Hall D Offline Software Performance and Status

12 GeV Software Review III
February 10, 2015
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High-Level Software Packages

Function	Package	"Locally" Grown?
Raw Data Format	EVIO	yes
Offline Data Format	HDDM (compressed XML, REST a variant)	yes
Geometry Specification	HDDS (an XML)	yes
Data Acquisition Framework	CODA	yes
Simulation Engine	GEANT 3	no
Event-Based Processing Framework	JANA	yes
Event Simulation and Event Reconstruction	sim-recon (sim: GEANT 3, recon: JANA)	yes
High-Level Event Analysis	Analysis Library (part of sim-recon)	yes
Histogramming, Fitting, etc.	ROOT	no
Amplitude Analysis (PWA)	AmpTools	yes

Low-Level Software Packages

Function	Package
XML Parsing	Xerces-C
Source Code Management	Subversion
Build System	SCons (some GNU Make)
Scripting	Python (some legacy Perl)
Database	MySQL/MariaDB and SQLite
Web Authoring	MediaWiki (mostly)
Data Transfer (WAN)	SRM, Globus Online

Computing Performance Example

Computing task times: assume a 10,000 core Haswell farm.

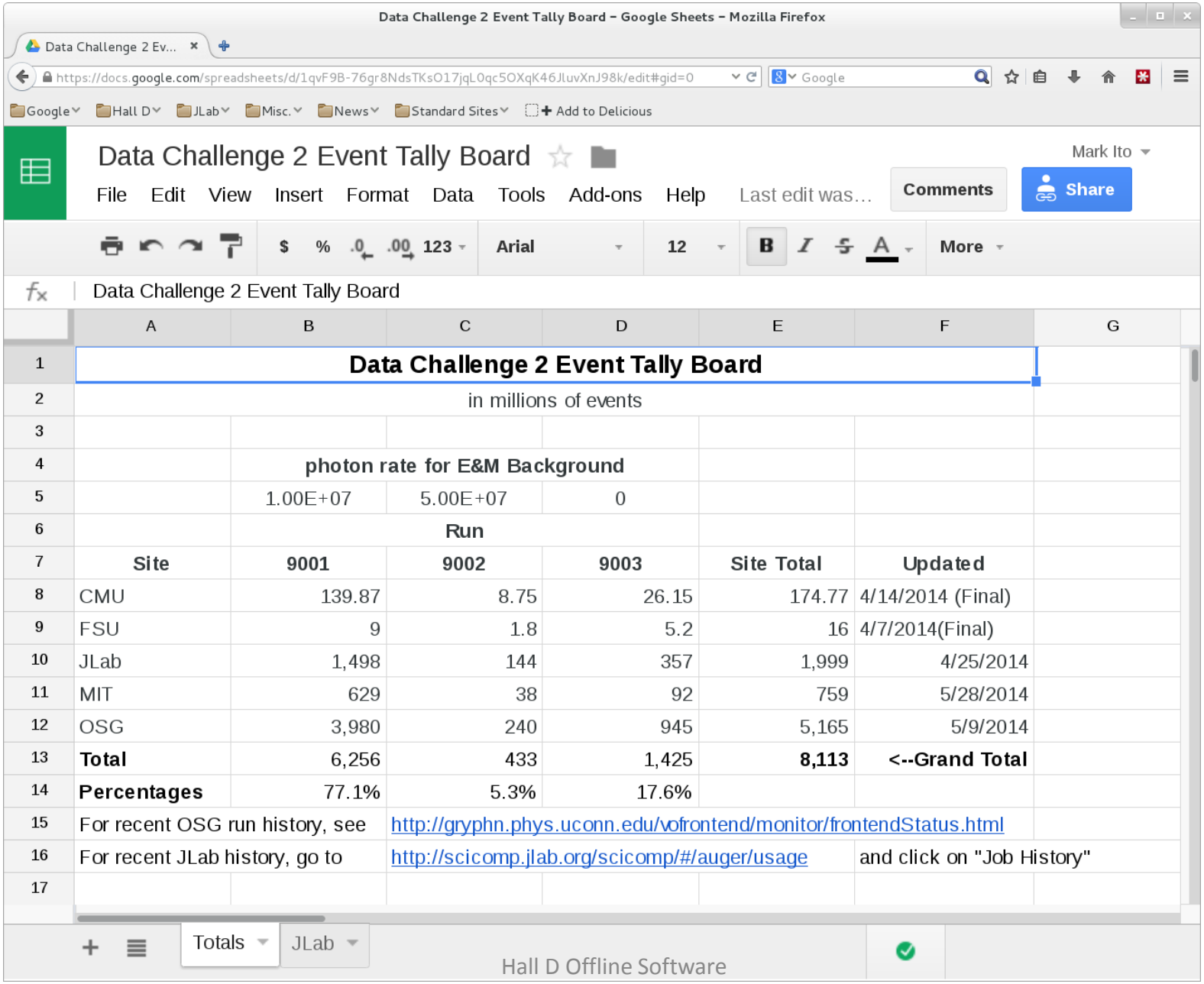
Fiscal Year	2015	2016	2017	2018	2019
Weeks of running	2	16	25	18	22
Trigger Rate (kHz)	2	20	20	20	20
Number of events (billions)	1.2	97	151	109	133
Reconstruction time (days)	0.06	5.1	8.0	5.7	7.0
Recon.+Sim. Time (days)	0.6	50.9	79.5	57.2	70.0
Total data to tape (PB)	0.05	4.0	6.3	4.5	5.6

