



www.cern.ch

CERN Report

R-D Heuer

ECFA, November 2014

Scientific Strategy

- Implementation of all four European Strategy high priority items
- Implementation of a diverse fixed target program also along the European Strategy topics including upgrades of most facilities



The Particle Physics Landscape at CERN

High Energy Frontier

LHC

Hadronic Matter

deconfinement

non-perturbative QCD

hadron structure

Low Energy

heavy flavours / rare decays

neutrino oscillations

anti-matter

Non-accelerator

dark matter

astroparticles

Multidisciplinary

climate, medicine

Non-LHC Particle Physics = o(1000) physicists / o(20) experiments

Scientific Diversity at **unique facilities**

CERN maintains and upgrades these facilities

Scientific Strategy

- Two main pillars of physics activities at CERN
 - High Energy Frontier, i.e. LHC, FCC, CLIC
 - Unique fixed target program, i.e. AD and ELENA, HIE-Isolde (and TSR), n-ToF(EAR1,2)
- Two main pillars for physics activities outside CERN
 - Neutrino Platform (mainly to the US: LBNF)
 - ILC

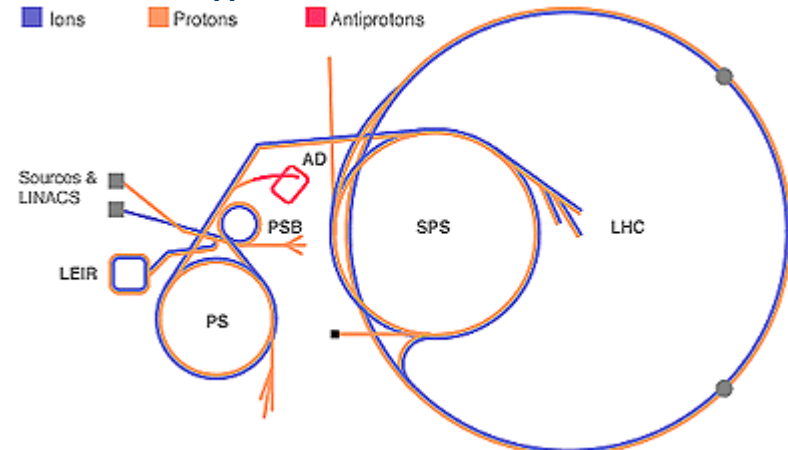
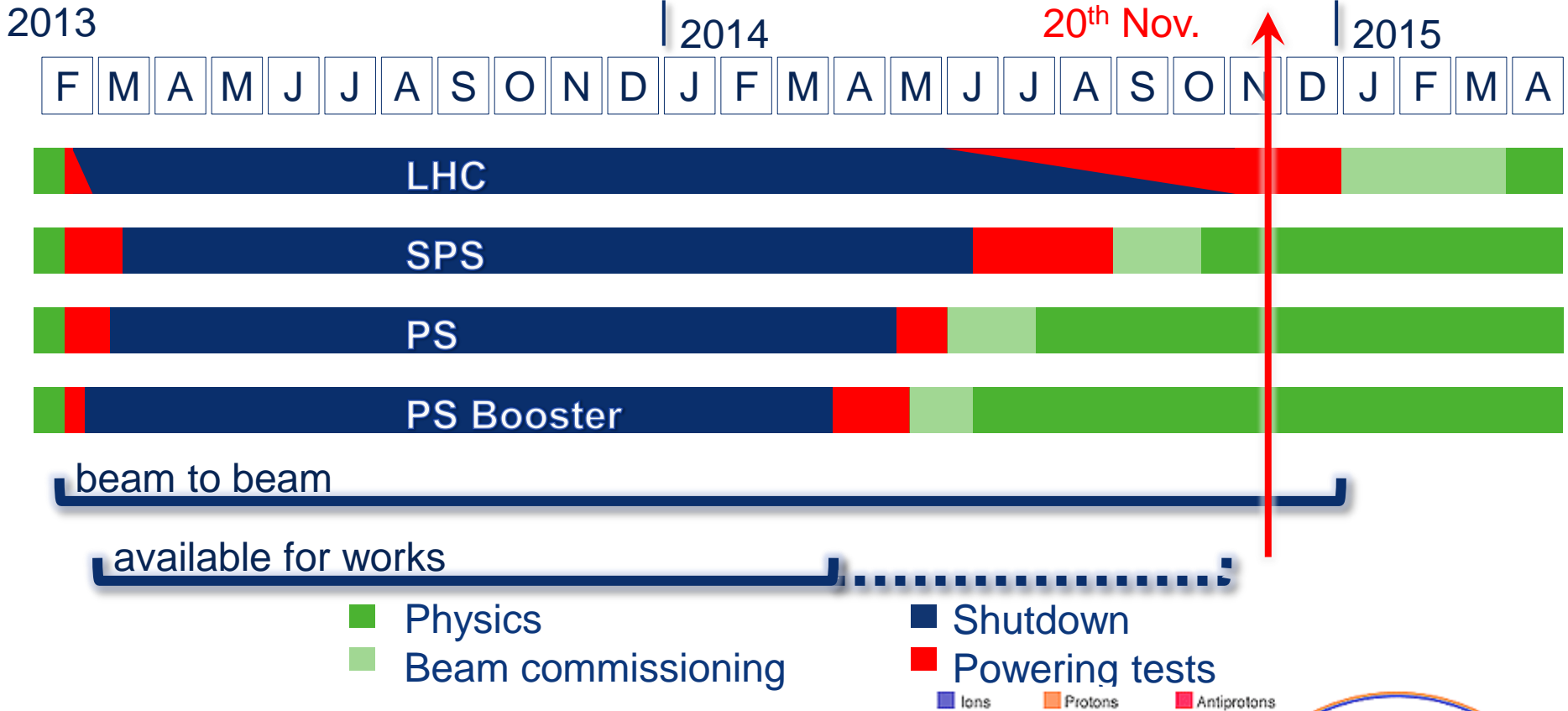
Collaboration forming

