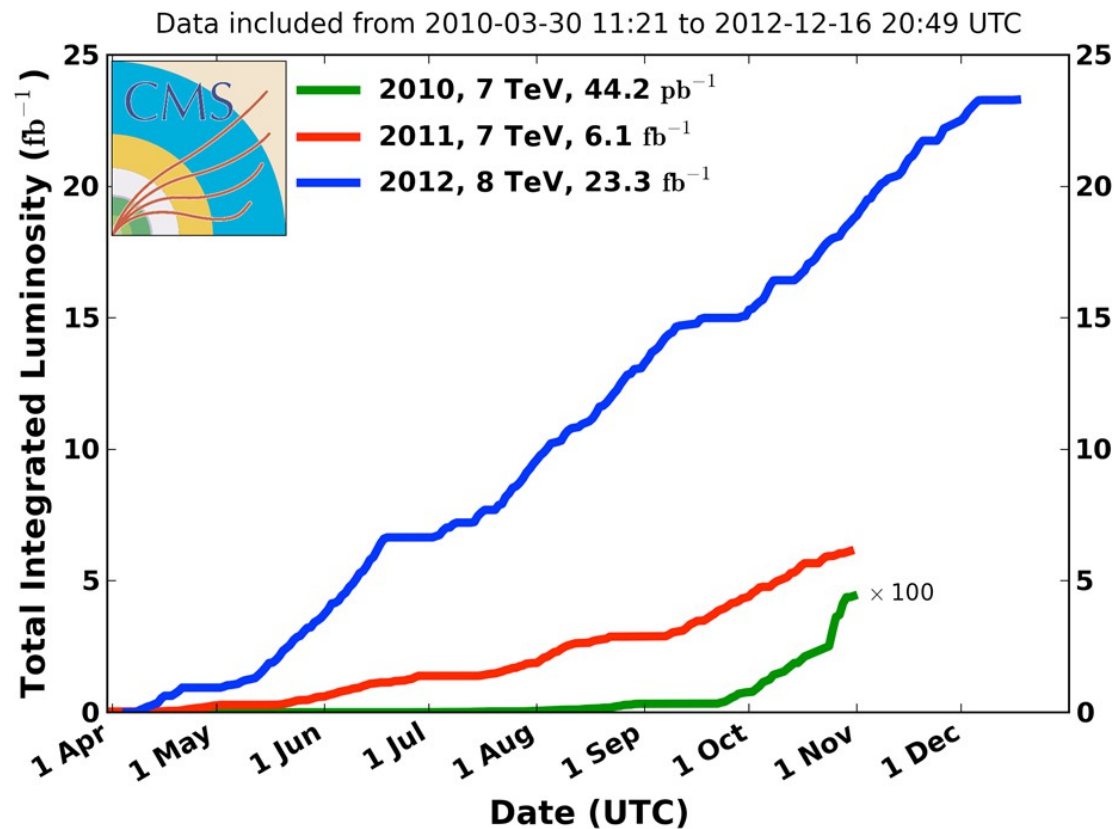


# LHC Status & Plans



# Integrated pp luminosity 2010-12

## CMS Integrated Luminosity, pp



✧ 2010 :  $E_{cm}=7$  TeV  
 $L=0.04$  fb<sup>-1</sup>

✧ 2011 :  $E_{cm}=7$  TeV  
 $L=6.1$  fb<sup>-1</sup>

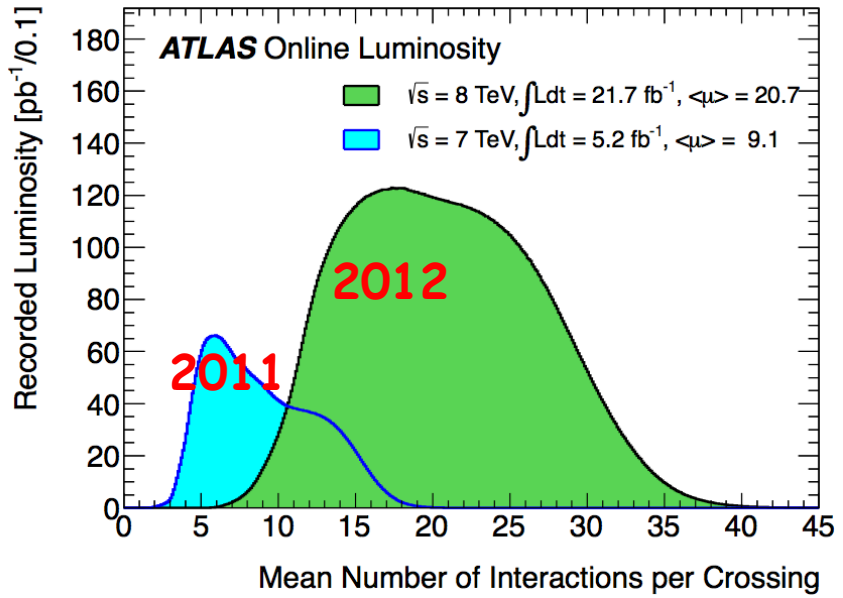
✧ 2012 :  $E_{cm}=8$  TeV  
 $L=23.3$  fb<sup>-1</sup>

# Performance through the year

	2010	2011	2012	Nominal
bunch spacing [ns]	150	50	50	25
<b>no. of bunches</b>	368	1380	1380	2808
<b>beta*</b> [m] ATLAS and CMS	3.5	1.0	0.6	0.55
max. <b>bunch intensity</b> [protons/bunch]	$1.2 \times 10^{11}$	$1.45 \times 10^{11}$	$1.7 \times 10^{11}$	$1.15 \times 10^{11}$
normalized <b>emittance</b> [mm-mrad]	~2.0	~2.4	~2.5	3.75
peak luminosity [cm <sup>-2</sup> s <sup>-1</sup> ]	$2.1 \times 10^{32}$	$3.7 \times 10^{33}$	$7.7 \times 10^{33}$	$1.0 \times 10^{34}$

