The Swift GRB MIDEX Mission

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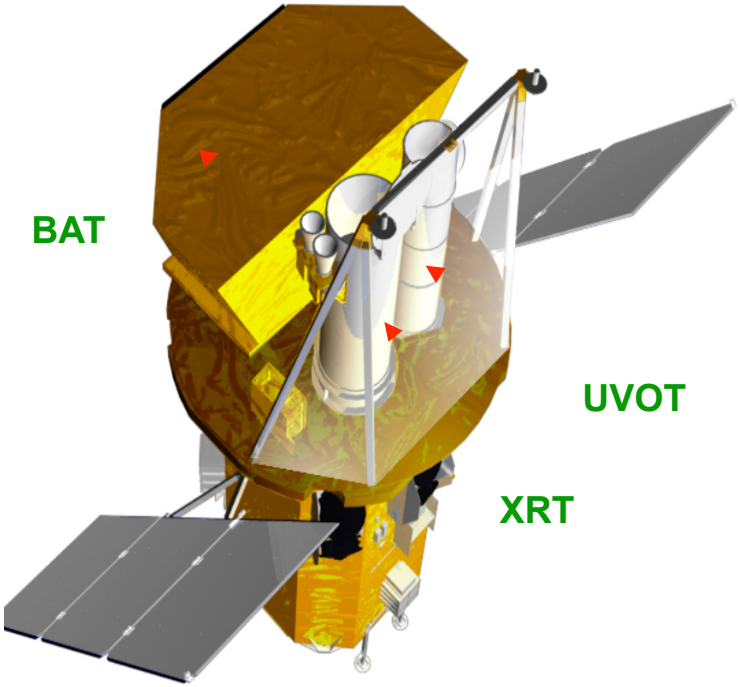
NASA-GSFC

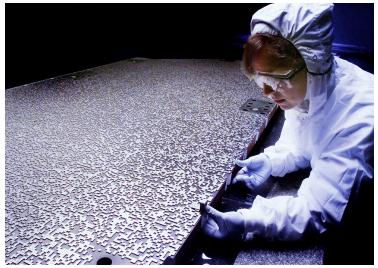
PIF-4

November 9, 2011

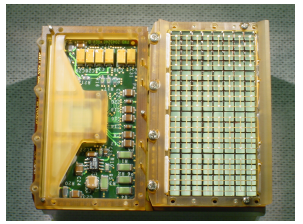
Mission Overview

- **Mission Parameters**
  - Selected in MIDEX program Nov. 1999
  - Managed at GSFC
  - Lead university partner is Penn State
  - Key hardware from UK and Italian partners
  - 2 year prime mission, >20 year orbit lifetime
- **Science Objectives**
  - Determine origin of gamma-ray bursts
  - Use bursts as early-universe probes
  - Perform all-sky survey in hard X-ray band
- **Science Payload/Operations**
  - Rapidly re-pointing, autonomous spacecraft
  - Multiwavelength payload
    - » BAT: Wide-field gamma-ray imager
    - » XRT: Grazing-incidence X-ray telescope
    - » UVOT: Sensitive optical telescope



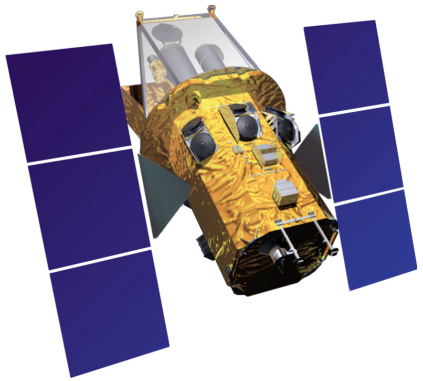


BAT mask



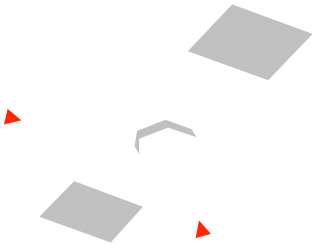
BAT detectors
1 or 128 modules

Mission Operations



Payload

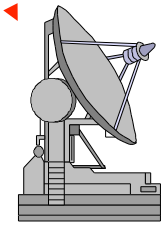
BAT
XRT
UVOT



TDRSS

Spacecraft

Spectrum Astro
Rapid Autonomous Slews



Malindi
(ASI)

Mission
Operations Center **PSU**
(MOC)

