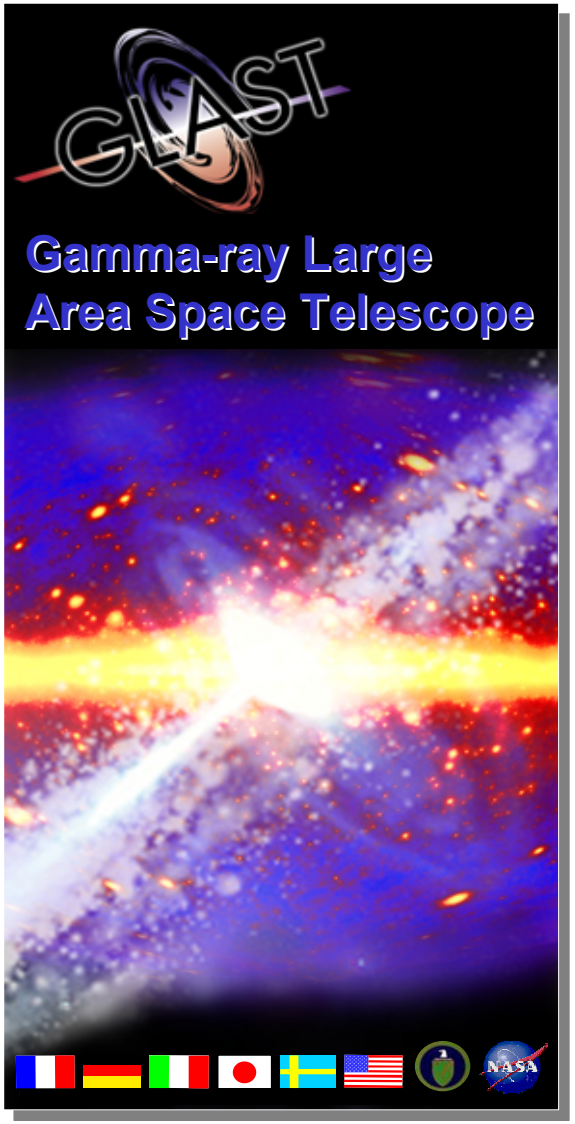


GLAST Large Area Telescope Instrument Science Operations Center

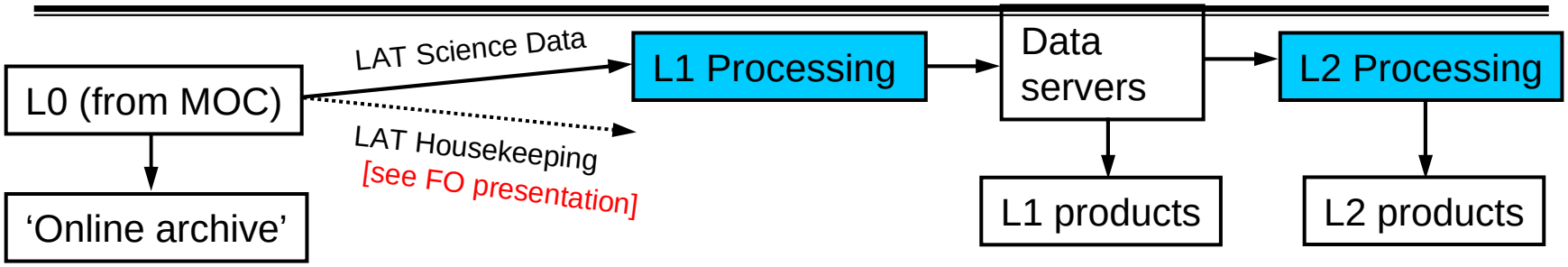
Science Operations II

Seth Digel & Eduardo do Couto e Silva
Stanford Linear Accelerator Center

Science Operations

- Part I
- Characterize, monitor and optimize LAT Performance at all levels
- Coordinate investigation of instrument anomalies
- Coordinate LAT operations scientist program
- Part II
- Science data processing
  - L1, automated L2, Quick look science/alerts, MC
  - Standard product generation/delivery (to GSSC)
- Development milestones
  - Ground readiness tests
  - End-to-end tests
  - Data Challenge 3
- Resource requirements
  - Interfaces with (support from) the LAT collaboration
  - Staffing profile

