

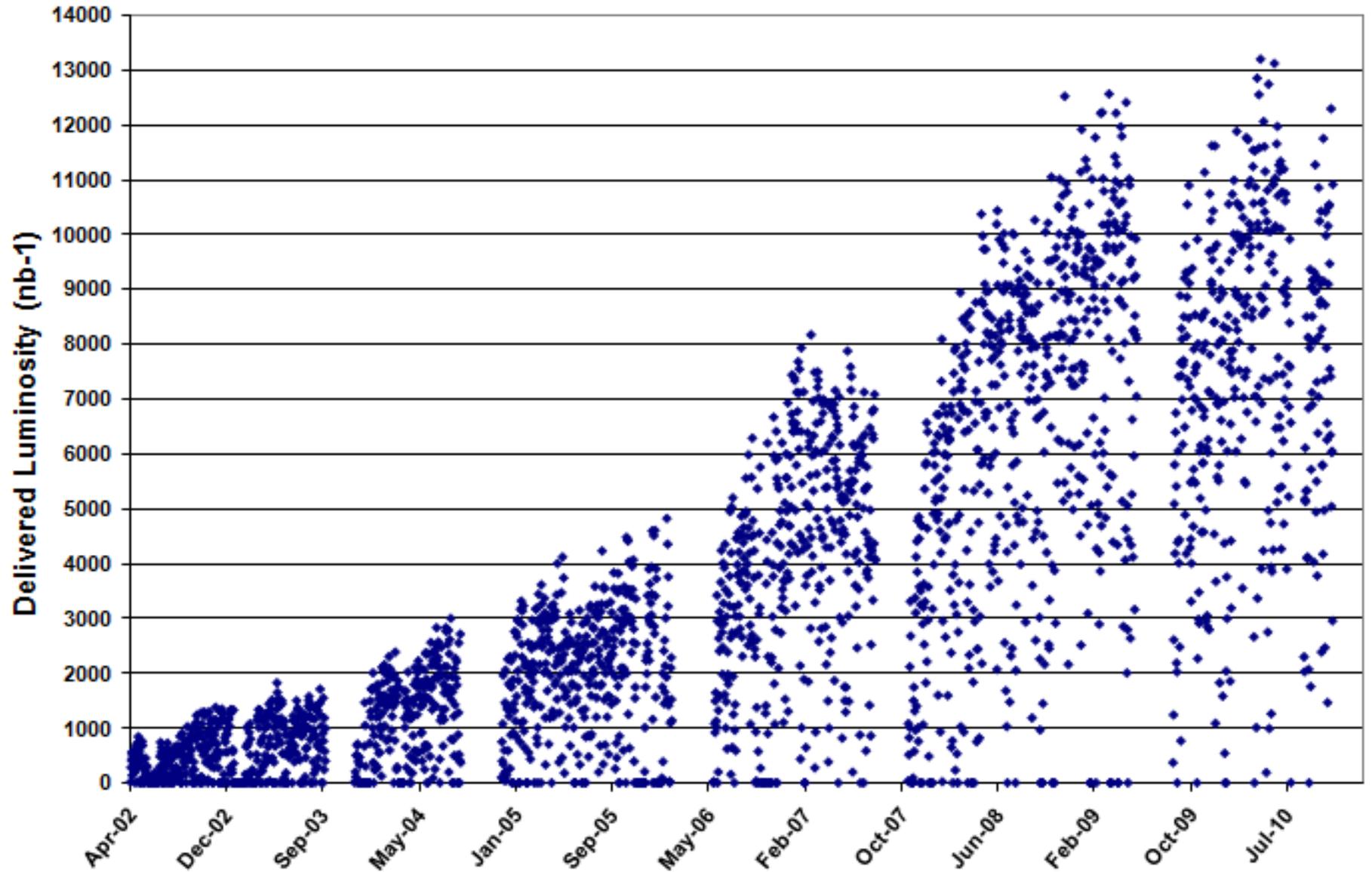


DØ Operations

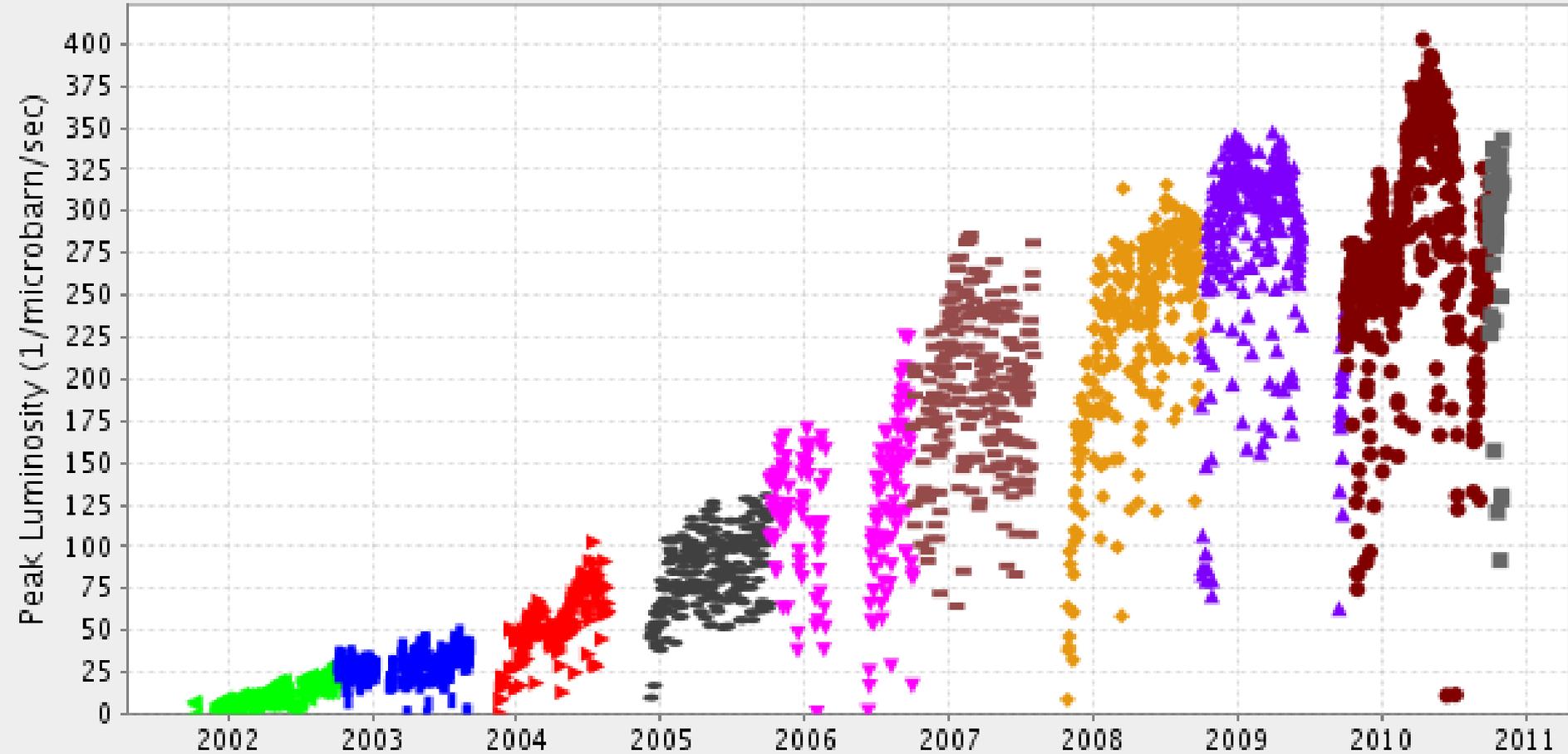
George Ginther
Fermilab and University of Rochester

DØ International Finance Committee Meeting
9 November 2010

Delivered Integrated Luminosity per Day



Peak Luminosity (1/microbarn/sec) Max: 402.4 Most Recent: 342.7

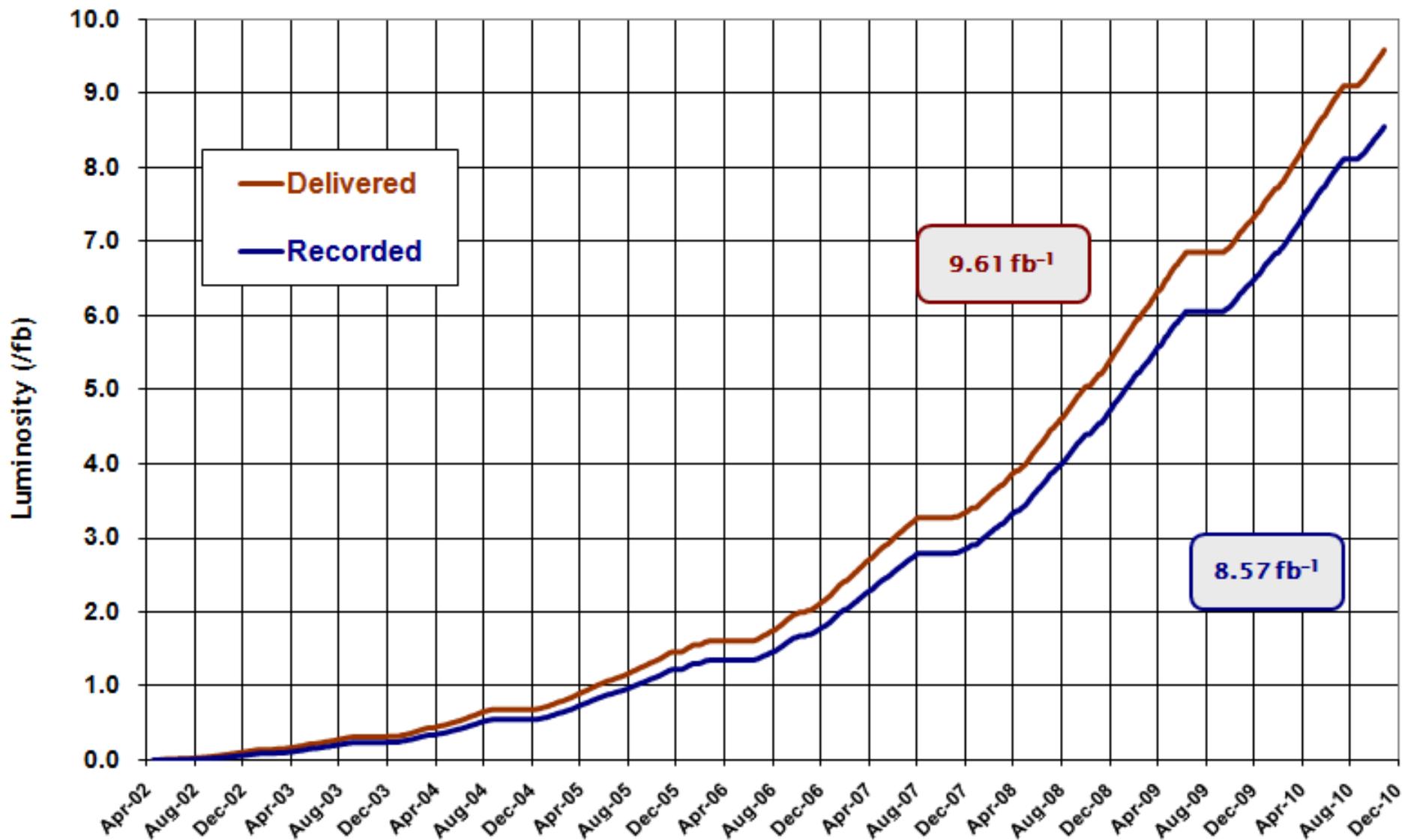


- Fiscal Year 11
- Fiscal Year 10
- ▲ Fiscal Year 09
- ◆ Fiscal Year 08
- Fiscal Year 07
- ▼ Fiscal Year 06
- Fiscal Year 05
- ▶ Fiscal Year 04
- Fiscal Year 03
- ◀ Fiscal Year 02

