

LHC Status;

CMAC , 14th March 2013

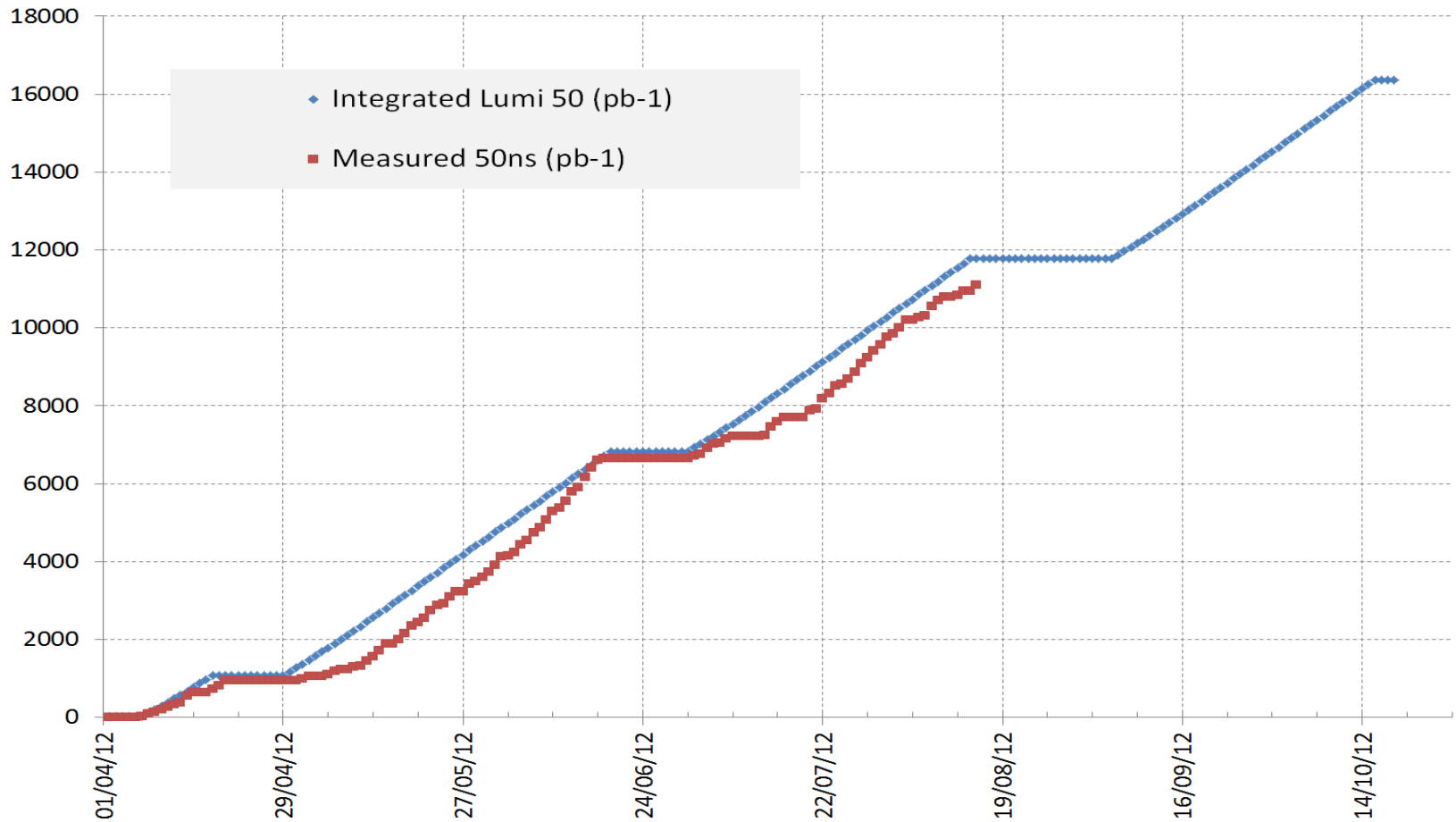
Steve Myers

(On behalf of the LHC team and international collaborators)

- 09:00 - 10:00 **Overview** of 2012 LHC p-p operation
- 10:00 - 10:30 Electron cloud **scrubbing** run and strategy for 2015
- 11:00 - 11:30 Highlights and conclusions of the LHC operations workshop in **Evian**
- 11:30 - 12:00 LHC beam **instrumentation** – performance, issues and plan
- 12:00 - 12:30 Overview of the LHC **p-Pb** run in early 2013
- 14:00 - 14:30 **Injector** performance during 2012/13
- 14:30 - 15:00 **LS1** activities in the injectors & expectation for 2015
- 15:00 - 15:30 **UFO** update including 25 ns
- 16:00 - 16:30 **HL-LHC** project overview
- 16:30 - 17:00 **High-field magnet** progress
- 17:00 - 17:30 **HE-LHC** studies and long-term plan