ICARUS has arrived at CERN

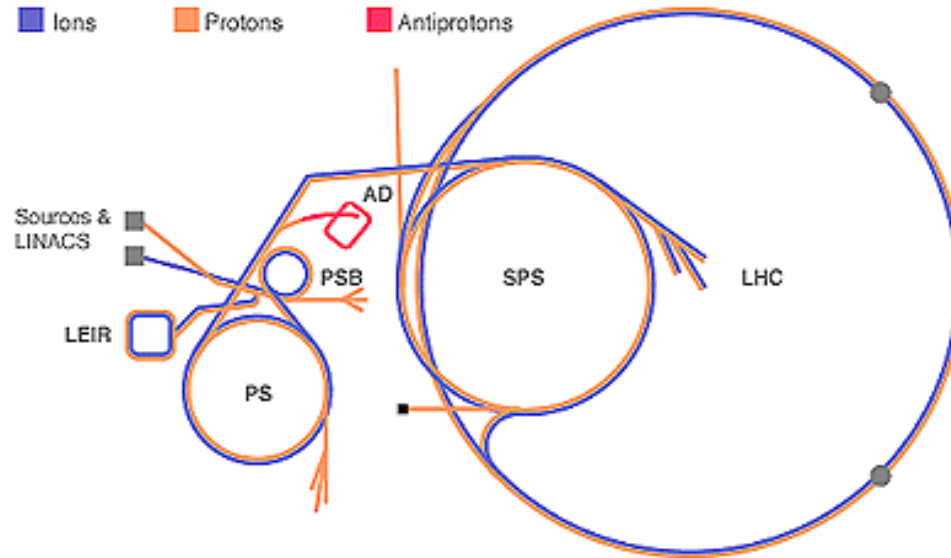
KEK <-> CERN offices opened



LS 1 from 16th Feb. 2013 to Dec. 2014

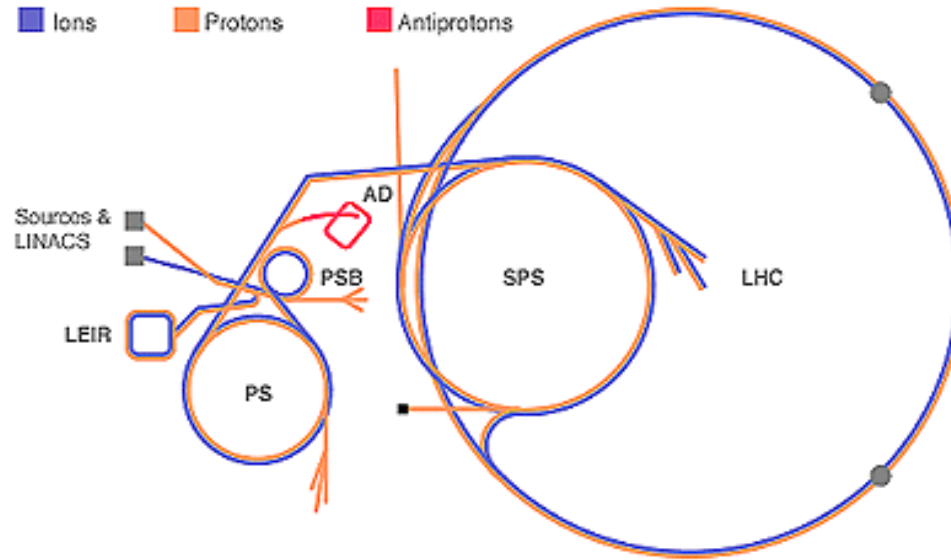


LS 1 from 16th Feb. 2013 to Dec. 2014



Shutdown terminated for all accelerators except LHC, they are delivering beams for physics

