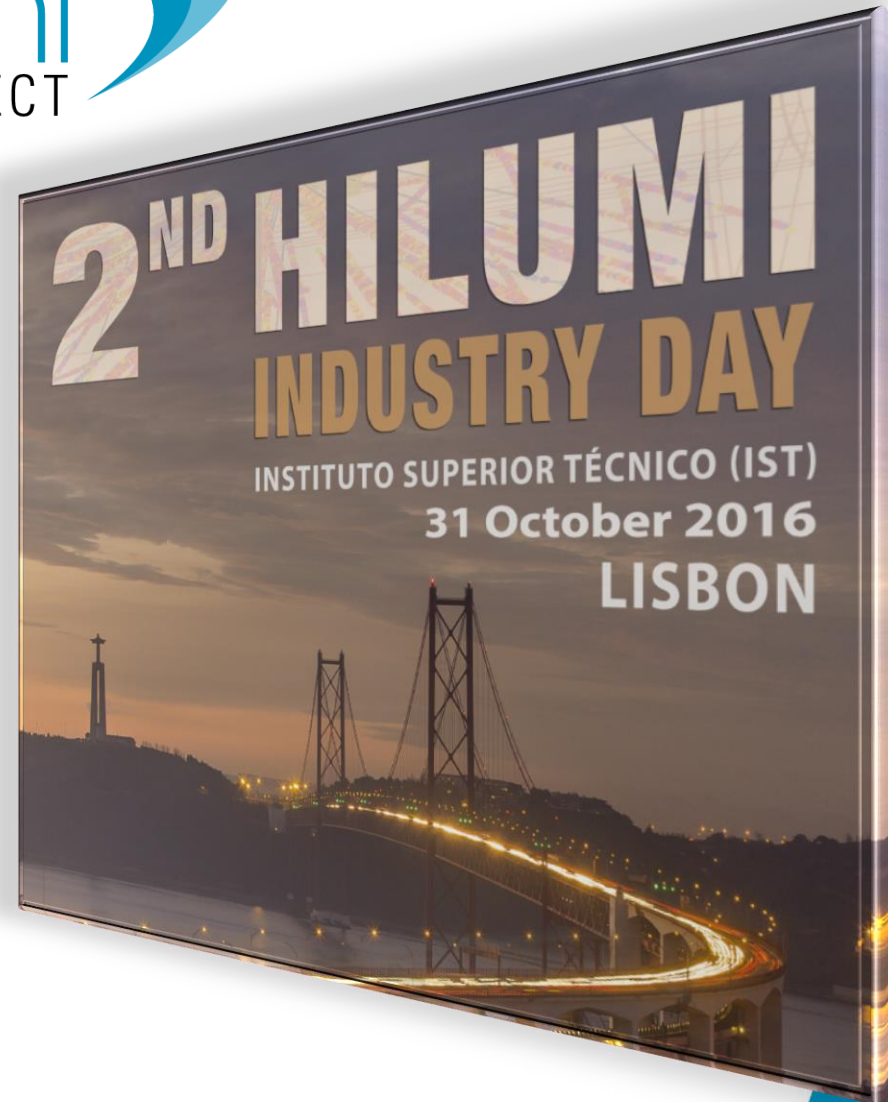




Introduction to the HL-LHC Project

Lucio Rossi – CERN
HL-LHC Project Leader



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:

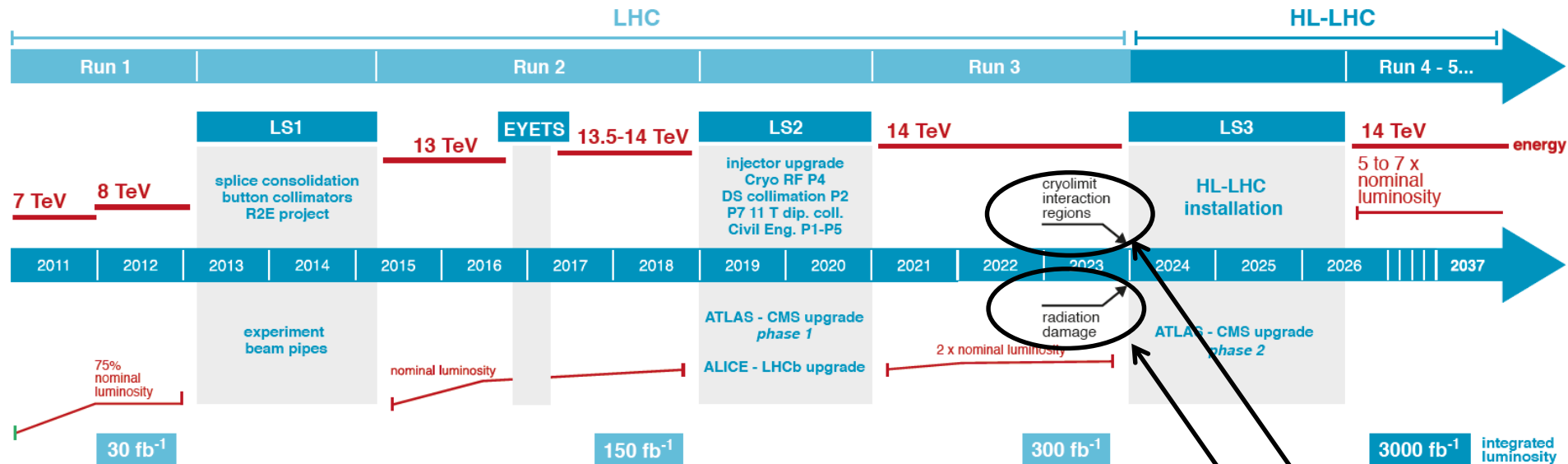
An integrated luminosity of **250 fb⁻¹ per year**, enabling the goal of $L_{\text{int}} = 3000 \text{ fb}^{-1}$ twelve years after the upgrade.

