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# GSSC LAT Data Server Overview

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# Outline

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- ▶ ***Definitions***
- ▶ ***Requirements***
- ▶ ***Design Goals***
- ▶ ***Overall System Architecture***
- ▶ ***Implementation Details***
- ▶ ***Benchmarks***



# Database Definitions

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- ▶ ***Photon Database (D1ph) – Database that holds all LAT events considered photons and that were used to construct the IRFs. This is the primary science database.***
- ▶ ***Event Database (D1ev) – Database that holds (possibly) all reconstructed LAT Events, both photons and particles.***
- ▶ ***Pointing and Livetime History Database (D2) – Database that holds spacecraft attitude, position and instrument status information in 30 sec intervals.***



# D1 Search Definitions

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## ▶ **“Standard” Search**

- *15° radius circle or 30° x 30° box on the sky for a time period of one year (LESDR 5.2.3.1.1)*
- *For photon database this is 50-600 MBytes of data depending on sky position*

## ▶ **“Large” Search**

- *Photon database: Search that would return more than 2GBytes of data per year of observation (LESDR 5.2.3.1.4)*
- *Event database: Search that would return more than 20Gbytes of data (LESDR 5.2.4.1.4)*



# D1 Database Design Requirements

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## ▶ **Search Parameters**

- *Search on values that are real or integer numbers, Booleans, dates and times. (LESDR 5.2.1.1.1)*
- *Times searchable to microsecond precision (LESDR 5.2.1.1.2)*
- *2-D positions on sphere (LESDR 5.2.1.1.3)*
- *Data quality (LESDR 5.2.1.1.4)*

## ▶ **The database must be remotely accessible. (LESDR 5.2.1.3)**

## ▶ **Portability – must not be tied to a single architecture or software system. (LESDR 5.2.1.6)**

## ▶ **HEASARC Compatibility**

- *Database will be turned over to HEASARC at the end of mission (LESDR 5.2.2.1)*
- *Must not require excessive effort (>1 FTE) to maintain. (LESDR 5.2.2.1.1)*



# Photon Database Performance Requirements



- ▶ **Derived from statistics of current satellite data archives**
- ▶ **Search Speeds**
  - *Standard Search – Data returned within 30 minutes per year of data searched. (LESDR 5.2.3.1.2)*
  - *Standard Search with additional sub-selections – All data returned within 45 minutes per year of data searched. (LESDR 5.2.3.1.3)*
  - *Large Search – All data returned within 3 days. Allows for processing during off peak hours. (LESDR 5.2.3.1.4)*
- ▶ **Number of Requests**
  - *Must perform up to 60 standard searches a day. (LESDR 5.2.3.2.1)*
- ▶ **Data Ingest**
  - *Ingest of new data must be complete within 10 minutes for a 5 hour observation data set (LESDR 5.2.3.3)*
  - *Ingest of reprocessed data may interrupt database access for no more than 60 minutes for a 5 hour observation data set. (LESDR 5.2.3.4)*
- ▶ **Database Restoration**
  - *Must be able to restore database after a crash in <3 days per year of data (LESDR 5.2.3.4.3)*



# Event Database Performance Requirements

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## ▶ **Search Speeds**

- *Standard Search – All data returned within 10 hours per year of data searched. (LES DR 5.2.4.1.2)*
- *Standard Search with additional sub-selections – All data returned within 15 hours per year of data searched. (LES DR 5.2.4.1.3)*
- *Large Search – All data returned within 7 days. (LES DR 5.2.4.1.4)*

## ▶ **Number of Requests**

- *Must be able to perform up to 1 standard search a day. (LES DR 5.2.4.2)*

## ▶ **Data Ingest**

- *Ingest of new data must be complete within 100 minutes for a 5 hour observation data set. (LES DR 5.2.4.3)*
- *Ingest of reprocessed data may interrupt database access for no more than 10 hours for a 5 hour observation data set. (LES DR 5.2.4.4)*

## ▶ **Database Restoration**

- *Must be able to restore database after a crash in <1 week per year of data (LES DR 5.2.4.4.3)*

## ▶ **Requirements are generous and design goals provide better performance**



# D2 Database Design Requirements

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## ▶ **Search Speed**

- *Retrieve 6 months of consecutive data (~50 MBytes) in 1 minute (SAEDR 5.4.1.5.2)*