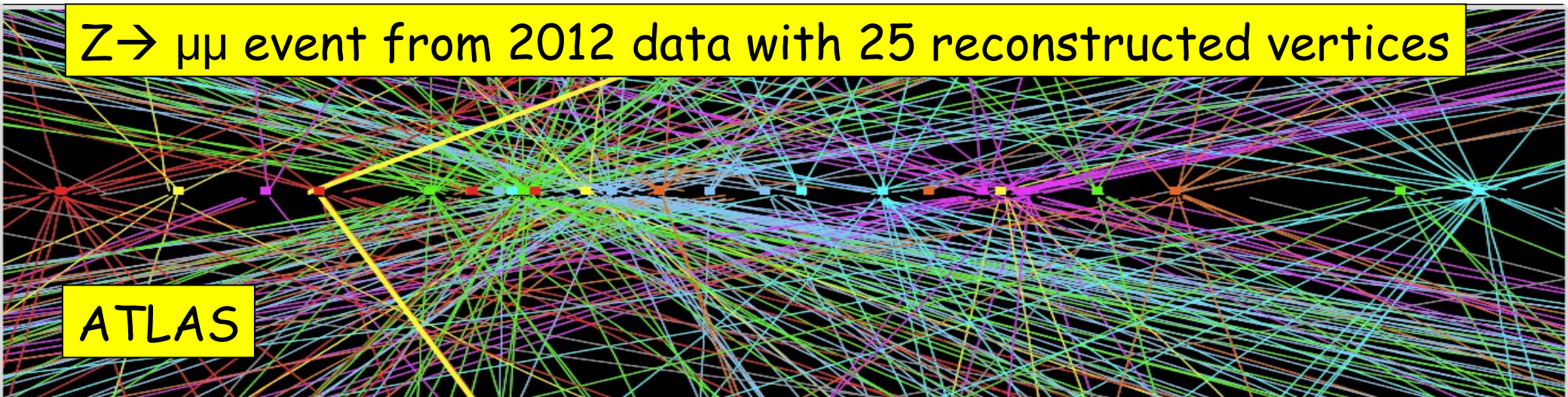
*x2x design when scaled to 7 TeV!*

# A challenge in RUN-I - pile up events

