



SWIFT UP-DATE:

Martin Ward

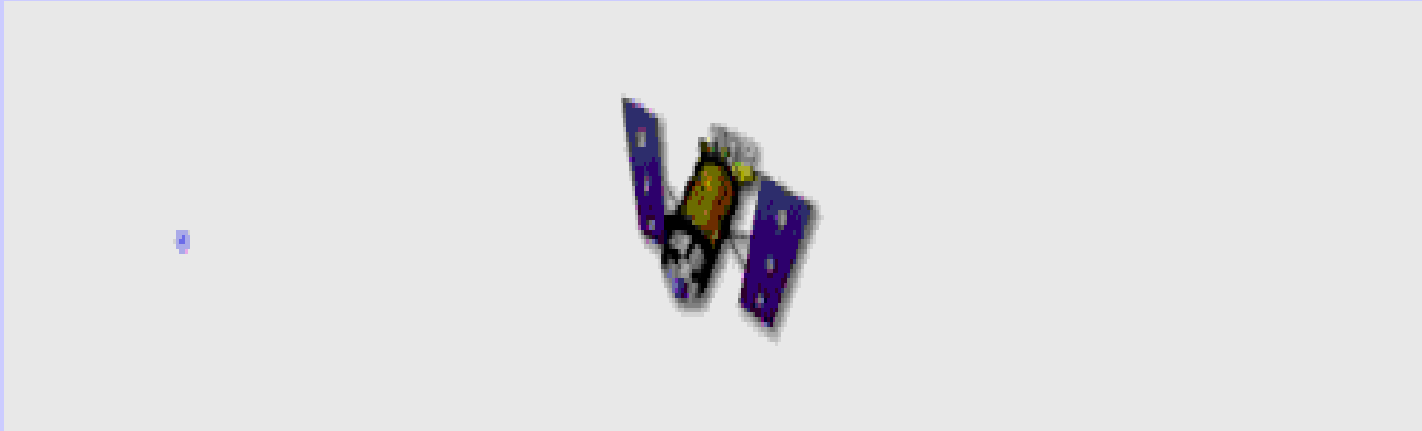
University of Durham

**Based on Swift P.I. Neil Gehrels
presentation at the AAS**

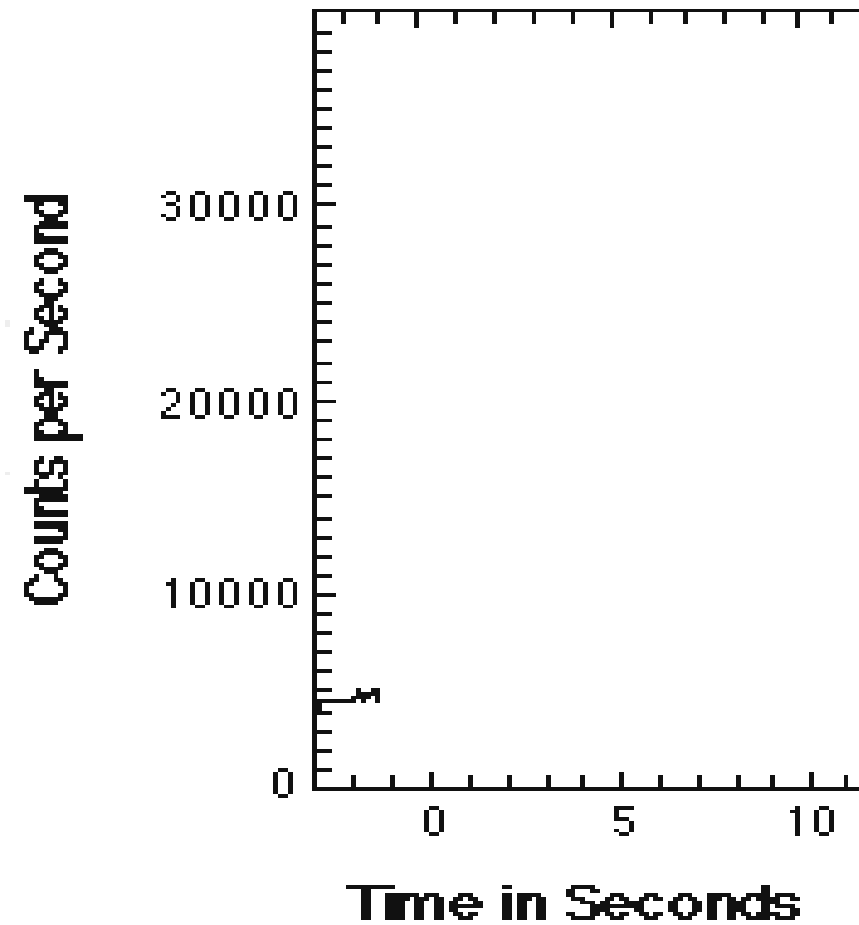
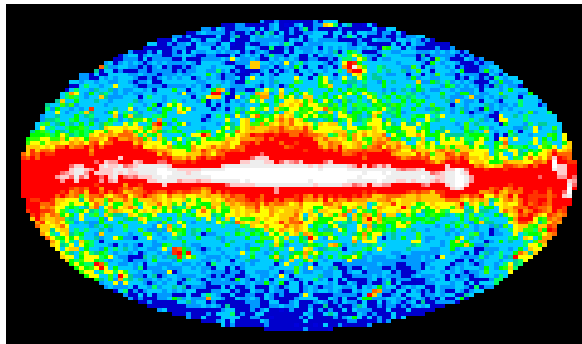
Jan. 2005

H.E. astro-particle meeting

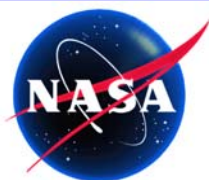
Cosners House Feb. 18-20th 2005



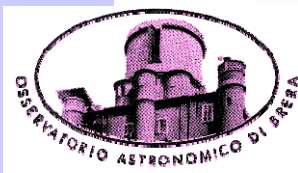
A Typical Burst



Swift



PENNSTATE



Los Alamos
NATIONAL LABORATORY

SWALES
AEROSPACE

OMITRON
inc.

