D0 Run II Data Handling Status: SAM and Enstore

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The D0 Prague Workshop

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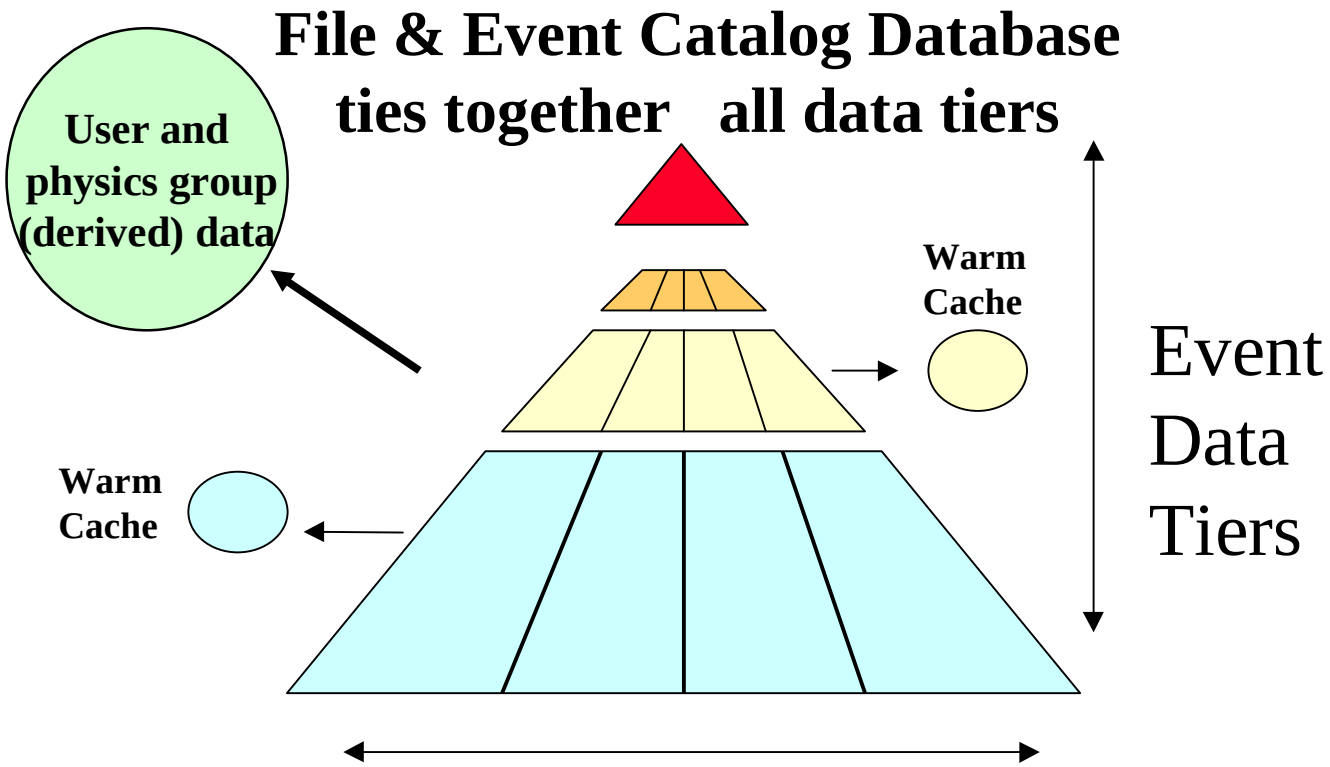
http://www-hppc.fnal.gov/enstore

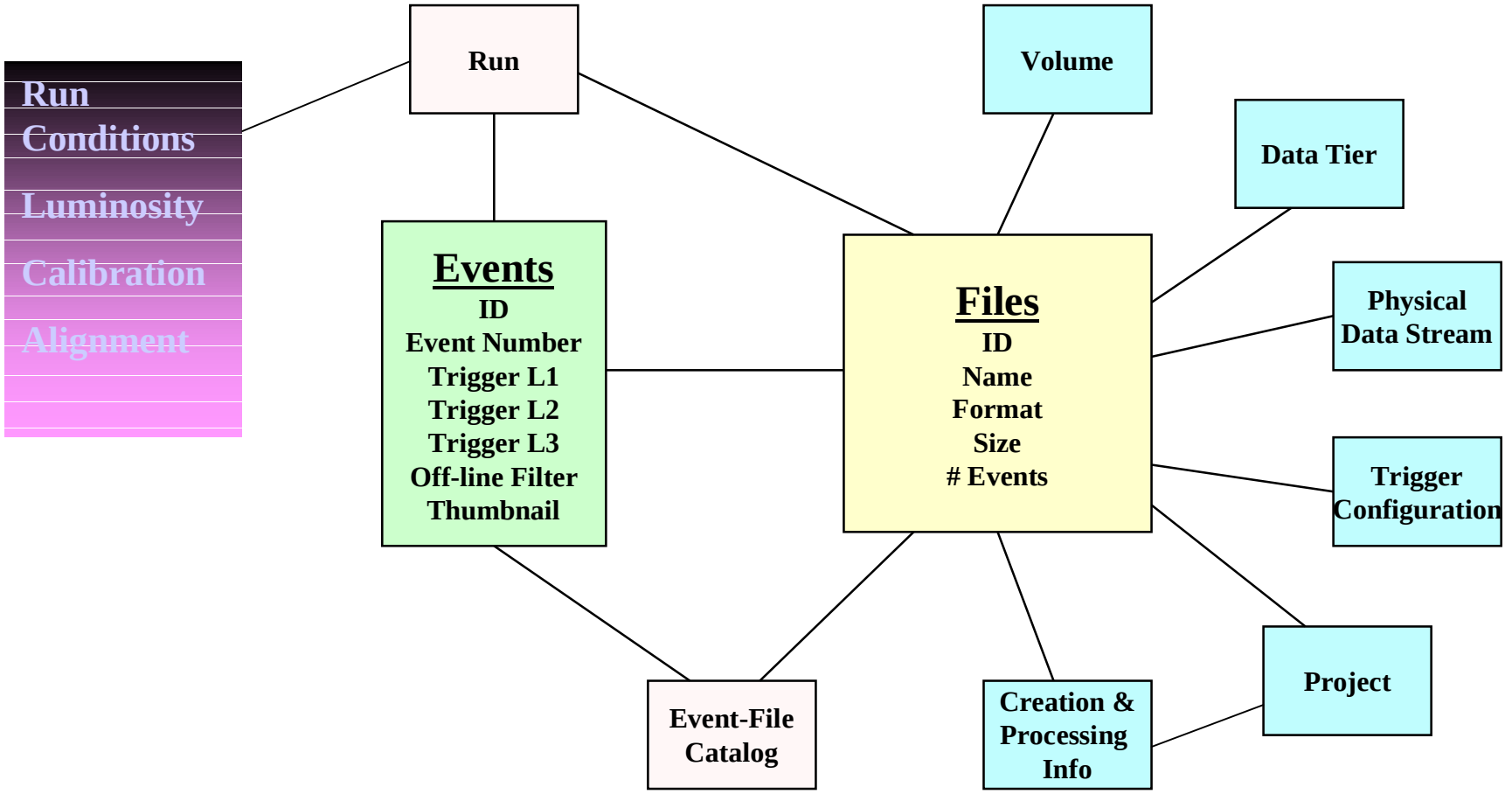
Topics

- The Sequential Access Model
- Brief Enstore Status
- Current SAM Features & Functionality
- D0 Integration Status
- Data Exchange with non-FNAL Centers
- Coming Attractions

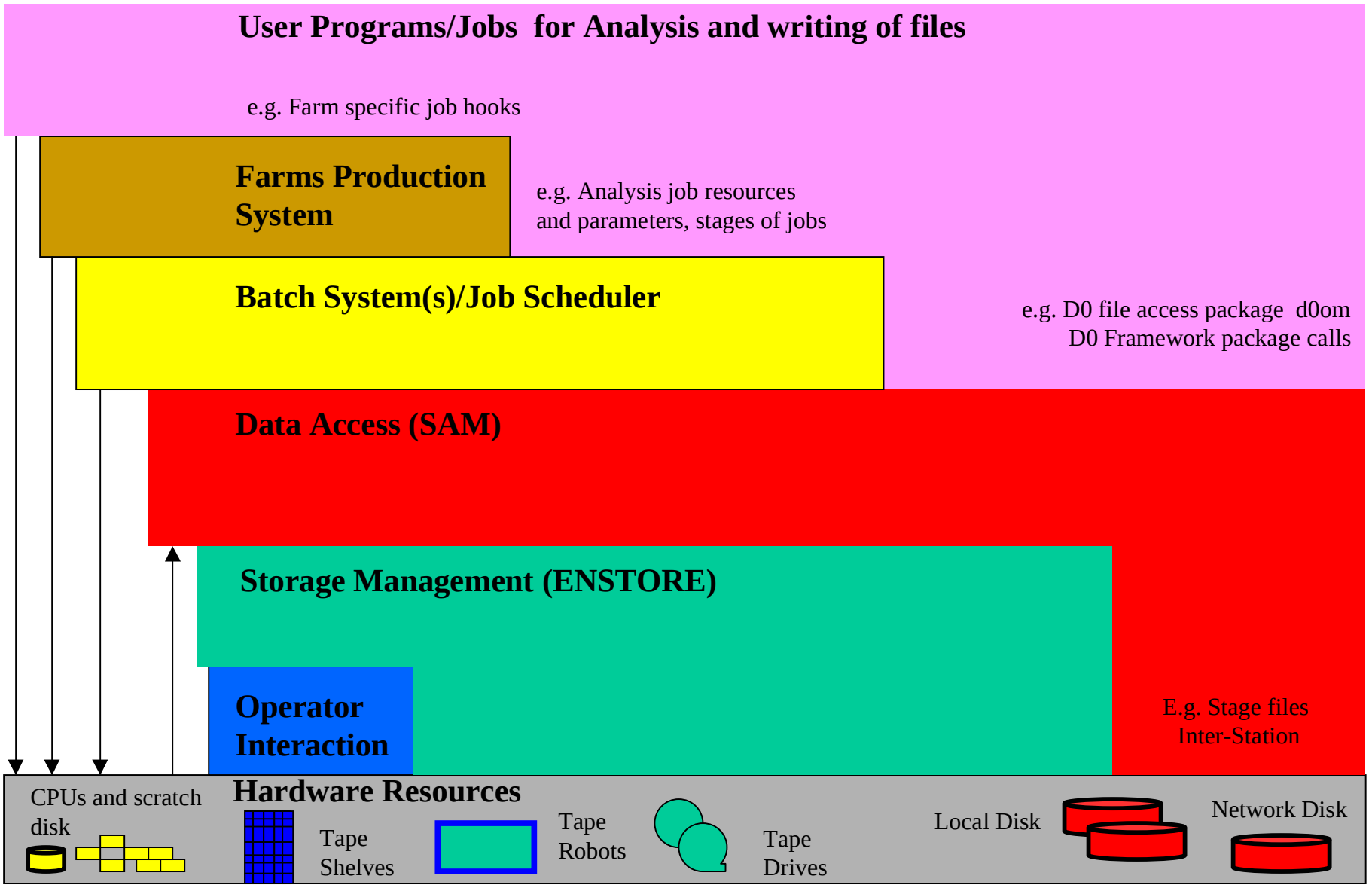
Sequential Access Model: SAM



SAM Simplified Schema



Software Layers for Data Management and Access



Enstore

- Enstore is the mass storage system
- Provides:
  - encp - copy files between media and disk
  - pnfs - namespace of files (courtesy DESY)
  - enstore - user control interfaces to Enstore system
  - web interface - details of what the system is doing
  - enstore_tape - volume import mechanism
- Enstore group manages
  - The D0 robot and tape drives
  - All mover and server hardware needed to operate the system