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

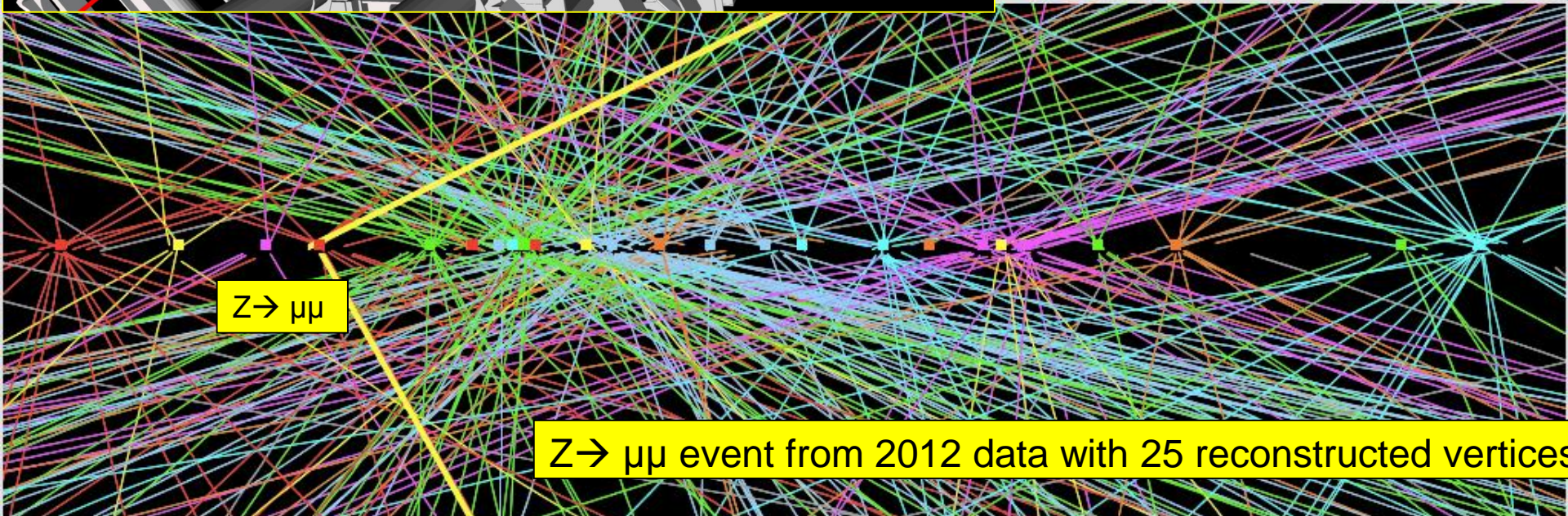
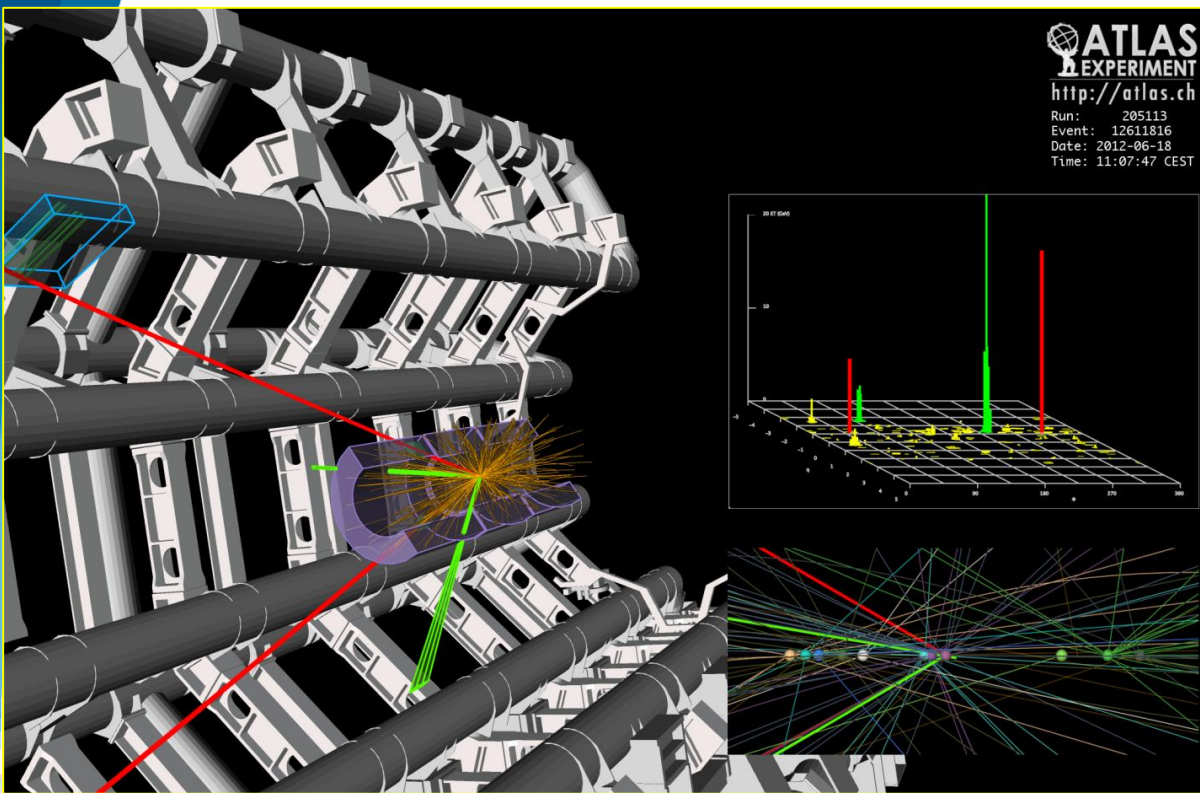
Technical limits to lumi increase (Machine & Experiments)



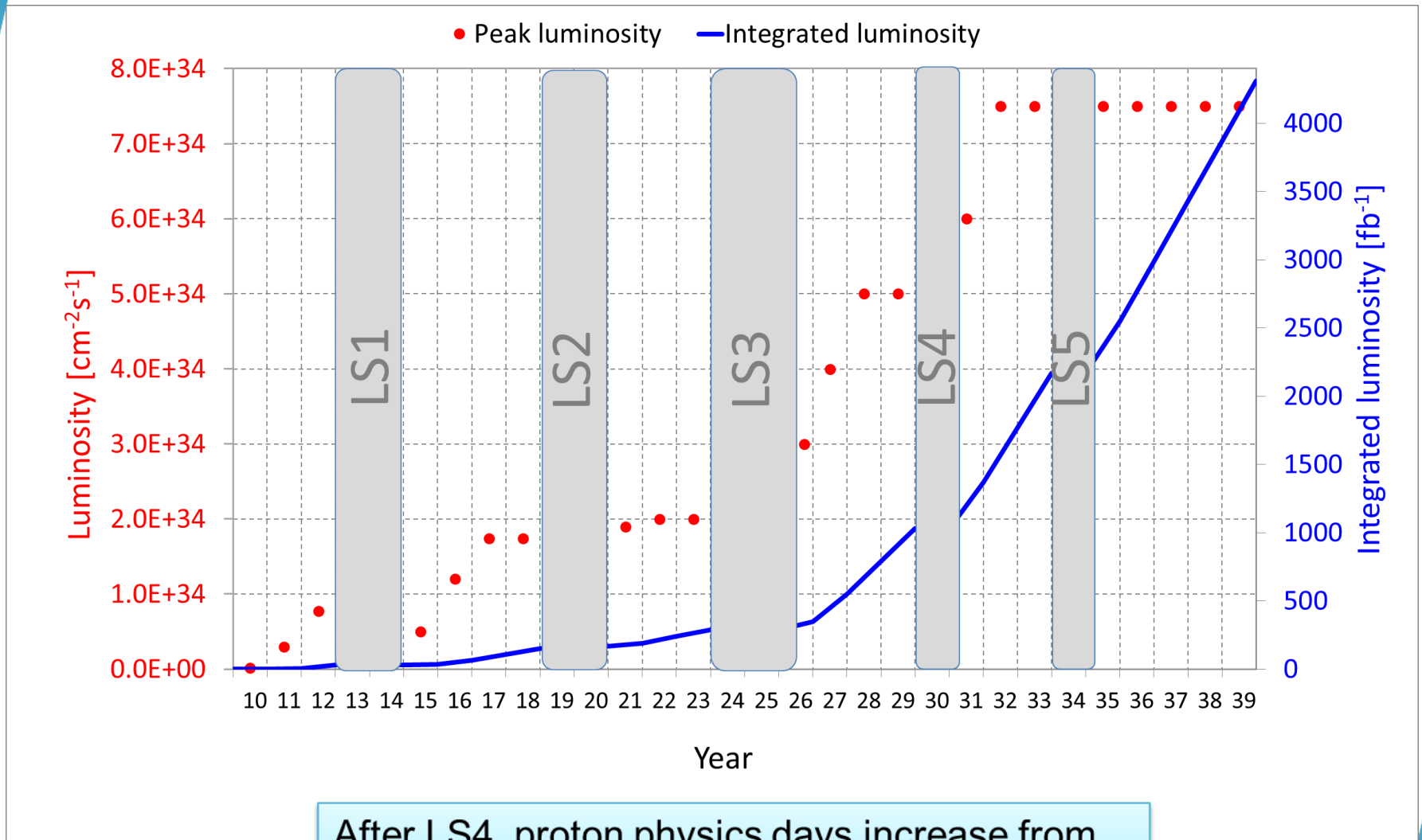
**More luminosity
⇒ higher the
collision rate**

