Fermilab
FY2002 Self-assessment
Process Assessment Report
For
Division/Section__Particle Phsysics Division_____

Date__September 30, 2002_____

Division/Section performing assessment

Particle Physics Division

Name of organization that owns assessed process

DØ Experiment Department

Organization Strategy

The goal of the DØ Experiment Department is to support the DØ Experiment and to study high energy physics processes based on data obtained from proton-antiproton collisions at Fermilab's Tevatron. The DØ detector uptime is a critical parameter providing a measure of the fraction of collisions produced by the Tevatron that are actually used for physics studies. Problems which lead to the experiment not being able to collect data (for example, the DAQ system being down, etc.) are analyzed during the self-assessment process. A successful assessment contributes to an improvement of the physics output of the laboratory.

Names of Personnel on Assessment team

L Stutte, J. Womersley, D. Denisov

Name of process assessed

DØ Detector "Uptime"

Brief description of process to be assessed

The Detector Uptime is a measure of the fraction of the proton-antiproton collisions delivered by the Tevatron which is utilized by the detector. We have chosen to use the data taking efficiency, defined to be the fraction of luminosity written in physics runs and stored to tape divided by the luminosity delivered by the accelerator, as our measure of Uptime. The Detector Uptime also takes account of collisions used for trigger studies and other detector study periods determined to be necessary by the DØ Collaboration for scientific reasons. The Uptime focuses on PPD's responsibility to keep the detector operational through the PPD DØ Department and PPD support departments.

There is a measurable Uptime percentage and metric set (see below). Our review examines the reasons for downtime and suggests ways to avoid such downtime in the future.

1. Are metrics associated with this process? If so, what are they?

   The metric for the process is the fraction of the luminosity for which the DØ Experiment is collecting physics data when Tevatron beams are colliding. This measurement is done using special scalers installed in the DØ Trigger Framework.

   We established the metric as follows:

   Outstanding: 95%. From experience of running large experiments in different fields with millions of readout channels this is a number that almost nobody has achieved so far. If DØ were to reach this level it would be an outstanding performance

   Excellent: 85%. This level is 5% above the average DØ Uptime achieved during Run I. We have to keep in mind that the detector was much simpler at that time and, for example, had no elements using liquid He. If we can do better than in Run I it is an excellent performance.

   Good: 65%. This number is typical for the initial period of operation for such a large detector as DØ. There are still ways to improve, but the Uptime is twice the downtime for such performance.

   Marginal: 50%. At this level we are losing half of the collisions delivered by the Tevatron. This is marginal performance.

   Unsatisfactory: 30%. This number is significantly below the typical level for the operation of large detectors in high energy physics. At this number, two thirds of the collisions are not analyzed by the experiment.

2. What are the names of the procedures associated with this process?

   All scalers relevant to the measurement of the number of collisions provided by the Tevatron and those analyzed by the DØ experiment are stored in the database every minute. Specially developed software is used to monitor and plot the uptime numbers for data taking runs, per day, per week or for longer periods.

3. Are these procedures being followed? Are they current?

   Monitoring of the DØ uptime is performed daily. All the procedures for monitoring are current and are being followed

4. Describe the methodology used to assess this process.

   Scalers in the Trigger Framework measure the number of proton-antiproton collisions in the center of the DØ detector. In addition, scalers measure the number of collisions when the detector was "alive" which means it was able to analyze trigger information for a particular crossing and write the data for events selected by the trigger system to tape. There are scalers which measure the number of collisions lost due to specific reasons, for example when no data taking run was configured, when the front-end electronics was not functioning properly (called front-end-busy – FEB) or when the DAQ system was not able to accept events. The plots below illustrate all of the above mentioned parameters.

