

GRBs in the **BATSE Era**
and
David Band

by

Jerry Fishman

NASA-Marshall Space Flight Center

David Band Memorial Symposium, GSFC

July 10, 2009

Topics:

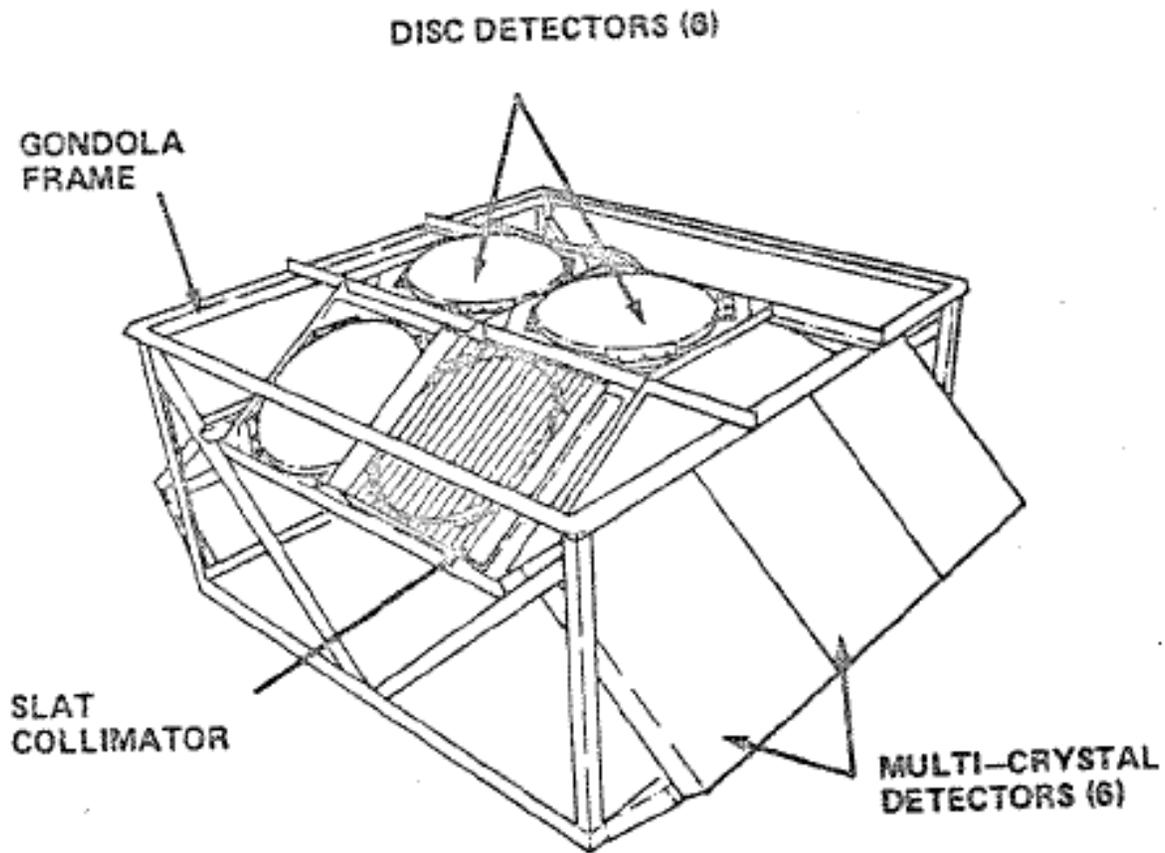
- **How BATSE Began**
- **The Spec. Detectors for BATSE**
- **Spectral Lines in GRBs ?**
- **D. Band, UCSD, & BATSE (J. Matteson)**
- **Huntsville GRB Symposia & D. Band**

Balloon Flights

**-to Determine the Frequency of
Weak GRBs (Log N – Log S)**

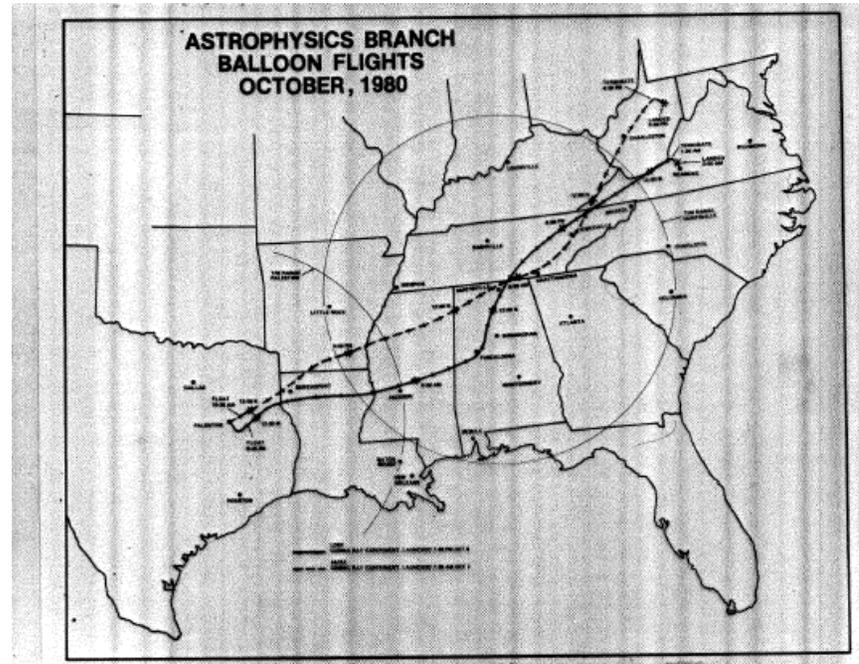
(and their sky distribution)