Science Center **GSFC**

GCN & Web

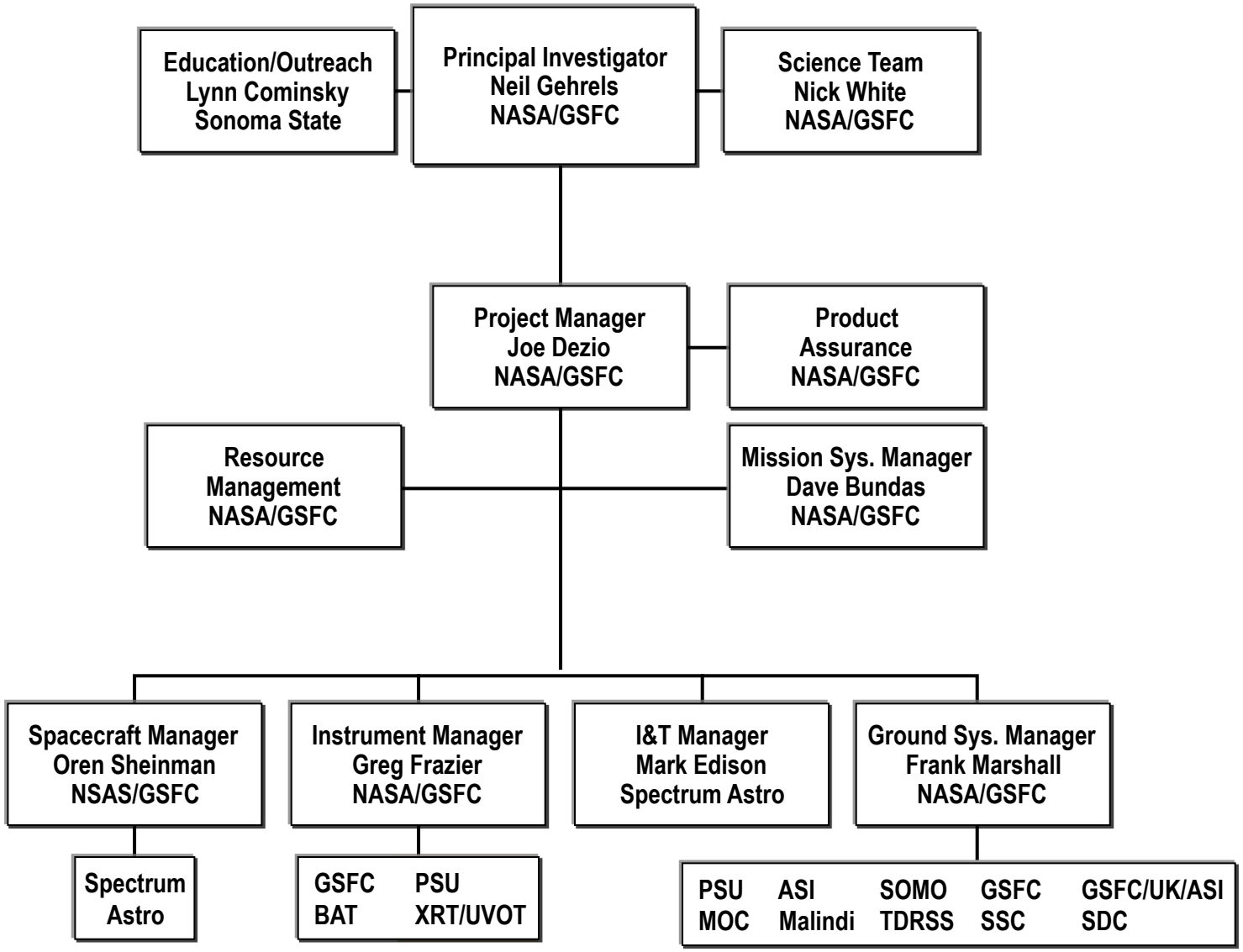
HEASARC
UK
Italian
Archives

User
Community

Delta 2320
600 km X 22^{o} inclination

