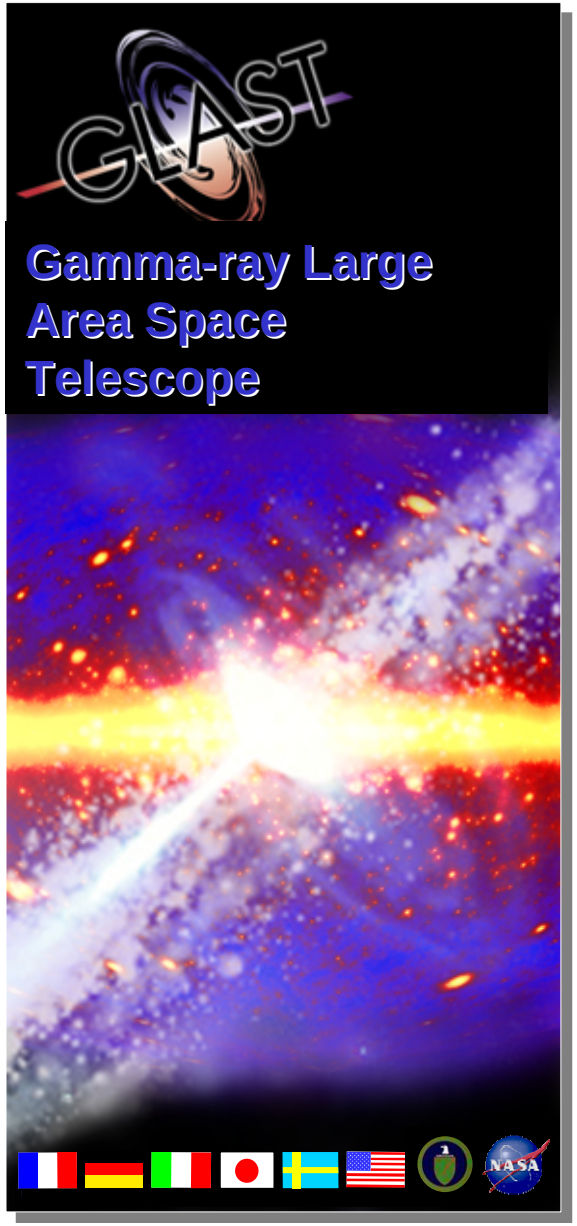

GLAST Large Area Telescope

ISOC Review
15 February 2006

FSW Activities, Organization, and Resource Needs

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Outline

- Introduction to FSW
- Main Responsibilities
- Activities Over Time
- Organization
- Resource Needs
  - People
  - Space and facilities
  - Things
- Summary

Introduction to Flight Software (FSW)