Science Data Processing



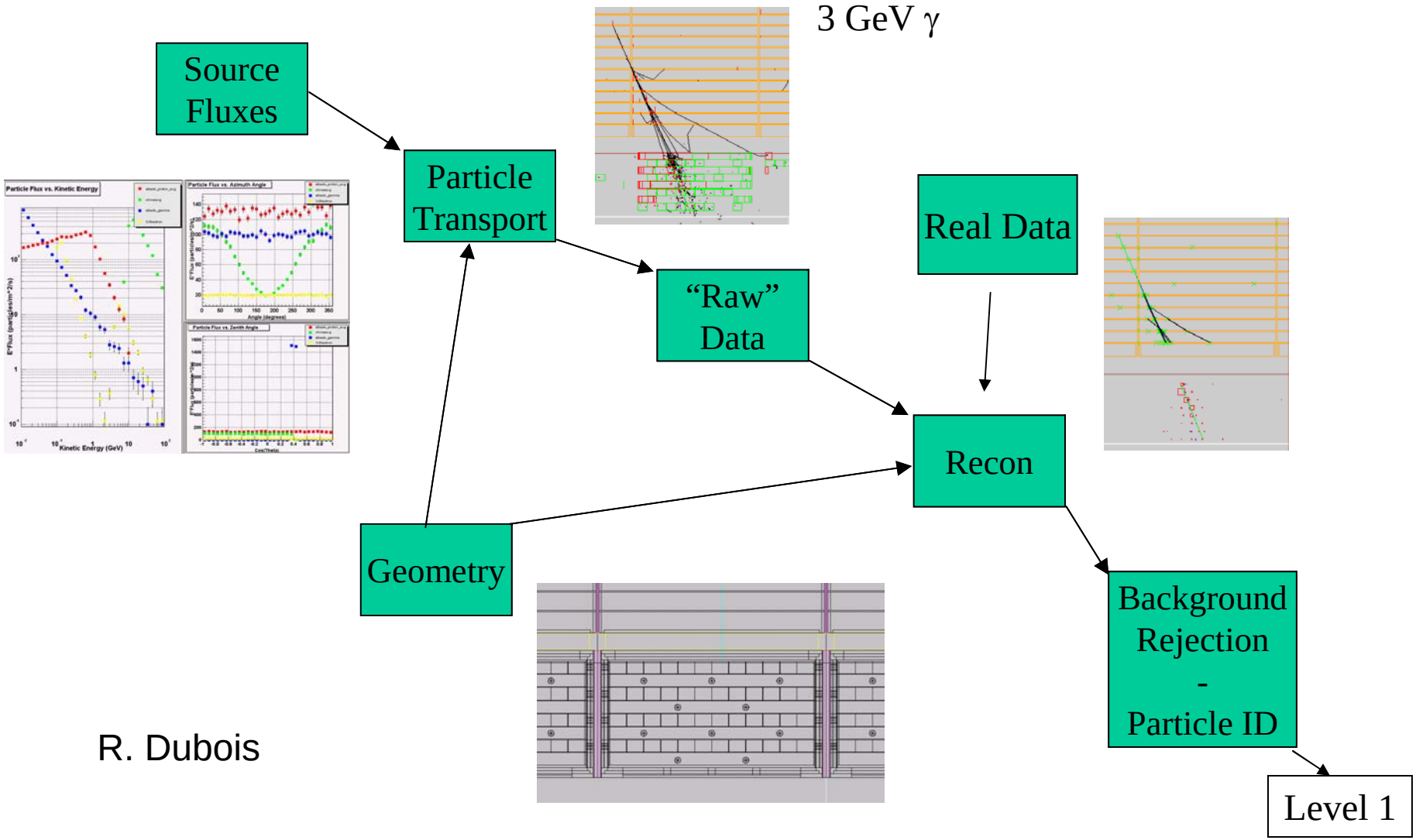
- **The ISOC is responsible for Level 1 and some Level 2 processing of LAT science data**
- **Level 1**
  - **Event reconstruction and classification [see SAS presentation]**
  - ***Duties:* maintenance of pipeline scripts, processing, reprocessing, configuration control**
- **Level 2 processing, broadly speaking, is astronomy: detecting and characterizing astrophysical sources of γ-rays**
  - **For some science topics, minimizing the latency or performing routine processing on behalf of the collaboration and guest observers, motivate having some automated L2 processing in the ISOC**