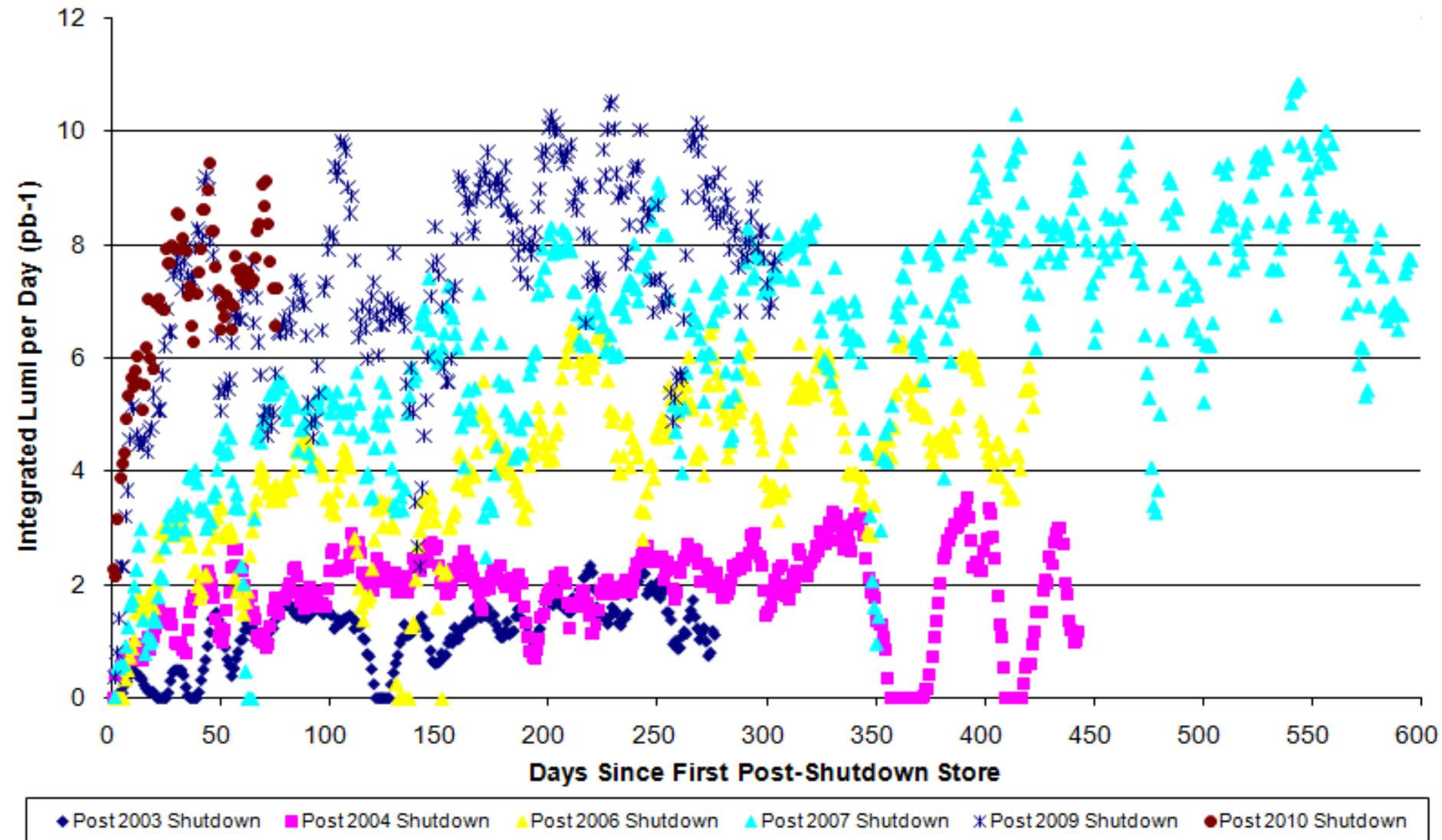


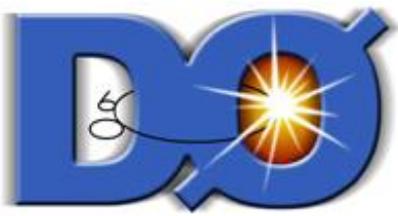
Run II Integrated Luminosity

19 April 2002 - 31 October 2010



7 Day Rolling Average Daily Delivered Luminosity





Run II DØ Detector

Calorimeters

Silicon and Fiber Trackers

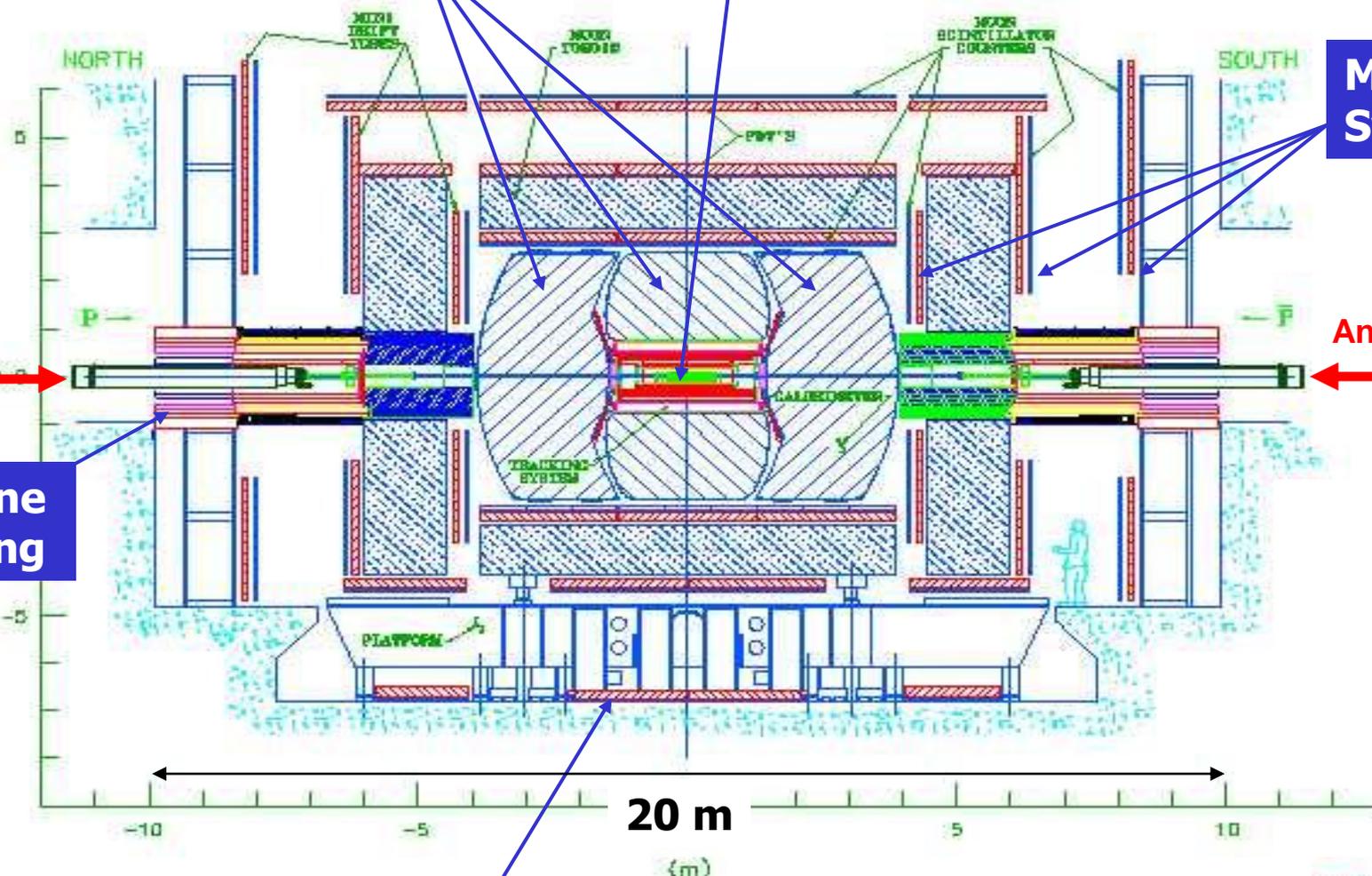
Muon System

protons

Anti-protons

Beamline Shielding

Electronics



100764
1-9-02

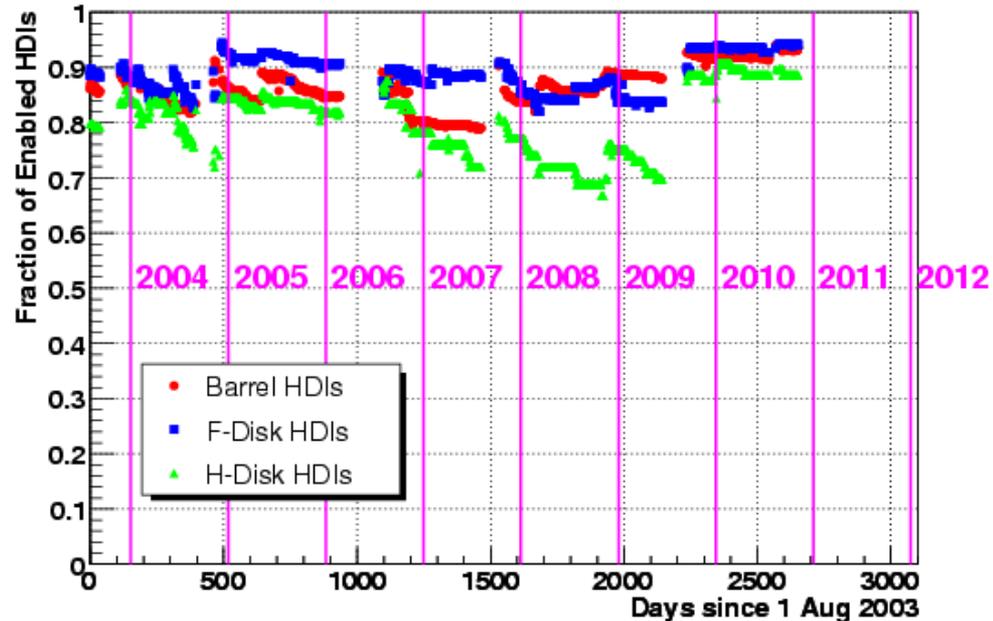


DØ Silicon Microstrip Tracker



- Precision tracking
- Displaced vertex reconstruction
 - Enables b-physics program and many other studies including Higgs to bb searches
- ~800k channels
- Optimized (and automated) high voltage ramping rate to minimize downtimes at begin and end of store
- Used 2010 shutdown access time to revive ~1% of channels which had previously been out of service
- Optimizing operating bias voltages, pedestals and readout thresholds

