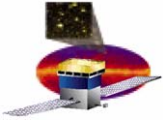# GLAST Large Area Telescope

Gamma-ray Large Area Space Telescope

Instrument Flight Software

FSW Monthly Review
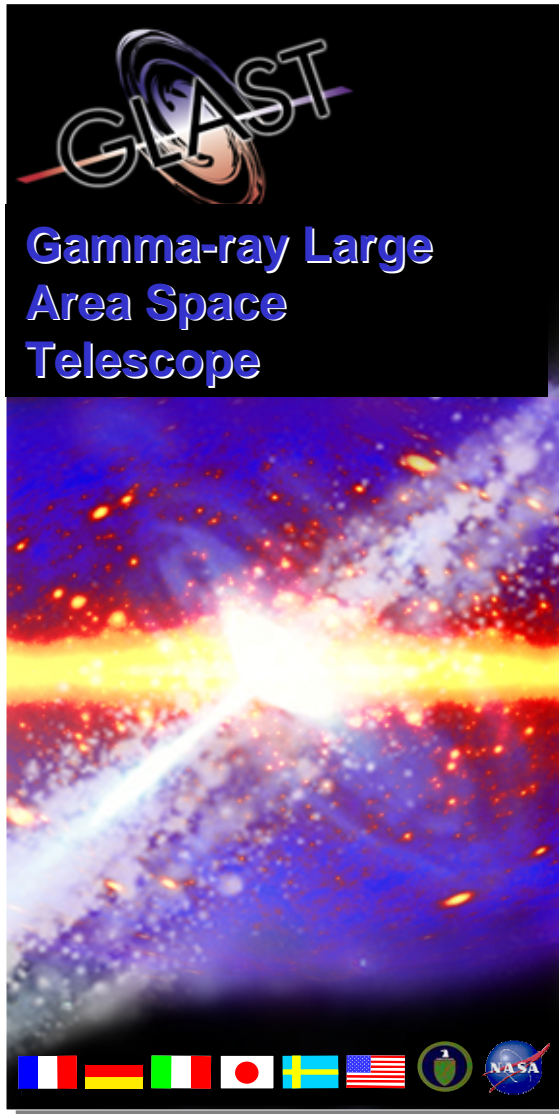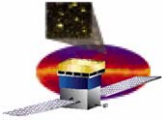**April 26, 2005**

Jeff Fisher
FSW Manager

Stanford Linear Accelerator Center

Outline

- **Where We're At (Current Status)**

- **Getting to the Test Readiness Review (TRR)**

- **Integration Plan**

- **Demonstrations**
  - **Completed demos**
  - **Scheduled demos**
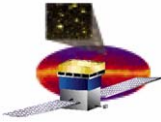
- **Test Script Dry Run Schedule**

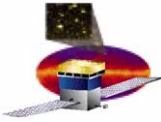**Gamma-ray Large Area Space Telescope**

Current Status

Current Status

- **Majority of software packages are complete or substantially complete**
  - **Complete:**
    - **All required functionality is implemented**
    - **Some level of testing has been performed**
  - **Substantially complete:**
    - **Specific, identified functionality must be added**
    - **Changes and retrofits may be needed to reflect changes in other packages**

- **Test procedures and scripts are underway**
  - **Updates of previously-developed procedures and scripts to conform to Virtual Spacecraft (VSC) interface are in progress**

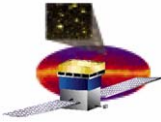# FSW Package Status

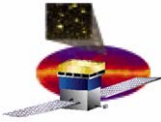| Function	Planned Code/Unit Testing Complete	Status	Remaining Effort (person weeks)	Forecast Code/Unit Testing Complete	Continuing Activities
Processor Basic Services (PBS)	Complete	100% coded	0	Complete	None
VxWorks (VXW)	Complete	100% coded	0	Complete	None
ZLIB Compression Tools (ZLIB)	3/19/04	100% coded	0	Complete	None
RAD750 Board Support (RAD750)	8/25/04	100% coded	0	Complete	None
SIB Board Driver (SIB)	6/04/04	100% coded	0	Complete	None
Primary Boot (PBC)	10/30/04	100% coded	0	Complete	Testing
Multiple Boot Image, Checksum (PBC)	1/21/05	100% coded	0	Complete	None
Secondary Boot (SBC)	10/30/04	100% coded	0	Complete	None
File Upload (FILE)	11/30/04	100% coded	0	Complete	None
CCSDS Packet Utilities (CCSDS)	9/01/04	100% coded	0	Complete	None
FSW Error Messaging (MSG)	12/15/04	100% coded	0	Complete	None
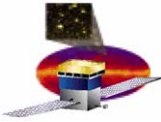
FSW Package Status

