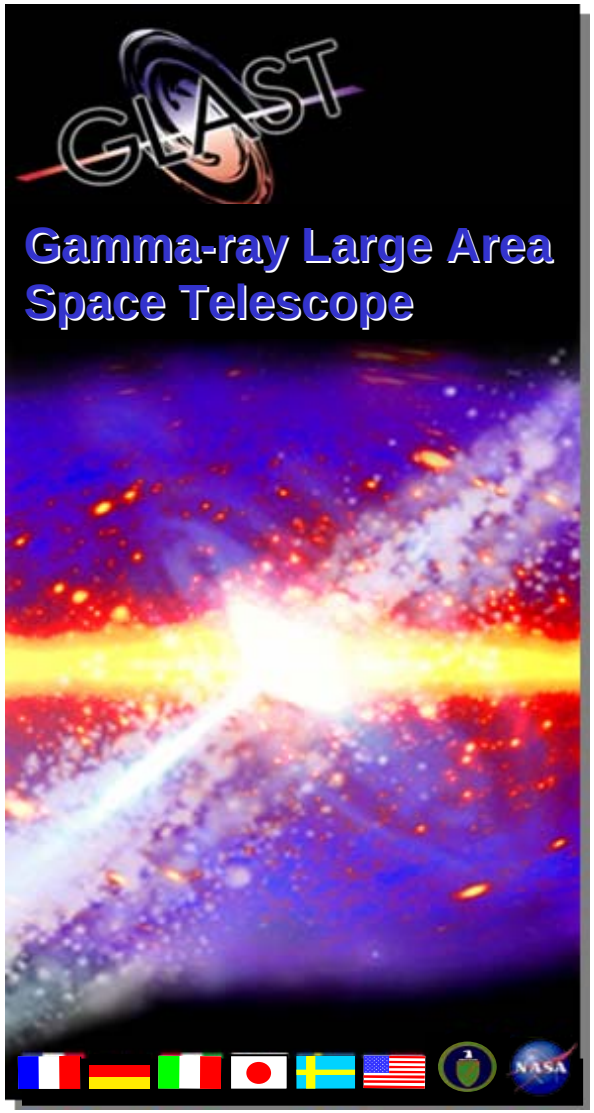


GLAST Large Area Telescope
Instrument Science Operations Center

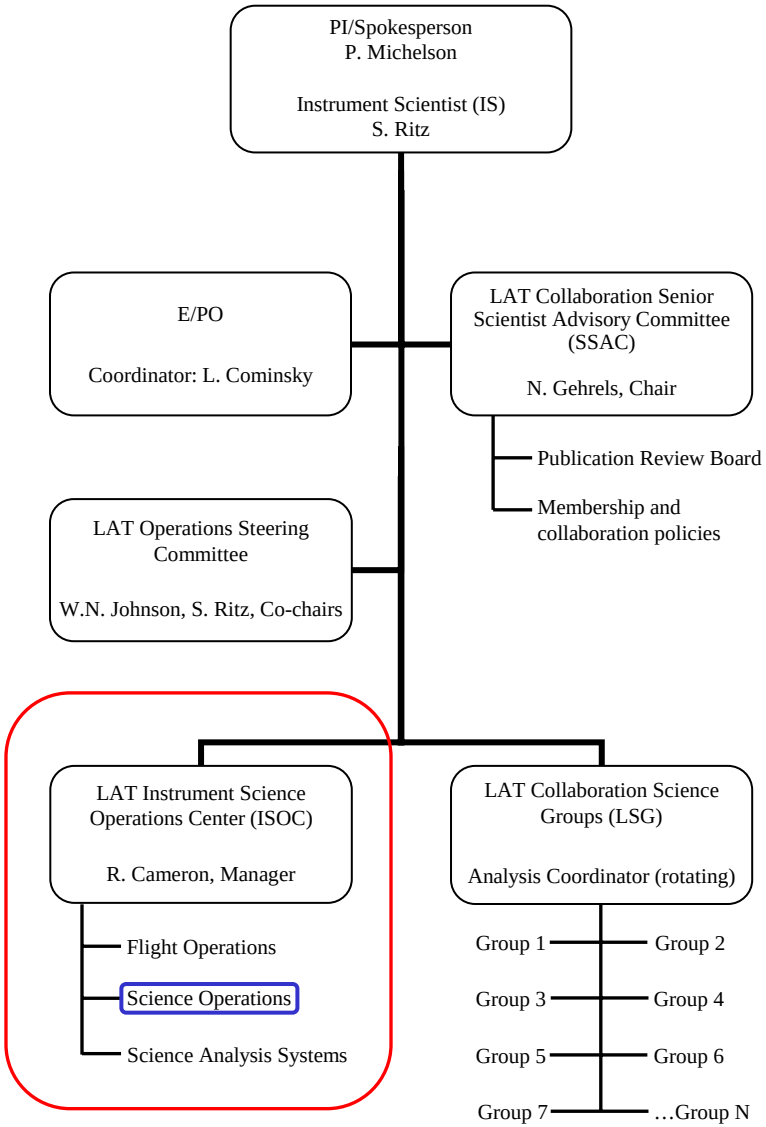
Science Operations Overview

Seth Digel and Eduardo do Couto e Silva

Outline

- Brief review of functions and organization
  - Collaboration contributions to SO tasks
- Status of Science Operations
- Future of SO through launch (& post-launch plans)