## ▶ **Number of searches**

- *Must be able to handle >1500 searches a day (SAEDR 5.4.1.5.2.3)*

## ▶ **Data Ingest**

- *Ingest of new data (5 hours of spacecraft operation) in 1 minute (SAEDR 5.4.1.5.1)*
- *Ingest of reprocessed data (5 hour period) in 5 minutes (SAEDR 5.4.1.5.3)*

## ▶ **Database Restoration**

- *Must be able to restore database after a crash in <1 day (SAEDR 5.4.1.5.4)*





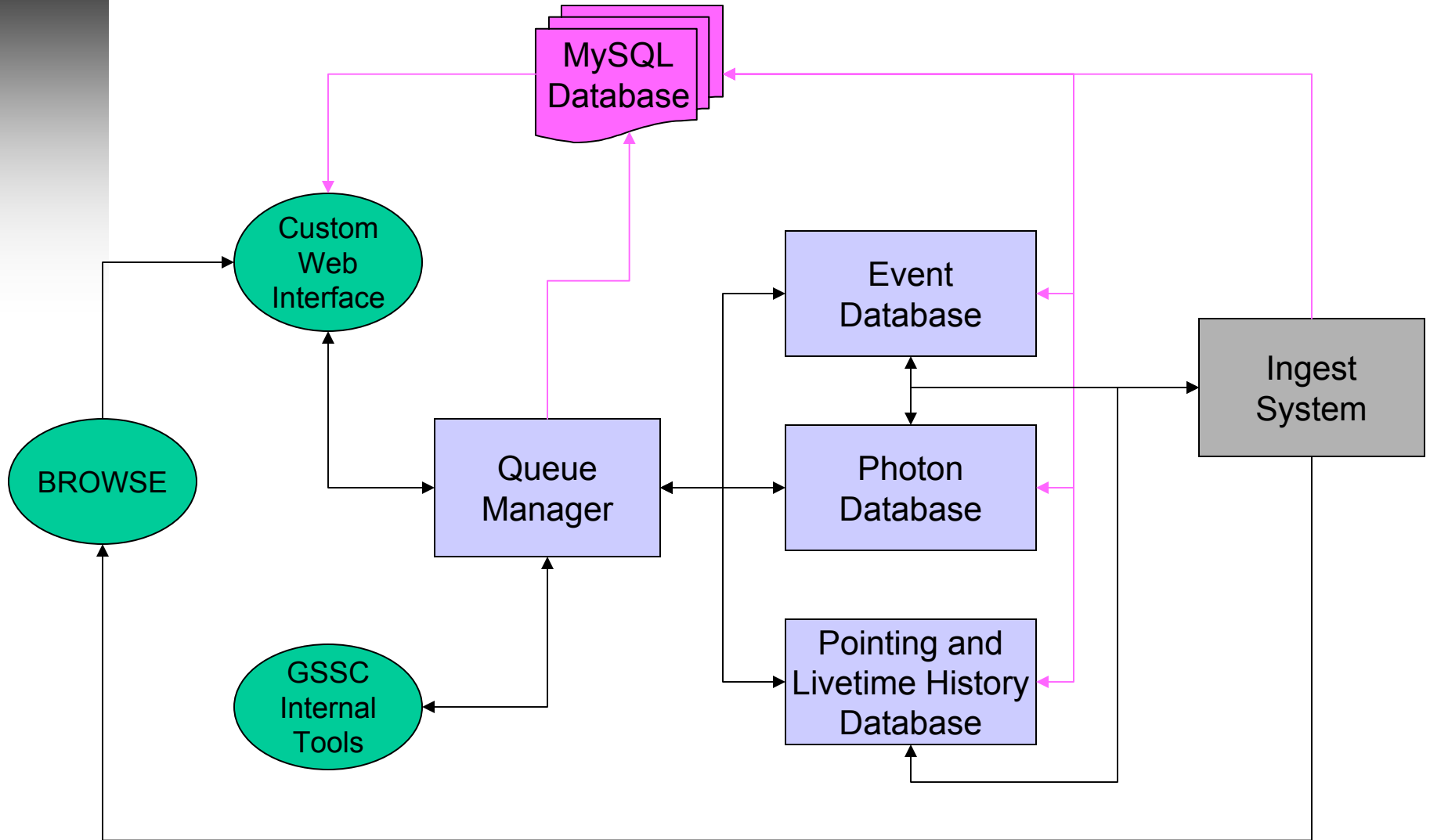
# Database Design Goals



	<i>Design Requirement</i>	<i>Design Goals</i>	<i>Current Performance</i>
<i>Standard D1 photon search – 1 year of data</i>	<i>30 min</i>	<i>1 min</i>	<i>~40 sec</i>
<i>Standard D1 event search – 1 year of data</i>	<i>10 hrs</i>	<i>30 min</i>	<i>N/T</i>
<i>D2 search – 6 months of data</i>	<i>60 sec</i>	<i>60 sec</i>	<i>7 sec</i>
<i>D1 photon ingest, new data – 5 hours of data</i>	<i>10 min</i>	<i>2 min</i>	<i>0.5-5 min</i>
<i>D1 event ingest, new data – 5 hours of data</i>	<i>100 min</i>	<i>20 min</i>	<i>N/T</i>
<i>D1 photon ingest, reprocessed data – 5 hours of data</i>	<i>60 min</i>	<i>12 min</i>	<i>N/T</i>
<i>D1 event ingest, reprocessed data – 5 hours of data</i>	<i>10 hrs</i>	<i>2 hrs</i>	<i>N/T</i>
<i>D2 Ingest, new data – 5 hours of data</i>	<i>1 min</i>	<i>1 min</i>	<i>10 sec</i>
<i>D2 Ingest, reprocessed data – 5 hours of data</i>	<i>5 min</i>	<i>1 min</i>	<i>N/T</i>
<i>D1 photon Data Restoration – year of data</i>	<i>3 days</i>	<i>3 hrs</i>	<i>10 min</i>
<i>D1 event Data Restoration – year of data</i>	<i>7 days</i>	<i>3 days</i>	<i>N/T</i>
<i>D2 Data Restoration – entire database</i>	<i>1 day</i>	<i>1 hr</i>	<i>10 min</i>