Science Data Processing (2)

- **Automated L2**
  - **Quick look science/alerts – GRB refinement/untriggered GRBs**
  - **Source monitoring/discovery of flares (overlap with Instrument Performance Monitoring)**
  - ***Duties:*** **algorithm development/coordination for untriggered GRBs, preparation and vetting of alerts and updates; maintenance of pipeline scripts, configuration, processing**
- **Monte Carlo simulations (Levels 1 & 2)**
  - **For support of reconstruction, event classification, instrument response functions, performance verification, and science tools functions of the ISOC**

Science Data Processing (3)

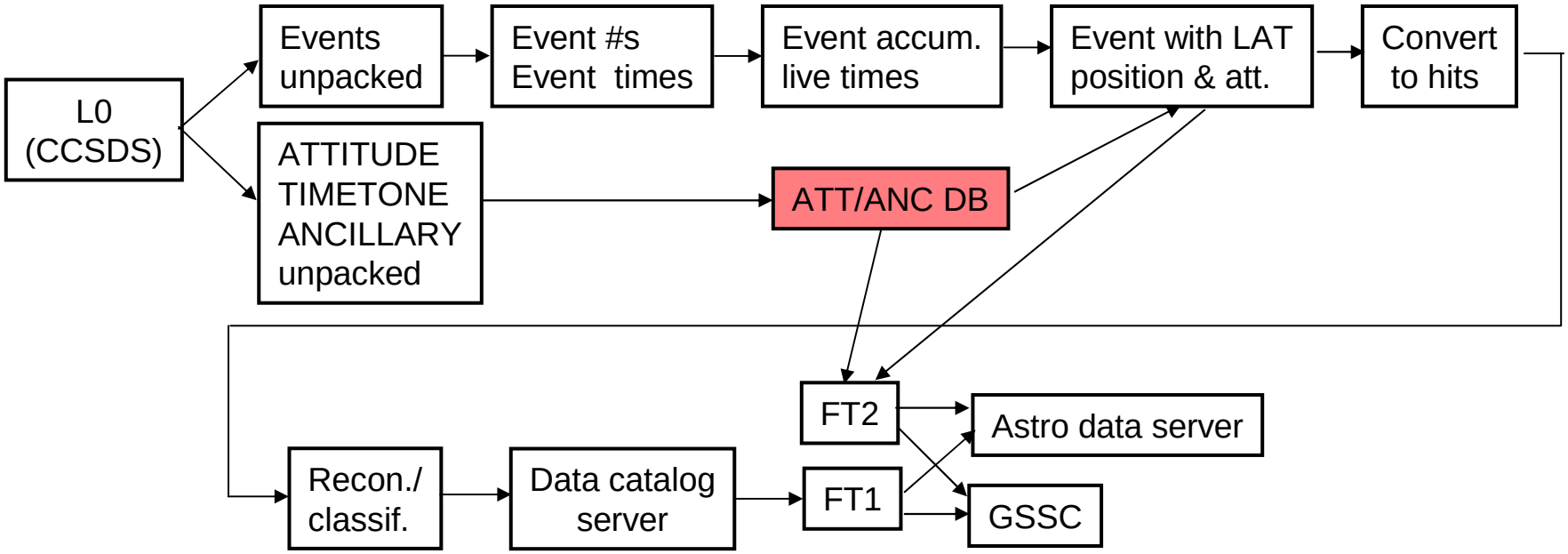
Level 1 Simulation/Reconstruction Chain



R. Dubois

Science Data Processing (4)