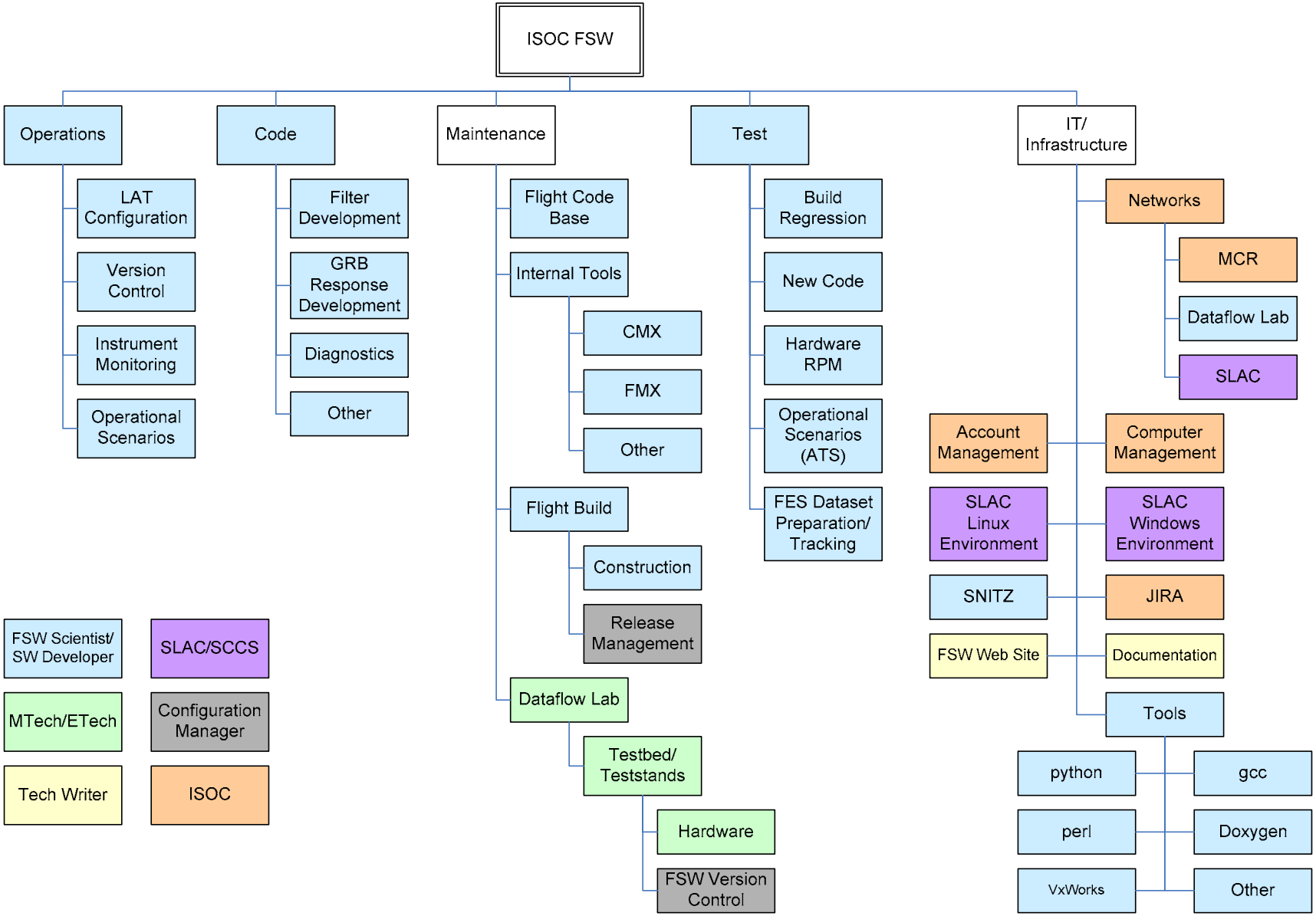
- **The LAT flight software code base includes all on-board software**

- **The flight software team –**
  - **Develops, maintains, and tests the software that configures the instrument and supports instrument housekeeping and data acquisition by the LAT**
  - **Provides the means for configuring the instrument for data collection, retrieving event data from detectors on the instrument, and storing that data for transmission to the ground for subsequent analysis by investigators**
  - **Develops and maintains the infrastructure that is used to develop and test the on-board software**

FSW – Major Responsibilities

- Develop, test, and maintain flight software
  - Develop new on-board filters
  - Develop diagnostic code in response to problems
  - Validate parameters and software for upload
  - Perform regression testing/validate new code
- Develop and maintain software tools for the development, testing, and documentation of the on-board flight software
- Maintain the tools that track LAT Configuration
  - Software versions
  - Uploaded data files, parameters
- Maintain the Dataflow lab
  - Maintain all flight spares, EGSE, and teststands including Testbed
  - Develop this space into a facility for troubleshooting, verification/validation, and running operational scenarios
- Maintain and develop documentation
  - Procedures, User's Manuals, Technical Documents, Website, etc.
- Monitor the dataflow system and help resolve instrument anomalies

FSW Activities - Breakdown



FSW Activities – Present

- Current Activities
  - Finish code development
    - GRB response
    - FMX (tool for tracking LAT Configuration)
  - FQT (Flight Qualification Testing)
    - Regression testing FSW builds
    - Formal testing of build containing full functionality
  - I&T support
    - Adding functionality to existing code base
    - Troubleshooting/debugging
- Current staffing
  - SLAC staff
    - 1 FSW lead
    - 6 SW developer/physicist + 1 FSW Test
    - 1 Tech Writer/Web developer
  - External Contributors
    - 2 SW developers (NRL)
    - 2 FES/filter (OSU)
    - 1 Configuration Management (GSFC)