LS 1 from 16th Feb. 2013 to Dec. 2014



Status LHC



Cool-down - status

Sector 12	1.9 K	CSCM OK
Sector 23	5 K	CSCM OK
Sector 34	26 K	
Sector 45	20 K	CSCM OK
Sector 56	1.9 K	CSCM OK
Sector 67	1.9 K	CSCM OK
Sector 78	5 K	CSCM OK
Sector 81	1.9 K	CSCM OK

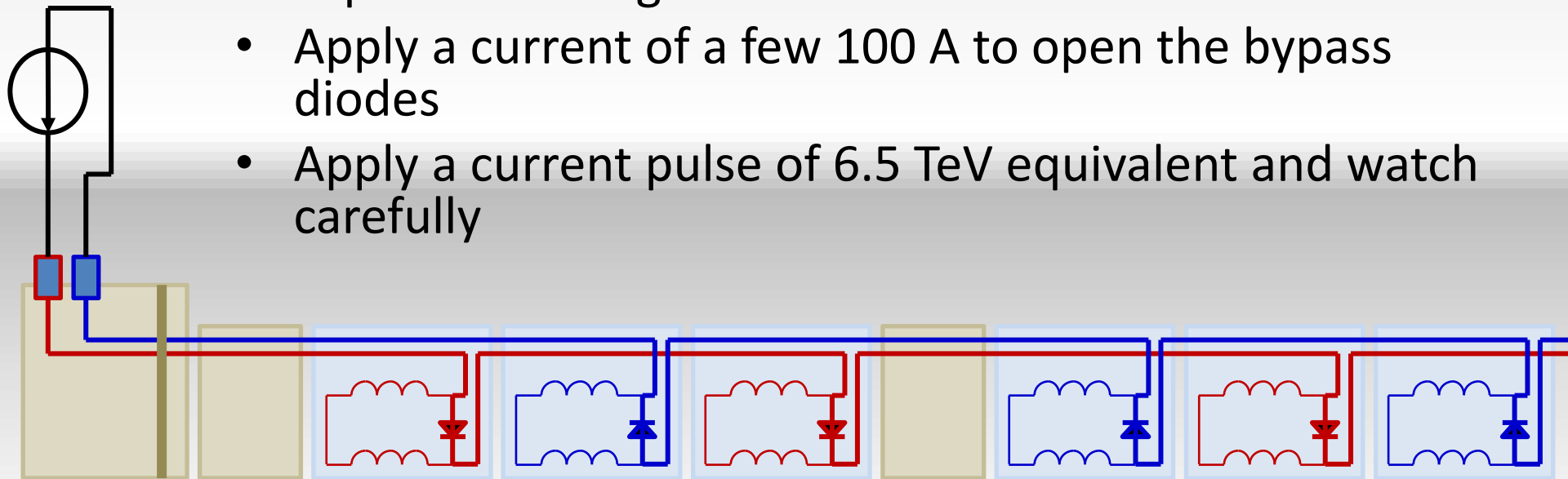
**Represents a major and successful effort by
the cryogenics group**

CSCM (Copper Stabilizer Continuity Measurement)

Fully qualify magnet bypass = copper stabilizer of the bus-bar + diode + diode leads

Bypass contains about 3500 connections/joints per sector!