Enstore Status

- Spring 99
  - Completely functional Version of Enstore
  - D0 robot available for integration testing.
  - Tape Import capability
- Summer 99
  - Version 1.0 software
  - Additional mover & server hardware
- Fall 99
  - Production hardware installation, additional tape drives
  - Developing operations support team

Spring 1999: SAM Version 0.0

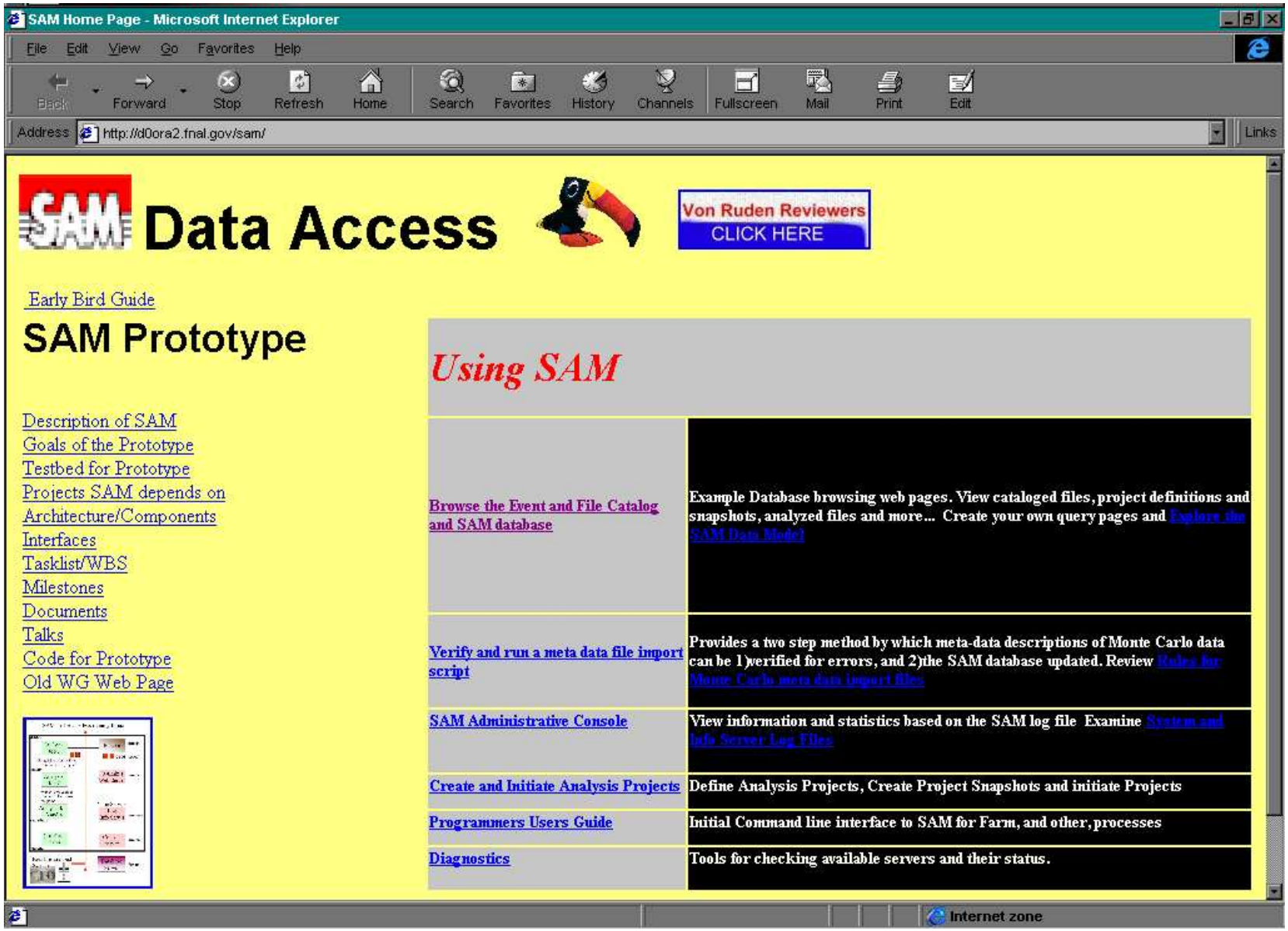
- Infrastructure
  - Production Database on a dedicated SUN server (D0ora1,2)
  - Database server
  - Log Server
  - Admin tools
- User Interfaces
  - Project definition user tools
  - Database browsing
  - Project Master
  - Data storage & delivery via command line interface
  - Overview and users' Guide
- Data availability and test platforms
  - Data: MCC 99 phase I - generated, digitized and reconstructed data
  - Platforms: SAM test bed, Test farms, d02ka