**Higgs: the needle in
the haystack**

**Picture repeated 40
millions times each
second**

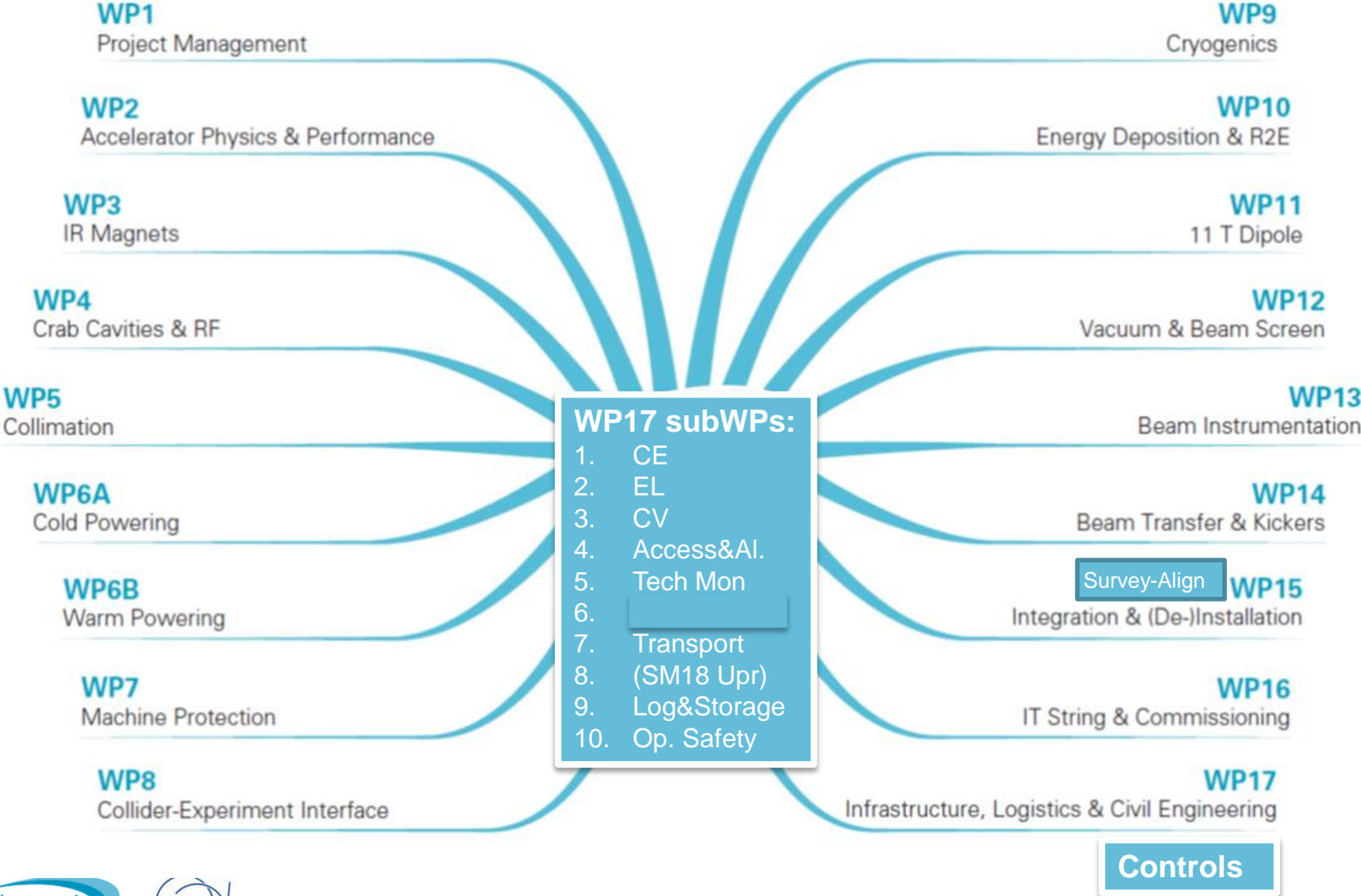


Luminosity profile: ULTIMATE

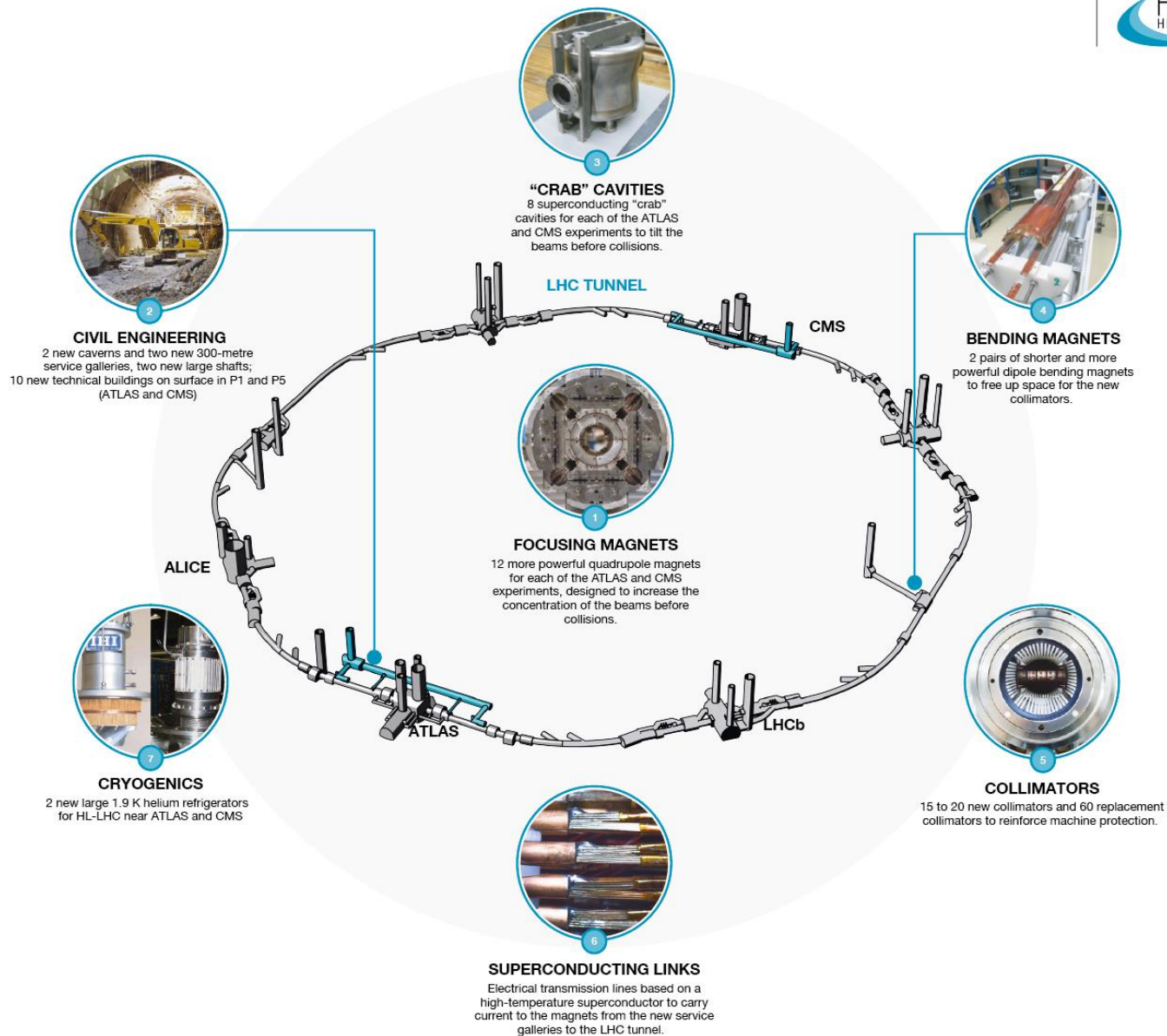


After LS4, proton physics days increase from standard 160 days to 200 and after LS5 to 220