ISOC in the LAT Collaboration



- The ISOC is the core of LAT operations activities
- 'Science' was added to the name IOC in 2003, not as a change of scope but to better reflect the role of the operations center
- All tasks in Science Operations are related to getting scientific results out – that is, well calibrated data from a well understood, optimally-operated instrument

Scope of SO

- **Data processing:** Level 1 (reconstruction and classification) and some higher-level (time-critical science and routine processing)
  'Automated Science Processing'
- **Data monitoring** (and by inference LAT and background monitoring, too)
- **Calibration & configuration** (includes alignment)
- **Other analysis functions** (optimizing configuration, filters, operations, instrument response functions)
- **Operations** (shifts, coordination with Flight Operations)

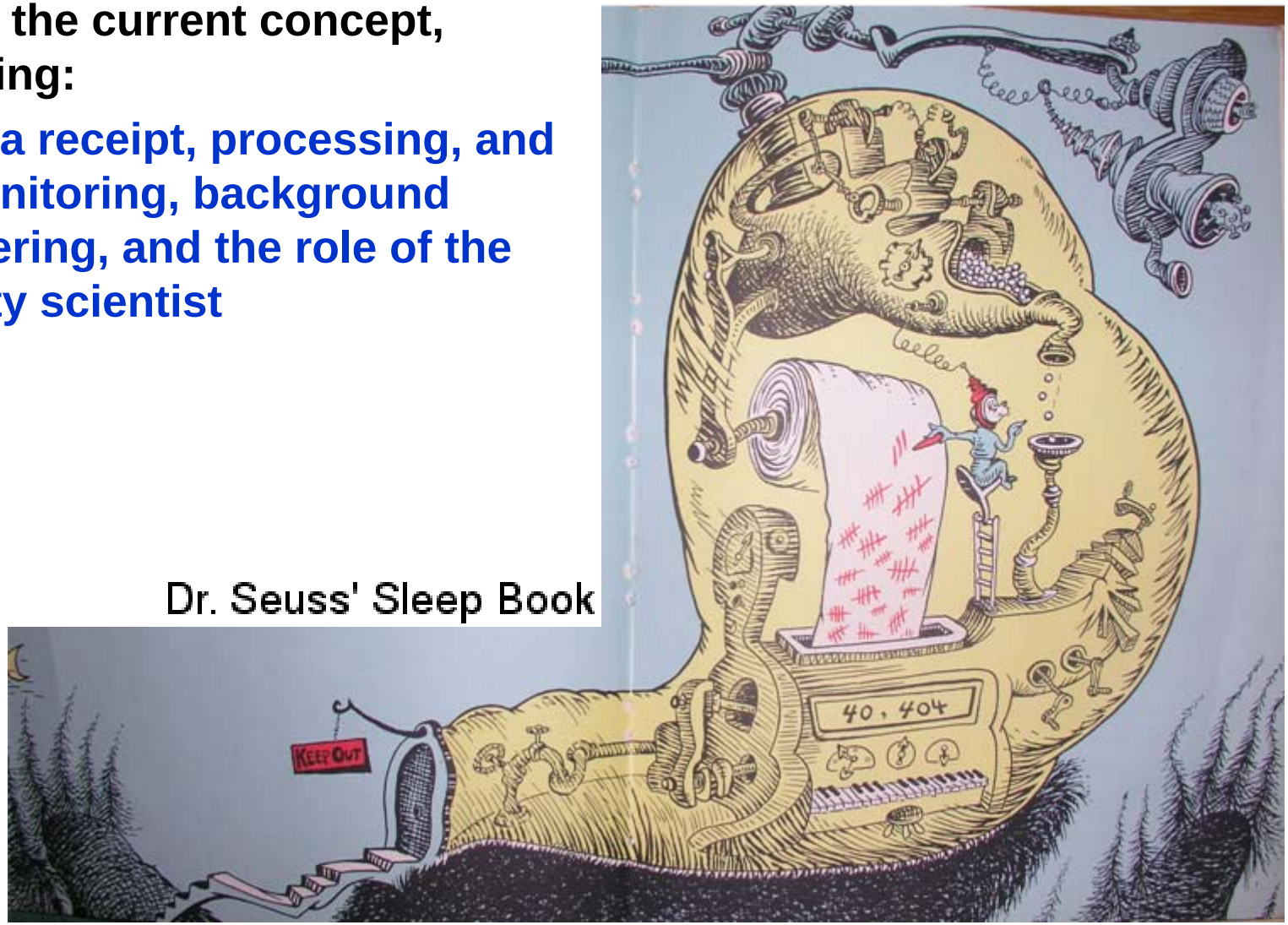
SO is a *customer of SAS* and *best friends with FO*