Computing Requirements Discussion

- Number of cores needed reduced by a factor of 3 with new Haswell chip relative to assumption of last estimate.
- Running time per year has decreased
  - Peak of 25 weeks in FY17 vs. 35 weeks in last estimate.
- Simulated data creation time has gone up factor of 7 relative to reconstruction since last estimate.
  - Original estimate suspect
  - Experimental resolution inclusion: much slower now.
  - Improvement likely possible, unimproved number used.
- Commissioning data: event reconstruction rate 50% better than that on simulated data, but…
  - “junk” events not accounted for yet (event fraction, recon. rate)
  - Beam-spectrum/trigger not realistic (different center-of-mass energy)
  - Code base slightly different (for commissioning geometry, recent improvements)

Data Challenges (DCs)

- DC1 - December 2012/ January 2013
  - 5 billion Events - OSG, JLab, CMU
  - 1200 Concurrent Jobs at Jlab
  - Data produced used to support proposal for GlueX Phase IV running
- DC2 - March/April 2014
  - 10 billion events with EM backgrounds included - OSG, JLab, MIT, CMU, FSU
  - 4500 Concurrent Jobs at JLab
  - 11,000 Concurrent Jobs on the OSG
  - Well under 0.1% failure rate
- DC3 - January/February 2015
  - Read data in raw-event format (EVIO) from tape and produce DST format (REST) files.
  - JLab only
  - Test throughput from Tape Library
  - Run Multi-threaded jobs