Project structure

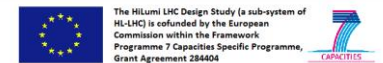


HiLumi LHC landmarks



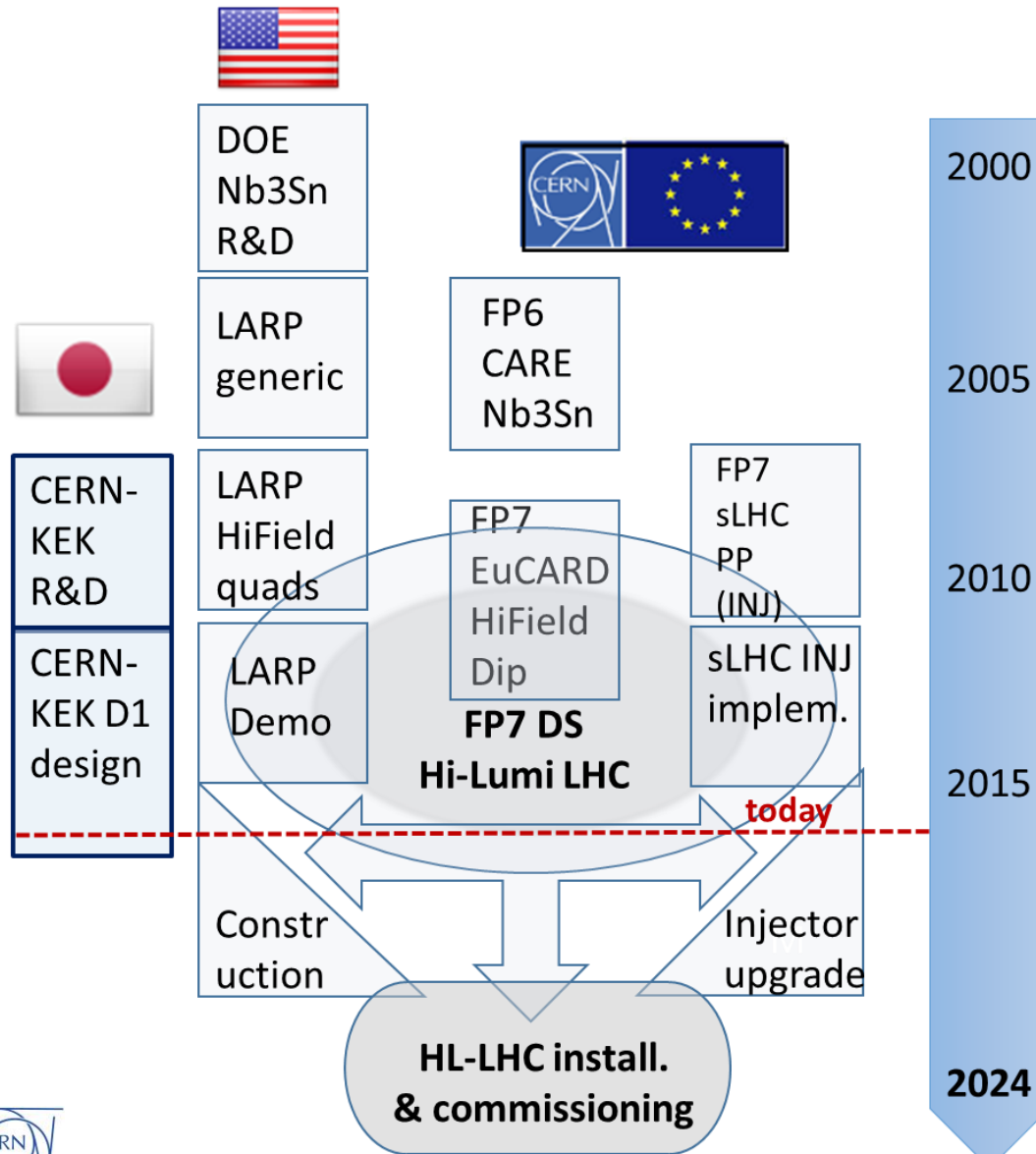
HL-LHC main milestones

- 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

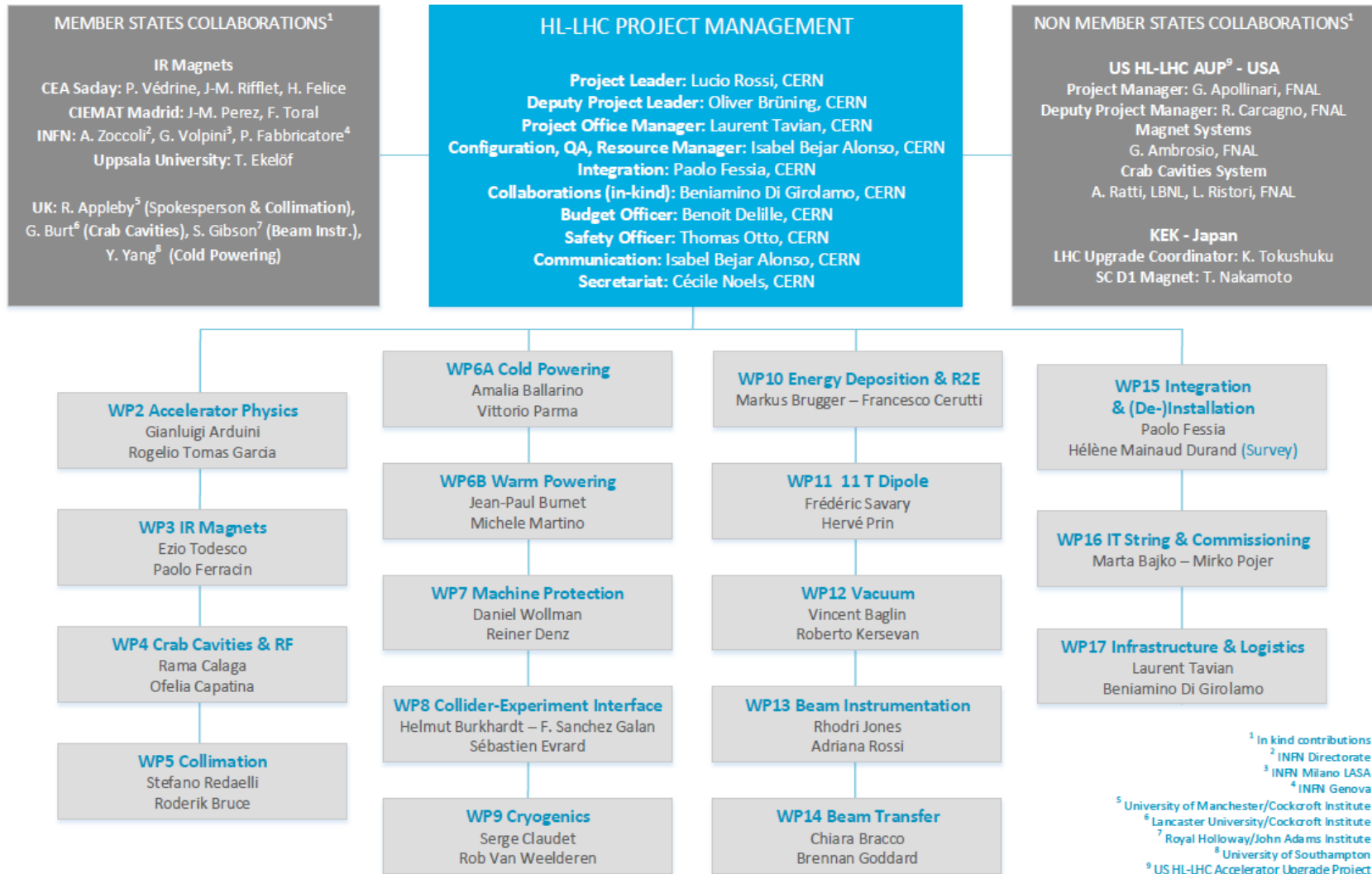


The HiLumi LHC Design Study (a sub-system of HL-LHC) is cofunded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 286404

HiLumi & Collaborations: the long route



High Luminosity LHC Project



¹ In kind contributions

² INFN Directorate

³ INFN Milano LASA

⁴ INFN Genova

⁵ University of Manchester/Cockcroft Institute

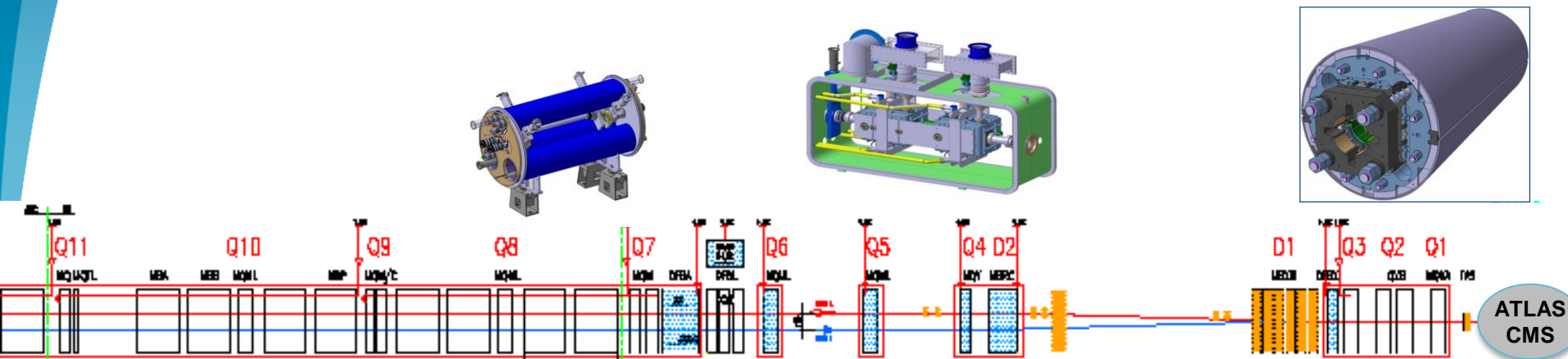
⁶ Lancaster University/Cockcroft Institute