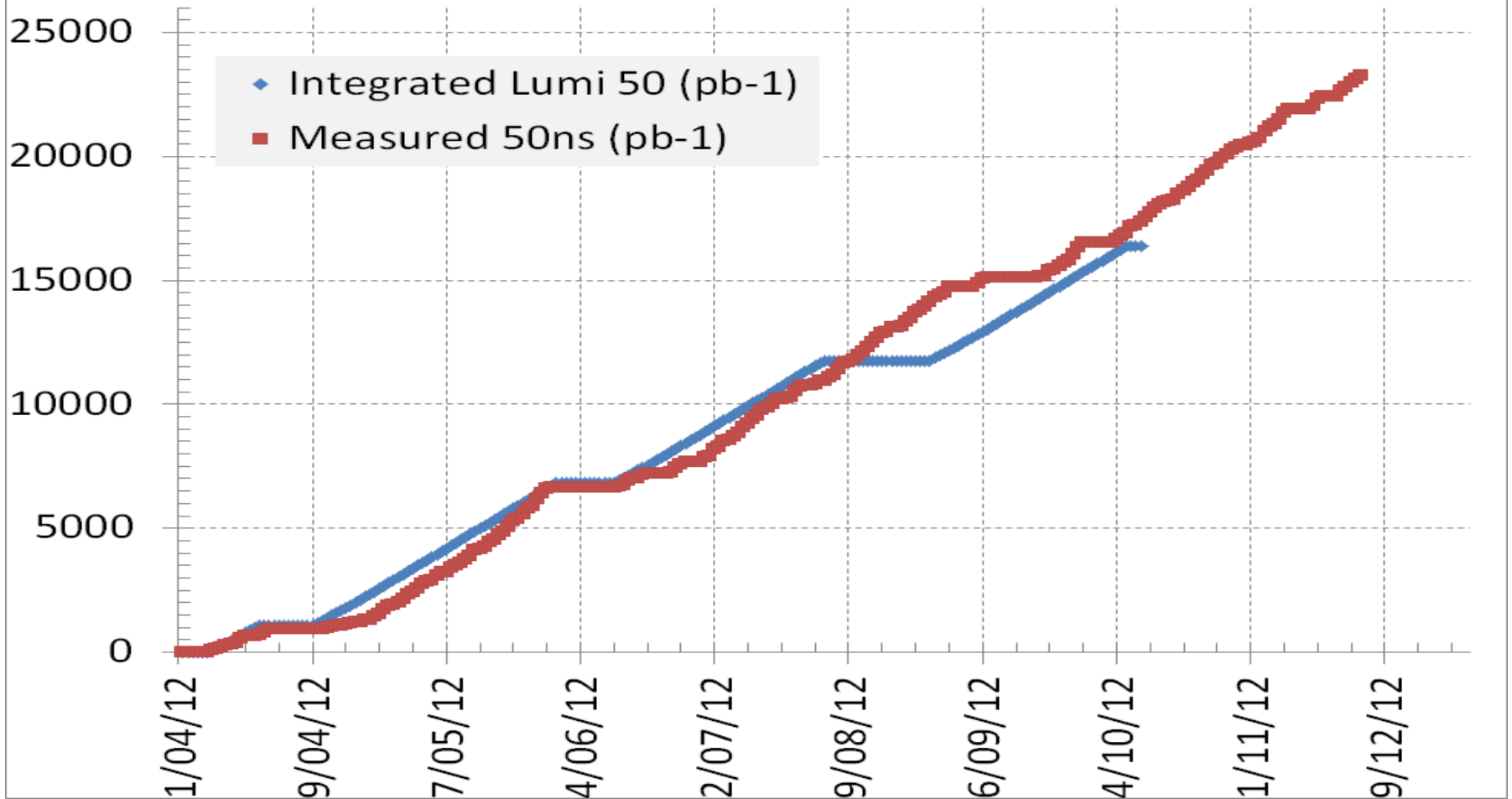
Where are we on Aug 16

2012 Measured vs Predicted Integrated Luminosity

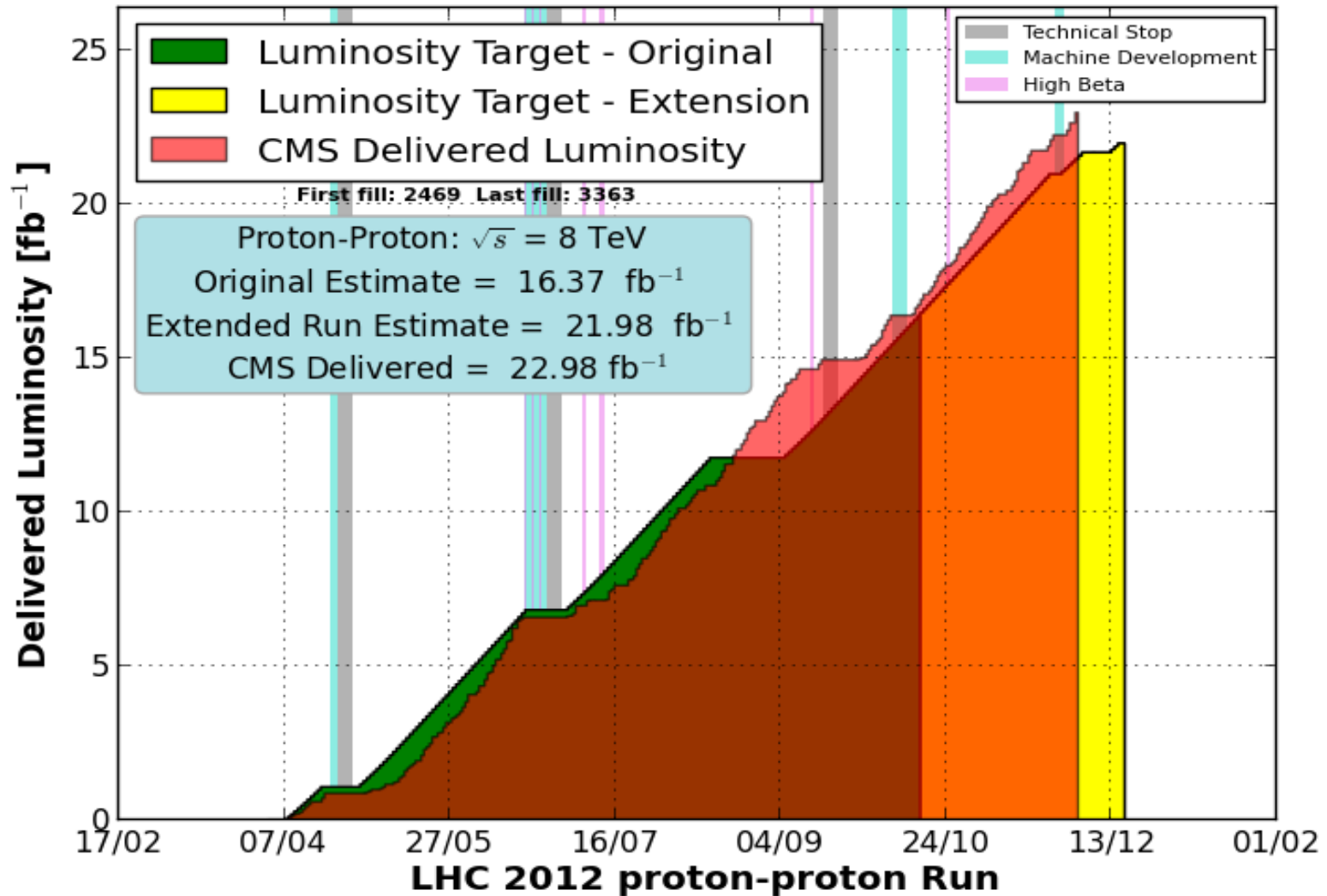


2012

2012 Measured vs Predicted



With the modified schedule



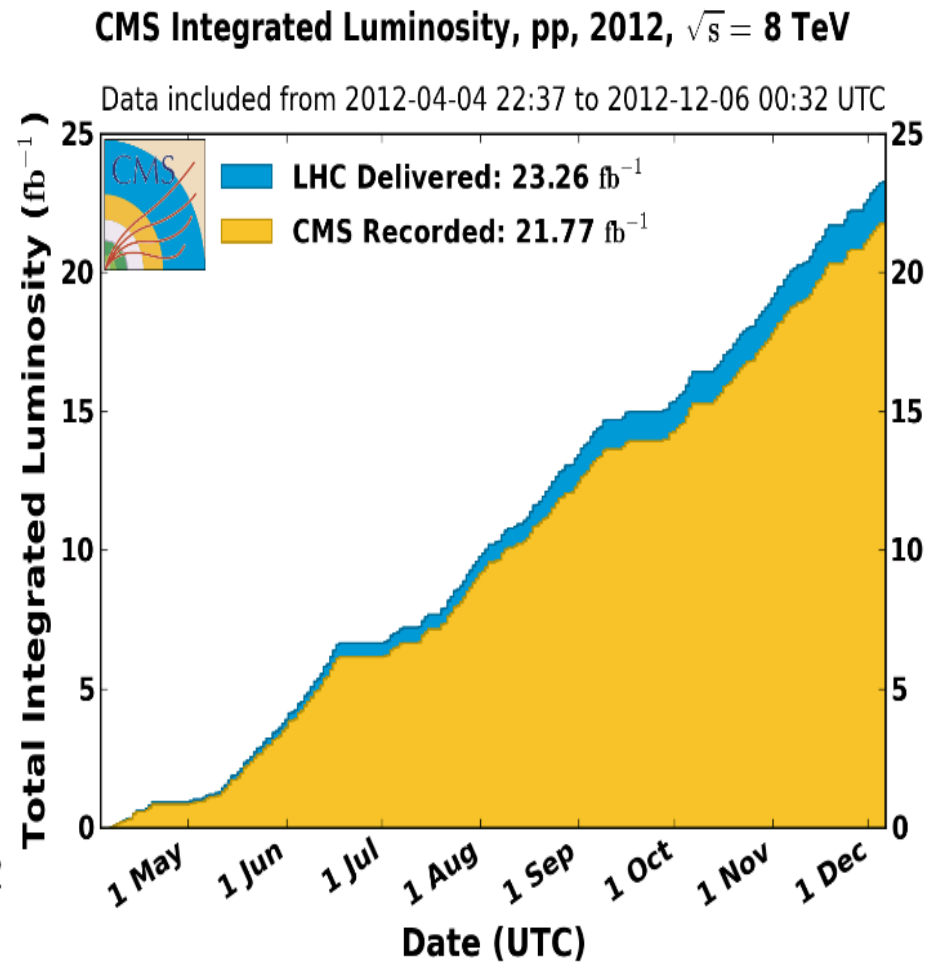
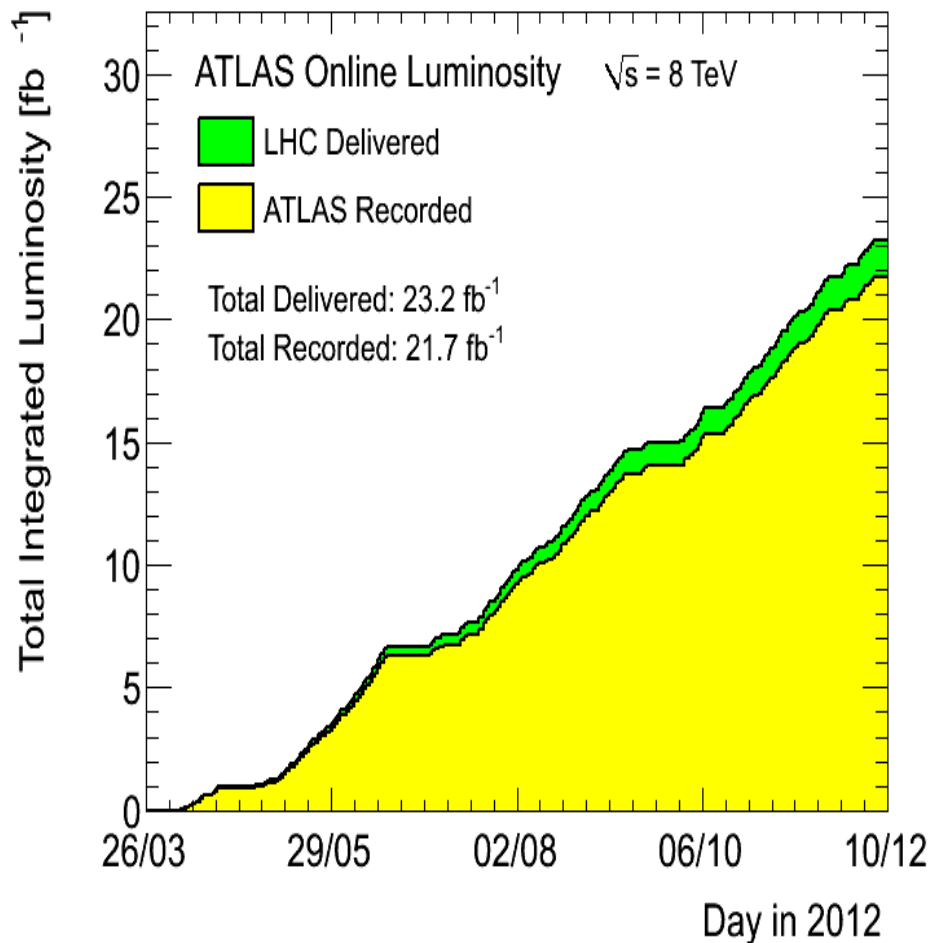
Total Luminosities 2012

