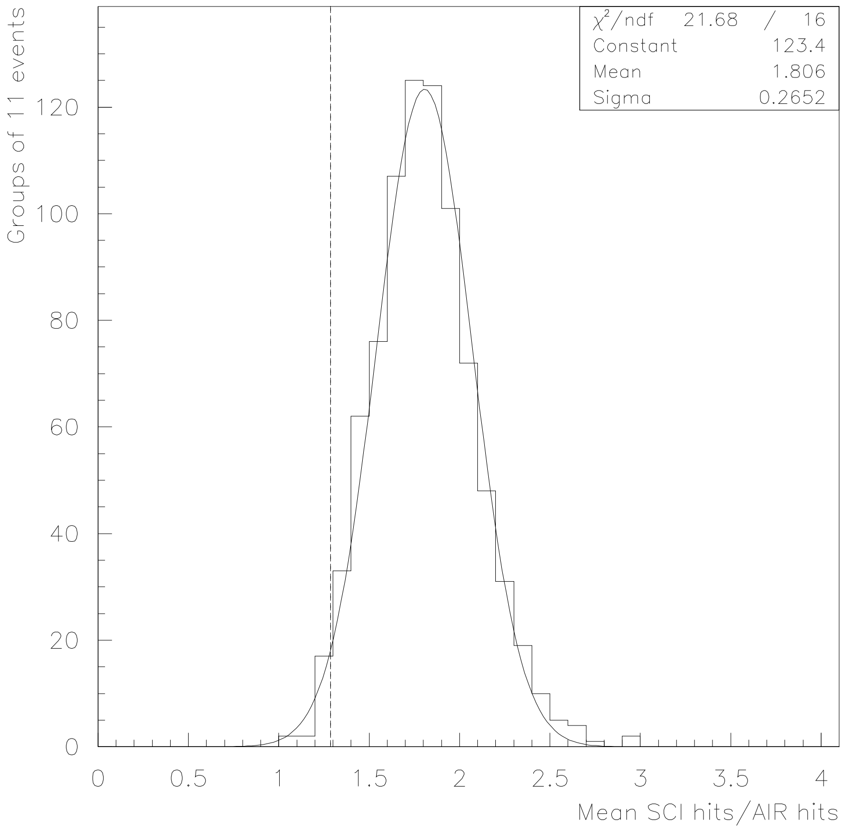


IPN ring obtained with WATCH - ULYSSES relative timing.



IPNrec ring obtained with AIROBICC - ULYSSES relative timing.

Search for WATCH GRB 920925c counterpart



Solid line (Gaussian fit) represents the background.

Dashed line represents the excess.

<SCI/AIR>	MC		Data	
	gammas	hadrons	excess	background
Mean	1.26	1.74	1.29	1.81
RMS	0.17	0.23	—	0.27

All-sky search

Declination band from -6° to 64° scanned with AIROBICC.

Data from March 1992 to November 1997 (with gaps).

120 million showers (3000 hours).

Search on several time scales, from 1 second to 1 hour.

No evidence for short time emission in the TeV range.

Integral flux upper limits F(>15 TeV) = 10^{-9} - 10^{-8} cm^{-2} s^{-1}.