- Connect the two 6 kA/200 V power converters in series
- Stabilize the sector 20 K so the magnets and bus are not superconducting.
- Apply a current of a few 100 A to open the bypass diodes
- Apply a current pulse of 6.5 TeV equivalent and watch carefully



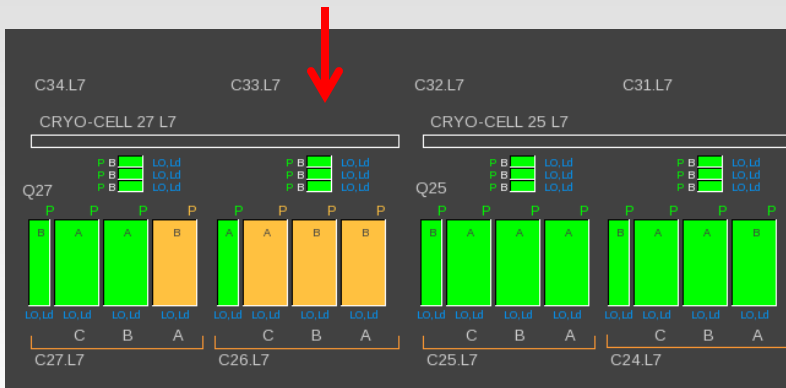
CSCM results so far

7 sectors completed

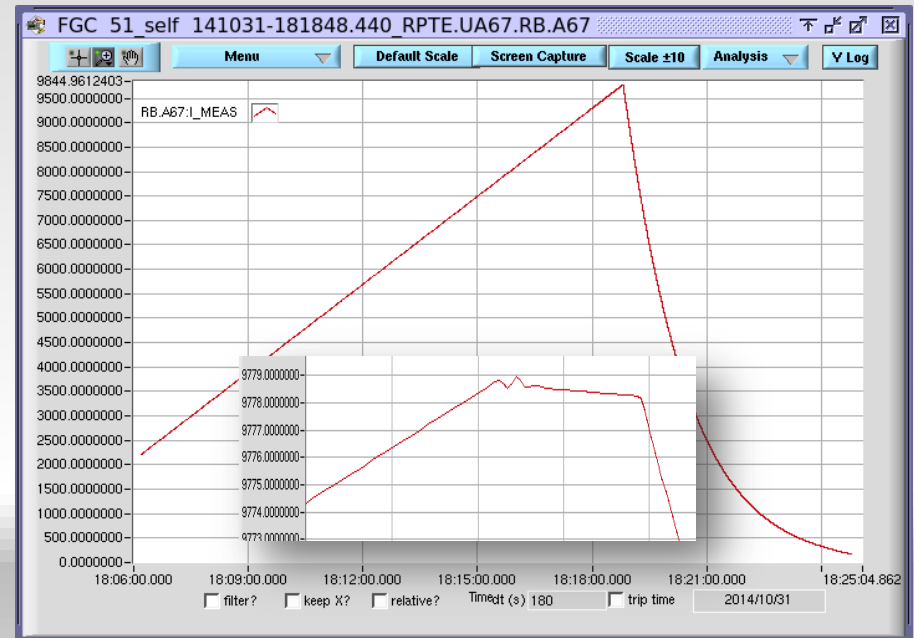
- RRR of the busbars as expected
- The main busbars, including the consolidated joints, behave as expected and are qualified for 6.5 TeV operation.
- The diodes behave as expected and are qualified for 6.5 TeV operation.

The first (re)training quench S67

- After the successful execution of the previous steps, the first ramp to nominal current was executed, leading to the first training quench at a current of 9779 A (corresponding to a bit less than 5.8 TeV)



- Secondary quenches were detected
 - A26L7 4248 A
 - C26L7 4235 A
 - A27L7 381 A



SM18 data for the first quenching magnet:

3285	Quench 1	Quench 2
I (A)	8391	12782
B (T)	5.93	8.96
E (TeV)	5.0	7.5

2015 Q3/Q4

	July			Aug					Sep					
Wk	27	28	29	30	31	32	33	34	35	36	37	38	39	
Mo	29	6	13	20	27	3	10	17	24	Special physic run	31	7	14	21
Tu														
We	1	MD 1		Intensity ramp-up with 25 ns beam					TS2			MD 2		
Th														
Fr														
Sa														
Su												lower beta*		

	Oct			Nov					Dec				
Wk	40	41	42	43	44	45	46	47	48	49	50	51	52
Mo	28	5	12	19	26	2	9	16	23	30	7	14	21
Tu			Floating MD					Ions setup				Technical stop	
We							TS3						
Th										IONS			
Fr					MD 3								Xmas
Sa													
Su													