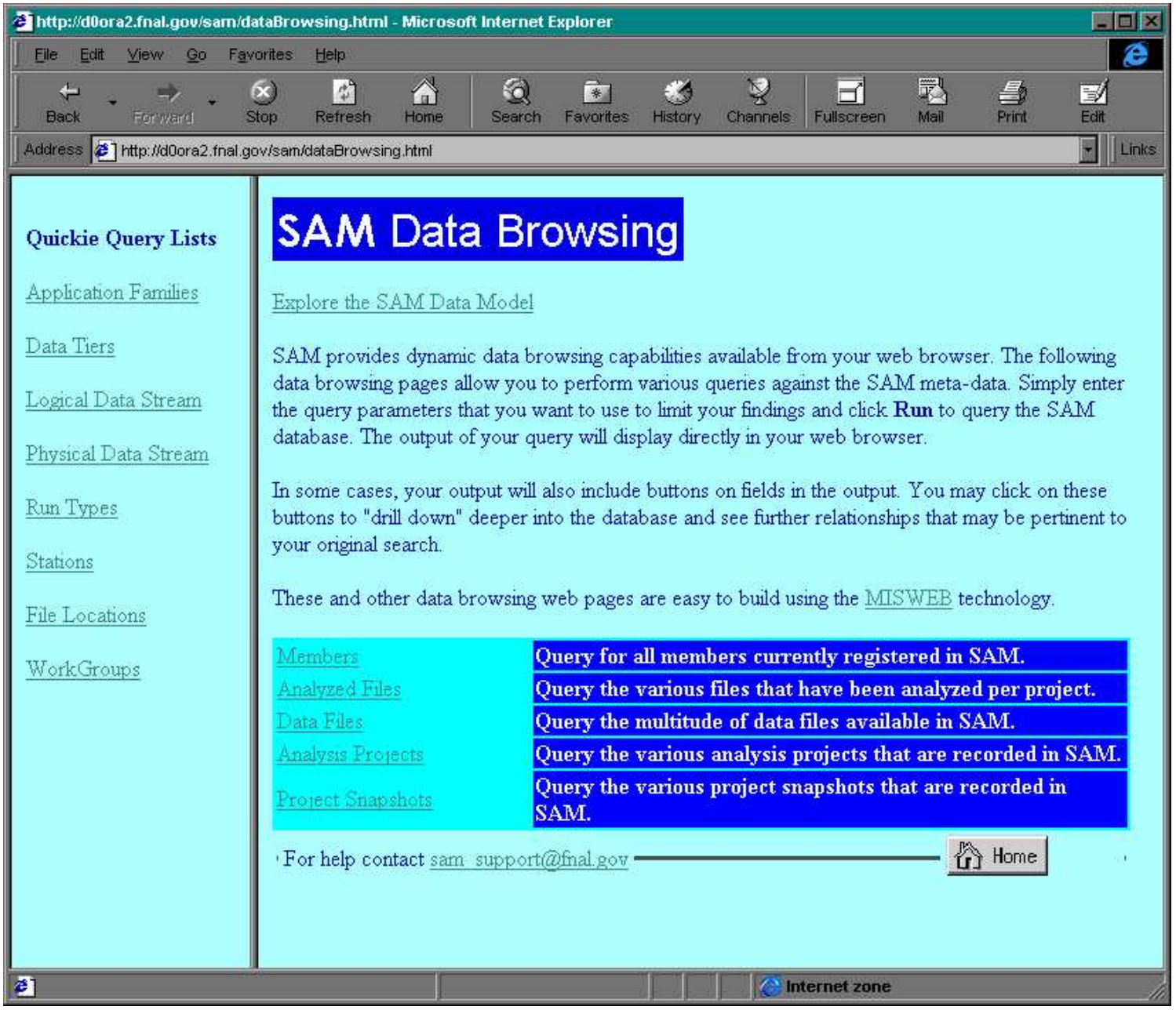
Oct 99: SAM V1.0 Features

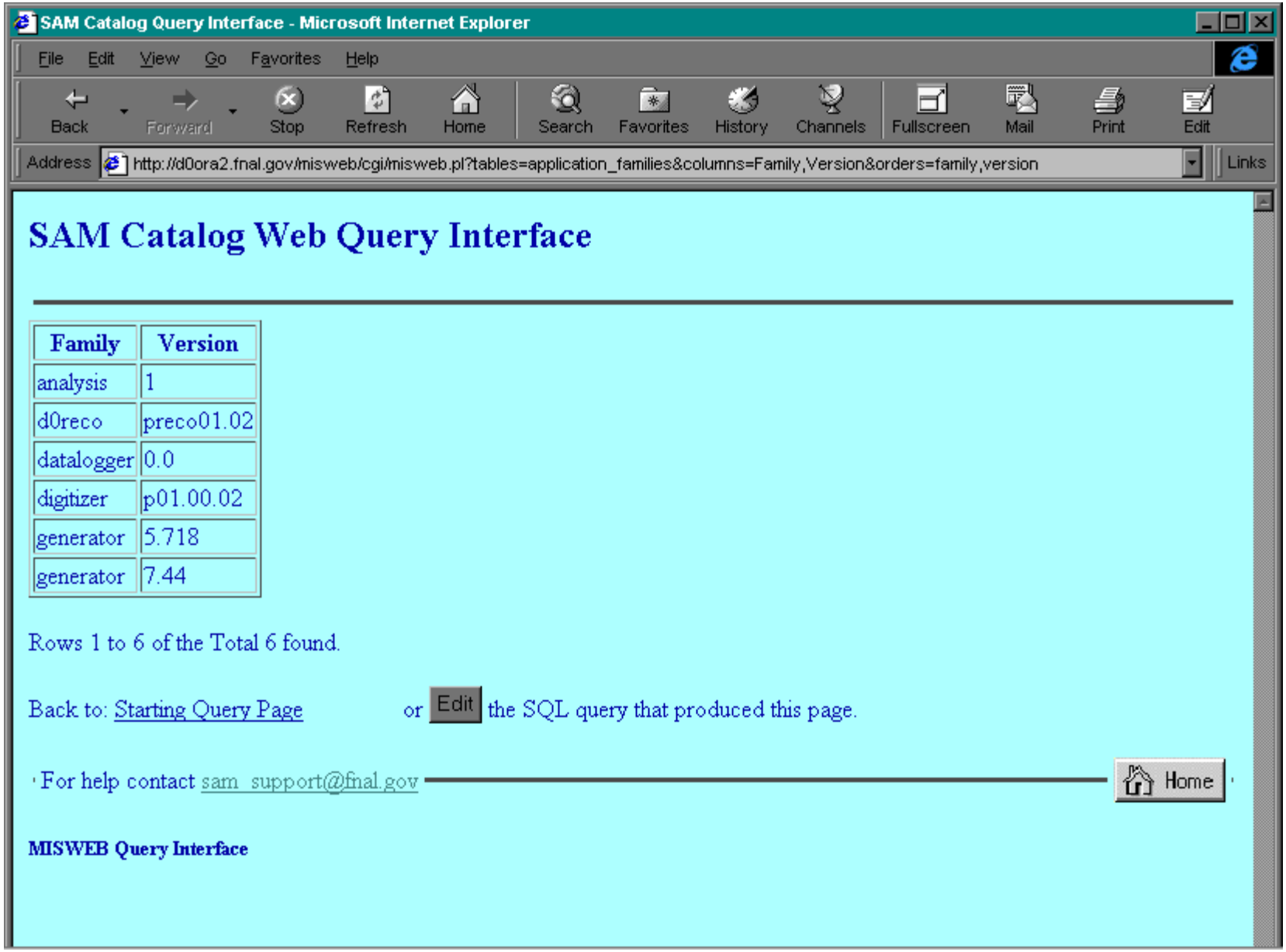
- Sam manager integrated with D0 Framework
- Additional data input support
  - On-line data logger,
  - User or production processed file,
  - Monte Carlo files
- File Storage Server
- Event Catalog loading and use
- File preferred locations function
- Python scripts for launching user applications

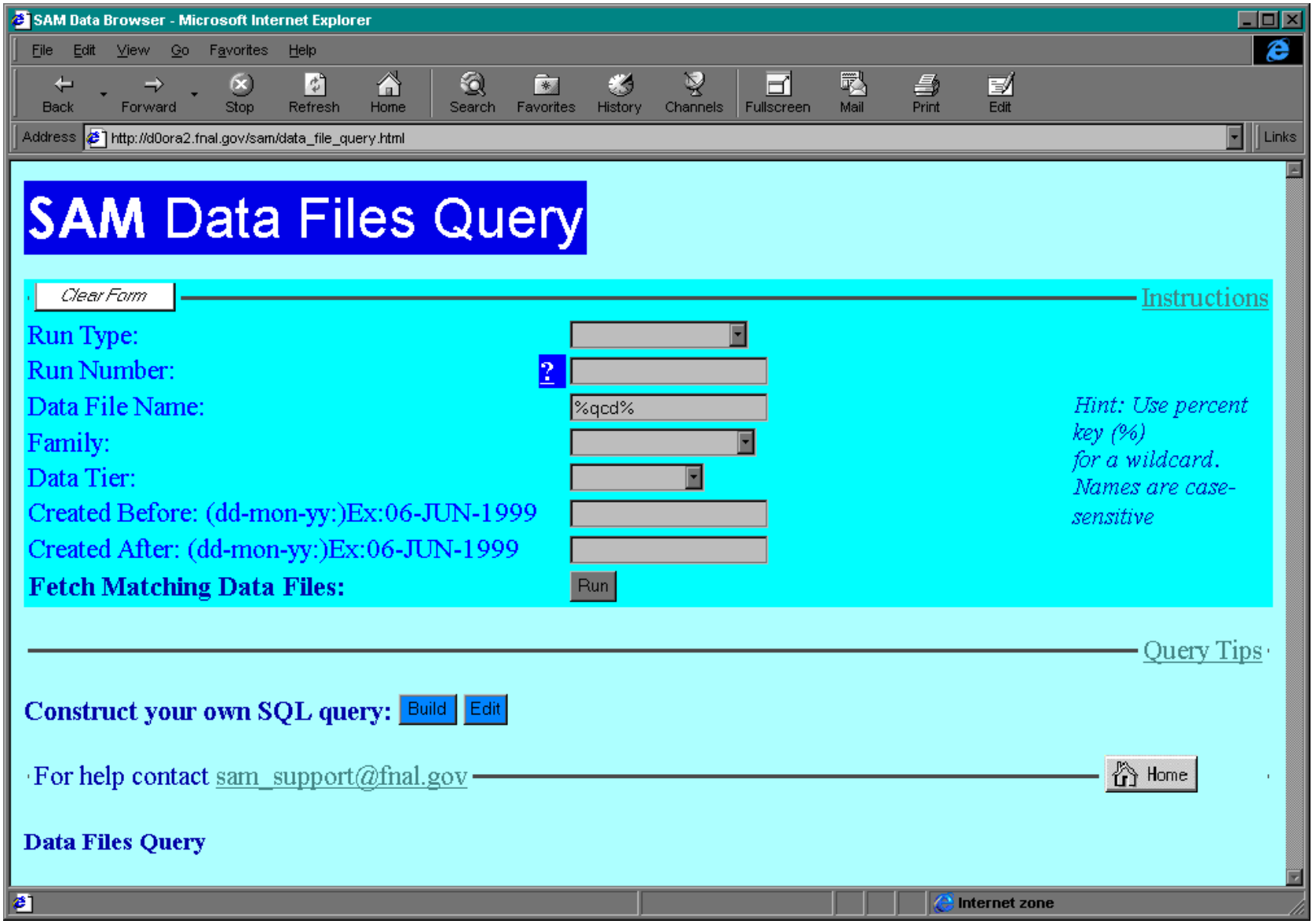
SAM V1.0 Features (cont.)

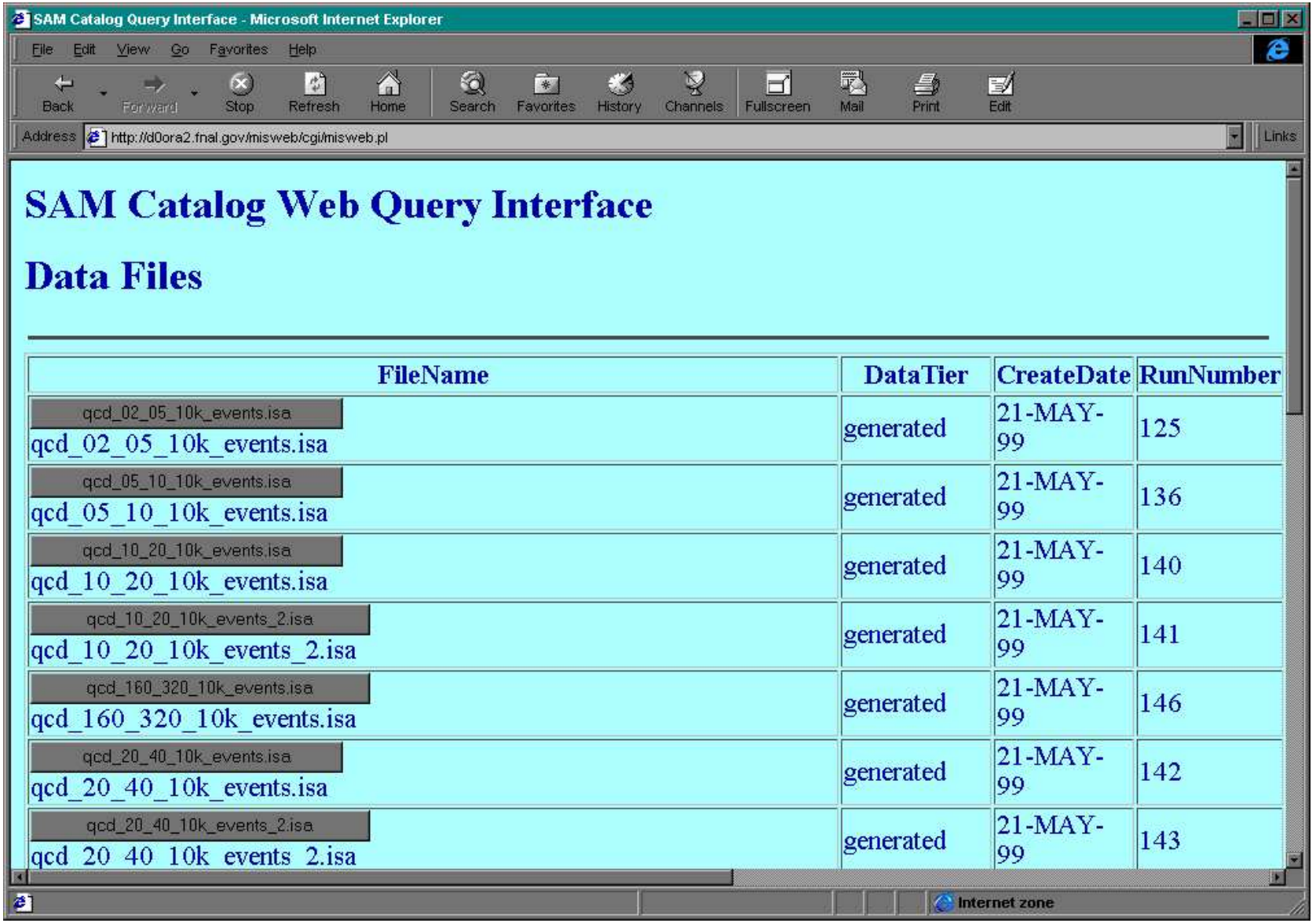
- Enhanced Database Server features
- Project tools with web-based GUI
- System monitoring tool