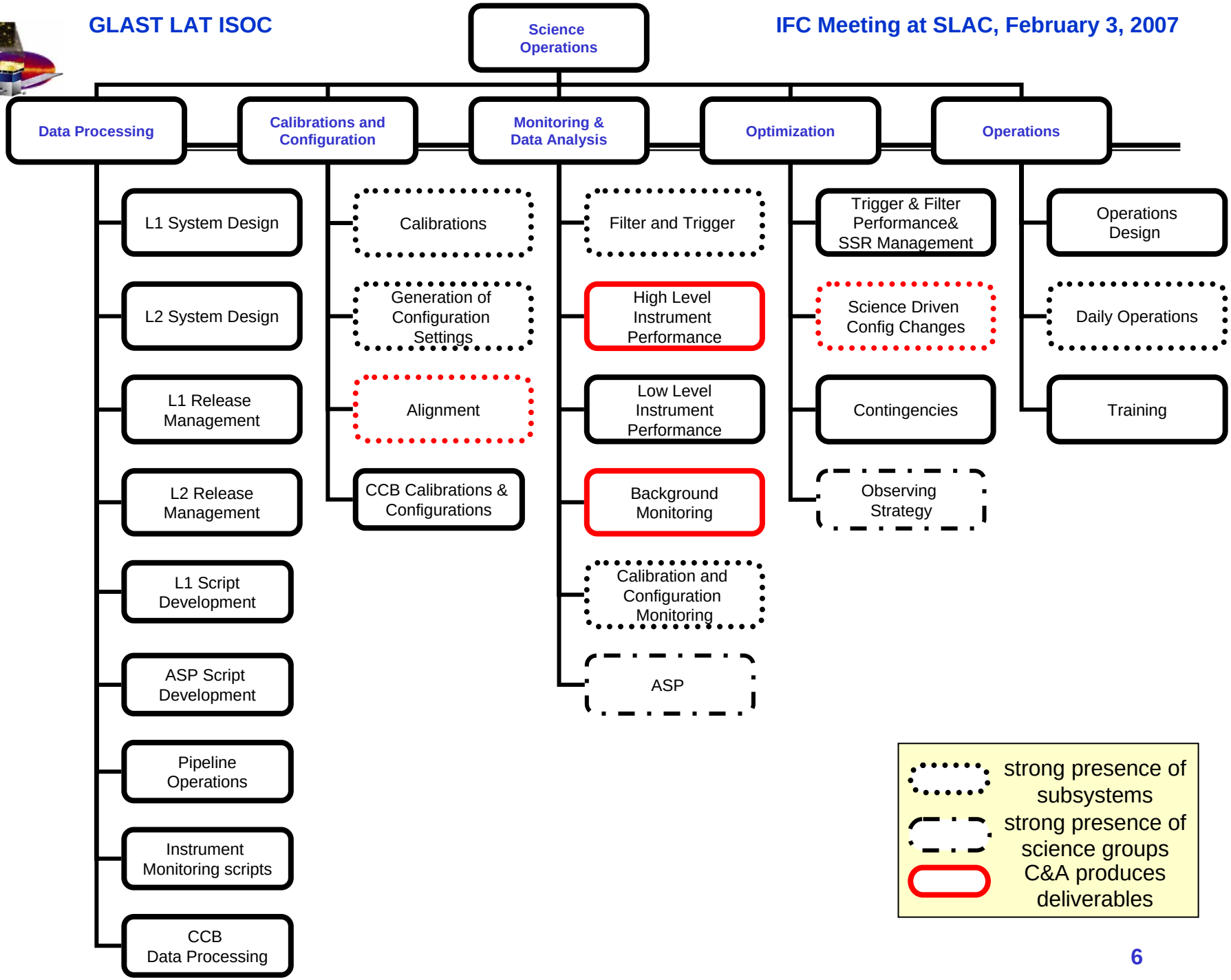
SO does not

- Develop processing infrastructure
- Control and command the LAT
- Monitor health & safety
- Modify flight software

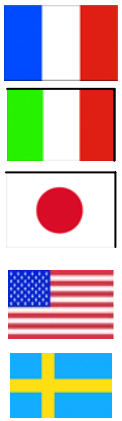
Science Operations Concept

- **Here's the current concept, including:**
  - **data receipt, processing, and monitoring, background filtering, and the role of the duty scientist**




Science Operations
Data Processing
Calibrations and Configuration
Monitoring & Data Analysis
Optimization
Operations
L1 System Design
L2 System Design
L1 Release Management
L2 Release Management
L1 Script Development
ASP Script Development
Pipeline Operations
Instrument Monitoring scripts
CCB Data Processing
Calibrations
Generation of Configuration Settings
Alignment
CCB Calibrations & Configurations
Filter and Trigger
High Level Instrument Performance
Low Level Instrument Performance
Background Monitoring
Calibration and Configuration Monitoring
ASP
Trigger & Filter Performance& SSR Management
Science Driven Config Changes
Contingencies
Observing Strategy
Operations Design
Daily Operations
Training
strong presence of subsystems
strong presence of science groups
C&A produces deliverables

Science Operations Across the Collaboration



- A recent focus of SO has been to identify areas where support is needed and available from the collaboration – *from now through the first year of the mission*
  - The ISOC is physically at SLAC but owing to the distribution of expertise across the collaboration, and also to the finite staffing at SLAC, we cannot cover all of SO here
  - The level of support pledged from collaborating institutions was quite heartening
- The following slides summarize what has been arranged (updated from our presentation at the Science Operations VRVS meeting on Jan. 19)
  - *Numbers are people, not FTEs*
  - For some large tasks (e.g., background monitoring) we are establishing groups to coordinate inter-institution work