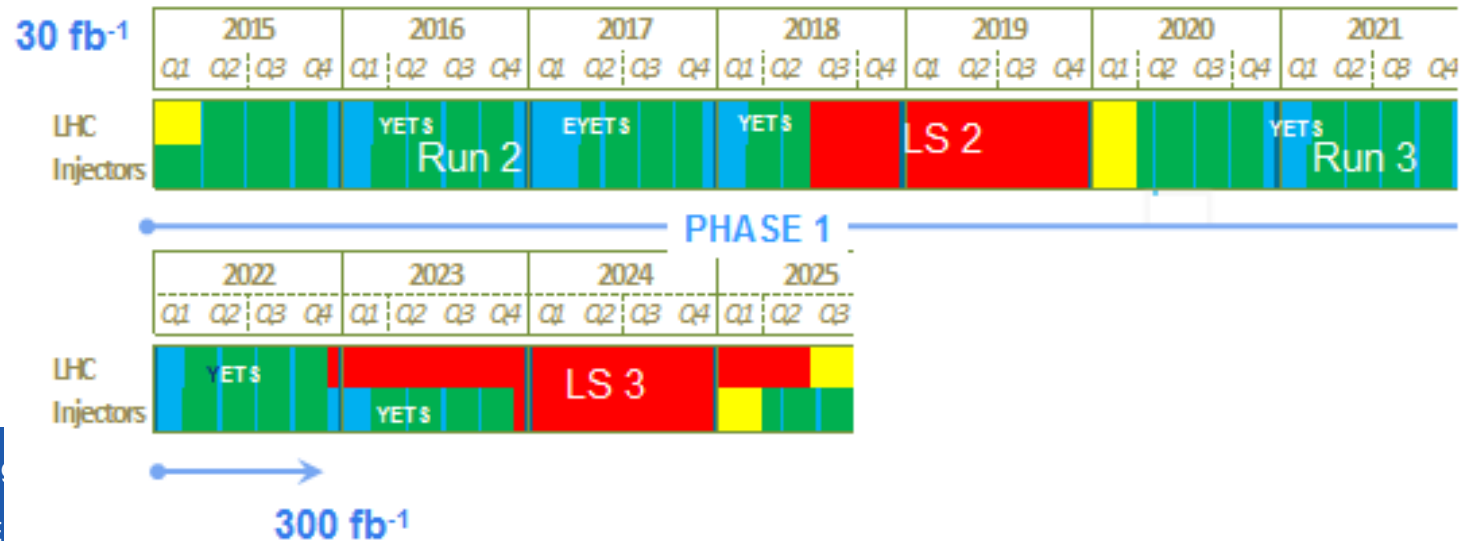
End physics [06:00] ↓

LHC goal for 2015 and for Run 2 and 3

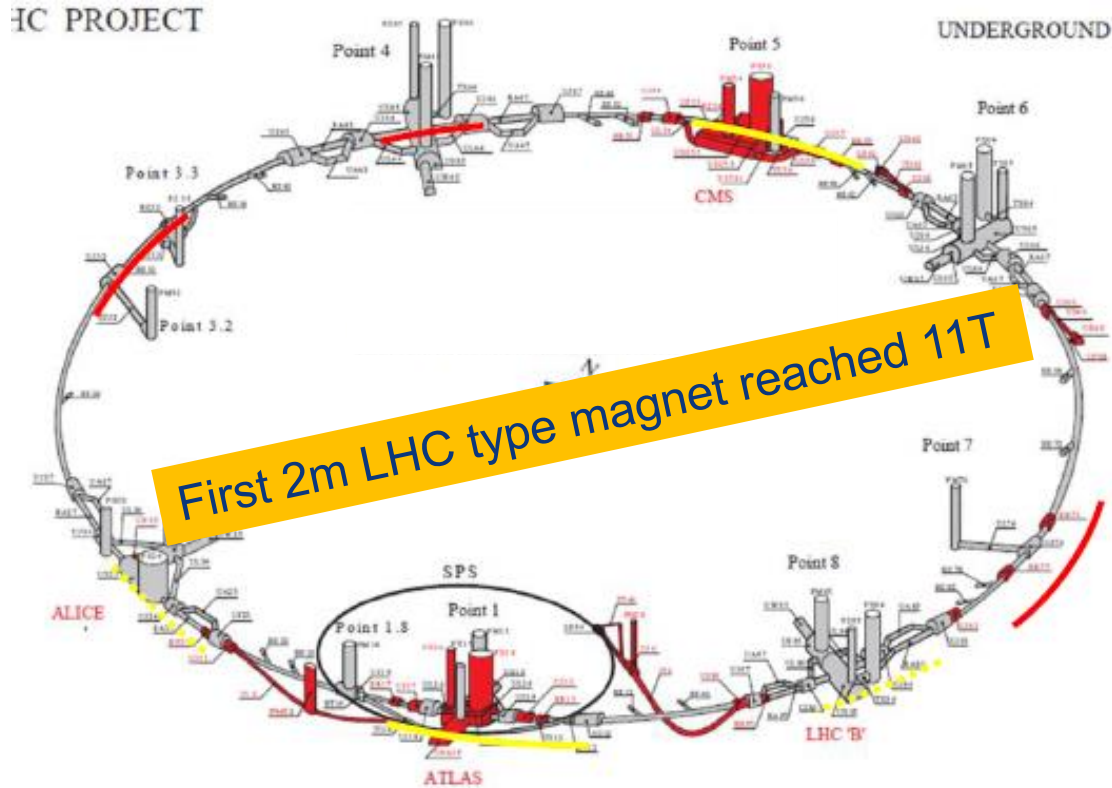
Integrated luminosity goal:
2015 : 10 fb^{-1}