ALICE: 9.81 pb⁻¹

ATLAS: 23.25 fb⁻¹

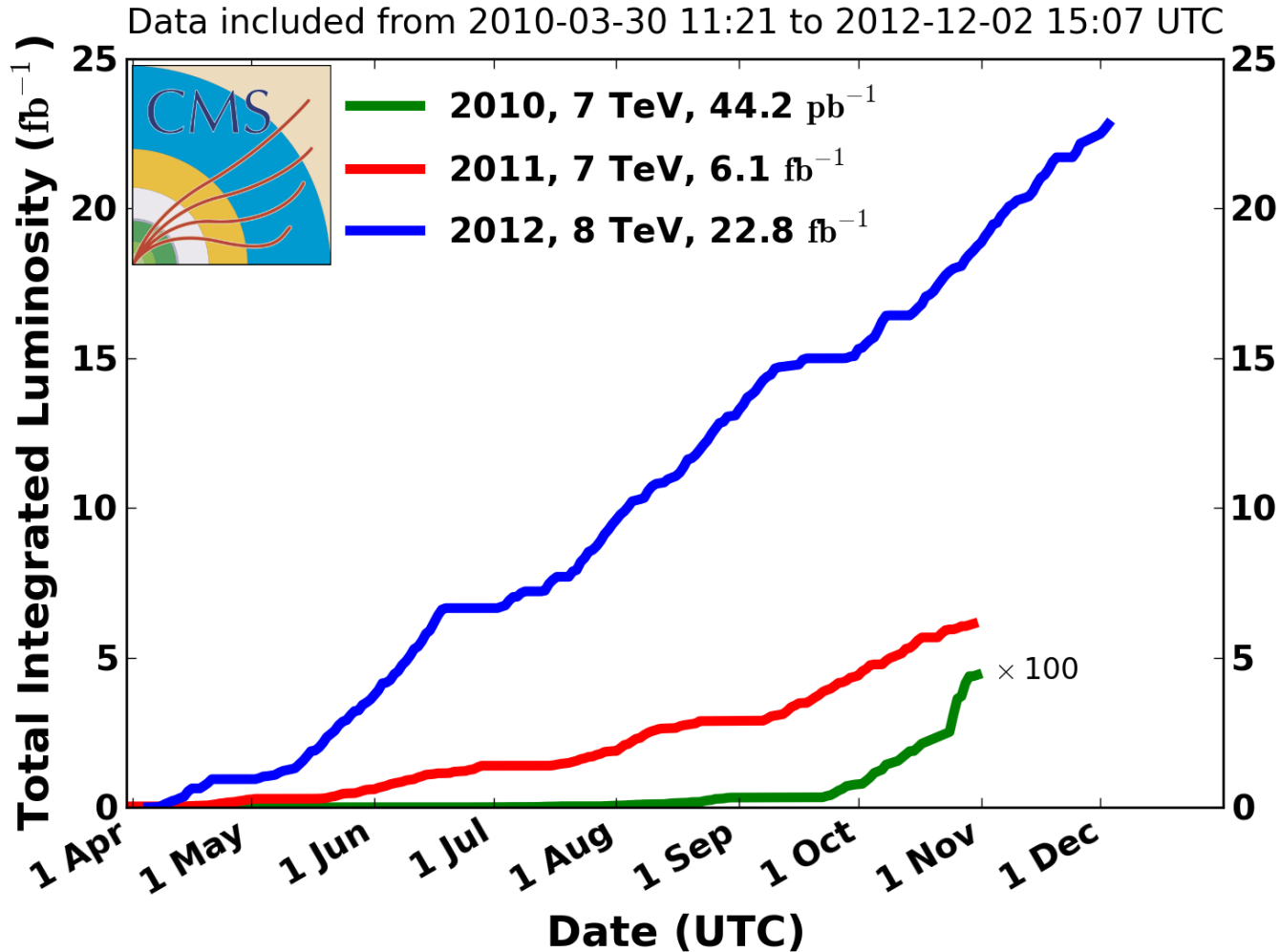
CMS: 23.26 fb⁻¹

LHCb: 2.19 fb⁻¹



Last 3 years

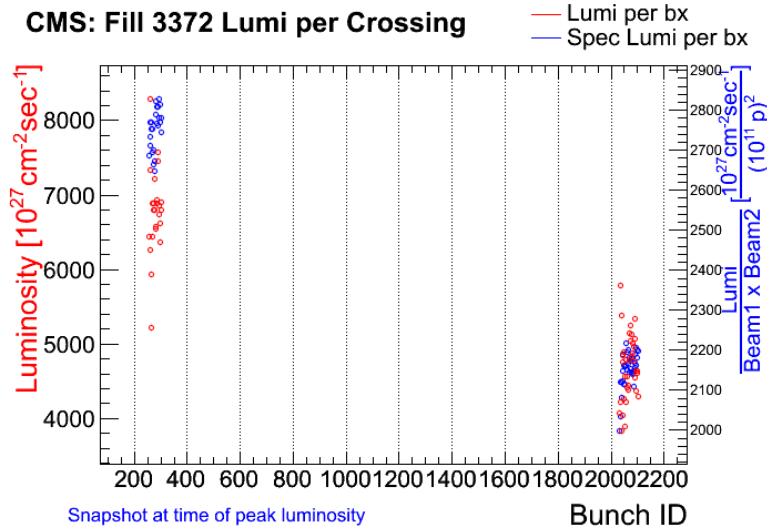
CMS Integrated Luminosity, pp



The end of 2012

- 25 ns tests
 - Electron cloud and vacuum (scrubbing)
 - Crossing angle, aperture, beam-beam, min β^*
 - UFOs
 - HOM heating

Injector High Brightness Beams

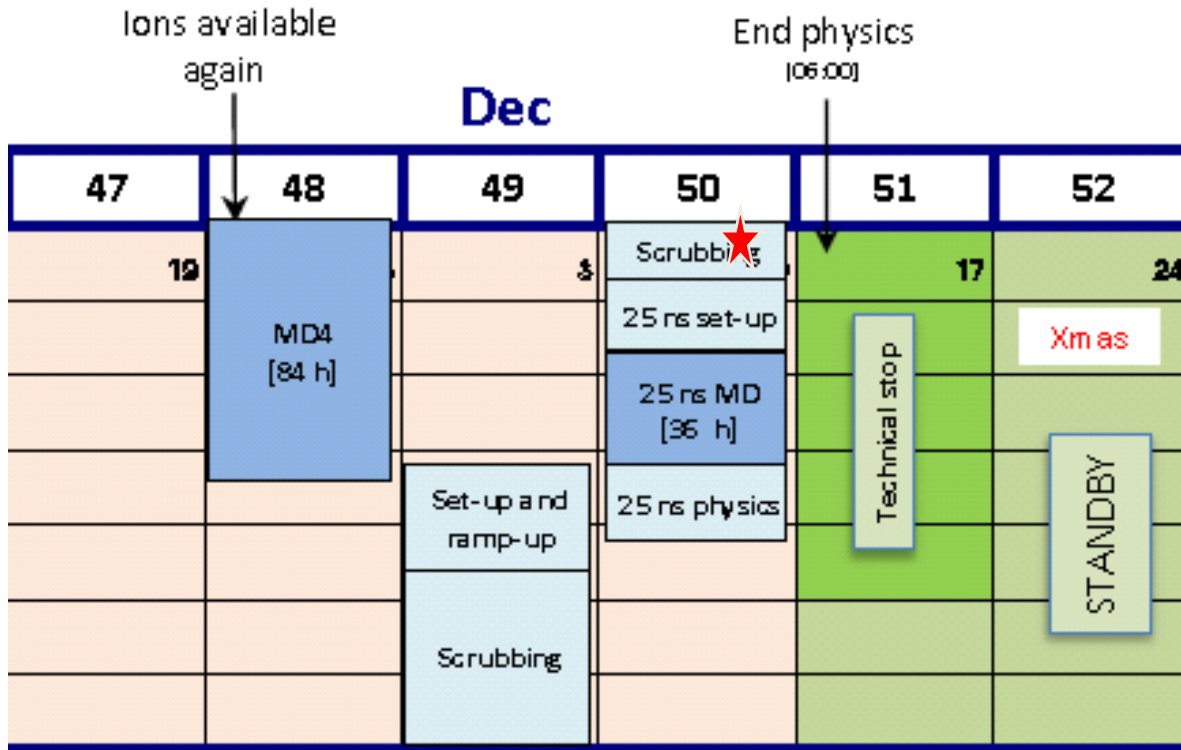


About 30 % gain in specific luminosity !

For 25ns operation, now seems possible $1.15\text{E}11$ with emittance of $1.4\mu\text{m}$ at LHC inj.

- High brightness beams from the injector chain
 - Very interesting option for 2015 operation, both 50 ns and 25 ns beam spacing
- Fill with one batch HB and 1 batch ‘standard’ 50 ns
 - Emittance for HB beam $\sim 1\text{-}1.2 \mu\text{m}$, standard $1.4\text{-}1.6 \mu\text{m}$.

