GLAST Burst Monitor

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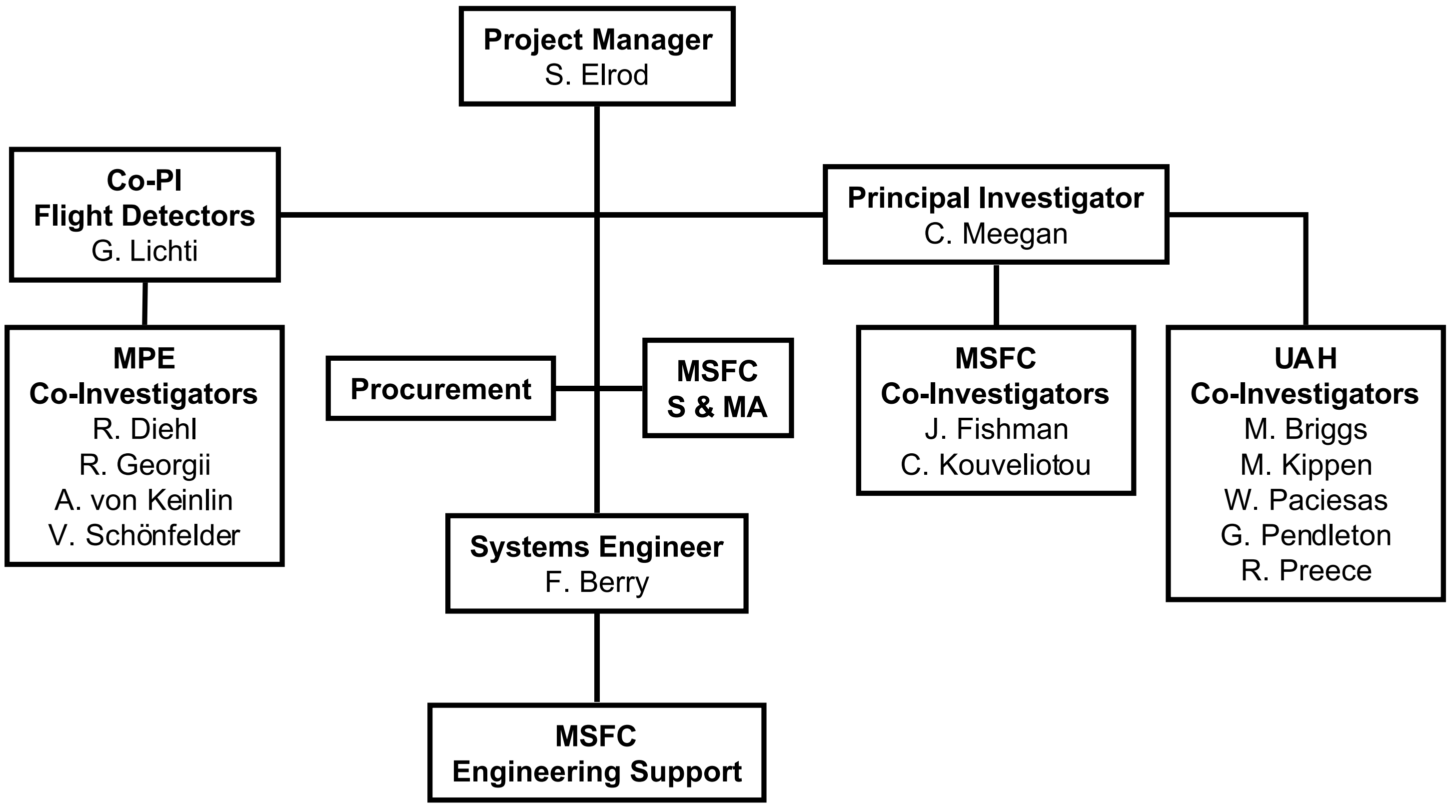
GBM Mission Statement

The mission of the GLAST Burst Monitor (GBM) is to enhance the science return of the Gamma Ray Large Area Space Telescope (GLAST) mission in the study of gamma-ray bursts. The GBM will detect bursts over a large solid angle and will continually measure the spectra of bursts over a wide energy band and with high temporal resolution. It will also determine the directions to the bursts to allow optional repointing of the observatory.

