



HL-LHC Project

Lucio Rossi – CERN
HL-LHC Project Leader

A poster for the 3rd Hi-Lumi Industry Day. The background is a night photograph of a large, illuminated arch bridge over a river. The text on the poster is as follows:

**3RD HI-LUMI
Industry Day**

**22-23
May 2017
The Park Royal
Warrington
UNITED KINGDOM**

Registration before 31 March 2017
<https://indico.cern.ch/event/607165/>

More information on HL-LHC and future needs
<https://project-hl-lhc-industry.web.cern.ch>

**AN EVENT FOR
COMPANIES WILLING
TO TAKE ON THE HL-LHC
TECHNICAL CHALLENGES**

Logos for HiLumi, CERN, and Science & Technology Facilities Council are at the bottom.



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:

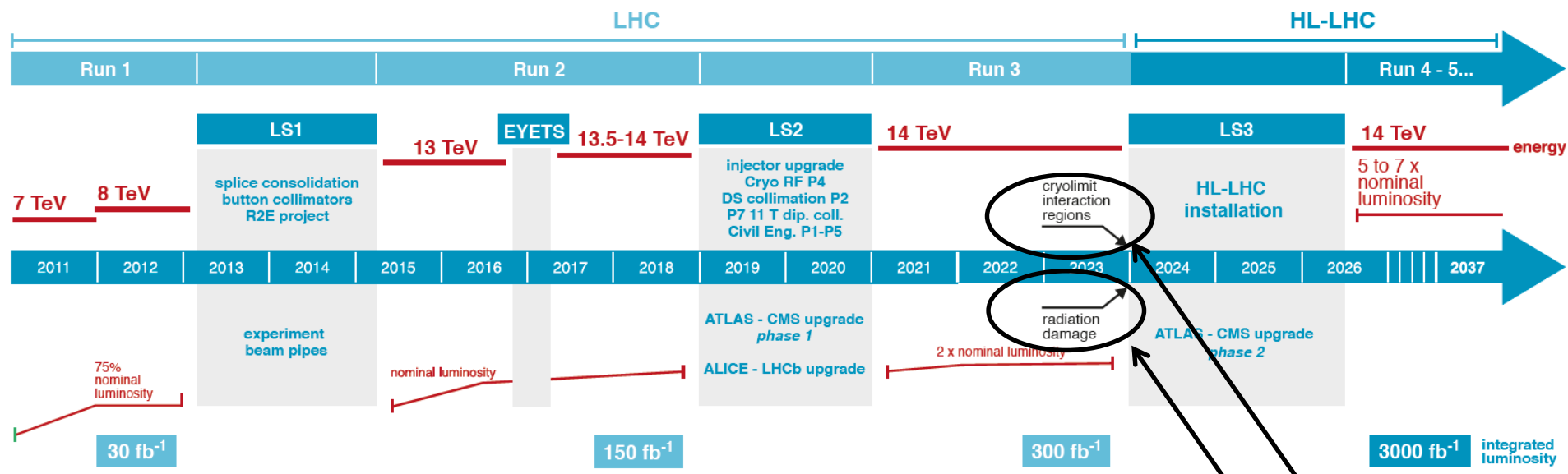
An integrated luminosity of **250 fb⁻¹ per year**, enabling the goal of $L_{\text{int}} = 3000 \text{ fb}^{-1}$ twelve years after the upgrade.

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

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

$L_{\text{peak ult}} \cong 7.5 \cdot 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ and **Ultimate Integrated** $L_{\text{int ult}} \sim 4000 \text{ fb}^{-1}$
LHC should not be the limit, would Physics require more...

LHC / HL-LHC Plan



cryolimit interaction regions

radiation damage

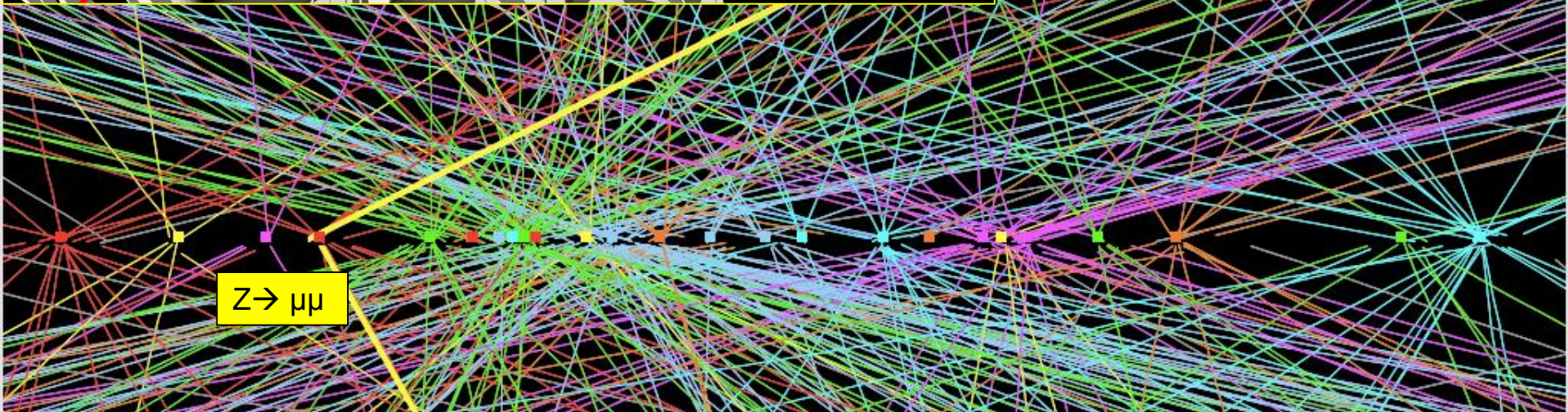
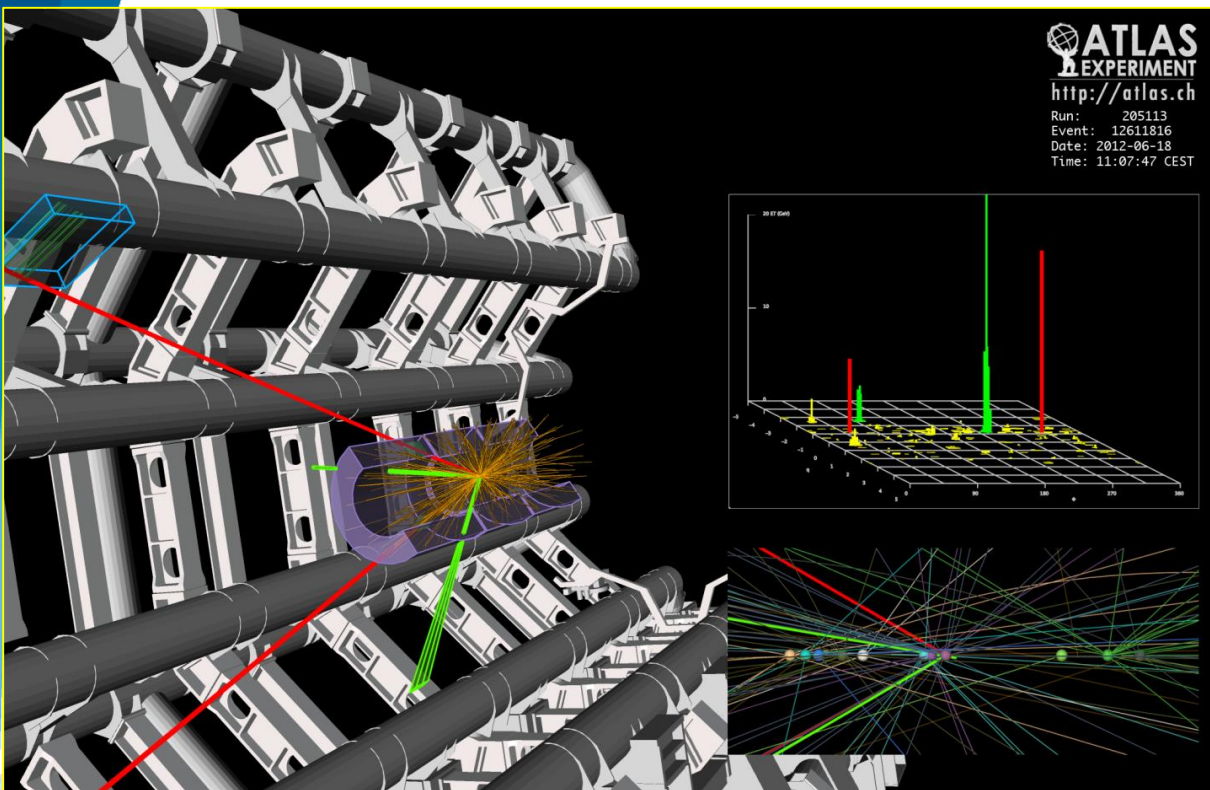
Technical limits to lumi increase (Machine & Experiments)