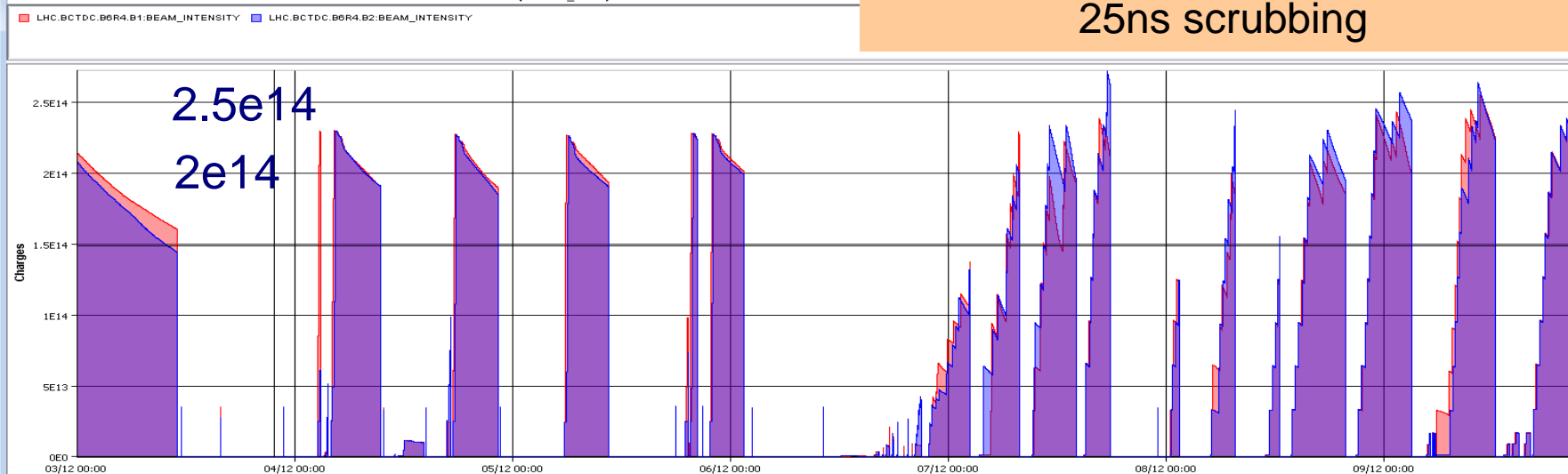
Scrubbing



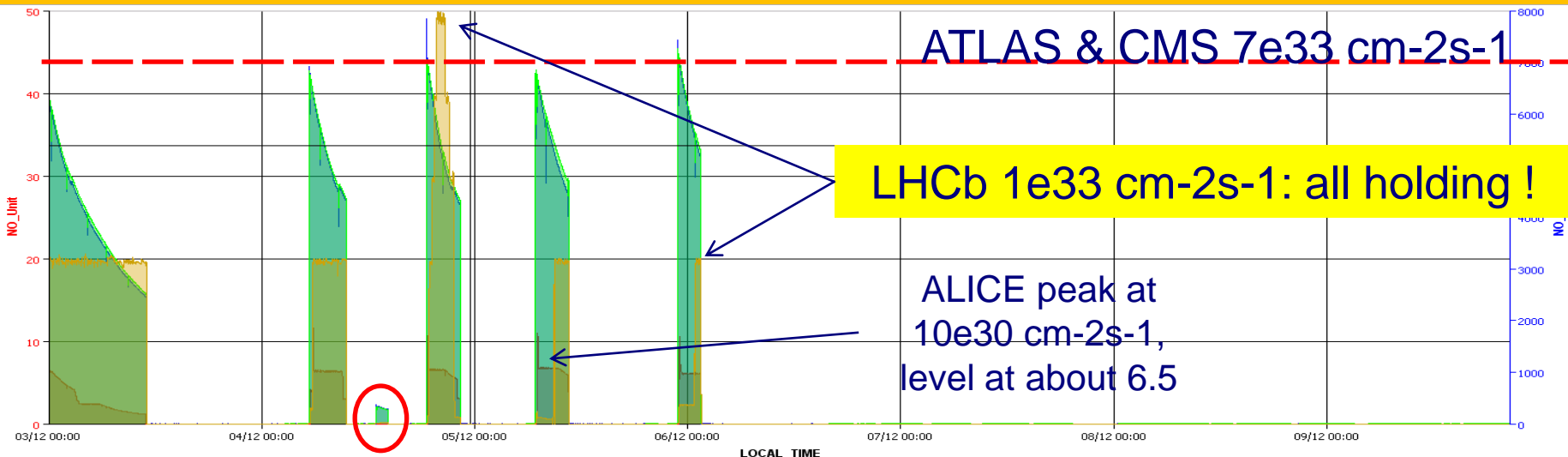


Beam currents and luminosity

Timeseries Chart between 2012-12-03 00:00:00.000 and 2012-12-09 20:37:25.354 (LOCAL_TIME)

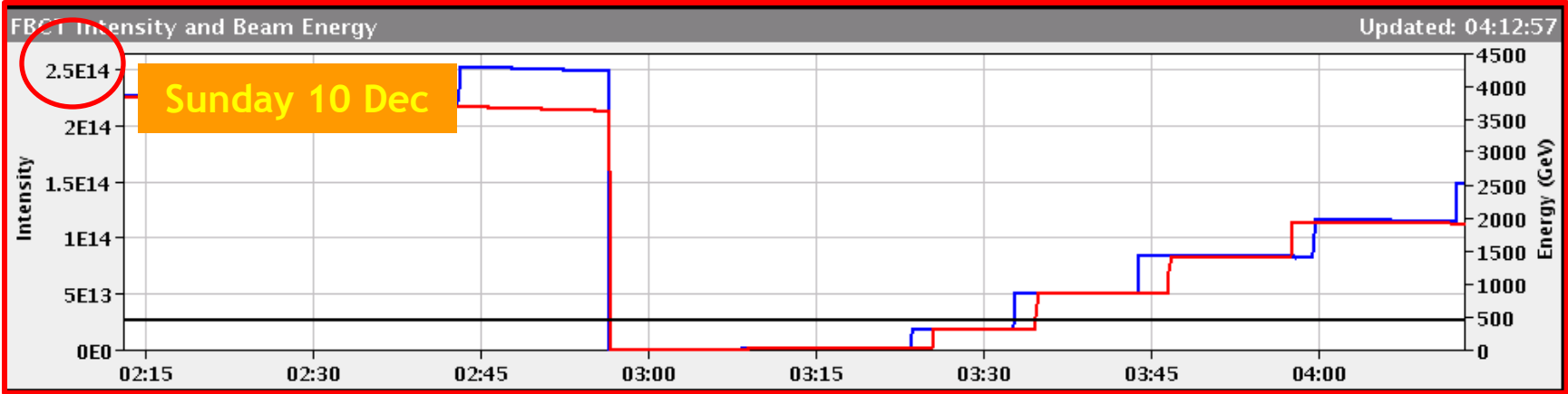
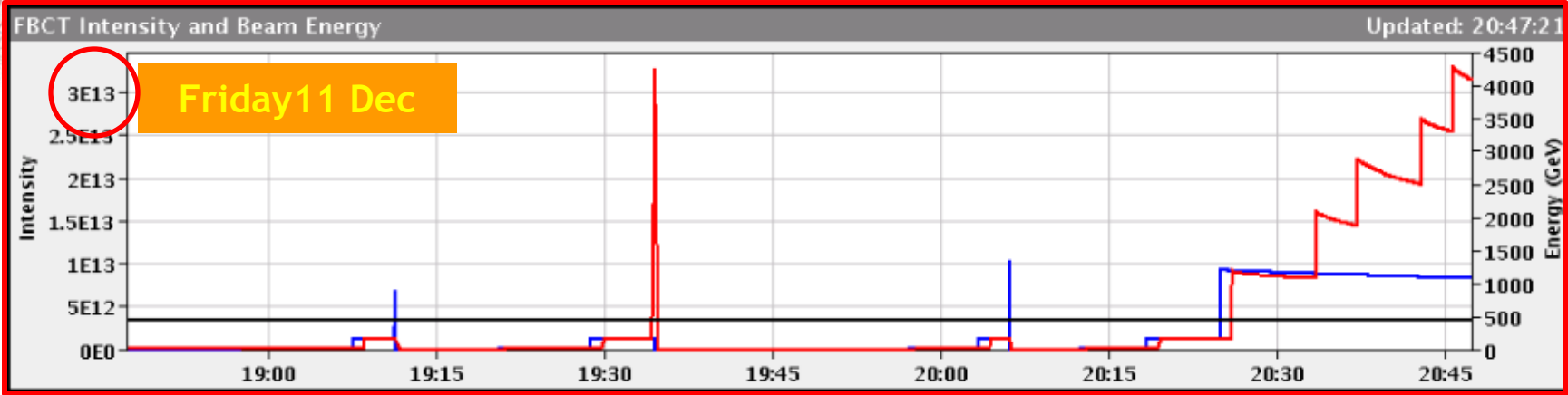


TDI HB RF TED



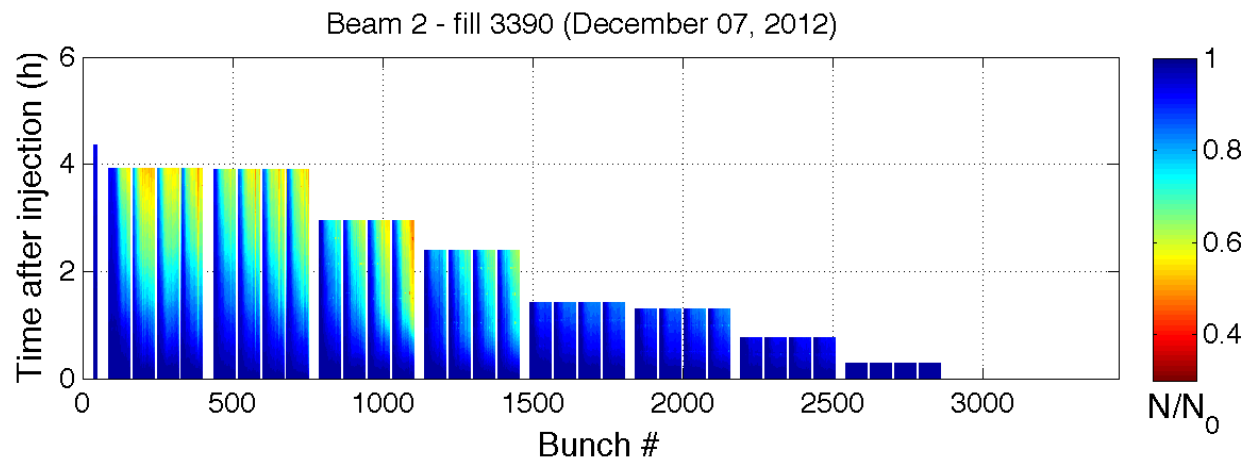
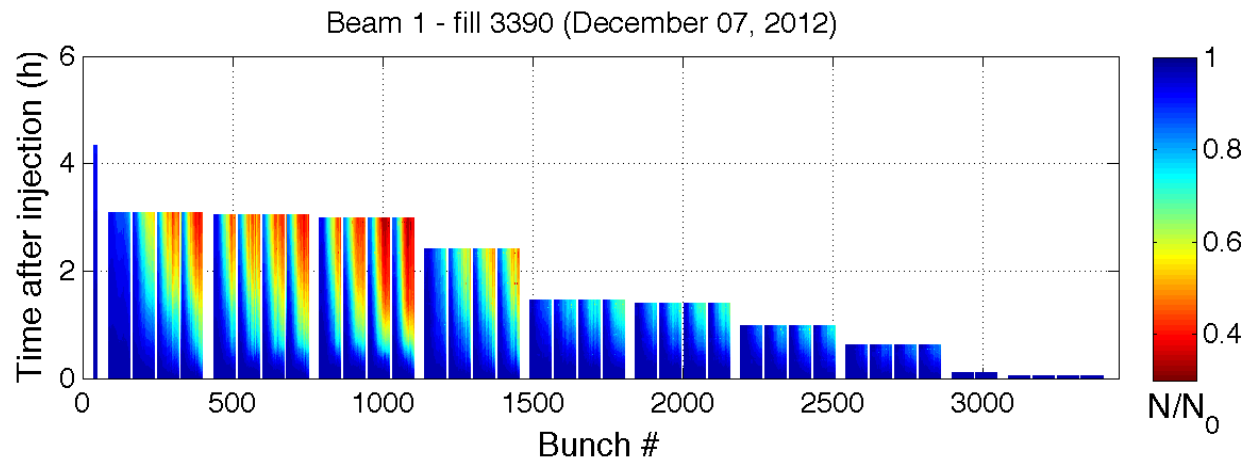
Beam quality evolution