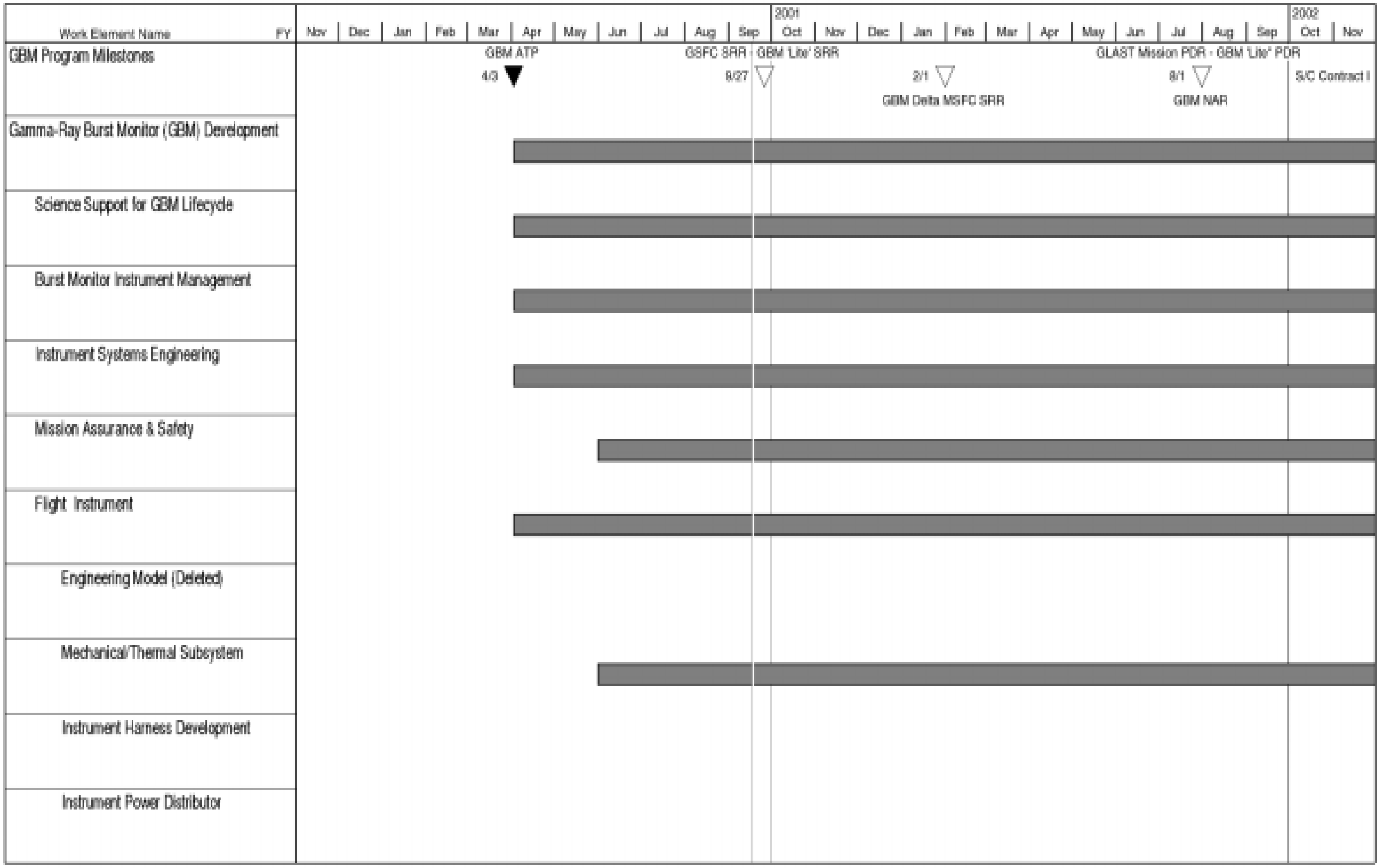
GBM Management and Science Team

- **Principal Investigator - Dr. Charles Meegan, MSFC**
- **Co-Principal Investigator - Dr. Giselher Lichti, MPE**
- **Project Manager - Stephen Elrod, MSFC**
- **Systems Engineer - Fred Berry, MSFC**
- **Co-Investigators (MSFC) - Dr. Jerry Fishman, Dr. Chryssa Kouveliotou**
- **Co-Investigators (MPE) - Dr. Robert Georgii, Dr. Andreas von Keinlin, Dr. Roland Diehl, Dr. Volker Schönfelder**
- **Co-Investigators (UAH) - Dr. William Paciesas, Dr. Geoff Pendleton, Dr. Robert Preece, Dr. Marc Kippen, Dr. Michael Briggs**

