

Introduction to the Collider-Experiment Interactions Day



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Collider-Experiments Interactions

- There is a need for several interactions between HL-LHC and the experiments with different urgency and importance
 - It is important to agree on:
 - How to tackle them
 - How to establish links between experts and a forum to discuss
 - How to follow up on issues
 - Collect ideas and a checklist of future studies

Structure of the day - morning

- We made a selection of topics
 - Understanding apertures and beam loss scenarios as we did for LHC
 - High luminosity implies higher apertures in the Triplet magnets and smaller more intense beams
 - A lot of work has been done to quantify effects
 - Iterations will be important
 - Aim is also to finalize the experimental beam pipe layout (not just the central section)

Structure of the day - morning

- We made a selection of topics
 - Understanding the impact of the vacuum equipment displacement
 - Put again on the table the discussions about
 - Pile-up maximum
 - Pile-up density
 - Bunch length
 - Overview of Experiments upgrade plans

Goal of High Luminosity LHC (HL-LHC) as fixed in November 2010

From FP7 HiLumi LHC Design Study application

The main objective of HiLumi LHC Design Study is to determine a hardware configuration and a set of beam parameters that will allow the LHC to reach the following targets:

A peak luminosity of $L_{\text{peak}} = 5 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ **with levelling**, allowing:

An integrated luminosity of **250 fb⁻¹ per year**, enabling the goal of **$L_{\text{int}} = 3000 \text{ fb}^{-1}$** twelve years after the upgrade.

This luminosity is more than ten times the luminosity reach of the first 10 years of the LHC lifetime.

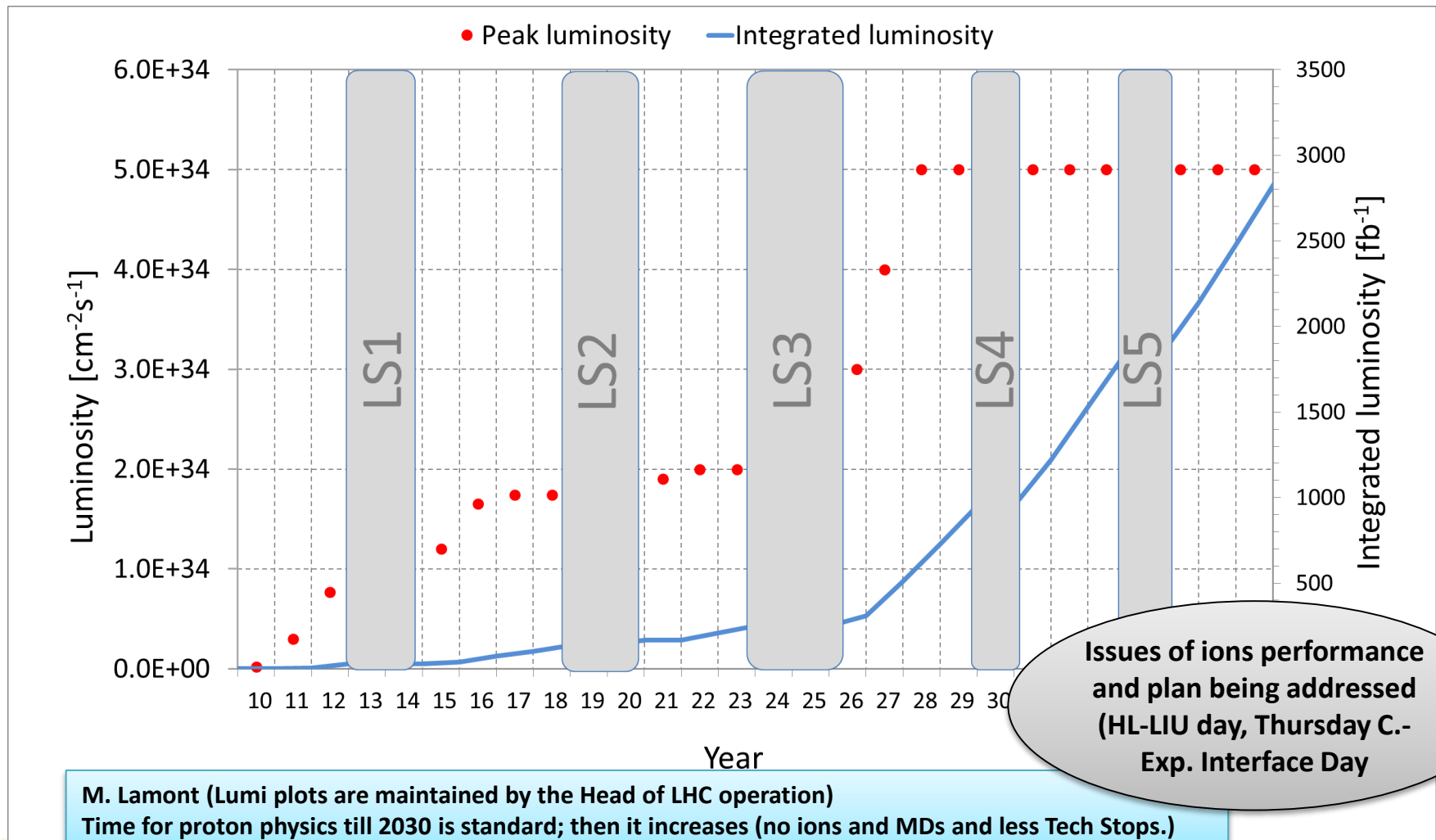
Concept of ultimate performance (use of existing margin) defined:

$L_{\text{ult}} \cong 7.5 \cdot 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ and **Ultimate Integrated $L_{\text{int ult}} \sim 4000 \text{ fb}^{-1}$**

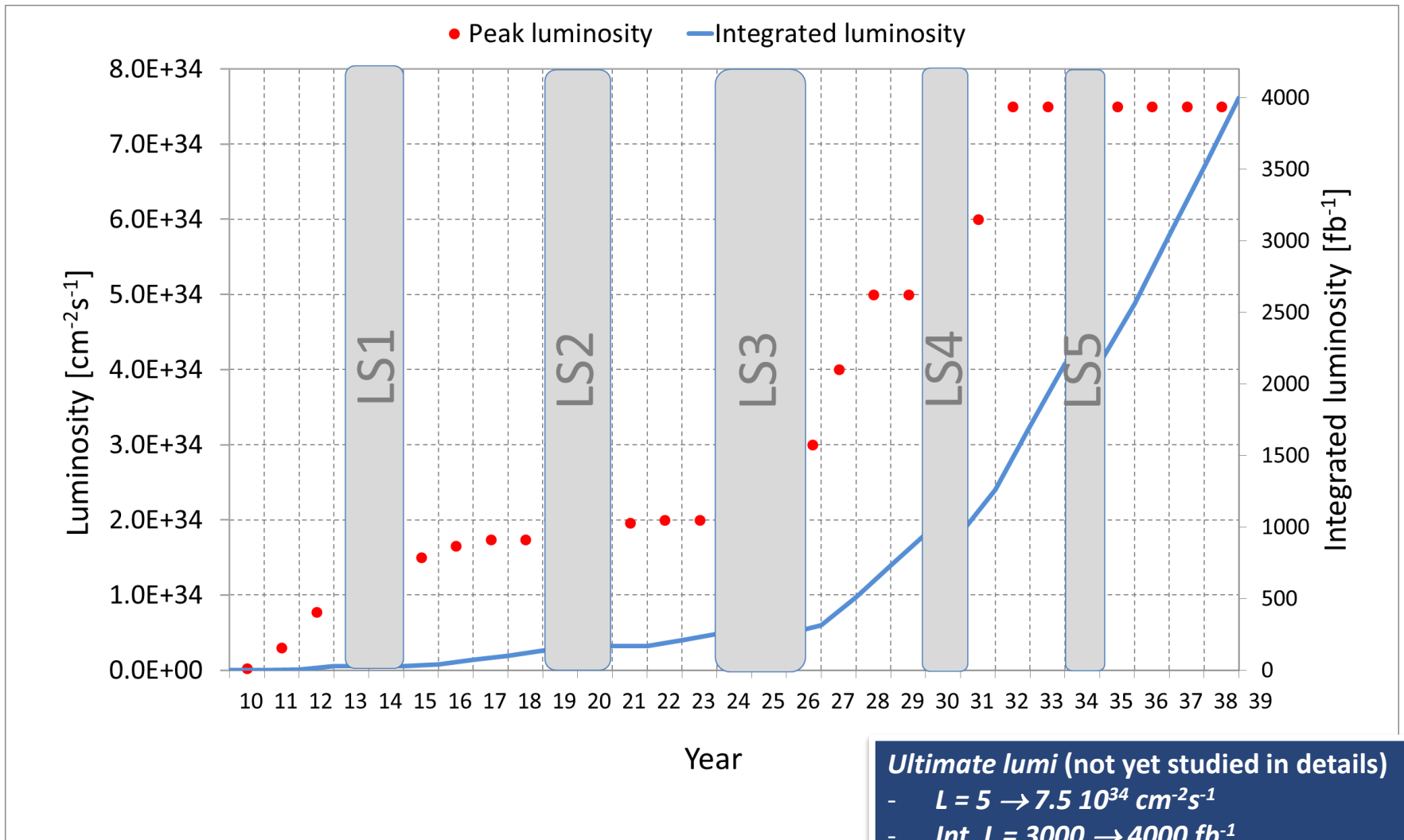
LHC should not be the limit, would Physics require more...