Beam lifetime



Beam quality evolution (preliminary)

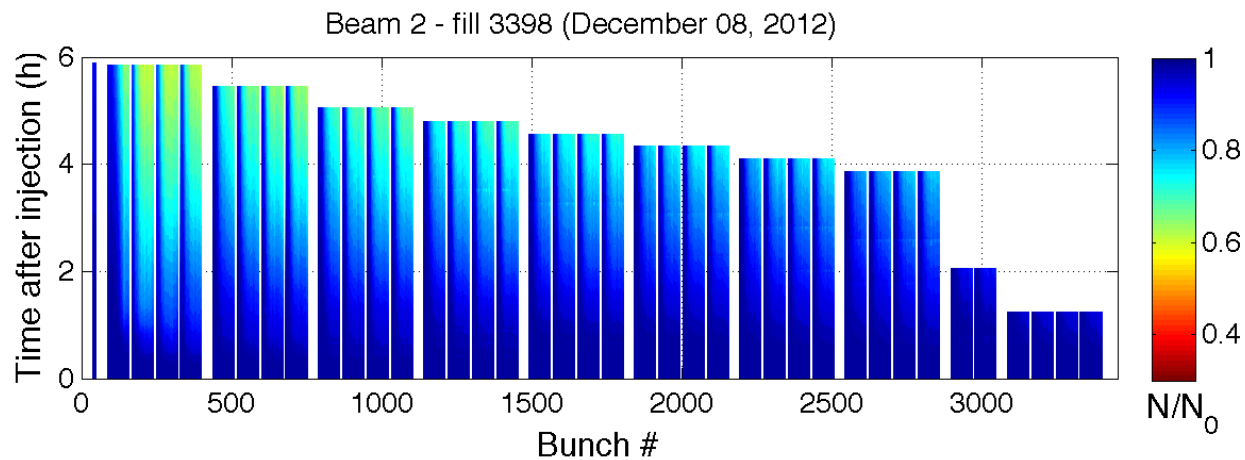
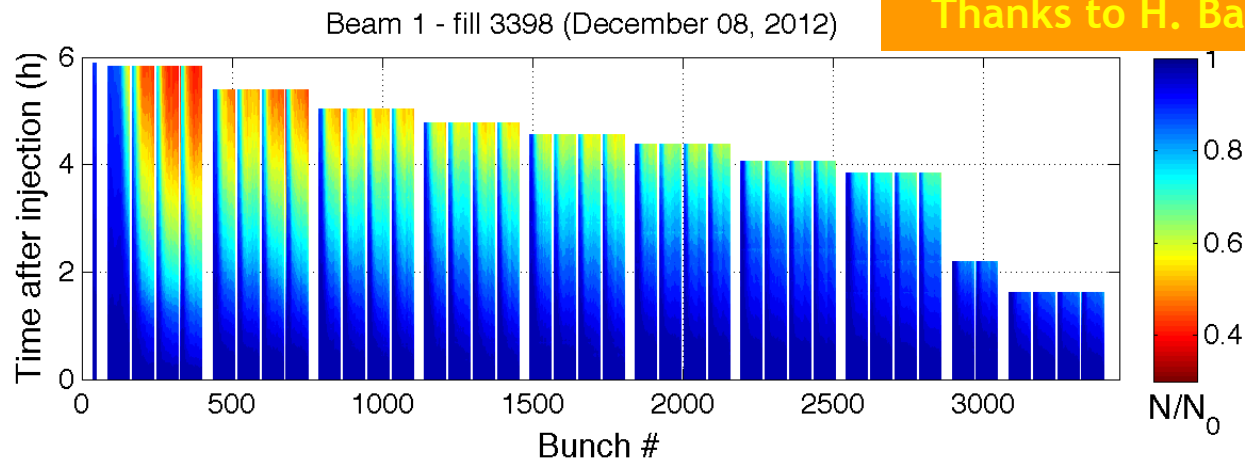
Beam lifetime - Friday Dec. 7th



Beam quality evolution (preliminary)

Beam lifetime - Saturday Dec. 8th

Thanks to H. Bartosik

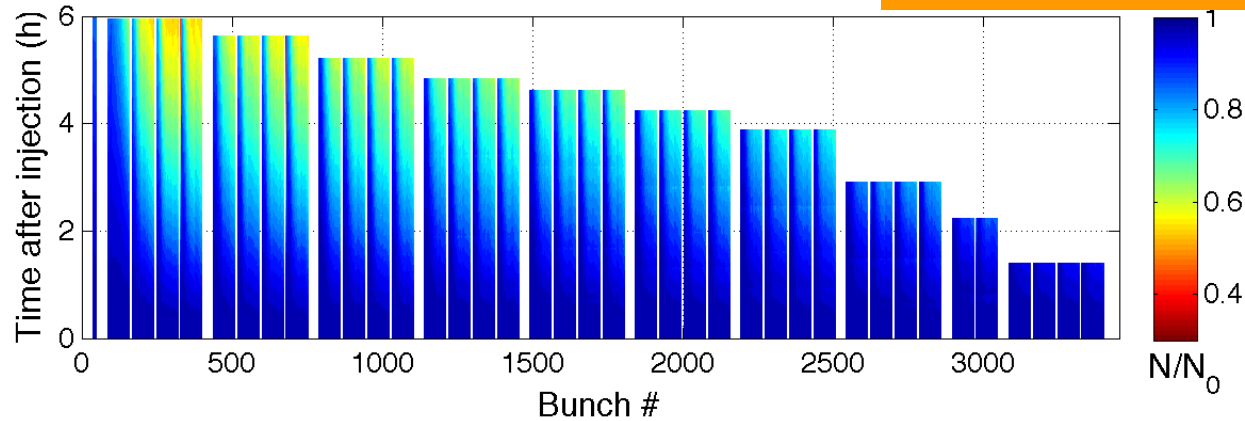


Beam quality evolution (preliminary)

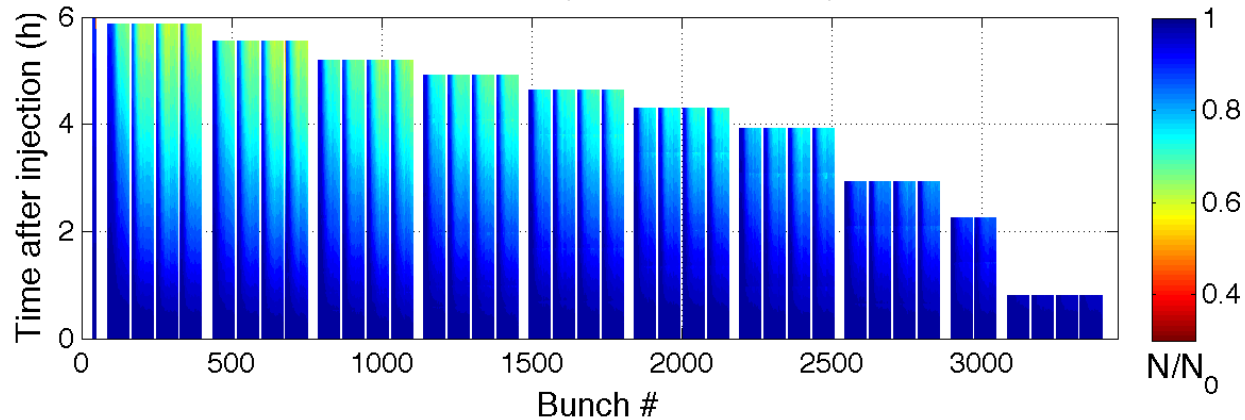
Beam lifetime - Sunday Dec. 9th

Beam 1 - fill 4305 (December 09, 2012)

Thanks to H. Bartosik



Beam 2 - fill 4305 (December 09, 2012)



2013 LHC & Injector Schedule

Draft

	Jan			Feb				Mar						
Wk	1	2	3	4	5	6	7	8	9	10	11	12	13	
Mo	31	7	14	21	28	4	Quench tests 11	18	25	4	↓ PS open	11	18	25
Tu	STANDBY													
We														
Th														
Fr														
Sa														
Su														

Recommission injectors & LHC (protons & ions) →

SHUTDOWN LS1

LHC PROTON-ION RUN IONS TO NORTH AREA

Powering tests

G. Friday

Monday	7	January
Tuesday	8	January
Wednesday	9	January
Thursday	10	January
Friday	11	January
Saturday	12	January
Sunday	13	January
Monday	14	January
Tuesday	15	January
Wednesday	16	January
Thursday	17	January
Friday	18	January
Saturday	19	January
Sunday	20	January
Monday	21	January
Tuesday	22	January
Wednesday	23	January
Thursday	24	January
Friday	25	January
Saturday	26	January
Sunday	27	January
Monday	28	January
Tuesday	29	January
Wednesday	30	January
Thursday	31	January
Friday	1	February
Saturday	2	February
Sunday	3	February
Monday	4	February
Tuesday	5	February
Wednesday	6	February
Thursday	7	February
Friday	8	February
Saturday	9	February
Sunday	10	February

- Restart
- First injection in the LHC
- Injection checks and Squeeze commissioning
- Collimation set up, IR2 aperture measurements, first collisions
- **First Stable beams, first injection of trains of p and Pb**

- End of ALICE minimum bias data taking
- **ALICE polarity change**
- Van der Meer scans
- Pb source refill