| Function	Planned Code/Unit Testing Complete	Status	Remaining Effort (person weeks)	Forecast Code/Unit Testing Complete	Continuing Activities
LAT Communications Board Driver (LCBD)	12/15/04	100% coded	0	Complete	None
Command and Telemetry Data Bus Driver (CTDB)	6/04/04	100% coded	0	Complete	None
Inter-task Communications (ITC)	4/08/05	100 % coded	0	Complete	Unit testing
LCB Service (LCS)	3/07/05	95% coded	< 1	5/15/05	Coding in progress
Command and Telemetry/1553 Service (CTS)	3/07/05	95% coded	< 1	5/15/05	Coding in progress
Instrument Configuration (LATC)	12/01/04	100% coded	0	Complete	None
Command and Telemetry Data Dictionary (LCAT)	1/10/05	LCAT tool complete	0	Complete	None
CPU monitor package (MON)	4/15/05	coded	<1	4/30/05	Unit testing
Startup package (CFG)	4/15/05	95% complete	1	5/15/05	Coding in progress

FSW Package Status

| Function	Planned Code/Unit Testing Complete	Status	Remaining Effort (person weeks)	Forecast Code/Unit Testing Complete	Continuing Activities
File and Memory Mgmt (LFS, MEM)	11/30/04	100% coded	1	Complete	Unit testing underway
Power/Initialize GASU (PIG)	11/15/04	100% coded	0	Complete	Bug fixes.
Housekeeping (LHK)	3/22/05	95% coded	1	4/30/05	Needs minor update after ITC complete
LAT Computer Manager (LCM)	4/30/05	95% coded	1	4/30/05	Coding in progress
Thermal Control (LTC)	3/22/05	100% coded	1	Complete	Bug fixes
Instrumented Memory Managers (IMM)	4/30/05	95% coded	1	4/30/05	Coding in progress
Time Hack Services (THS)	4/30/05	95% coded	1	4/30/05	Coding in progress
Spacecraft Messages (LSM) – includes Attitude Processing (ATT)	4/30/05	95% coded	1	4/30/05	Coding in progress
Watchdog (LSW)	4/15/05	100% coded	0	Complete	Bug fixes.

FSW Package Status

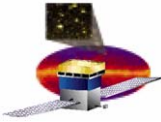| Function	Planned Code/Unit Testing Complete	Status	Remaining Effort (person weeks)	Forecast Code/Unit Testing Complete	Continuing Activities
Mode Control (LIM)	4/30/05	Coding has begun	3	5/15/05	In progress at NRL
LAT Multiplexed Counters (LMC)	4/15/05	90% coded	1	4/30/05	Bug fixes and update
Charge Injection Calibration (LCI)	4/18/05	80% coded	3	5/15/05	Coding continues
Diagnostics (LDF)	5/15/05	Not started	4	6/22/05	Related to calibration; will continue after LCI completed
Event Integrity and Delivery (EDS)	3/22/05	100% coded	0	Complete	Bug fixes.
Event Filtering (EFC)	3/22/05	90% coded	1	5/6/05	Debugging in lab
GRB Detection and Response (part of LPA)	5/15/05	60% coded	2	6/22/05	Deferred until completion of filter & diagnostics
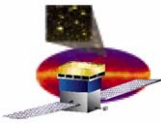
FSW Test Procedure and Script Status

