

# Introduction générale du projet et des activités SU

Hélène Mainaud Durand



CERN, Mini revue sur les activités SU, 29/06/17

## **Outline**

- Introduction to HL-LHC project (L. Rossi's slides)
- Introduction to HL-LHC survey activities





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

An integrated luminosity of **250 fb<sup>-1</sup> per year**, enabling the goal of **L**<sub>int</sub> = **3000 fb<sup>-1</sup>** twelve years after the upgrade.

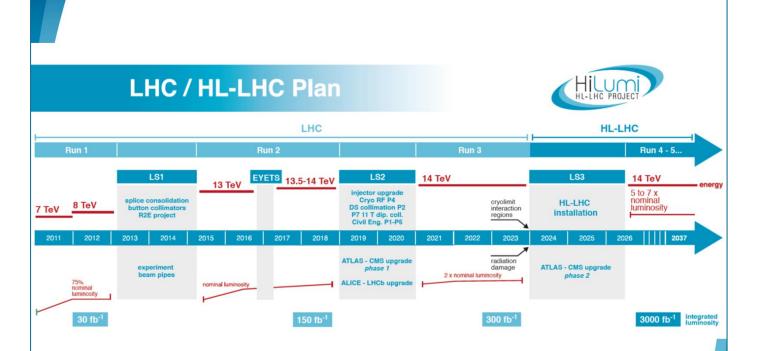
This luminosity is more than ten times the luminosity reach of the first 10 years of the LHC lifetime.

Ultimate performance established 2015-2016: with same hardware and same beam parameters: use of engineering margins:

L<sub>peak ult</sub> ≅ 7.5 10<sup>34</sup> cm<sup>-2</sup>s<sup>-1</sup> and Ultimate Integrated L<sub>int ult</sub> ~ 4000 fb<sup>-1</sup>

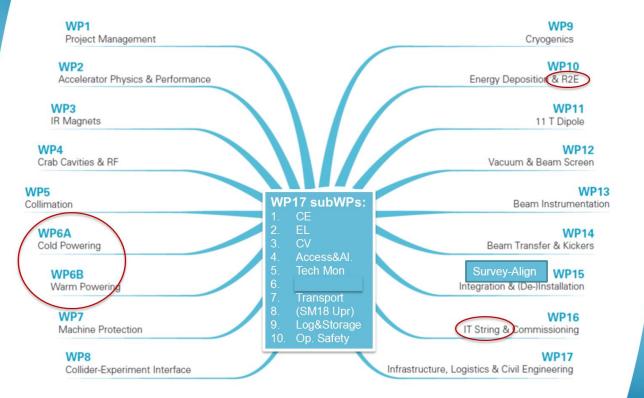
LHC should not be the limit, would Physics require more...







### **Project structure**





### High Luminosity LHC Project

#### MEMBER STATES COLLABORATIONS<sup>1</sup>

IR Magnets
CEA Saday: P. Védrine, J-M. Rifflet, H. Felice
CIEMAT Madrid: J-M. Perez, F. Toral
INFN: A. Zoccoli<sup>2</sup>, G. Volpini<sup>3</sup>, P. Fabbricatore<sup>4</sup>
Uppsala University: T. Ekelöf

UK: R. Appleby<sup>5</sup> (Spokesperson & Collimation), G. Burt<sup>6</sup> (Crab Cavities), S. Gibson<sup>7</sup> (Beam Instr.), Y. Yang<sup>8</sup> (Cold Powering)

#### **HL-LHC PROJECT MANAGEMENT**

Project Leader: Lucio Rossi, CERN
Deputy Project Leader: Oliver Brüning, CERN
Project Office Manager: Laurent Tavian, CERN
Configuration, QA, Resource Manager: Isabel Bejar Alonso, CERN
Integration: Paolo Fessia, CERN

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Collaborations (in-kind): Beniamino Di Girolamo, CERN
Budget Officer: Benoit Delille, CERN
Safety Officer: Thomas Otto, CERN
Communication: Isabel Bejar Alonso, CERN
Secretariat: Cécile Noels, CERN

#### NON MEMBER STATES COLLABORATIONS1

US HL-LHC AUP9 - USA

Project Manager: G. Apollinari, FNAL Deputy Project Manager: R. Carcagno, FNAL Magnet Systems G. Ambrosio, FNAL Crab Cavities System