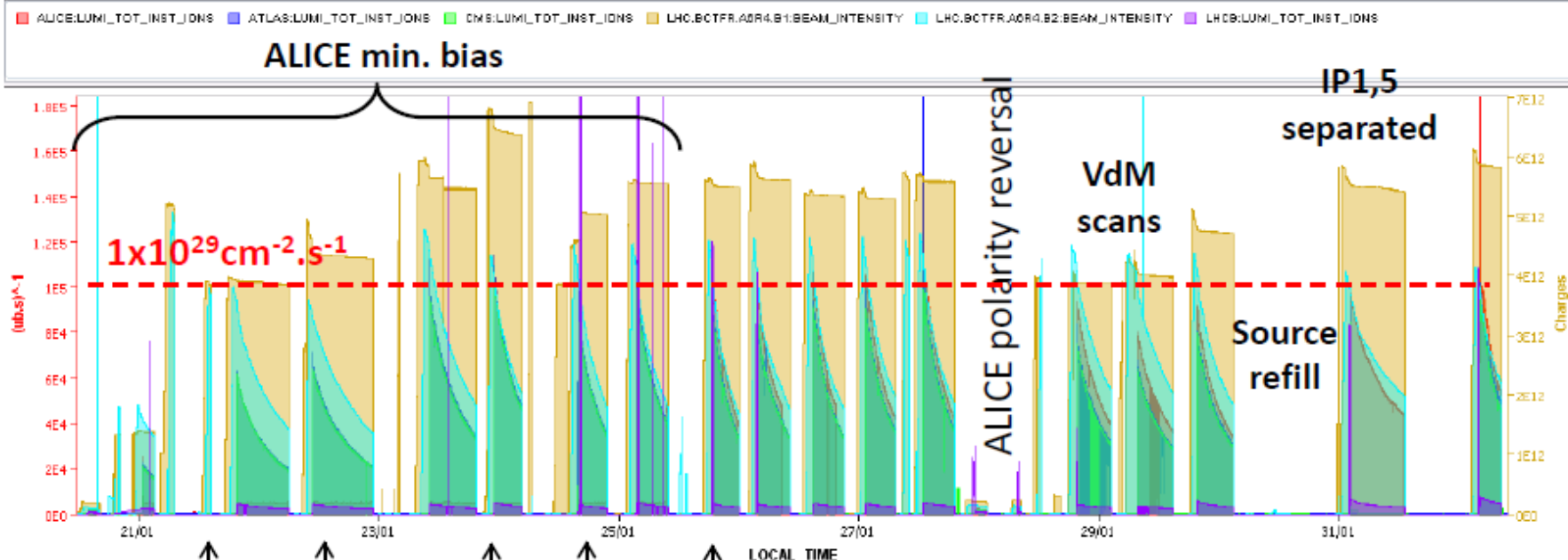
p-Pb

- **Beams reversal**

- Van der Meer scans

Pb-p

Timeseries Chart between 2013-01-20 03:49:00.000 and 2013-02-02 12:00:30.000 (LOCAL_TIME)



Increase of BLM monitor factor (losses during cogging)

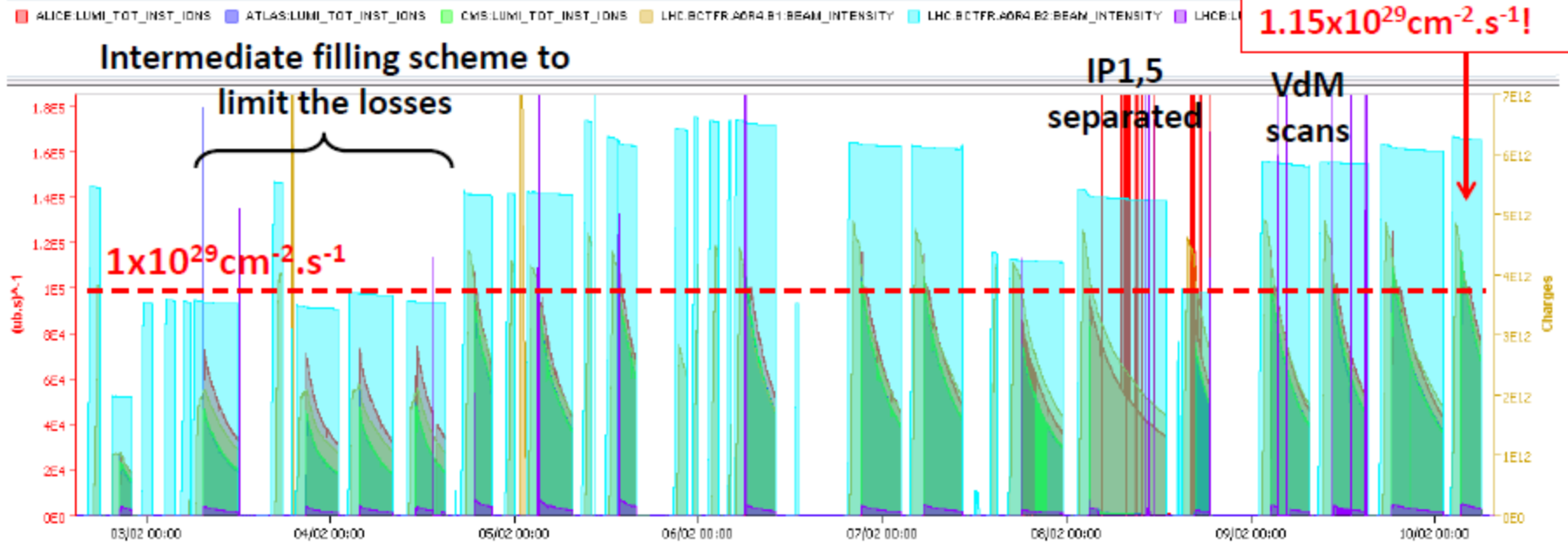
Problem of losses during cogging solved

TOTEM Roman Pots moved in

ALFA Roman Pots moved in

Longitudinal blow up ON

Timeseries Chart between 2013-02-02 03:49:00.000 and 2013-02-10 09:36:53.103 (LOCAL_TIME)



Max. peak luminosity
 $1.15 \times 10^{29} \text{ cm}^{-2} \cdot \text{s}^{-1}$!

Intermediate filling scheme to limit the losses

IP1,5 separated

VdM scans

$1 \times 10^{29} \text{ cm}^{-2} \cdot \text{s}^{-1}$

Increase of BLM monitor factor (losses end of ramp + squeeze)

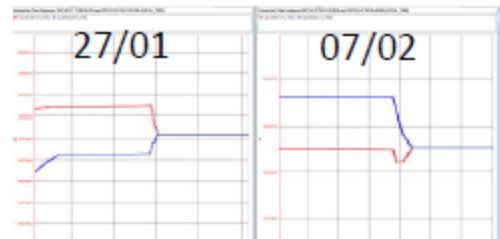
Increase bandwidth of orbit feedback

Increase of BLM monitor factor (losses during the squeeze),

Increase of BLM monitor factor (losses at the start of the ramp), rematch injection energy to the SPS

reduction of longitudinal blow-up at injection

Common frequency trimmed by -10Hz



RF frequencies

Summary and conclusion

- In the very short time allocated for the run a new mode of operation of the LHC was commissioned in 10 days, and the physics requirements were fulfilled in both configurations p-Pb and Pb-p in three weeks of physics,

<http://lhc-statistics.web.cern.ch/LHC-Statistics/index.php>

Online Integrated Luminosity

ALICE: 31.94 nb⁻¹ ATLAS: 31.2 nb⁻¹ CMS: 31.69 nb⁻¹ LHCb: 2.12 nb⁻¹

Thanks to all for the devotion and intense work !

- ALICE, ATLAS, CMS, LHCb, ALFA, TOTEM, LHCf took some data,
- Pb beam from the injectors was of very high quality,
- We did not suffer from beam-beam effects thanks to low proton beam intensity,
- Proton beam intensity could not be increased due to BPMs' bad readings at the sensitivity limit,
- The duration of fills was driven by strong burn-off and IBS, and fills were routinely dumped by the BPMSs false reading for low intensity Pb bunches,
- BLMs thresholds were pushed to theoretical quench limits, losses could maybe have been reduced with more relaxed collimators settings,
- The run allowed various measurements to be analysed to prepare future high luminosity ion runs, emittance measurements are the most important but calibration remains very difficult,
- The ion quench test is still requested...

Summary

- Integrated luminosity goal for 2012 exceeded
- “Higgs” discovered
- Proton-lead run a big success (2013)
- LS1 well under way (2013)

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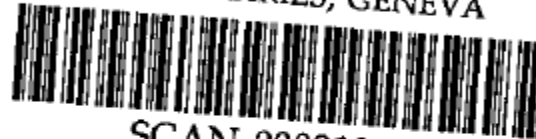
SPARES