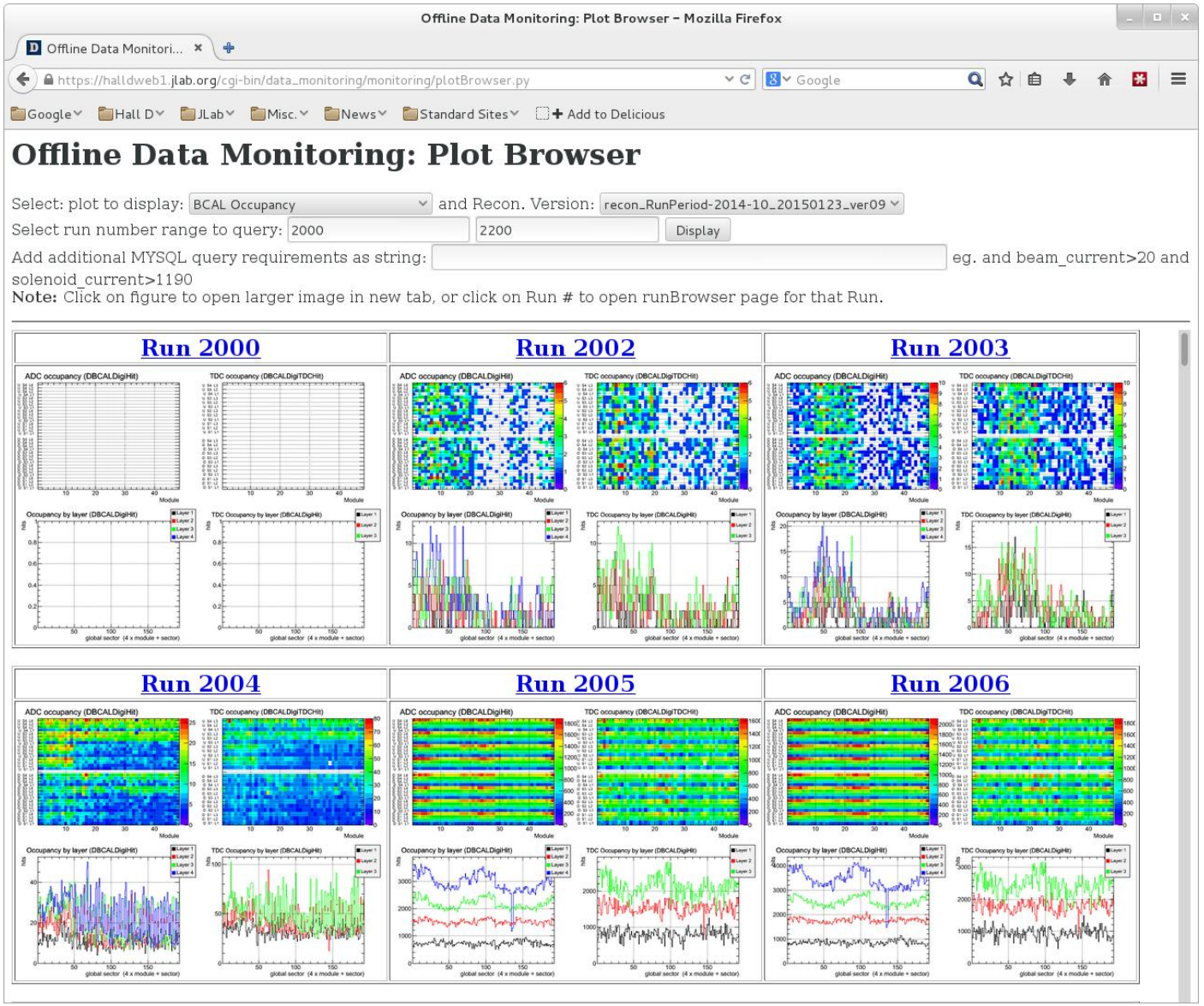


	A	B	C	D	E	F	G
1	**Data Challenge 2 Event Tally Board**						
2	in millions of events						
3							
4		**photon rate for E&M Background**					
5		1.00E+07	5.00E+07	0			
6		**Run**					
7	**Site**	**9001**	**9002**	**9003**	**Site Total**	**Updated**	
8	CMU	139.87	8.75	26.15	174.77	4/14/2014 (Final)	
9	FSU	9	1.8	5.2	16	4/7/2014(Final)	
10	JLab	1,498	144	357	1,999	4/25/2014	
11	MIT	629	38	92	759	5/28/2014	
12	OSG	3,980	240	945	5,165	5/9/2014	
13	**Total**	6,256	433	1,425	**8,113**	**<--Grand Total**	
14	**Percentages**	77.1%	5.3%	17.6%			
15	For recent OSG run history, see	http://gryphn.phys.uconn.edu/vofrontend/monitor/frontendStatus.html					
16	For recent JLab history, go to	http://scicomp.jlab.org/scicomp/#/auger/usage				and click on "Job History"	
17							