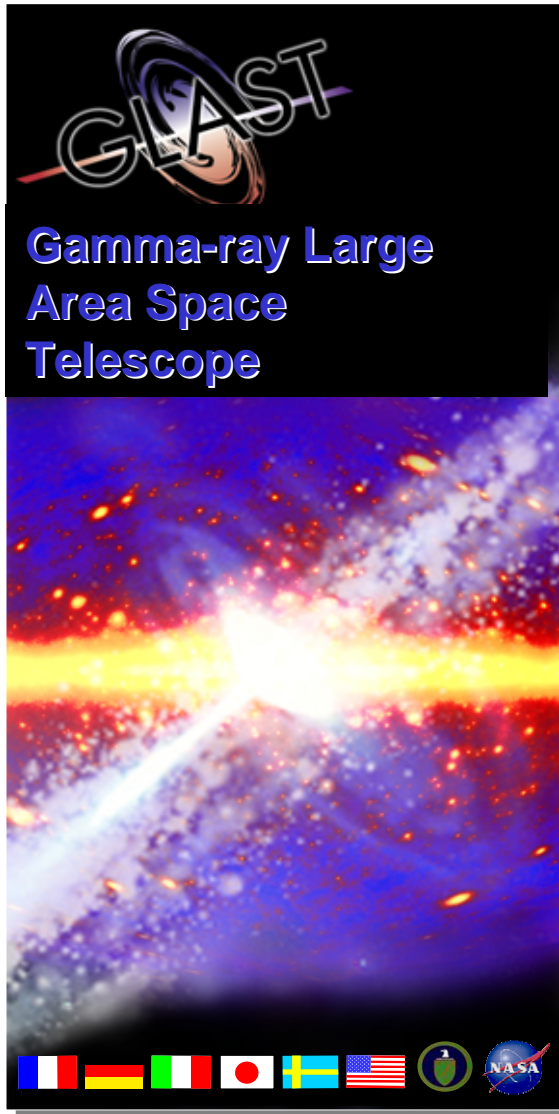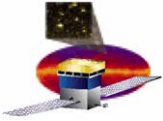| Test Suite Name	Tests	Engineer	Planned Procedure Development	Planned Script Development	Actual Procedure Development	Actual Script Development
1553 Interface (IF1553)	3	Shantha	April 1	April 8	3/3	
FSW and LAT Initialization (FSWINI)	15	Igor K.	April 1	April 22	15/15	
File Management (FILMGT)	10	Shantha	April 1	April 15	8/10	
Memory Upload and Dump Verification (MEMMGT)	9	Shantha	April 8	April 15	6/7	
LAT Pointing Calculations (PTCALC)	1	Igor V.	April 15	April 29		
Vehicle Signals Interface Verification (VSGIFV)	3	Mark Mao	April 15	April 29	3/3	
LAT Time Signal Processing (TIMPRC)	4	Mark M.	April 15	April 22	4/4	
Command Functional (CMDFNC)	10	Shantha	April 22	April 29		
Narrowband Telemetry Verification (NBTLMV)	5	Shantha	April 29	May 6		
Event Filtering (EVTFIL)	4	Igor V.	April 29	May 13		
T&DF, TKR, CAL, and ACD Internal Configuration Test (SIUCFG)	4	Igor K.	April 29	May 13		
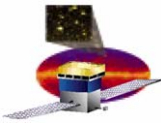
FSW Test Procedure and Script Status (2)

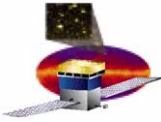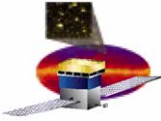| Test Name	Tests	Engineer	Planned Procedure Development	Planned Script Development	Actual Procedure Development	Actual Script Development
Operational Modes – Mode Control and Standard Operation Modes (OPMODE)	12	Igor K.	May 6	May 20		
LAT Thermal Control System (THRMCS)	14	Shantha	May 6	May 13		
SIU/EPU CPU-to-CPU Communications Functional Test (IPCFNC)	1	Igor K.	May 13	April 29		
LAT Event Performance Monitoring and Operations (EVTPMO)	5	Igor V.	May 13	May 27	4/5	
Electronic Calibration (FECALB)	5	Igor K.	May 20	June 3		
Wideband Telemetry Verification (WBTLMV)	1	Igor V.	May 20	May 27		
GRB Handling/Repoint Requests and Logic (GRBREQ)	5	Igor V.	May 27	June 17	3/5	
GRB Detection and Location (GRBPRC)	2	Igor V.	June 3	June 24	1/ 2	
Operational Modes –Diagnostic and Calibration Modes (DCMODE)	11	Igor K.	June 6	June 17		
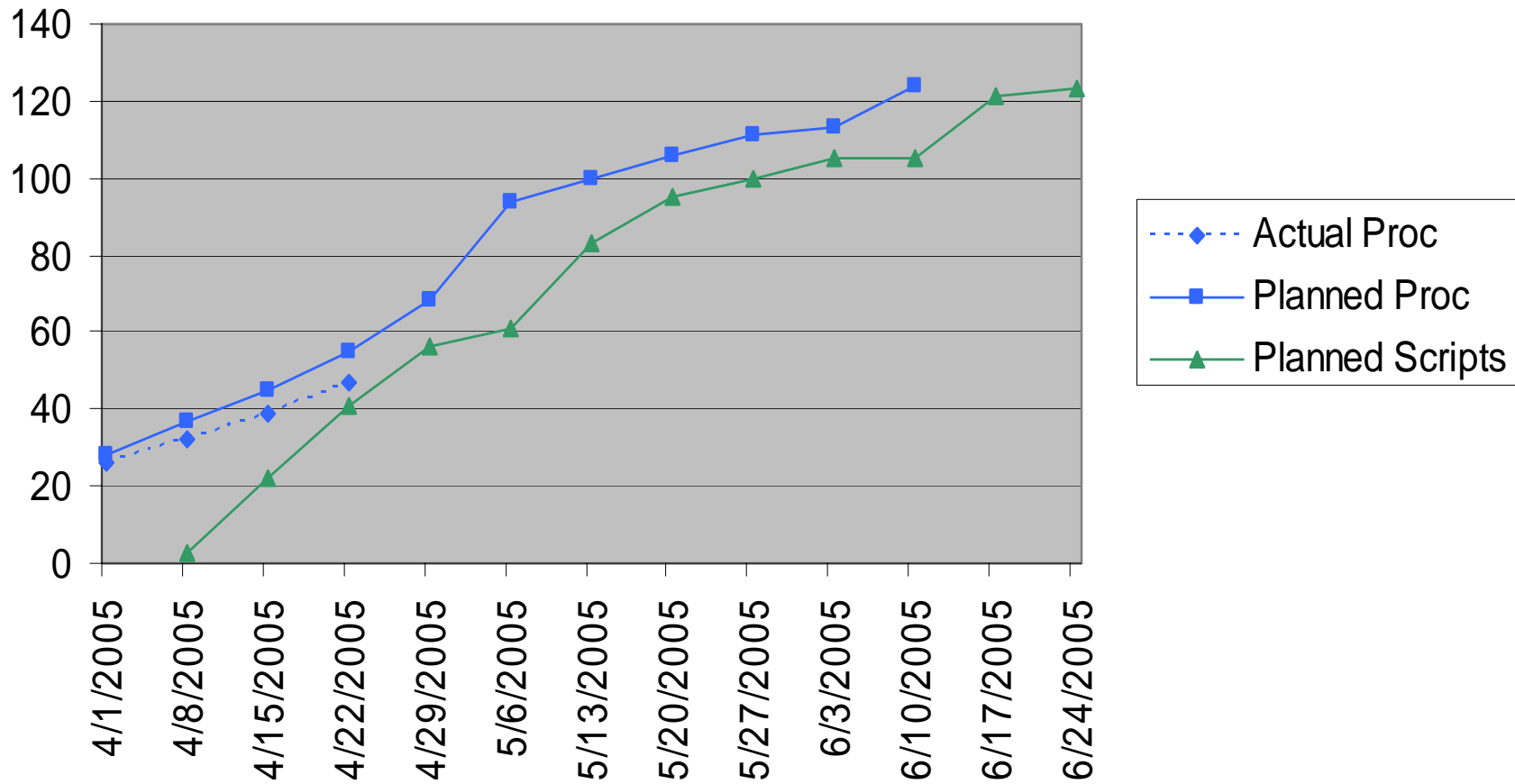
- **Requirements are mapped to 124 tests**