LHC 1

ps

LEP/LIBRARY

CERN LIBRARIES, GENEVA



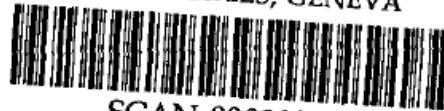
SCAN-0008106

LEP Note 440

11.4.1983

PRELIMINARY PERFORMANCE ESTIMATES FOR A LEP PROTON COLLIDER

S. Myers and W. Schnell



PRELIMINARY PERFORMANCE ESTIMATES FOR A LEP PROTON COLLIDER

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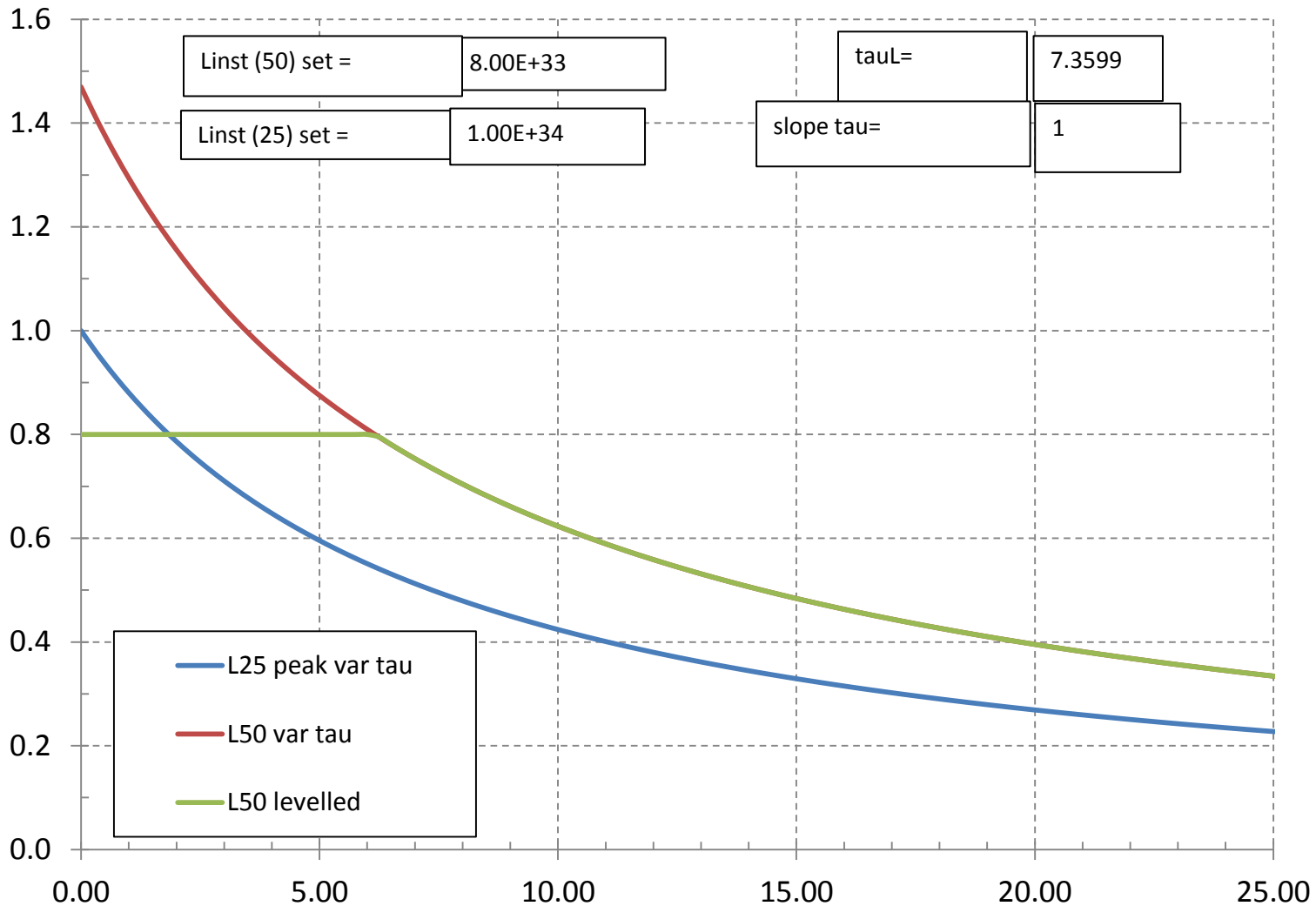
1. Introduction

This analysis was stimulated by news from the United States where very large $p\bar{p}$ and pp colliders are actively being studied at the moment. Indeed, a first look at the basic performance limitations of possible $p\bar{p}$ or pp rings in the LEP tunnel seems overdue, however far off in the future a possible start of such a p-LEP project may yet be in time. What we shall discuss is, in fact, rather obvious, but such a discussion has, to the best of our knowledge, not been presented so far.

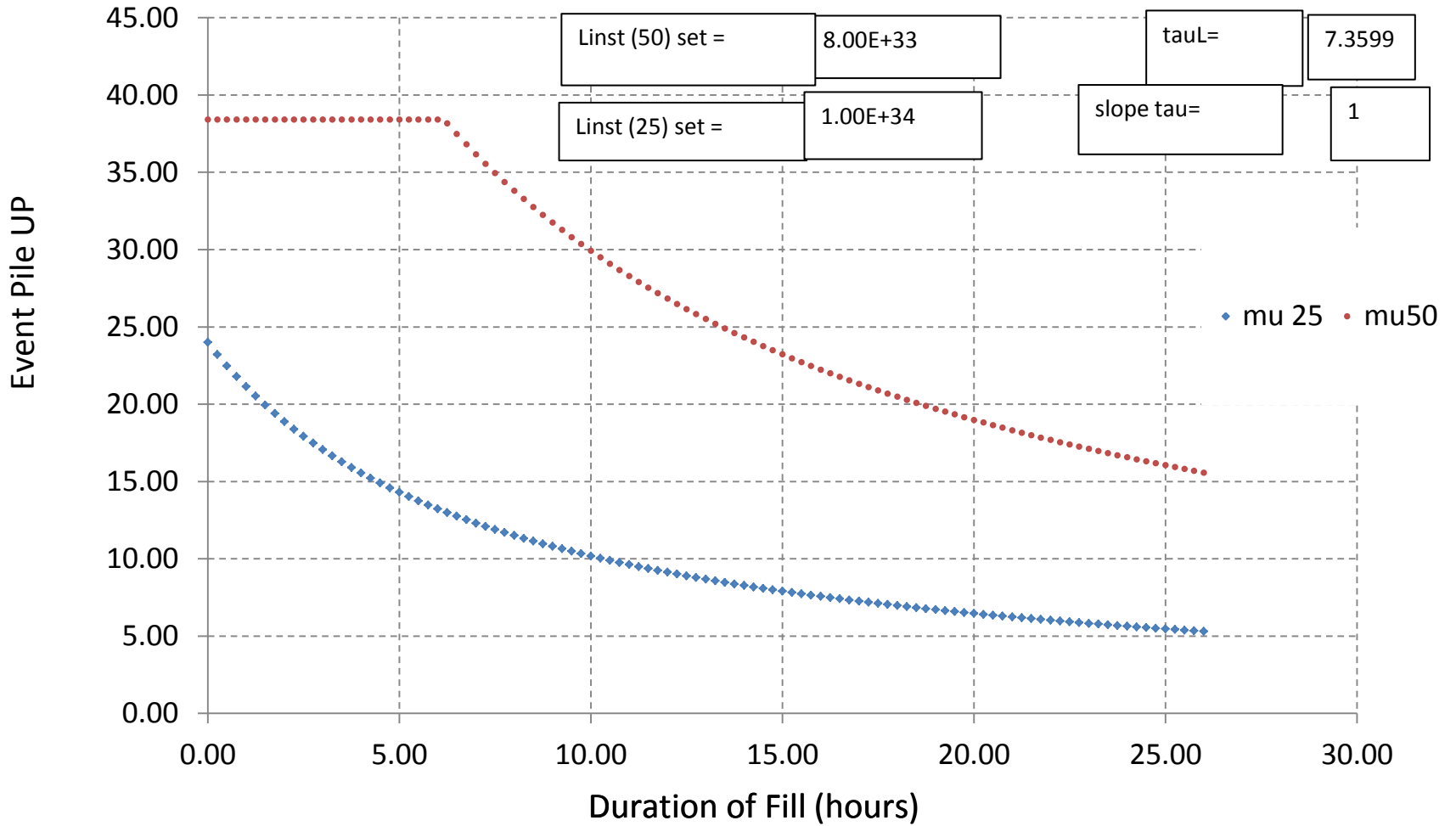
We shall not address any detailed design questions but shall give basic equations and make a few plausible assumptions for the purpose of illustration. Thus, we shall assume throughout that the maximum energy per beam is 8 TeV (corresponding to a little over 9 T bending field in very advanced superconducting magnets) and that injection is at 0.4 TeV. The ring circumference is, of course that of LEP, namely 26,659 m. It should be clear from this requirement of "Ten Tesla Magnets" alone that such a project is not for the near future and that it should not be attempted before the technology is ready.