More luminosity
⇒ higher the
collision rate

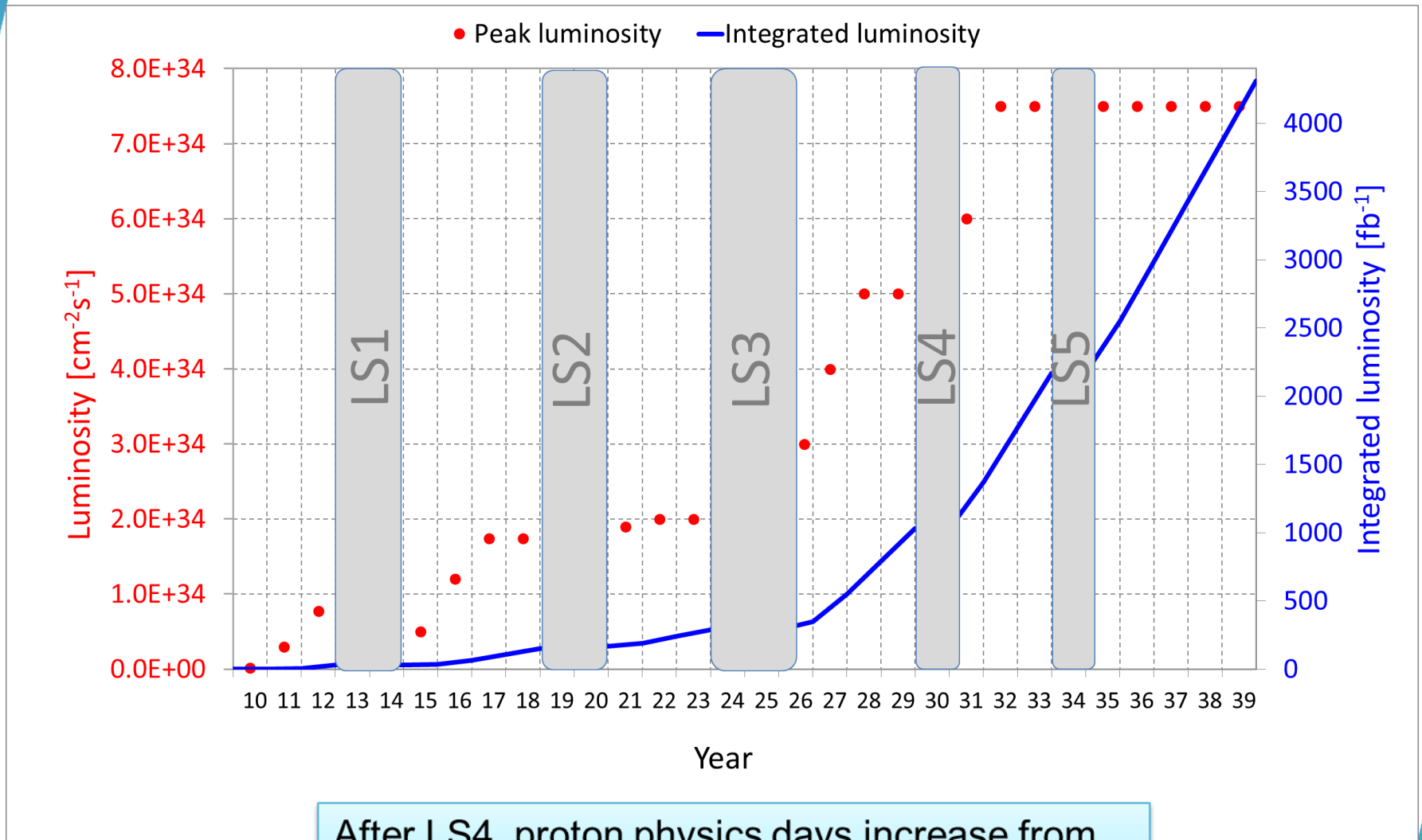
Higgs: the needle in
the haystack

Picture repeated 40
millions times each
second



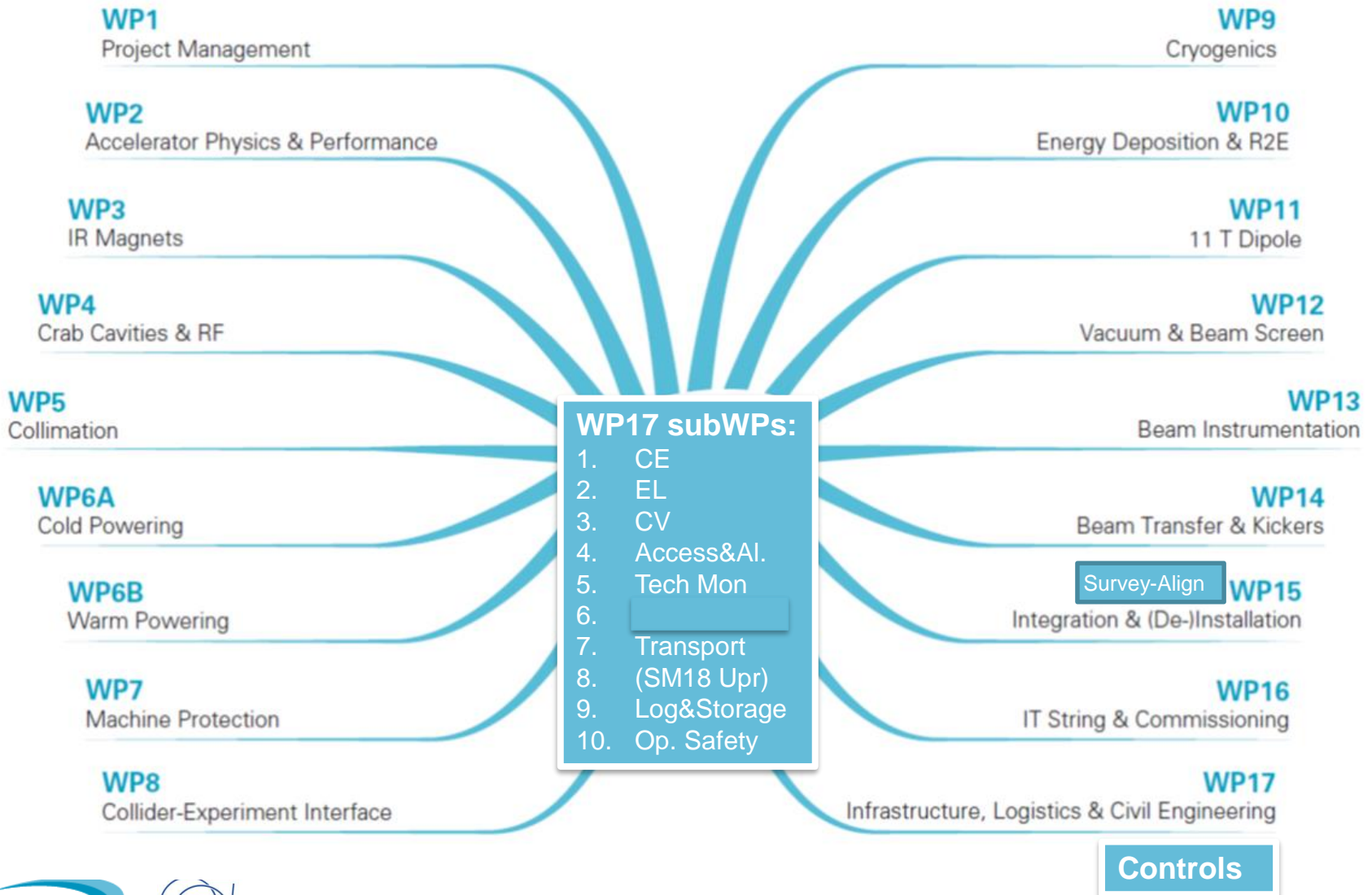
$Z \rightarrow \mu\mu$ event from 2012 data with 25 reconstructed vertices