5. Results of the assessment:

a) The existing process provides full information about the DØ Detector Uptime parameter;

b) Based on the results of monitoring this parameter, many issues which seriously affected the DØ Experiment performance have been identified and many of them resolved. For example, for some time one of the major issues reducing Uptime was instabilities in the DØ Experiment readout system. As a result, the DØ Collaboration decided to design and implement a new DAQ system which was accomplished over the first 6 months of year 2002;

c) We have identified no deficiencies in the way the Uptime monitoring itself has been carried out over the last year, or the way the metric has been calculated;

d) The monitoring process is working extremely efficiently. Over the last six months we were able to increase the DØ Uptime from ~40% (graded "marginal") to ~65% (graded "good"). We have a good understanding, at any given time, of the current problems and the limits on our ability to increase Uptime. This guides the work of experts to resolve various technical issues;

e) This is the first time we are assessing DØ's performance based on the Uptime metric. We can compare our current result, 65%, with the DØ experiment's performance in Run I (1992-1996) which was ~80%. While there is still room for improvement, the current Uptime number is satisfactory for a very complex modern high energy physics experiment;

f) **The current performance achieved in Uptime by the DØ experiment is "Good" based on the metric described above**.

Identified opportunities for improvement

We have identified the following opportunities for improvement:

a) Finish integration of the systems for which commissioning is not yet completed: fiber tracker and fiber tracker trigger, Level 2 trigger, Level 3 trigger;
b) Modify elements of those sub-systems which have proved to have low reliability: silicon detector high voltage distribution fanouts, Level 2 trigger forward muon software, muon readout code in PDTs;
c) Improve monitoring software and develop software to automatically resolve issues: global monitor process to verify physics quality of data, software to automatically reinitialize parts of the readout system;
d) One major reason for current problems is a lack of qualified personnel to work on the issues, so we are forced to set priorities for personnel and attack the most serious issues first, leaving less critical issues for the future.

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Schedule for implementation of improvements

Schedule for the implementation of improvements is divided into short term and longer term goals:

a) By January 1st 2003 we are planning to increase the Uptime from 65% to 75%. The major steps to permit this are fixes of the Level 2 trigger muon code to be more robust, implementation of the new silicon high voltage fanouts to reduce the number of high voltage trips, and overall improvements in our procedures during data taking;
b) During 2003 our goal is to increase Uptime to 80%. We expect to reach this by reducing the amount of time spent in commissioning different sub-detectors and sub-systems with concentration on steady and smooth data taking.

Status of improvements from previous assessment

None, as this is the first time we are assessing the DØ Experiment Uptime.

Attachments (supporting data, worksheets, reports, etc.)

Lists of problems are identified and put on the Web daily (see below). All these problems are discussed during regular weekly meetings of the Operations group and specific action items are set. Below is an example of a typical weekly Operations Meeting agenda:

> Place: 9th circle
> Time: Fri, Sept 6, 2:00-3:30 pm
>
> Agenda
> ------

>	Mechanical/Electrical	Russ
>	SMT	Harald
>	L2	Reinhard
>	CFT/PS	George
>	Calorimeter	Leslie
>	Muon	Dmitri
>	FPD	Carlos A.
>	Lumi	Brendan
>	Examines	Pushpa
>	Trigger Commissioning	Ron L.
>	L1 CAL	Bob
>	L1 CTT	Stefan
>	L1 Muon	Rob
>	L3	Gordon
>	Controls	Fritz
>	Online	Stu

>
> We will review systems that introduced the
> most physics downtime from the past week: SMT and L2. For reference,
> refer to the web page:
>
> http://www-DØ.fnal.gov/~DØrun/DØ_private/operations/downtime/
>
> which is current through Wed, Sept 4th. Note: This page does not take
> into account the deadtime due to pauses and front end busies.

Plots presented below summarize the current DØ Uptime as measured for efficiency for a single Run, single day and one week.

Major Sources of Downtime for Monday 26-Aug-2002 (0.9 hrs)

Cause	Start Time	Duration	Fraction of Total Downtime	Comments
L3 Supervisor	10:02	0.5 hrs	55%	2 GB of log files needed to be removed.

Major Sources of Downtime for Sunday 25-Aug-2002 (1.6 hrs)

Cause	Start	Duration	Fraction of	Comments

	Time		Total Downtime	
L2 SLIC 35	01:10	1 hr	63%	See email from Marc Buehler
L2 Muon Central	23:32	0.5 hrs	31%	See email from Marc Buehler

Major Sources of Downtime for Saturday 24-Aug-2002 (2.2 hrs)				
Cause	Start Time	Duration	Fraction of Total Downtime	Comments
L2 TCC	03:30	2 hrs	90%	See email from Marc Buehler & Daniel Mendoza and follow-up email from Philippe Laurens

Major Sources of Downtime for Friday 23-Aug-2002 (0.7 hrs)				
Cause	Start Time	Duration	Fraction of Total Downtime	Comments
Muon Special Run	20:47	0.5 hrs	70%	Change to/from global to special trigger. Test trigger with recording off.