- **Several Groups in the U.S. & U.K.**
- **Relatively easy to do**

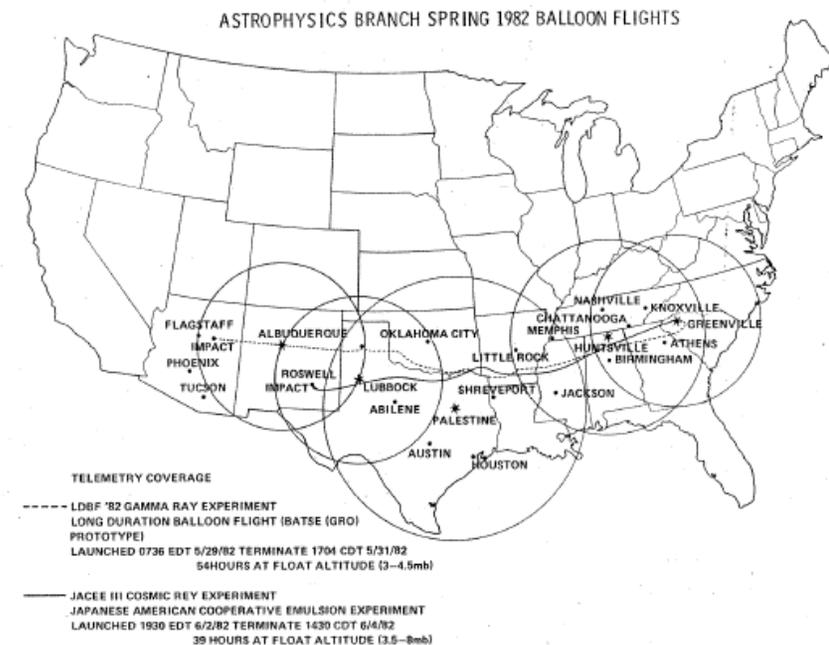


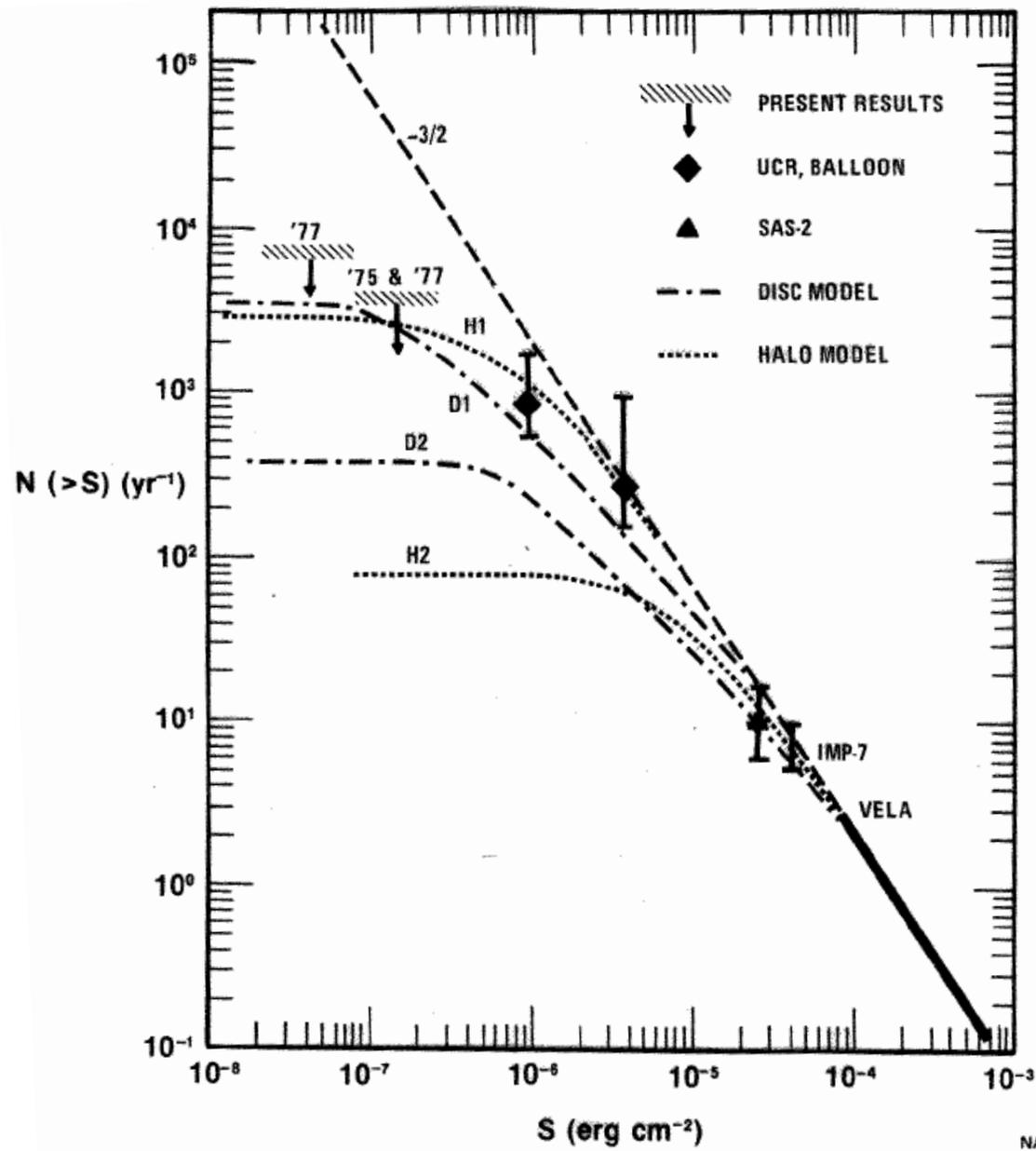
BALLOON FLIGHT CONFIGURATION -1977

1980
BATSE Prototype
Balloon Flight



1982
BATSE Prototype
Balloon Flight





INVESTIGATION AND TECHNICAL PLAN
FOR THE
TRANSIENT EVENT MONITOR ON THE GAMMA-RAY OBSERVATORY

Gerald J. Fishman, Principal Investigator
Charles A. Meegan, * Co-Investigator
Thomas A. Parnell, Co-Investigator

GEORGE C. MARSHALL SPACE FLIGHT CENTER

February 14, 1978

*NAS/NRC Research Associate

TRANSIENT EVENT MONITOR

(not BATSE)

PROPOSAL SUMMARY

Objectives

General: Provide the Gamma-Ray Observatory (GRO) with a monitor of the entire unoccluded sky for transient events and bursts.

- Specific:
- Measure the frequency versus size distribution of gamma-ray bursts over a burst energy range of 6×10^{-8} to 6×10^{-4} erg/cm².
 - Provide a single-station determination of burst directions within several degrees.
 - Measure time variations of the intensity and spectra of strong bursts and other transient events on time scales down to 10^{-4} sec.
 - Provide a near-Earth station for an interplanetary burst timing network for strong bursts to derive arc-second directions.
 - Continuously monitor stronger X-ray and gamma-ray sources such as Cyg X-1 for transient phenomena.

Instrument

Detectors: Twelve 48 cm diameter, 1.27 cm thick NaI(Tl) discs with anti-coincidence shields.

12 detectors,
20" x 1/2 "

Configuration: To be determined during study phase so that maximum sky is viewed with uniform sensitivity. Options include two 6-detector arrays and four 3-detector arrays, among others.