- Summary of L1 processing steps - Event and calibration/geometry databases are not shown explicitly
- Brief review of scope: 6-8 downlinks/day, >50 CPUs for ~1 hr turnaround of L1 [see SAS talk]



Science Data Processing (5)

- Summary of automated L2 processing
- GRB refinement & search for untriggered LAT GRBs (with and without GBM timing or information from other missions)
- Search for flaring blazars
  - Time scales and sensitivities make this a job for ground processing rather than onboard the LAT
  - Detection of previously-unknown sources when they flare, checking fluxes of known sources
  - [Solar flare follow-up unlikely]
- Monitoring sources
  - ~25 from the start – fluxes to be released on an ongoing basis during year 1
  - Longer list for the LAT collaboration, on an ongoing basis

Time critical

Science Data Processing (6)

- **Generation/delivery of standard products**
  - **Some are L1, some are L2, and some are calibration/configuration histories**
  - ***Duties:*** **(Except for the point source catalog) Generation and delivery of the products to the GSSC with definition and schedule in an ICD under development; maintenance of LAT data servers for the LAT collaboration [see SAS talk]**

Table 3-2: LISOC Data Products

CD ID	Product	Description	Delivered	Latency	Size (bytes)	Deliver to
S-002	LAT Events	Subset of merit n-tuple for subset of the events telemetered to the ground	Per Ku downlink (~6-8 per day)	1 day	250 M	GSSC
S-003	LAT Low-Level Calibration	Calibration information for the subsystems, e.g., dead, off or noisy TKR strips, ACD tile status and PMT gains, CAL status and light sharing.	Weekly	1 week	TBD	GSSC
S-004	LAT IRFs	Full IRF for all possible parameters	On update	N/A	5 M	GSSC
S-005	LAT Pointing and Livetime History	LAT orientation and mode at 30 s intervals; used to calculate exposures	Per Ku downlink (~6-8 per day)	1 day	100 k	GSSC
S-006	LAT Configuration history	Detailed LAT configuration history, all registers of each subsystem as updated	On update	12 hours	1 M	GSSC
S-007	LAT Transient Data	Summary information for transient sources (GRBs, solar flares, and AGN flares) derived from LAT event data	Per transient	8 hours	100 k	GSSC
S-008	LAT Point Source Catalog	Table of detected gamma-ray sources with derived information	On update	N/A	10 M	GSSC
S-009	LAT Burst Catalog	List and characterization of gamma-ray bursts; location, duration, intensity	On update	N/A	TBD	GSSC
S-010	Interstellar Emission Model	Model for diffuse gamma-ray emission from the Milky Way, input for high-level data analysis; will be refined using GLAST data	Initial model updated periodically	N/A	40 M	GSSC

From draft Science Data Products ICD

Development Milestones

- Ground Readiness Tests (Science Operations aspects)
  - GRT 5 (June): L0 -> L1 and some L2 data products
  - GRT 6 (August): again
  - GRT 7 (September): again
- End-to-End Tests
  - ETE 1 (December): Real LAT data -> L0 (post-test) -> L1 -> GSSC
  - ETE 2-5 (March-July): Same with real-time data handling
  - ETE 6-7 (August-): Same, with GLAST in FL
  - Automated L2 processing will have to be verified through simulation
- Data Challenge 3 [see SAS talk for what is a Data Challenge]
  - Spring 2007
  - Scale up to 1-year simulated data for analysis
  - Introduce IOC SO functions as a 'real time' aspect

Resource Requirements

- Interfaces with the Collaboration - Areas where the ISOC receives support from the LAT collaboration at large
  - Calibration & Analysis & Operations scientists topics are covered by Eduardo
  - For Science Data Processing in particular Science Operations will have support from the collaboration in these areas
    - Transient sources – GRBs and blazar flares – development of algorithms for detection and characterization
    - Generation of LAT point source catalog – see above