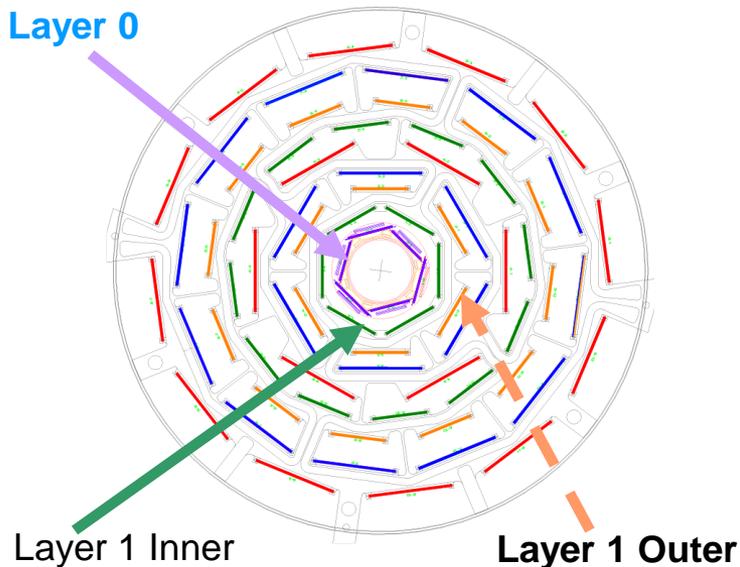
Enabled HDIs versus time (November 5, 2010)



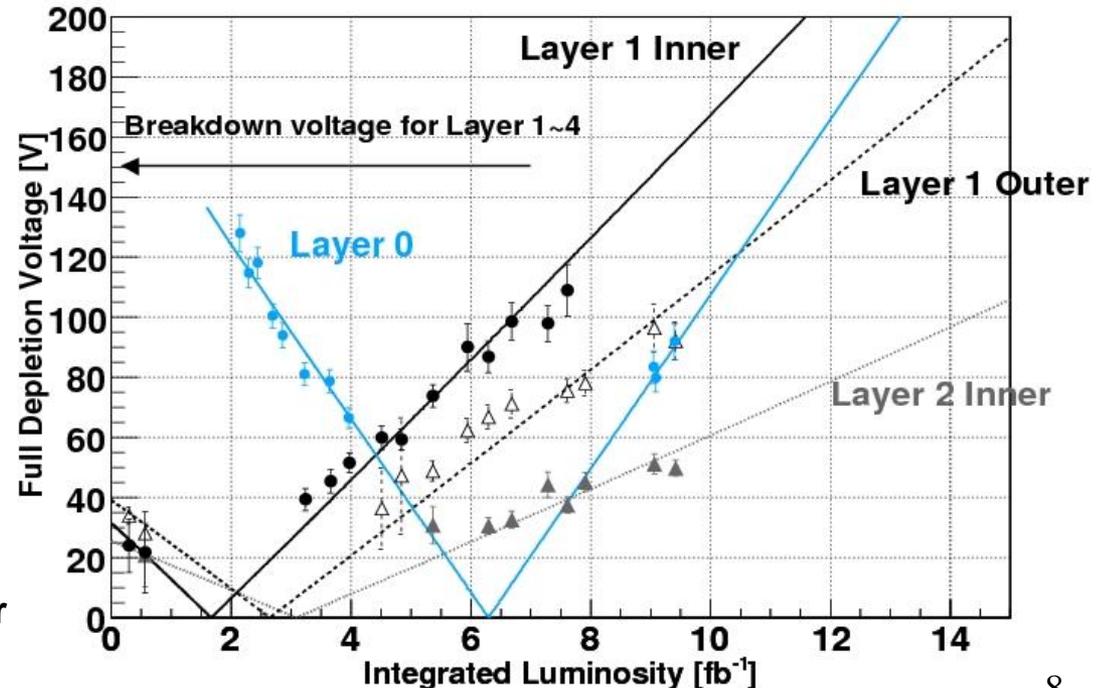


DØ Silicon Microstrip Tracker

- Monitoring impact of radiation damage and adjusting bias voltages accordingly
- Inner Layer 1 sensors may no longer be fully depleted
- Layer 0 was installed in 2006 to enhance impact parameter resolution and compensate for consequences of rad damage



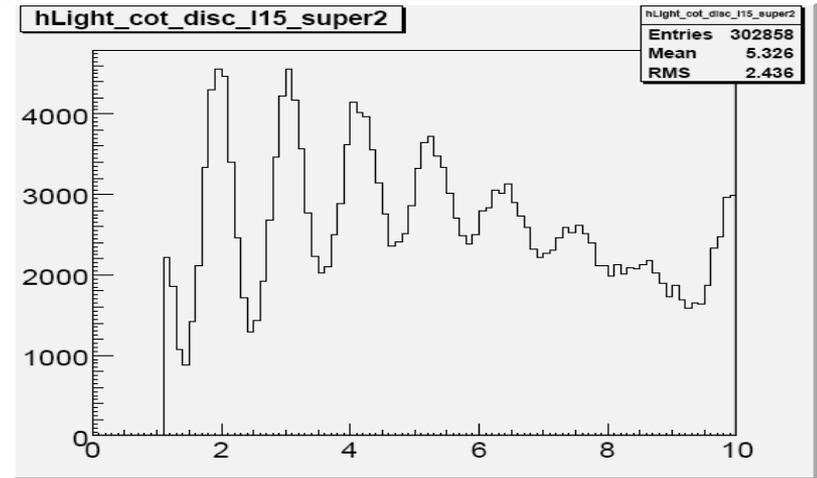
DØ Silicon Detector Radiation Aging Status as of October 2010



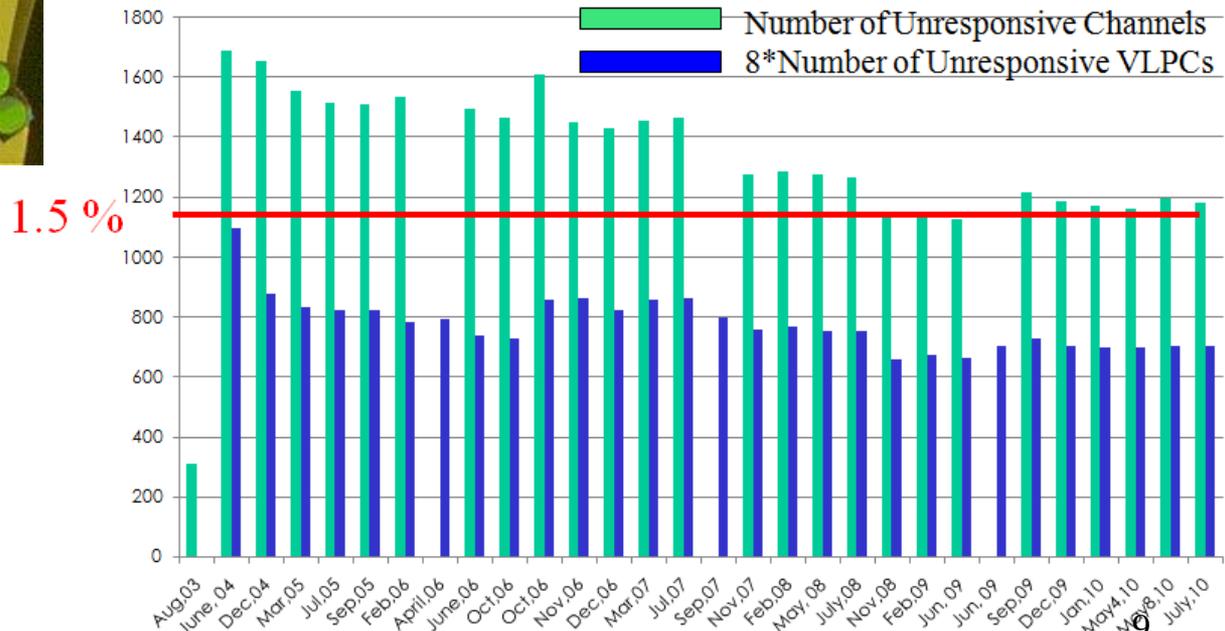
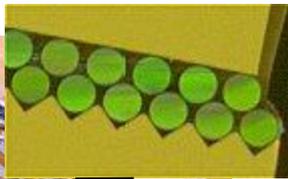


DO Central Fiber Tracker

- 76800 individual scintillating fibers
- 16 double layers of ~1mm fibers for charged track reconstruction
- VLPC readout with light sensitive detectors operating at 9K
- Less than 2% non-responsive channels