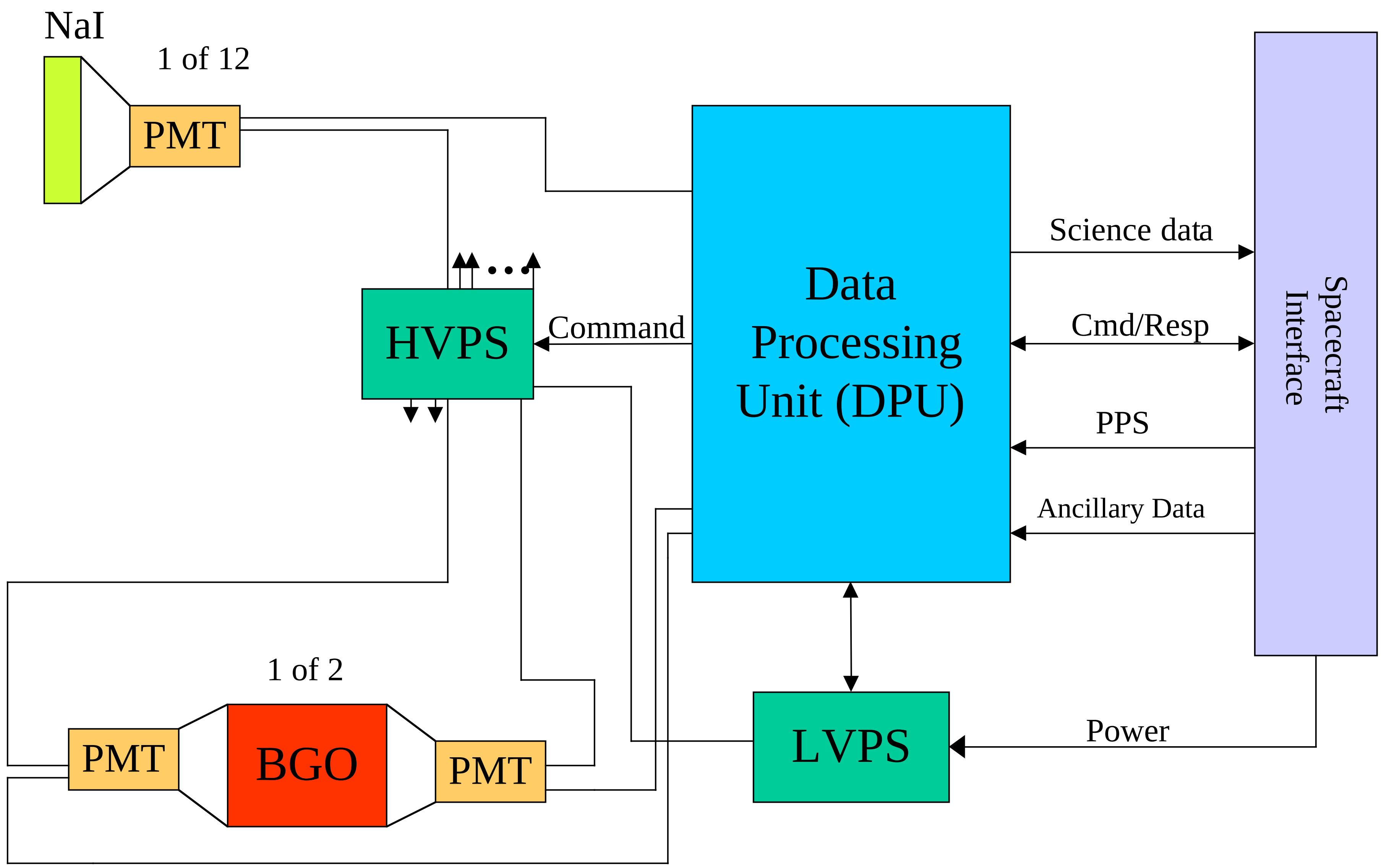
Organizational Chart



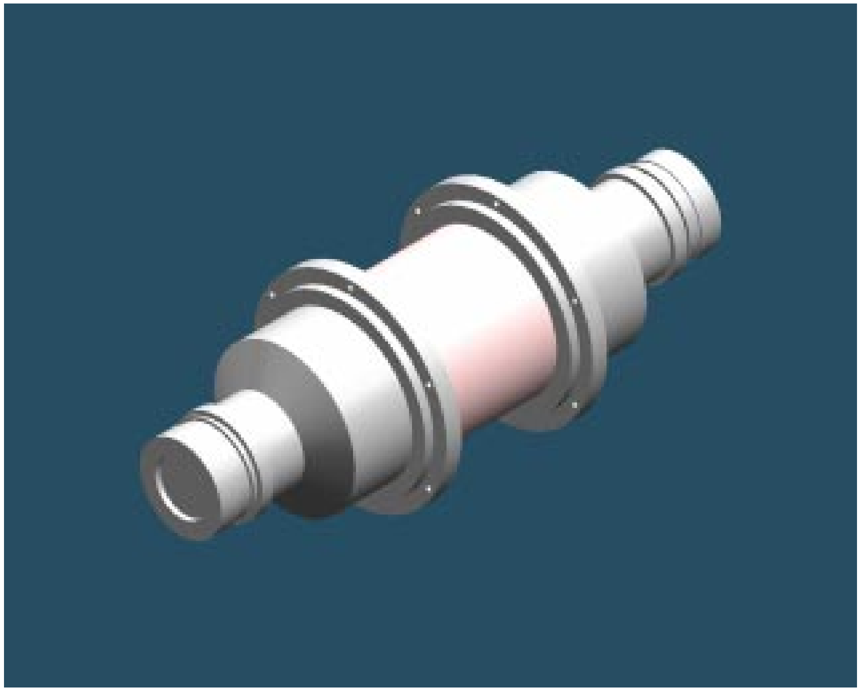
GBM Near Term Schedule



GBM Functional Block Diagram



GBM Detector Concept Drawings



BGO Detector

NaI Detector

Mass Estimate for GBM

					Contingency	
		M[kg]	Number	M[kg]	%	kg
Crystal mass:	**BGO**	11.47	**2**	**22.9**	1%	0.2
	NaI	0.59	**12**	**7.1**	1%	0.1
Al-Housing for 1 detector:						
	BGO	0.28	**2**	**0.6**	5%	0.0
	NaI	0.03	**12**	**0.4**	5%	0.0
PMT (incl. Housing +Bleeder string):						
	M[kg]	0.86	**16**	**13.8**	15%	2.1
Mounting Flanges	**M[kg]**	0.065	**16**	**1.0**	100%	1.0
DPU:	**M[kg]**	2	**1**	**2.0**	100%	2.0
HVPS:	**M[kg]**	3.35	**1**	**3.4**	10%	0.3
LVPS:	**M[kg]**	2.27	**2**	**4.5**	10%	0.5
Thermal Hardware:	**M[kg]**	0.13	**16**	**2.1**	50%	1.0
(Heater, radiator)			==========			
			Total	**57.7**		
Contingency	**M[kg]**	**7.3**		**7.3**		
Total with Contingency.				**65.0**		
	Allocation			**70.0**		
	Margin			**5.0**		