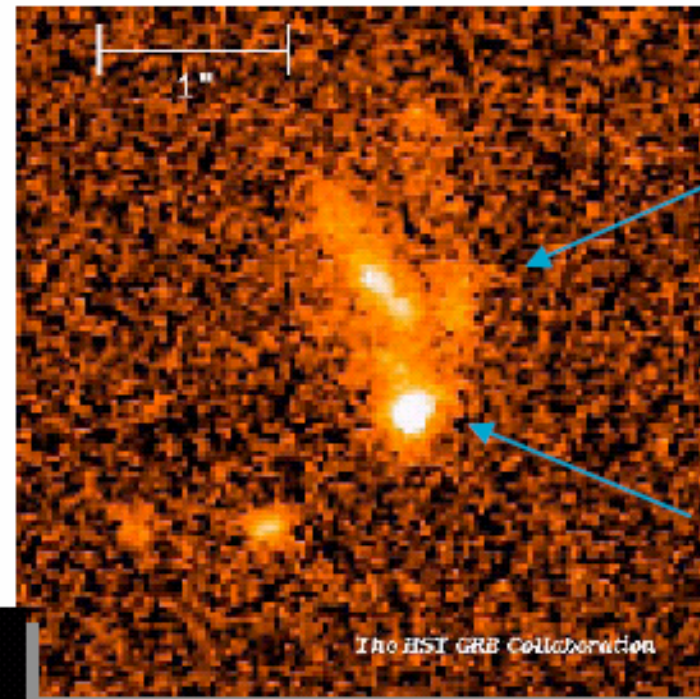
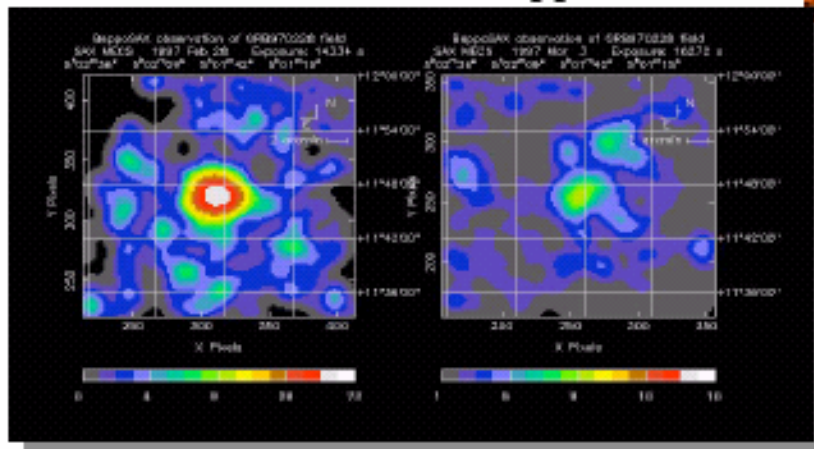
Motivations for Swift