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

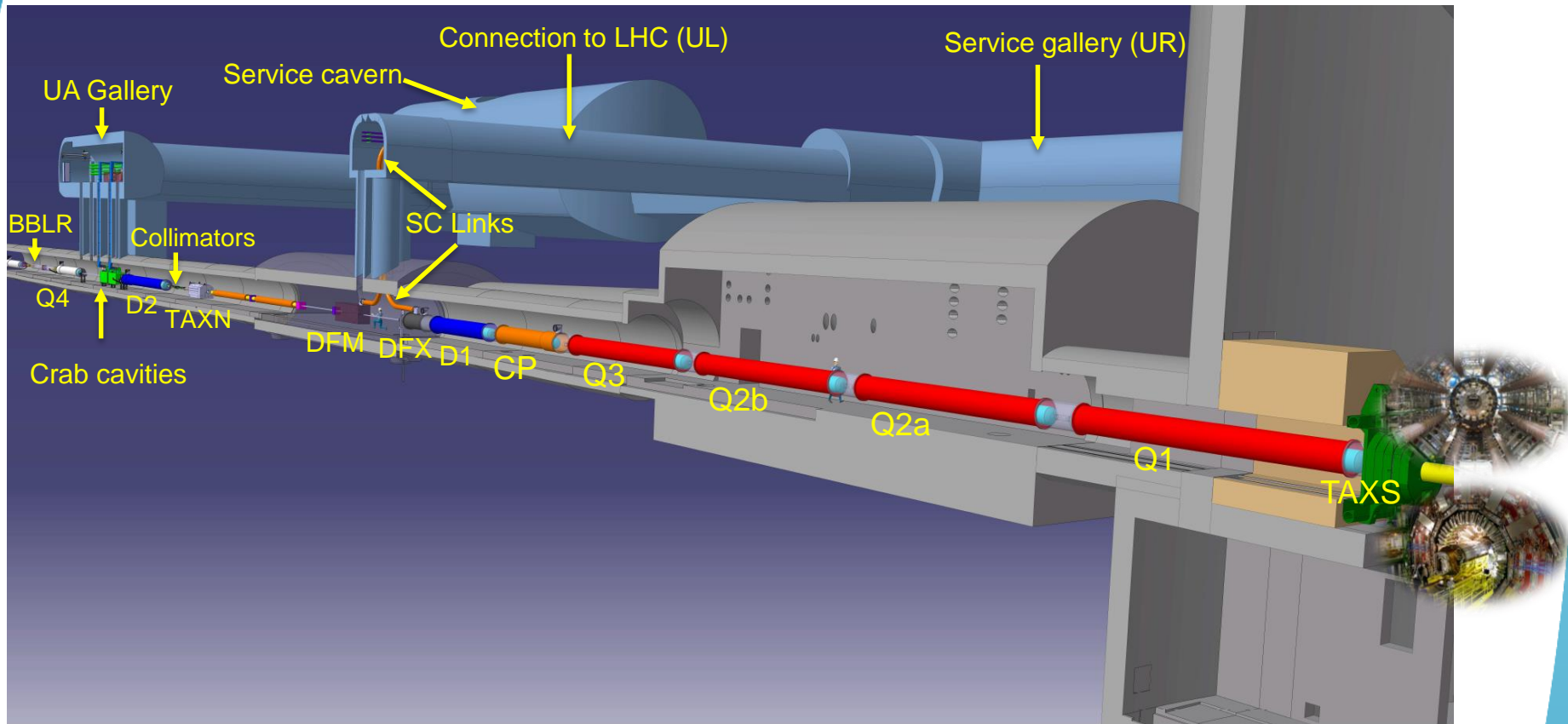
Interaction Region (ITR)

Complete change and new lay-out

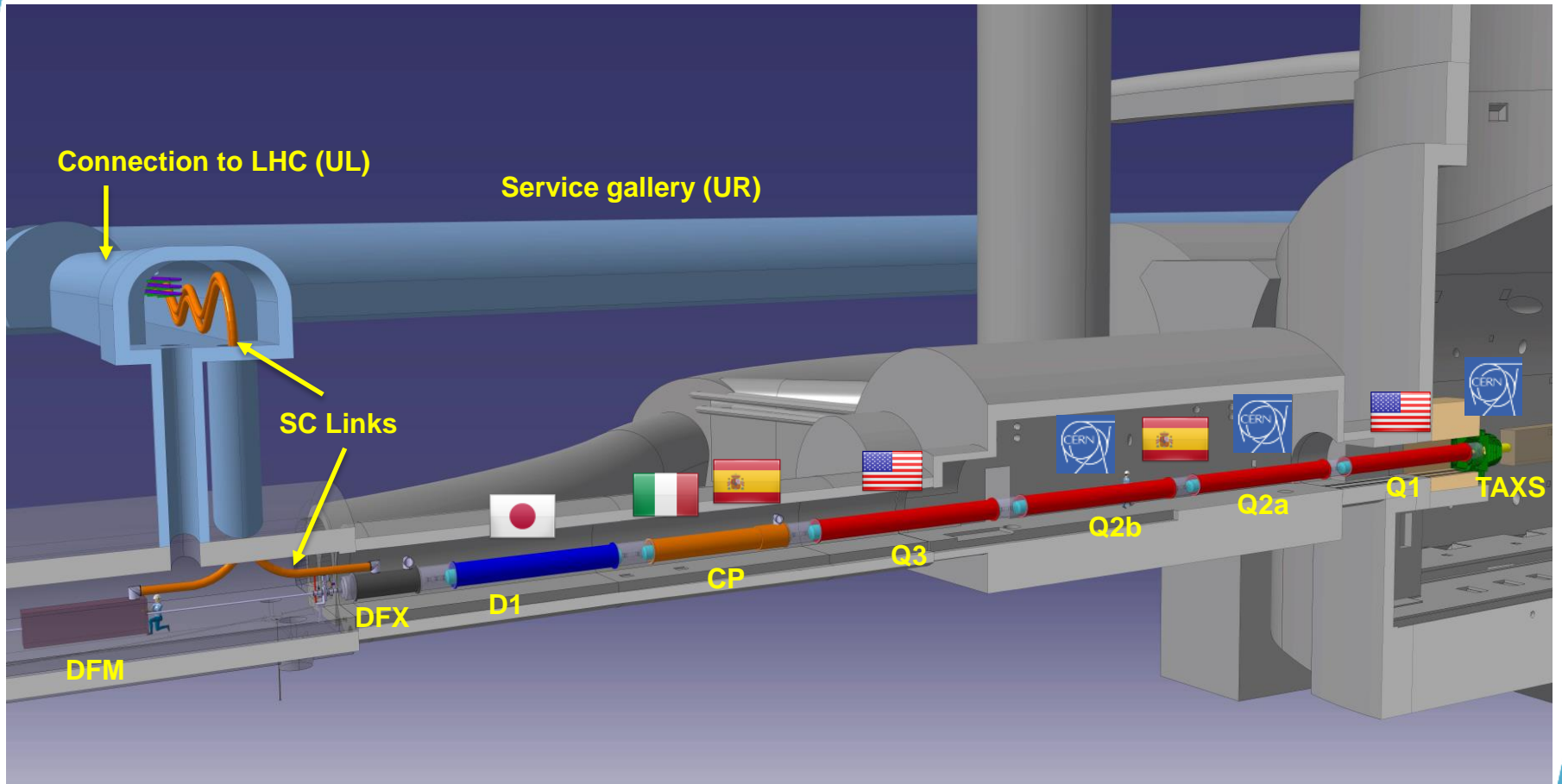
1. TAXS
2. Q1-Q2a-Q2b-Q3
3. D1
4. All Correctors Magnets
5. Heavy shielding (W)

> 1.2 km of LHC !!