Monitoring and Data Analysis

- **Tasks with support from Collaboration**
  - **Background monitoring/trigger rates/SSR monitoring**
    - Japan(2-4), SLAC (2-3), INFN (1), NRL(1), GSFC(1)
    - Eduardo will arrange a meeting to kick off the group
  - **Filter performance**
    - OSU (2-3), SLAC(1-2), NRL(1), GSFC(1)
    - E. Grove will arrange a meeting to kick off the group
  - **Monitoring of high level performance (IRF monitoring not generation)**
    - INFN, ASI, IN2P3, SLAC
    - Seth will arrange a meeting to kick off the group
  - **(Pre-digi) monitoring and diagnostics of low level data**
    - SLAC (3), INFN (3-4), NRL(1)
    - Working group already exists
  - **TKR performance monitoring (e.g. efficiencies, occupancy, TOT MIP peak)**
    - SLAC(1), INFN, Japan(2-3)
    - Anders will organize a kick-off meeting
  - **CAL performance monitoring**
    - NRL(2-3), Montpellier(1-2), Bordeaux(1-2), SLAC(1)
  - **ACD performance monitoring**
    - GSFC (2), SLAC(1)
  - **Time dependent monitoring : (need people here!)**
    - Need a volunteer to
      - » arrange a meeting with subsystems to define quantities
      - » write the code (Eric Charles has already an example)
  - **Update current digi and Recon reports: (need people here!)**
  - **Implement automated reports per downlink/day/week/month (need people here!)**
    - infrastructure may need to be tailored for different timescale and different levels of monitoring
    - e.g., ASP, alignment, calibrations?

Data Processing

- A. Borgland will organize a kick-off meeting to divide the work
  - INFN (2-3), SLAC(2-3)
- Tasks with support from Collaboration
  - Pipeline task monitoring (critical):
    - Define which quantities to monitor (failed jobs, etc.)
    - Define a Pipeline monitoring dashboard for shifters and experts
  - Infrastructure for routine tasks
    - How to make plots & reports, interface to the trending system.
    - Optimize running of parallel tasks
  - L1,L2 release management
    - Verification of production level code used for data for processing
      - testing reprocessing and works towards consolidation for operations on orbit
  - Develop scripts for non-automated functions used during operations
    - Involve interaction with databases/catalog/data server
  - First training session for pipeline operations experts during Feb end-to-end tests

Data Processing (2): ASP

- Tasks with support from Collaboration
  - Algorithms for flaring source detection INFN (2), ASI (2)
    - Blazar flare alerts
    - Implementation in pipeline in the context of ASP
  - Joint GBM spectral analysis Hiroshima (1), INFN (1)
    - How to get access to the GBM data
    - Implementation in pipeline in the context of ASP
  - Define and develop Web interface to present and serve publicly accessible data ASI (3?), SLAC (2), GSFC (GSSC)
    - What to display, plot types, user interaction, what is to be downloadable
  - Tool for maintenance of source list for monitoring (need help)
  - Dedicated testing of ASP NOT by developers (need help)
    - Verify flux and spectra
    - Characterize GRB blind search and flare detection performance

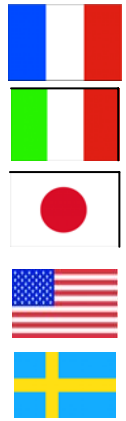
Calibrations and Configuration

- **Tasks with support from Collaboration**
  - Develop procedure for ACD calibrations GSFC (2), SLAC(1)
    - Beam test may provide initial data point
      - Can we address the non-linearity of electronics?
    - (CAL & TKR procedures are further along at this point)
  - Trending TKR, CAL, ACD calibrations (wait for general trending application to be finished by SAS)
  - Continue development of alignment code
    - Within a tower INFN(1), intertower INFN(1), LAT & Spacecraft SLAC(1), GSFC(1)
    - Test alignment code and study systematic misalignments (need help)
  - Develop trade-off studies to identify when changes are needed for calibrations, configurations and trigger and data masks (need help)
    - At what point do we update these according some change in a high level quantity (e.g., background rates)?
      - Affects offline reprocessing and on-board configuration

Optimization

- **Tasks with support from Collaboration**
  - **Scanning/rocking (need help)**
    - **use (or develop) orbit/attitude simulator that understands observing constraints, for amplitude and phasing of rocking and earth avoidance studies**
  - **SAA perimeter SLAC(2) , (need help)**
    - **procedure for defining the appropriate perimeter using LAT flight data – currently cannot be simulated well (task relates to background model)**
  - **IRFs (Interest of SO is in having the capability to generate IRFs; contributions of support to the IRF generation working group are specifically sought)**
    - **studies of event classes**
    - **validation of IRFs with Gleam INFN(4)**
  - **Contingencies INFN(2?)**
    - **optimizing operations after a LAT hardware failure**
      - **For example simulate a loss of ACD tile and impact on definitions of ROI**