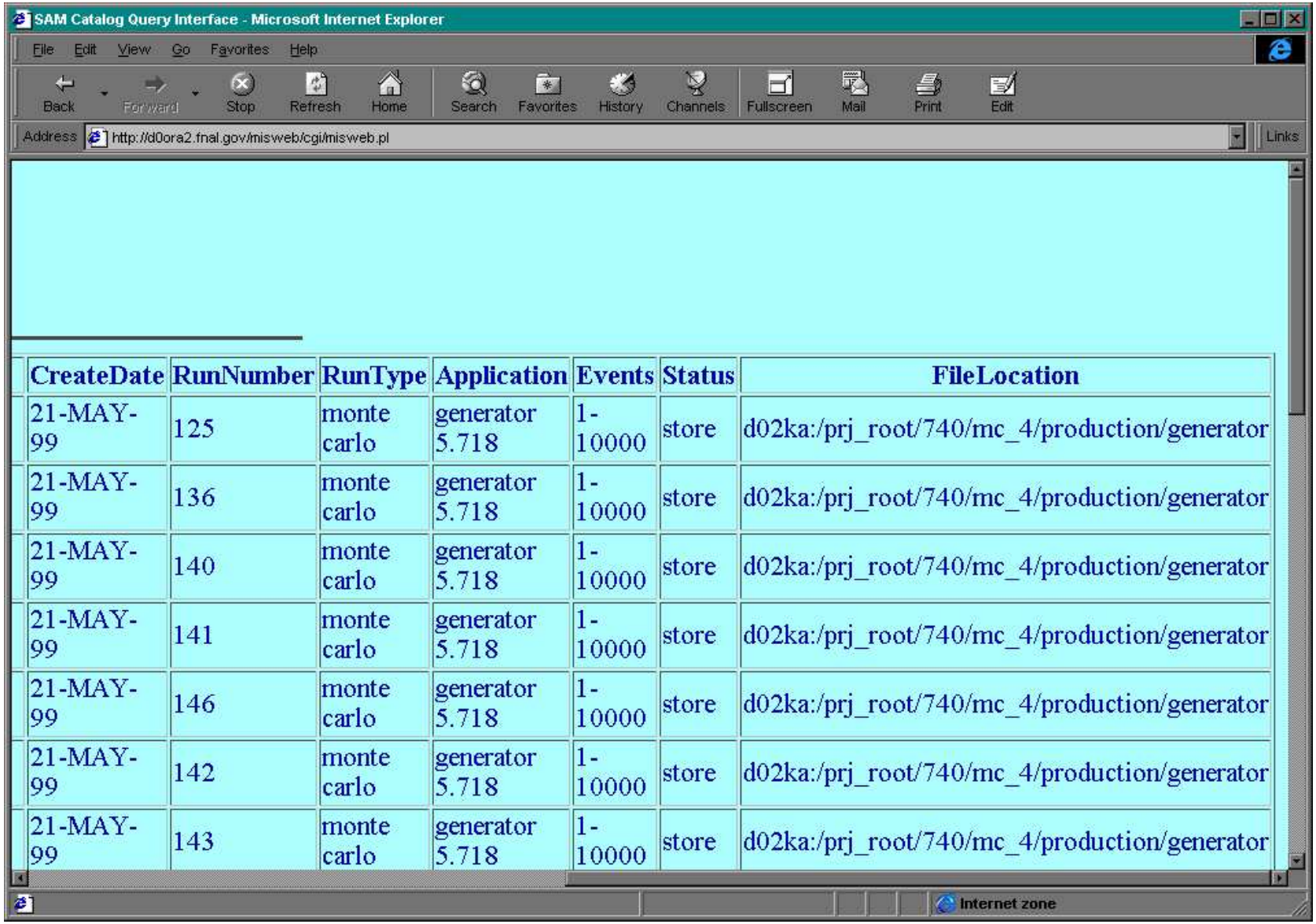

SAM Home Page - Microsoft Internet Explorer
File Edit View Go Favorites Help
Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit
Address http://d0ora2.fnal.gov/sam/
Links
Data Access
Von Ruden Reviewers
CLICK HERE
Early Bird Guide
SAM Prototype
Description of SAM
Goals of the Prototype
Testbed for Prototype
Projects SAM depends on
Architecture/Components
Interfaces
Tasklist/WBS
Milestones
Documents
Talks
Code for Prototype
Old WG Web Page
Using SAM
Browse the Event and File Catalog and SAM database
Example Database browsing web pages. View cataloged files, project definitions and snapshots, analyzed files and more... Create your own query pages and Explore the SAM Data Model
Verify and run a meta data file import script
Provides a two step method by which meta-data descriptions of Monte Carlo data can be 1)verified for errors, and 2)the SAM database updated. Review Rules for Monte Carlo meta data import files
SAM Administrative Console
View information and statistics based on the SAM log file Examine System and Info Server Log Files
Create and Initiate Analysis Projects
Define Analysis Projects, Create Project Snapshots and initiate Projects
Programmers Users Guide
Initial Command line interface to SAM for Farm, and other, processes
Diagnostics
Tools for checking available servers and their status.
Internet zone


http://d0ora2.fnal.gov/sam/dataBrowsing.html - Microsoft Internet Explorer
File Edit View Go Favorites Help
Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit
Address http://d0ora2.fnal.gov/sam/dataBrowsing.html
Links
Quickie Query Lists
Application Families
Data Tiers
Logical Data Stream
Physical Data Stream
Run Types
Stations
File Locations
WorkGroups
SAM Data Browsing
Explore the SAM Data Model
SAM provides dynamic data browsing capabilities available from your web browser. The following data browsing pages allow you to perform various queries against the SAM meta-data. Simply enter the query parameters that you want to use to limit your findings and click Run to query the SAM database. The output of your query will display directly in your web browser.
In some cases, your output will also include buttons on fields in the output. You may click on these buttons to "drill down" deeper into the database and see further relationships that may be pertinent to your original search.
These and other data browsing web pages are easy to build using the MISWEB technology.
Members
Query for all members currently registered in SAM.
Analyzed Files
Query the various files that have been analyzed per project.
Data Files
Query the multitude of data files available in SAM.
Analysis Projects
Query the various analysis projects that are recorded in SAM.
Project Snapshots
Query the various project snapshots that are recorded in SAM.
For help contact sam_support@fnal.gov
Home
Internet zone


SAM Catalog Query Interface - Microsoft Internet Explorer
File Edit View Go Favorites Help
Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit
Address http://d0ora2.fnal.gov/misweb/cgi/misweb.pl?tables=application_families&columns=Family,Version&orders=family,version
Links
SAM Catalog Web Query Interface
Family Version
analysis 1
d0reco preco01.02
datalogger 0.0
digitizer p01.00.02
generator 5.718
generator 7.44
Rows 1 to 6 of the Total 6 found.
Back to: Starting Query Page or Edit the SQL query that produced this page.
For help contact sam_support@fnal.gov
Home
MISWEB Query Interface

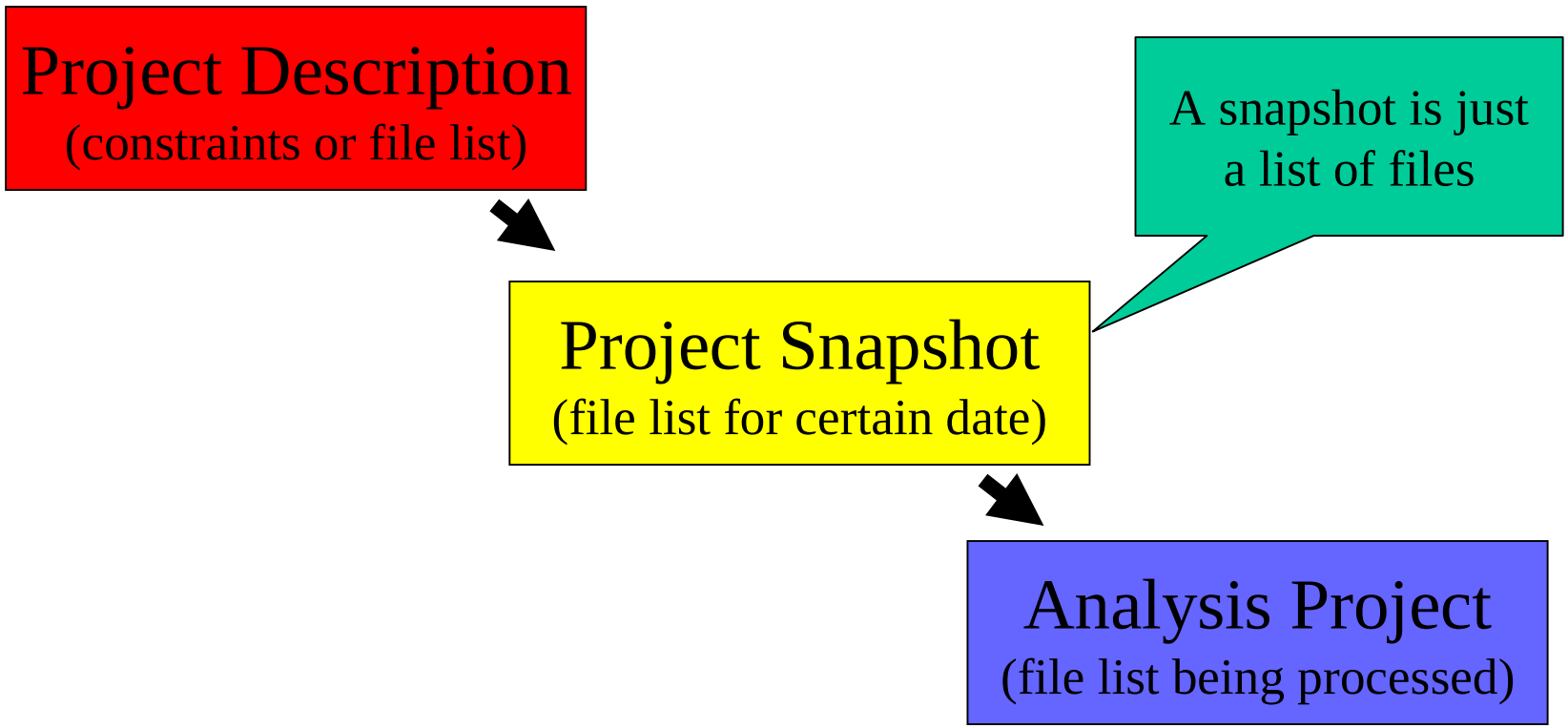

SAM Data Browser - Microsoft Internet Explorer
File Edit View Go Favorites Help
Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit
Address http://d0ora2.fnal.gov/sam/data_file_query.html
Links
SAM Data Files Query
Clear Form
Instructions
Run Type:
Run Number:
Data File Name:
%qcd%
Family:
Data Tier:
Created Before: (dd-mon-yy:)Ex:06-JUN-1999
Created After: (dd-mon-yy:)Ex:06-JUN-1999
Fetch Matching Data Files:
Run
Hint: Use percent key (%) for a wildcard. Names are case-sensitive
Query Tips
Construct your own SQL query:
Build
Edit
For help contact sam_support@fnal.gov
Home
Data Files Query
Internet zone