KEK - Japan

LHC Upgrade Coordinator: K. Tokushuku SC D1 Magnet: T. Nakamoto

#### WP2 Accelerator Physics

Gianluigi Arduini Rogelio Tomas Garda

#### WP3 IR Magnets

Ezio Todesco Paolo Ferracin

#### WP4 Crab Cavities & RF

Rama Calaga Ofelia Capatina

#### WP5 Collimation

Stefano Redaelli Roderik Bruce

#### WP6A Cold Powering

Amalia Ballarino Vittorio Parma

#### WP6B Warm Powering

Jean-Paul Burnet Michele Martino

#### WP7 Machine Protection

Daniel Wollman Reiner Denz

#### WP8 Collider-Experiment Interface

Helmut Burkhardt – F. Sanchez Galan Sébastien Evrard

#### WP9 Cryogenics

Serge Claudet Rob Van Weelderen

#### WP10 Energy Deposition & R2E

Markus Brugger – Francesco Cerutti

#### WP11 11 T Dipole

Frédéric Savary Hervé Prin

#### WP12 Vacuum

Vincent Baglin Roberto Kersevan

#### WP13 Beam Instrumentation

Rhodri Jones Adriana Rossi

#### WP14 Beam Transfer

Chiara Bracco Brennan Goddard

#### WP15 Integration & (De-)Installation

Paolo Fessia Hélène Mainaud Durand (Survey)

#### WP16 IT String & Commissioning

Marta Bajko – Mirko Pojer

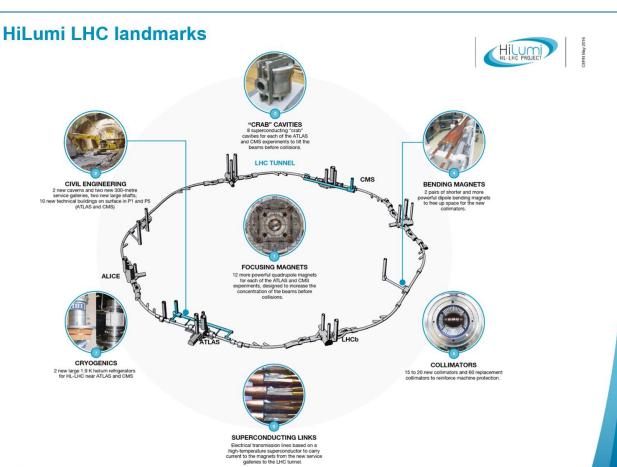
#### WP17 Infrastructure & Logistics

Laurent Tavian Beniamino Di Girolamo

> <sup>1</sup> In kind contributions <sup>2</sup> INFN Directorate <sup>3</sup> INFN Milano LASA <sup>4</sup> INFN Genova

<sup>5</sup> University of Manchester/Cockcroft Institute <sup>6</sup> Lancaster University/Cockcroft Institute <sup>7</sup> Royal Holloway/John Adams Institute <sup>8</sup> University of Southampton <sup>9</sup> US HL-HPC Accelerator Upgrade Project







### **HL-LHC** main milestones

- 2010 : High Luminosity LHC Design Study established & application for EU funds
- 2011: approval and start of the EU co-funded FP7-HiLumi LHC Design Study with 20 Institutions
  - 2013: Approval by EU HEP strategy of HiLumi as main project for the next decade; Kick off meeting in Daresbury of HL-LHC as construction project; P5 subpanel (USA) also put HL-LHC as next main project
- 2015: 1st C&S Review 1, end of the FP7-Design Study and insertion of the full funding profile in the CERN budget till 2026 (approved formally till 2020);
- 2015 Oct : end of FP7 design phase issue of first TDR-V0



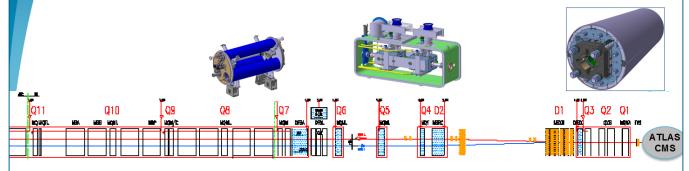
 2016 (June Council): formal approval of the entire HL-LHC project; declared an ESFRI landmark



- 2016 June-August: re-baseline of the project
- 2016 2nd Cost & Schedule Review with full endorsement of new baseline cost



### The largest HEP accelerator in construction



#### Dispersion Suppressor (DS) in P7

#### **Modifications**

- 1. In IP2: new DS collim. in C.Cryost.
- 2. In IP7 new DS collimation with 11 T

Cryogenics, Protection, Interface, Vacuum, Diagnostics, Inj/Extr, Controls, new UG and surface infrastr.