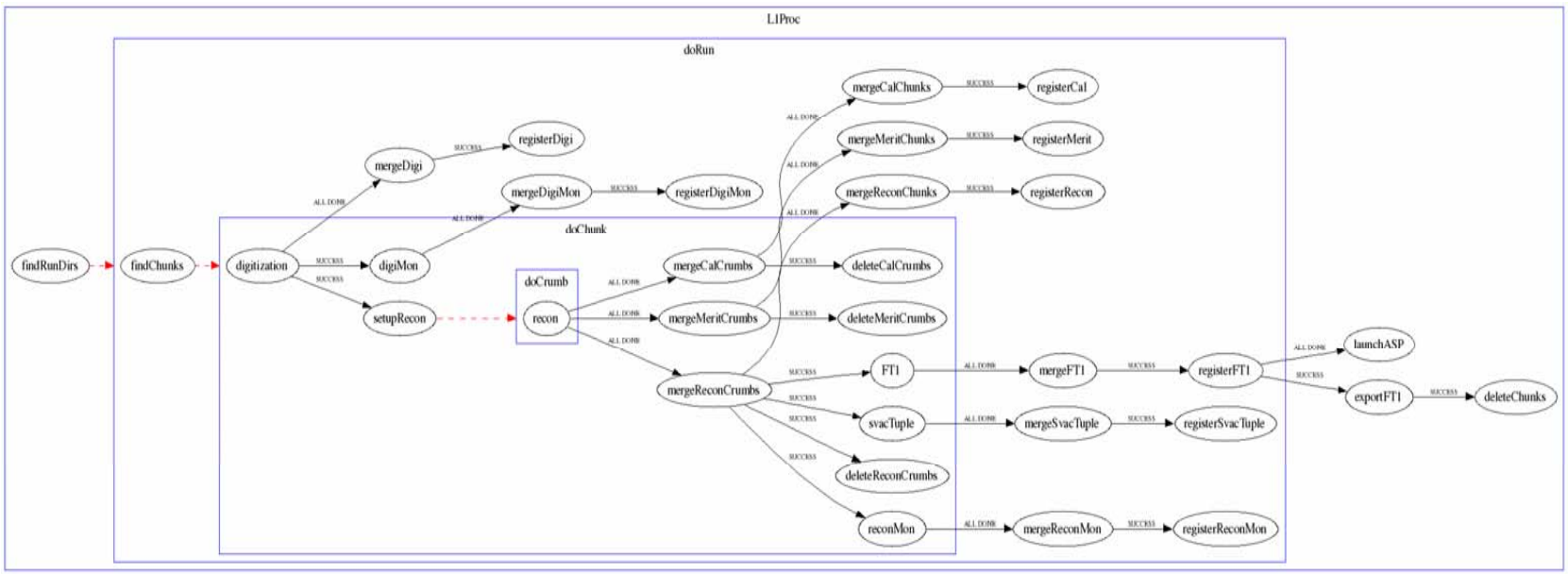
Daily Operations from SO Perspective



- Working group web page
  - https://confluence.slac.stanford.edu/display/ISOC/Operations
- The group is formed currently with worldwide representation from the LAT
  - J. Conrad, E. Grove, L. Latronico, B. Lott, T. Mizuno, D. Thompson
  - S. Digel, E. do Couto e Silva, G. Godfrey, H. Tajima, G. Thayer
- Near-term tasks
  - Define roles and responsibilities for shift takers in Science Operations
    - compare experiences from other missions
    - review/provide input/test tools developed for shifts by Science Operations crew
    - ensure smooth interfaces between groups during operations
    - prepare an operations manual
    - G. Godfrey is leading definition of SciOps screens; IN2P3 and INFN will help implement
  - Define processes for special calibrations and anomaly resolution
    - assess how timescales required for updates impact on the exchange between Flight and Science Operations
      - include control room operations and offline analysis
    - discuss documentation and validation steps
  - Define training and testing of Science Ops shift takers
    - increase complexity during Service Challenges and End-to-End tests
- Tell me if you want to hear the proposal for Operations during the first year
  - Shift leader, shift scientists
- Or about anomaly resolution procedures

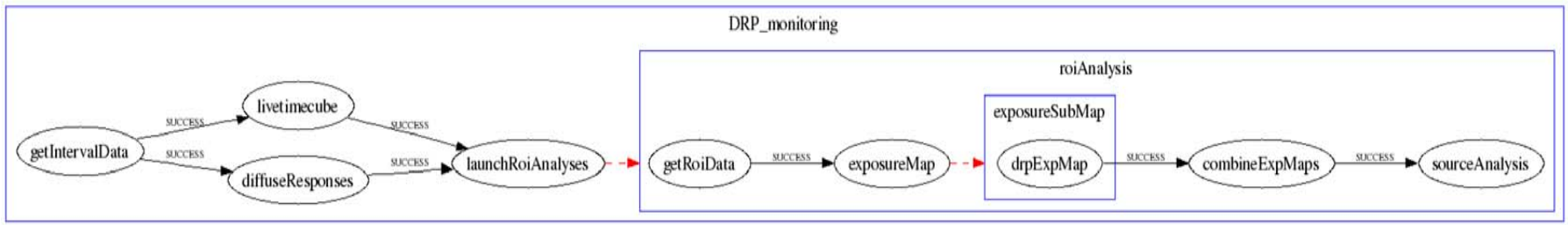
Status of L1 processing

- **L1 Pipeline task (W. Focke & L. Wai)**
  - **Input is 'Level 0.5' from data receiving task, which sorts telemetry and uncompresses event data**
  - **Not implemented yet is generation of pointing history and accumulation of live time (needed for exposure calculations)**
  - **This task registers the L1 data and starts automated science processing**