SAM Catalog Query Interface - Microsoft Internet Explorer
File Edit View Go Favorites Help
Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit
Address http://d0ora2.fnal.gov/misweb/cgi/misweb.pl
Links
SAM Catalog Web Query Interface
Data Files
FileName
DataTier
CreateDate
RunNumber
qcd_02_05_10k_events.isa
qcd_02_05_10k_events.isa
generated
21-MAY-99
125
qcd_05_10_10k_events.isa
qcd_05_10_10k_events.isa
generated
21-MAY-99
136
qcd_10_20_10k_events.isa
qcd_10_20_10k_events.isa
generated
21-MAY-99
140
qcd_10_20_10k_events_2.isa
qcd_10_20_10k_events_2.isa
generated
21-MAY-99
141
qcd_160_320_10k_events.isa
qcd_160_320_10k_events.isa
generated
21-MAY-99
146
qcd_20_40_10k_events.isa
qcd_20_40_10k_events.isa
generated
21-MAY-99
142
qcd_20_40_10k_events_2.isa
qcd_20_40_10k_events_2.isa
generated
21-MAY-99
143
Internet zone



CreateDate	RunNumber	RunType	Application	Events	Status	FileLocation
21-MAY-99	125	monte carlo	generator 5.718	1-10000	store	d02ka:/prj_root/740/mc_4/production/generator
21-MAY-99	136	monte carlo	generator 5.718	1-10000	store	d02ka:/prj_root/740/mc_4/production/generator
21-MAY-99	140	monte carlo	generator 5.718	1-10000	store	d02ka:/prj_root/740/mc_4/production/generator
21-MAY-99	141	monte carlo	generator 5.718	1-10000	store	d02ka:/prj_root/740/mc_4/production/generator
21-MAY-99	146	monte carlo	generator 5.718	1-10000	store	d02ka:/prj_root/740/mc_4/production/generator
21-MAY-99	142	monte carlo	generator 5.718	1-10000	store	d02ka:/prj_root/740/mc_4/production/generator
21-MAY-99	143	monte carlo	generator 5.718	1-10000	store	d02ka:/prj_root/740/mc_4/production/generator

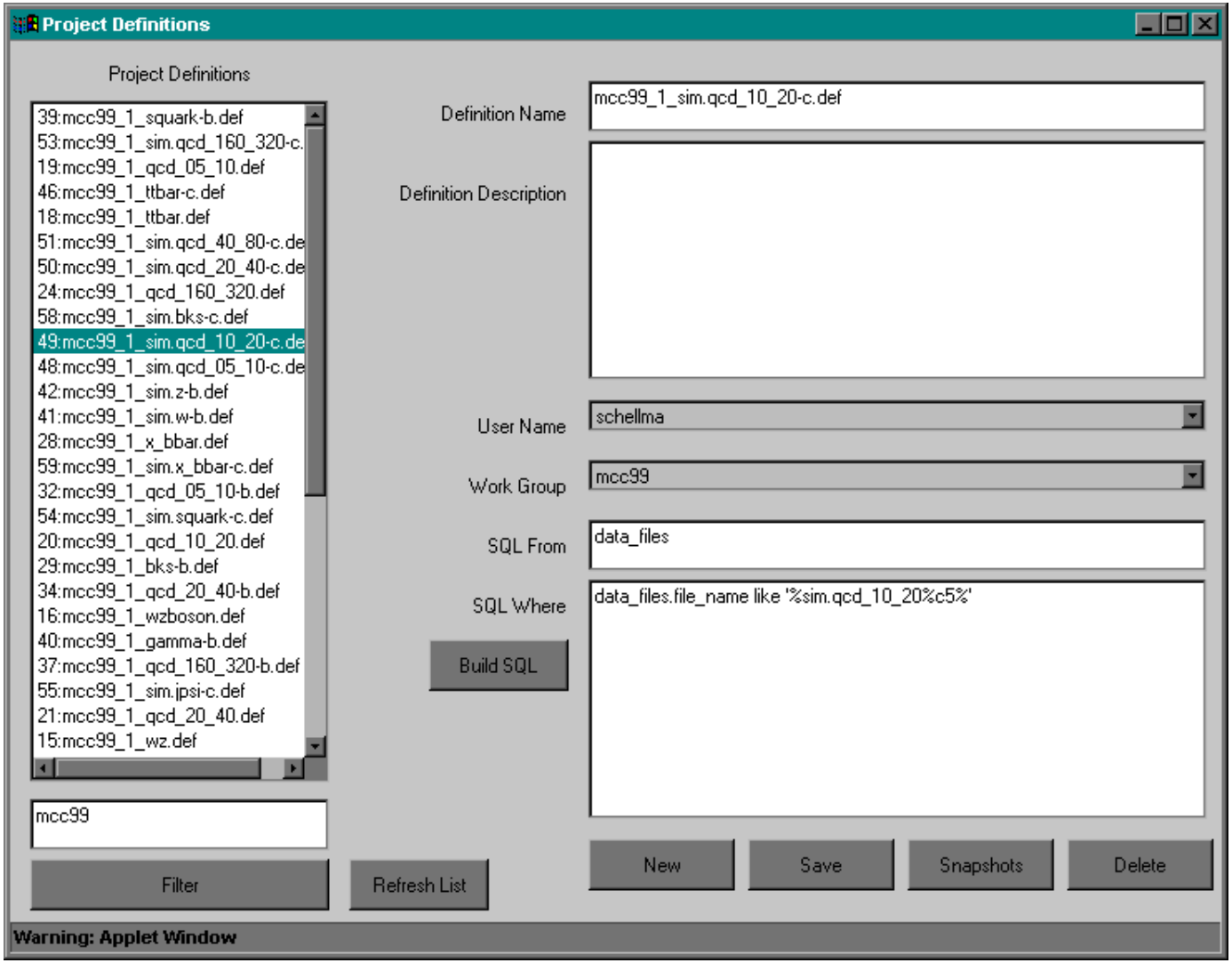
The Life of a Project



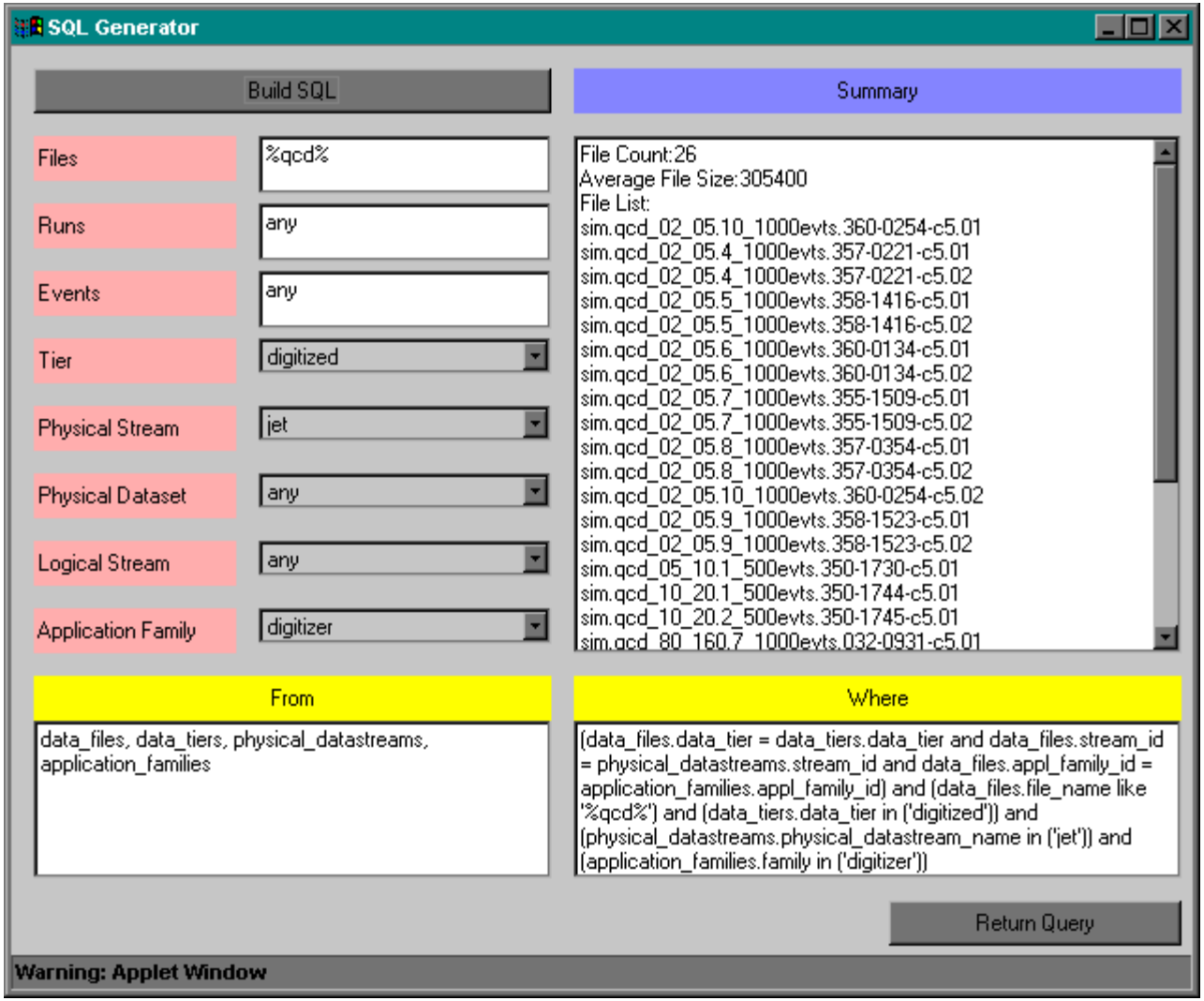
Creating Projects

- Command Line Interface
  - translate constraints
  - resolve query
  - create definition
  - create snapshot
  - create analysis project
- Graphical User Interface
  - Same functionality as CLI
  - Easier for new users to get started
  - Based on Java 2, must use recent ie (5.0.1) or Netscape (4.5) browsers.