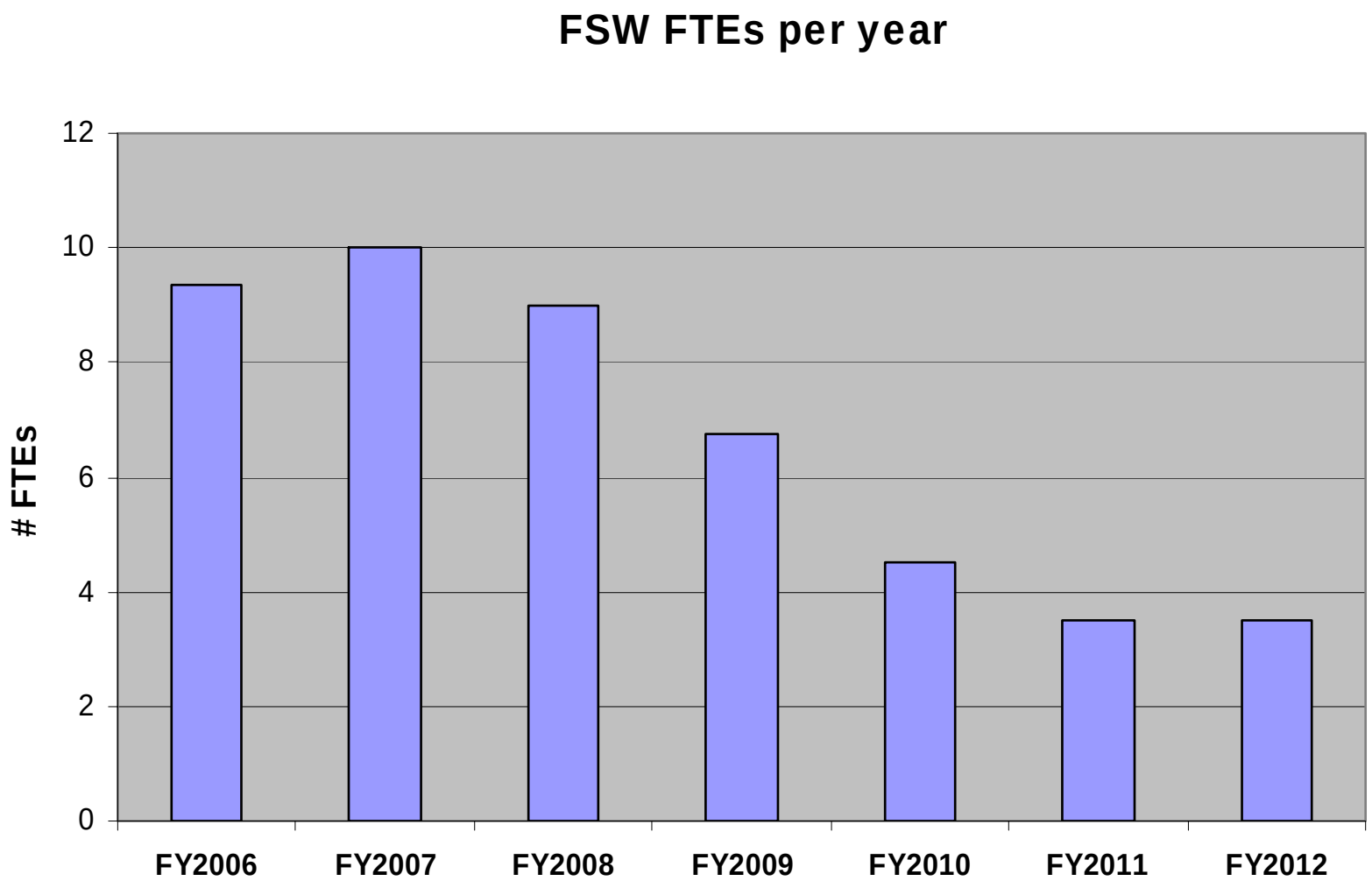
FSW Activities – Future

- **Future Activities**
  - **Support I&T and system testing at NRL**
  - **Maintain code base and *retain the ability to grow the flight software***
    - **Filter development**
    - **GRB Response development**
    - **Creation of diagnostic code to debug problems and spy on state of LAT**
  - **Maintain internal software tools**
  - **Validation/Verification of new software uploads, parameters, and procedures**
  - **Interface with other ISOC groups to –**
    - **Monitor dataflow system: trigger, filter, background rates, etc.**
    - **Define new instrument configurations**
    - **Troubleshoot/resolve instrument anomalies**
- **Future steady-state staffing plan**
  - **4 – 5 SW developer/physicists**
    - **Contribute to FSW and PVO**
  - **Some SLAC staff will have moved from GLAST to other projects**
    - **Some support available**