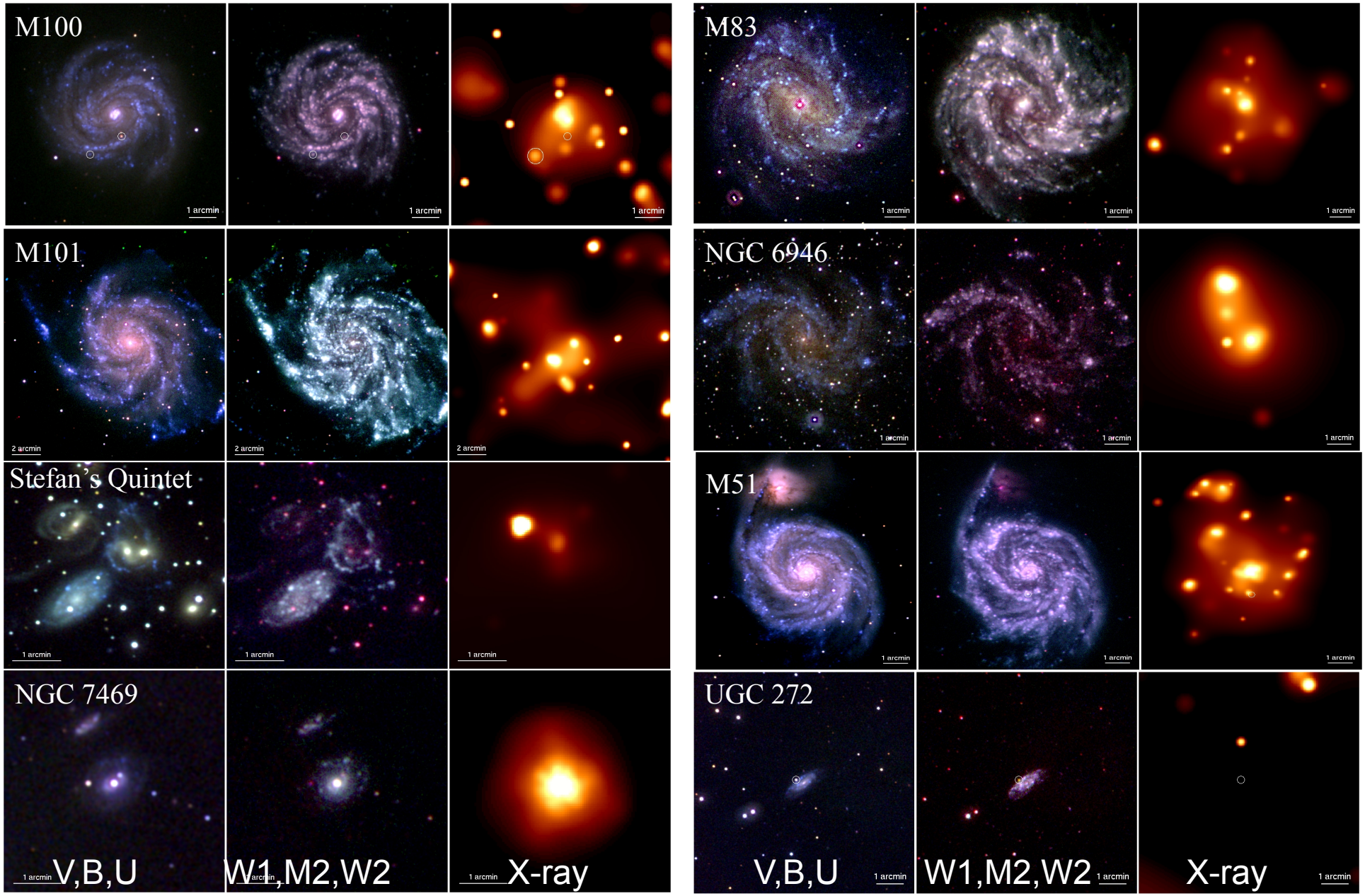
Launch
Nov 2004

Swift Org Chart

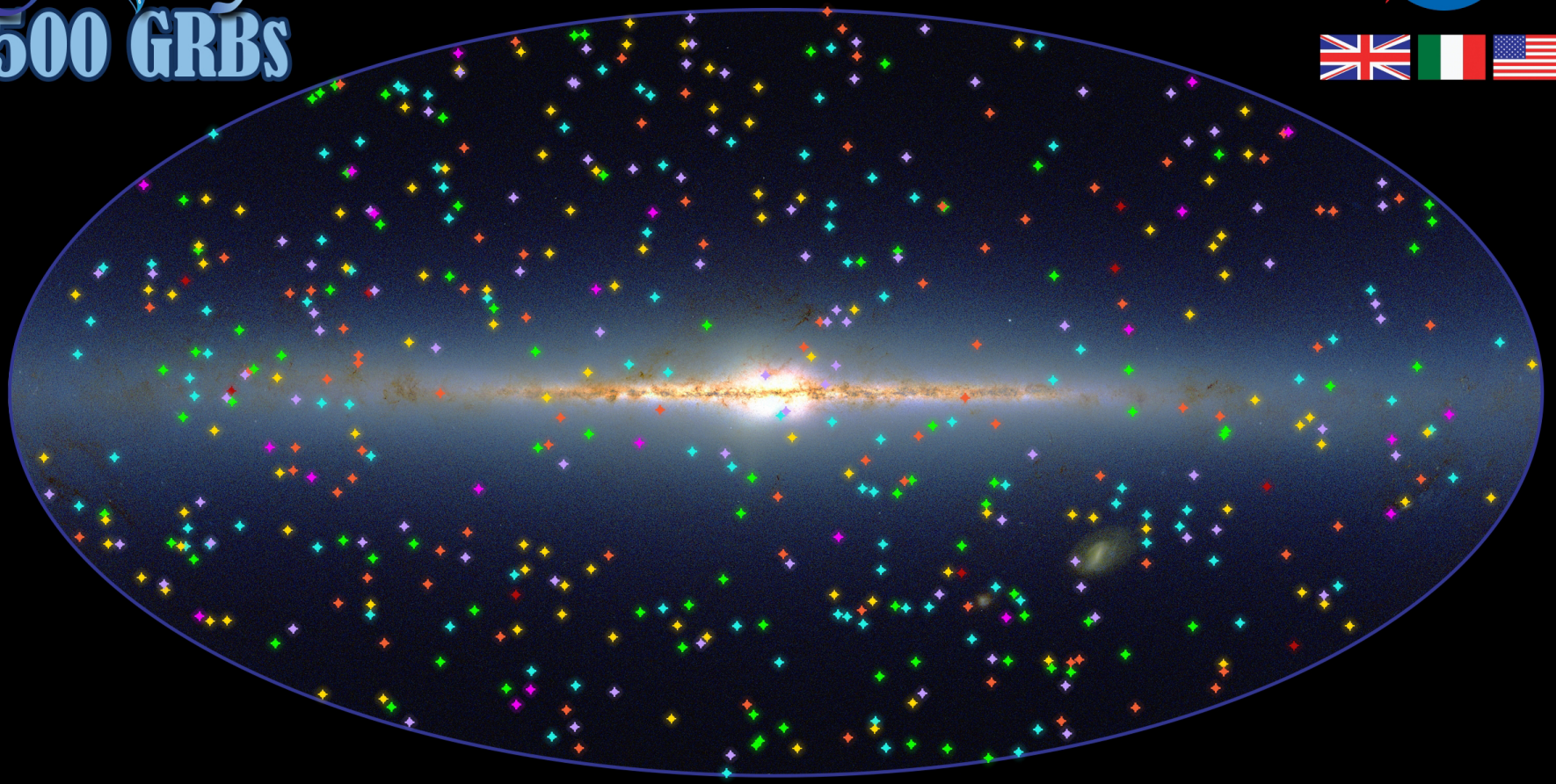


XRT & UVOT Galaxy Images

S. Immler



Swift 500 GRBs

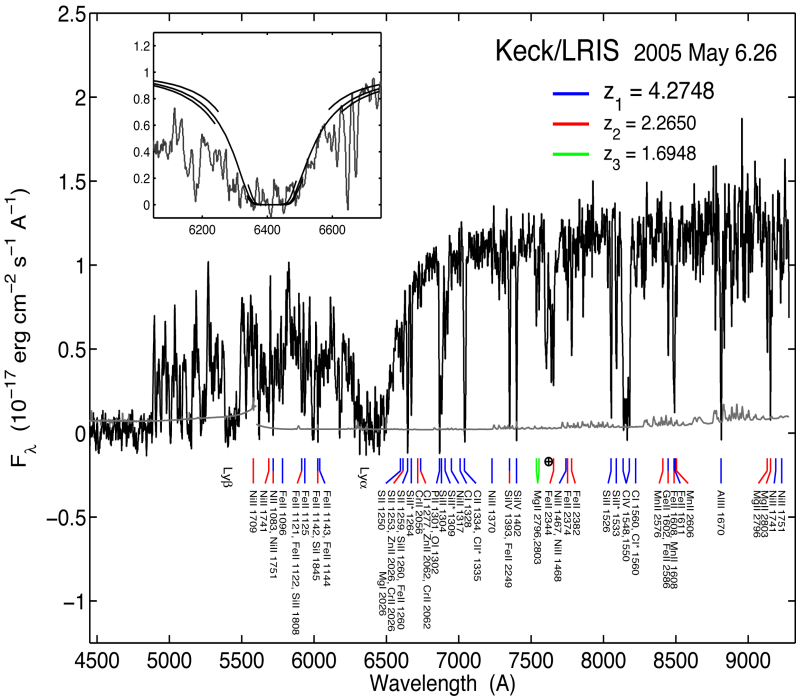