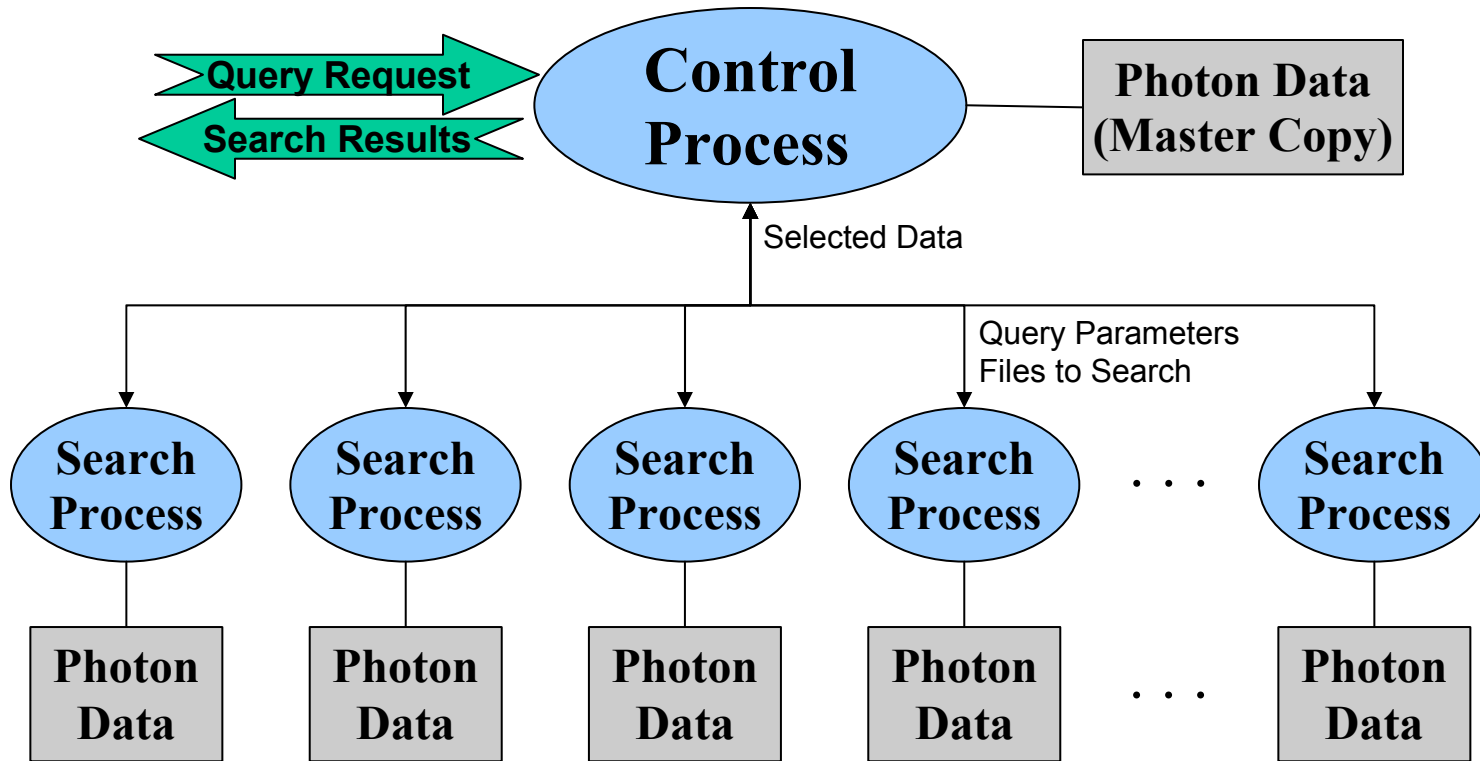


# D1/D2 Database System Design





# D1 Photon Database Design





# Photon Database Internal Storage

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- ▶ **All data is in HEASARC compatible FITS files**
- ▶ **Each node (control and search) has a complete copy of the photon data.**
  - *Fast data access from internal disk*
  - *Multiple backups in case of failure of a single data disk*
- ▶ **Data broken into sky regions and time periods in internal data files**
- ▶ **Hierarchical Triangular Mesh (HTM) used to define regions**
  - *Developed for Sloan Digital Sky Survey at Johns Hopkins*
  - *Recursively divides sky into spherical triangles*
- ▶ **Conducted trade study to determine optimal combination of HTM pixelization level and time binning**
  - *Best time of ~39 sec was level 3 pixelization (512 sky regions) with 2 month time bins*



# File Metadata Database I

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- ▶ **Currently 3 database tables (will eventually be 7)**
- ▶ **Ingest\_data – version information for database**
  - Database name – (Photon, Event, Spacecraft)
  - Start time of current data file (Mission Elapsed Time seconds)
  - Current file version – incremented if reprocessed data received for this file, reset to 0 upon creation of new file
  - Database version – incremented every time reprocessed data is received. Will allow “roll-back” to earlier version of database if necessary
- ▶ **Photon\_file\_comp – what composes the data files**
  - Filename base – This is a stub that contains the file data start time and version number of the set of data files the input data was added to.
  - Input filename – The name of the data file that was ingest
  - Ingest date – The data the file was added to the data set.



# File Metadata Database II

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- ▶ ***Photon\_file\_data – What is in the actual files***
  - *Filename – The name of the internal data file*
  - *Date modified – The date and time the file was last modified*
  - *N\_photons – The number of photons in the data file*
  - *startTime – The start time of the data file*
  - *stopTime – The end time of the data file*
  - *First\_DB\_version – The first database version the file is valid in*
  - *Last\_DB\_version – The last database version the file is valid in*
  - *HTMpixel – the HTM pixel the file corresponds to.*