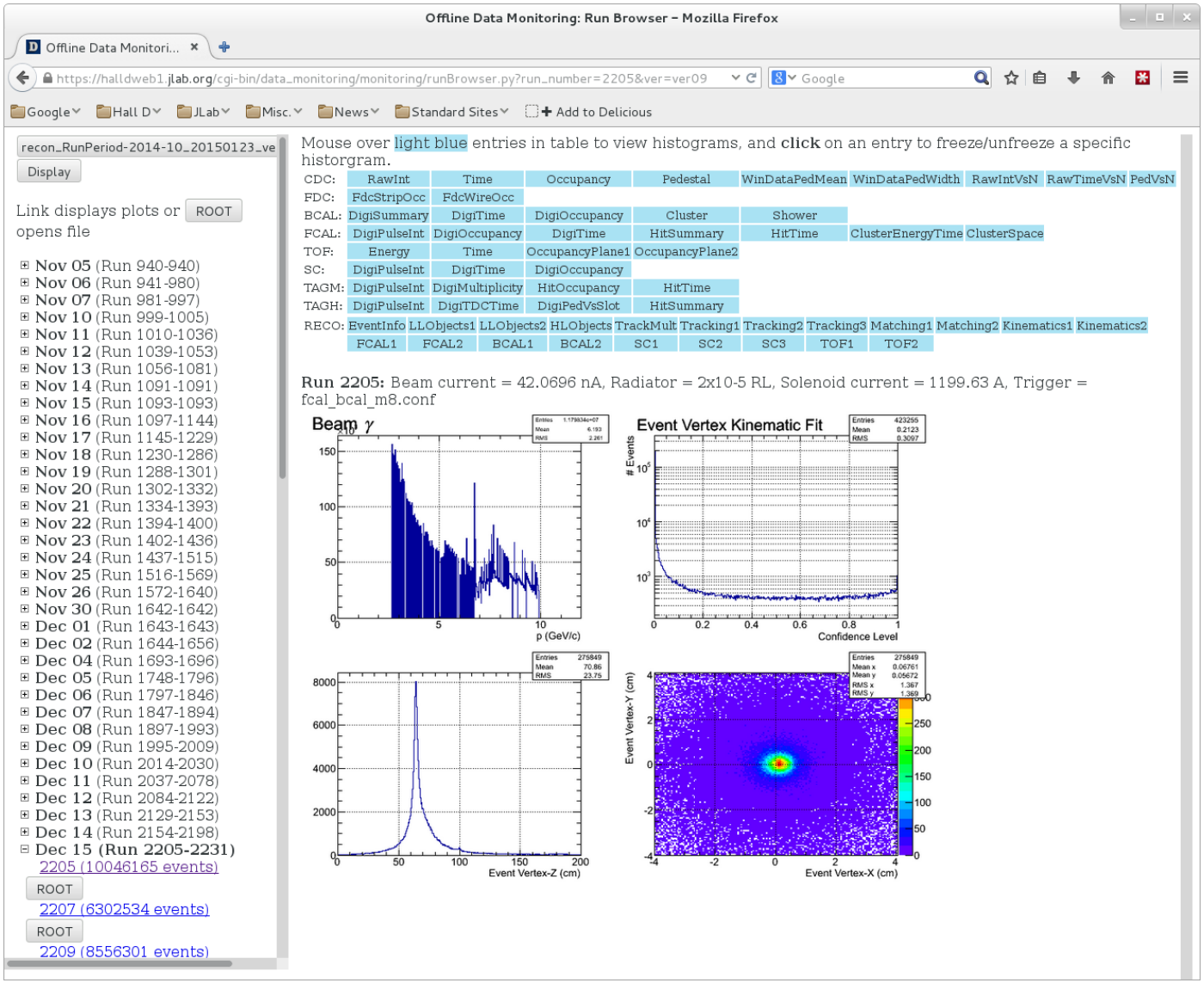
Offline Monitoring

- Weekly reconstruction pass through data
  - All data as of Friday afternoon
  - Online monitoring plots reproduced
  - Full reconstruction with updated code and constants
  - Skims of raw events done for calibration
  - DST data produced (REST format)
- Web site for browsing results
- REST data good enough to observe multi-particle final states
- Continuing on a bi-weekly schedule
- Paul Mattione (CMU), Kei Moriya (ASU), Justin Stevens (MIT), Sean Dobbs (NU)