Luminosity profile: ULTIMATE

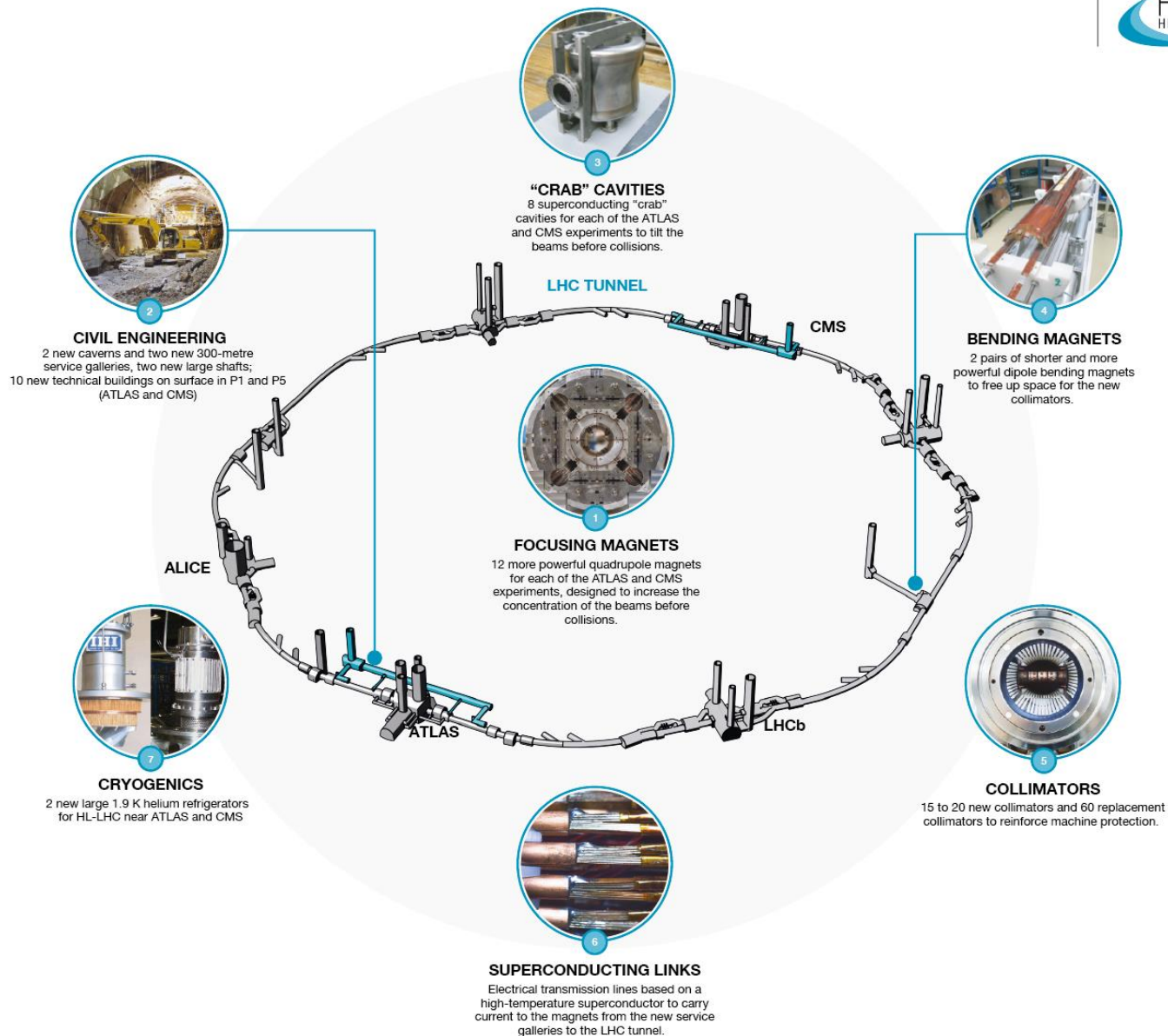


After LS4, proton physics days increase from standard 160 days to 200 and after LS5 to 220

Project structure



HiLumi LHC landmarks



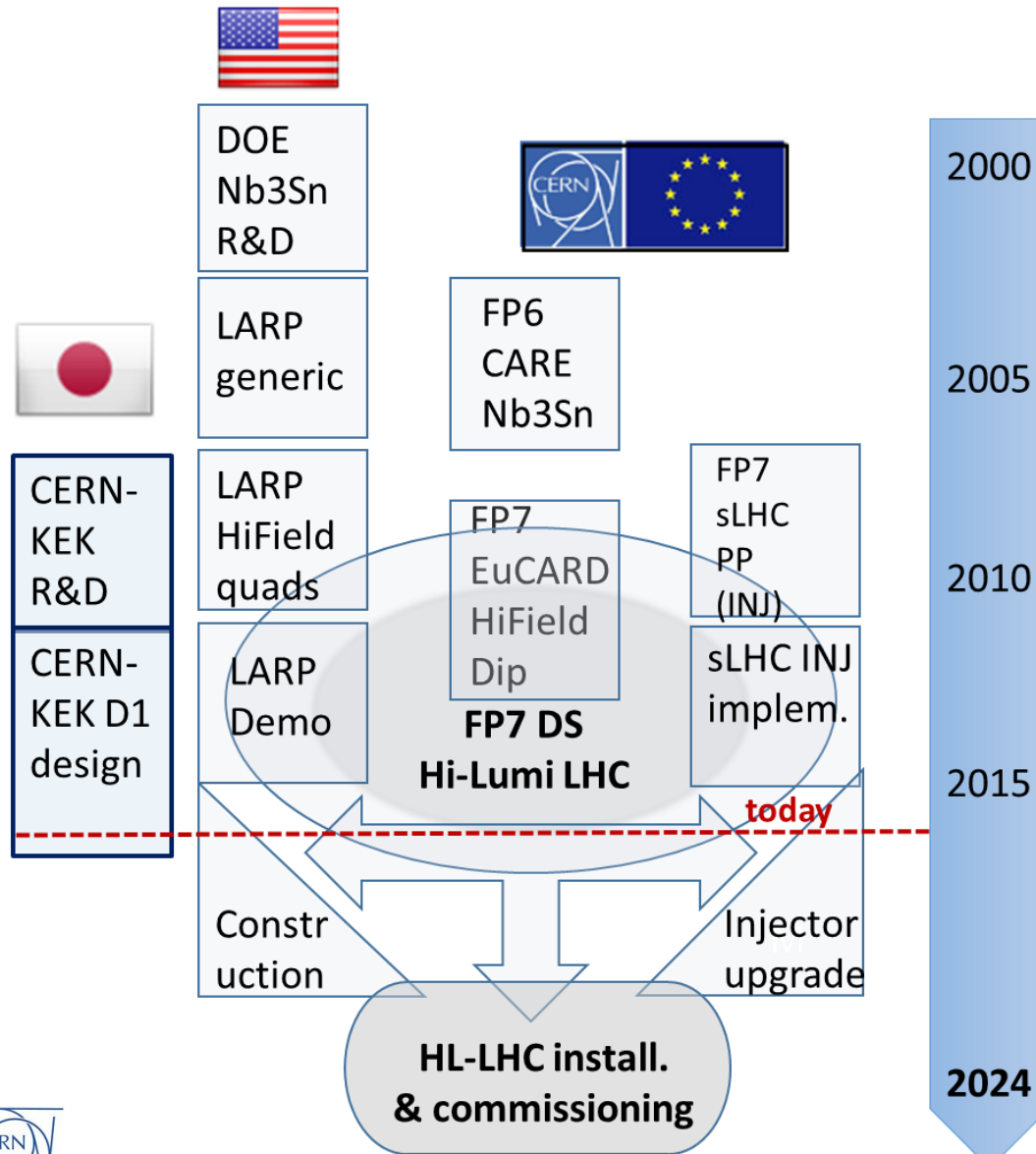
HL-LHC main milestones

- 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; HL declared an ESFRI landmark**
- 2016 June-August: re-baseline of the project
- 2016 October endorsement of new baseline by C&SR n.2
- 2017 January: technical endorsement of of re-baselinee by C-MAC