# Sample photon\_file\_data Entries



filename	modified	n_photons	start_time	stop_time	f_DB_ver	l_DB_ver	HTM_pix
N3321_000000000.811_V01.fits	2004-09-14 23:01:22	78352	0.810755359	5192964.39219536	1	1	N3321
N3321_005192964.422_V01.fits	2004-09-15 23:23:06	75676	5192964.42167179	10380720.8784425	1	1	N3321
N3321_010380720.970_V01.fits	2004-09-16 19:15:23	84248	10380720.9699239	15573604.9799768	1	1	N3321
N3321_015573605.217_V01.fits	2004-09-17 08:52:05	58666	15573605.2165841	20758694.9444996	1	1	N3321
N3321_020758695.407_V01.fits	2004-09-20 14:51:22	86182	20758695.4070489	25956942.8102773	1	1	N3321
N3321_025956943.127_V01.fits	2004-09-21 05:26:23	84268	25956943.1269949	31141488.8384952	1	1	N3321
N3321_031141488.938_V01.fits	2004-09-21 05:40:23	7789	31141488.938296	31539599.4946347	1	1	N3321
S3321_000000000.811_V01.fits	2004-09-14 23:00:30	20638	0.810755359	5192964.39219536	1	1	S3321
S3321_005192964.422_V01.fits	2004-09-15 23:22:15	22436	5192964.42167179	10380720.8784425	1	1	S3321
S3321_010380720.970_V01.fits	2004-09-16 19:14:30	23566	10380720.9699239	15573604.9799768	1	1	S3321
S3321_015573605.217_V01.fits	2004-09-17 08:51:10	19569	15573605.2165841	20758694.9444996	1	1	S3321
S3321_020758695.407_V01.fits	2004-09-20 14:50:24	25107	20758695.4070489	25956942.8102773	1	1	S3321
S3321_025956943.127_V01.fits	2004-09-21 05:25:17	21376	25956943.1269949	31141488.8384952	1	1	S3321
S3321_031141488.938_V01.fits	2004-09-21 05:40:20	2239	31141488.938296	31539599.4946347	1	1	S3321



# Screenshots – Search Page




File Edit View Go Bookmarks Tools Window Help

http://glast.gsfc.nasa.gov/cgi-bin/ssc/U1/LATDataQueryDev.cgi Search

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Data

Data Access

Data Analysis

LAT Event, Photon and Spacecraft Query

The Photon database currently holds N photons starting collected between Date1 and Date2.

[D1/D2 Database Access User Manual](#)

**1. Do you want to search around a position ... ?**

**Object Name Or Coordinates:**   
(e.g. '12 00 00, 4 12 6' or '12, 15')  
 J2000/B1950: rA, dec  
 Galactic/Supergalactic: Latitude, Longitude  
 Object: Object Name

**Coordinate System:**

**Area to Search:**    
For a circle, enter the radius in degrees. The default radius is 15.  
 Box and Ellipse searches are temporarily disabled.





# Screenshots – Query Submitted




File Edit View Go Bookmarks Tools Window Help

http://glast.gsfc.nasa.gov/cgi-bin/ssc/U1/LATDataQueryDev.cgi Search

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## Query Successfully Submitted

Your query has been successfully submitted to the search system. The estimated time until completion of the query is 24 seconds. The results of the query can be accessed at:

**Data Access** <http://glast.gsfc.nasa.gov/cgi-bin/ssc/U1/QueryResults.cgi?id=L050111121636FE57EF3F38>

**Data Analysis** If you would like to receive an e-mail notification when the query is completed please enter your e-mail address below.

E-mail notification not yet implemented

- + Privacy, Security, Notices
- + Get Plugins (Acrobat, etc.)
- + Contact NASA
- + Contact the GLAST SSC

Curators: [J.D. Myers](#) and [D. Petry](#)  
 Responsible NASA Official: [Phil Newman](#)  
 NASA Science Official: [Jay Norris](#)

Last Modified:

Last updated on: July 16, 2003

Done



# Screenshots – Results Page



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http://glast.gsfc.nasa.gov/cgi-bin/ssc/U1/QueryResults.cgi?id=L050111115204FE57EF3

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### LAT Data Query Results

Welcome to the LAT Data Query Results page. This page provides access to the LAT data requested from the GSSC's data servers.

The filenames of the result files consist of the Query ID string with an identifier appended to indicate which database the file came from. The identifiers are of the form: `_DDNN` where DD indicates the database and NN is the file number. The file number will generally be '00' unless the query resulted in a very large data return. In that case the data is broken up into multiple files. The values of the database field are:

- EV - Event Database
- PH - Photon Database
- SC - Spacecraft Pointing, Livetime and History Database

The query results are:

**Query Result File(s)**

[ftp://Megacy.gsfc.nasa.gov/FTP/glast/L050111115204FE57EF3F16\\_PH00.fits](ftp://Megacy.gsfc.nasa.gov/FTP/glast/L050111115204FE57EF3F16_PH00.fits)

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To get the results from another query, enter the query ID string below:

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[+ Contact the GLAST SSC](#)