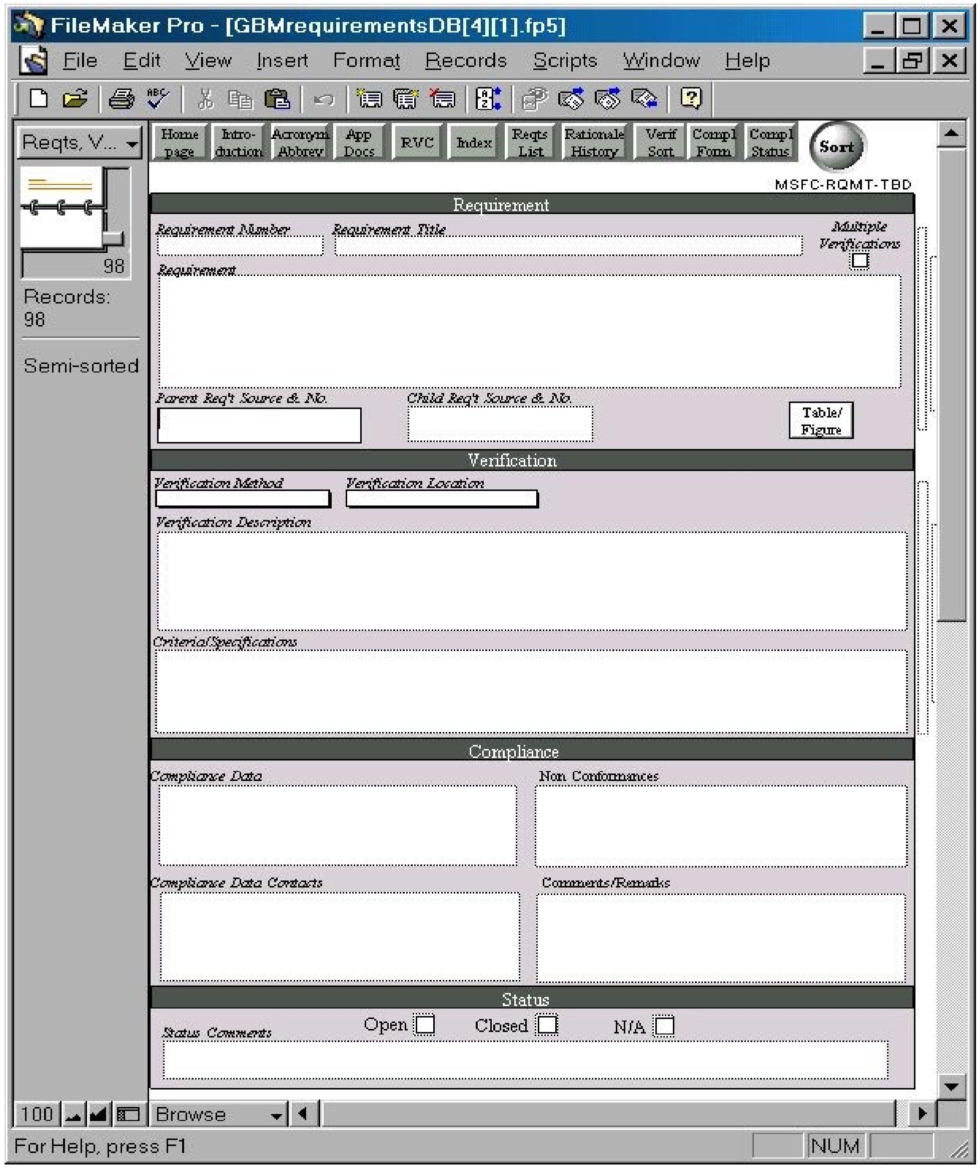
Power Estimate for GBM

					Contingency	
		Watts	Number	Total Watts	%	Watts
PMT (incl. Bleeder string & Preamp):						
	NaI	0.3	**12**	**3.6**	25%	0.9
	BGO	0.6	**2**	**1.2**	25%	0.3
DPU:		10	**1**	**10.0**	100%	10.0
HVPS:		5	**1**	**5.0**	25%	1.3
LVPS:		2	**2**	**4.0**	25%	1.0
Thermal Hardware:		0.2	**16**	**3.2**	100%	3.2
(Heater, radiator)				==========		
			Total	**27.0**		
Contingency		**16.7**		**16.7**		
Total with Contingency.				**43.7**		
	Allocation			**50.0**		
	Margin			**6.4**		

GBM Requirements Verification

- GBM is using a standard MSFC Requirements, Verification and Compliance (RVC) database.
- Each requirement is numbered and categorized.
- Verification method and description captured on same page.
- Compliance data either referenced or stored electronically in data base.
- Non conformances summarized and referenced in database, and dispositioned by the GBM configuration control board.