Major Sources of Downtime for Thursday 22-Aug-2002 (2.4 hrs)				
Cause	Start Time	Duration	Fraction of Total Downtime	Comments
L3 Supervisor	00:04	1.5 hrs	63%	See report from Gordon Watt made at Fri Aug 23rd Operations Mtg.
SMT SEQC x68	19:34	0.5 hrs	20%	New hardware interface to download GUI
High Pbar Halo	18:59	0.25 hrs	10%	Run delayed so MCR could bring down halo.

Major Sources of Downtime for Wednesday 21-Aug-2002 (0.2 hrs)				
Cause	Start Time	Duration	Fraction of Total	Comments

			Downtime	
SMT HV trip	22:45	0.2 hrs	>90%	Water leak from heat exchanger in MCH221

Major Sources of Downtime for Tuesday 20-Aug-2002 (0.5 hrs)				
Cause	Start Time	Duration	Fraction of Total Downtime	Comments
Muon Central Special Run	03:28	0.3 hrs	60%	Change to/from global to special trigger. Test trigger with recording off.

Major Sources of Downtime for Monday 19-Aug-2002 (0.7 hrs)				
Cause	Start Time	Duration	Fraction of Total Downtime	Comments
Two Calorimeter Pedestal Downloads	02:58 & 05:58	0.4 hrs	57%	Killing hot cell requires freeing global trigger, rerun calorimeter pedestal download, then reload global trigger.

Major Sources of Downtime for Sunday 18-Aug-2002 (0.7 hrs)				
Cause	Start Time	Duration	Fraction of Total Downtime	Comments
Zero Bias Special Run	01:03	0.25 hrs	35%	Change to/from global to special trigger.
Muon HV	15:14	0.15 hrs	20%	Failed attempt to change threshold on PDT DW14.

Major Sources of Downtime for Saturday 17-Aug-2002 (2.7 hrs)				
Cause	Start Time	Duration	Fraction of Total Downtime	Comments
L3 Supervisor	14:36	1 hr	37%	See report from Gordon Watt made at Fri Aug 23rd Operations Mtg.
Download of	01:59	0.75 hrs	28%	Igor Vasilyev & Vladimir

new pixel tzeroes				Lipaev had problems with crate 32.
Start of store	13:52	0.25 hrs	9%	Prescale set 20E30 was not appropriate for 22E30 beginning lumi. Went to 30E30 prescale set.
Tuning prescales	14:14	0.25 hrs	9%	Recording was turned off so prescales could be tuned.
Muon central trigger	22:27	0.15 hrs	6%	Testing new muon central trigger.