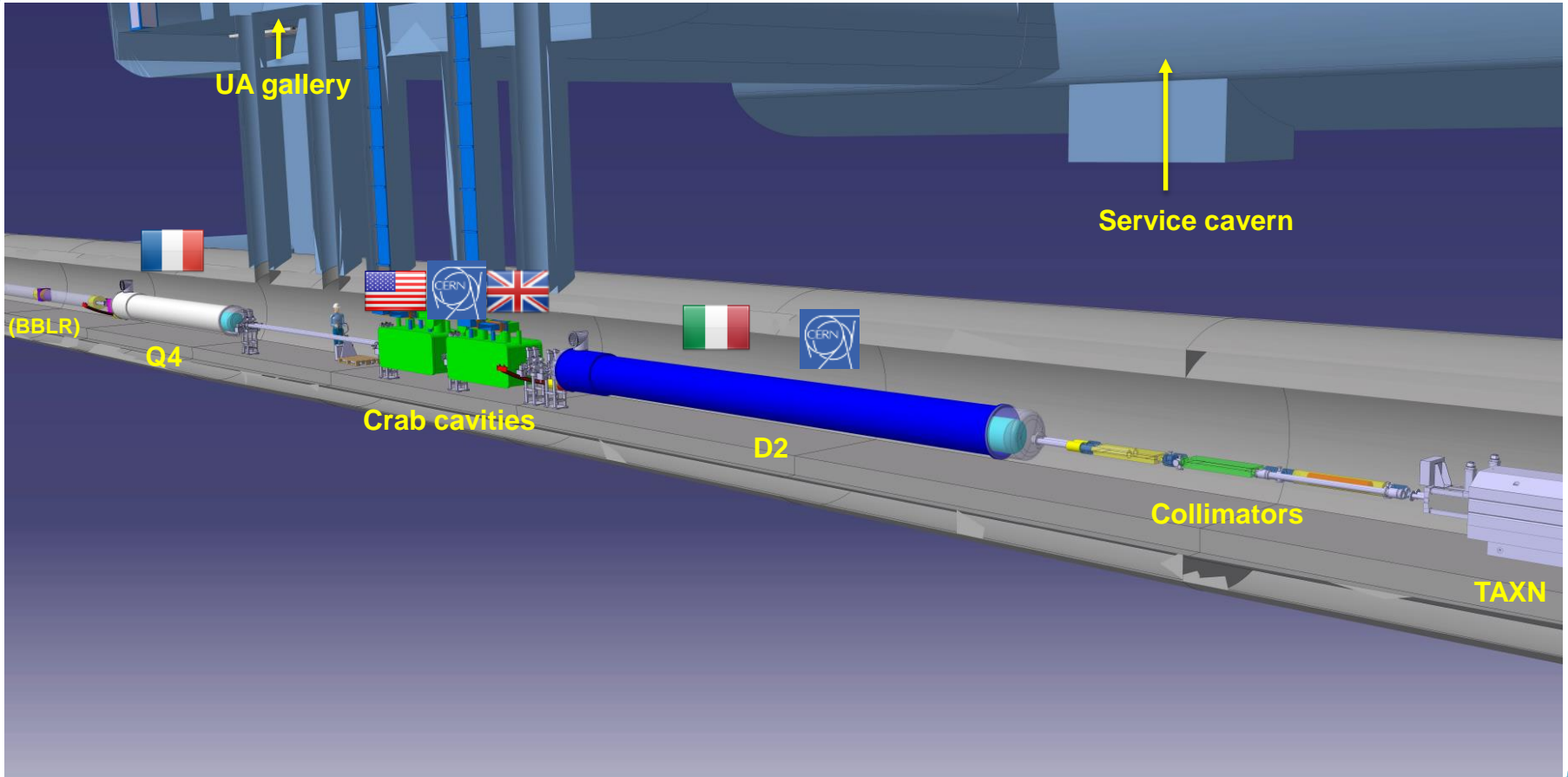
The Insertion Region (till Q4)