Status of Automated Science Processing

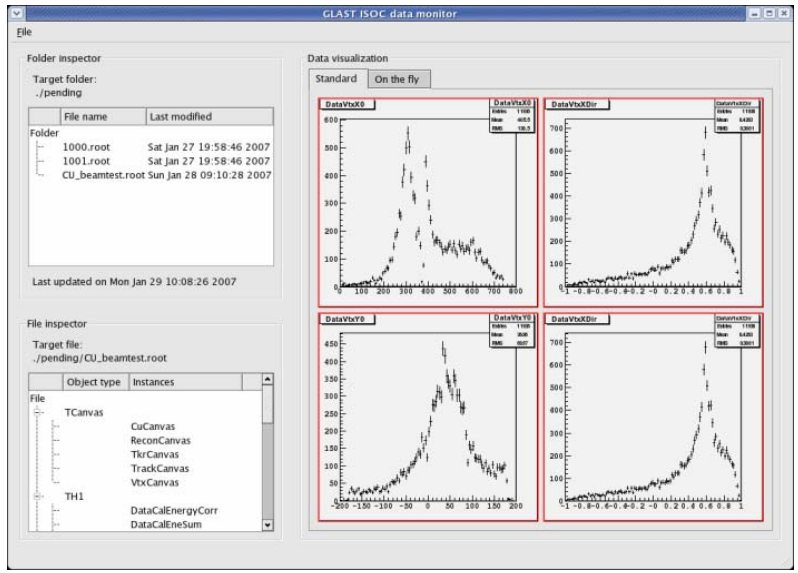
- All tasks (GRB refinement, GRB detection, source monitoring, and transient detection) have been scripted, although with prototype algorithms in some cases
- Source monitoring example (J. Chiang, J. Carson)
  - Not triggered by L1 pipeline; runs as a scheduled task



Status of monitoring

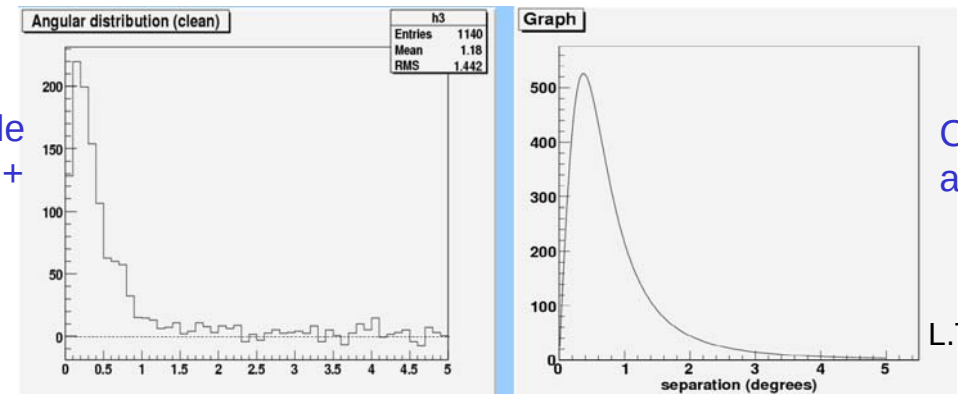
- **Ongoing monitoring (automated) of instrument performance, detector element level through instrument response functions**

Prototype for pre-digi monitoring; evolution from monitoring tool for beam test



L. Baldini, J. Bregeon (INFN)

Phase selected, diffuse background subtracted profile of gamma rays around Vela + Geminga (1-3 GeV, class A, costh > 0.9, 55 days)



Class A IRF (on-axis, 1.1 GeV, DC2)

L.Tibaldo (INFN)

Timeline for Tests in 2007

End-to-End Tests

Feb 26	Mar 2	May 21	Jul 10	Aug 11	Aug 20	Oct 9
ETE1a	ETE1b	ETE 2	ETE 3	ETE 4	ETE 5	ETE 6

Basic & Advanced Commanding

Basic & Advanced Operations (include contingencies)