Projected Sensitive Area:
5500 cm² in any direction

Sensitivity to Gamma-Ray Bursts:
 6×10^{-8} erg/cm² for a 10 sec burst

Sensitivity to Longer-Lived Transients:
1/3 Crab in 10 sec assuming same spectrum as the Crab

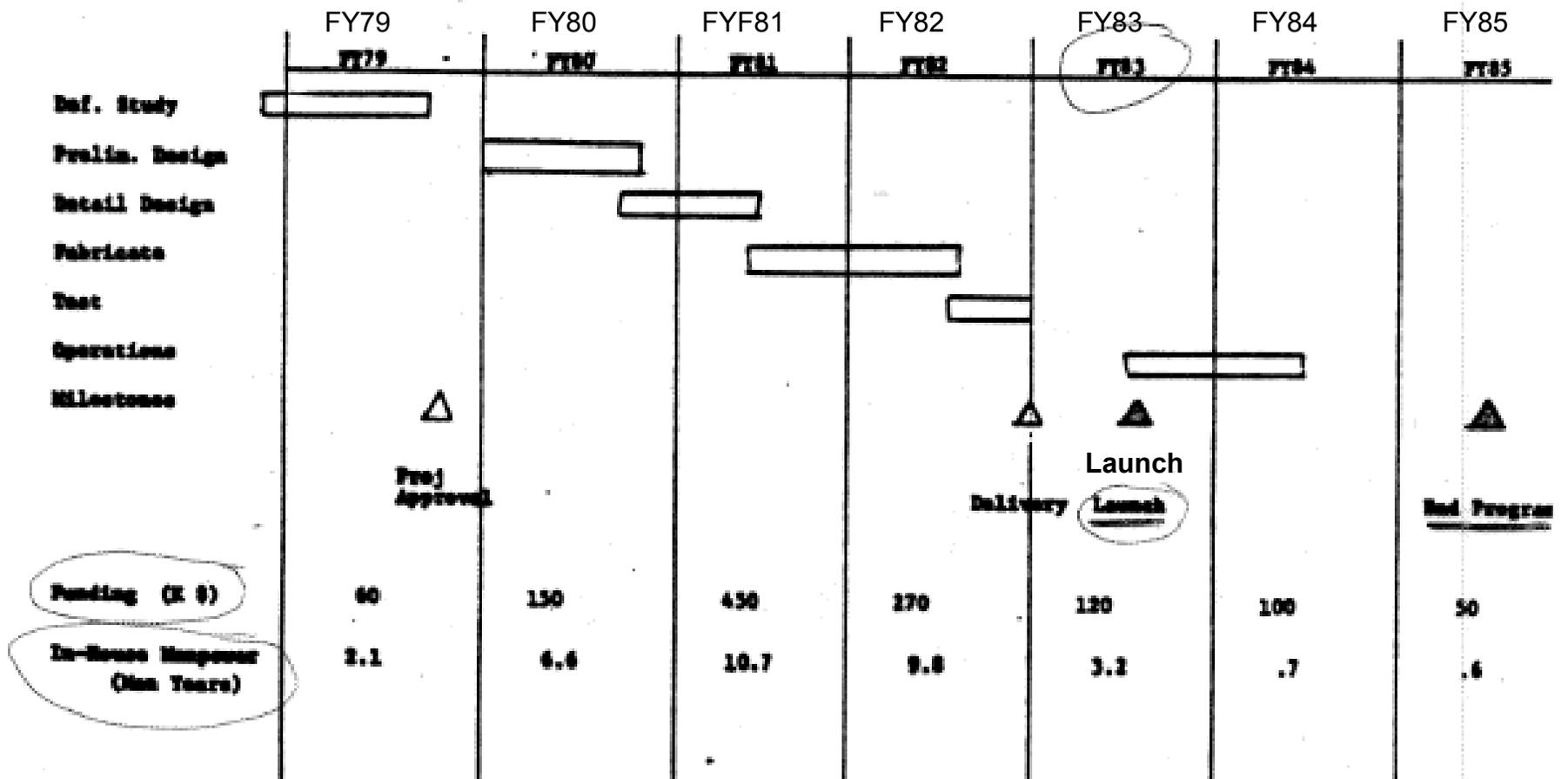
Energy Range: 60 to 600 KeV in ~6 channels
Time Resolution: 0.1 msec
Burst Trigger Logic: Microprocessor-controlled for minimum false trigger
Development Status: Commercially available NaI discs in similar instrument successfully flown on balloon experiments

Spacecraft Requirements

		<u>Final Values</u>
Weight:	508 kg (1118 lb) / 266 kg	1100 kg
Power:	32 W / 29	210w
Data Rate:	800 bps continuous ✓	2500 bps
Aspect Information Requirements:	0.1°	
Timing:	0.1 msec absolute	
Location Constraints:	Detector arrays placed for minimum shadowing of front surfaces over wide field of view	
Pointing Requirements:	None	

Transient Event Monitor

TRANSIENT EVENT MONITOR = SATJ&
SCHEDULE & RESOURCES



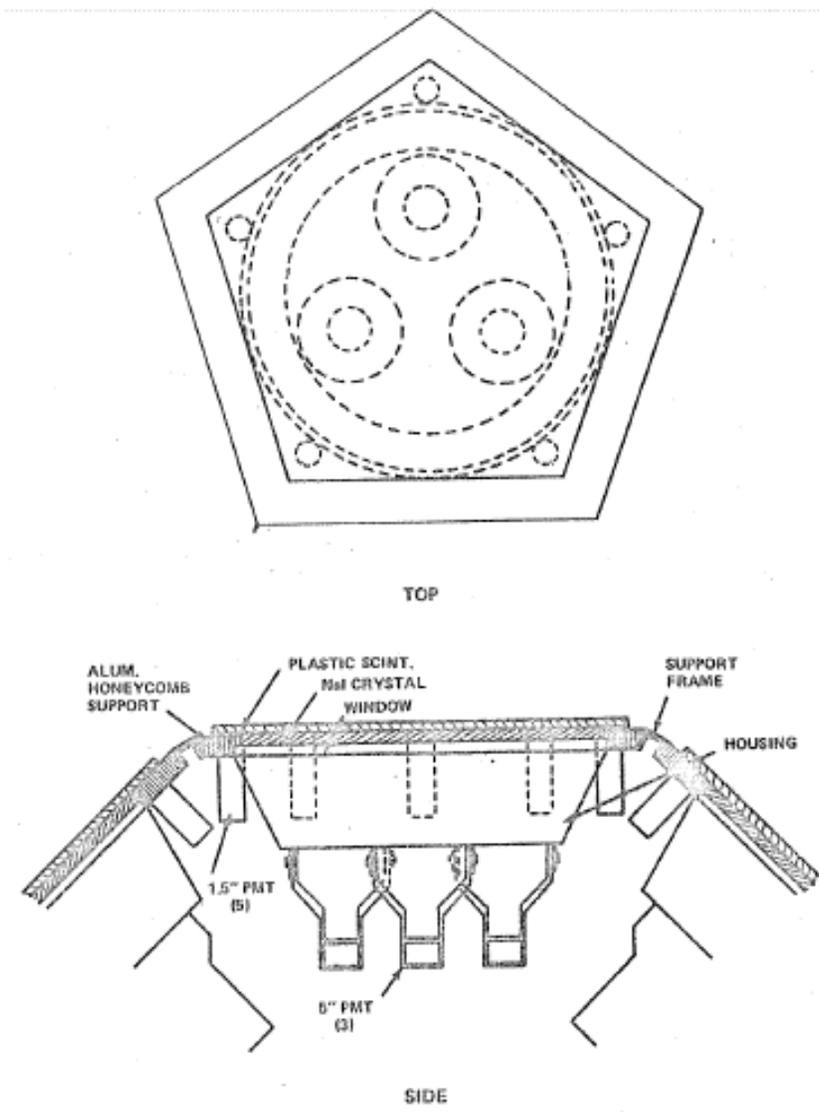
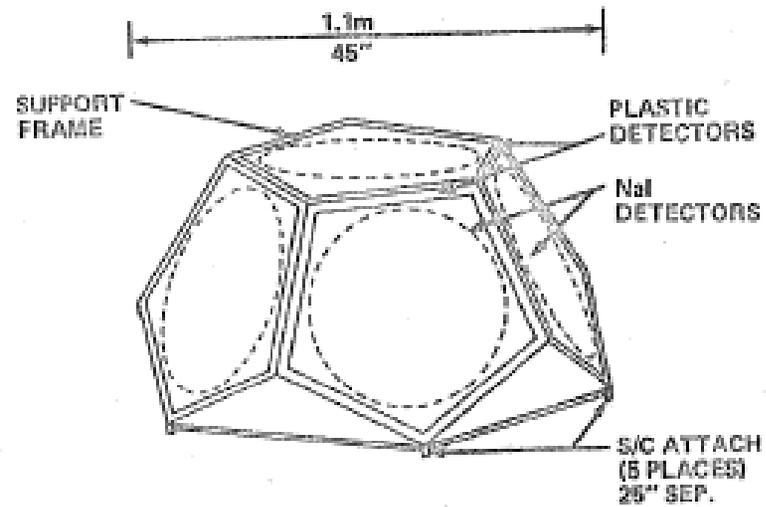
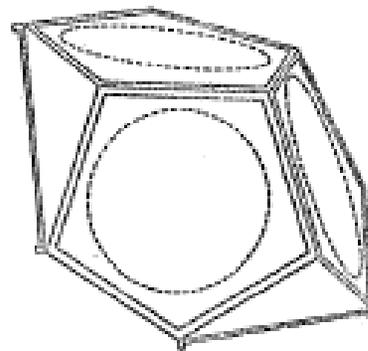