Retaining Knowledge

- **On-board software functionality:**
  - Primary and secondary boot process/rad750 processor
  - Collection and transmission of LAT housekeeping data
  - Configuration of the instrument for data acquisition
  - Calibration of the instrument
  - Physics event filtering, characterization, and delivery
  - Communication between the Spacecraft and the LAT
  - Telemetry and telecommand services
  - Spacecraft attitude/time management
  - Thermal control
  - Core processes and functions: multi-CPU communications, inter-task communications, software watchdog, etc.
- **Test software:**
  - Regression testing of builds
  - Front-End Simulators (FES)
- **Software tools:**
  - CMX
  - FMX
- **Hardware:**
  - Testbed, 1x4 grid, EGSE
  - FES

FTE Estimates



FSW group is changing composition over the years as experienced people move on and less experienced people come in. Information must be transferred from one set of people to another, but time needs to be allotted to allow new people to learn.

FTE Justification

- **Skill set of people necessary for maintaining FSW in the future**
  - **Real-time programming, VxWorks**
  - **Experience with commissioning and operating a particle physics detector**
  - **C/C++, python, perl, unix/linux**
  - **Configuration Management**
  - **Ability to work within existing FSW framework**
  - **Understanding of trigger and dataflow system**

$\Rightarrow$ **FSW group contains many people with in-depth knowledge about the operation of the T&DF system and the instrument**

- **To fully utilize members of FSW over the length of the mission:**
  - **Re-task code developers to monitoring of instrument**
    - **Trigger and dataflow system**
    - **Filter**
    - **Background rates**
  - **Contribute to calibrations and defining new instrument configurations**

