Introduction

R. Garoby

The LIU Project

Apparently single and simple goal:

To prepare the proton beam for HL-LHC after LS2 (~2021)

… it concerns also the Lead beam

+ progressive improvement of beam characteristics is important…

+ other users should not suffer and preferably benefit…

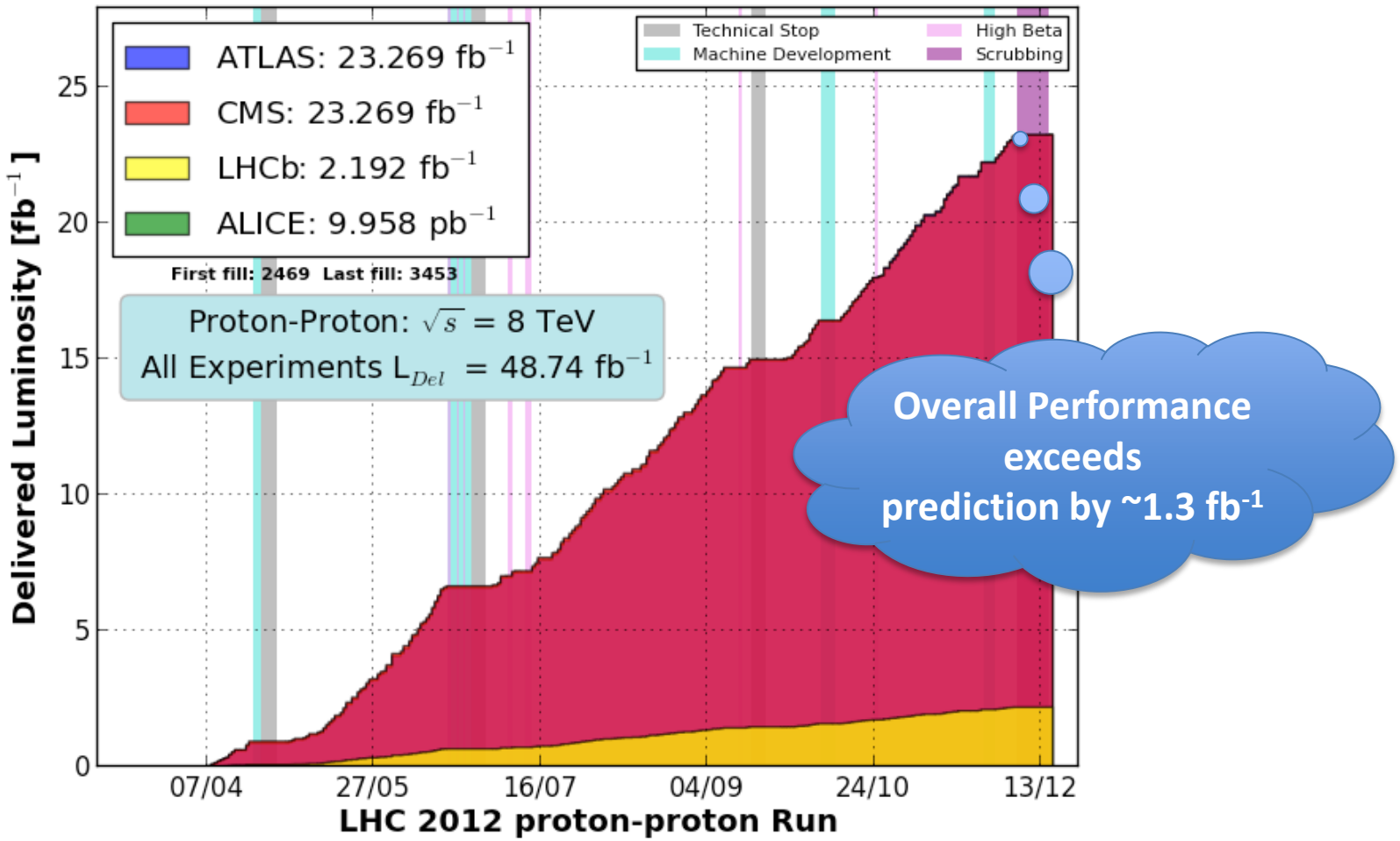
Very large extension:

- Most accelerators at CERN are concerned
- Many groups & teams are involved
- Roles overlap (close interconnection OP-LIU)
- Material resources are from multiple origins (exploitation, consolidation, LIU…)

Today's meeting is a unique opportunity to get a snapshot at what is happening in the context of LIU

Outstanding LHC performance

LHC performance with protons in 2012



Proton injectors' performance for LHC in 2012

It would have been impossible without the regular and excellent proton beam delivered by the injectors…

Nominal specs'

	Defined Characteristics 2004 (Source: LHC-OP-ES-0002 rev 1.0, EDMS: 487892)										
	PSB extraction				PS extraction			SPS extraction			
	Ip / ring [x10^{11}]	ε_h and ε_v [mm · mrad] 1σ, norm.	nb batches	nb bunches	Ip / bunch [x10^{11}]	ε_h and ε_v [mm · mrad] 1σ, norm.	nb bunches	Ip / bunch [x10^{11}]	ε_h and ε_v [mm · mrad] 1σ, norm.	ε_{longit} [eVs]	nb bunches
LHC25	2.4 - 13.8	≤ 2.5	2	4 + 2	0.2 -1.15	≤ 3	72	0.2 -1.15	≤ 3.5	≤ 0.8	1 - 4 x 72
LHC50	1.2 - 6.9	≤ 2.5	2	4 + 2	0.2 -1.15	≤ 3	36	0.2 -1.15	≤ 3.5	≤ 0.8	1 - 4 x 36

Expected in 2012 (Chamonix 2012)

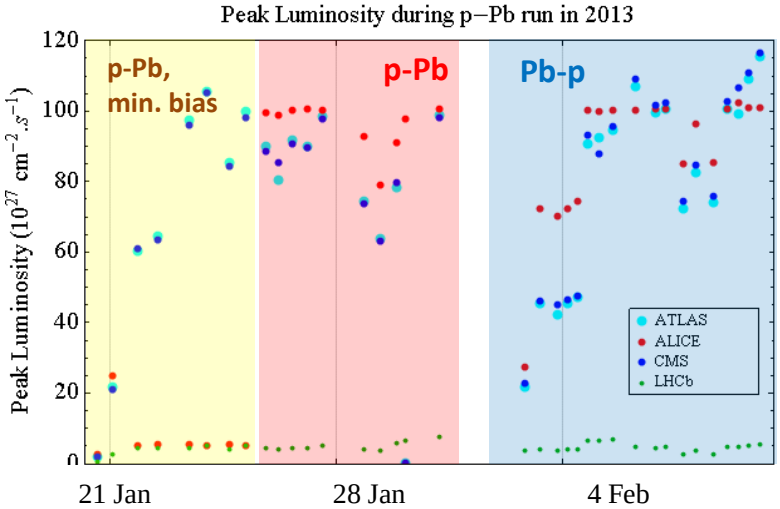
	Tentative Operational Characteristics 2012										
	PSB extraction				PS extraction			SPS extraction			
	Ip / ring [x10^{11}]	ε_h and ε_v [mm · mrad] 1σ, norm.	nb batches	nb bunches	Ip / bunch [x10^{11}]	ε_h and ε_v [mm · mrad] 1σ, norm.	nb bunches	Ip / bunch [x10^{11}]	ε_h and ε_v [mm · mrad] 1σ, norm.	ε_{longit} [eVs]	nb bunches
LHC25	16	2.5	2	4 + 2	1.3	2.5	72	1.15	3.5	0.7	1 - 4 x 72
LHC50	11	1.6	2	4 + 2	1.8	1.9	36	**1.6**	**2**	≤ 0.8	1 - 4 x 36