Figure 3. Detector module (one of twelve).

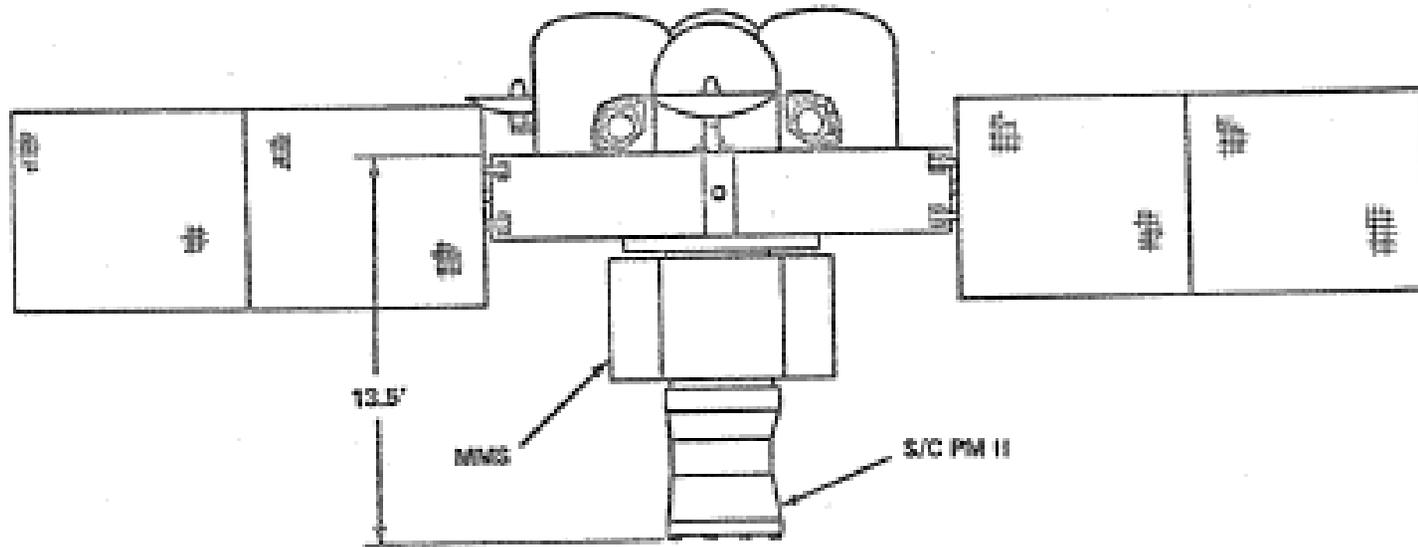


SIX-DETECTOR OPTION



THREE-DETECTOR OPTION

Figure 4. Detector array.

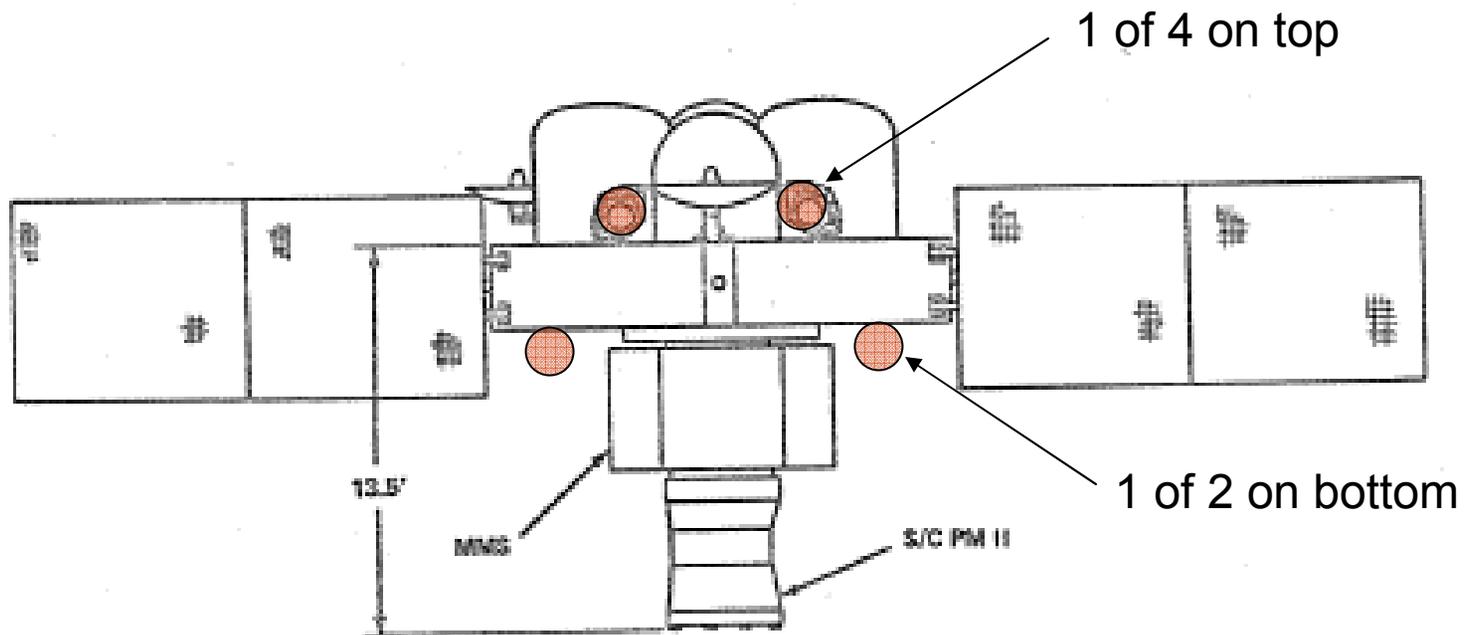


Original Proposal – 12 Detectors (4 clusters of 3 det.)