Comparison 25ns and 50ns

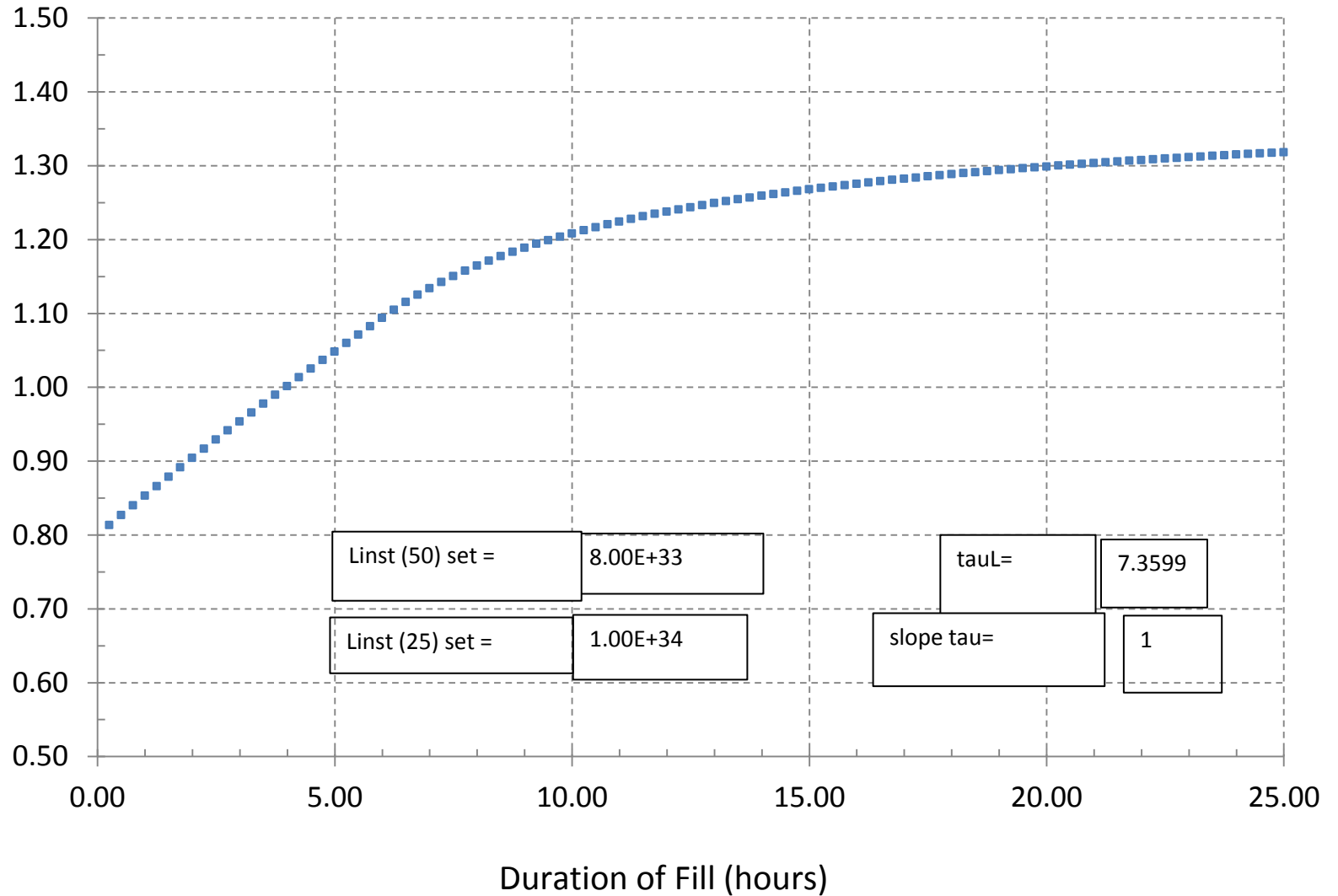
Peak Luminosities (E34)



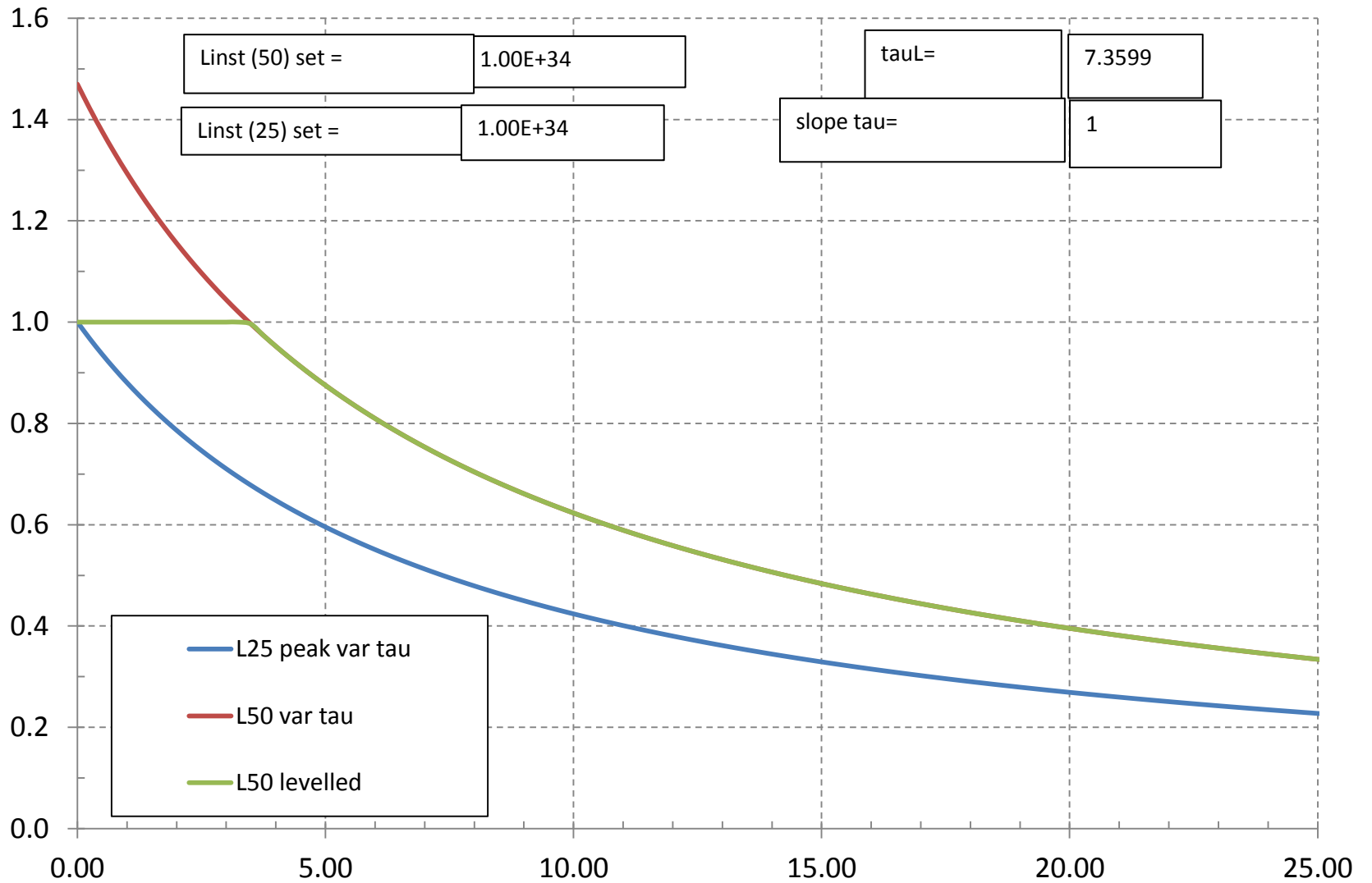
Event Pile Up (During Fill)



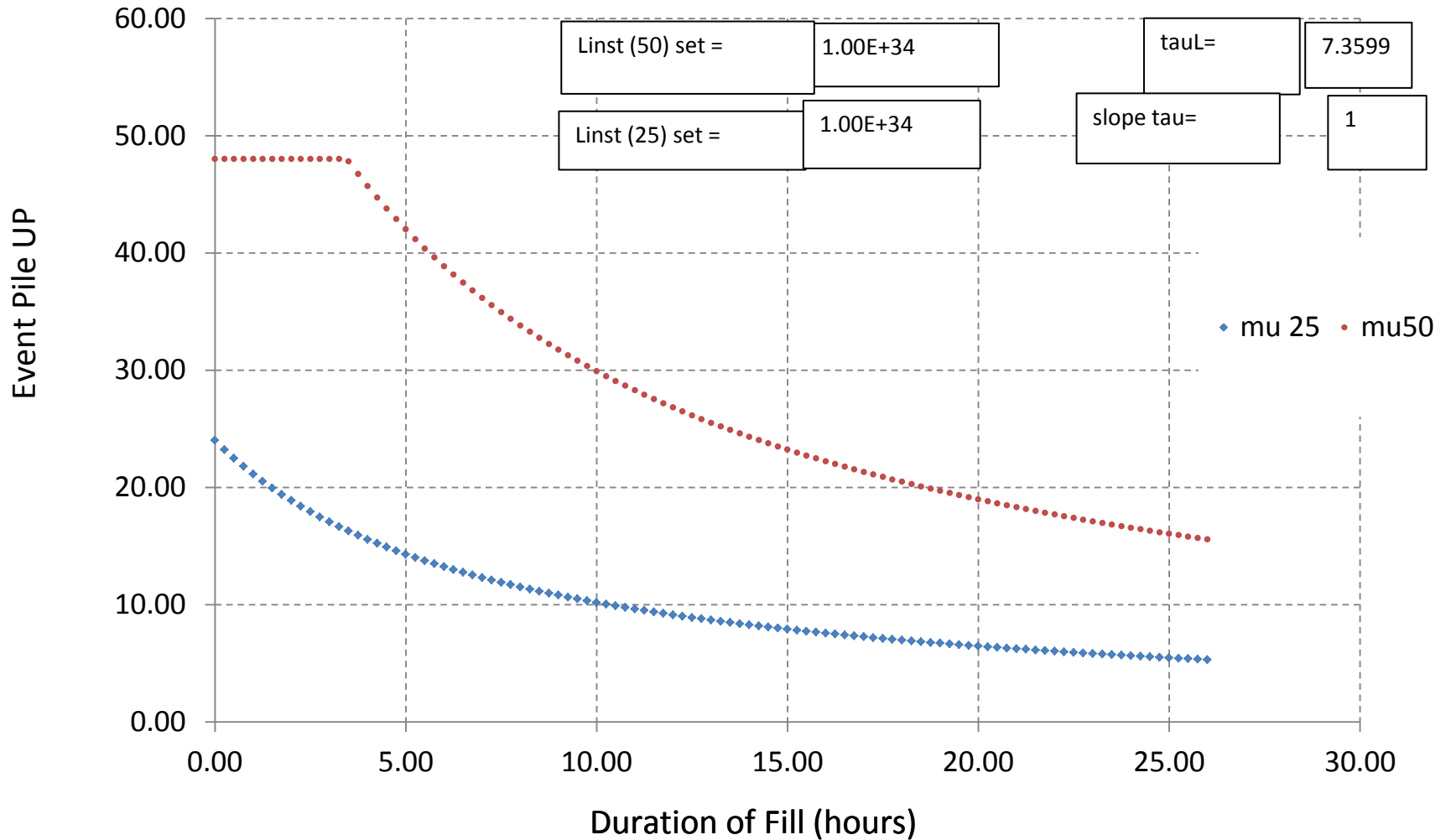
Integrated Ratio 50 to 25 ns



Peak Luminosities (E34)



Event Pile Up (During Fill)



Integrated Ratio 50 to 25 ns