Black Hole Birth

Ultrarelativistic Outflows

Early Universe Probes

GRB 970228 - BeppoSAX



host
galaxy

GRB

The HST GRB Collaboration

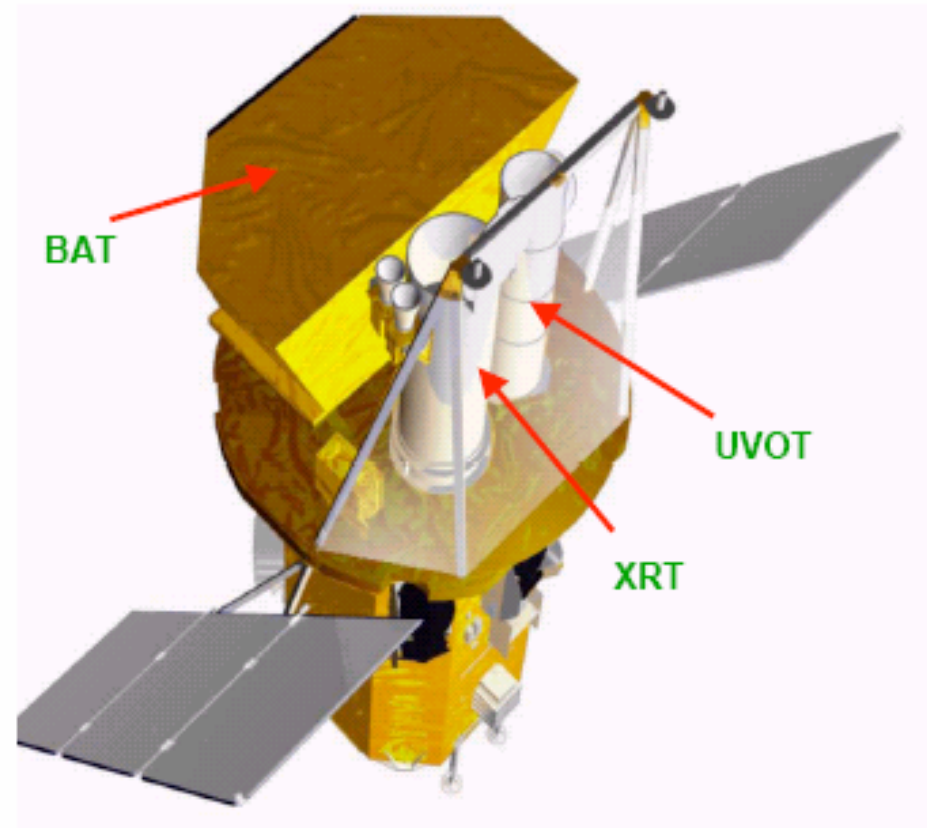
Swift Observatory at KSC



Swift Instruments

Instruments

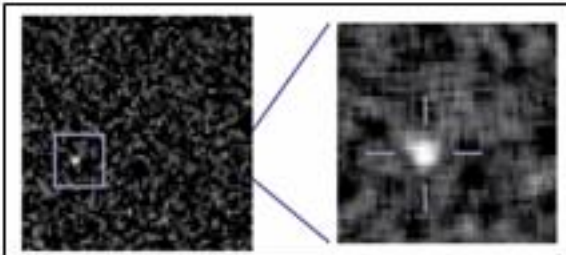
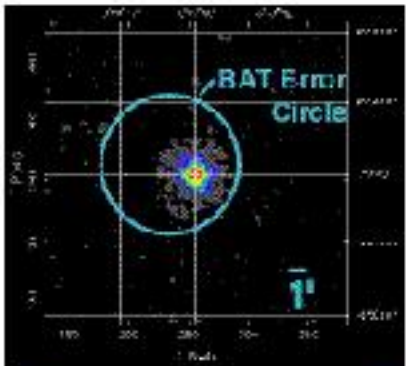
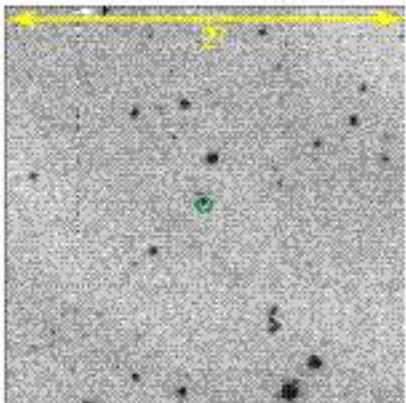
- **Burst Alert Telescope (BAT)**
 - New CdZnTe detectors
 - Most sensitive gamma-ray imager ever
- **X-Ray Telescope (XRT)**
 - Arcsecond GRB positions
 - CCD spectroscopy
- **UV/Optical Telescope (UVOT)**
 - Sub-arcsec positions
 - Grism spectroscopy
 - 24th mag sensitivity (1000 sec)
 - Finding chart for other observers



Spacecraft

- Autonomous re-pointing, 20 - 75 s
- Onboard and ground triggers

Swift Data

<u>Notification</u>	<u>Time (sec)</u>	<u>Event</u>	<u>Cascade of Images</u>
	0	GRB	
Rapid position	15	BAT position Spacecraft slew	
Arcsec position	70	XRT position	
Spectra, light curves, images	~110	XRT & BAT	
UVOT finding chart	240	UVOT image	



Hurricane Isabelle

- Hurricane Isabelle hits Goddard
- 75% of local homes lose power
- Goddard closes for 2 days
- No damage to Swift!