The HiLumi LHC Design Study (a sub-system of HL-LHC) is cofunded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404

HiLumi & Collaborations: the long route



High Luminosity LHC Project

MEMBER STATES COLLABORATIONS¹

IR Magnets
 CEA Saclay: P. Védrine, J-M. Rifflet, H. Felice
 CIEMAT Madrid: J-M. Perez, F. Toral
 INFN: A. Zoccoli², G. Volpini³, P. Fabbriatore⁴
 Uppsala University: T. Ekelöf

**UK: R. Appleby⁵ (Spokesperson & Collimation),
 G. Burt⁶ (Crab Cavities), S. Gibson⁷ (Beam Instr.),
 Y. Yang⁸ (Cold Powering)**

HL-LHC PROJECT MANAGEMENT

Project Leader: Lucio Rossi, CERN
Deputy Project Leader: Oliver Brüning, CERN
Project Office Manager: Laurent Taviano, CERN
Configuration, QA, Resource Manager: Isabel Bejar Alonso, CERN
Integration: Paolo Fessia, CERN
Collaborations (in-kind): Beniamino Di Girolamo, CERN
Budget Officer: Benoît 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
 A. Ratti, LBNL, L. Ristori, FNAL

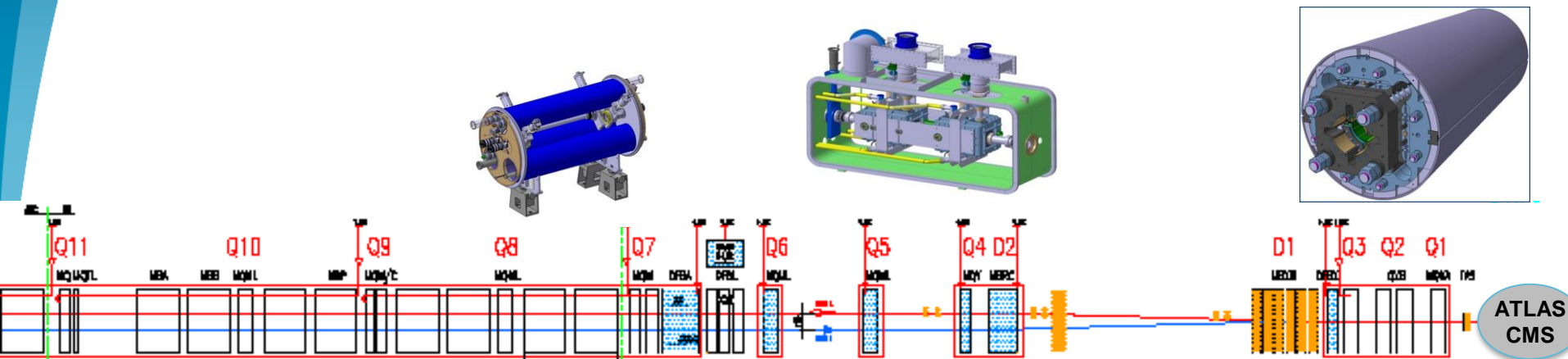
KEK - Japan
 LHC Upgrade Coordinator: K. Tokushuku
 SC D1 Magnet: T. Nakamoto



¹ In kind contributions
² INFN Directorate
³ INFN Milano LASA
⁴ INFN Genova
⁵ University of Manchester/Cockcroft Institute
⁶ Lancaster University/Cockcroft Institute
⁷ Royal Holloway/John Adams Institute
⁸ University of Southampton
⁹ US HL-LHC Accelerator Upgrade Project



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... extension of 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

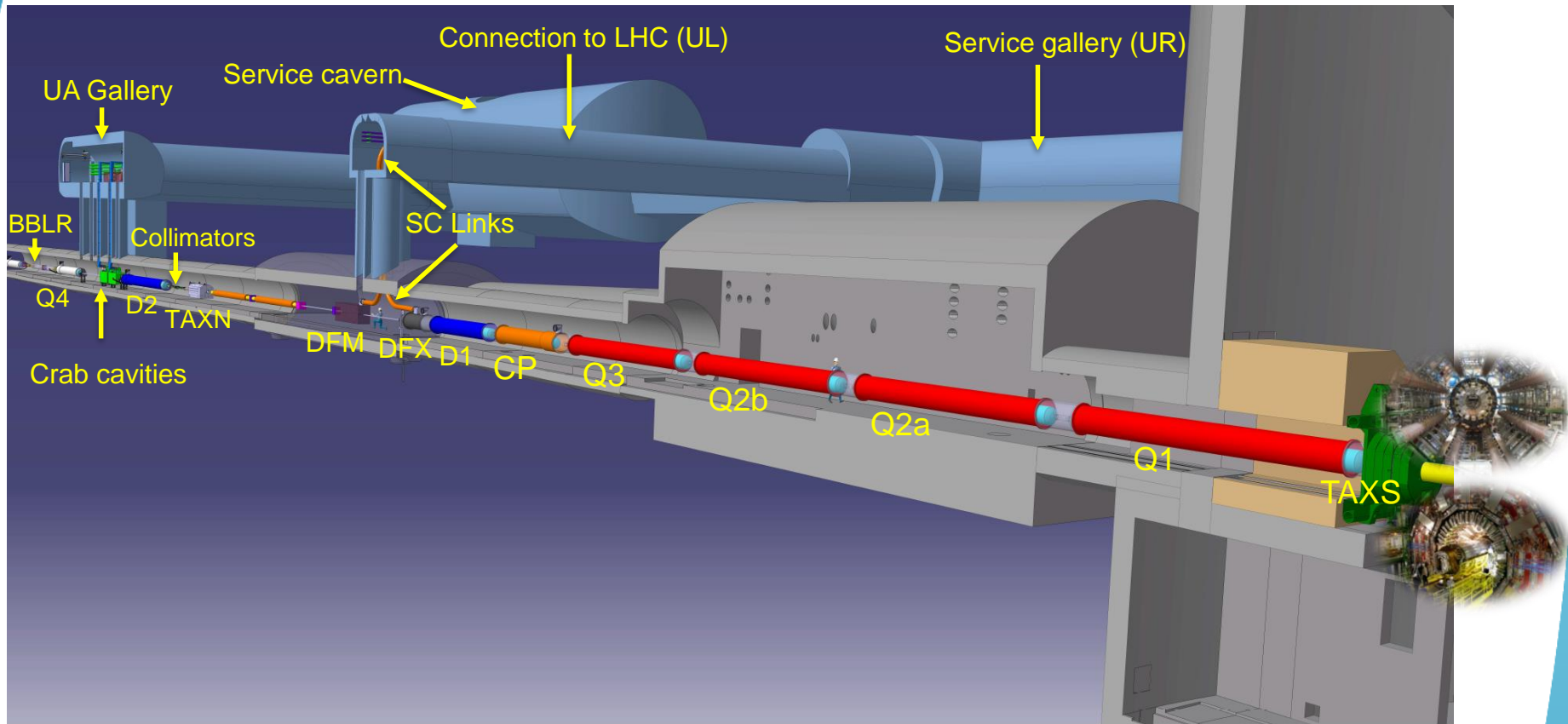
Interaction Region (ITR)