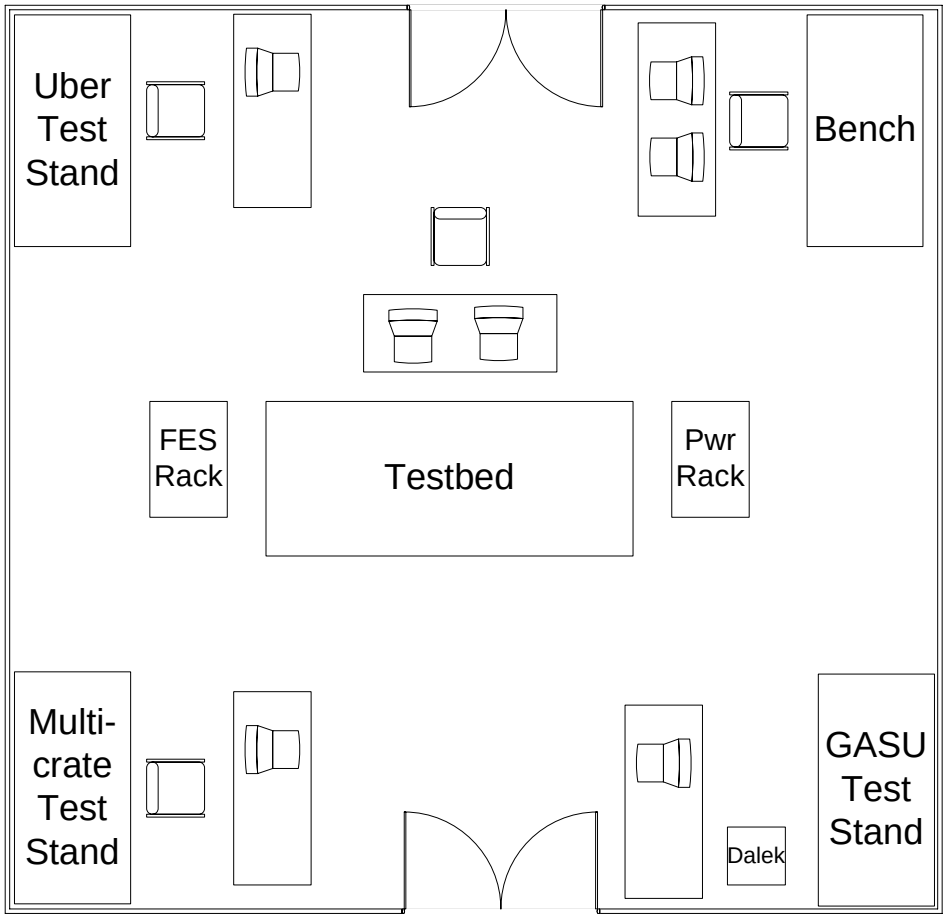
Summary of staff needs

- People (included in previous FTE Estimate)
  - 1.0 FTE: SW developer/physicist
    - Now: Support I&T and system test
    - Launch: Resolve instrument anomalies (quickly)
    - Future: Retain core FSW knowledge
      - Need overlap between the incoming and outgoing staff
  - 1.0 FTE: SW developer
    - Maintain existing software tools
    - Develop new tools that help all ISOC groups interface to LAT configuration information
    - Act as "Configuration Manager" for FSW and HW
  - 0.5 FTE: Lab Technician
    - Custodian to dataflow lab
    - Maintenance of hardware infrastructure