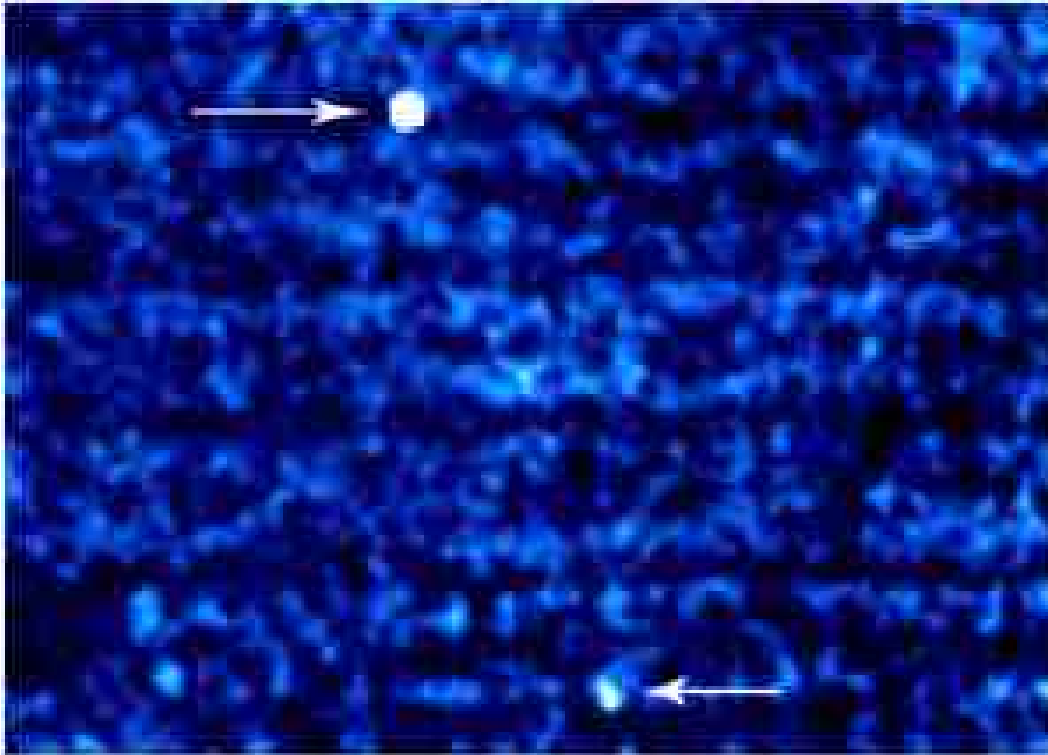
NASA MIDEX Mission selected in
1999

Primary science is to study gamma-
ray bursts throughout the Universe

International hardware participation
from UK and Italy

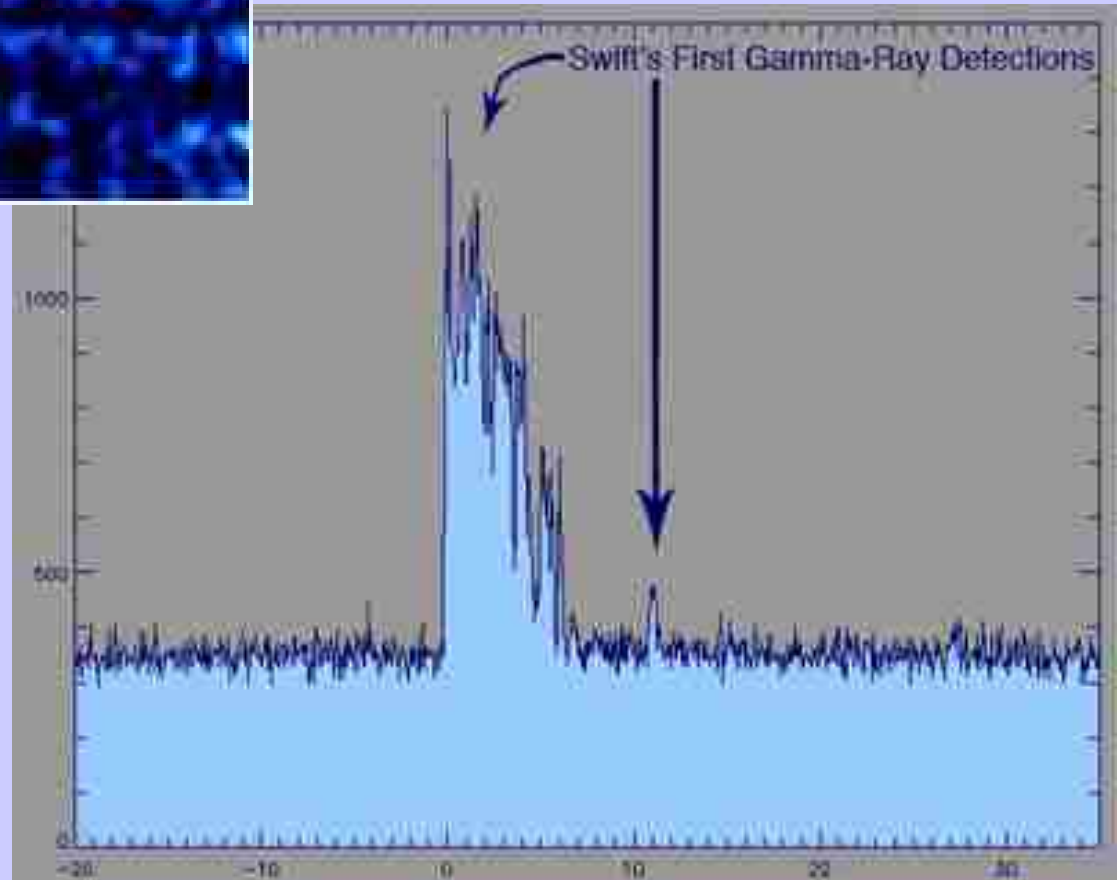
