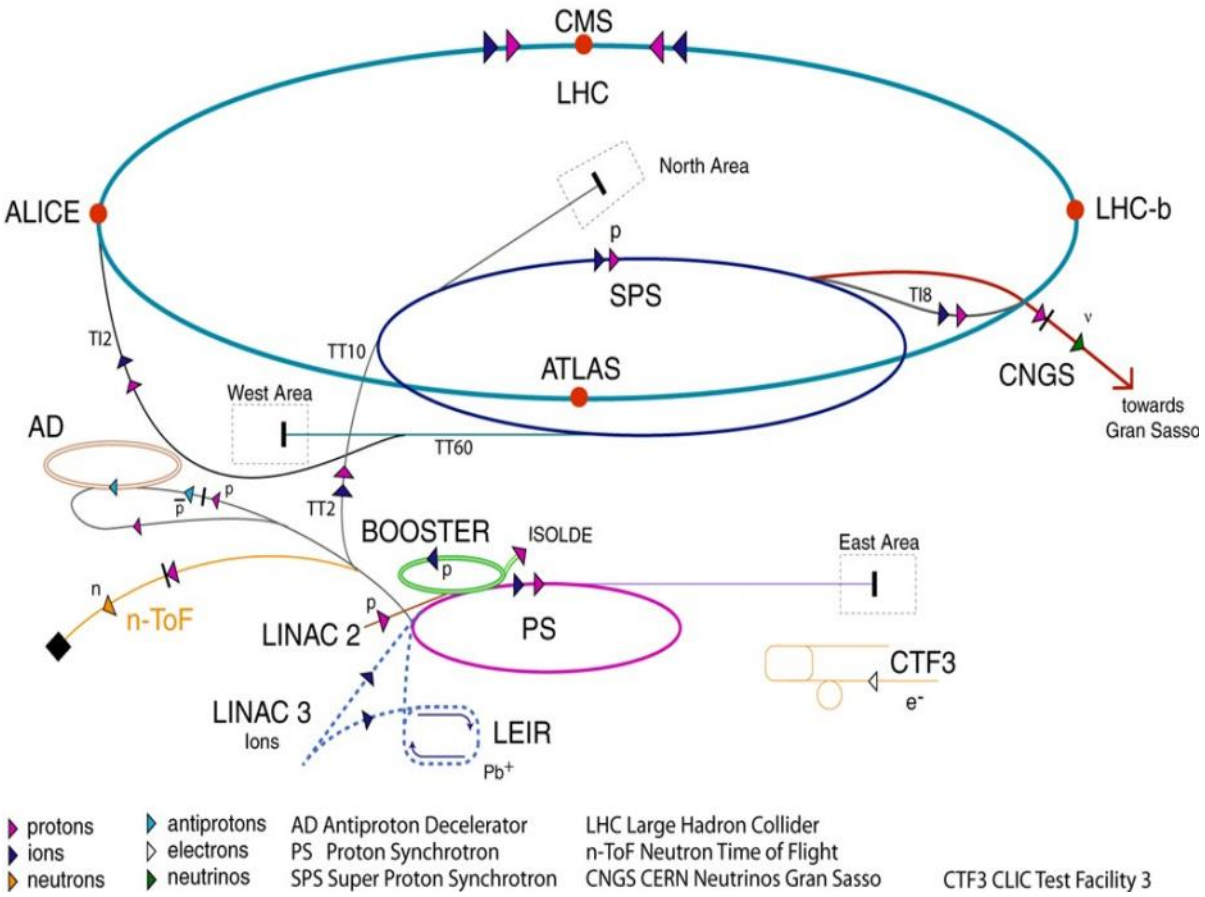
Welcome to CERN

Cryogenics at CERN

CERN, Tuesday 3rd of September 2019