Getting to the TRR

Getting to the TRR

- **Integration approach starts with an initial set of packages constituting a "Candidate Release" (CR)**
  - **After successful demonstration and shakeout of a Candidate Release, another set of packages is added**
  - **This new suite of packages becomes the next Candidate Release**

- **Approach uses two milestones for functional blocks bundled into a CR:**
  - **FSW package functionality is confirmed by demonstration**
  - **Test script functionality is confirmed by dry runs**
    - **Also revalidates that required packages are still functional**
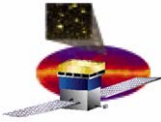   - **Scripts executed using the VSC**

FSW Phased Integration Plan

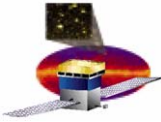| Package Suite	Integration Focus	Hardware Required	Confirm Integration Using
Base	ITC, multi-CPU operations	Test Stand	Demonstration
A	Secondary boot Watchdog File and memory management Alert/diagnostic telemetry Housekeeping	Test Stand	Demonstration
B	Event filtering and deadtime monitoring	Test Stand	Demonstration
C	Spacecraft interfaces (discretes, magic 7) Mode control Thermal Control	VSC	Test script dry run
D	Charge injection calibration	VSC	Test script dry run
E	Event monitoring (trigger rates, VETO rates) Diagnostics	VSC	Test script dry run
Full	GRB Detection and Response	VSC	Test script dry run