The Inner Triplet region with in-kinds



The MS region with in-kinds



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

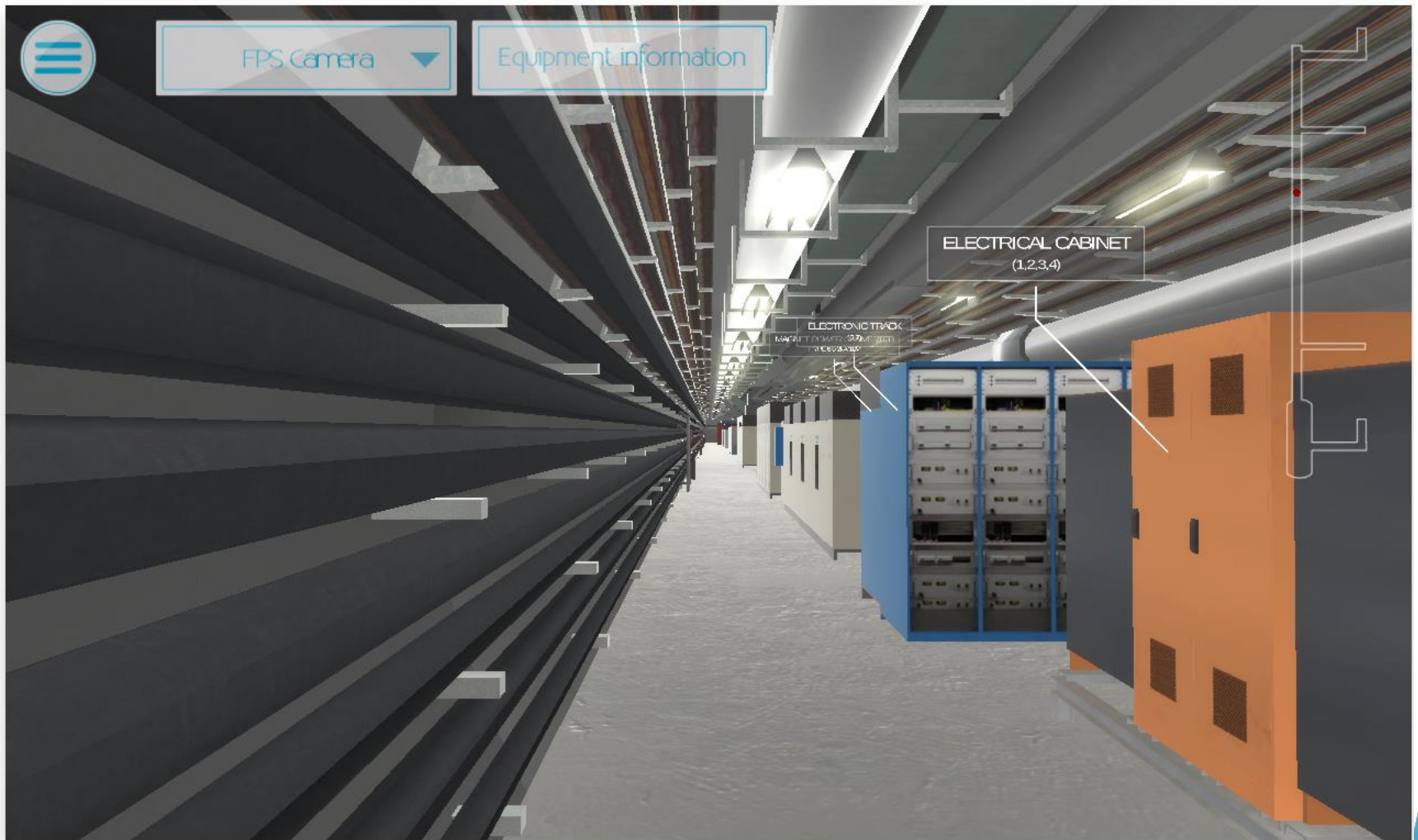


unity WebGL

HiLumi3D 



On the new HL-LHC infrastructures



unity WebGL

HiLumi3D



Schematic time plan

HL-LHC Plan



FP7
Hi-Lumi
DESIGN STUDY

PDR PREPARATION

ASSESS & TDR

CONSTRUCTION AND TEST

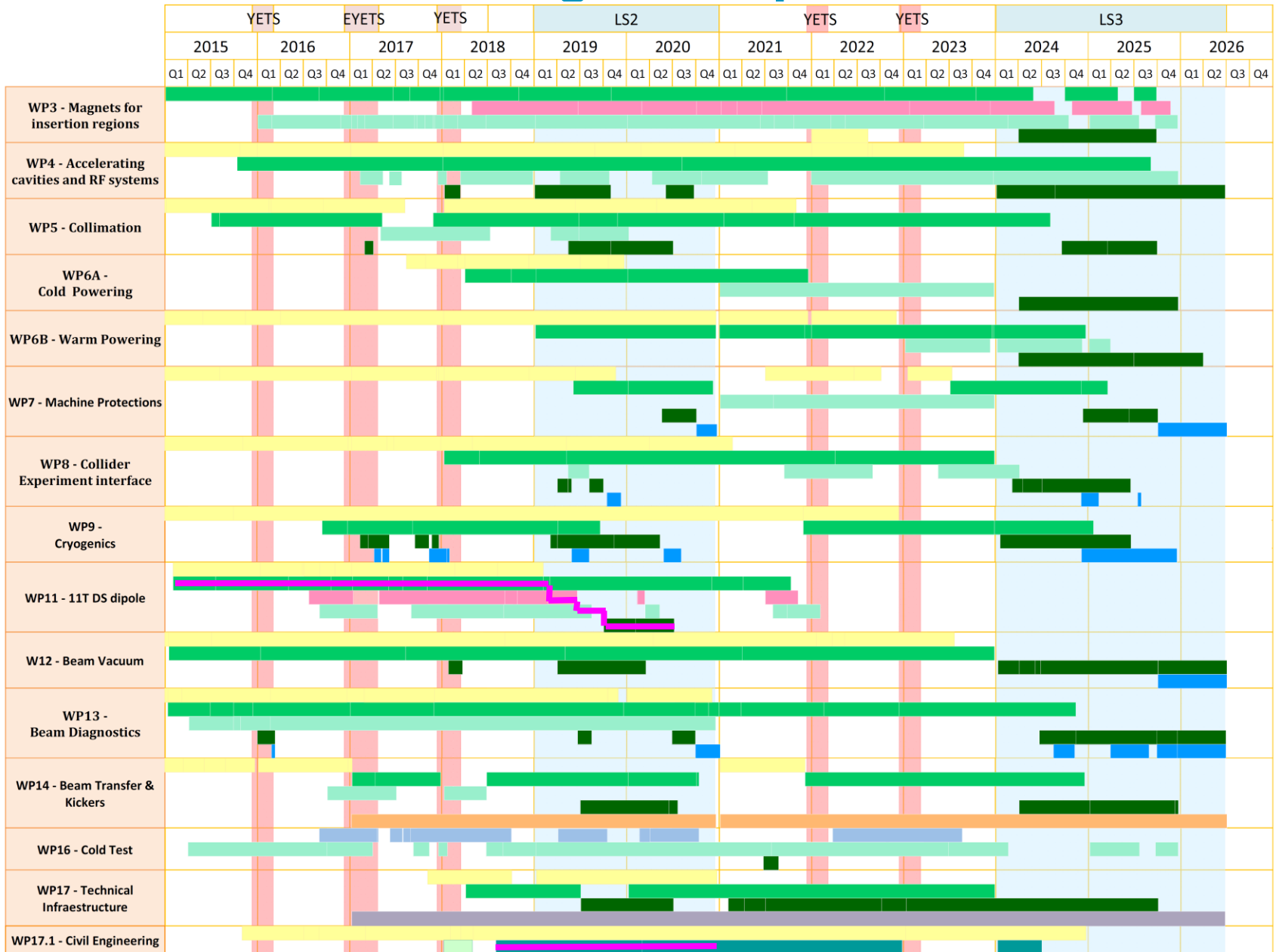
INSTALLATION

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

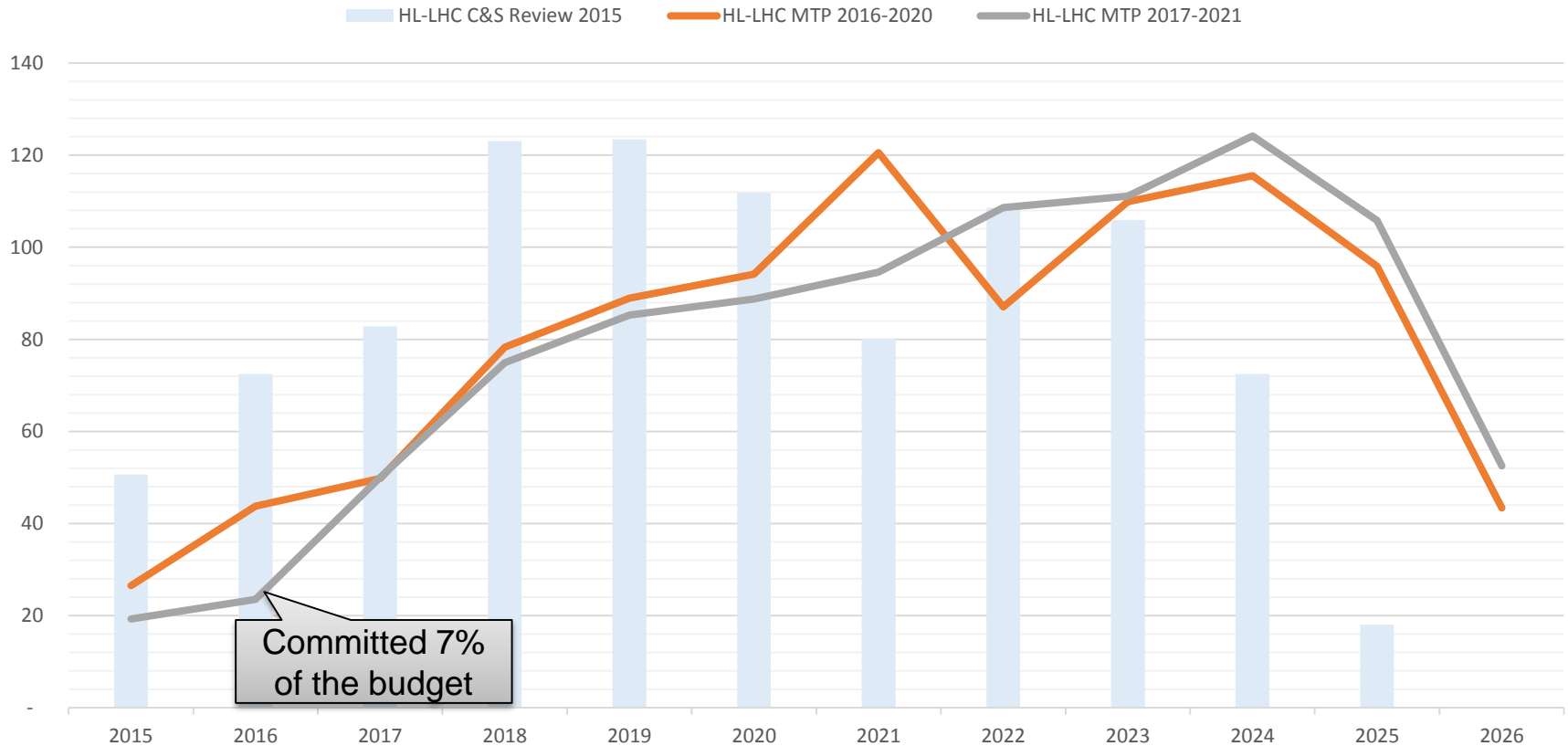


Detailed general plan



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

HL-LHC Cost Center Profile



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

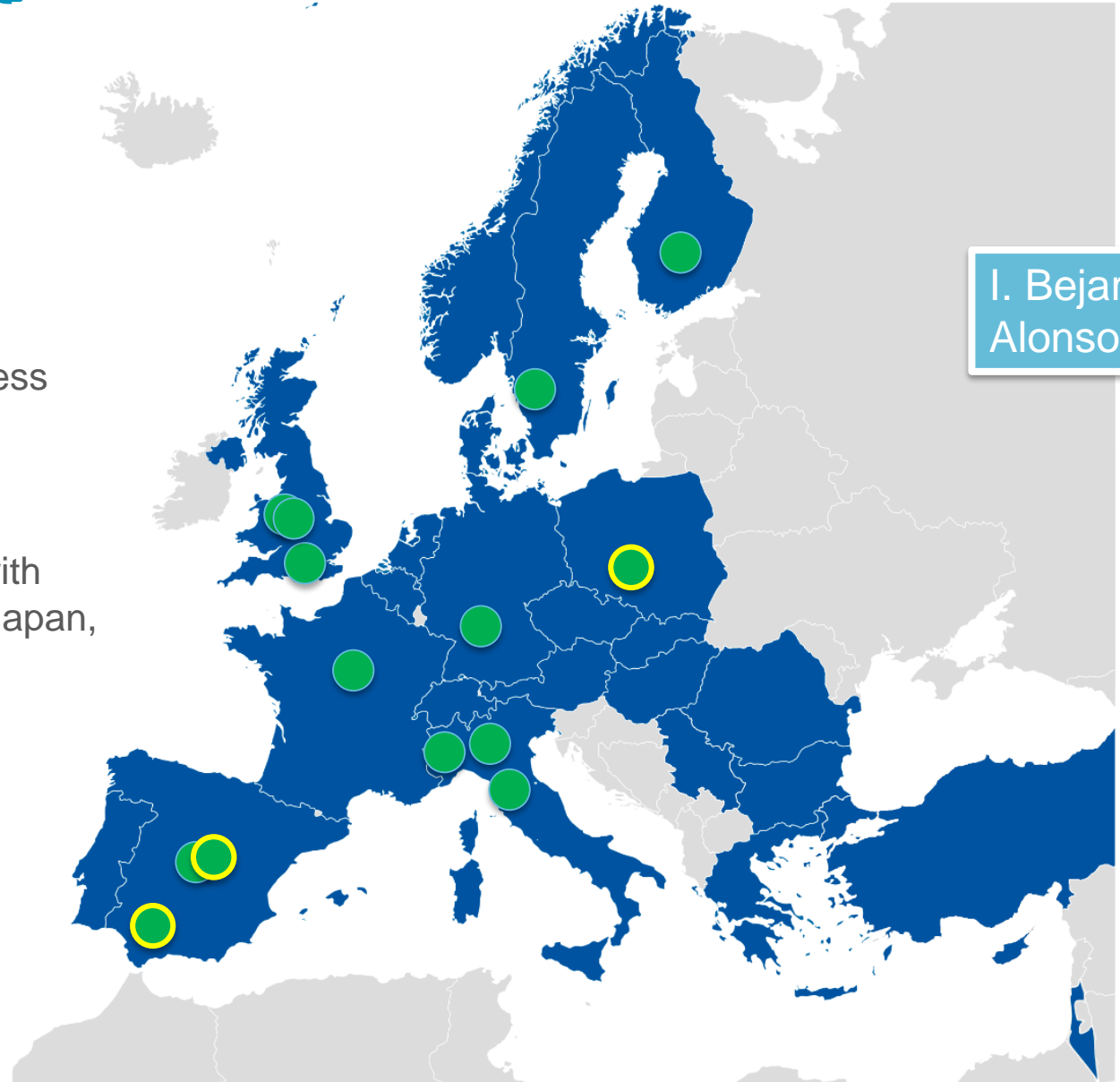


Increasing number of in kind contributions

- HL-LHC
- Negotiation in process
- Past

I. Bejar Alonso

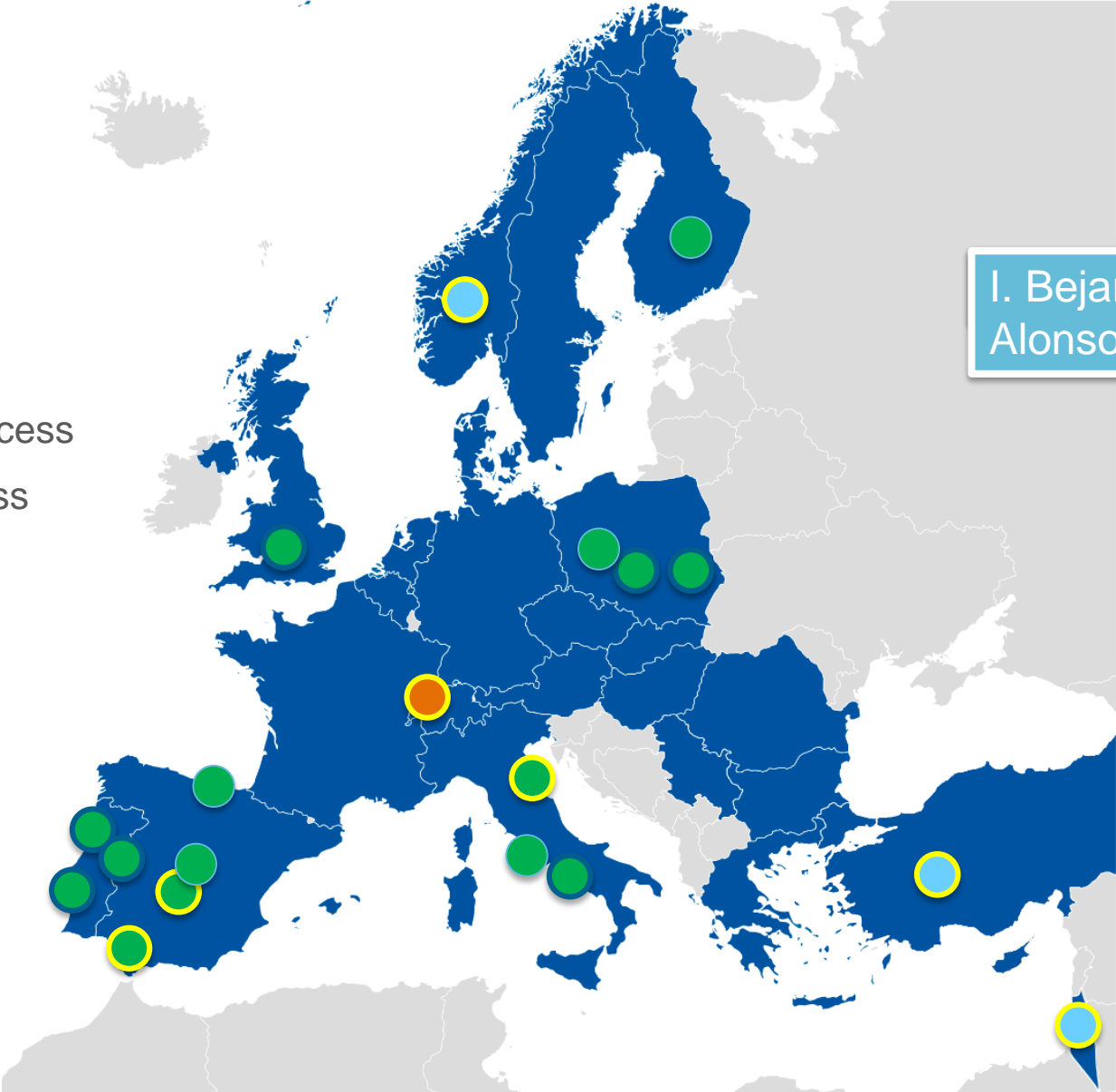
Under discussion with
Canada, Georgia, Japan,
Russia, USA



Diversification of MPAs

- HL-LHC
- Used by HL-LHC
- Under Signature process
- Negotiation in process
- Past

I. Bejar Alonso



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>

HiLumi Industry
Industry Relations and Procurement Website for the HL-LHC project

Building the HL-LHC with the Industry

ILOs
ILOs Portal

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	Foreseen Cost Range (in CHF)	Quantity	Quantity (unit)
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](#))

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	PK
DE	HERAEUS	PL
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	PL
DK	DANFYSIK	PT
ES	JEMA	RO
FI	KEMPOWER	RS
FR	TRANSTECHNIK, SIGMAPHI	SE
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



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
QUACO companies ready for announcement
3 Oct 2016
6th HL-LHC Collaboration Meeting in Paris on 14-16 November 2016