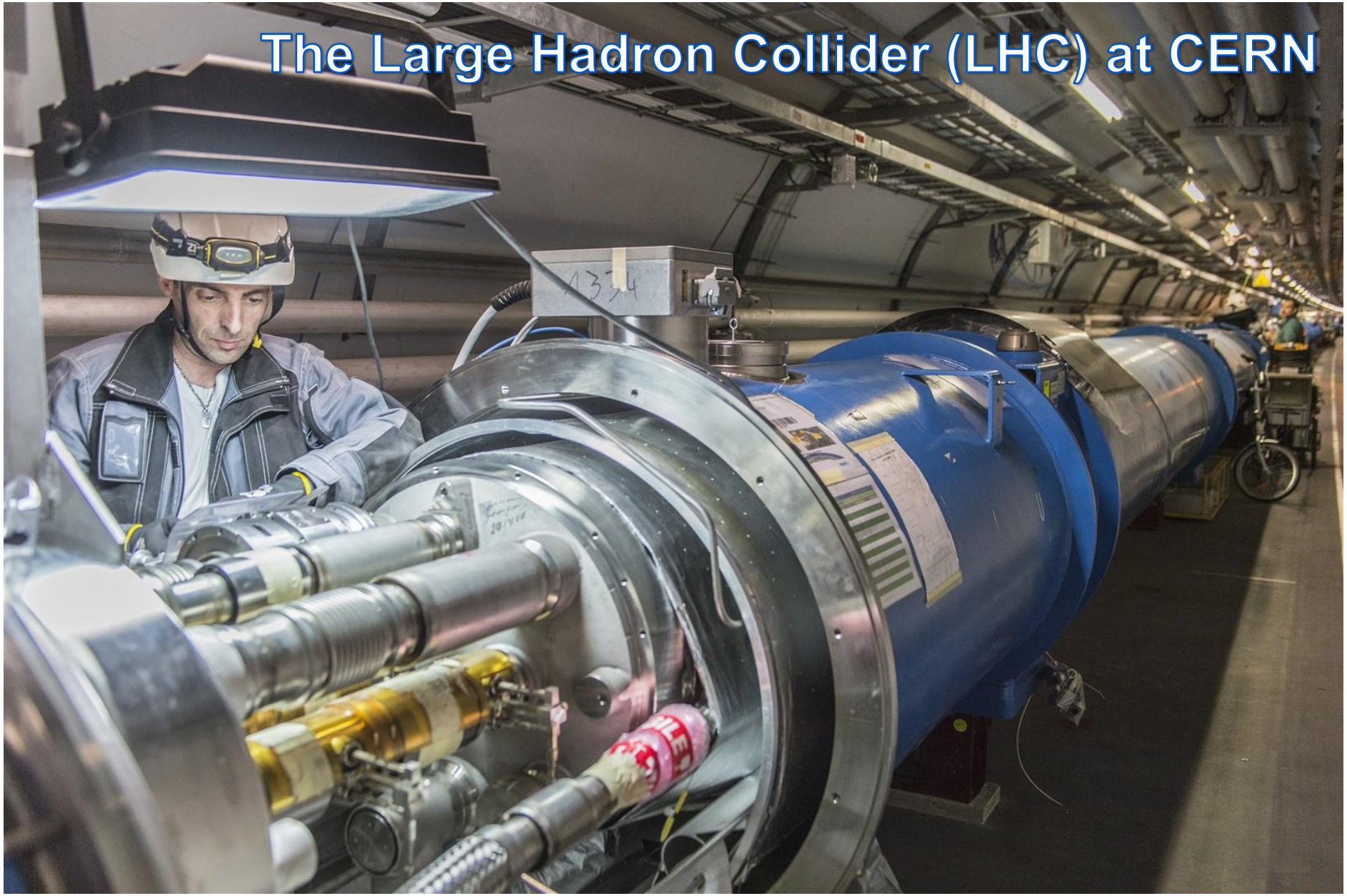
D. Delikaris
Head of Cryogenics Group (CRG)
Technology Department (TE)
CERN