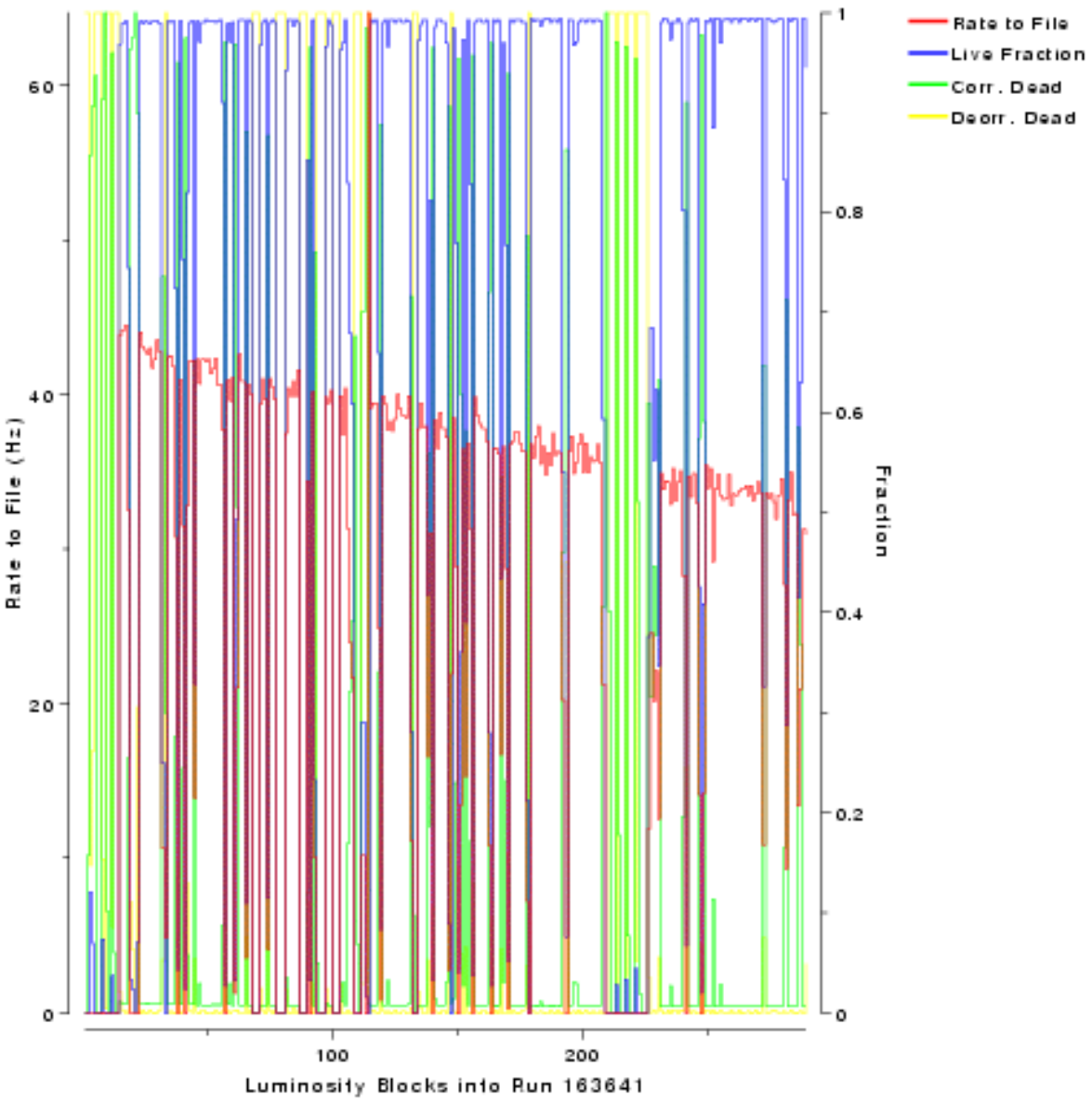
Major Sources of Downtime for Saturday 31-Aug-2002 (2.3 hrs)				
Cause	Start Time	Duration	Fraction of Total Downtime	Comments
L2 CAL Alpha Crashes & Replacement	00:30 & 03:09 & 5:07	0.75 hrs	33%	See email from Johannes Elmsheuser & Reinhard Schwienhorst
SMT HV trip	23:31	0.5 hrs	22%	Paused from 23:02 to attempt reset. Stopped run at 23:31. Called expert (Harald Fox). Disabled 3 HDIs: 6613-0A07-A & C, 6413-0B11-F
L2 Global Alpha Crash	01:47	0.25 hrs	11%	Stop run, free trigger. Restart Alpha, reinit COOR, load trigger.
DAQ console DØol07 hung	06:31	0.25 hrs	11%	Could not control any windows. The windows manager consumed 99.9% of CPU, and it could not be killed and restarted. Reset the node.
SMT HDI trips	01:02	0.15 hrs	7%	Channels SE1B14 were drawing more DVDD current than others. Ramp down HV, redownload, ramp back up.
Muon Special Run	16:12	0.15 hrs	7%	Change to/from global to special trigger. Test trigger with recording off.