Regression Testing (Last pre-ship test) More contingencies

Check out (Last mission test) At launch site

Service Challenge

ISOC Test 1 and 2

Summer	Oct Launch – 30
1	2

Flight Ops and Science Ops

Mission Planning Exercises

Mar 5-11	Jun 4-13
MPE 1	MPE 2

Instrument Commissioning

Apr 13-15	Aug 15-16
Inst COM 1	Inst COM 2

Launch & Early Orbit Sims

Mar 13-15	May 30-Jun 1	Jul 16-20	Sep 25-27	Nov 7
LEO 1	LEO 2	LEO 3	LEO 4	LEO 5

Mostly Flight Ops

More on Testing

- Success of rehearsals depends on participation of LAT collaborators
  - success depends on participation of LAT collaborators
- Service Challenges with simulated Data
  - Data Processing
  - Monitoring
  - Offline Data Analysis
  - Reprocessing
  - Calibrations
- End-to End Tests (and Mission Simulations) with real LAT data
  - Control room activities and procedures
  - Interface with Flight Ops and GSSC
    - Mission Planning and Timeline
    - Alerts and Messages
    - Correlations of housekeeping and science data
  - Data Processing
  - Monitoring
- Tools currently being developed by SAS will be used for both type of rehearsals
  - See talk from Richard Dubois

Summary

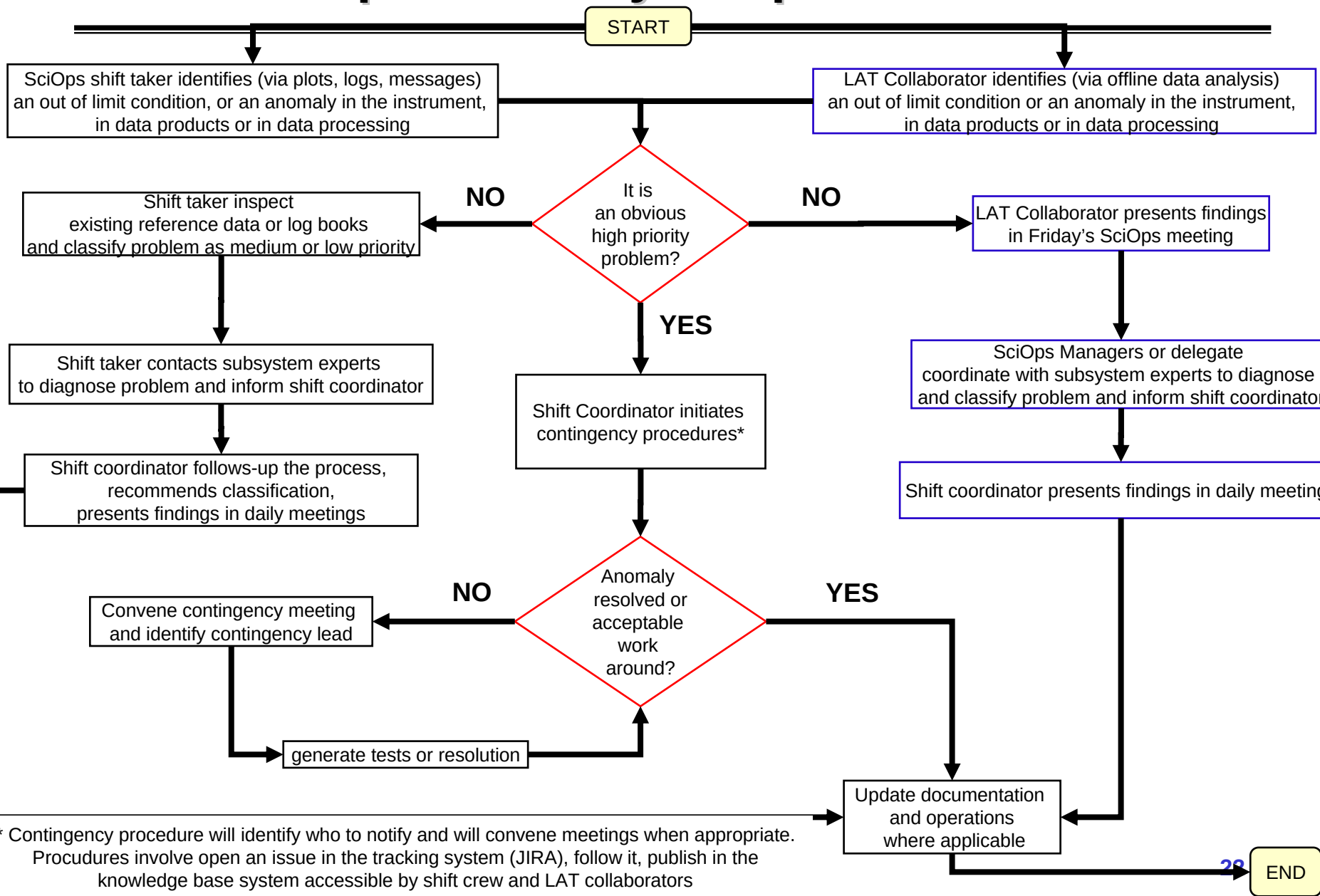
- Science Operations is part of the ISOC but not physically limited to SLAC
- Vital contributions are coming from other institutions and will be needed for testing, and operations
- The milestones enforced by the testing plan are certainly close enough to ensure focus