Resource Requirements (2)

task	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012
TOTAL (SO + LAT Collab)	8.75	14.25	15.50	12.00	9.75	9.75	9.75
TOTAL (SO)	6.50	10.25	11.50	8.00	5.75	5.75	5.75
Total (SO scientists)	4.00	6.75	7.25	4.00	3.50	3.50	3.50
Total (SO software dev)	2.50	3.50	4.25	4.00	2.25	2.25	2.25
TOTAL (LAT Collab)	2.25	4.00	4.00	4.00	4.00	4.00	4.00
Management	0.50	0.50	1.00	0.50	0.50	0.50	0.50
Scientists	0.50	0.50	1.00	0.50	0.50	0.50	0.50
Software Dev	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT Collaboration	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Calibrations	0.75	1.50	1.75	1.25	1.25	1.25	1.25
Scientists	0.50	1.00	1.00	0.50	0.50	0.50	0.50
Software Dev	0.25	0.50	0.75	0.75	0.75	0.75	0.75
LAT Collaboration	0.50	0.75	0.75	0.75	0.75	0.75	0.75
Performance	2.25	3.00	3.25	2.00	1.00	1.00	1.00
Scientists	1.25	1.75	1.75	0.50	0.50	0.50	0.50
Software Dev	1.00	1.25	1.50	1.50	0.50	0.50	0.50
LAT Collaboration	0.50	0.75	0.75	0.75	0.75	0.75	0.75
On-orbit Monitoring	1.00	1.50	1.50	1.00	1.00	1.00	1.00
Scientists	0.50	1.00	1.00	0.50	0.50	0.50	0.50
Software Dev	0.50	0.50	0.50	0.50	0.50	0.50	0.50
LAT Collaboration	0.75	0.50	0.50	0.50	0.50	0.50	0.50
Investigation of Anomalies	0.00	0.25	0.50	0.25	0.25	0.25	0.25
Scientists	0.00	0.25	0.25	0.25	0.25	0.25	0.25
Software Dev	0.00	0.00	0.25	0.00	0.00	0.00	0.00
LAT Collaboration	0.00	0.25	0.25	0.25	0.25	0.25	0.25
Level 1 Processing	0.50	0.75	0.75	0.50	0.50	0.50	0.50
Scientists	0.25	0.50	0.50	0.25	0.25	0.25	0.25
Software Dev	0.25	0.25	0.25	0.25	0.25	0.25	0.25
LAT Collaboration	0.00	0.25	0.25	0.25	0.25	0.25	0.25
Level 2 Processing	0.75	1.25	1.25	1.25	0.75	0.75	0.75
Scientists	0.50	1.00	1.00	1.00	0.50	0.50	0.50
Software Dev	0.25	0.25	0.25	0.25	0.25	0.25	0.25
LAT Collaboration	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Science Data Products	0.50	1.00	1.00	0.75	0.25	0.25	0.25
Scientists	0.25	0.50	0.50	0.25	0.25	0.25	0.25
Software Dev	0.25	0.50	0.50	0.50	0.00	0.00	0.00
LAT Collaboration	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Operations Scientist Program	0.25	0.50	0.50	0.50	0.25	0.25	0.25
Scientists	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Software Dev	0.00	0.25	0.25	0.25	0.00	0.00	0.00
LAT Collaboration	0.00	1.00	1.00	1.00	1.00	1.00	1.00