Number of PhotoElectrons



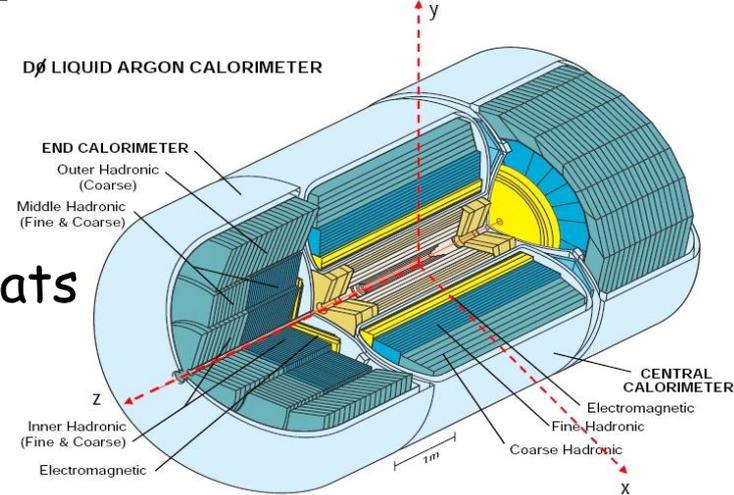
August 2003

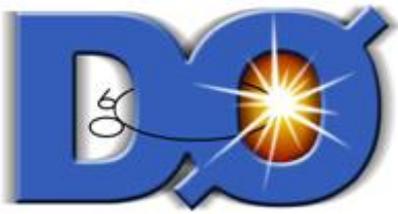
July 2010



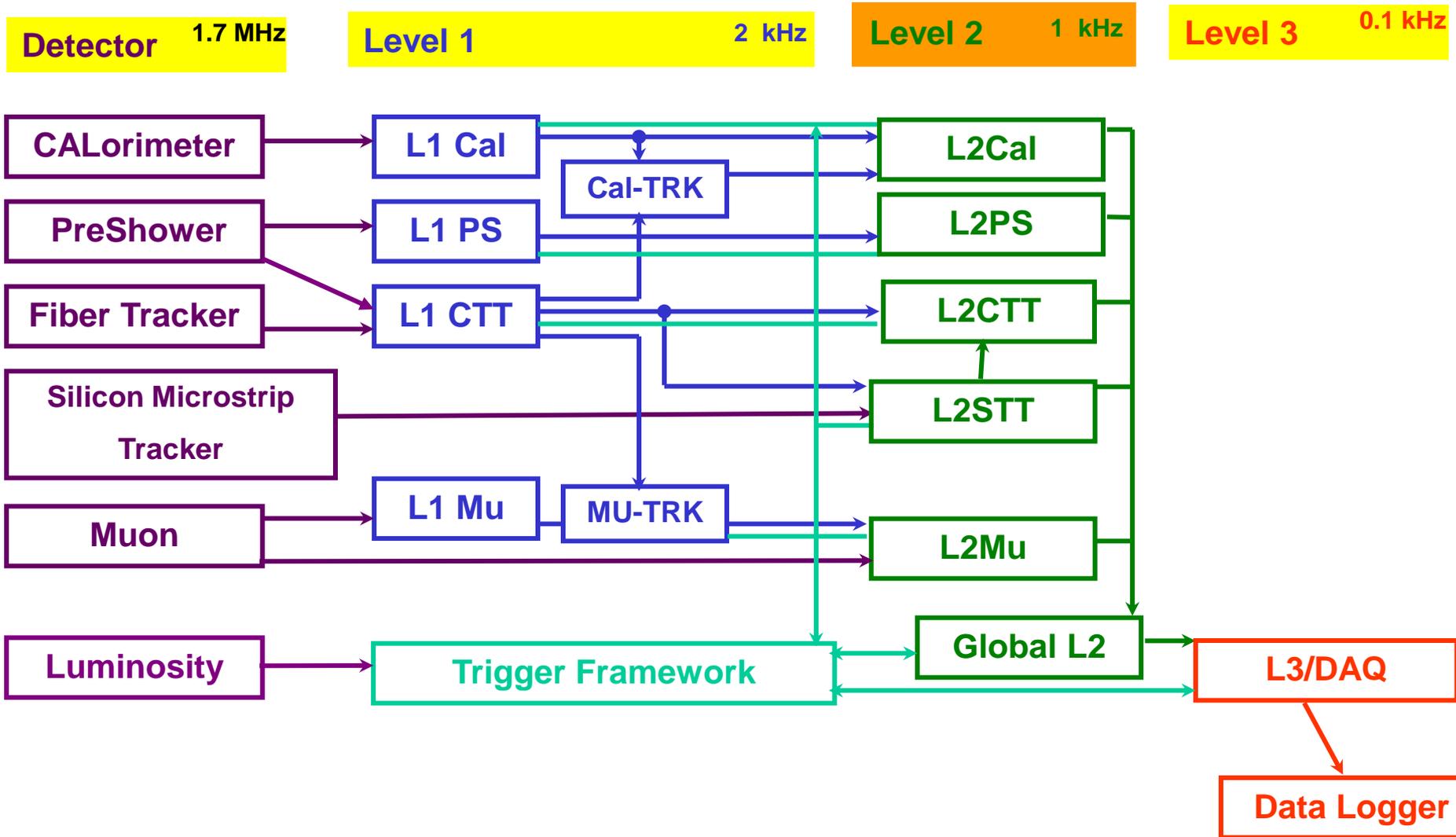
Calorimetry

- Liquid argon calorimeters in three cryostats
 - 50000 channels
- Calibrations performed between stores
 - on daily basis by CALMUO shifter
- Majority of problems encountered are minor and rapidly fixed
 - Switched Capacitor Array daughter card failure every other week
 - Replacement requires 20 minutes in the collision hall access
 - Base Line Subtraction board failure every other month
 - Replacement requires 30 minutes in the collision hall access
 - Base Line Subtraction Power supply failures several times a year
 - Replacement requires an hour in the collision hall access
 - Preamp power supply failure a few times a year
 - Redundant supplies
 - When both supplies fail, need to move iron for access to preamps, which requires ~8 hour collision hall access
- Continuing to monitor and address noise issues as they arise
 - Sensitivity to muon readout problems
- Continuing to optimize performance of Inter Cryostat Detector
 - Monitoring and improving individual channel stability