Complete change and new lay-out

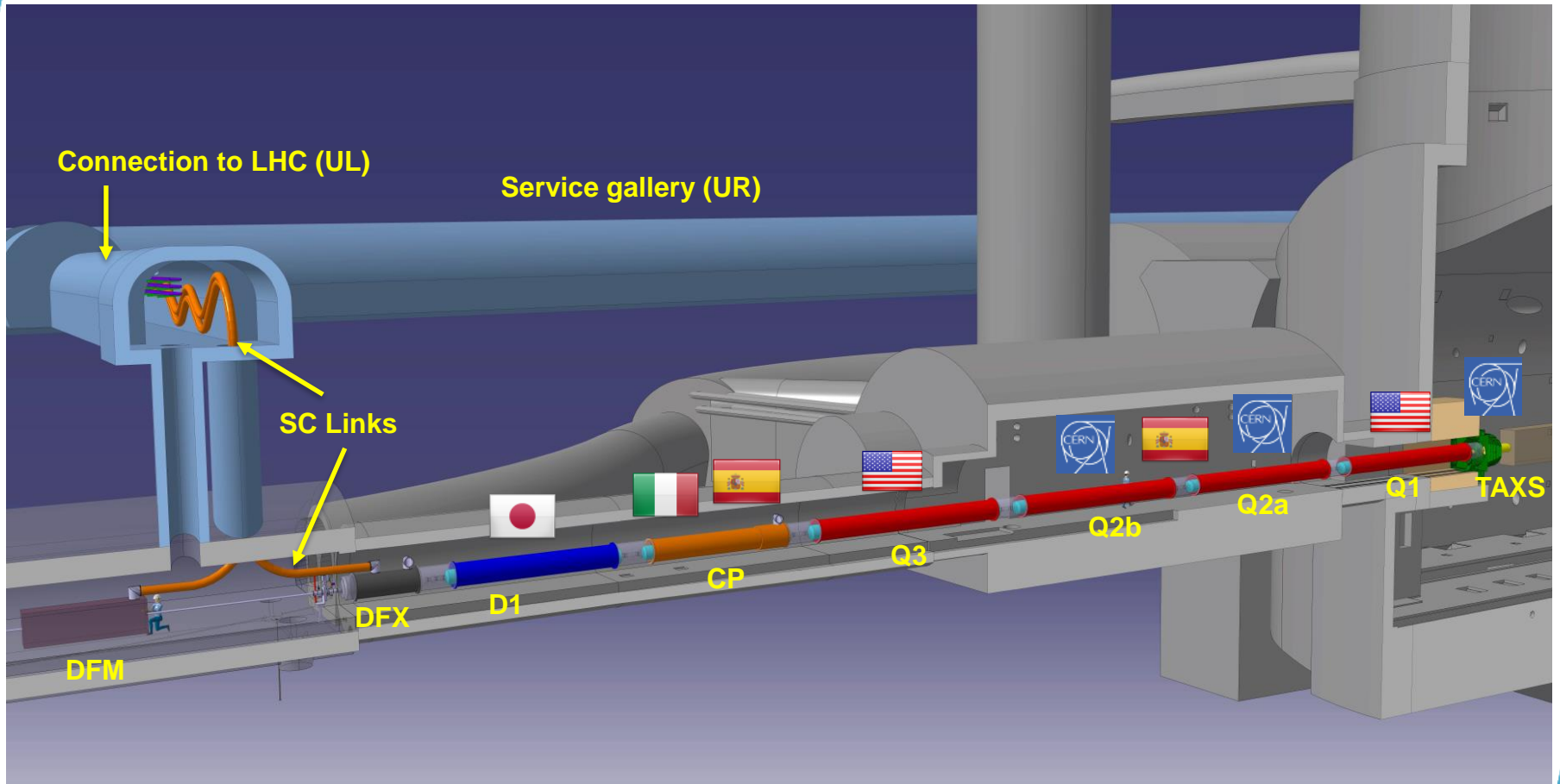
1. TAXS
2. Q1-Q2a-Q2b-Q3
3. D1
4. All Correctors Magnets
5. Heavy shielding (W)

> 1.2 km of LHC !!

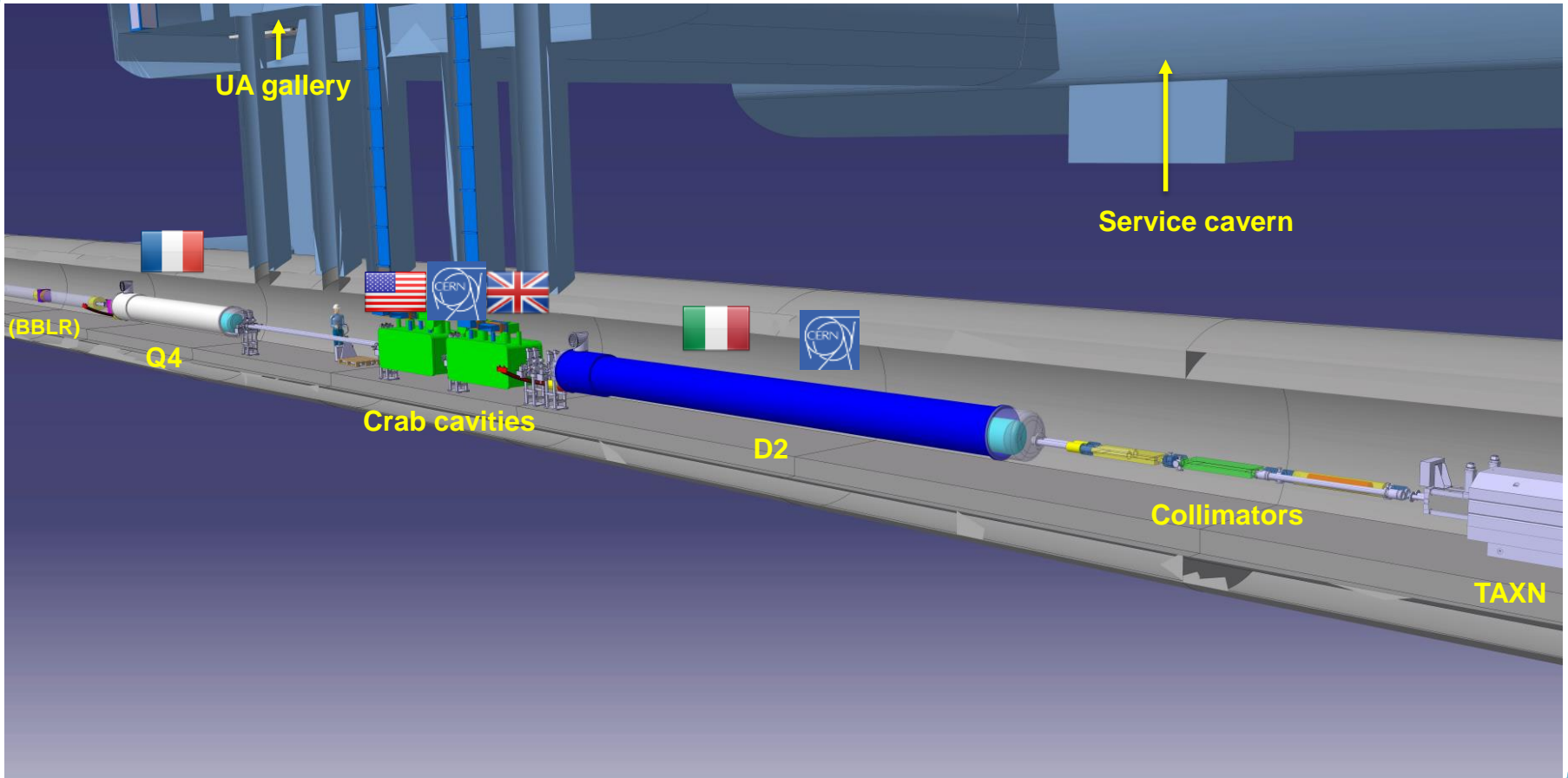
The Insertion Region (till Q4)



The Inner Triplet region with in-kinds



The MS region with in-kinds



How it could look like in point 5 (after HL)