Run2: $\sim 100\text{-}120 \text{ fb}^{-1}$
(better estimation by end of 2015)

300 fb^{-1} before LS3



The HL-LHC Project

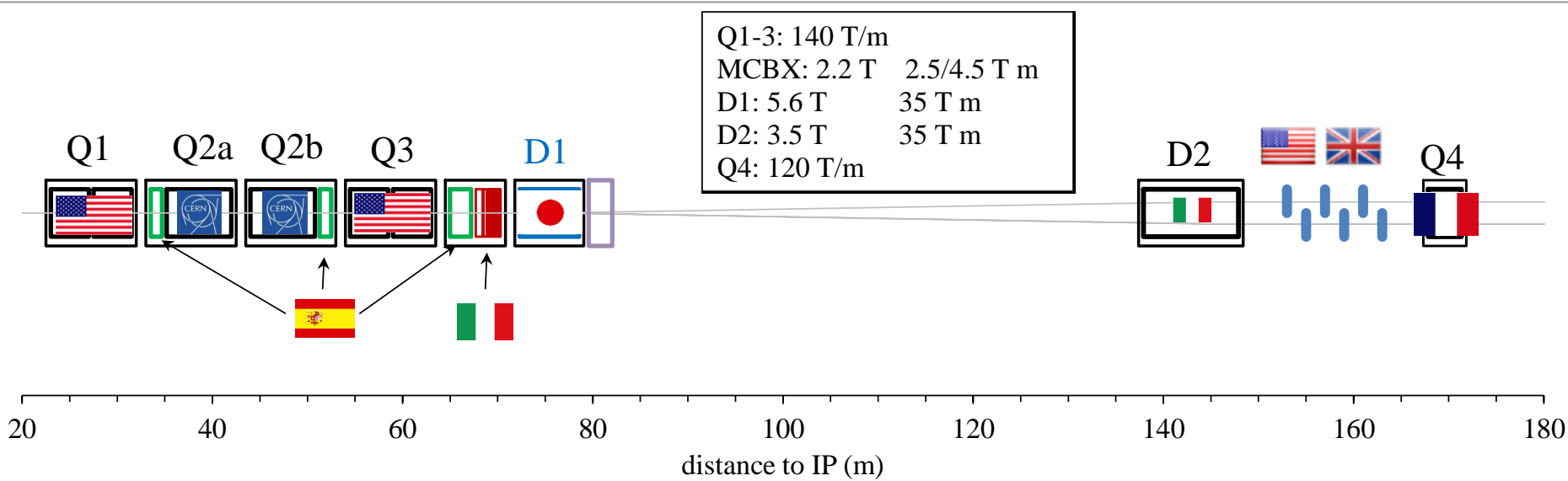


- New IR-quads Nb_3Sn (inner triplets)
- New 11 T Nb_3Sn (short) dipoles
- Collimation upgrade
- Cryogenics upgrade
- Crab Cavities
- Cold powering
- Machine protection
- ...

Major intervention on more than 1.2 km of the LHC

Setting up International collaboration

Baseline layout of HL-LHC IR region



with national laboratories **but also involving industrial firms**

High Luminosity LHC Participants

All parts of HL-LHC → ESFRI Roadmap (?)