Curators: [J.D. Myers](#) and [D. Petry](#)  
 Responsible NASA Official: [Phil Newman](#)  
 NASA Science Official: [Jay Norris](#)

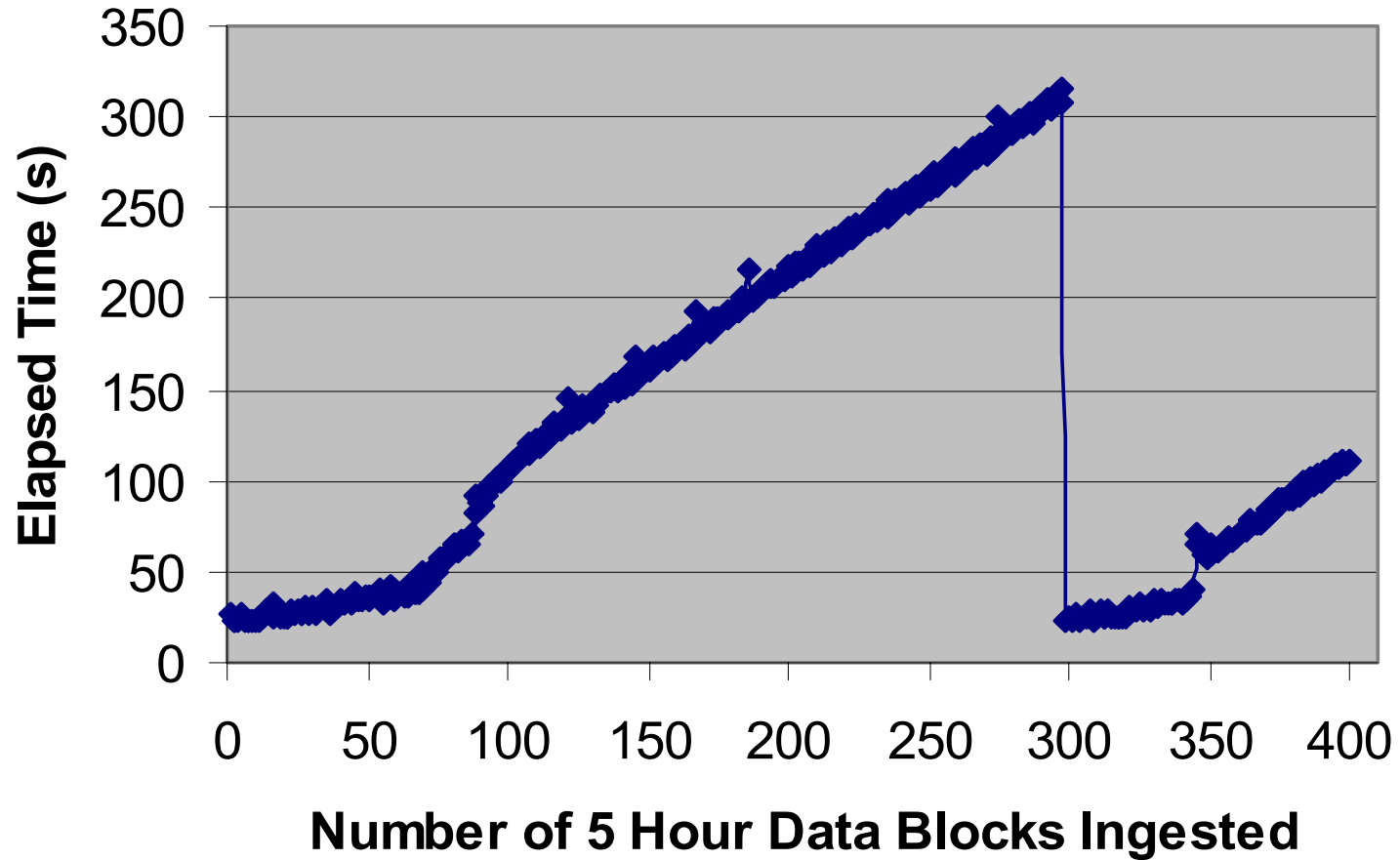
Last Modified:

Last updated on: July 16, 2003



# Ingest Performance

## GSSC LAT Data Server Photon Ingest Performance





# Search Performance

## GSSC LAT Data Server Search Performance