Gamma-ray Large Area Space Telescope
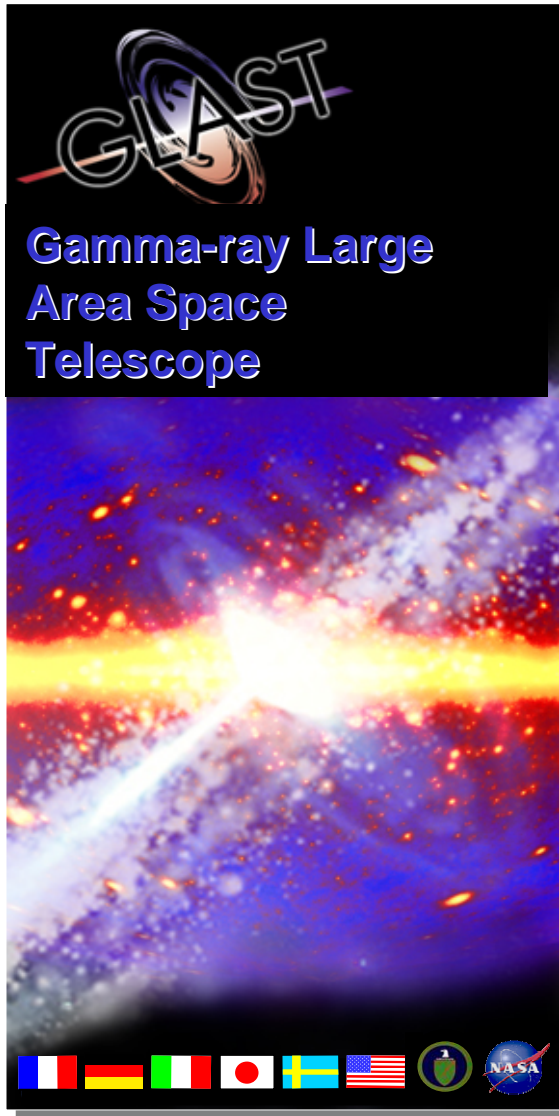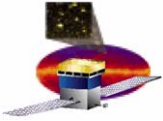
Demonstrations
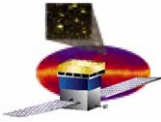
Completed Demonstrations

- **1553 Interface**
- **LCB Driver, Instrument Register Configuration**
- **SIU and EPU Boot**
- **File Upload to SIU**
- **Spacecraft Interfaces**
  - **Capability to handle Magic 7 and discrete signals**
- **Housekeeping (collected by single CPU)**
- **File and Memory Management on SIU**
- **Thermal Control System**
- **Basic Processing of Attitude and Time Messages**
- **Inter-task, Inter-CPU Communications**
  - **Base Candidate Release based upon completion of ITC Service Layer and integration with calling packages**
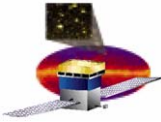- **Watchdog**

Upcoming Demos/Candidate Releases

| Demo, followed by CR	Number of Requirements	Date
Secondary Boot Code, File and Memory Management, Diagnostic Telemetry, and Alert Telemetry	3 2 2 1 2	4/27/05
Housekeeping	3	4/29/05
Event Filtering and Deadtime Monitoring	4 3	5/6/05
LAT Communications Board Driver, 1553 Communications Driver, and Spacecraft Interfaces	3 3 3	5/13/05

Upcoming Demos/CRs (2)

Demo followed by CR	Number of Requirements	Date
Mode Control and Instrument Safety, and Thermal Control System	12 9	5/20/05
Charge Injection Calibration and Configuration	17 3	5/27/05
Event Monitoring and Delivery, and Diagnostics	7 19	6/3/05
GRB Detection and Response	14	6/20/05

Demo to Requirements Mapping

Status thru March
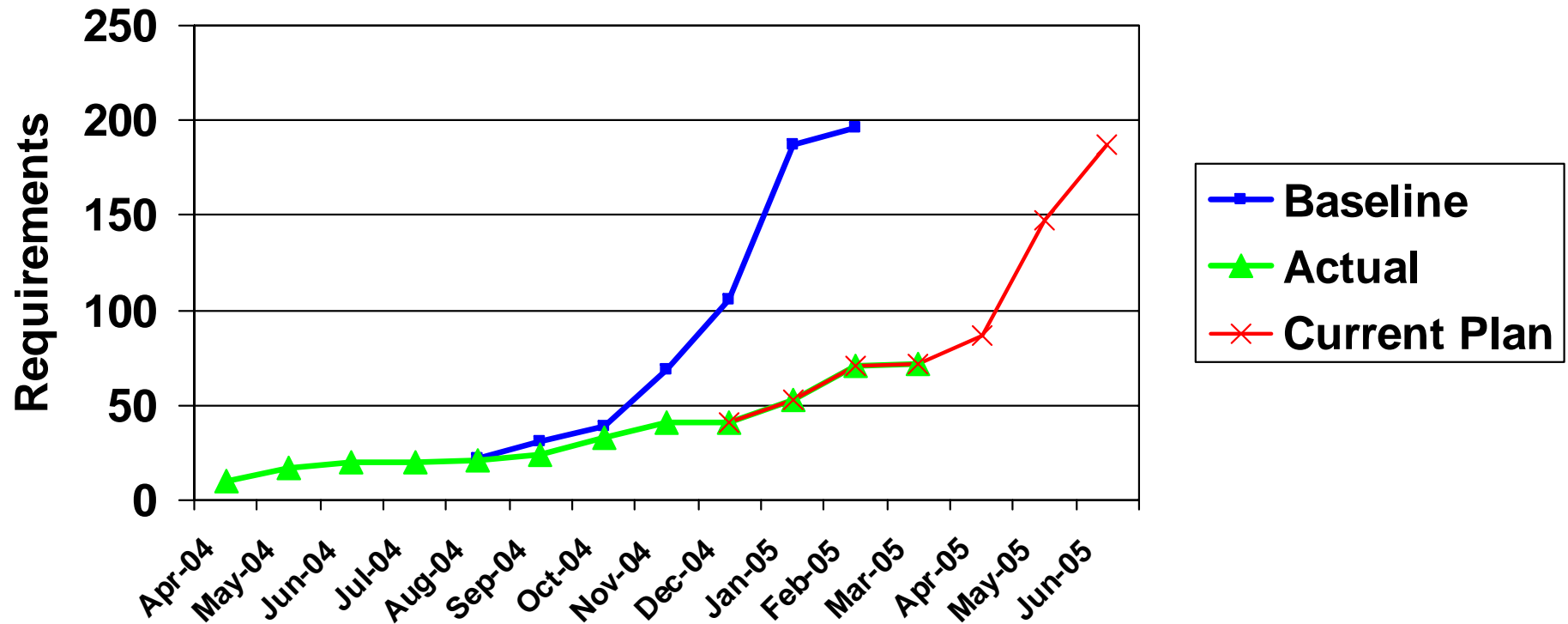
Test Script Dry Runs
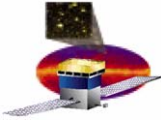
Level 3 Milestones