Launch on November 20, 2004



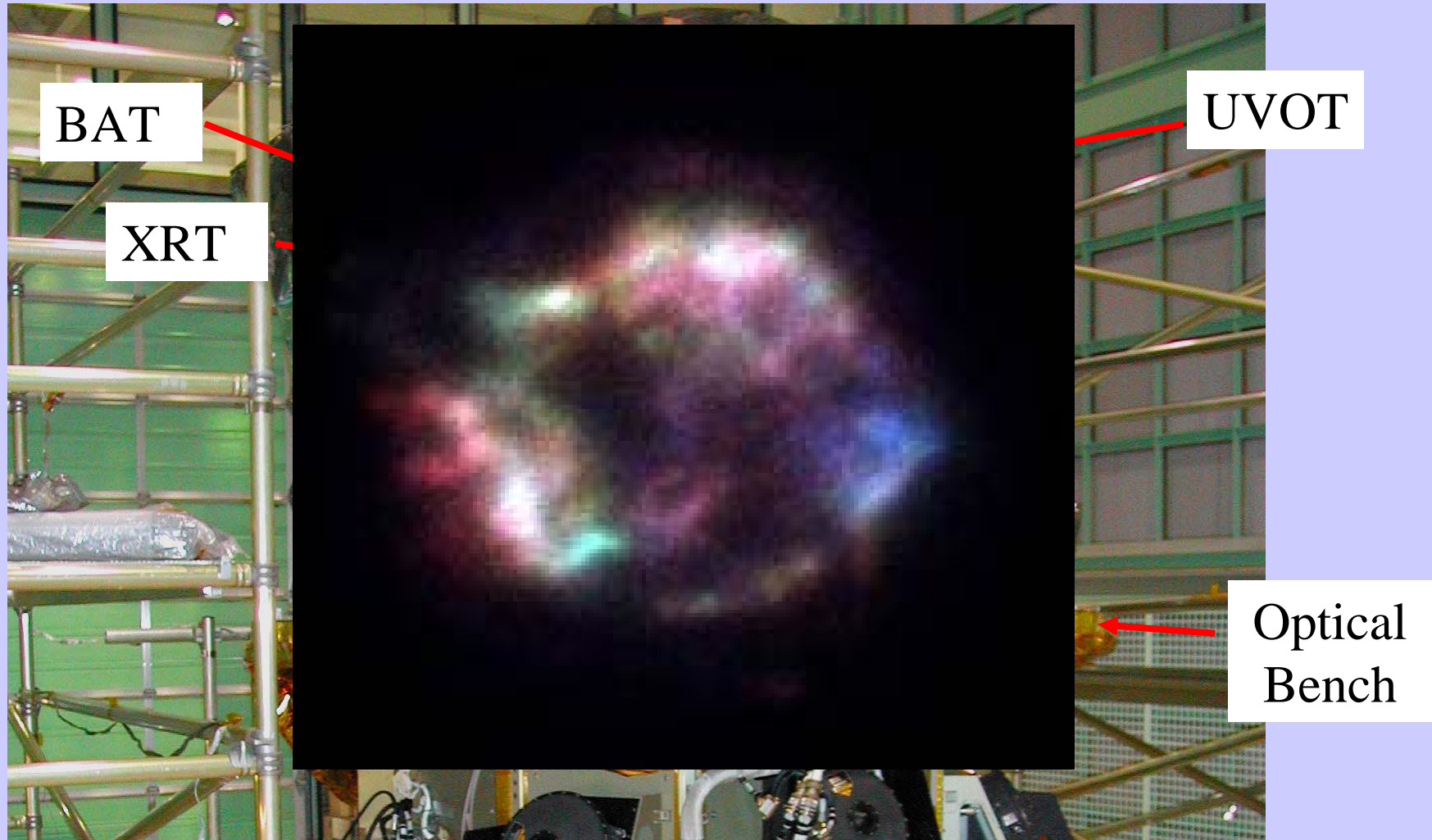


1st BAT Image
Cyg X-1, Cyg X-3

1st BAT GRB
Dec.11th 2004



Swift Instruments



One of the 1st XRT images: CASS-A

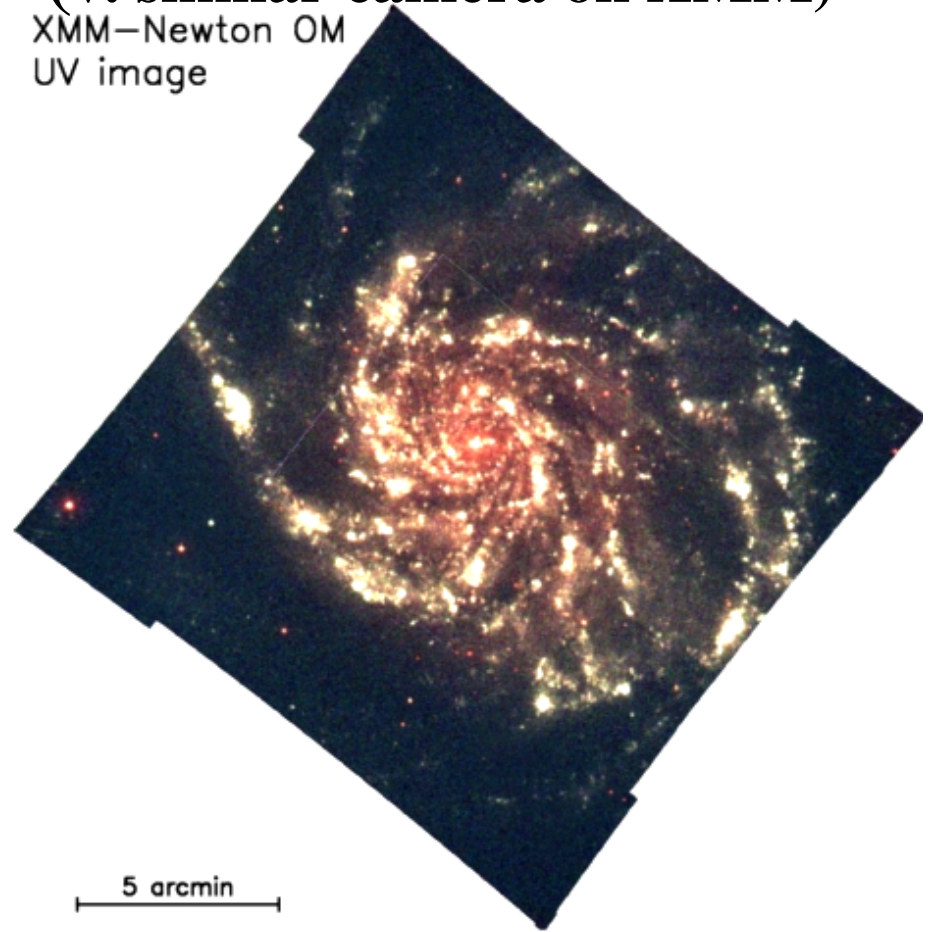
Swift UVOT 1st light Feb. 1st 2005 (M101)