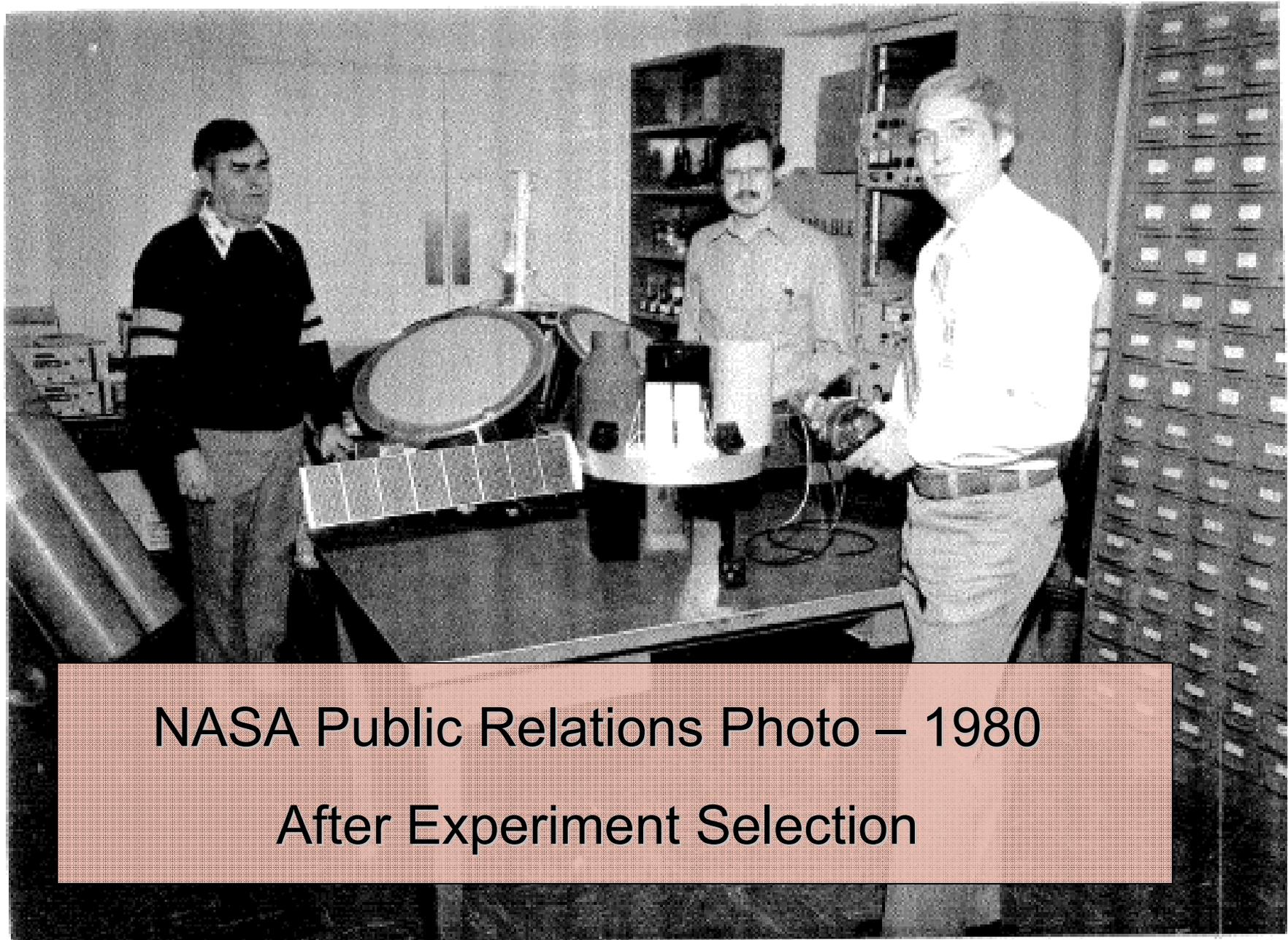
BATSE Requirements Review - 1980

<u>Item</u>	<u>Original Proposal</u>	→	<u>Requested Revision</u>	<u>Rationale</u>
Experiment Title	Transient Event Monitor for the GRO	→	Burst and Transient Source Experiment	More descriptive of objectives
Configuration	Arrays of 3 or 6 modules	→	Individual Modules	More flexible, easier to integrate, less interference
Number of modules	12	→	6	Result of selection process
Module Placement	6 top, 6 bottom	→	4 top, 2 bottom	Full sky coverage, maximum support of other experiments
Bit Rate	800 bps		1500 bps	Re-allocation of telemetry rate by Project Office
Module Envelope	p. 11 - MSFC proposal		See attached drawing	Result of definition study (preliminary)
Weight	34 kg - each of 12 modules 40 kg - additional structure 10 kg - central electronics 10 kg - cables 40 kg - contingency 508 kg - total experiment		45 kg - each of 6 modules 0 - additional structure 40 kg - central electronics & mass memory 10 kg - cables 40 kg - contingency 360 kg - total experiment	Result of preliminary definition study
Analog Electronics Box Location	Not specified		Within 50 cm of rear of each module	Result of preliminary definition study
Weight	Not specified		3 kg each - (incl. in module weight)	"
Size	Not specified		5 cm x 10 cm x 10 cm	"

MSFC-003



Directed Change from Proposal: 6 Detectors
(4 on top + 2 on bottom)