26 Sep 2016



Hilumi Project

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

Add Experience
Add Education

View profile as

500+ connections



Industry



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.



15 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 HiLumi INDUSTRY DAY
Do not miss the HiLumi Industry Day! They will be held in Lisbon, Portugal on 31 October 2016 and in



Industry for Hilumi

95 members

HL-LHC Industry [EDIT LINKS](#)

Shopping List WP11

Home	Package Name	PBS Number	LHC Equipment Code	Work Package Reference	Date Of
E/O Documents	Coil End Spacers	11.1.3.3.0.0		WP11	
Present Departmental Requests	Coil Keys	11.1.3.3.0.0		WP11	
Work Packages	Coil Saddles	11.1.3.3.0.0		WP11	
Project Breakdown Structure List	Cabling Keys	11.1.3.3.0.0		WP11	
Shopping Lists	Copper Lytas	11.1.3.3.0.0		WP11	
Domains Of Activity	Copper Profiles	11.1.3.3.0.0		WP11	
Activities To Work Packages	End Covers	11.1.3.3.0.0		WP11	
Recent	Steel Laminations			WP11	
Shopping List WPs	Fine Blanket Steel Laminations			WP11	
Site Contents					
EDIT LINKS					

Public



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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

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



OPINIONS ON THIS TOPIC



facebook



CERN releases first photos
October 29, 2016
Did you guess it?
The photo was taken end of September 2016 and shows the lowering into one test tunnel in South of one of the first models of the superconducting 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/industry-day-2016](#)





***We're heading for
construction!!
Do you want to know
more? Come to →***



**Thanks all WP leaders, PO office members and to all speakers for the terrific works in preparing this review!
Thanks to Depts and Groups for supporting the project!**