Function	Planned	Forecast/Actual
Intertask Communications	3/11	4/15
Housekeeping	3/18	4/29
Watchdog	4/15	4/22
Mode Control	4/22	5/20
Charge Injection Calibration	4/29	5/27
Event Integrity and Delivery	5/6	5/6
Diagnostics	5/6	6/15
GRB Detection & Response	5/20	6/20

Level 3 Milestones
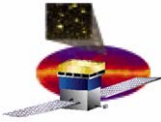
- **Housekeeping demo is tied to ITC**
  - LHK package is being updated to be included in the initial candidate release
  - Delayed due to ITC integration activities

- **Watchdog was successfully demonstrated on April 22**
  - Delayed due to ITC integration activities

- **Mode Control is scheduled for 5/20**
  - NRL currently preparing for initial candidate release
  - Delayed due to ITC integration activities

- **Charge Injection Calibration**
  - work is going more slowly then planned
  - Underestimated the complexity of the task
- **Diagnostics**
  - Tied to completion of Charge Injection Calibration
  - Work will commence after completion of Charge Injection Calibration

- **GRB Detection & Response**
  - Tied to completion of all filter related tasks
  - Work will commence after completion of all filter related tasks
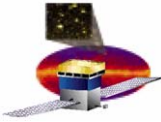
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Test Script Dry Run Schedule

Test Suite Name	# of Tests Scripts	Dry Run Date
1553 Interface (IF1553)	3	May 16
FSW and LAT Initialization (FSWINI)	15	May 17
File Management (FILMGT)	10	May 18
Memory Upload and Dump Verification (MEMMGT)	7	May 19
SIU/EPU CPU-to-CPU Communications Functional Test (IPCFNC)	1	May 23
T&DF, TKR, CAL, and ACD Internal Configuration Test (SIUCFG)	4	May 24
Operational Modes – Mode Control and Standard Operation Modes (OPMODE)	12	May 25
Vehicle Signals Interface Verification (VSGIFV)	3	May 26
LAT Time Signal Processing (TIMPRC)	4	May 26
Command Functional (CMDFNC)	10	May 31
Electronic Calibration (FECALB)	5	June 1

Test Script Dry Run Schedule (2)

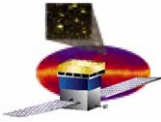| Test Suite Name	# of Tests Scripts	Dry Run Date
Narrowband Telemetry Verification (NBTLMV)	5	June 2
Event Filtering (EVTFIL)	4	June 6
LAT Thermal Control System (THRMCS)	14	June 7
LAT Event Performance Monitoring and Operations (EVTPMO)	5	June 9
LAT Pointing Calculations (PTCALC)	1	June 13
Operational Modes – Diagnostic and Calibration Modes (DCMODE)	11	June15
Wideband Telemetry Verification (WBTLMV)	1	June 20
GRB Handling/Repoint Requests and Logic (GRBREQ)	5	June 27
GRB Detection and Location (GRBPRC)	2	June 29