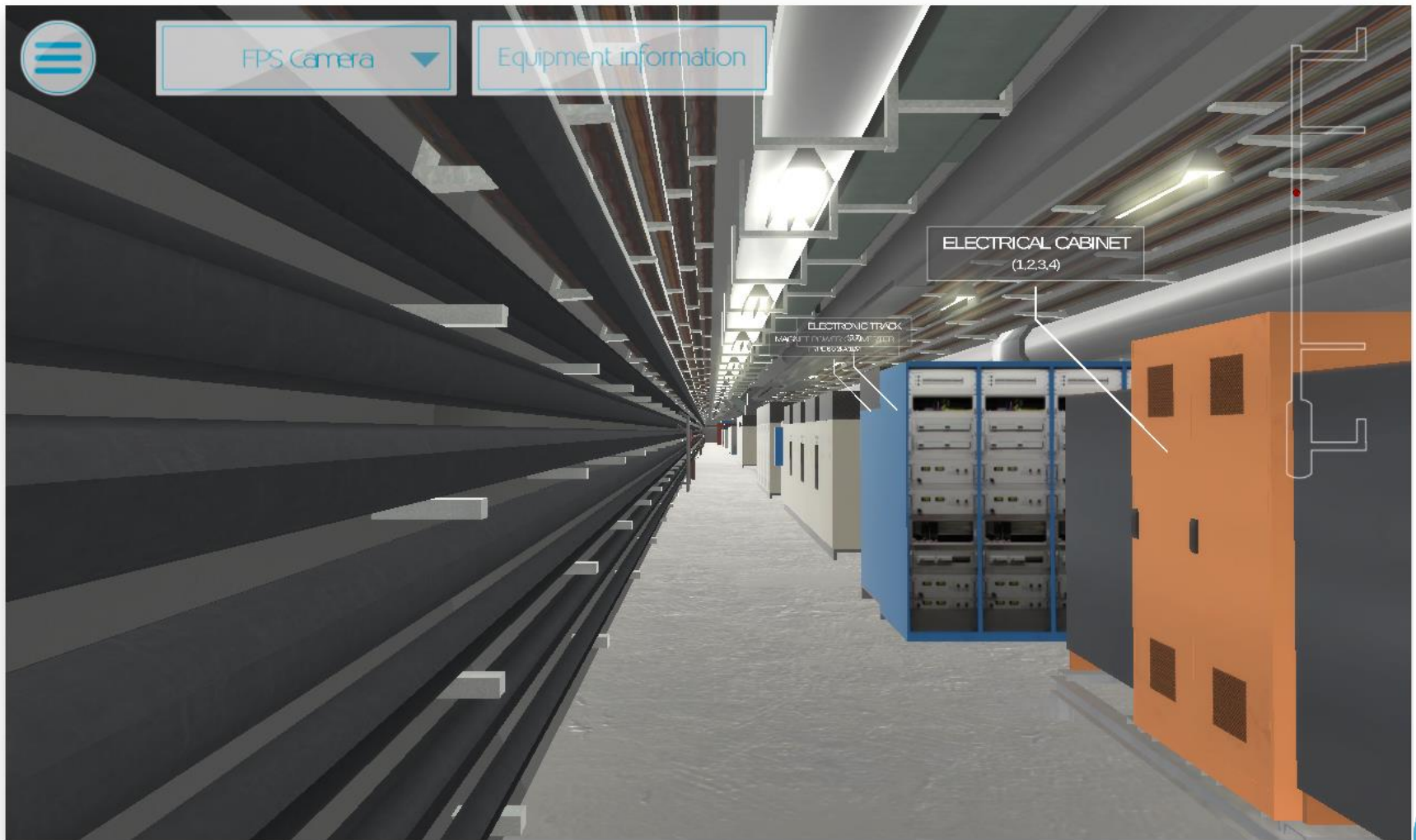


unity WebGL

HiLumi3D 



On the new HL-LHC infrastructures



unity WebGL

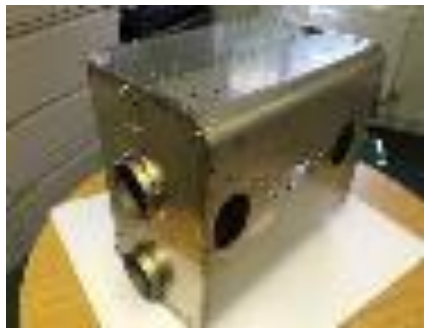
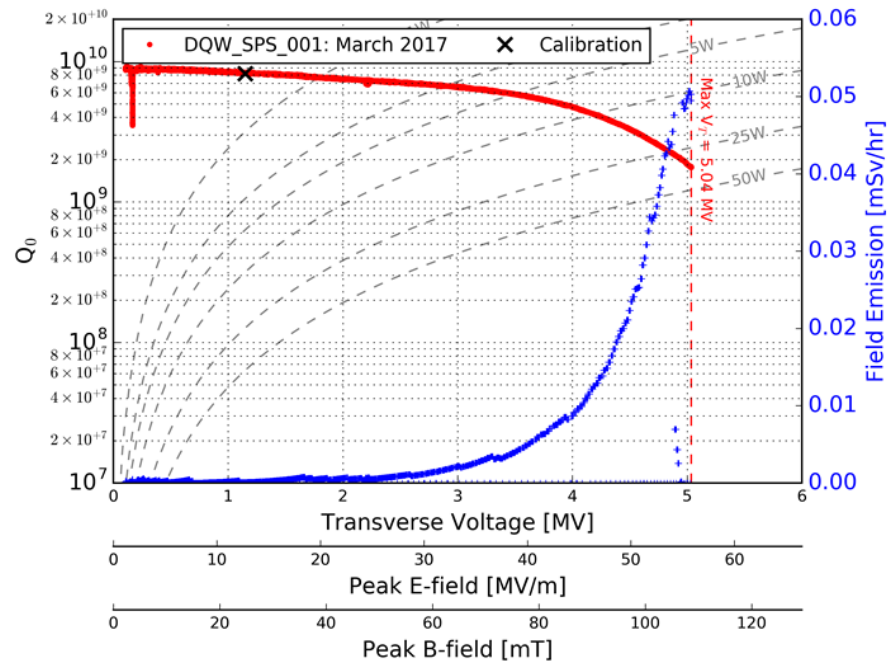
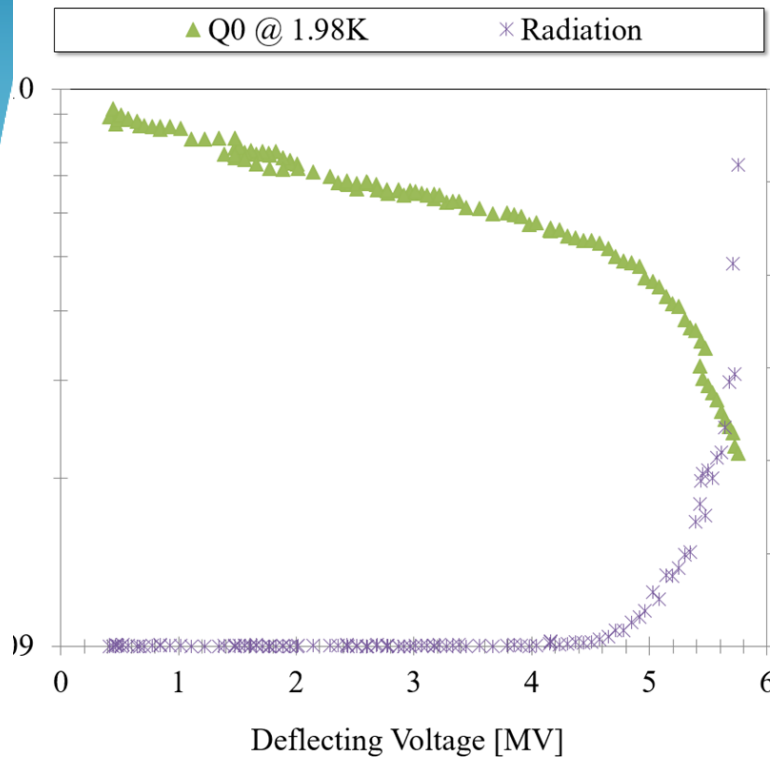
HiLumi3D



Magnets – first long proto near to test



SRF – Crab cavity successful test



Magnetic shielding from UK UNILAN STFC Daresbury



Schematic time plan

HL-LHC Plan



FP7
Hi-Lumi
DESIGN STUDY

PDR PREPARATION

ASSESS & TDR

All prototypes are under construction, while series manufacturing is approaching!