Backup slides

Operations: Proposal being Reviewed

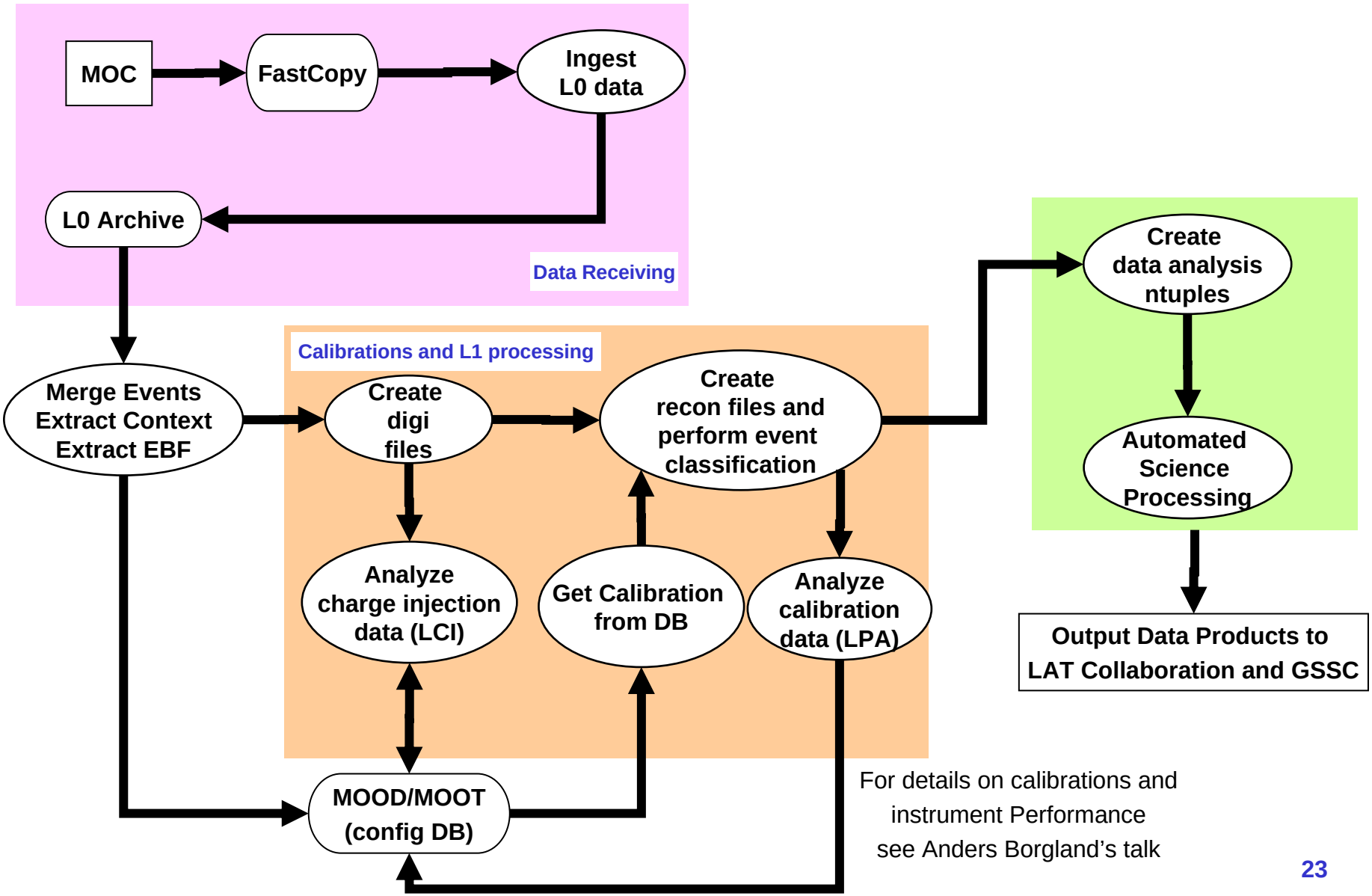
- Prepare for 24/7 coverage @ SLAC for the first 6 months
  - Commissioning Phase : 60 days
  - Transition Phase: 120 days
    - will reassess at least twice whether 24/7 coverage is needed
- Roles
  - Shift Coordinator
    - resident at SLAC (rotate every 6 months)
      - » will consider shorter assignments after initial 6 months if operations are smooth enough
    - appointed at least 6 months in advance to allow training and smooth transition
  - Shift Scientist
    - resident at SLAC (rotating every 2 weeks)
    - consider coverage outside SLAC after reassessment early 2008
      - » to be discussed: frequency of shifts per institution and training of people
    - current questions: how long should shifts be and 'overhead' per run or downlink
- Automate tasks
  - Minimize routine work to be performed by Science Operations crew
    - rely on computer generated alerts/messages
- Conservative attitude toward changes in the instrument configuration
  - We are in space…don't touch if it is working
- Routine coordination meetings
  - SciOps and LAT Collaboration
    - Fridays, VRVS
  - SciOps, ISOC, GSSC, GBM, MOC
    - Tuesday Weekly timeline planning (timeline)
  - FlightOps and MOC
    - Daily tag ups 6 am PDT
    - SciOps invited but not required

Sci Ops Anomaly Response Process



* Contingency procedure will identify who to notify and will convene meetings when appropriate. Procudures involve open an issue in the tracking system (JIRA), follow it, publish in the knowledge base system accessible by shift crew and LAT collaborators

Simplified Functional Diagram for Data Flow



For details on calibrations and instrument Performance see Anders Borgland's talk