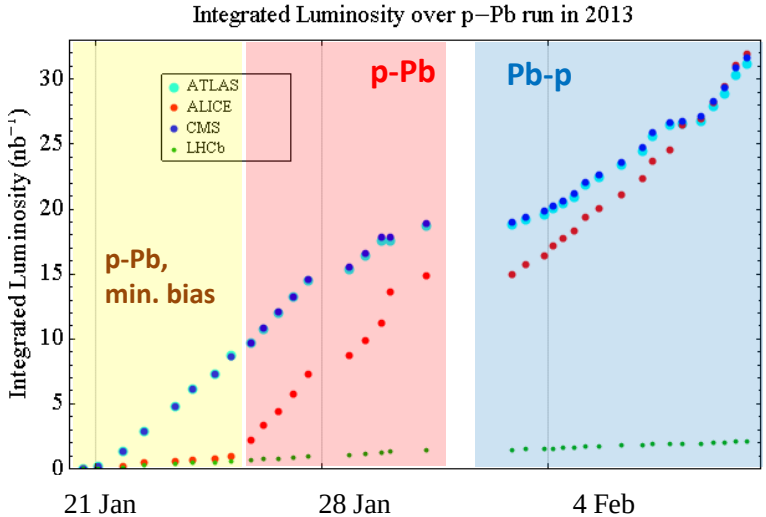
Achieved in 2012

	Achieved Operational Characteristics 2012										
	PSB extraction				PS extraction			SPS extraction			
	Ip / ring [x10^{11}]	ε_h and ε_v [mm · mrad] 1σ, norm.	nb batches	nb bunches	Ip / bunch [x10^{11}]	ε_h and ε_v [mm · mrad] 1σ, norm.	nb bunches	Ip / bunch [x10^{11}]	ε_h and ε_v [mm · mrad] 1σ, norm.	ε_{longit} [eVs]	nb bunches
LHC25	16	2.3	2	4 + 2	1.3	2.4	72	1.35	~ 3	0.7	1 - 4 x 72
LHC50	12	1.35	2	4 + 2	1.9	1.5	36	**1.65**	**1.65**	≤ 0.8	1 - 4 x 36