End/Begin stores	**17:02 & 20:42**	**0.15 hrs**	**7%**	**Lower/raiser SMT and Muon high voltages, stop/start recorded runs.**

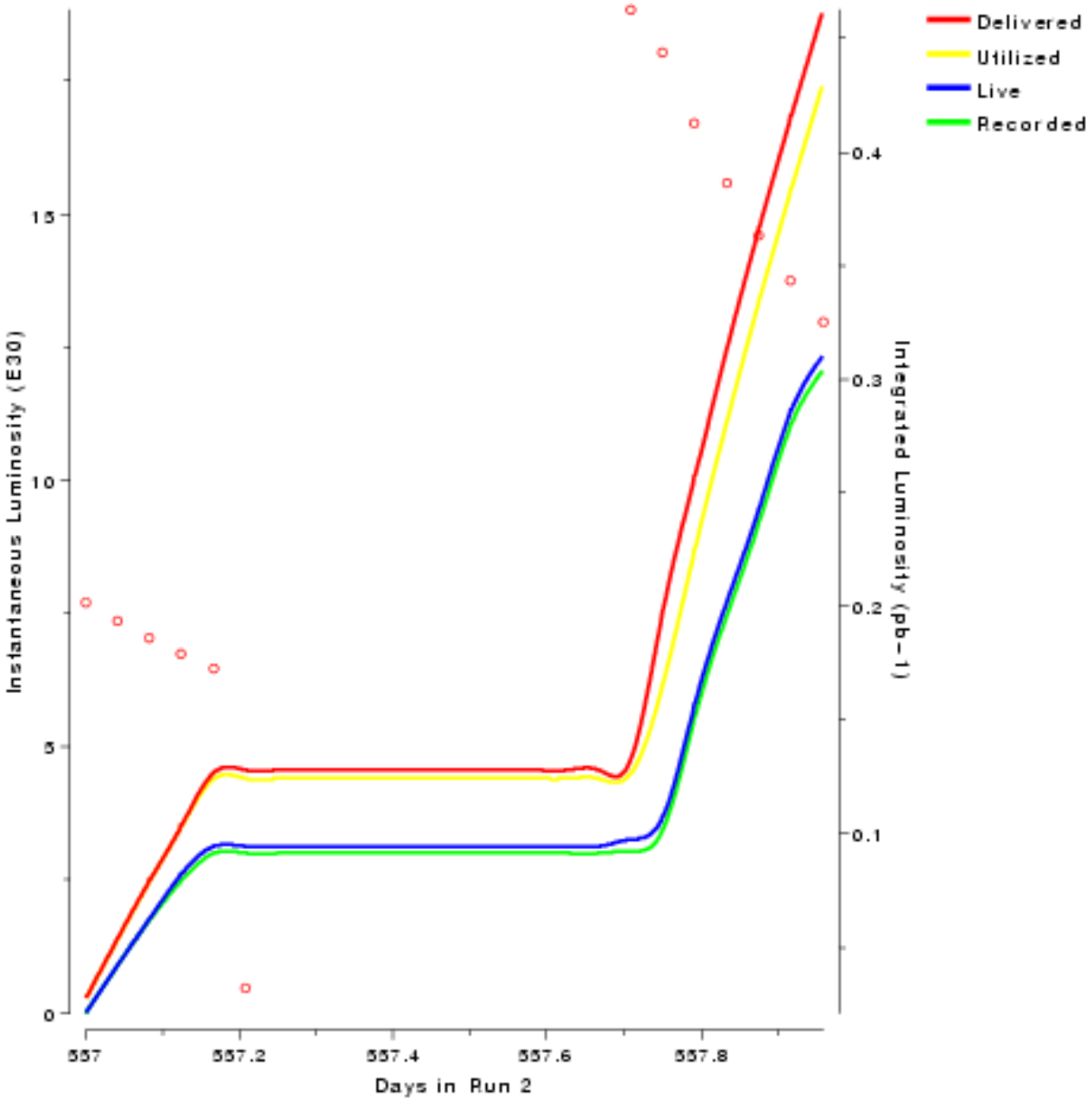
Major Sources of Downtime for Sunday 01-Sep-2002 (1.9 hrs)				
Cause	**Start Time**	**Duration**	**Fraction of Total Downtime**	**Comments**
SMT HDIs FEB, HV trips	**10:40**	**0.66 hrs**	**35%**	**HDIs H3-L2-HD15 & H3-L2-HD17 rising currents raise FEB. Powered down & back up. HV pods 720P and 340 P trip. Reset & changed current limts.**
Dimuon eta-phi test	**11:42**	**0.33 hrs**	**17%**	**Investigated problems with the L2 muon eta-phi separation filter. Adjusted prescales with recording off.**
L2 MUC FEB & missing inputs	**00:16**	**0.25 hrs**	**13%**	**See email from Johannes Elmsheuser**
L2 Global Alpha Crash	**12:03**	**0.25 hrs**	**13%**	**Stop run, free trigger. Restart Alpha, reinit COOR, load trigger.**
CFT x50 downloads	**02:29 & 02:41**	**0.20 hrs**	**11%**	**Hole in L3 phi distribution developed after SCLinit. First download fixed one hole, but a different one developed, which required a second download. Run was stopped both times.**