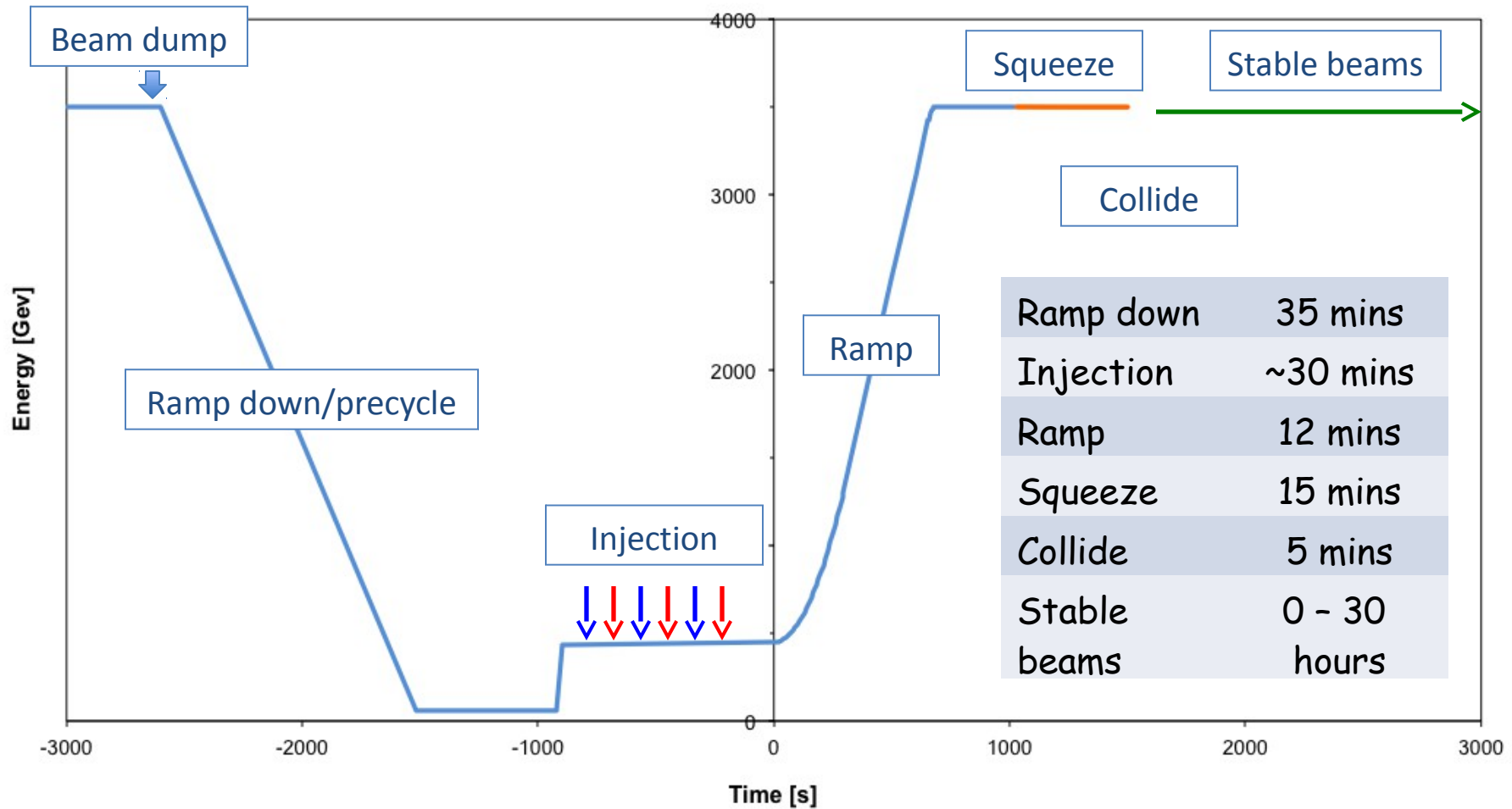


pile up will increase at higher energy → experiments request 25 ns operation in 2015