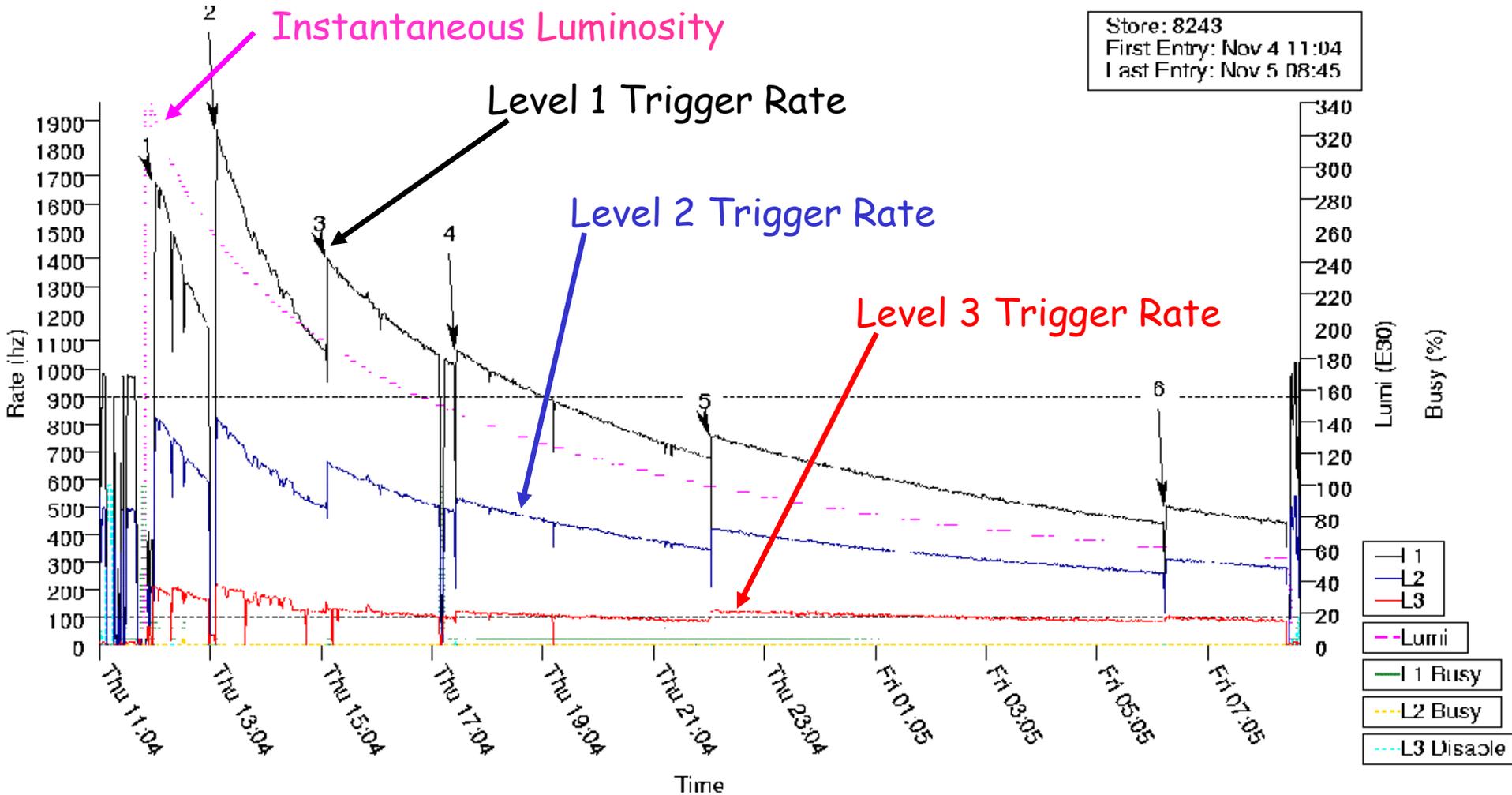


Trigger Overview





Rates from a recent Store at DØ



- Initial luminosity $337 \text{ E30 cm}^{-2} \text{ s}^{-1}$



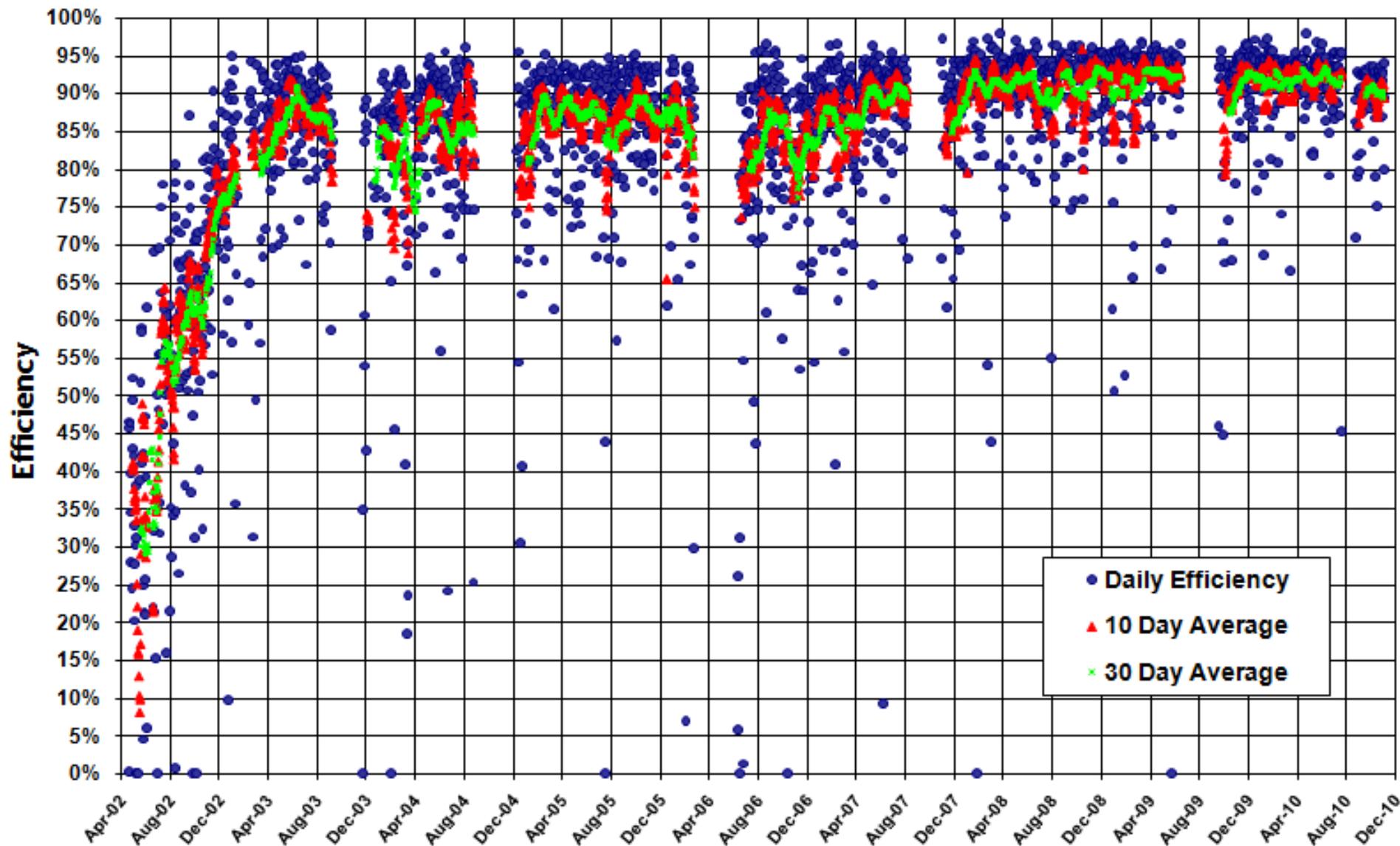
Recent Operational Advances

- Optimize trigger to accommodate increasing peak instantaneous luminosities
- Optimizing transitions to improve performance
 - Begin Store and End Store transitions
- Continue enhancing automated monitoring of detector status
- Continue improving documentation and guidance
- Streamline Level 2 tools to improve recovery from data flow interruptions
- During the recent four week shutdown
 - Installed faster readout firmware for the Central Fiber Tracker
 - Updated Level 1 Central Track Trigger equations to compensate for degradations in light yield and to reflect current unresponsive fiber list
 - Replaced scintillator and 14 (of 48) PMTs in the luminosity monitor
 - Individual channel recoveries and maintenance activities



Daily Data Taking Efficiency

April 2002 - 31 October 2010





Sources of DØ Inefficiencies

- Downtime---Failures, Downtimes and Special Studies ~3%
 - Readout electronics failures
 - Crate resets to address loss of synchronization
 - Power supply trips
 - Electronics cooling failures (water and/or air)
 - High voltage trips
 - Calorimeter Noise
 - Unscheduled power outages
 - Shifter (and expert) responses to unusual conditions
 - Low rate of individual failures tends to result in longer recovery times when failures occur
 - Transitions for special studies/calibrations
- Downtime---Begin/End Store and Begin/End Run Transitions <1%
 - Ramping Silicon Microstrip Tracker and muon system high voltages
 - Changing trigger prescale sets during run transitions
- Operations team tracks causes of failures and errors and addresses root causes of downtime where possible
- Deadtime---Front End Busy due to event readout ~5%
 - Sensitive to choice of trigger and event occupancy

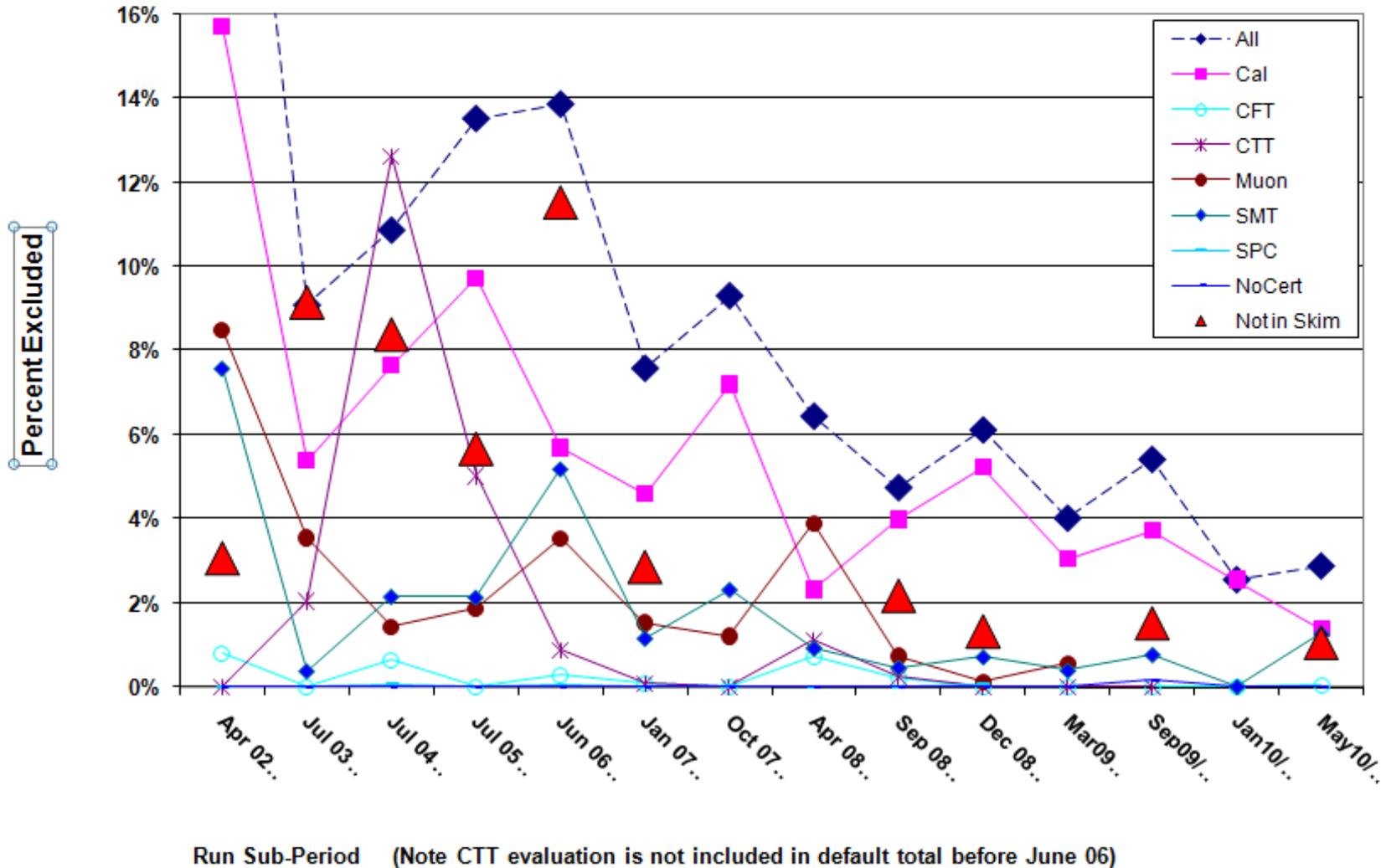


Integrated Luminosity at DØ

- Fiscal year 2009 included an 13 week shutdown
 - Uptime 0.949
 - Livetime 0.960
- Fiscal year 2010 included new peak luminosities and a 4+ week shutdown
 - Uptime 0.962
 - Livetime 0.951
- Average efficiency approaching a plateau, but FY10 detector uptime is at an all time high

	Delivered Lumi (fb ⁻¹)	Recorded Lumi (fb ⁻¹)	Efficiency =Uptime*Livetime
FY02	0.060	0.030	0.500
FY03	0.256	0.210	0.820
FY04	0.368	0.309	0.840
FY05	0.634	0.550	0.868
FY06	0.650	0.555	0.854
FY07	1.302	1.134	0.871
FY08	1.753	1.589	0.906
FY09	1.889	1.731	0.916
FY10	2.454	2.248	0.916

Default Data Quality Assessments

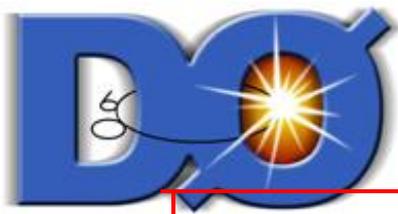


- Fraction of recorded data which satisfies default data quality requirements increased to better than 96% for recent samples
- More than 90% of total recorded data satisfies default DQ requirements



DO Detector Operations

- To achieve and maintain high efficiency detector operations and record the highest possible quality data around the clock all year long requires a substantial and dedicated operations team
 - Run Coordinators and Technical Integration Coordinator
 - Generate run plan and provide operations coordination
 - Serve as primary operations interface to Accelerator Division
 - Subsystem coordinators, on-call experts and support personnel
 - Pager carrying support network to insure prompt expert availability
 - Primary and secondary pagers for each subsystem generally rotate among pool of experts
 - Mechanical and electrical support crews
 - Computing and database experts
 - Well-trained operators in the control rooms serving on shifts
- Performance of detectors must be carefully monitored and plans for improvements must be appropriately scrutinized and scheduled
 - Minimize disruptions
 - Maximize performance
- Understanding and improvement of detector performance is facilitated by timely offline reconstruction and analysis of resulting data



Spokespersons

Technical Integration Coordinator

Special Projects
M. Johnson

Triggermeister

Run Coordination
S. Gruenendahl, W. Lee
Electrical Operations:
M. Matulik
Mechanical Operations:
R. Rucinski

L1 CTT
S. Gruenendahl

L1 Muon/Cal Track
N. Khalatyan

L2
M. Mulhearn

L2STT
D. Boline
V. Parihar

L3/DAQ
J. BackusMayes
G. Watts

Online
W. Lee

Controls
G. Savage

Global Monitoring
E. Cheu
V. Sirotenko

Data Quality
A. Jonckheere
N. Khalatyan

SMT
N. Parua
Sung Woo Youn

Luminosity Monitor
I. Katsanos
M. Prewitt

Central Muon
A. Ito
PDT's
P. Kasper
Trigger counters
A. Ito
I. Kiselevich

Forward Muon
A. Schukin
MDT detectors
V. Abazov
MDT Electronics
P. Neustroev
Pixel detectors
A. Schukin
Pixel electronics
T. Fitzpatrick

Fiber Tracker/ Preshowers
J. Warchol
Fiber Tracker
J. Warchol
Preshowers
A. Evdokimov