Cause	**Start Time**	**Duration**	**Fraction of Total Downtime**	**Comments**
SMT HV trips & disable channels	**02:37 & 02:45**	**0.33 hrs**	**47%**	**HV channels A20P, 602P and 603N. Disabled NW0A07-A, NW0B11-F, NW0A07-C.**

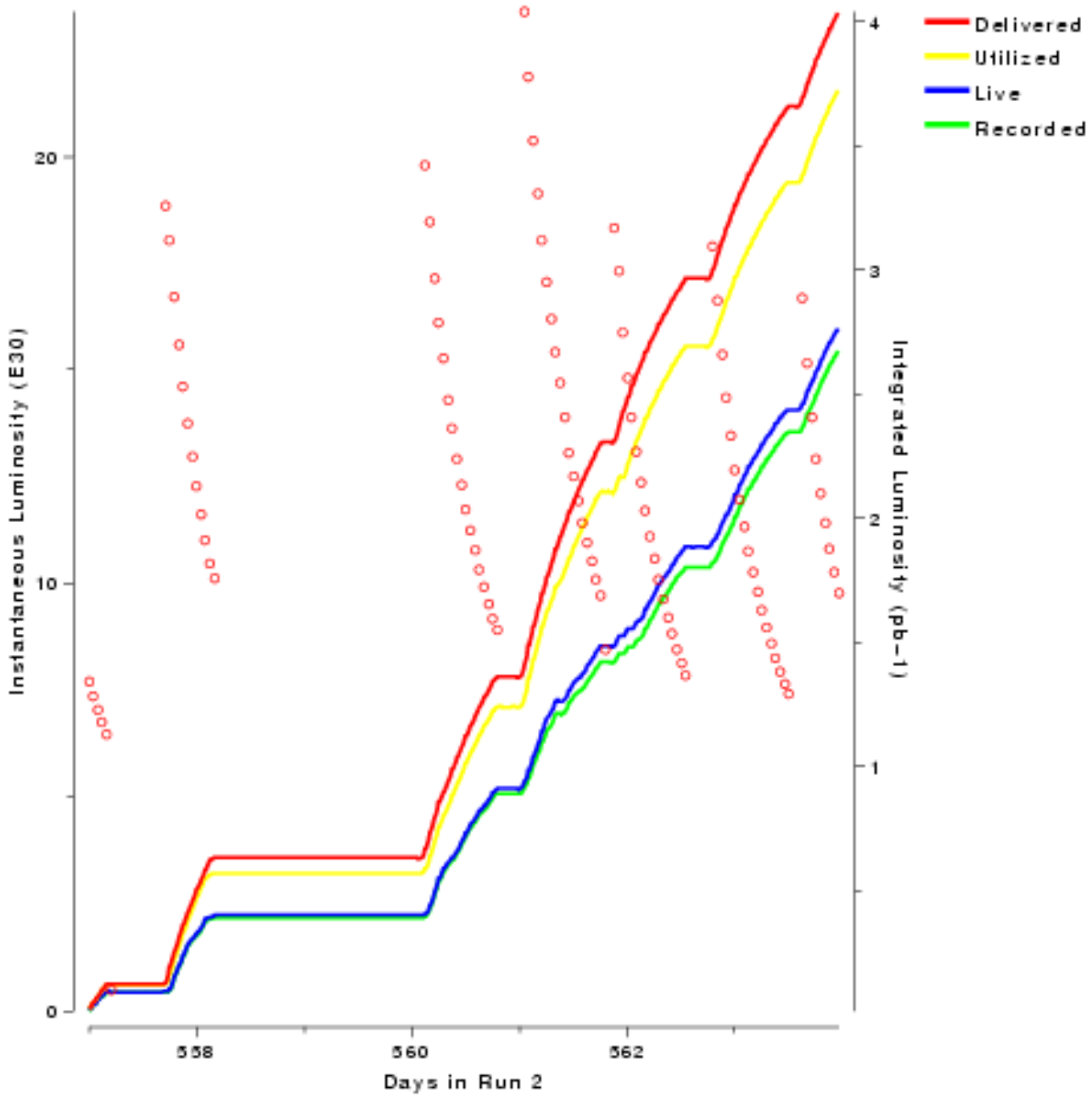
Begin Store 1723 & Start Recorded Run	**19:57**	**0.25 hrs**	**36%**	**Ramping SMT and Muon HV. First run delayed?**