2004 2005 2006 2007 2008 2009 2010

www.nasa.gov/swift

Blasts from the past

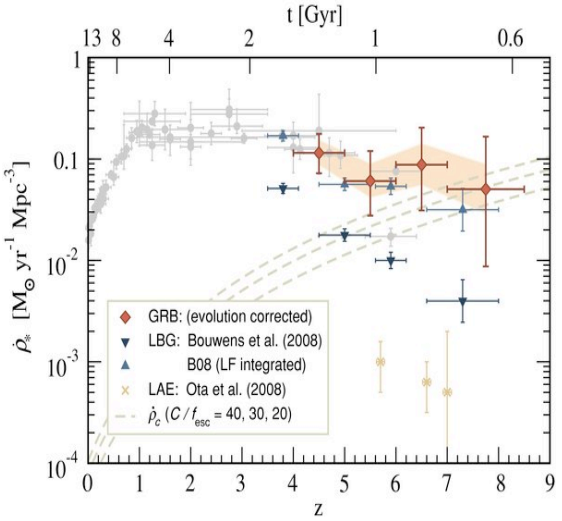
z	GRB	Optical Brightness
9.3	090429B	K = 19 @ 3 hrs
8.2	090423	K = 20 @ 20 min
6.7	080813	K = 19 @ 10 min
6.29	050904	J = 18 @ 3 hrs
5.6	060927	I = 16 @ 2 min
5.3	050814	K = 18 @ 23 hrs
5.11	060522	R = 21 @ 1.5 hrs