CONSTRUCTION AND TEST

INSTALLATION

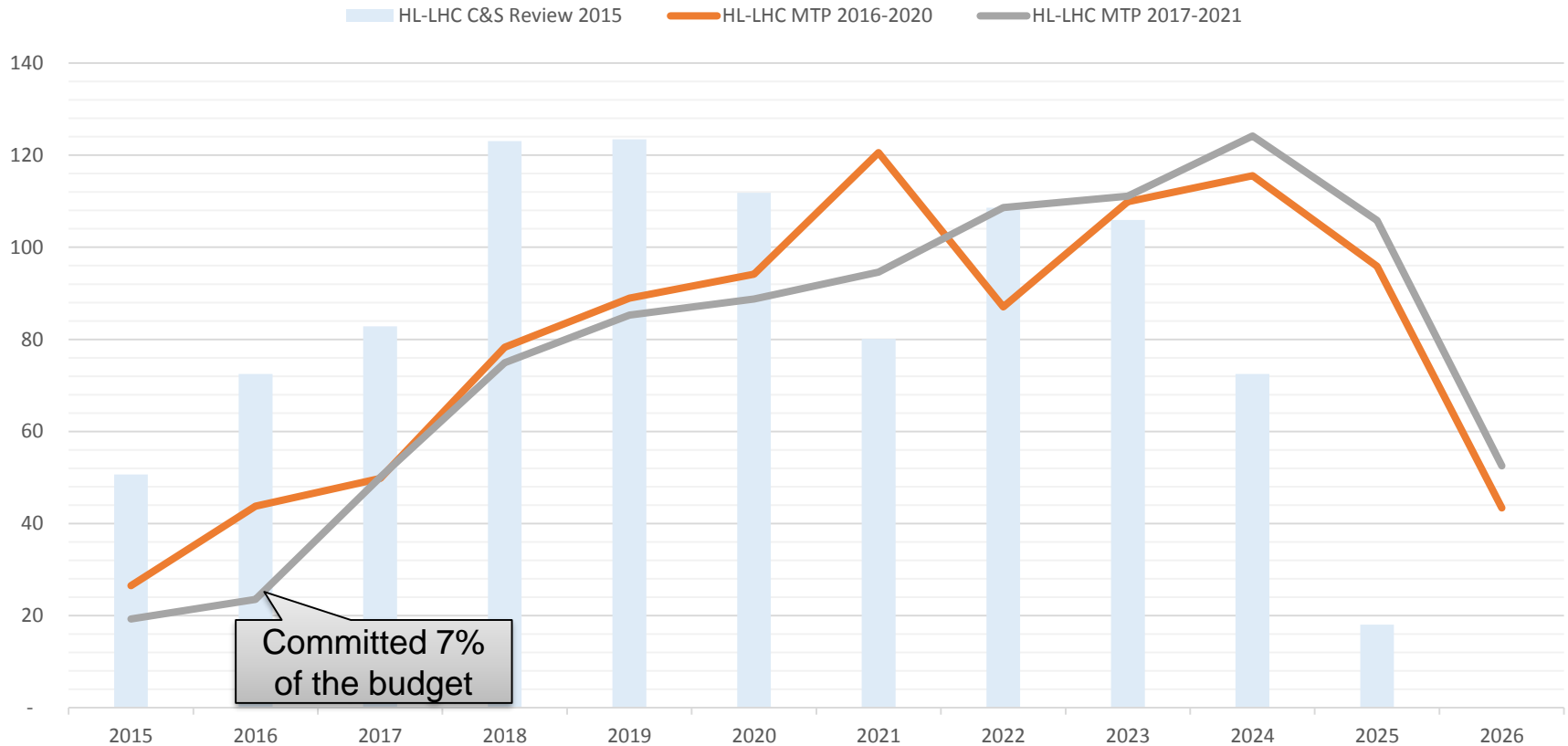
PHYSICS

2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040

We are making an effort to go to Industry also for assembly, and not only for components, rather than import the work in the CERN facilities.
However we have to stay in the assigned budget!

HL-LHC Budget (CtC) : 950 MCHF (2015 CHF)

HL-LHC Cost Center Profile



Big drivers:
Magnet Systems, C.E., RFCC, Cryo, Coll., T.I.

UK is an important partner in HiLumi

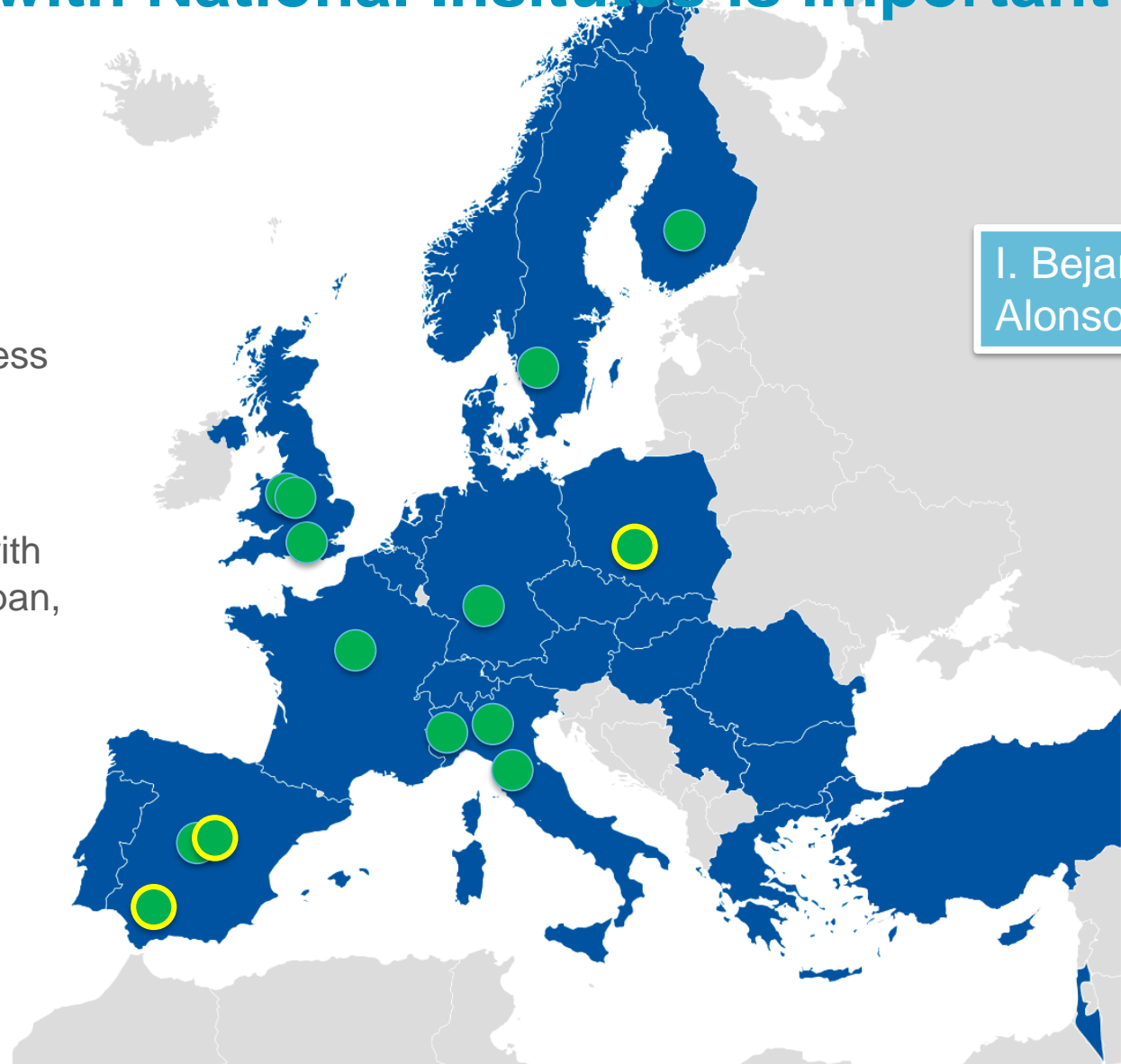
- Participation to FP7 HiLumi LHC desing study:
 - STFC, UNIMAN, UNILAN, UNILIV, RHUL, SOTON, UNIHUDD
- 2017: Agreement between CERN and STFC-UNIDundee aimed at LESS (surface treatment)
- 2017-2020: agreement between CERN and :
 - UNIMAN, STFC, UNILAN, SOTON, UNIHUDD, RHUL, Bedford New College
 - Aimed at:
 - Collimation – SRF (crab cavity) – Beam Instr. – Cold Powering
- 2020 ?