Existing Equipment/Lab Space

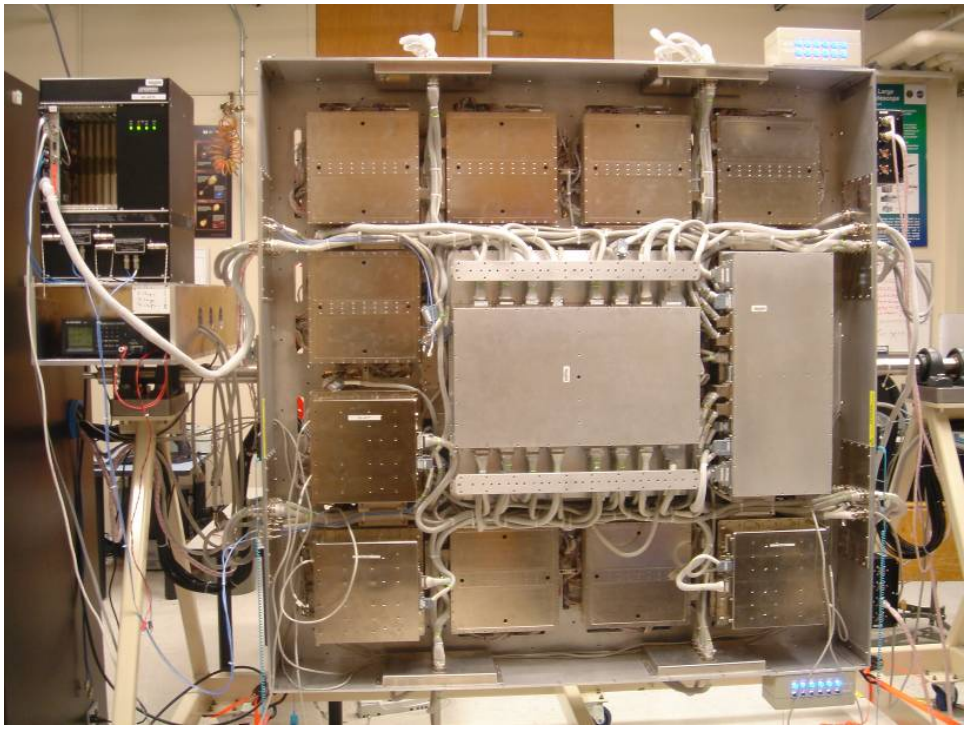
Bldg 84

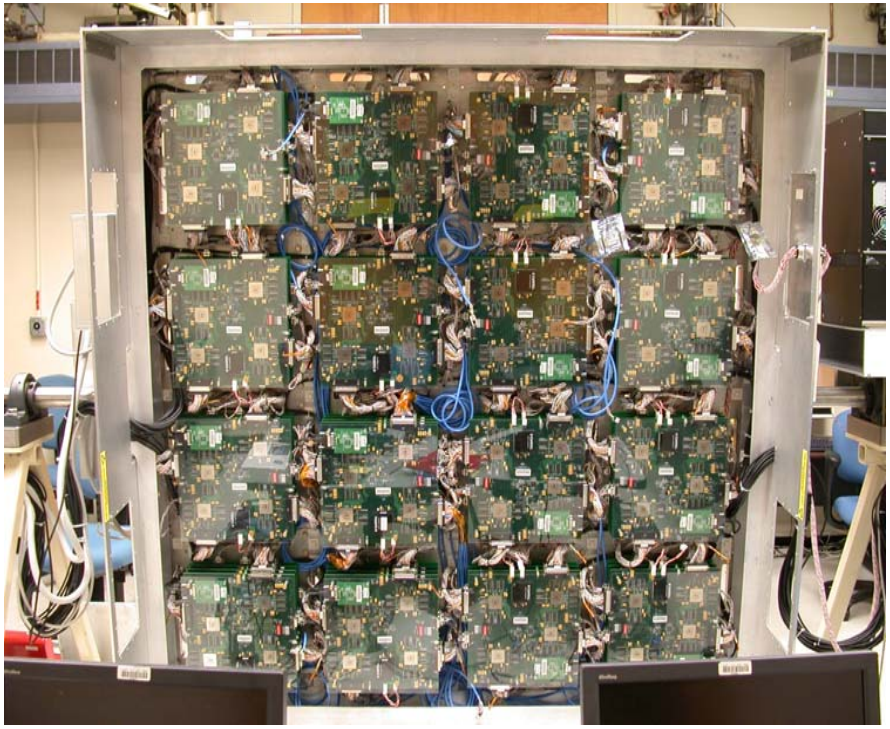
Room
B101



LAT Testbed

- **Provides a full Trigger and Dataflow system with flight-like interfaces and hardware**
- **Front-end Simulator (FES) ingests Monte Carlo data**
  - **Dataflow integrity and throughput**
  - **Filter**





Hardware Infrastructure

- **Existing hardware:**
  - **LAT Testbed and FES (Front End Simulator)**
  - **VSC (Virtual Spacecraft)**
  - **SIIS (Spacecraft Simulator)**
  - **Test stands (trigger and dataflow system)**
  - **EGSE and flight spares in Building 33**

- **LAT Testbed and test stand usage**
  - **Commissioning of LAT Dataflow System**
  - **Code development/debugging by FSW, FSW test, I&T, ISOC**
  - **Testing flight software functionality at the system level**
  - **Running operational scenarios**
  - **Regression testing of new FSW builds**

Incoming Equipment

- ISOC FSW will maintain the existing equipment
- ISOC FSW will inherit flight spares and all useful EGSE from I&T
  - 1x4 grid
    - 2 Trackers (flight spare + non-flight)
    - 4 CAL units (3 flight spares + 1 EM)
    - 4 flight TEMs
    - GASU and other support electronics
  - LAT Power Rack/LAT Control Rack
  - Mobile Computing Racks
  - SIIS (Spacecraft to Instrument Interface Simulator)
  - Mini-LAT with muon telescope
  - Miscellaneous EGSE
    - GASUs
    - PDUs
    - VME crates
    - Spare parts and miscellaneous