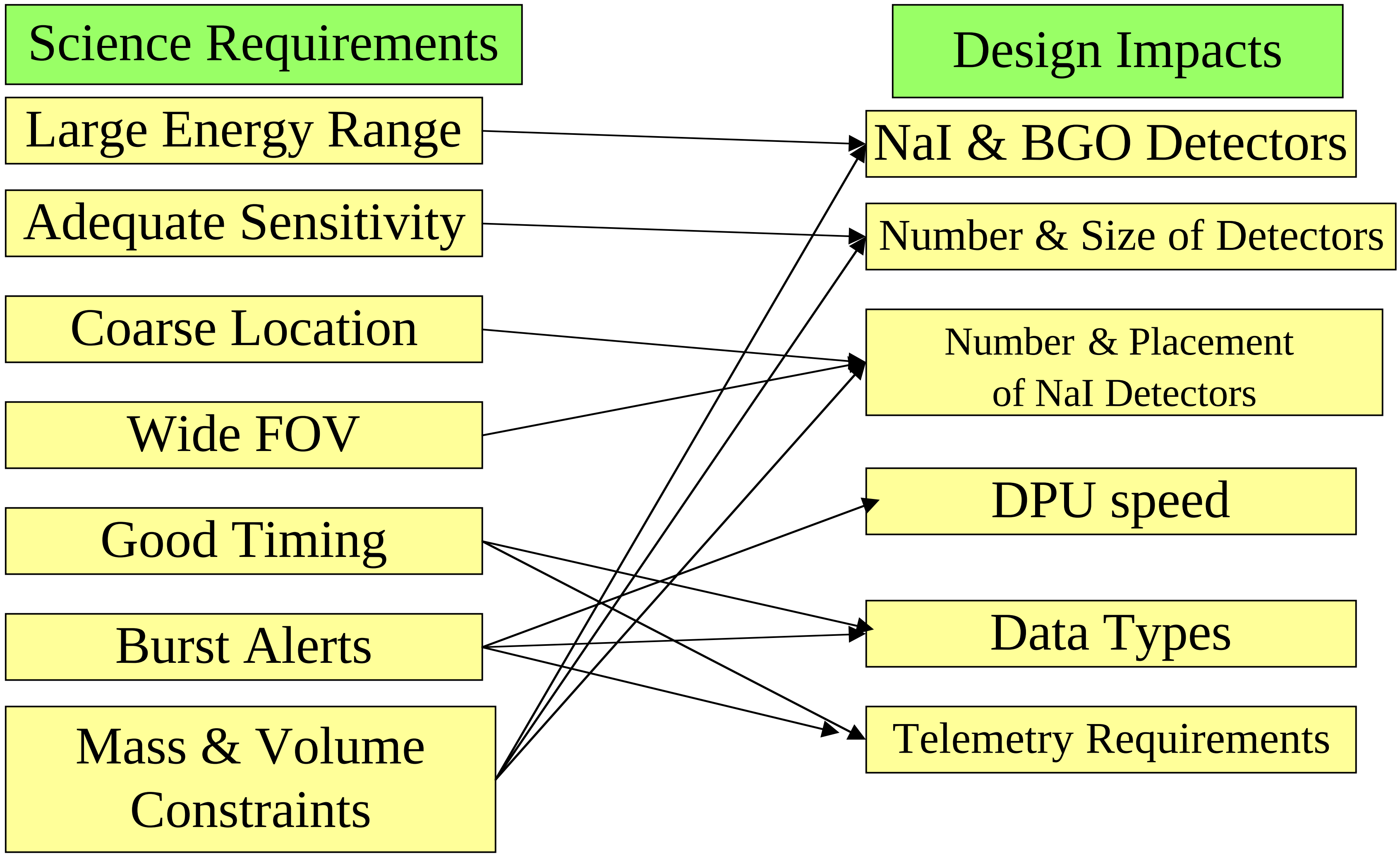
GBM Sample Verification Sheet



GBM System Level Performance Requirements

Title	Requirement	Goal
Energy Range	10 keV – 25 MeV	5 keV – 30 MeV
Energy Resolution	20% FWHM at 511 keV	
On-board Burst Locations	20 degrees within 2 s	10 degrees within 1 s
Ground Burst Locations	5 degrees computed in 5 s	3 degrees computed in 1 s
Final Burst Locations	3 degrees computed in 1 day	
Sensitivity (5σ)	0.5 photons $cm^{-2}s^{-1}$	0.3 photons $cm^{-2}s^{-1}$
Field of View	8 steradians	10 steradians