$Z \rightarrow \mu\mu$  event from 2012 data with 25 reconstructed vertices



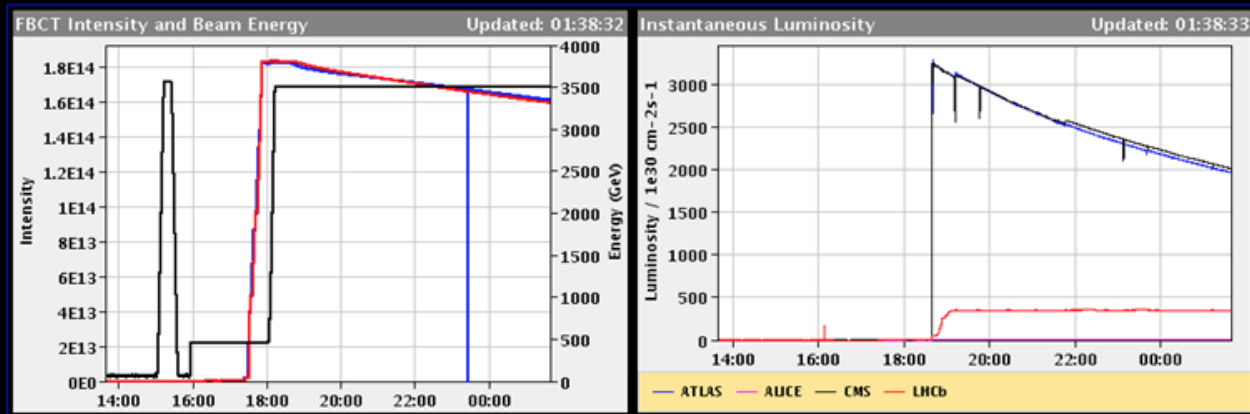
# Operational cycle



turn around 2 to 3 hours on a good day

## PROTON PHYSICS: STABLE BEAMS

Energy: 3500 GeV      I(B1): 1.63e+14      I(B2): 1.61e+14



luminosity leveling at around  $4 \cdot 10^{32} \text{ cm}^{-2}\text{s}^{-1}$  via transverse separation (with a tilted crossing angle)

Comments 03-10-2011 01:37:51 :

\*\*\* STABLE BEAMS \*\*\*

!!! CONGRATULATIONS TO LHCb !!!

!!! FOR THEIR 1ST 1.00/fb !!!

BIS status and SMP flags		B1	B2
Link Status of Beam Permits		true	true
Global Beam Permit		true	true
Setup Beam		false	false
Beam Presence		true	true
Moveable Devices Allowed In		true	true
Stable Beams		true	true

AFS: 50ns\_1380b+1small\_1318\_39\_1296\_144bpi      PM Status B1: **ENABLED**      PM Status B2: **ENABLED**

# Run-II: 2015

- ✧ energy: **6.5 TeV** (magnet retraining)
- ✧ bunch spacing: **25 ns**
  - pile-up considerations
- ✧ injectors potentially able to offer nominal intensity with even lower emittance
- ✧ **uncertainties for 2015:**
  - electron cloud
  - UFOs

*both get more difficult at 25 ns & at higher energy*

- ✧ energy (limited by retraining)

	Number of bunches	Ib LHC FT[1e11]	Emit LHC [um]	Peak Lumi [cm-2s-1]	~Pile-up	Int. Lumi per year [fb-1]
25 ns low emit	2520	1.15	1.9	<b>1.7e34</b>	52	~45

**expected maximum luminosity from inner triplet heat load (collisions debris)**  
 **$1.7 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1} \pm 20\%$**

# draft 2015 shedule

		Jan				Feb			Mar					
Wk		1	2	3	4	5	6	7	8	9	10	11	12	13
Mo		29	5	12	19	26	2	9	16	23	2	9	16	23
Tu														
We														
Th														
Fr														
Sa														
Su														

Re-commissioning with beam

HW tests & machine checkout

Pilot

		Apr		May						June					
Wk		14	15	16	17	18	19	20	21	22	23	24	25	26	
Mo		30		13	20	27	4	11	18	25	1	8	15	22	
Tu			5 nb <sup>-1</sup>												
We					TS1									TS2	
Th			7.0 TeV										MD		
Fr			3.5 TeV												
Sa				MD 1											
Su															