Nominal upgrade parameters

3000 fb⁻¹ would be reached in 2037



HL-LHC *ultimate performance*



Ultimate lumi (not yet studied in details)

- $L = 5 \rightarrow 7.5 \cdot 10^{34} \text{ cm}^{-2}\text{s}^{-1}$
- $\text{Int. } L = 3000 \rightarrow 4000 \text{ fb}^{-1}$
- $\text{Pile up } \mu \sim 200$



Luminosity the main ingredients

$$L_0 = 1 \cdot 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$$

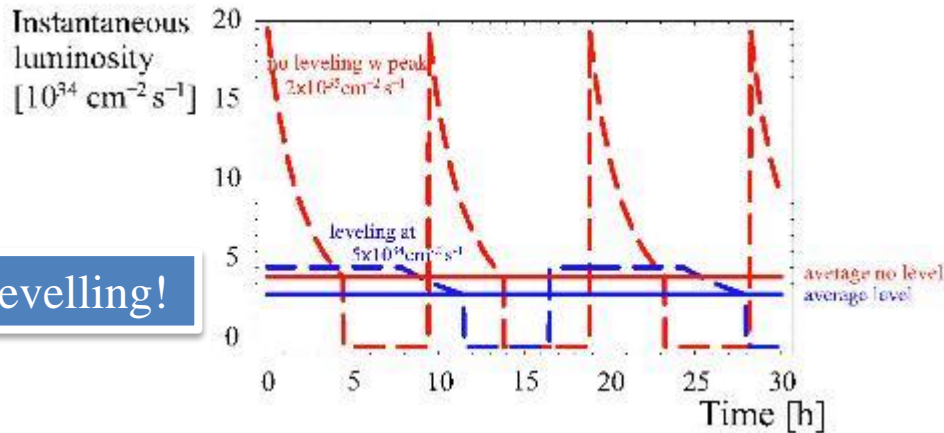
$$\dot{N}_{evt} = L \times \sigma_{evt}; N_{evt} = \int L dt \times \sigma_{evt}$$

L_{int}

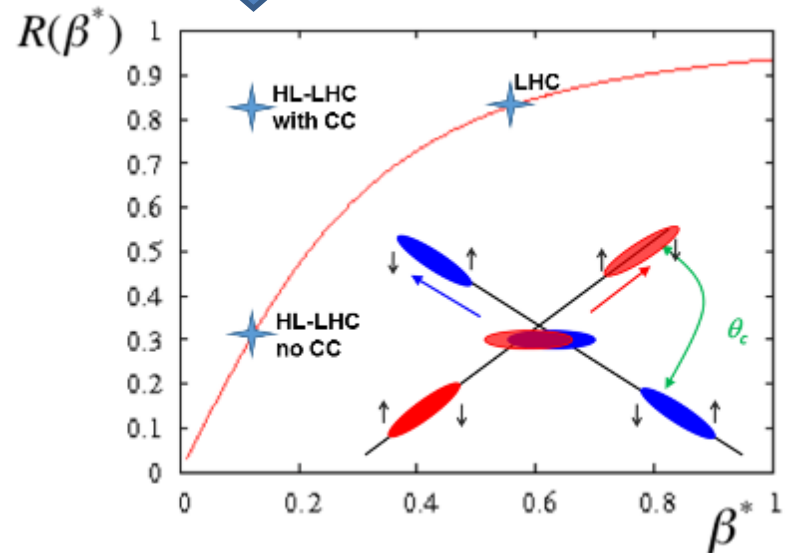
$$L = \frac{\gamma f_{rev} n_b N_b^2}{4\pi \epsilon_n \beta^*} R$$

Beam current: $f_{rev} n_b N_b^2$
 energy: γ
 Beam size: $4\pi \epsilon_n \beta^*$

$$R = \frac{1}{\sqrt{1 + \left(\frac{\theta_c \sigma_s}{2\sigma^*}\right)^2}}$$



Levelling!