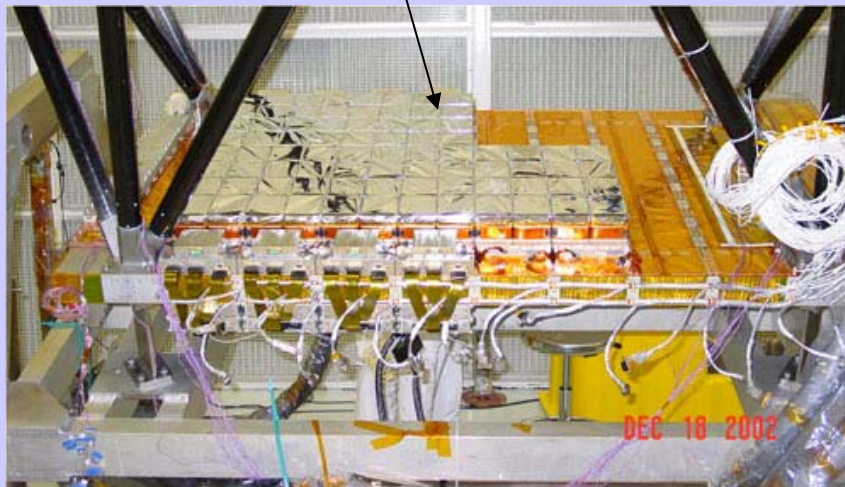
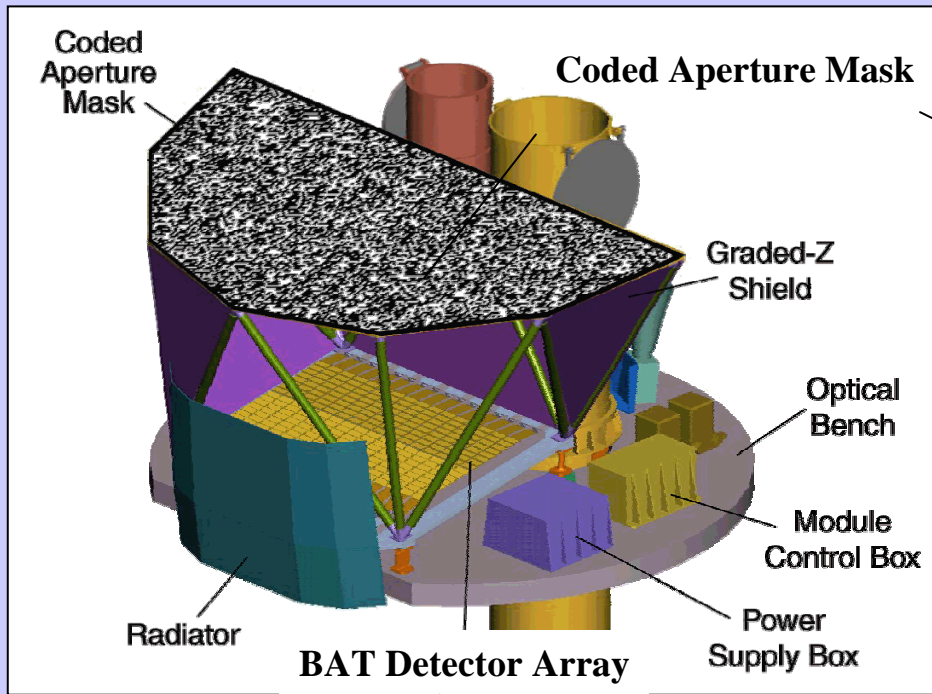
Comparison with XMM OM UV Image

(v. similar camera on XMM)

XMM-Newton OM
UV image



Burst Alert Telescope (BAT)



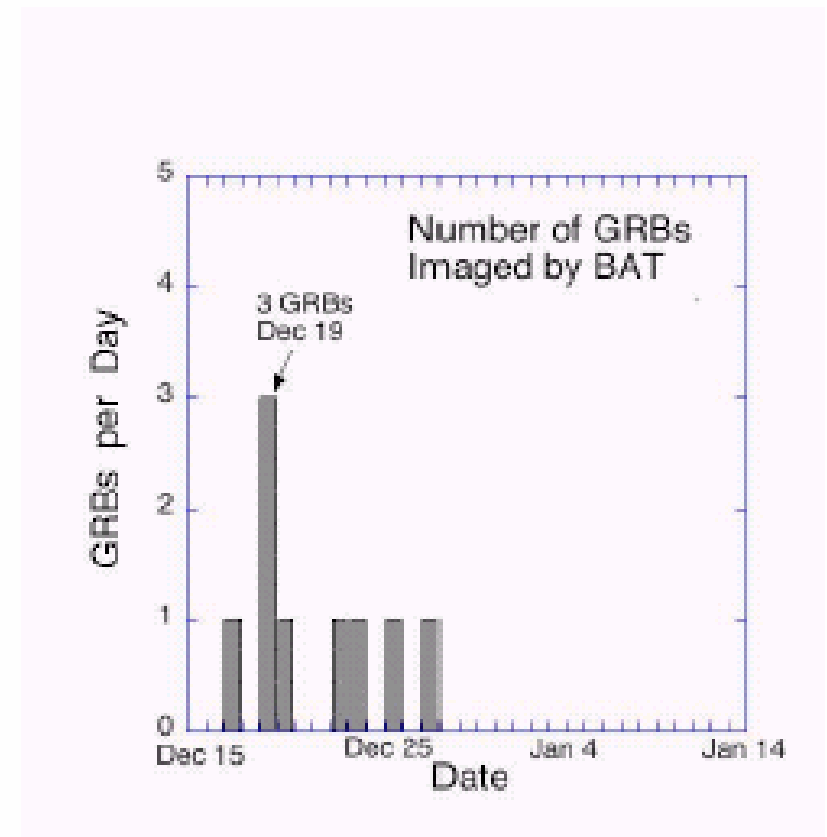
BAT Characteristics

Telescope	Coded Aperture	
Telescope PSF	17 arcmin FWHM	
Position Accuracy	1-4 arcminutes	•
Detector	CZT	
Detector Format	32768 pixels	
Energy Resolution	7 keV FWHM (ave.)	
Timing Resolution	100 microseconds	
Field of View	2 Steradians, partially-coded	•
Energy Range	15 – 150 keV	•
Detector Area	5200 cm ²	•
Sensitivity	0.2 photons/cm ² /s	
Max Flux	195,000 cps (entire array)	
Operation	Autonomous	