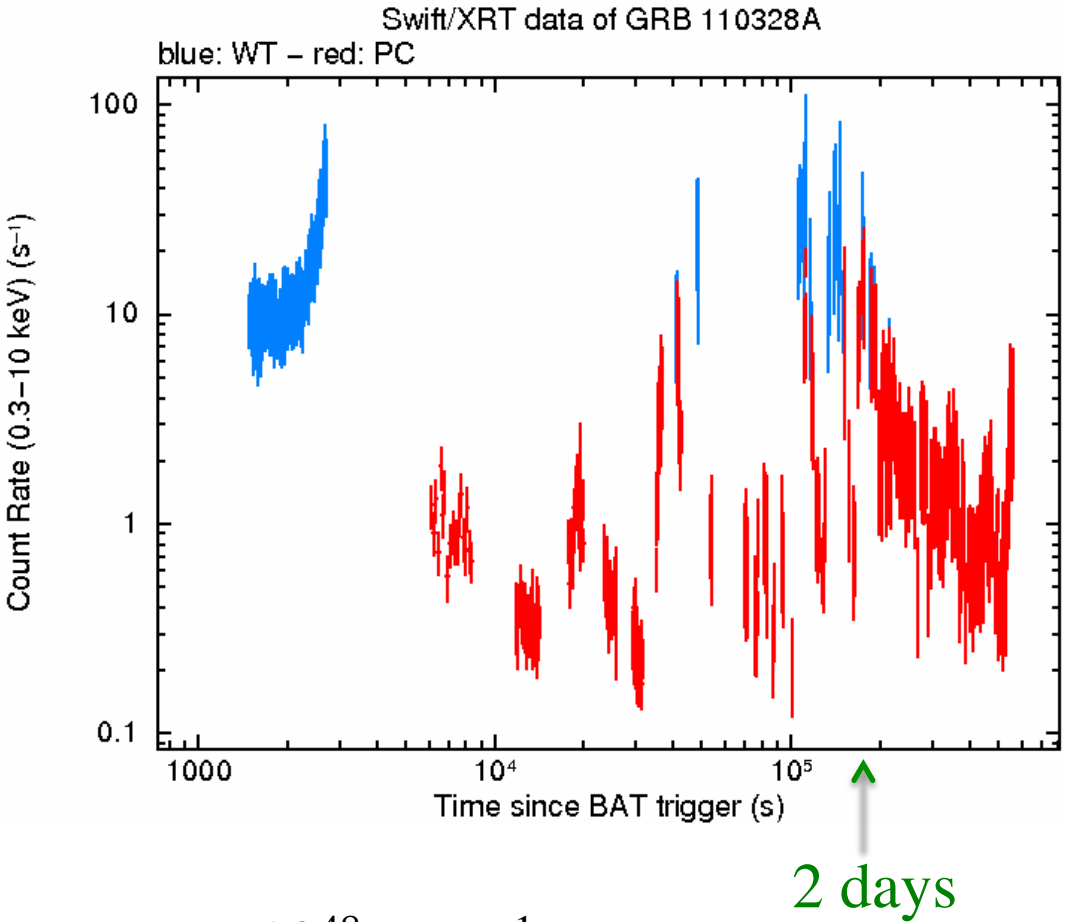
z = 9.3 >> 13.1 billion lt yrs

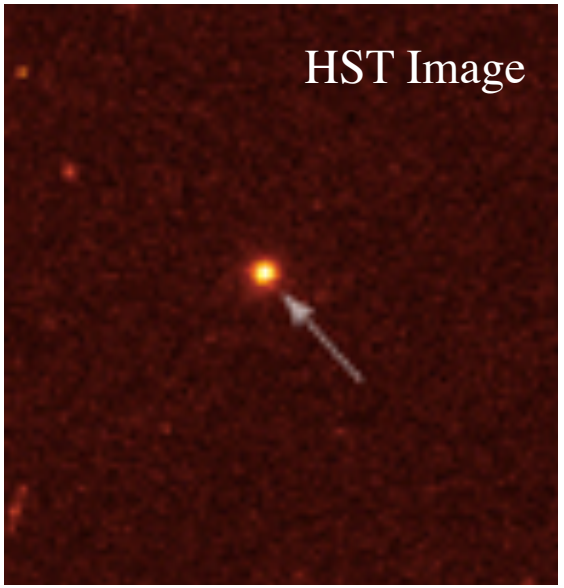
K ~ 32 for galaxy @ z = 8
million times fainter than GRBs