SLAC
NATIONAL ACCELERATOR LABORATORY



BROOKHAVEN
NATIONAL LABORATORY



BERKELEY LAB



Fermilab



OLD
DOMINION
UNIVERSITY



Science & Technology
Facilities Council



UNIVERSITY OF
LIVERPOOL

LANCASTER
UNIVERSITY



MANCHESTER
1824



ROYAL HOLLOWAY
UNIVERSITY OF LONDON



UNIVERSITY OF
Southampton



ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE



CSIC
Consejo Superior de Investigaciones Científicas



Ciemat
Centro de Investigaciones
Energéticas, Medioambientales
y Tecnológicas



Istituto Nazionale
di Fisica Nucleare



KEK

KEK (KEK) KEK (KEK) KEK (KEK) KEK (KEK)

LHC roadmap: schedule beyond LS1

LS2 starting in 2018 (July) => 18 months + 3 months BC

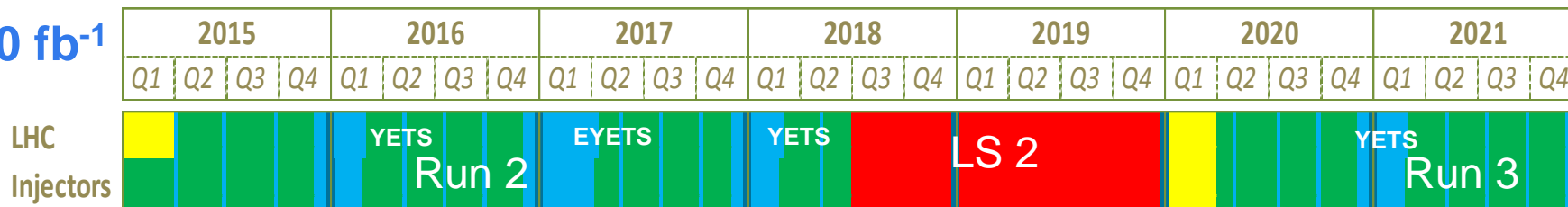
LS3 LHC: starting in 2023 => 30 months + 3 months BC

Injectors: in 2024 => 13 months + 3 months BC

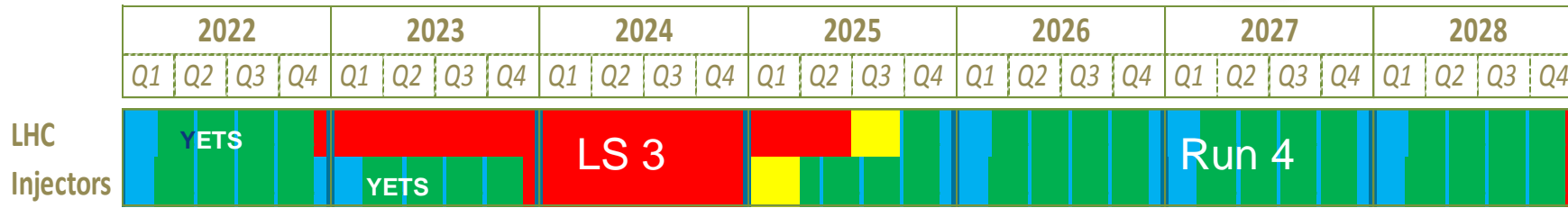
(Extended) Year End Technical Stop: (E)YETS



30 fb⁻¹

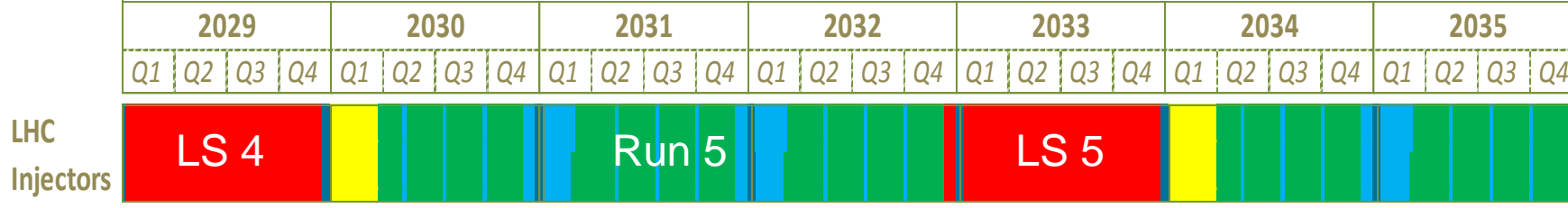


PHASE 1



300 fb⁻¹

PHASE 2



Future Circular Collider Study - SCOPE

CDR and cost review for the next ESU (2018)