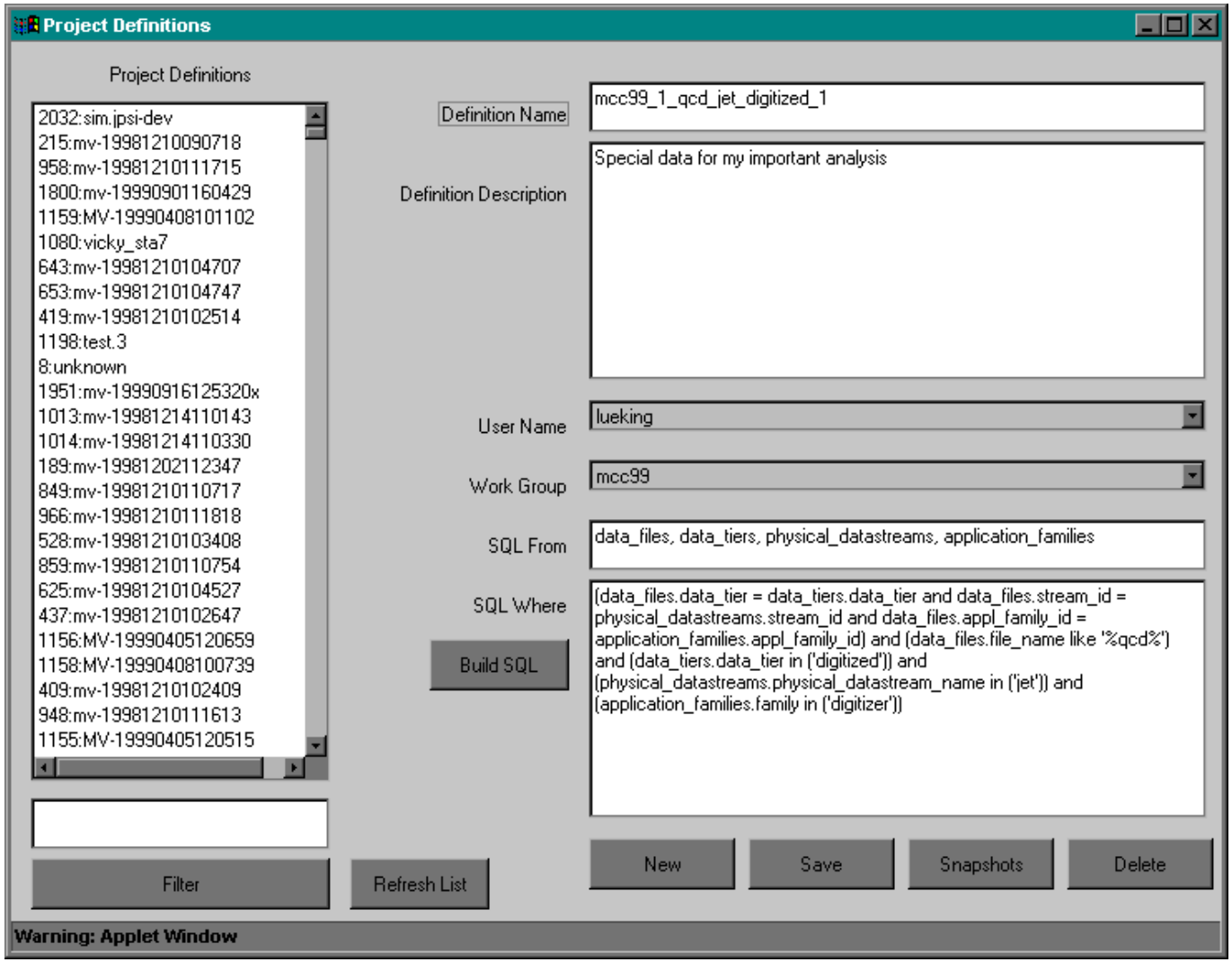
Defining a Project



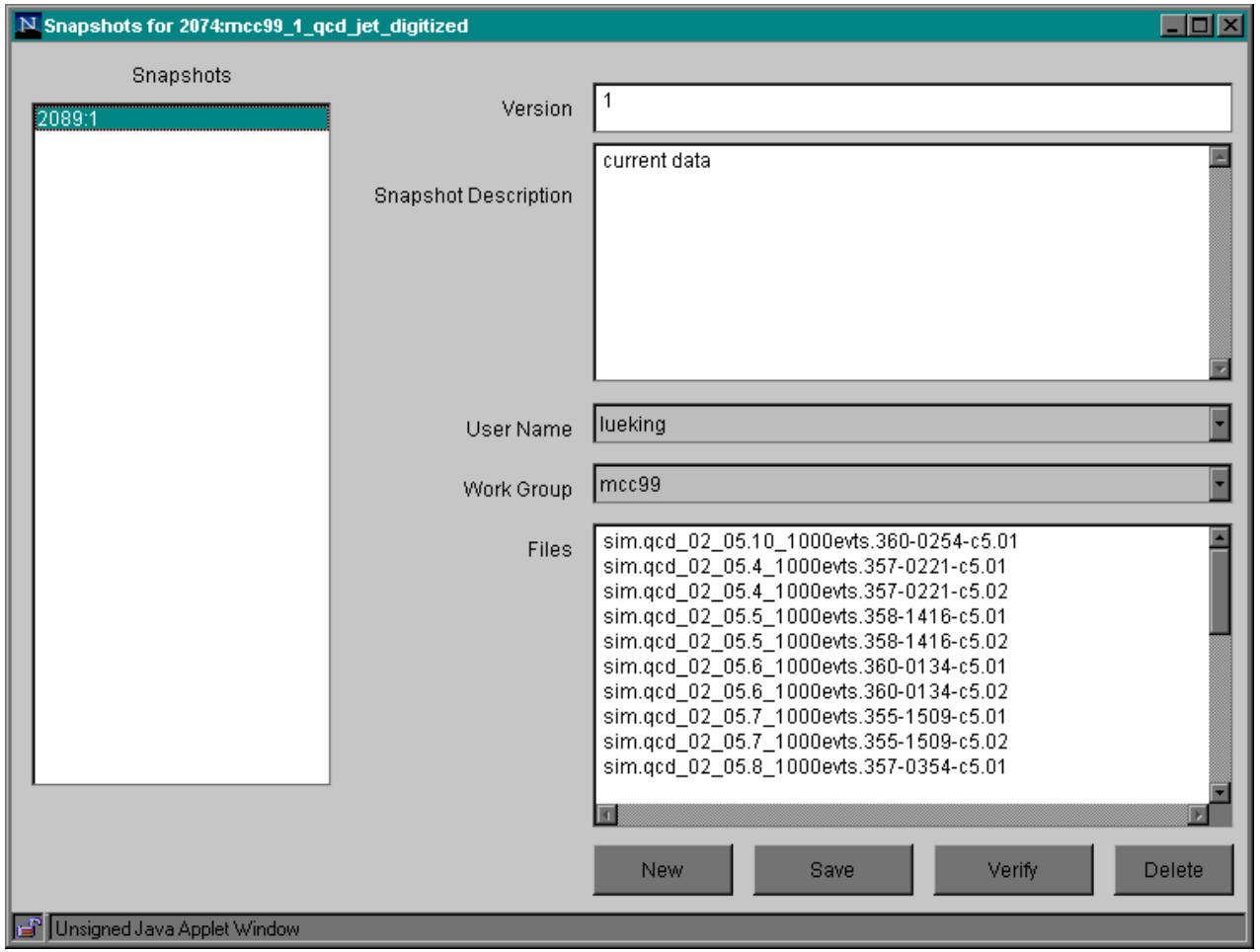
Constraint to SQL Helper



Creating New Definition



Making a Snapshot



Analyzing Projects: Getting Started

1.Project "**mcc99_1_ttbar**" exists at the station "d02ka".

2.Define station and project.

```
shell$ export SAM_STATION=d02ka
shell$ export SAM_PROJECT=mcc99_1_ttbar
```

3. Start the project master.

```
shell$ sam start project
```

4. Start a stager, if files are at remote location

```
shell$ sam start stager  --rtfile=pid_file
```

5. Connect the stager to project master

```
shell$ sam add stager --pid=`cat pid_file`
```

Analyzing Projects: File Delivery

1. To start a consumer and consumer process:

```
shell$ sam start consumer --appfamily=d0reco --version=3.1415925
        --group=mcc99 --rtfile=cid_file
shell$ sam start process --cid=`cut -f -d' '  cid_file` --rtfile=cpid_file
```

2.To request next file from the project set:

```
shell$ sam get next file --cid =` cut -f -d' '  cid_file ` \
--cpid=`cat cpid_file`  --rtfile=fname_file
```

3. The user code processes the file in *fname_file* and loops over this command until "END OF STREAM" is found in *fname_file* .

4. Inform the project master consumer is done with the file

```
shell$ sam release --file=`cat fname_file` --status={ok|error} \
--cid=`cut -f -d' '  cid_file ` --cpid= =`cat cpid_file`
```

5. Loop back to 2.

Analyzing Projects: Finishing Up

1. To stop the running project master:
   shell$ sam stop project

2. The user can request the consumer statistics :
   shell$ sam dump consumer --cid=‘cat cid_file’.

The output will contain the number of files in the project, the number of files consumed/not consumed etc. In the future, we plan to display CPU usage per file (or per event) and other useful statistics.