Star Formation Rate



Swift Transient - Sw J1644+57





Transient at center of dwarf non-AGN galaxy at z=0.35

$L_x \sim 10^{48}$ erg s^{-1}

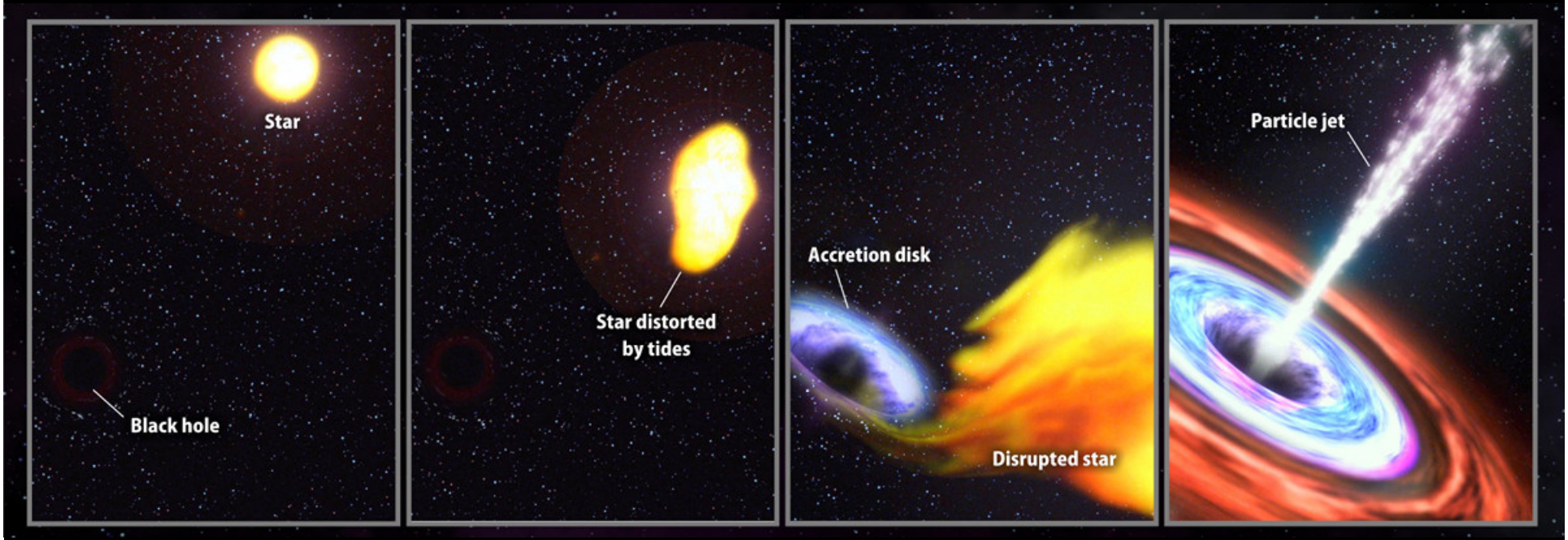
$E \sim 10^{51}$ ergs

$M_{BH} \sim 10^6 - 10^7\ M_\odot$

Bloom et al., Levan et al., Burrows et al. 2011

Model Explanation

- Star ripped apart by massive black hole
- Jet formed and beamed at us



Lessons Learned #1

- Swift selected at peak of "faster, better cheaper" culture at NASA
- Proposed with 16% contingency
- XRT and UVOT proposed in university rocket-program mode
  - Full space development qual program added for XRT and UVOT
  - Reviews added at every step. Over 120 reviews in total
- Full cost accounting change occurred during Swift development

- Result was 1 year launch slip and 27% budget growth
  - Cancellation review with Ed Weiler

- Survived cancellation without major science descopes due to
  - Full disclosure
  - Commitments from Center, Spectrum Astro and university partners

Lessons Learned #2

Science Management

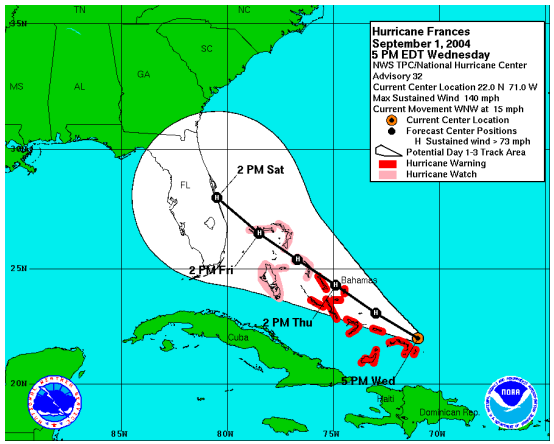
- Set up an Executive Science Committee to discuss and vet critical decisions

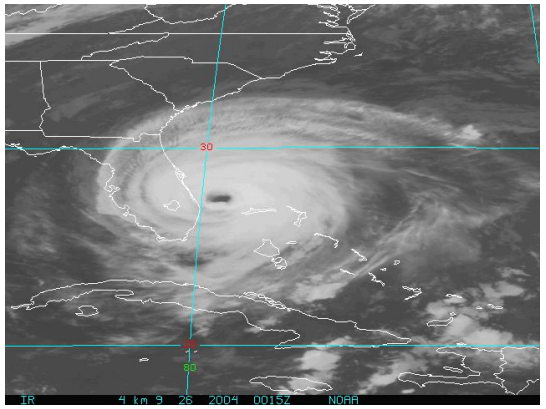
- Pay attention to the university / NASA Center interface. The culture are different and can clash.

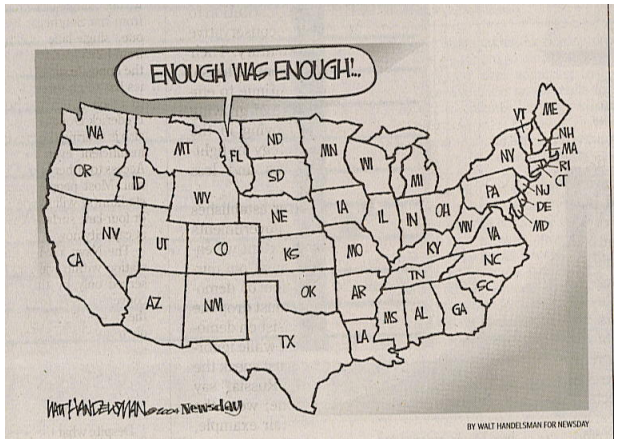
Lessons Learned #3

- Arrange for fair weather at launch site:

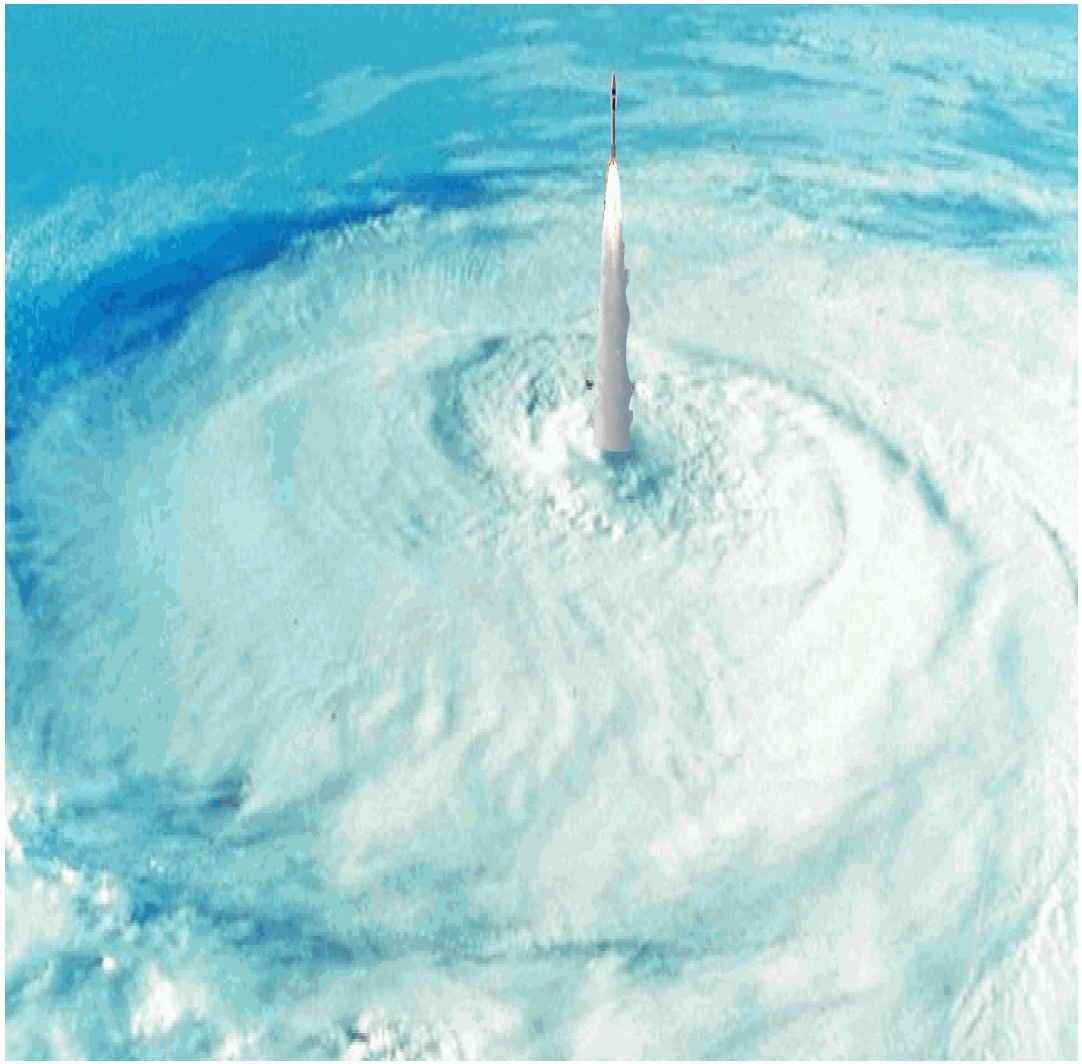
2004 Hurricanes:
- Charley Aug 13
- Frances Sept 4
- Ivan Sept 10
- Jeanne Sept 25







Let's Launch Anyway !!!



Lessons Learned #4

Contacts and Communication

- PI and PM relationship is key to mission success
- Frequent communication can reduce natural tensions between roles

- NASA HQ needs to be in the know
- Better to immediate tell of problems than let news reach HQ through the grape vine
- PM and PI should each have personal ties to key HQ personnel

Discussion Topics

- Roles and responsibilities (PI, PM)
- Credibility, openness
- Every day counts
- Personnel fully on board
- Contractor partnering ("we" relationship)
- Contractor concerns
- Descope politics