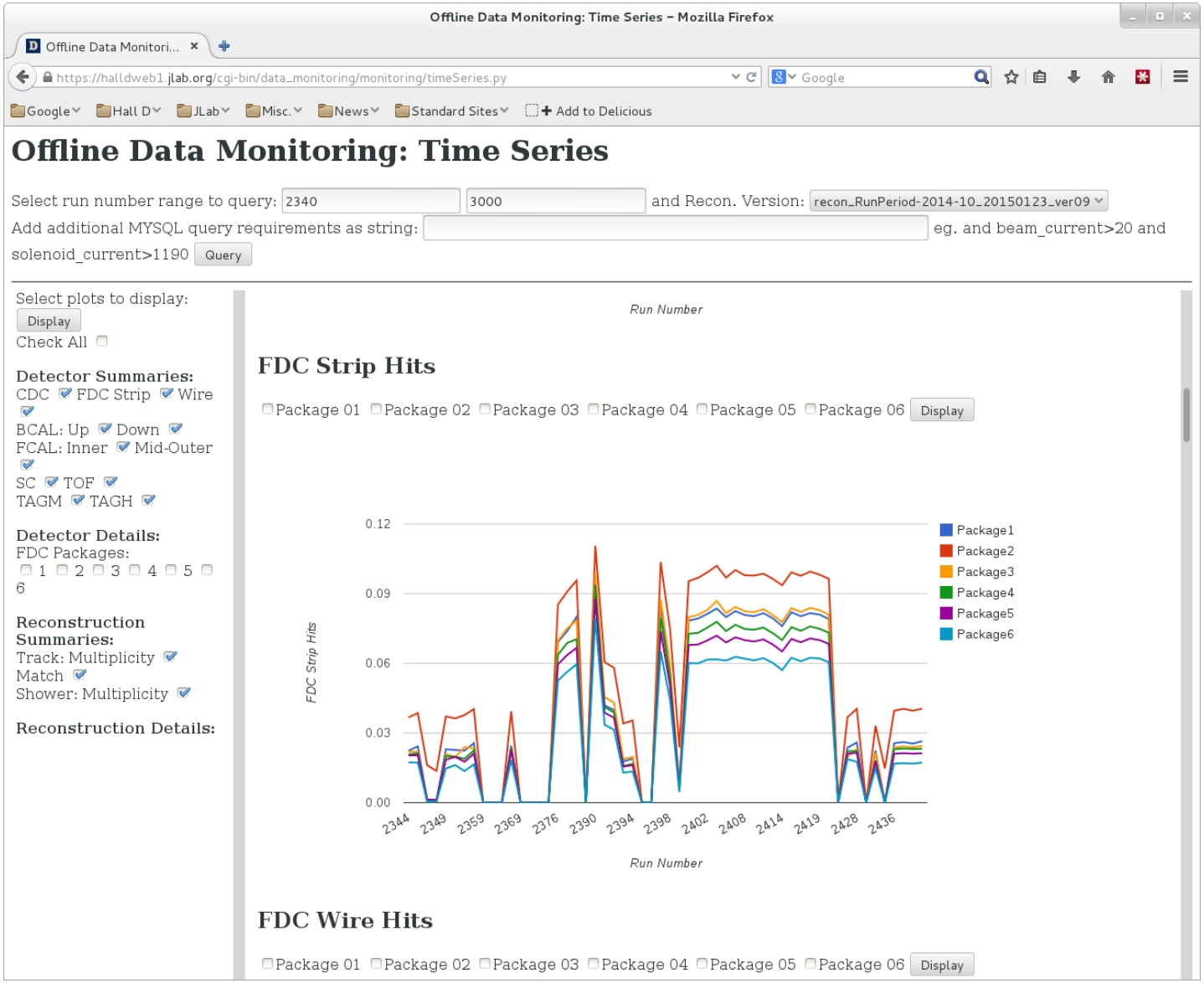
Plots for a selected range of runs



Plots for a given run



Quantities as a function of run number



Calibration Working Group

- Bi-weekly meetings
  - chaired by Sean Dobbs of Northwestern
- Preliminary list of constants compiled in advance of run, used to guide activity
- Calibration procedures still being developed
- Substantial progress:
  - Basic timing offsets
  - Global energy scale for calorimeters determined
- All collaborating institutions involved.

Calibration Database Experience

- Fully integrated into reconstruction
- Near-complete migration of constants into database
- All detector groups making contributions (no known rogue systems)
- SQLite form of database as alternate to MySQL/MariaDB
  - Complete history and versioning support
  - Solves:
    - Distribution (remote sites, network-challenged computing)
    - Server contention from farm usage
  - Drawback: no automated back-annotation

Data Distribution

- Used OSG SRM to archive DC2 OSG results to JLab Tape Library
- Raw data shipped to CMU using Globus Online (raw data)
- Distribute REST data to outside institutions

Event-Based Data Management

- Raw data stays on JLab Tape Library
- Reconstructed REST-formatted data compact
  - Fall 2014 REST data only 113 GB total
  - Keep as much as possible disk-resident at JLab
  - Distribute most (all?) to collaborating institutions
- Data Catalog/Tracker needs development
  - Existing package?
  - Develop one?
  - Dependence on details of how data distributed

Online Conditions Database

- Database to store online run conditions, e. g., magnet current settings, configuration files, etc.
- Two were deployed
  - One looks great (API, modern web interface)
  - One was useful (hand work required, HTML-base web interface, CSS-free)
  - Effort underway to consolidate and expand.

Things To Do

- Real data exposed areas requiring further work:
  - Online Conditions Database
  - Data Catalog
  - Version Management
    - Made branch to deal with non-standard detector configuration
    - branch-to-trunk merge problematic
- Geant4: need to pick up the pace of development
- Still need profiling discipline!
  - Simulation speed has decayed
- Code review system needs design and implementation
  - Size of collaboration makes this a challenge
- Never-ending data challenge never got started

Summary

- Software performed all critical tasks needed to support detector commissioning and to see physics signals.
- The collaboration feels that we reached a number of milestones that we did not expect to see until the April 2015 run.
- Many basic tasks lie ahead: calibrations, monitoring, reconstruction Q/A.
- Software infrastructure to support these activities largely in place.