✓PYTHON example program is available, and should be easier to use

✓D0Framework SamManager interface will be available in October release

File Store Server

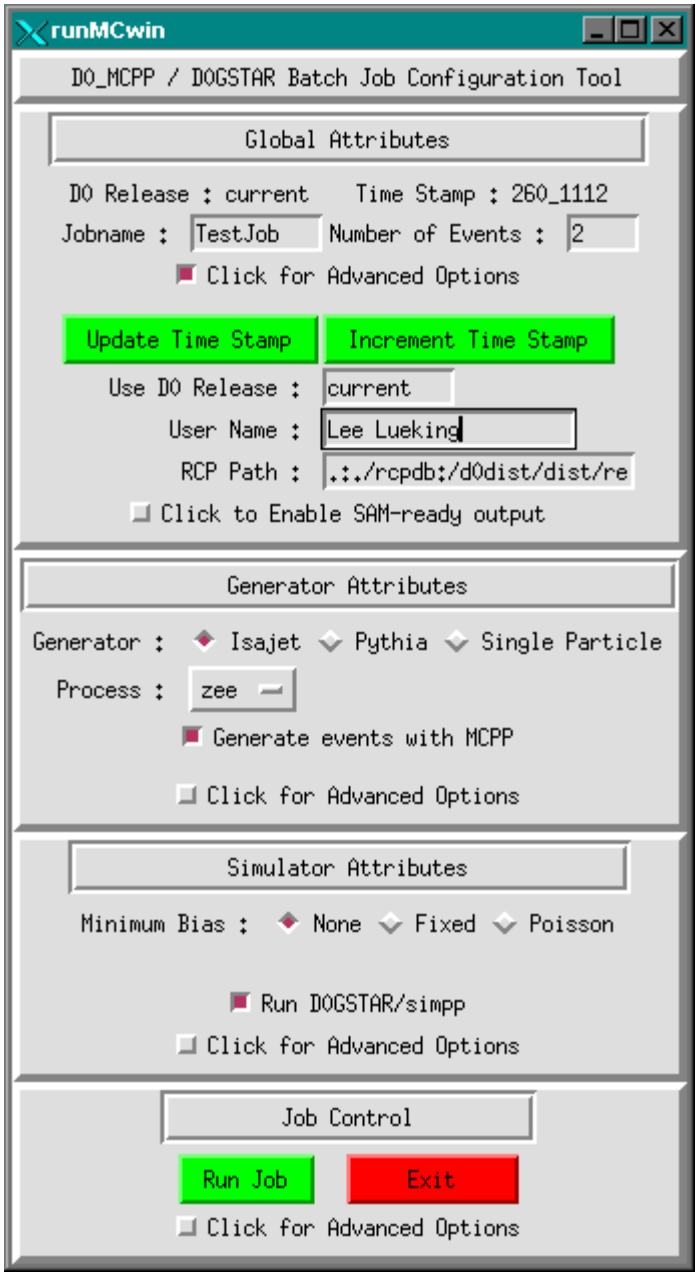
- Files are stored into sam using the File Storage Server
  - Command :

    sam store --descrip=meta_data_file --source=source_directory --destination=destination_directory
  - Meta_data_file:
  - from import_classes import *

    TheFile = ReconstructedFile(name='fifo.ace',
    size=12345,events=Events(1, 100, 70), tier='reconstructed',
    start_time='08/01/1998 17:00:00', end_time='08/01/1998 18:00:00',
    parent_name='ssh-kurino')
  - Metadata formats for data logger, MC data, etc.

Adding data to SAM: MC example

- Greg Graham has created Python GUI tool which helps with MC processing
- Automatically generates the metadata files to put data into the SAM system
- Can use
  - sam store … for FNAL data
  - sam declare … for data shipped to us on tape
- More info at:
  http://www-d0.fnal.gov/~ggraham/mc_runjob.html



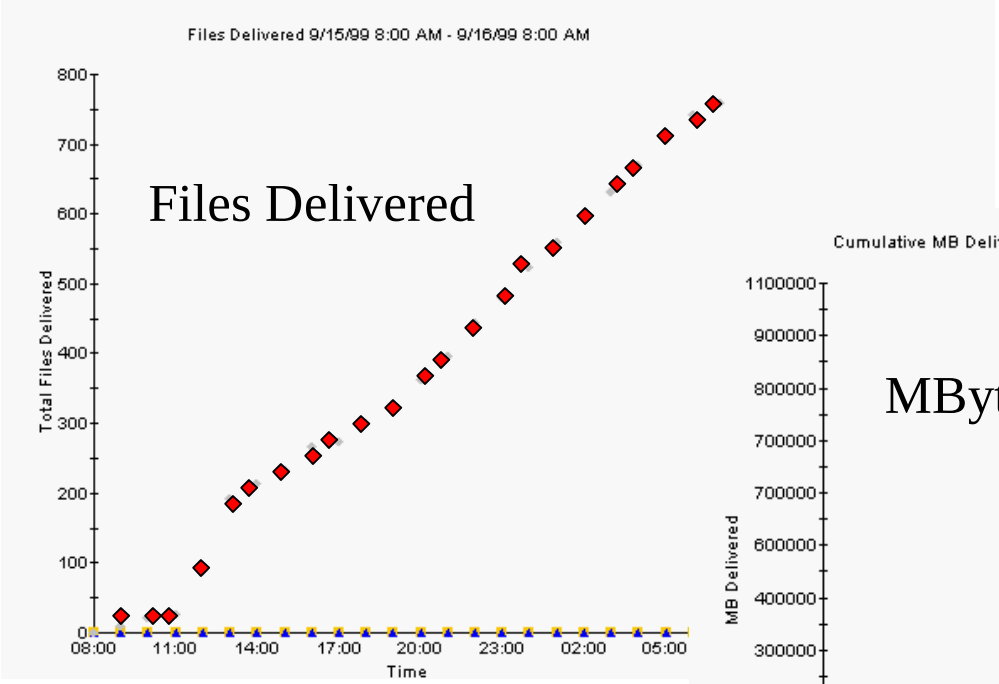
Early Bird Users

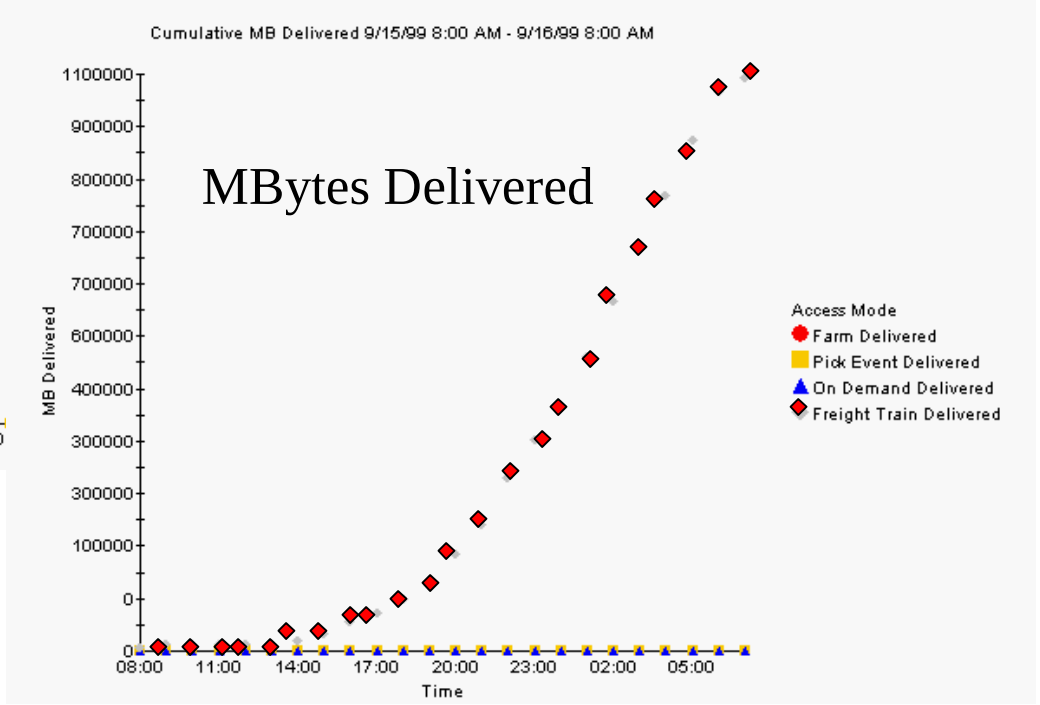
- The system has been used over the summer for data processing on the proto-farm.
- Introduce the system to new users in early summer. Received good user feedback.
- Working toward setting up analysis of MCC99 data on d02ka.
- Learning what users really want and need.

Progress and Experience to Date

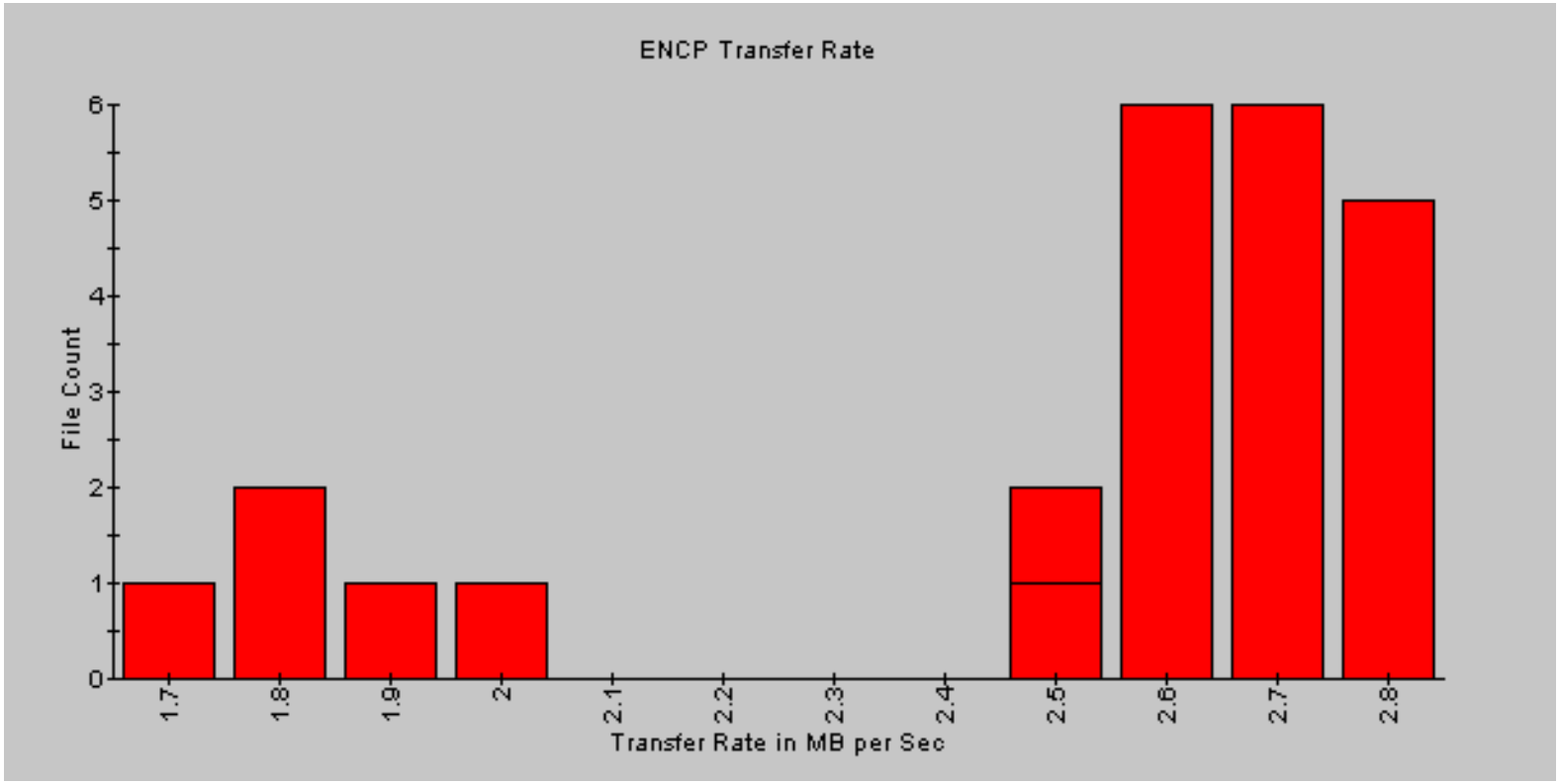
- Integration testing using D02ka, D0 Robot, Enstore system, SAM cluster, prototype farm over the summer
- Enstore is working and is becoming more reliable.
- Through SAM, able to transparently access MCC99 data.
  - d02ka disk, (200 GB)
  - Samson disk (sam cluster enstore robot emulator, 36 GB)
  - D0 Robot tape data
- Reconstruction processing on farm, using SAM projects to feed 4 farm nodes under the Farm Batch System.
- SAM is working on all strategic platforms (except DEC Unix).