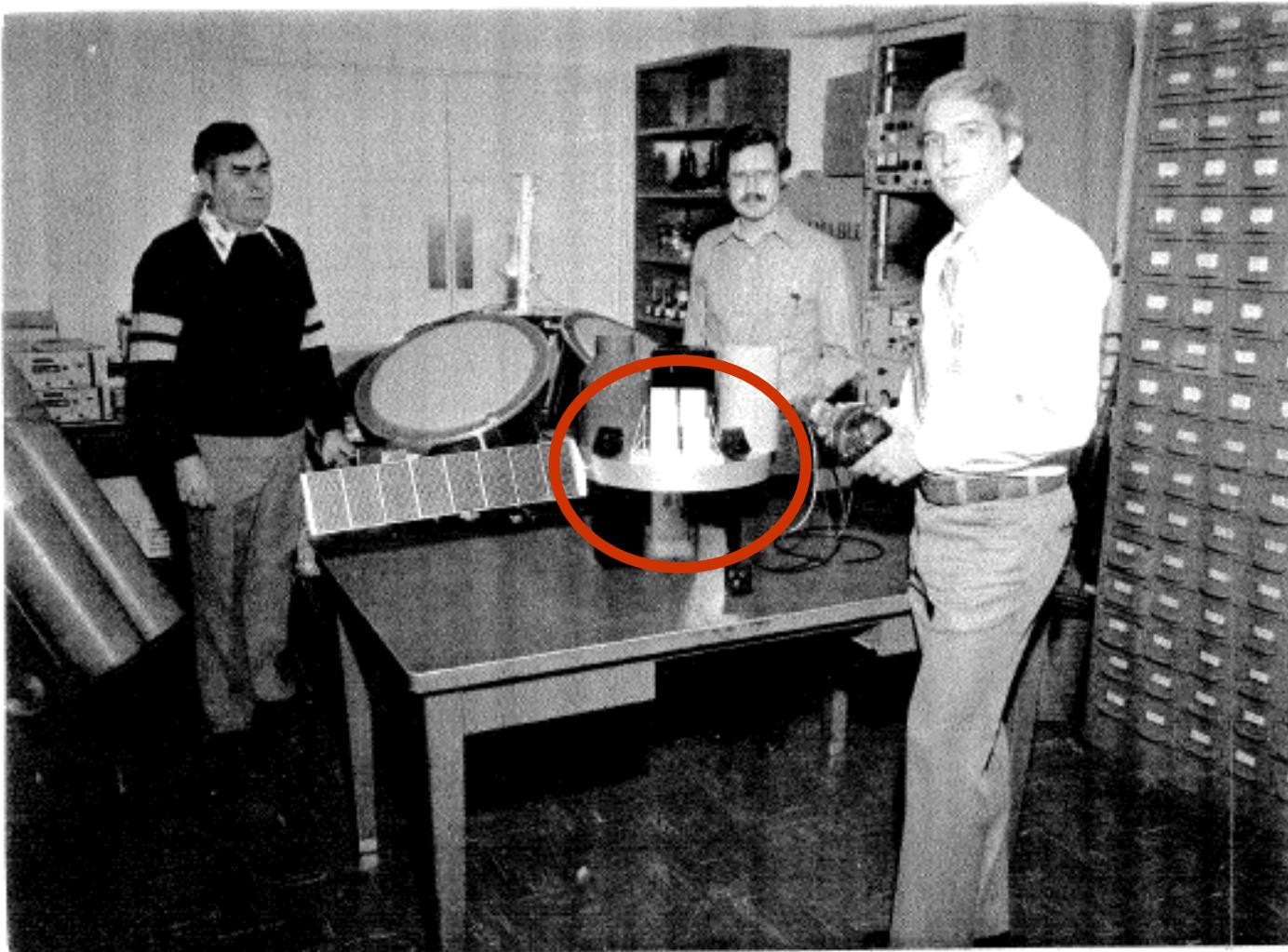


NASA Public Relations Photo – 1980
After Experiment Selection



Balloon Prototype Detectors

(Medical Gamma-ray Imaging Camera Plates;
same size as BATSE, 20" x 1/2")



**Early Model of GRO:
4 BATSE Modules on top;
2 on the Bottom**

COMPTEL

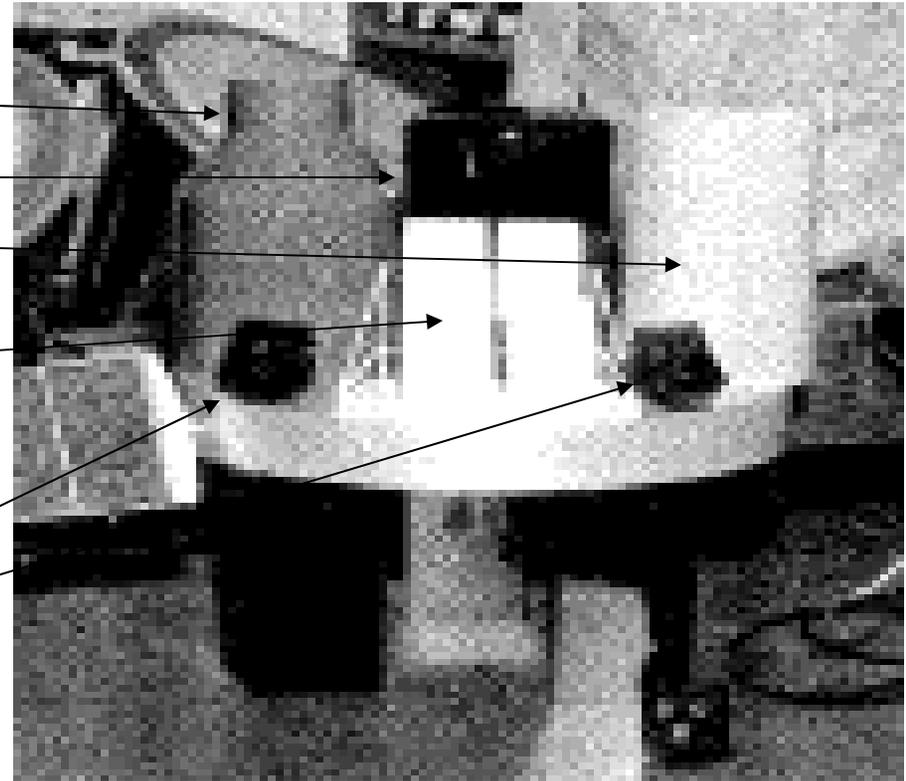
EGRET

GRSE

OSSE

(4 Movable
Modules)

Two (of six)
BATSE
Modules



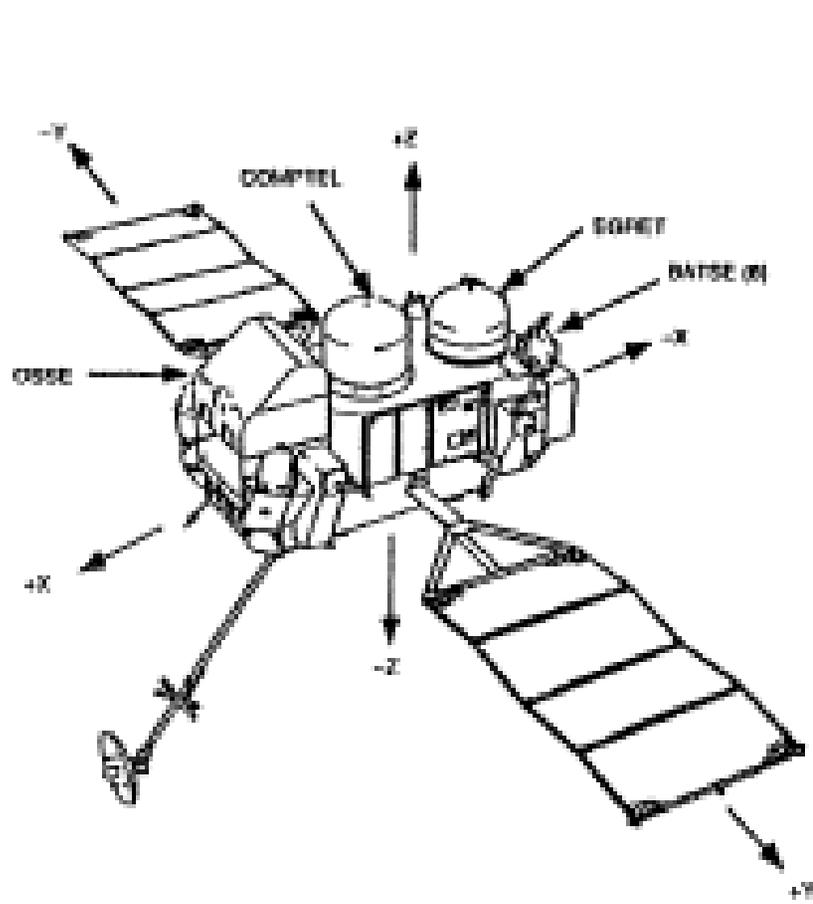
Five Instruments on GRO:

EGRET, COMPTEL, GRSE, OSSE, BATSE

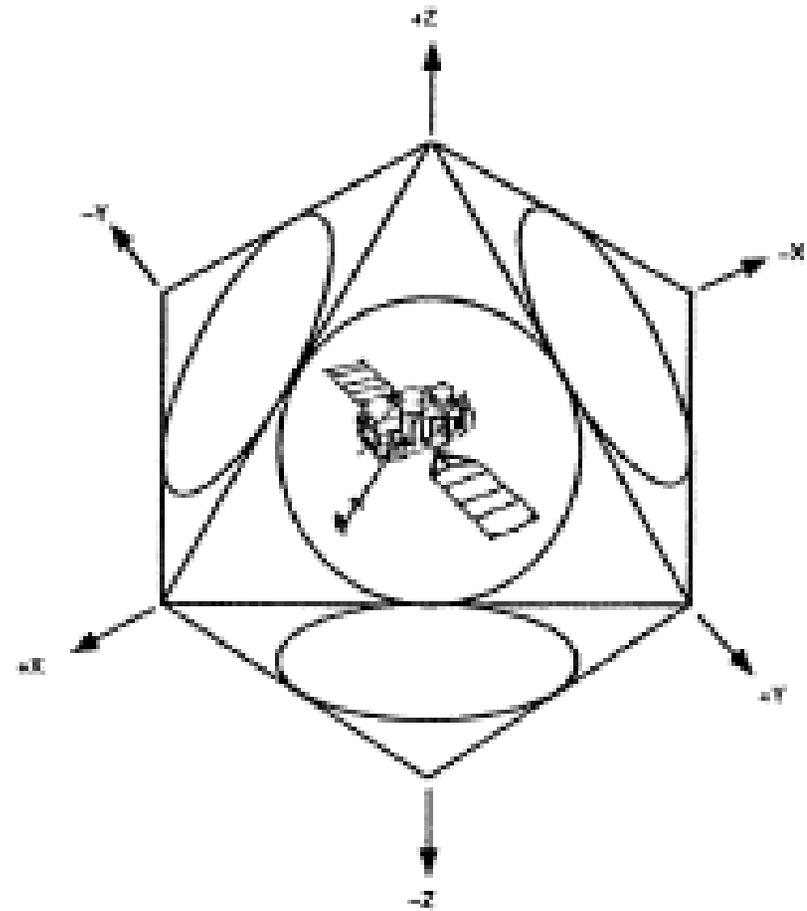
1981

- Loss of **GRSE** from GRO
- Selection of TRW for S/C
- Long, Flat S/C Design

Final GRO Configuration



COMPTON OBSERVATORY



BATSE DETECTOR ASPECT

- How BATSE Began
- **The Spec. Det. for BATSE**
- Spectral Lines in GRBs?
- D. Band, UCSD, & BATSE (J. Matteson)
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1982: Letter to NASA HQ

(Charles Pellerin, Dir. Astrophysics)

- regarding the removal of **GRSE** from GRO
- imploring (begging) that a high resolution, wide-field capability be added to GRO, specifically for observations of GRBs
- *Signed by R. Lingenfelder, R. Ramaty, S. Woosley, and D. Lamb*



National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

GRO-83-94-011

BATSE/GRO Spectroscopy Modification

A proposal to include an all-sky, medium resolution spectroscopy capability on the Burst and Transient Source Experiment (BATSE) for the Gamma Ray Observatory (GRO)

I. Investigation and Technical Plan

Principal Investigator: Gerald J. Fishman
Space Science Laboratory
NASA/Marshall Space Flight Center



National Aeronautics and
Space Administration

Washington, D.C.
20546

→ FEB 2 1984

→ EZ (AGO)

Dr. Gerald J. Fishman
Space Sciences Laboratory
Marshall Space Flight Center
National Aeronautics and Space Administration
Marshall Space Flight Center, AL 35812

Dear Dr. Fishman:

We have completed the review of your proposal, "BATSE/GRO Spectroscopy Modification," and I am happy to inform you that I have accepted your proposal for incorporation into the Burst and Transient Source Experiment (BATSE) on the Gamma Ray Observatory (GRO).

You will continue to be responsible for fulfilling the functions of Principal Investigator. In addition the following persons are approved as co-investigators:

→	Dr. Charles A. Meegan	NASA/MSFC
	Dr. Thomas A. Parnell	NASA/MSFC
	Dr. Robert B. Wilson	NASA/MSFC
→	Dr. James L. Matteson	University of California at San Diego
→	Dr. Bonnard J. Teegarden	NASA/GSFC
→	Dr. Thomas L. Cline	NASA/GSFC

It is clear that the enhanced scientific return resulting from this modification is potentially very significant. It is also clear that making a change at this stage in the program introduces some risk. You should understand that the modification is being accepted with the understanding that it can be carried out within existing cost and schedule constraints. Should any problem arise, I will reexamine this decision.

The GRO will be one of the cornerstones of the Space Science program in this decade. I am looking forward to the new and exciting results which will come from the scientific investigations on this mission.

Sincerely,

B. I. Edelson
Associate Administrator for
Space Science and Applications

cc:
MSFC/FA01/T. J. Lee
GSFC/403/J. Madden



National Aeronautics and
Space Administration

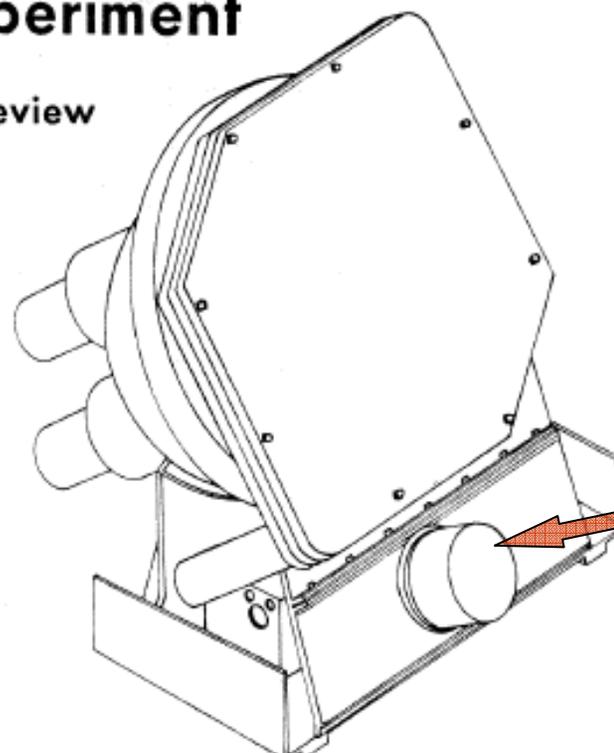
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

BATSE

Burst and Transient Source Experiment

Critical Design Review

June 4-6, 1984



Spec. Mod.