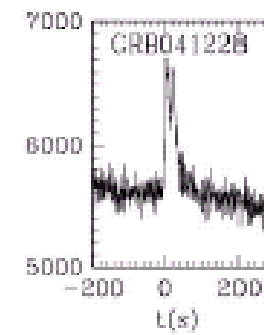
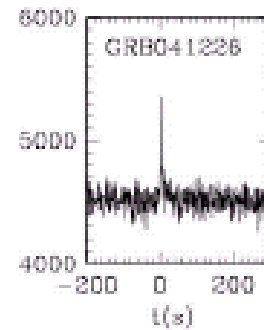
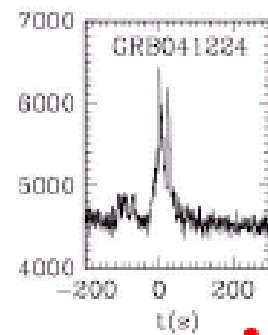
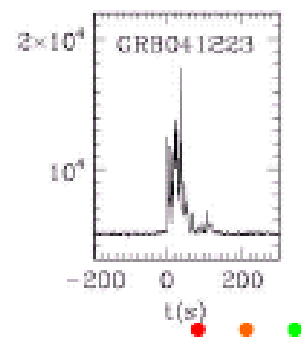
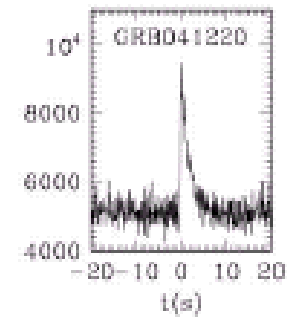
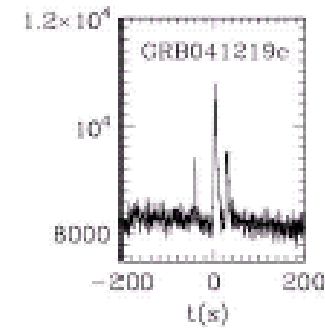
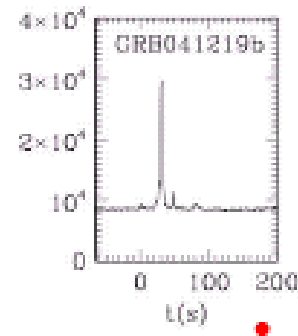
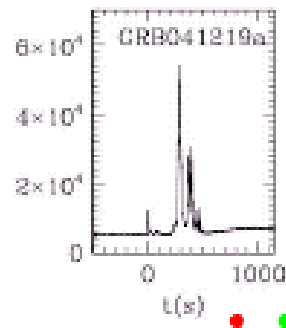
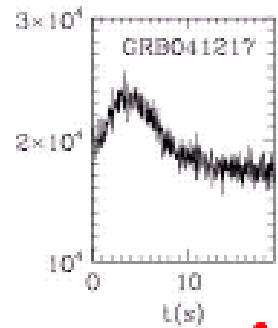
Scientific Findings To Date

(up to Jan. 2005)

- **9 GRBs detected since Dec. 17**
- **Large GRB detected on Dec. 19 (GRB 041219)**
- **XRT pointed at GRB 041223 via ground command at ~4.5 hours. Afterglow detected.**
- **Giant flare detected from soft gamma repeater SGR 1806-20 on Dec. 27**
- **BAT is performing sensitive monitoring of hard x-ray sky**

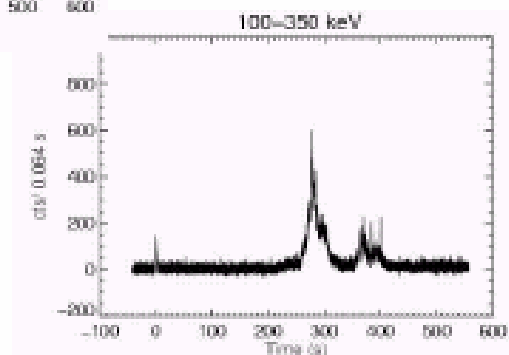
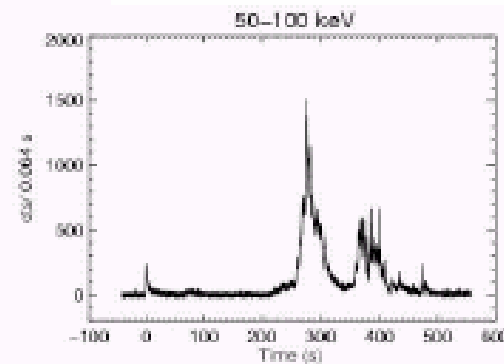
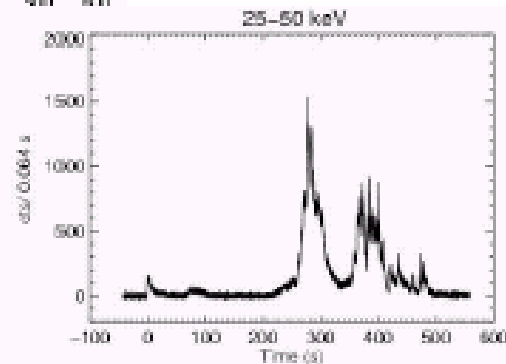
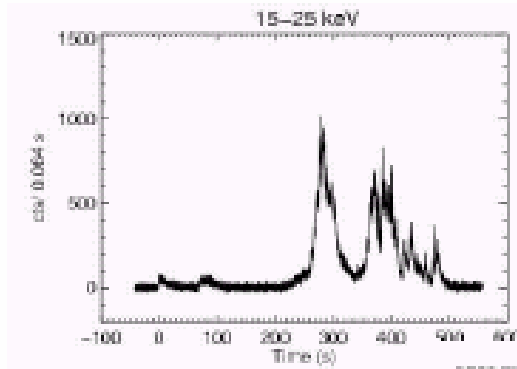