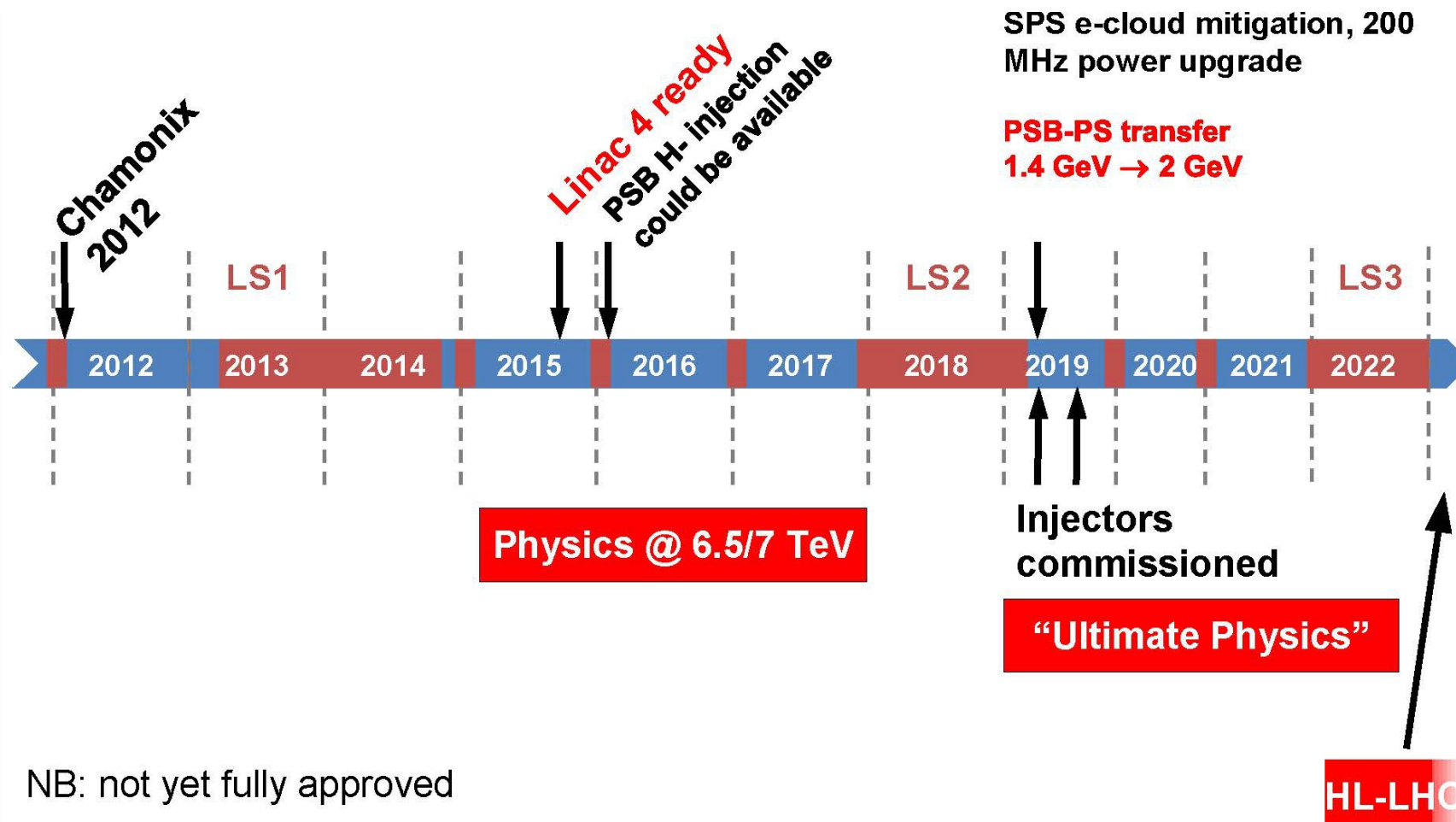
Scrubbing

Scrubbing

in red beam time requested by LHCf



# Plan for next 10 years



# Luminosity forecast for next 10 years

---

~30/fb at 3.5 & 4 TeV	<b>2012 DONE</b>
~400/fb at 6.5-7 TeV	<b>2021 goal (?)</b>
~3000/fb at 7 TeV	<b>2035 goal (??)</b>

*to obtain 3000/fb by 2035  
we need the **HL-LHC***