Spectroscopy
Detector Added
to Each Module



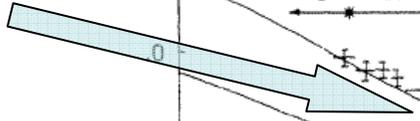
Following the Spec. Mod. Add-on, David Band became part of the BATSE Team at UCSD, specializing in spectral observations of GRBs, but he also maintained an interest in many other aspects of GRBs.

David collaborated and worked closely with many members of the BATSE Team, as you will hear in other presentations today.

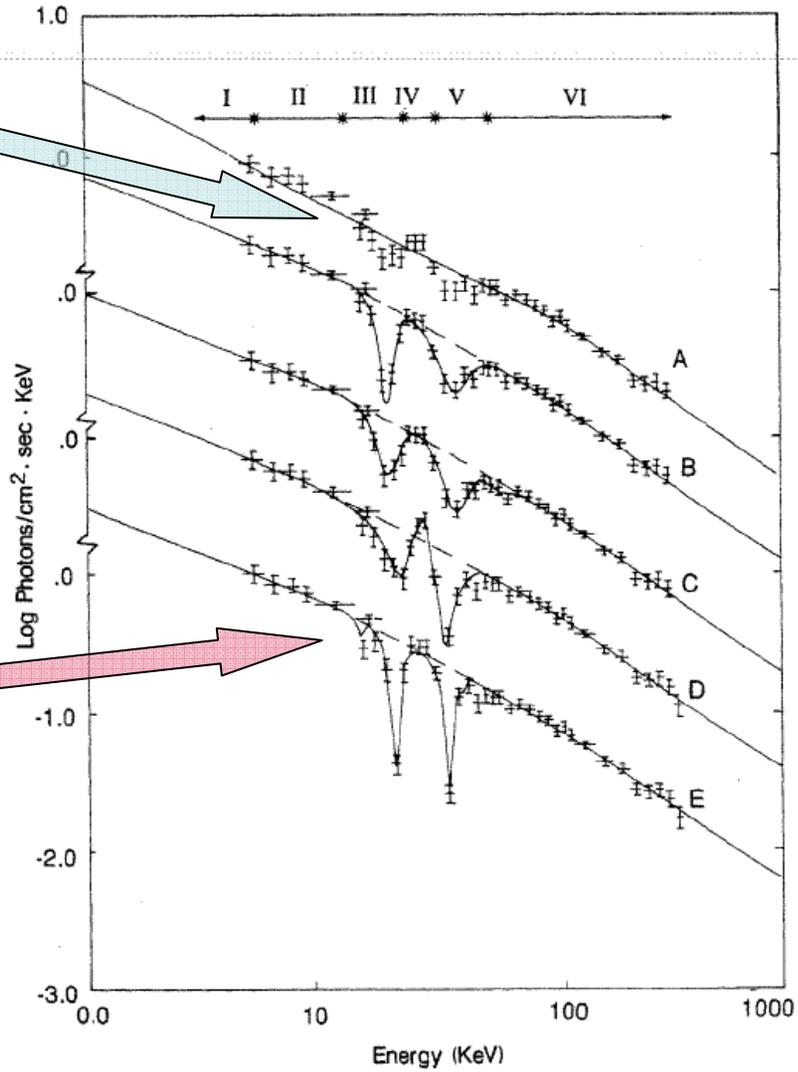
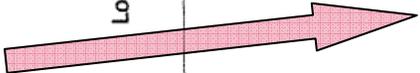
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Spectral Lines in GRBs ??

“Raw”
(Un-processed) data



Model-dependent
De-convolution



- How BATSE Began
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•Huntsville GRB Symposia & D. Band

Huntsville GRB Conferences (6)

- | | | | |
|------|-------------|-----------------------|------------------------------|
| I. | 1991 | Oct. 16-18 | The
BATSE
Era |
| II. | 1993 | Oct. 20-22 | |
| III. | 1995 | Oct. 25-27 | |
| IV. | 1997 | Sept. 15-20 | |
| V. | 1999 | Oct. 18-22 | |
| | -- | (gap following BATSE) | |
| VI. | 2008 | Oct. 20-23 | (GBM-Fermi) |



HUNTSVILLE, ALABAMA

The Huntsville GRB Conferences

***David Band authored or
co-authored 36 papers !***

The Huntsville GRB Conferences

**David Band: Subjects of some of his
papers at the HSV Conferences:**

- *GRB Intensity & Isotropy Measures*
- *Dipole & Quadrupole Meas.*
- *Constraints on Heliospheric Models*
- *Constraints on Galactic Halo Models*

The Huntsville GRB Conferences

David Band's subjects (cont.)

- *Distribution of GRB Peak Rates*
- *Evidence that GRBs Repeat*
- *Evidence that GRB Don't Repeat*
- *C_{max}/C_{min} Distributions*

The Huntsville GRB Conferences

David Band's subjects (cont.)

- *High Time Resolution GRB Spectroscopy*
- *Statistics of BATSE GRB Spectral Features*
- *Nearest neighbors of GRBs*
- *Correlations of GRBs with Known Objects*
- *Robotic Optical Afterglow Observations*



Huntsville Banquet

Oct. 21, 2008

**U.S. Space and
Rocket Center**





Public Lecture by
N. Gehrels →

Transfer of the “Bat” from
the Swift Team back to the
GBM (BATSE) Team ↘

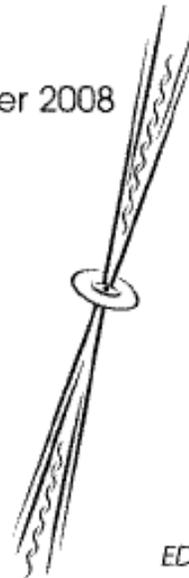




GAMMA-RAY BURSTS

6th Huntsville Symposium

Huntsville, Alabama 20-23 October 2008



EDITORS

Charles Meegan
Universities Space Research Association
Neil Gehrels
NASA Goddard Space Flight Center
Chryssa Kouveliotou
NASA Marshall Space Flight Center

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Gamma-Ray Burst Monitor
Swift
University of Alabama, Huntsville
Curry Foundation

**AMERICAN
INSTITUTE
OF PHYSICS**

Melville, New York, 2009
AIP CONFERENCE PROCEEDINGS ■ 1133



David L. Band

1957-2009

"He reckoned the number of the stars."

Psalm 147

The End