Effects of Requirements on Design



GBM Detector Mounting

NaI detectors:

The direction to any point in the sky within 120 degrees (TBC) of the +Z axis shall be <80 degrees (TBC) from the normal vectors of at least 3 unobstructed non-collinear NaI detectors, with 95% probability. The goal is 4 unobstructed non-collinear detectors with 100% probability. Solar panels are not considered to be an obstruction.

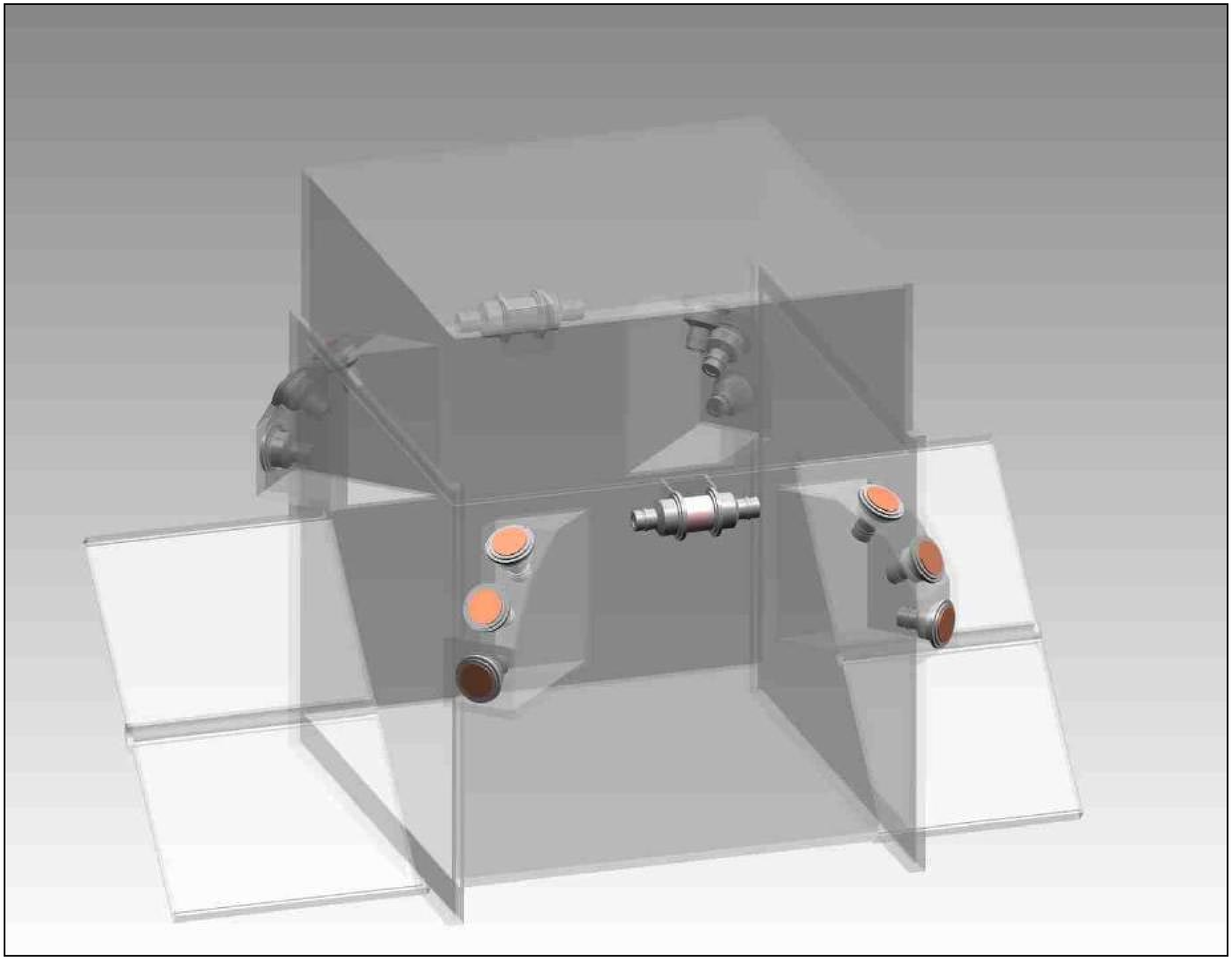
The angle between the normals of any two NaI detectors shall be >25 degrees (TBC).