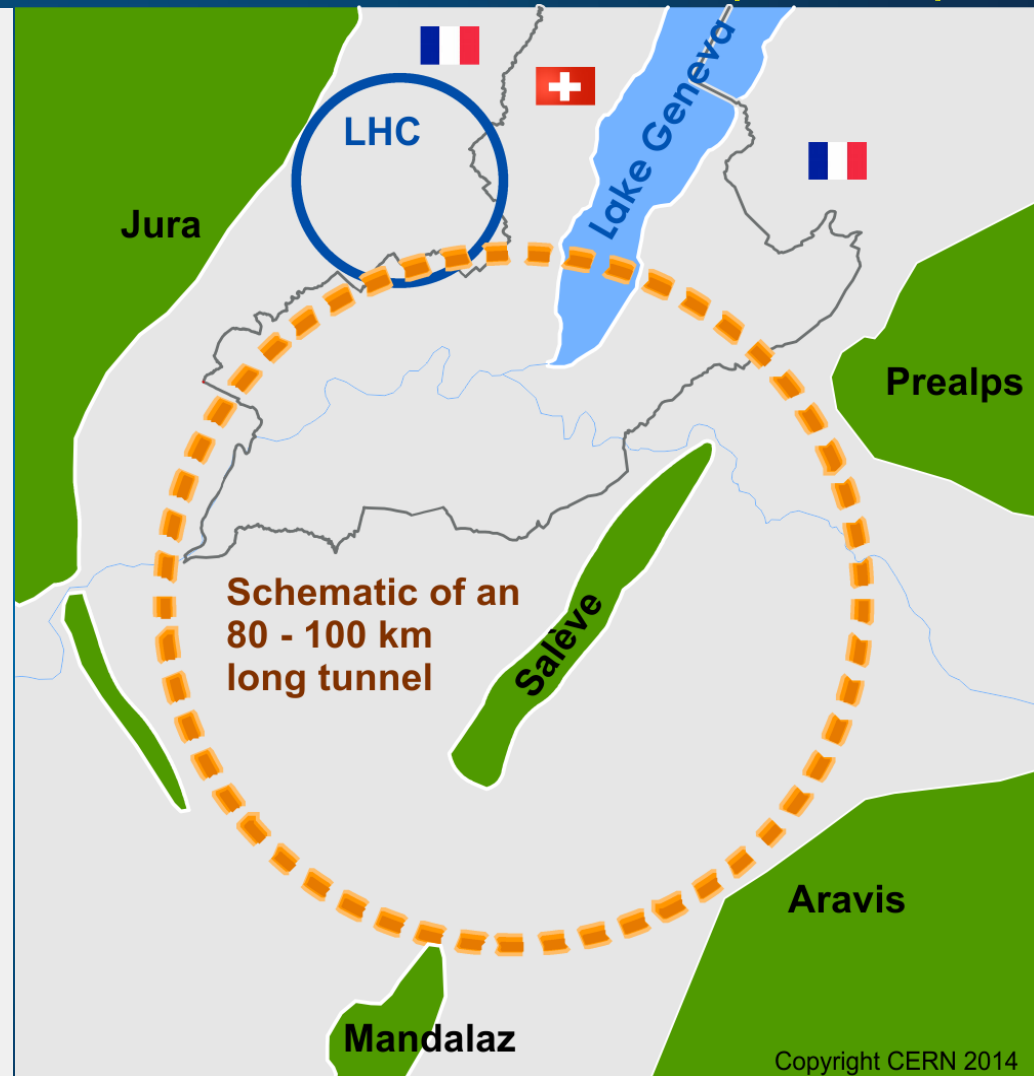
Forming an international collaboration to study:

- **pp -collider (*FCC-hh*)**
→ defining infrastructure requirements

~16 T \Rightarrow 100 TeV pp in 100 km

~20 T \Rightarrow 100 TeV pp in 80 km

- **e^+e^- collider (*FCC-ee*)** as potential intermediate step
- **p - e (*FCC-he*) option**
- **80-100 km infrastructure** in Geneva area





MoU Status 8. September 2014

- **20 MoUs signed**, 15 further agreed, pending signatures
- ALBA/CELLS, Spain
- BINP, Russia
- CBPF, Brazil
- CIEMAT, Spain
- Cockcroft Institute, UK
- CSIC/IFIC, Spain
- DESY, Germany
- EPFL, Switzerland
- Hellenic Open U, Greece
- JAI/Oxford, UK
- KEK, Japan
- King's College London, UK
- MEPhI, Russia
- Sapienza/Roma, Italy
- TU Darmstadt, Germany
- TU Tampere, Finland
- U. Geneva, Switzerland
- U. Iowa, USA
- U. C. Santa Barbara, USA
- U Silesia, Poland



Summary FCC

- Good progress is made in forming an International FCC collaboration.
- An H2020 DS proposal, focused on the FCC hadron collider design has been submitted to EC.
- Main technology R&D areas have been identified and a work plan is being established with potential partners.

Miscellaneous

Open Access
SCOAP3
Data

CERN 60th events