Test Readiness Review

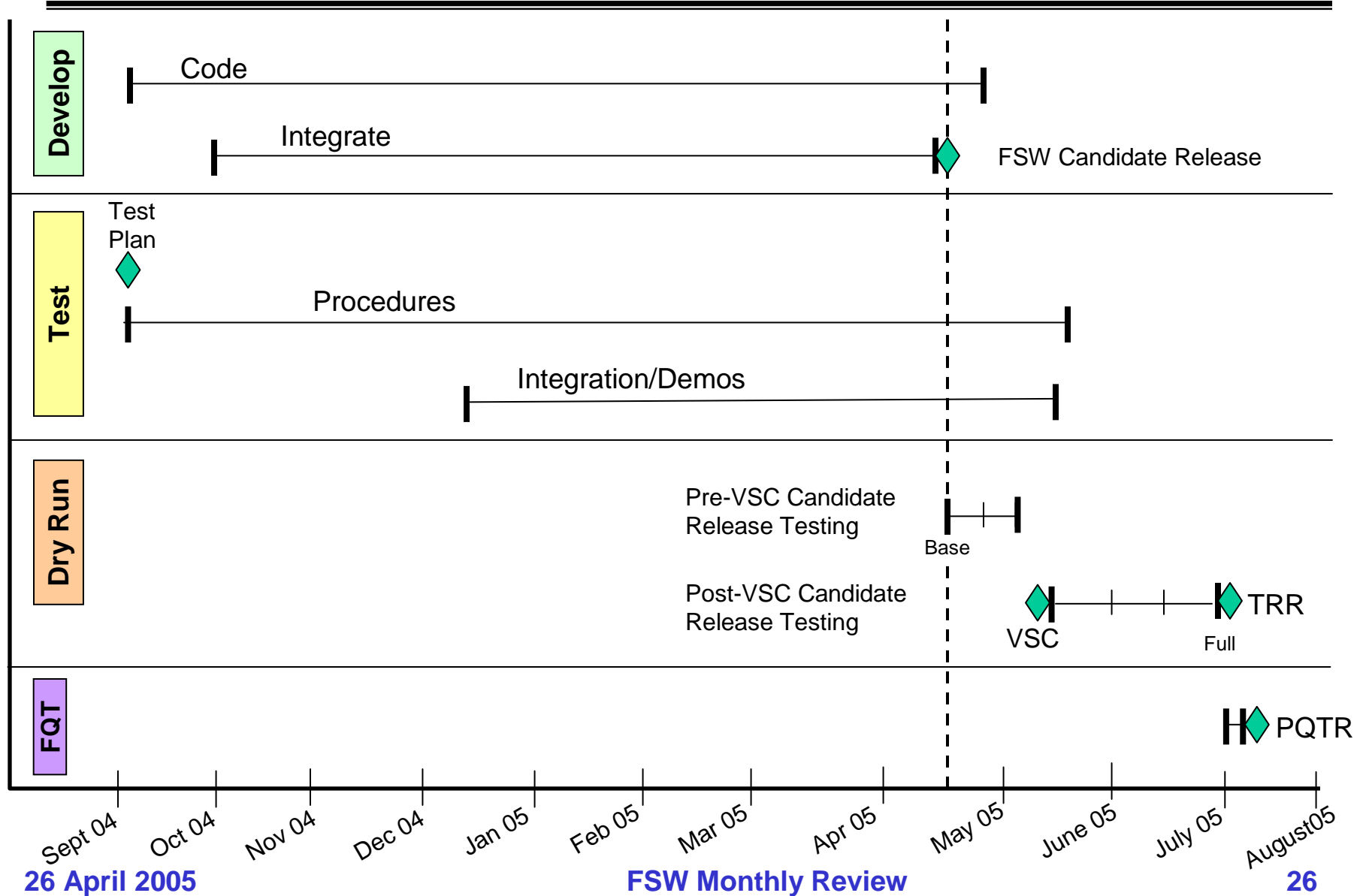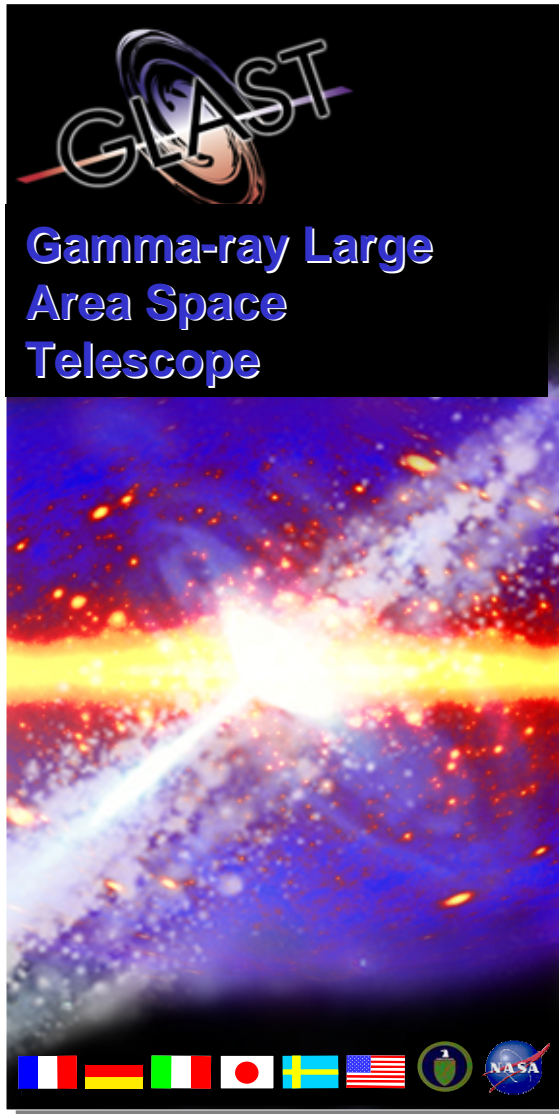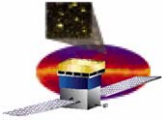- **Review package status**
  - **Identify missing functionality and bugs**