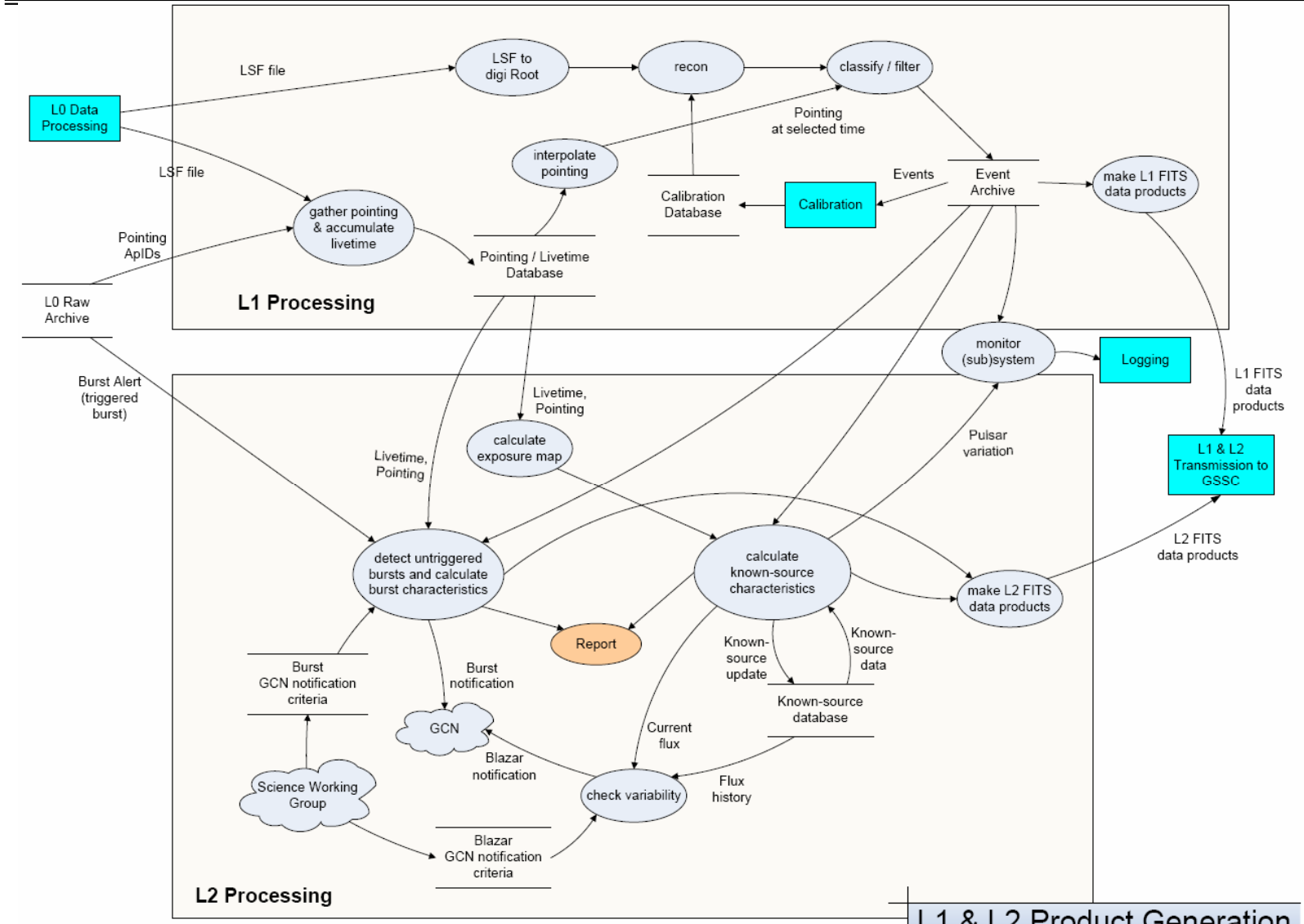
Eduardo's talk

- Personnel
  - Contributions from LAT collaboration are significant, both resident and nonresident at SLAC
  - 1 FTE ≠ 1 person
- Peak year
  - FY2008 (launch)
- Operations become routine and automated as much as possible
  - FY2009 and on

Summary

- We understand the functions, the milestones, the challenges, and the staffing/M&S requirements for Science Operations in the ISOC
- Science Operations in the ISOC are drawing on the expertise gained at SLAC during the development and testing of the LAT and of the analysis system for LAT data
- For several aspects of Science Operations support from the LAT collaboration at large will integrate well with ISOC

Backup slides follow



L1 & L2 Product Generation

22 Nov 2005