SAM Integration Tests





SAM- Integration Tests



SAM- Integration Tests

Station Name	Project Name	Cnsmr Counts	Mode	Succ. File Xfers	Avg/ StdDev ENCP Latency	Avg/ StdDev File Size	Avg System Thruput	Inst. Thruput MB/Sec
d02ka	simple-test-1-9_99-22.53.15	0	Freight Train	1	711.49/1006.21	396.0/0.0	0.110	2.631
d02ka	simple-test-1-9_99-04.12.33	0	Freight Train	1	1035.67/1464.66	347.0/0.0	0.097	2.696
d02ka	simple-test-1-9_99-00.56.26	0	Freight Train	2	291.48/546.2	382.0/56.57	0.212	2.281
d02ka	simple-test-1-9_99-23.38.48	0	Freight Train	3	945.46/475.68	391.33/41.3	0.327	2.728
d02ka	simple-test-1-9_99-06.30.11	0	Freight Train	1	956.83/1353.16	344.0/0.0	0.095	2.62
d02ka	simple-test-1-9_99-09.32.19	0	Freight Train	2	372.33/644.89	205.0/289.91	0.114	2.809
d02ka	simple-test-1-9_99-02.31.24	0	Freight Train	2	376.89/78.23	358.0/55.15	0.199	2.694
d02ka	simple-test-3-9_99-04.38.59	0	Freight Train	3	488.74/576.12	568.33/126.06	0.473	2.736
d02ka	simple-test-1-9_99-01.16.52	0	Freight Train	1	275.55/389.69	410.0/0.0	0.114	2.035
d02ka	simple-test-1-9_99-06.10.35	0	Freight Train	1	1725.57/0.0	397.0/0.0	0.110	2.644
d02ka	simple-test-4-9_99-09.32.22	0	Freight Train	1	653.73/0.0	692.0/0.0	0.192	1.86
d02ka	simple-test-3-9_99-01.45.50	0	Freight Train	1	85.67/0.0	727.0/0.0	0.150	2.843
d02ka	simple-test-3-9_99-09.32.21	1	Freight Train	2	163.45/162.17	672.5/48.79	0.373	2.265
d02ka	simple-test-3-9_99-09.04.12	0	Freight Train	1	463.13/0.0	177.0/0.0	0.049	2.764
d02ka	simple-test-4-9_99-05.50.58	0	Freight Train	1	371.92/205.86	682.0/42.43	0.352	2.123
d02ka	simple-test-4-9_99-03.55.39	0	Freight Train	0	0.0/0.0	0.0/0.0	0	0
d02ka	simple-test-4-9_99-06.05.16	0	Freight Train	0	0.0/0.0	0.0/0.0	0	0
d02ka	simple-test-4-9_99-02.43.46	0	Freight Train	2	188.0/0.49	568.5/108.19	0.316	2.702
d02ka	simple-test-4-9_99-08.50.11	0	Freight Train	1	151.02/0.0	652.0/0.0	0.100	2.862
d02ka	simple-test-1-9_99-09.04.12	0	Freight Train	0	0.0/0.0	0.0/0.0	0	0
d02ka	simple-test-1-9_99-04.57.59	0	Freight Train	0	0.0/0.0	0.0/0.0	0	0

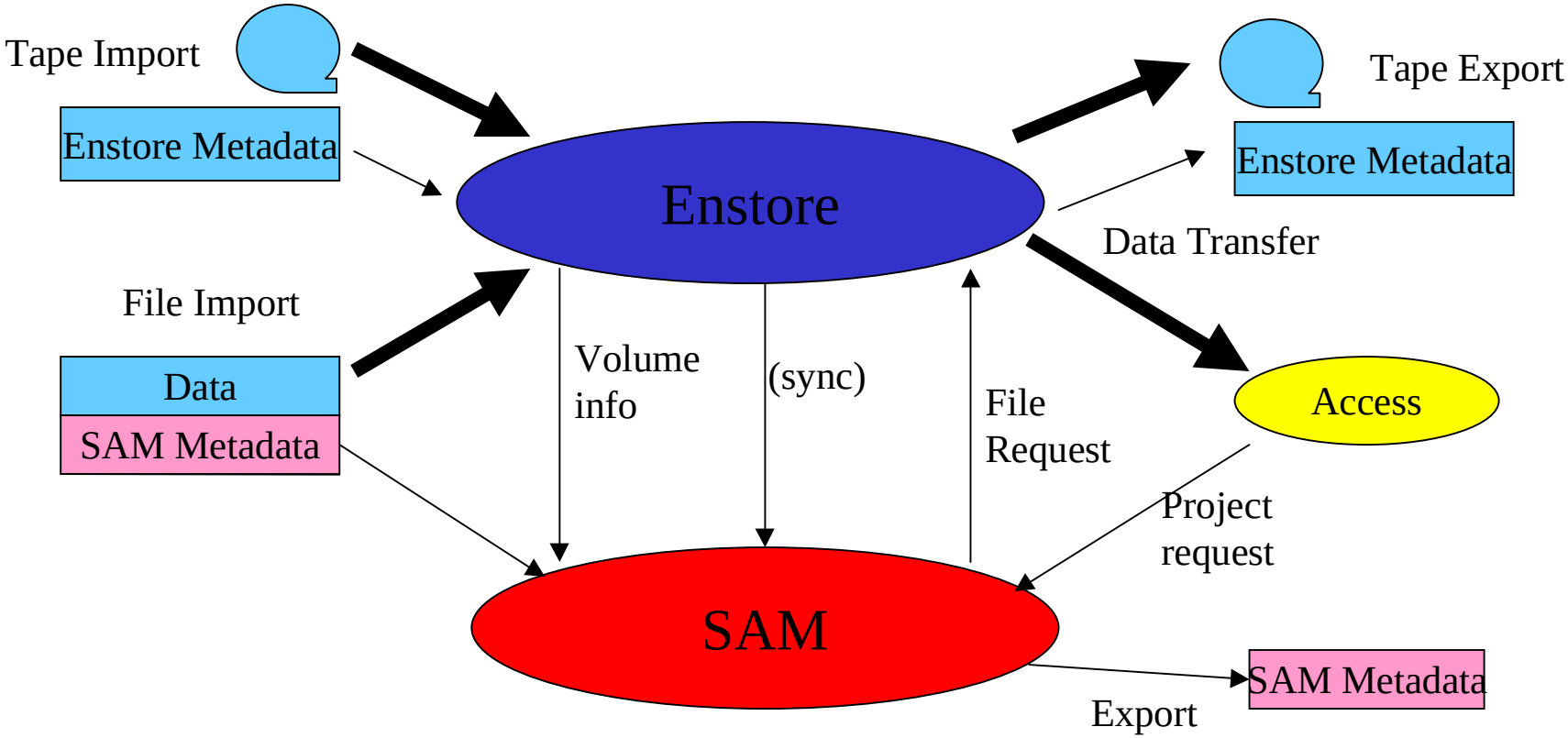
Data Exchange

- Small:(10 GB/week)
  - File transfers over network connection
  - File staging server for remote delivery
- Medium: (100 GB/week)
  - One or two tapes per week
  - By arrangement with FNAL
- Large: (more than 100 GB/week)
  - Many tapes per week
  - Tapes sent to FNAL can be placed directly into the d0robot, if properly formatted.
  - Tapes sent from FNAL will have “Enstore/D0 standard” format, unless otherwise arranged.

Enstore/D0 Tape Format

- Beginning:
  - ANSII Volume Header (VOL1, label, padding)
- Data Files
  - Data in cpio wrapper
  - 2 GB filesize limit
  - FILEMARK between files
- End:
  - EOT Volume header (if written by Enstore)
  - FILEMARK
  - FILEMARK
  - EOT Volume header (if written by enstore_tape)

Data Import/Access/Export



Enstore Tape Import/Export

- Remote users can create cpio formatted tapes which can be added directly to the FNAL Enstore system.
- Interface

```
enstore_tape init[--tape-device=devname] [--tape-db=dbdir] [--verbose] --
    volume-label=label

enstore_tape write [--tape-device=devname] [--tape-db=dbdir] [--verbose] --
    volume-label=label file_list [file_list ...]

enstore_tape flatten_db [dbname] | output_file

perscription for reading tapes using generally available GNU cpio
```

- More details at: rip8.fnal.gov/enstore/volume_import.html

Future Objectives

- Finish design and implementation for
  - Station
  - Optimizer
  - Interface to Batch System
- More work on event and file database.
- Import of MCC99 phase II data as it arrives.
- Thumbnail data access
- Pick Event access
- Better understanding of the use of luminosity data
- Data analysis accounting tools
- Archiving user/group “special data” files

Summary

- We are working closely with the Enstore group. They are providing reliable storage and access for our data in the d0 robot.
- A working version of SAM has been available since late spring 99. It has been tested on several platforms. Tried by early bird users.
- Many new features will be available with the Oct. 99 release which integrates the system more closely into the D0 framework.
- All of the MC Challenge Phase I & II data will be available through SAM.
- We have tape Import/Export features which will make data exchange with remote sites straightforward.
- Many new features are planned in the months ahead.
- We appreciate comments and suggestions from our user community.