- **Review test procedure/script status**
  - **Dry runs must be complete in all areas to be performed in FQT**
  - **Some functional areas may be deferred**

- **Review documentation**
  - **FSW Design Document (complete draft)**
  - **FSW User Manual (complete draft)**
  - **Test Plan**
  - **Version Description Document**

FSW Develop and Test Schedule Through FQT

Develop

Code

Integrate — FSW Candidate Release

Test

Test Plan

Procedures

Integration/Demos

Dry Run

Pre-VSC Candidate Release Testing
Base

Post-VSC Candidate Release Testing
VSC — Full — TRR

FQT

PQTR

Sept 04 Oct 04 Nov 04 Dec 04 Jan 05 Feb 05 Mar 05 Apr 05 May 05 June 05 July 05 August05

Gamma-ray Large Area Space Telescope

Glossary & Backup

Glossary of FSW Terms

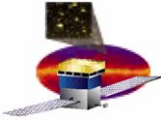| Term	Definition
ATT	Attitude Processing (package)
CCSDS	CCSDS Packet Utilities (package)
CFG	FSW Configuration and Initialization (package)
CR	Candidate releases: series of software builds with increasingly complete suite of FSW.
CTS	Command and Telemetry Service (package)
CTDB	Command and Telemetry Data Bus (1553) Driver (package)
EDS	Event Delivery Service
EFC	Event Filter Code
FILE	File Upload (package)
FQT	Formal Qualification Testing
GRB	Gamma Ray Burst
IMM	Instrumented Memory Manager (package)
ITC	Inter-task Communications Toolkit (ITC)
LATC	LAT Configuration (LTC)
LCBD	LAT Communications Board Driver (package)
LCM	LAT Computer Manager (package)
LCI	LAT Charge Injection Calibration (package)
LCS	LCB Communications Service (package)

Glossary of FSW Terms (2)

Term	Definition
LDF	LAT Diagnostics Framework (package)
LFS	LAT File System (package)
LHK	LAT Housekeeping (package)
LIM	LAT Instrument Manager (package)
LMC	LAT Multiplexed Counters (package)
LPA	LAT Physics Acquisition
LSM	LAT Spacecraft Messages (package)
LSW	LAT Software Watchdog (package)
LTC	LAT Thermal Control (package)
Magic 7	Set of data messages sent from Spacecraft to SIU: Attitude message (at 5 Hz), Timetone message (1 Hz), Ancillary message (1 Hz)
MEM	Memory Management (package)
MON	CPU Monitor (package)
MSG	FSW internal error messaging (package)
PBC	Primary Boot Code (package)
PBS	Processor Basic Services (package)
PIG	Power-up and Initialize GASU (package)
PQTR	Post Qualification Test Review

Glossary of FSW Terms (3)

Term	Definition
RAD750	RAD750 Board Support (package)
SBC	Secondary Boot Code (package)
SIB	SIB Board Driver (package)
THS	Time Hack Services (package)
TRR	Test Readiness Review
VSC	Virtual Spacecraft: Spacecraft simulator constructed at SLAC
VXW	VxWorks BSP (package)
ZLIB	ZLIB Compression Tools (package)

FSW Packages Per Candidate Release

Package Suite	Integration Focus	Package List
Base	ITC, multi-CPU operations	ITC, CTS, LCS, LCM PBC, SBC, PBS, VXW, ZLIB, RAD750, SIB, CCSDS, CTDB, MSG, LCBD, PIG
A	Secondary boot Watchdog File and memory management Alert/diagnostic telemetry Housekeeping	SBC MON FILE, LFS, MEM LHK
B	Event filtering and deadtime monitoring	LPA (part I), including EFC, EDS
C	Spacecraft interfaces (discretes, magic 7) Mode control Thermal control	ATT, LSM, THS LIM LTC
D	Charge injection calibration Instrument configuration	LCI LCAT
E	Event monitoring (trigger rates, VETO rates) Diagnostics	LPA (part 2) LDF
Full	GRB Detection and Response	LPA (part 3)