BGO Detectors:

At least one unobstructed BGO detector must be visible from any point in the sky within 150 degrees (TBC) of the +Z axis, with 95 % probability. The goal is 100% probability over all directions. Solar panels are not considered to be an obstruction.

The axis of symmetry of the BGO detectors should be perpendicular to the Z axis.

GBM Detector Placement Concept



GBM Detector Performance Requirements

Title	Requirement	Goal
Effective Area for Locations	>110 cm^2 at 122 keV, on axis	
	>90 cm^2, 40 to 400 keV, on axis	
	>45% of on axis at 60 degrees	
Effective Area for Spectra – low E	>100 cm^2 at 14 kev, on axis	> 50 cm^2 at 6 keV, on axis
	>40 cm^2 at 14 keV, up to 60°	> 15 cm^2 at 6 keV, up to 60°
Effective Area for Spectra – high E	>80 cm^2, at 1.8 Mev, up to 90°	
Spectral Resolution	<35 % FWHM at 14 keV	< 22% HWHM at 6 keV
	<20 % FWHM at 60 keV	
	<11 % FWHM at 662 keV	
	<7 % FWHM at 1.8 MeV	
Gain Stability	2% over 1.5 hours	

GBM DPU Performance Requirements

Title	Requirement	Goal
Peak Rate performance	10^5 cps per detector, 6 x 10^5 cps total	
Dynamic Range	200:1	300:1
Linearity	1%	
Automatic Gain Control	Monitor 511 keV line and adjust HV	
Burst Trigger	16 ms integrations	
CTIME data	8 channels, 0.512 s	Adjustable to 0.128 s
CSPEC data	128 channels, 8.192 s	Adj. to 2.048 s
TTE data	250,000 events pre-trigger	500,000 events pre-trigger
Housekeeping data		Deadtime counters

GBM Requirements Issues

- **System linearity and stability need further study**
- **DPU redundancy/cost trades**
- **DPU/Spacecraft Interface**
  - Small increase in telemetry buffer can achieve goal of science enhancement
  - Max Spacecraft Bus Rate affects TTE Buffer
- **Trigger alerts need to be coordinated with LAT team**
- **Requirements levied on GLAST project**
  - Observatory mass model
  - Spacecraft simulator
  - TBD spacecraft level radioactive source calibration
- **Detector Mounting –** Thermal, FOV, Mechanical

GBM Ground Support System (pre-launch)

- **Purpose**
  - System test & calibration
  - S/C integration & test
- **Functions**
  - Receive & store data
  - Monitor detector rates, housekeeping, status
  - Display & analyze detector spectra
  - Generate & transmit instrument commands
  - Simulate detector response
- **Capabilities**
  - Process/store >95% of real-time packets
  - Transportability
  - Critical custom components redundant
  - DPU interface
  - GLAST S/C interface
    - S/C simulator required

GBM Ground Support System (post-launch)

Instrument Operations Center

- **Purpose**
  - Instrument operations
  - Data archival
  - Primary data analysis
- **Functions**
  - Process data, level 1 $\rightarrow$ 2
  - Maintain flight S/W
  - Monitor detector calibration
  - Monitor detector rates, housekeeping, status
  - Locate GRBs
  - Deconvolve GRB spectra
    - Mass Model required
- **Functions (continued)**
  - Generate/transmit instrument commands
  - Compute GRB peak flux, fluence, duration
  - Produce and deliver high-level data
  - Interface to GLAST MOC/SSC
  - Autonomous GRB location software for MOC