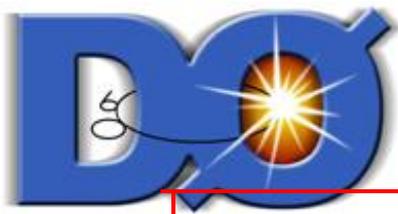
Calorimeter
D. Schamberger
S. Dyshkant (Deputy)
L1 Cal
S. Cihangir
D. Edmunds
ICD
L. Sawyer
A. White

Solenoid
H. Fisk

Detectors
Muon: T. Diehl
CFT/PS: M. Corcoran
SMT: N. Parua
CTT: M. Corcoran
Cal: K. Herner, J.Sekaric,
L. Zivkovic
L1CAL: S. Cihangir
Lum: G. Snow

Technical Organization

October 17, 2010



Spokespersons

Technical Integration Coordinator

Special Projects
M. Johnson

Triggermeiste 

Run Coordination
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Electrical Operations:
M. Matulik
Mechanical Operations:
R. Rucinski

L1 CTT 
S. Gruenendahl

L1 Muon/Cal Track
N. Khalatyan

Data Quality
A. Jonckheere
N. Khalatyan

SMT 

Luminosity Monitor 
I. Katsanos
M. Prewitt

L2 
M. Mulhearn

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Cal: K. Herner, J. Sekaric,
L. Zivkovic
L1CAL: S. Cihangir
Lum: G. Snow

Fiber Tracker/ Preshowers
J. Warchol
Fiber Tracker
J. Warchol
Preshowers
A. Evdokimov

Central Muon 
A. Ito
PDT's
P. Kasper
Trigger counters
A. Ito
I. Kiselevich

L2STT
D. Boline
V. Parihar

L3/DAQ
J. BackusMayes
G. Watts

Calorimeter 
D. Schamberger
S. Dyshkant (Deputy)
L. Sawyer
A. White

Forward Muon 
A. Schukin
MDT detectors
V. Abazov
MDT Electronics
P. Neustroev
Pixel detectors
A. Schukin
Pixel electronics
T. Fitzpatrick

Online
W. Lee

Controls 
G. Savage

Technical Organization

October 17, 2010

Global Monitoring 



DØ Shift Team

- Operations Shift personnel (based in cryo control room)
 - PPD Mechanical Department personnel supporting DØ operations
 - Monitor and control cryo systems and associated support
 - HVAC and safety system monitoring
- Captain/Global Monitor serves as shift coordinator
 - Implements Run Plan
 - Serves as contact to the Accelerator Division main control room
 - Monitors trigger and physics examines
- Data acquisition shift personnel keep DAQ running smoothly
 - Substantial commitment to control room presence over several month period
 - Generally 42 shifts over 16 weeks
 - Provides continuity and familiarity
- Detector subsystems shift personnel
 - Monitor, calibrate, and operate detector subsystems and associated triggers
 - Calorimeter and Muon and Level 1 Cal and Cal Track Match trigger
 - Silicon Microstrip Tracker and Central Fiber Tracker and Level 1 Central Track Trigger and Level 2 Silicon Track Trigger
- SAM shifter -- Remote shift activity
 - Monitor data server status and react accordingly
 - Monitor output from data reconstruction pass
 - Monitor reconstructed data quality



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- SAM shifter -- Remote shift activity
 - Monitor data server status and react accordingly
 - Monitor output from data reconstruction pass
 - Monitor reconstructed data quality

- During smooth operation, shifters are frequently able to get other work done in parallel with shift responsibilities
- Detector subsystem shifters may be released during extended downtimes or shutdowns



Recent International Participation in DØ Shifts

(July 2009 through June 2010)

- Captain



- Data acquisition (DAQ) shifts



- Calorimeter / Muon shifts



- Tracking shifts



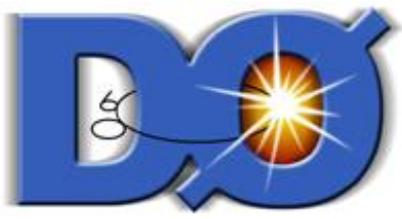
- SAM shifts -- Remote shift activity



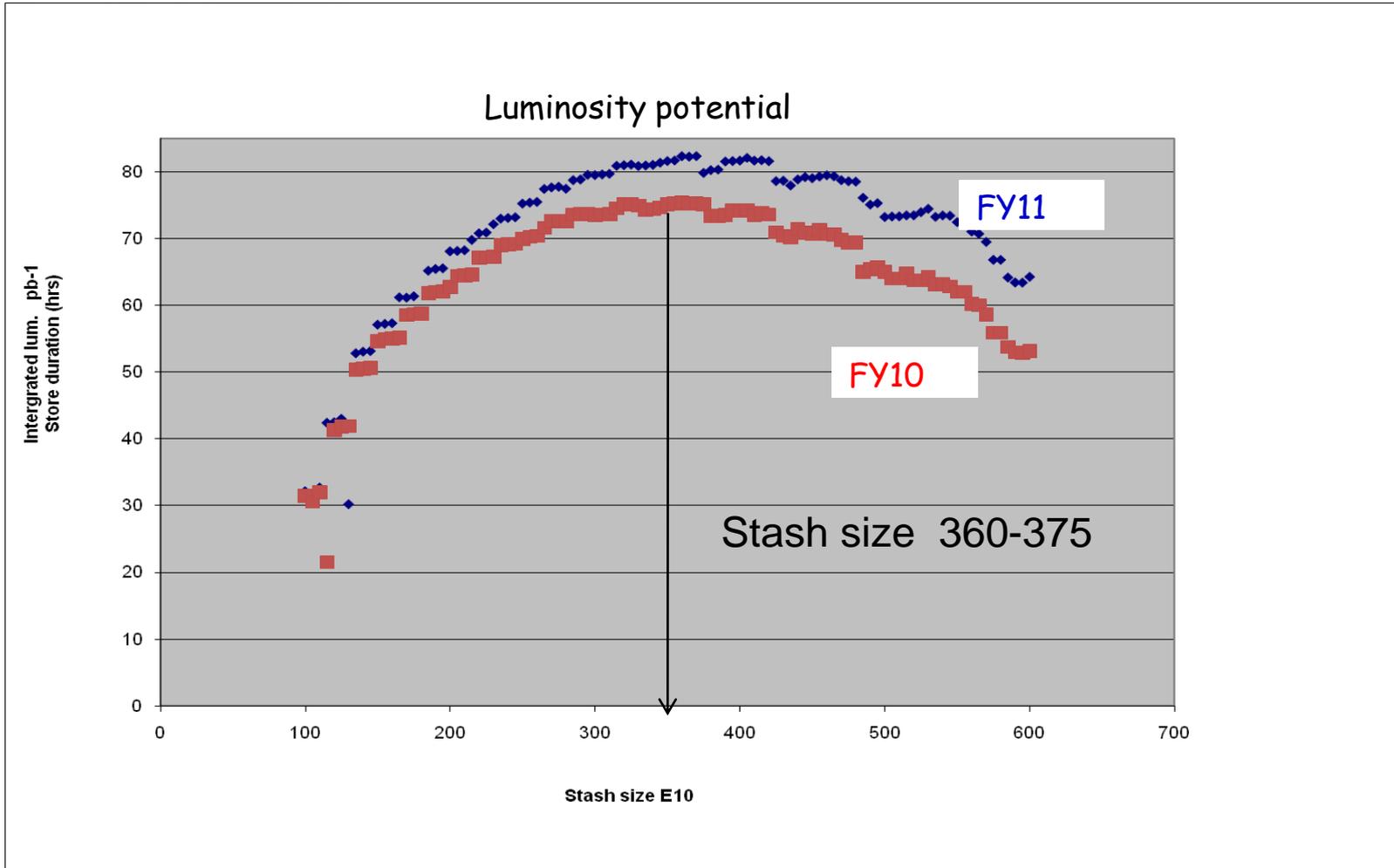


DØ Detector Operations Summary

- The DØ detector is operating safely, reliably, and efficiently
 - Highest priority triggers run unprescaled at largest peak instantaneous luminosities delivered to date ($>3.9E32 \text{ cm}^{-2} \text{ s}^{-1}$)
- Recorded data accumulating at a rate of better than 51 pb^{-1} per week of operation during FY2010
- Anticipate $>10 \text{ fb}^{-1}$ recorded by the end of FY2011
 - Shutdown schedule for 2011 uncertain
 - The operations challenge continues to be maintaining effective operations as pressure increases on the available resources and the detector ages
- Many interesting and timely results are being extracted from the accumulating data
 - See talk by Stefan Soldner-Rembold later this morning
- The DØ Collaboration, Fermilab and the funding agencies have made and continue to make significant contributions to these accomplishments
 - Thanks for this essential support for detector operations
 - DØ will continue to need support to build on these successes and fully capitalize on the exciting opportunities available
 - Looking forward to the possibility of very productive running through 2014!