LHC performance for p-Pb in 2013

ALICE: 31.94 nb^{-1} ATLAS: 31.2 nb^{-1} CMS: 31.69 nb^{-1} LHCb: 2.12 nb^{-1}

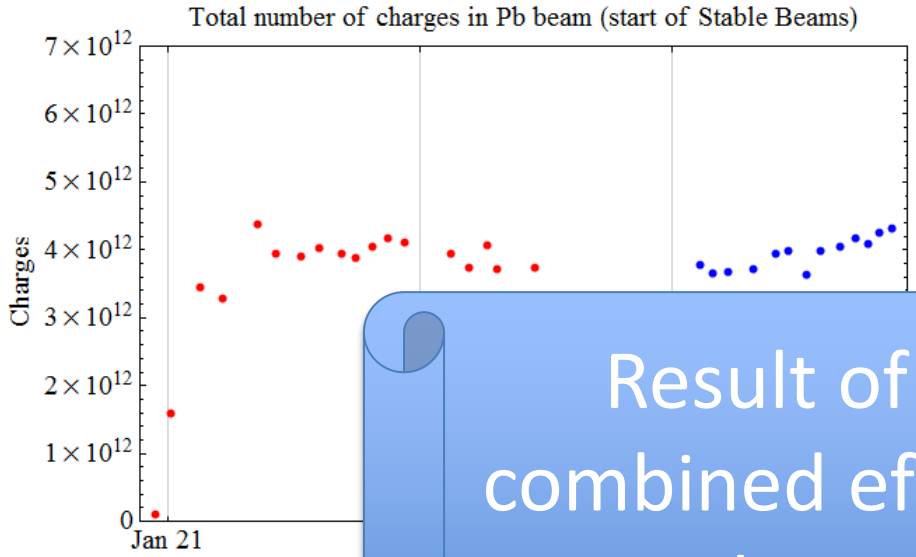


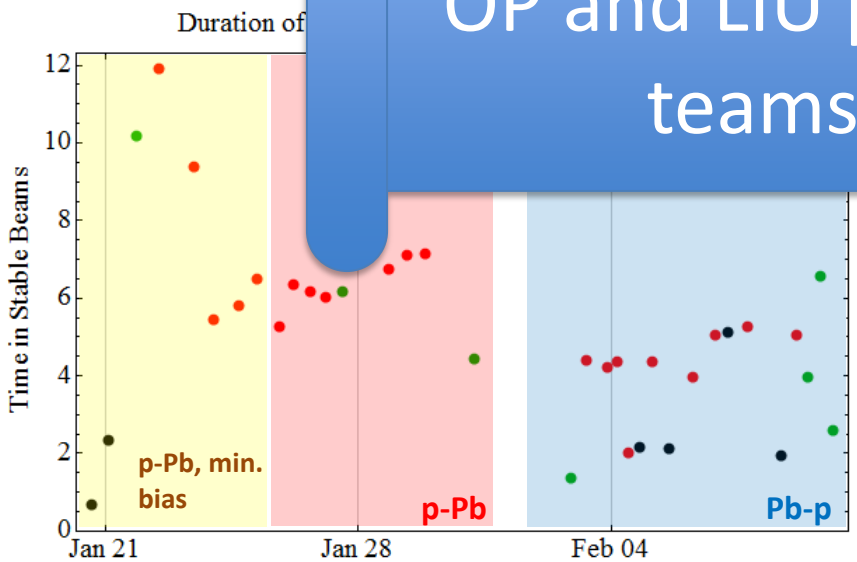


- Full instantaneous luminosity $1x10^{29}$ cm^{-2}.s^{-1} already reached with the first fill with full filling scheme
- Levelling in ALICE at $1x10^{29}$ cm^{-2}.s^{-1} in almost all standard fills
- Two fills were done with IP1 and 5 separated, allowing ALICE to catch up after initial minimum-bias
- Van der Meer scans done in both configurations
- Final integrated luminosity above experiments' request of 30 nb^{-1}
- The run ended with record peak luminosity of $1.15x10^{29}$ cm^{-2}.s^{-1}, record turn around of 2.37 h

R. Versteegen

Lead injectors' performance for LHC in 2012





Result of the combined efforts of OP and LIU project teams!

- Injectors provided very good quality Pb beams: average number of ions per bunch was 1.44×10^{8} at start of stable be s (mean over the run), i.e. almo vice the nominal

ere dumped by the holds in IR6 due to or low intensity Pb

was reached faster) than with B2 (p-Pb), l durations of more than 10h were reached with intermediate filling schemes and special fills colliding only in ALICE (and LHCb).

R. Versteegen

Remarkable progress of LIU developments

Beams expected @ SPS extraction after LS1

		Bunch intensity [10^{11} p/b]	Transv. Emittance** [1 σ norm, mm.mrad]	Bunches per batch (@ SPS inj.)	PSB rings	Harm. @PS inj.
Baseline for physics	25 ns****	1.15	2.8	72	6	7
	25 ns BCMS	1.15	1.4	48***	8	9
Eventually for startup	50 ns	1.65	1.7	36		7
	50 ns					9

** Transverse
Beam are pr
After LS1 it w

*** Filling sch
in Luminosity

**** Better pe

1.4 10^{11} produced but no emittance measurements available@SPS

Combined effects of progresses in PSB (refined adjustments), PS (BCMS…) and SPS (Q20…)

Progress in beam studies

- Progress in the PSB (Low emittance, space charge...) – **E. Benedetto**
- Progress in the PS (Xverse damper, resonance compensation, impedance...) – **G. Sterbini**
- Progress in the SPS (transfer efficiency, beam instabilities, ...) – **T. Argyropoulos**
- BCMS beam results (up to LHC...) – **S. Hancock**
- Q20 in SPS – **H. Bartosik**
- Progress on e-clouds (PS and SPS) – **G. Iadarola**
- Results and plans for Lead ions – **D. Manglunki**

Progress in hardware development

- Linac4 construction status and plans – **M. Vretenar**
- Latest results in the 3 MeV test place (RFQ, ion source, chopper...) – **G. Bellodi**
- H^- injection system in the PSB – **W. Weterings**
- Finemet cavities: status and plan for PSB RF and PS damper during LS1 – **M. Paoluzzi**
- Digital LLRF – **M.E. Angoletta**
- Potential of the wide band transverse damper – **G. Kotzian**

Planned changes during LS1

- PSB (new dump, new PCs for multipoles,...) – **K. Hanke**
- PS (shielding, long, damper,...) – **S. Gilardoni**
- SPS (new BWS, 800 MHz upgrade...) – **B. Goddard**

LET'S LISTEN TO THE ACTORS…

AND CELEBRATE!
[16h20 – Salle des pas perdus]