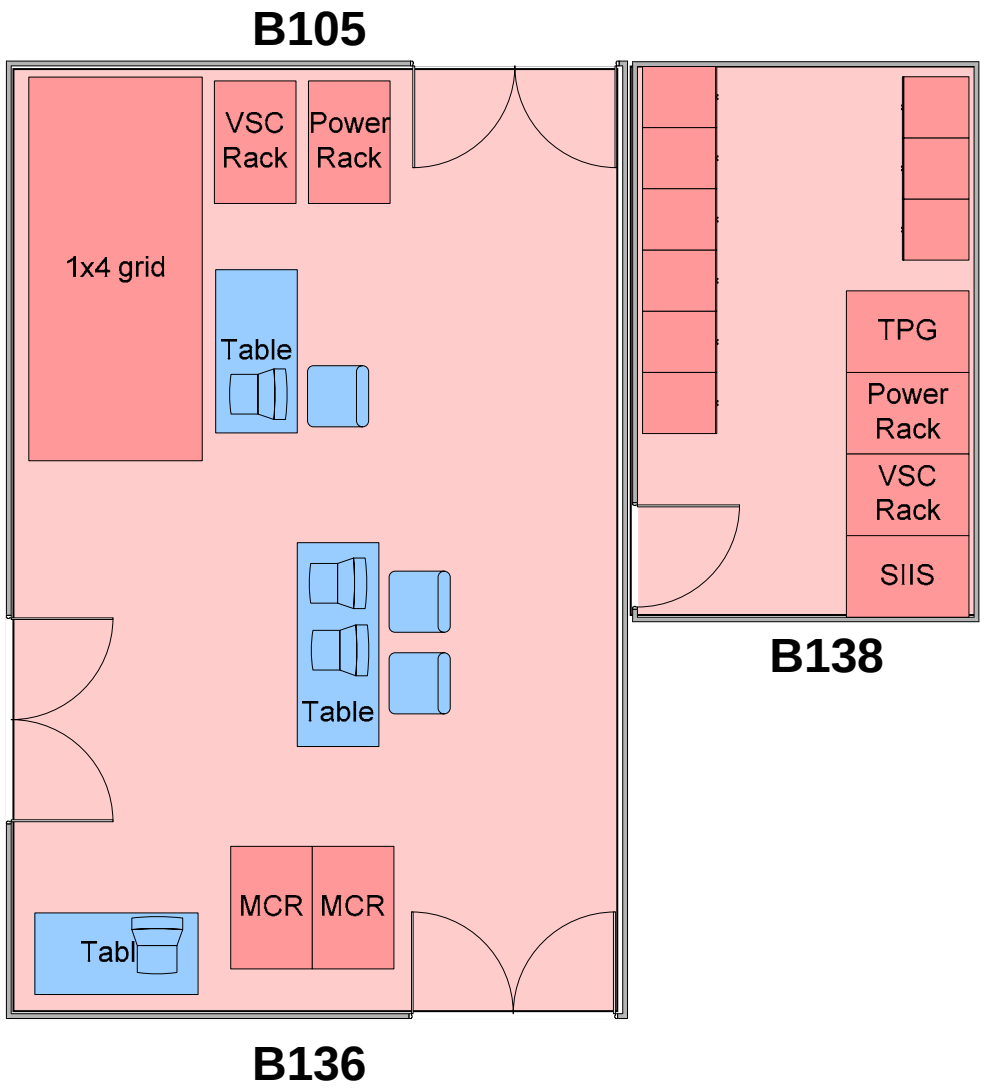
New and Improved Dataflow Lab

Infrastructure Changes to B101

- To accommodate the flight units, install
  - Install Nitrogen (keep 1x4 grid clean and dry)
  - Install Oxygen sensor for safety
  - Maintain temperature at 22°C ± 5°C
  - Maintain humidity at 30% - 50%
  - Monitor and archive humidity and temperature
- Changes to existing lab space
  - Install double doors to new lab space in B105
- Additions to existing lab space
  - Additional air conditioning
  - Additional power feeds and outlets
  - Bus bars installed (facility ground)
  - UPS providing 10 min @ 7500W
  - Storage solution for spares

New Lab Space

- **B105/B136**
  - Today: cubicle/office area
  - Future: lab space and workstations to interface to hardware test stands in B101
- **B138**
  - Today: storage area (not GLAST)
  - Future: GLAST storage
- **Both rooms brought up to the same standard as B101**
  - Tile
  - Paint
  - Air conditioning
  - Power feeds
  - ~10 Ethernet drops



Other Resource Needs

- Things
  - Software licenses (i.e., VxWorks)
  - Software
  - Computers (Suns, laptops)
  - DSL for core staff (on call)
  - Travel
    - GSFC
    - NRL, I&T support
    - NRL staff
  - Conferences, meetings
- Collaboration support
  - Filter development
  - Parameters for optimizing instrument performance
- SLAC support
  - Networking
  - Windows environment
  - Unix/linux environment
- ISOC support
  - Configuration Management
  - Account management/computer maintenance

Summary

- **FSW activities will evolve over time from primarily code development to operations and instrument monitoring**

- **Resources needs**
  - **3 FTEs to maintain FSW activity level through FY2009 and beyond**
  - **Upgraded/additional lab space**
  - **Collaboration support for filter development**
  - **SLAC support for networking**

- **Concerns**
  - **Retaining knowledge of core FSW for length of mission**
  - **Maintenance of VxWorks license (by SLAC or FSW?)**