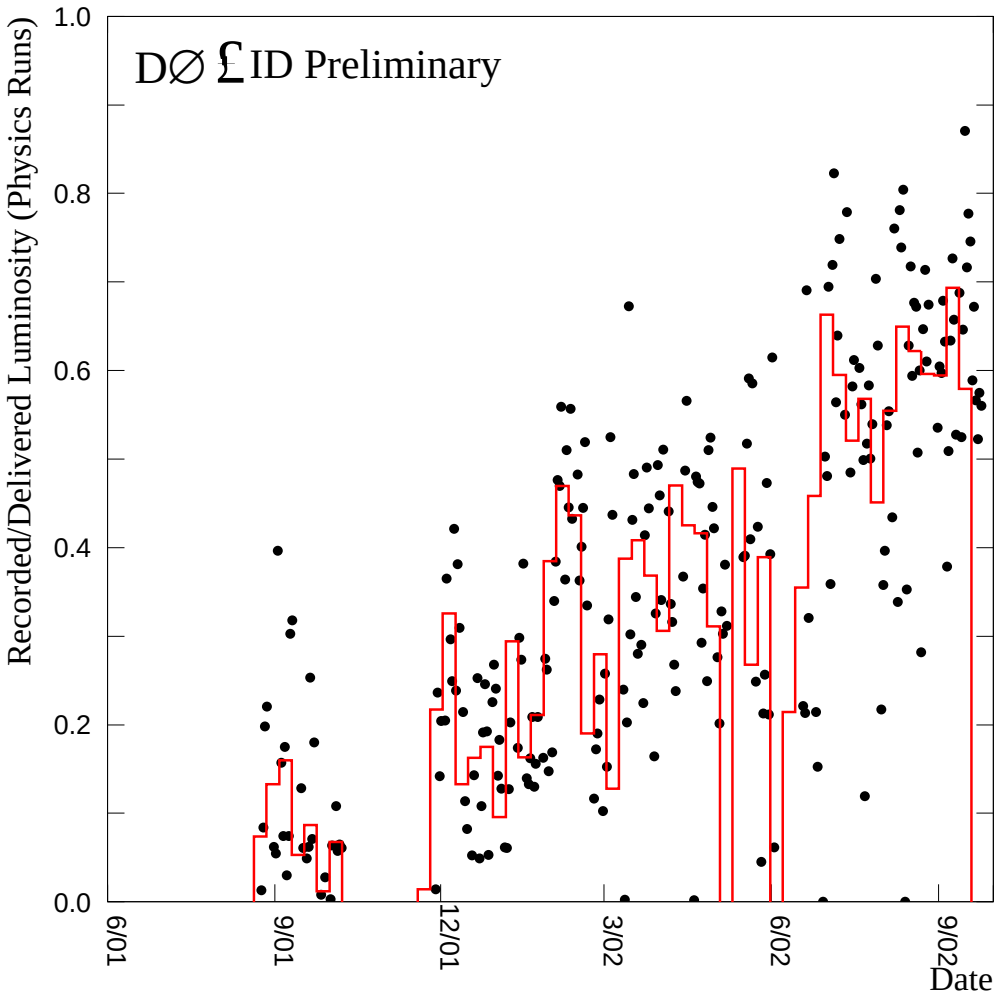
Single Run Uptime Plot



Daily Uptime Plot



Weekly Uptime Plot



Evolution of the metric over time