Increasing number of in kind contributions ⇒ relation with National Institutes is important

- HL-LHC
- Negotiation in process
- Past

I. Bejar
Alonso

Under discussion with
Canada, China, Japan,
Russia, USA



Update of Make or Buy Plan

- Additional information in the Shopping Lists within the procurement plans provided to the ILOs and uploaded into the Industry website
<https://espace.cern.ch/HiLumi-Procurement/SitePages/Shopping%20Lists.aspx>



Package Name	PBS Number	LHC Equipment Code	Work Package Reference	Date of MS	TYPE	Scheduled Issue Date	Tender Reference no.	Manufacturing Time	Manufacturing Time (units)	Required On Site	Forecast Cost Range (in CHF)	Quantity	Quantity (units)
Coil End Spacers	111.3.3.0.0		WP11			01/06/2016		6 months		01/06/2016	<50k	10	sets of 24 parts
Coil Keys	111.3.3.0.0		WP11			01/06/2016		6 months		01/06/2016	<50k	10	sets of 4 parts
Coil Saddles	111.3.3.0.0		WP11			01/06/2016		6 months		01/06/2016	<50k	10	sets of 4 parts
Collaring Keys	111.3.3.0.0		WP11			01/06/2016		6 months		01/06/2016	<50k	24	sets of 6m
Copper Lugs	111.3.3.0.0		WP11			01/06/2016		6 months		01/06/2016	50k << 200k	84	strips
Copper Profiles	111.3.3.0.0		WP11			01/09/2016		8 months		01/09/2016			
End Covers	111.3.3.0.0		WP11			01/07/2017		8 months		01/07/2017			
Steel Laminations	111.3.3.0.0		WP11			01/07/2017		8 months		01/07/2017			
Fine Blanked Steel Laminations			WP11			01/04/2016	DO-29499	8 months		01/04/2016			

I. Bejar Alonso

- Identification of main Domains of Activity and those areas for which would be required to seek new/more suppliers (Brochures on [EDMS: CERN-0000151340](https://cds.cern.ch/record/151340))

Domains of Activity	Presently identified as potential suppliers	
Raw Materials – High RRR Niobium & NbTi	MS Firms	MS Firms
	AT	IL
	BE	IT
	BG	NL
	CZ	NO
	CH	MetSuisse
	DE	HERAEUS
	DK	PT
	ES	RO
	FI	RS
	FR	SE
	GR	SK
	HU	TR
		UK

Looking for...

- Raw materials for manufacturing of components of WP4 equipment (Bare Cavities, HOM couplers, etc...)
- Procurement of sheets high RRR Nb and NbTi Rods

Domains of Activity	Presently identified as potential suppliers	
Cu alloy - GLIDCOP	MS Firms	MS Firms
	AT	IL
	BE	IT
	BG	NL
	CZ	NO
	CH	PK
	DE	PL
	DK	PT
	ES	RO
	FI	RS
	FR	SE
	GR	SK
	HU	TR
		UK

Looking for...

- Material hardness to radiation
- Superconducting properties
- Material also required by WPS (Collimation System)

Domains of Activity	Presently identified as potential suppliers	
Power Converters	MS Firms	MS Firms
	AT	IL
	BE	IT
	BG	NL
	CZ	NO
	CH	PK
	DE	HEINZINGER
	DK	DANFYSIK
	ES	JEMA
	FI	KEMPOWER
	FR	TRANSTECHNIK, SIGMAPHI
	GR	SK
	HU	TR
		UK

Looking for...

- New Power Converters to be installed for HL-LHC project
- Based on switch-mode technology
- R&D for some type of converters is required

Communicating

Collaborators

Industry

Public

Hilumi HL-LHC PROJECT
The HL-LHC Project
High Luminosity Large Hadron Collider

Home Project Activities HL-LHC Design Study Intranet Contact

Intranet
Collaborators only
Member registration
View to access the Intranet

HIGHLIGHTS
A novel optics scheme
3 Oct 2016
QIACO companies ready for announcement
3 Oct 2016
6th HL-LHC Collaboration Meeting in Paris on 14-16 November 2016
26 Sep 2016

Hilumi HL-LHC PROJECT
HL-LHC Industry
Industry Relations and Procurement Website for the HL-LHC project

Home General Info Procurement Overview Tendering Application Timeline Events Contact

Building the HL-LHC with the Industry

The HL-LHC Industry Website has been specially designed for all those firms that wish to participate in this ambitious project. We want to share all the relevant information related to the procurement that will be required to accomplish this major upgrade of the LHC.

The industry will have a crucial role and will be heavily involved within the HL-LHC Project. It will be the main source to provide the technologies and equipment that are required to successfully achieve the goals of this upgrade of the LHC.

The HL-LHC will collaborate with many types of industries and businesses to pursue its goals. Knowledge and technology to be developed during the HL-LHC project will make a lasting impact on society.

13 September 2016
2nd HL-LHC INDUSTRY DAY in Lisbon
The 2nd Industry Day is coming very soon. Do register to take part in this event and gather first-hand information about the HL-LHC project from CERN representatives.
Register here!

4 September 2016
2nd and 3rd HL-LHC INDUSTRY DAY
Do not miss the Hilumi Industry days! They will be held in Lisbon, Portugal on 31 October 2016 and in

About CERN Students & Educators Scientists CERN people

TOPIC The High-Luminosity LHC

LEARN MORE ABOUT THIS TOPIC
New technologies for the High-Luminosity LHC

OPINIONS ON THIS TOPIC

This content is archived on the CERN Document Server

The High-Luminosity Large Hadron Collider (HL-LHC) project aims to crank up the performance of the LHC in order to increase the potential for discoveries after 2025. The objective is to increase luminosity by a factor of 10 beyond the LHC's design value.

Luminosity is an important indicator of the performance of an accelerator: it is proportional to the number of collisions that occur in a given amount of time. The higher the luminosity, the more data the experiments can gather to allow them to observe rare processes. The High-Luminosity LHC, which should be operational by 2025, will allow precise studies of the new particles observed at the LHC, such as the **Higgs boson**. It will allow the observation of rare processes that are inaccessible at the LHC's current sensitivity level. For

Hilumi Project
International Project at CERN
Geneva, Canton of Geneva, Switzerland | Research

Add Experience
Add Education

500+
connections

View profile as

Hilumi HL-LHC PROJECT

Industry for Hilumi
95 members



Hilumi HL-LHC PROJECT
HL-LHC Industry

Shopping List WP11

Package Name	PBS Number	LHC Equipment Code	Work Package Reference	Date Of
Coil End Spacers	11.1.3.0.0		WP11	
Coil Keys	11.1.3.0.0		WP11	
Coil Saddles	11.1.3.0.0		WP11	
Cabling Keys	11.1.3.0.0		WP11	
Copper Lytas	11.1.3.0.0		WP11	
Copper Profiles	11.1.3.0.0		WP11	
End Covers	11.1.3.0.0		WP11	
Steel Laminations			WP11	
Fine Steel Laminations			WP11	



CERN shared this photo.
Click on a photo to see more.

Did you guess?
This photo was taken end of September 2016 and shows the lowering into one test tunnel in Hall 5 of one of the first models of the new quadrupole magnets for the future HL-LHC High Luminosity Large Hadron Collider.
Read more about new technologies for the High Luminosity LHC: [http://cern.ch/accelerating-news](#)





***Construction ahead!!
Want to know more?
Come to Madrid →***



Thanks to all participants for making this meeting a landmark in the project