Additional Information



Accelerator Division -- Model Projection -- 29 October 2010

Given our current stacking rate (nominal) ~26 mA/hr

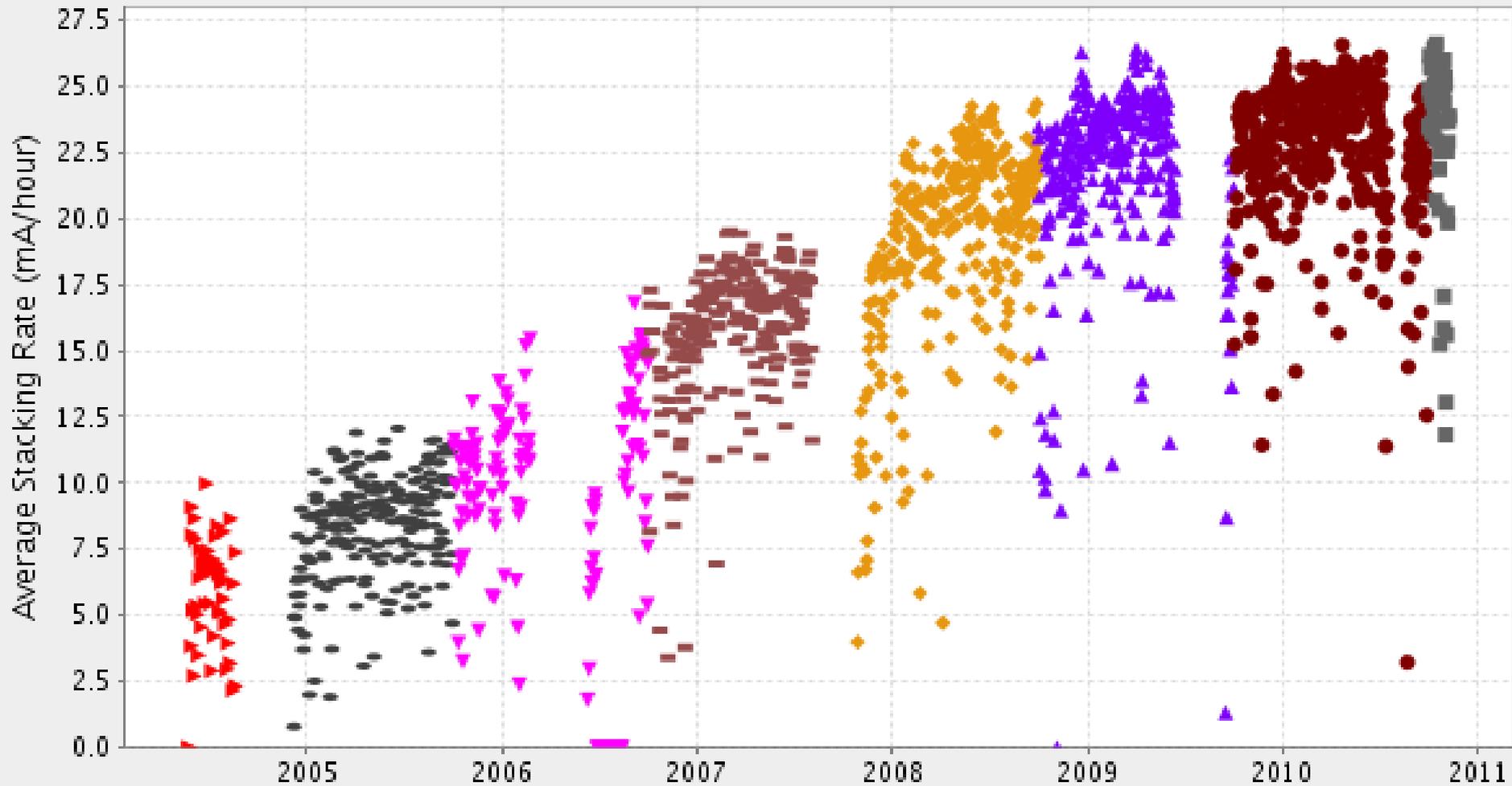
Shot setup time ~1 hours

Using existing Pbar emittances and Intensities

Using projected Proton emittances and intensities

Current target for FY2011 is 53 pb⁻¹ delivered per week

Average Stacking Rate



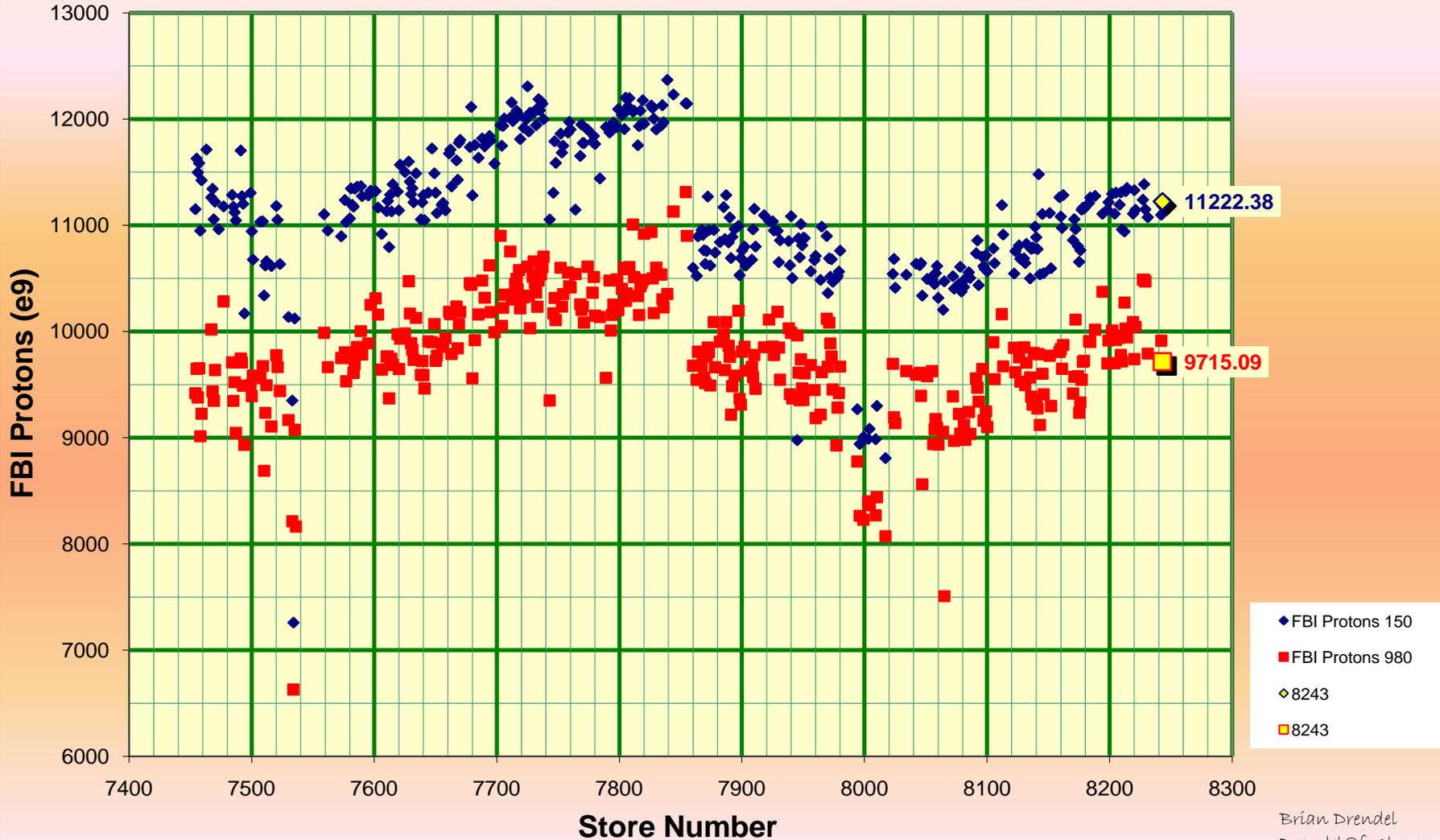
■ Fiscal Year 11 ● Fiscal Year 10 ▲ Fiscal Year 09 ◆ Fiscal Year 08 ■ Fiscal Year 07
▼ Fiscal Year 06 ■ Fiscal Year 05 ▶ Fiscal Year 04

- The average rate counts the total number of pbars accumulated divided by the total number of hours in stacking mode. 28



Proton intensity in the Tevatron

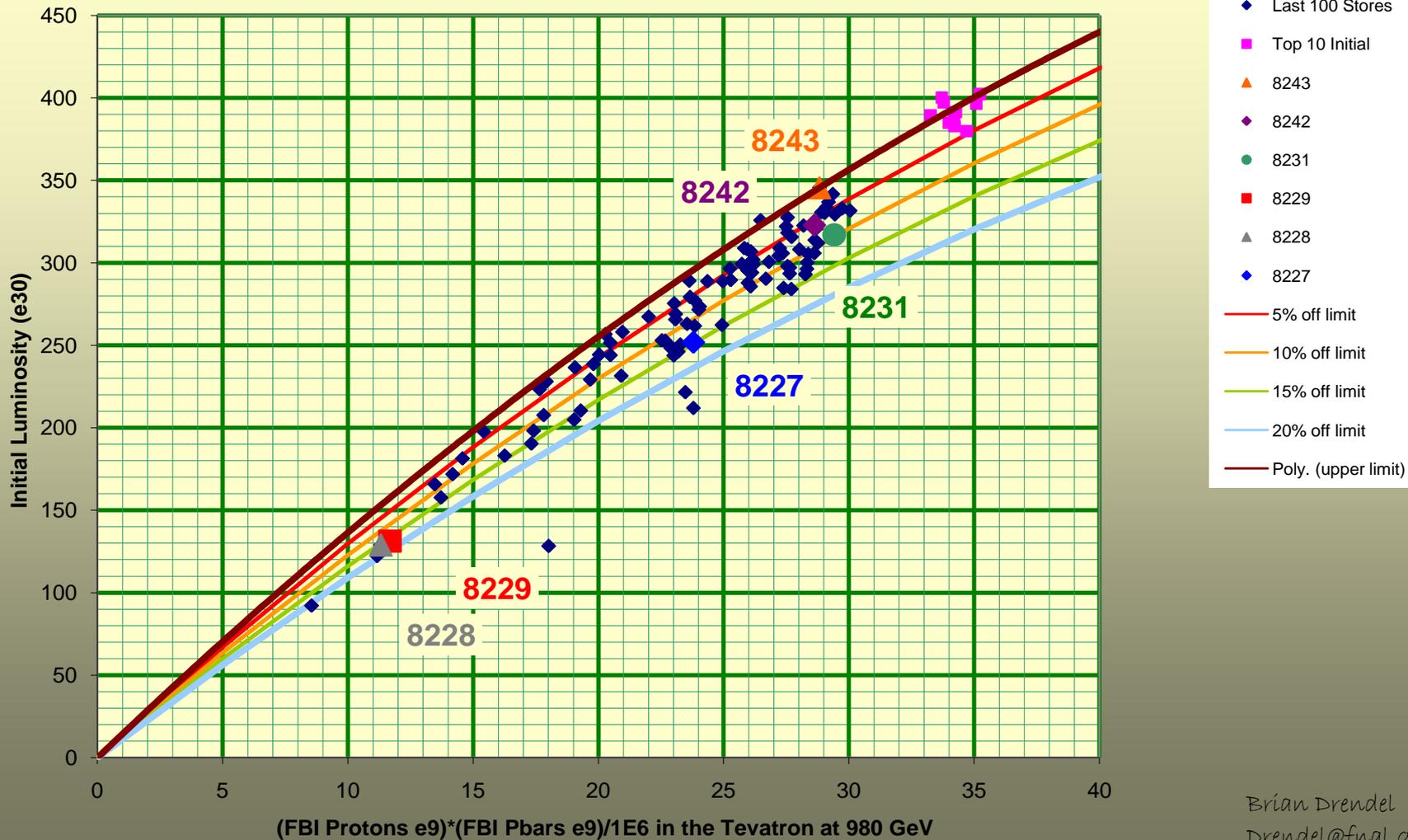
FBI Protons in the Tevatron





Luminosity vs proton and pbar intensity at 980 GeV

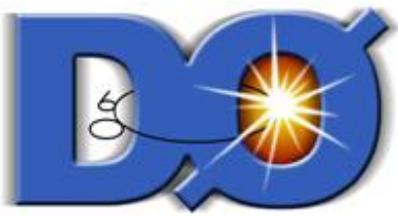
Average Initial Luminosity vs Protons*Pbars at 980GeV