#### Matching Section (MS)

#### Change/new lay-out

- 1. TAXN
- 2. D2
- 3. CC
- 4. Q4
- 5. Correctors
- 6. Q5
- 7. Q5@1.9K in P6
- 8. New collimators

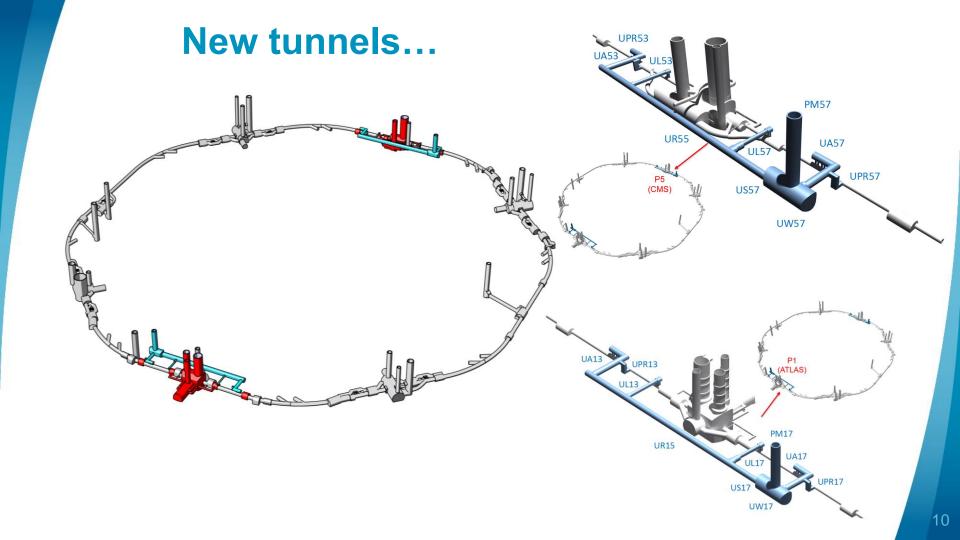
#### **Interaction Region (ITR)**

# Complete change and new lay-out

- 1. TAXS
- 2. Q1-Q2a-Q2b-Q3
- 3. D1
- 4. All correctors
- 5. Heavy shielding (W)

> 1.2 km of LHC !!





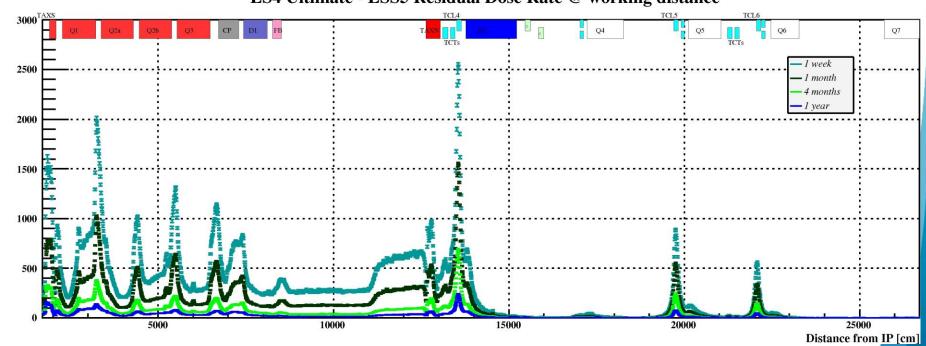
# New components...

- Magnets (quadrupoles, dipoles, corrector package)
- Targets absorbers
- Beam instrumentation
- RF components (crab cavities, etc.)
- Masks
- Collimators
- Etc.

# Difficult environmental conditions...

### Residual dose rates

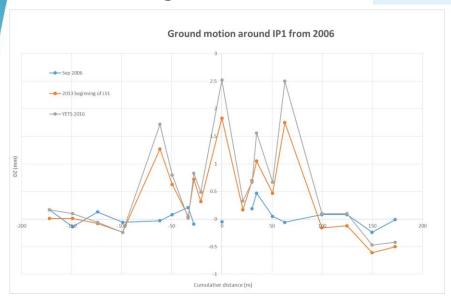


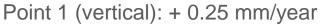


### **Ground motion**

Vertical ground motion

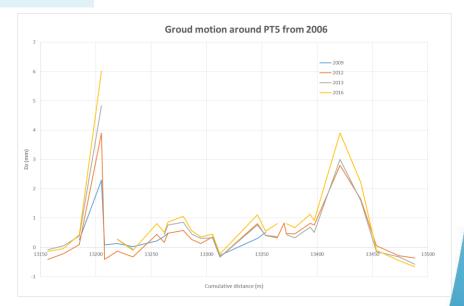
Edms n°1233554





- Near the center of the cavern floor
- Between cavern and tunnel

Stable area after 100 m on each side of IP1



Point 5 (vertical): ground motion observed at the level of the new UJ caverns:

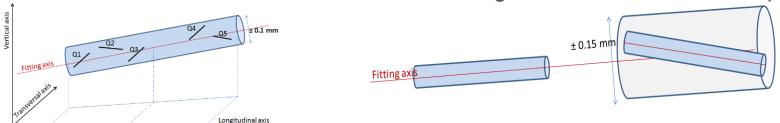
80m-130 m on each side of IP5

# **Beam requirements**

CERN-ACC-2015-0014

Estimation of the deviation of the IT magnets from a laser straight line, with a quadratic sum of the following independent contributions: ± 0.27 mm

- Fiducialisation: mechanical axis vs external fiducials: ± 0.1 mm
- Smoothing:
  - Mechanical axis of quadrupoles included in a cylinder with a radius of 0.1mm
  - Left / right mechanical axis included in a cylinder with a radius of 0.15 mm.
- Misalignment between alignment campaigns: ± 0.17 mm (integrating ground motion, mechanical stress encountered during vacuum and cool-down phases)



Remote adjustment of the position of the main components from Q1 to Q5 (5DO)

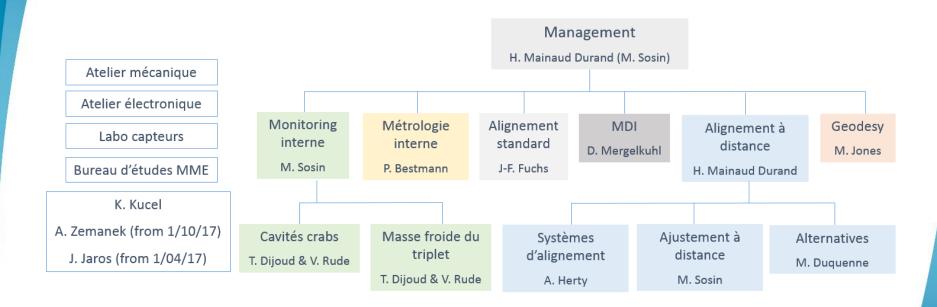
# **Alignment improvements**

- Internal monitoring of the position of the cold mass inside the cryostat of the Inner Triplet quadrupoles
- Internal monitoring of the position of the crabs cavities inside their cryostat
- Remote determination and remote adjustment of intermediary components under discussion (collimators, warm BPM, masks in front of Q4 and Q5).
- Trace position of bellows, vacuum components, etc. through the life of the machine (train to perform such measurements during YETS and LS)
- Develop a standardized support for the adjustment of intermediary components (same configuration of adjustments, all adjustment knobs on the transport side)

# Scope: "alignment & internal metrology"

### Mandate:

- Cover all geodetic aspects of the project
- Perform the alignment of the components of the beam lines & specific components in MDI area
  - Using standard means when possible
  - With specific alignment systems (sensors & actuators)
- Cover the internal metrology aspects
- Carry out the as-built measurements needed in all newly equipped area



#### HL-LHC: mini-revue sur les activités SU

☐ Thursday 29 Jun 2017, 08:30 → 12:30 Europe/Zurich

♦ 864-1-D02 - BE Auditorium Prevessin (CERN)

08:40 → 09:00 Introduction générale du projet et des activités SU

Speaker: Helene Mainaud Durand (CERN)

09:00 → 09:20 Alignement standard

Speaker: Jean-Frederic Fuchs (CERN)

09:20 → 09:40 Métrologie interne et fiducialisation

Speaker: Patrick Bestmann (CERN)

**09:40** → 10:00 **TAXS** 

Speaker: Dirk Mergelkuhl (CERN)

**10:00** → 10:20 **Géodésie** 

Speaker: Mark Jones (CERN)

**10:20** → 10:30 **Discussion** 

**10:30** → 10:45 **Pause café** 

10:45 → 11:05 Ajustement à distance

Speaker: Mateusz Sosin (CERN)

11:05 → 11:25 Systèmes d'alignement

Speaker: Mr. Andreas Herty (CERN)

**11:25** → 11:45 Etudes spéciales

Speaker: Mathieu Duquenne (Conservatoire National des Arts et Metiers - CNAM (FR))

11:45 → 12:05 Monitoring des masses froides et cavités crabs

Speaker: Mateusz Sosin (CERN)

12:05 → 12:25 Organisation des activités et conclusion

Speaker: Helene Mainaud Durand (CERN)







# Thank you very much