Light Curves of BAT GRBs



- \bullet = detected by other gamma-ray instrument
- \bullet = slewed to and imaged by XRT
- \bullet = detected by ground-based optical/IR

GRB 041219



- Long duration GRB lasting 500 s
- Fluence of $\sim 10^{-4}$ erg cm^{-2}
- Fluence in top 1% of CGRO/BATSE bursts
- Duration in top 2% of CGRO BATSE bursts
- Imaged by INTEGRAL & Swift

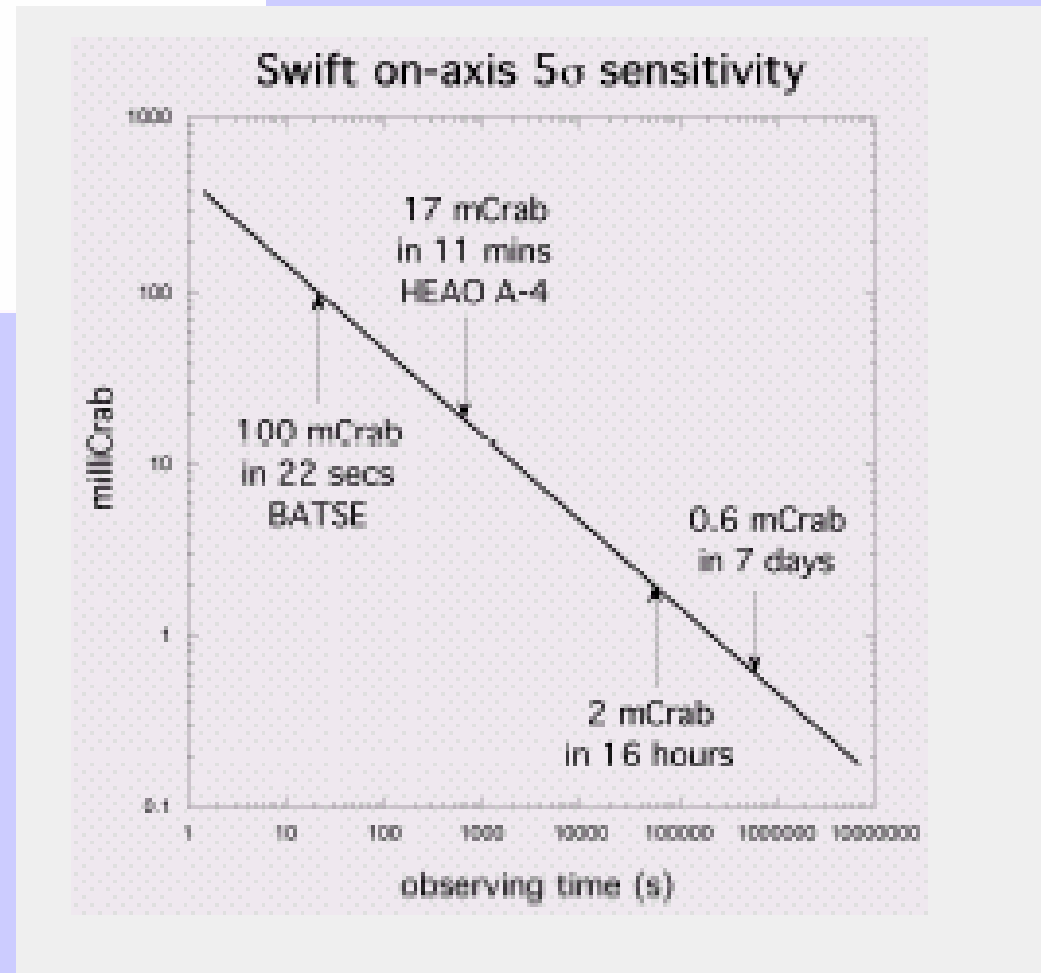
- IR fast-fading counterpart ("flash") discovered at early time
- Real-time (RAPTOR) optical detection
- Radio counterpart
- Campaign underway to determine host and redshift

Swift Non-GRB Capabilities

Hard x-ray survey of sky

Transient monitoring

Multiwavelength response to transients detected by others



Giant Flare from SGR 1806-20

SGRs are galactic neutron stars with huge magnetic fields ($\sim 10^{15}$ G) that have occasional active periods and outbursts.

SGR 1806-20 discovered in 1986. Four known SGRs

Detected on Dec. 27, 2004 by all non-occulted gamma-ray detectors in space

Huge main peak lasting 0.5 sec followed by 400 sec of pulsations

Estimate (Boggs et al. GCN 2936) puts fluence greater than ~ 0.1 erg cm^{-2} , 1-2 orders of magnitude greater than SGR 1900+14 1998 and SGR 0526-66 1979 flares.

Radio transient detected. Slightly extended source. Polarization detected.

Summary

- Swift is working well – all instruments functioning to spec.
- Number of bursts consistent with predictions ie. 100-150 per year
- Swift data goes live in April 2005 ie. all processed download products will be openly available in real time