	Introduction	<i>Beniamino DI GIROLAMO</i>
	<i>Main Auditorium, CERN</i>	08:30 - 08:45
09:00	Overview of aperture, risks, losses, collimation and background	<i>Helmut BURKHARDT</i>
	<i>Main Auditorium, CERN</i>	08:45 - 09:15
	Collimation tracking studies for extraction failures	<i>Roderik BRUCE</i>
	<i>Main Auditorium, CERN</i>	09:15 - 09:30
	Sources of failures and their tracking	<i>Kyrre Ness SJOBAEK</i>
	<i>Main Auditorium, CERN</i>	09:30 - 09:50
10:00	Effects of losses and LHC/HL-LHC comparison in ATLAS and CMS	<i>Moritz GUTHOFF</i>
	<i>Main Auditorium, CERN</i>	09:50 - 10:10
	Experiments upgrade plans	<i>Sergio BERTOLUCCI</i>
	<i>Main Auditorium, CERN</i>	10:10 - 10:30
	Coffee break	
	<i>Bldg. 500, Mezzanine and Pas perdus, CERN</i>	10:30 - 10:55
11:00	LHC VAX Displacement and impact on experiments	<i>Francisco SANCHEZ GALAN</i>
	<i>Main Auditorium, CERN</i>	10:55 - 11:15
	Pile-up and bunch length: experiments input	<i>Pippa WELLS</i>
	<i>Main Auditorium, CERN</i>	11:15 - 11:45
	Pile-up (maximum and density) and bunch length - Discussion	<i>Beniamino DI GIROLAMO et al.</i>
	<i>Main Auditorium, CERN</i>	11:45 - 12:00
12:00	Lunch break	
13:00		
	CERN	12:00 - 13:30

Structure of the day - afternoon

- We made a selection of topics
 - Response to the request to study the impact on the collider for supplying nominal LHC luminosity to LHCb
 - Latest updates to Heavy Ions
 - Requests
 - Possibilities

	LHCb request for running at nominal LHC luminosity	<i>Eric THOMAS</i>
	<i>Main Auditorium, CERN</i>	13:30 - 13:50
14:00	Optics aspects and impact on luminosity	<i>Riccardo DE MARIA</i>
	<i>Main Auditorium, CERN</i>	13:50 - 14:10
	Energy deposition aspects for LHCb request	<i>Francesco CERUTTI</i>
	<i>Main Auditorium, CERN</i>	14:10 - 14:30
	Hardware changes around LHCb	<i>Ilias EFTHYMIPOULOS</i>
	<i>Main Auditorium, CERN</i>	14:30 - 14:50
15:00	Heavy ions requests for all experiments	<i>Johannes Peter WESSELS</i>
	<i>Main Auditorium, CERN</i>	14:50 - 15:10
	Heavy ions performance	<i>John JOWETT</i>
	<i>Main Auditorium, CERN</i>	15:10 - 15:30
	Coffee break	
	<i>Bldg. 500 Pas perdus and Mezzanine, CERN</i>	15:30 - 16:00

Spirit of this session

- We had no way of being exhaustive
- Many studies are far from being completed because of the hectic schedules and documents, activities, shutdowns, data taking
- But we wanted to resume links and communication from both sides
- By the end of the morning we will have a discussion session and proposals for further studies
- I asked the speakers to respect the time to allow discussions

What we can't cover

- Although equally important
 - Physics motivations
 - Possible synergies around the R2E topics
 - Deeper discussions on radiation levels and background
 - Civil Engineering synergies
 - I invite the experiments colleagues to review the presentations of the Tuesday plenary session
<https://indico.cern.ch/event/400665/timetable/#20151027.detailed>
 - The list can be long... It means it will deserve more interactions in the future

Concluding...

- Please:
 - Enjoy
 - Discuss
 - Don't be shy
 - We can still explore ideas, but please express them before too late
- **A BIG THANK YOU TO ALL PLAYERS**
 - Really a lot of effort has been done for this session