Operating Environment at DØ

- Potentially hazardous environment
 - High voltages and currents, cryogenics, radiation, high magnetic fields, heights, hazardous materials (beryllium)
- Safety is a key component of effective operations
 - Each individual must take responsibility for safety
 - Management must foster an environment where the importance of safety is clearly communicated and provide the tools necessary to generate and support that environment
 - Division and Lab ES&H serve as essential resources in this effort
 - Training for all personnel
 - Employee and User Orientation
 - DØ specific Orientation
 - Drills (and safety system tests)
 - Additional training for specific activities
 - Safety considerations integrated into Detector Design and Operations Implementations
 - Operational Readiness Clearances
 - Written procedures
 - Job Hazard Analysis
 - Follow-up on unusual situations
 - Solicit and respond to grass roots input



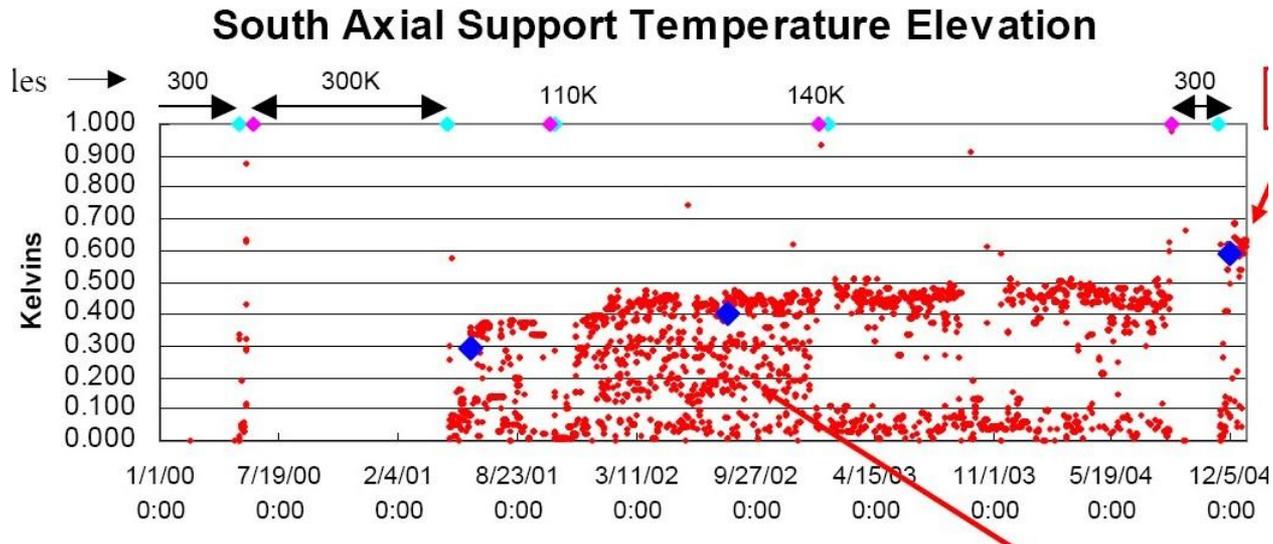
Some Operational Challenges During the Past Year

- Trigger Rate Dips
- Calorimeter purple haze exploration
- Muon PDT COBOs with improper parameters
- Investigate impact of humidity upon SMT operating point
- Chiller failures
- DAQ cluster downtimes
- Unanticipated power outages
- Level 1 Muon cable broken during detector opening
- STT configuration feature
- Collection of Calorimeter Calibration Triggers
- Power supply failures



Some Potential Issues to Watch at DØ

- Protecting the solenoid coil—need to keep the coil cold

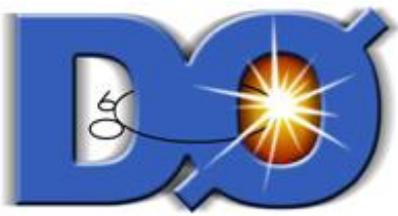


- Minimizing beam losses and impact of beam losses
 - Muon readout failures
 - Limited number of available spares
 - Muon power supplies failures
 - Generate acceptance losses and access requests



Improving Efficiency

- Minimize downtimes during stores
 - Automate end store activities
- Hunt and eliminate rare sources of data flow interruptions whenever and wherever possible
 - Improve automated monitoring
 - Process watcher
 - Attempt to identify compromised power supplies prior to failure
 - Improve guidance for alarms
 - Improve diagnostics when appropriate
 - Silicon Track Trigger
 - Muon PDT
 - Level 2 Trigger
 - Improve documentation and shifter training
- Minimize need to access to the collision hall
- Streamline between store activities
- Record cosmic triggers between stores as opportunities permit



Some Near Term Activities

- Update alignment at Level 3
- Update Level 2 track sorting algorithm in anticipation of increasing peak lumis
- Investigate SMT busy performance
- Update VME scaler readout firmware
- Continue deployment of SMT Watch Dog PROMS (in crates 0x62 and 0x68) to facilitate reliable bad HDI download only
- Continue addressing remaining dataflow interruptions
- Clean up remaining disabled alarms?
- Continue clarification of alarm guidances and other documentation



Some Longer Term Activities

- Address DAQ cluster failures
- Rollout updated SMT readout firmware to addresses suppression of charge collection
- Evaluate F disk and H disk HV (to compensate for rad damage)
- Complete implementation of R2D0
- Investigate Central Fiber Tracker busy feature
- Resolve rack M324 readback feature
- Enhance calorimeter MET monitoring via SES alarms in dq_calor
- Implement major alarm annunciator in SES
- Generate simple HV status summary available at all shift stations
- Clarify alarm hierarchy in SES alarms
- Automate prescale selection at BOS?
- Automate monitoring of beam dump and broadcast announcement when beam disappears
- Continue investigation of Level 2 features
 - Rate dips and L2Cal hangs



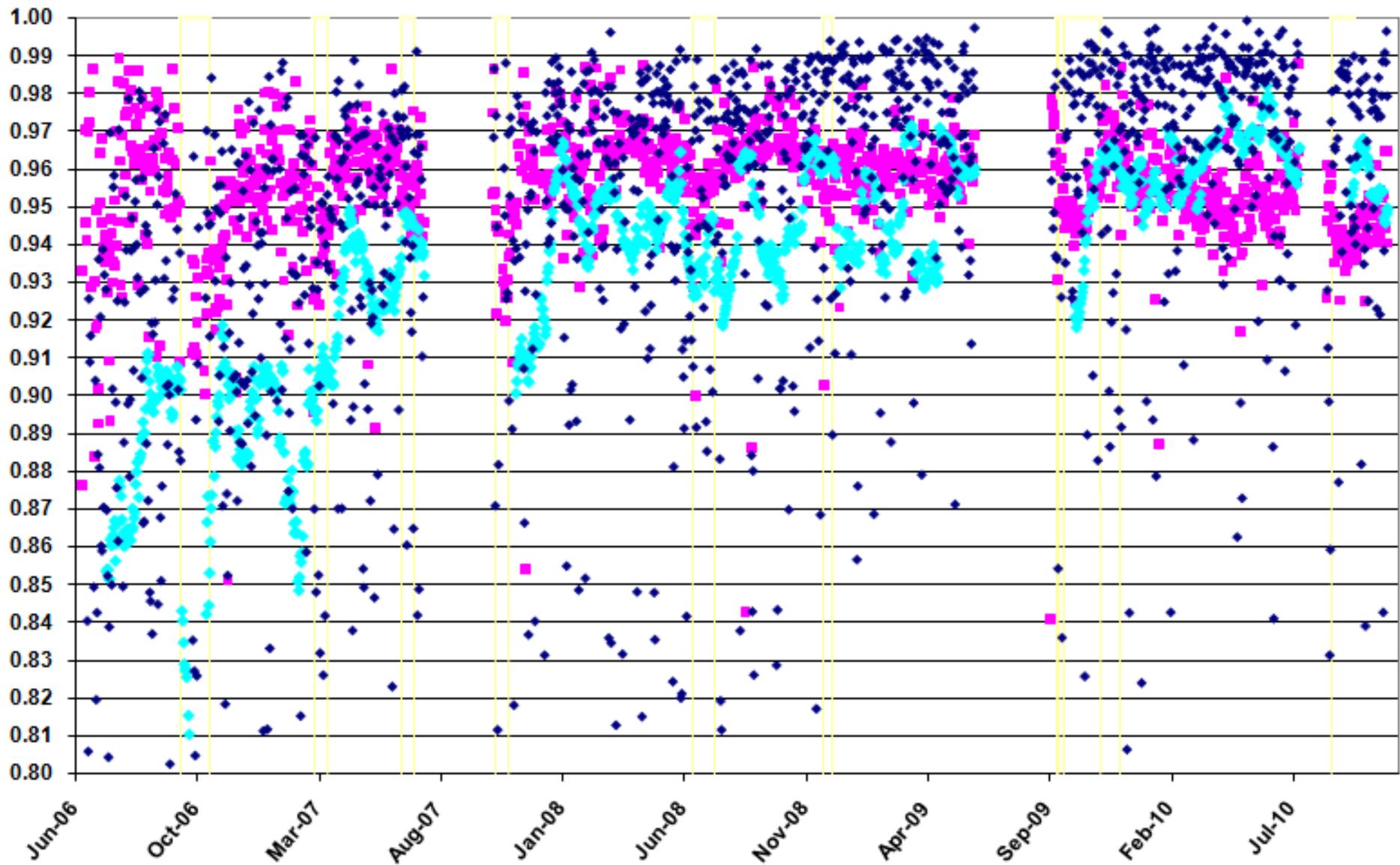
Additional Longer Term Activities

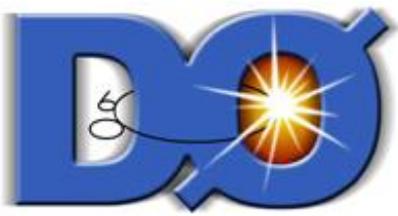
- Improve chiller margin
- Implement SES alarms for luminosity monitoring
- Enhance monitoring of HV calibration/stability
- Extract lessons from CAL HV shutdown experience?
- Update handling of Silicon Track Trigger FEBs
- Follow-up on CFT gain change?
- Implement AFE enhancements?

Run IIb

Daily Uptime Fraction (in blue and 30 day average also in blue)

and Daily Livetime Fraction (in magenta)





Integrated Luminosity

	Delivered Lumi (fb ⁻¹)	Recorded Lumi (fb ⁻¹)	Efficiency	Comments
2002	0.133	0.083	0.624	2 weeks shutdown
2003	0.193	0.164	0.850	11 weeks shutdown
2004	0.386	0.325	0.842	15 weeks shutdown
2005	0.801	0.698	0.871	
2006	0.735	0.618	0.841	15 weeks shutdown
2007	1.160	1.020	0.879	12 weeks shutdown
2008	2.211	2.012	0.910	1 week shutdown
2009	1.920	1.761	0.917	13 weeks shutdown
2010	>2.092	>1.912	~0.91	>4 weeks shutdown