CERN: Accelerators Complex

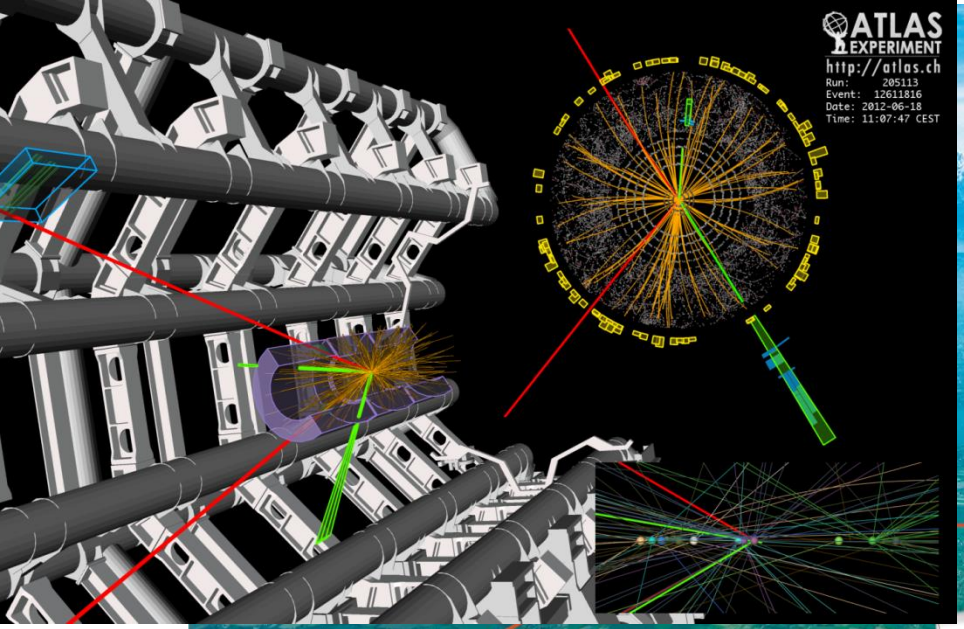


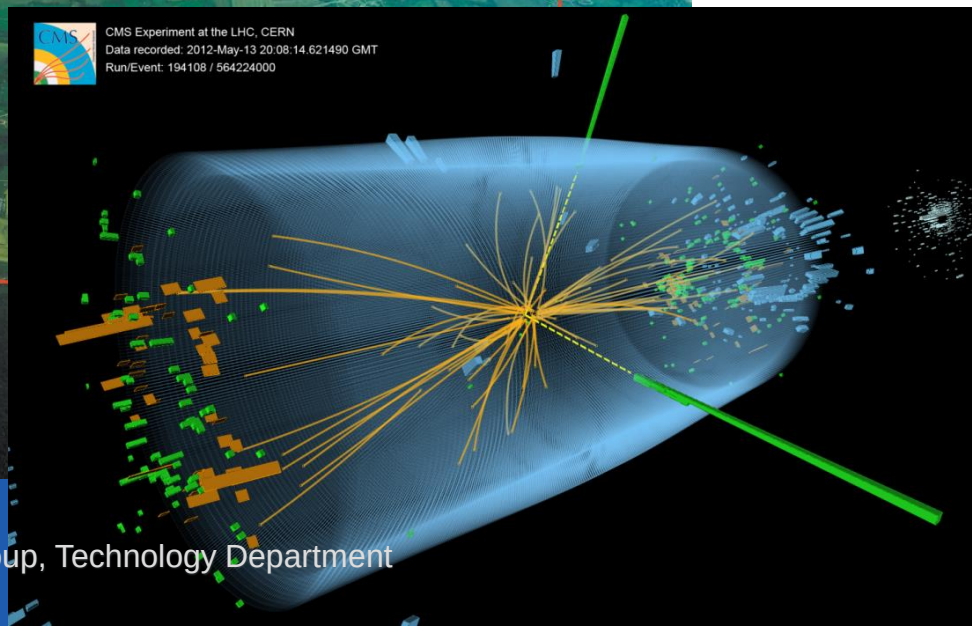
CERN AC - F116

The Large Hadron Collider (LHC) at CERN



The Large Hadron Collider & Higgs events on ATLAS & CMS detectors





The Cryogenics Group

76 Staff members
16 Fellows
1 Doctoral student
5 Project associates
3 Technical students
1 Trainee

Industrial support resources
(service contracts):

General mechanical, electrical,
instrumentation support: 22 FTE

Maintenance & Operation (M&O)
dedicated service contract: 47 FTE

- Cryogenic Laboratory & Instrumentation
- Mechanical Engineering
- Process Controls & Electrical Engineering
- Maintenance Management & Logistics
- Operation

Cryogenics
Staff Members

D. DELIKARIS Group Leader

S. CLAUDET Deputy

J. BREMER - Detectors link-person
S. JUNKER - Radiation Safety Support Officer
T. KOETTIG - Safety link-person
O. PIROTTE - Cryogenics Safety Officer

Secretariat: C. CAZENOVES

Controls & Electrical Support
CE

M. PEZZETTI

TH. BARBE
C. BATAILT
B. D'HULSTER
C. FLUDER
B. IVENS
S. MARTIN
R. ROUZET
A. TOVAR-GONZALEZ
D. VALENCON
A. ZMUDA

Cryolab & Instrumentation
CI

J. BREMER

J. CASAS-CUBILLOS
M. CHALIFOUR
P. CHAMBOUVET
L. DUFAY-CHANAT
C. FABRE
T. KOETTIG
J.M. QUETSCH
N. TRIKOUPIS
A. VACCA
R. VAN WEELDEREN
N. VAUTHIER

Mechanical & Engineering Support
ME

A. PERIN

C. BERTHELIER
B. BITZBERGER
F. DHALLA
R. GUEYDAN
S. JUNKER
L. LE MAO
A. LEES
J. METSELAAR
D. MAJOURNAL
E. MONNERET
J. MOULEYRE
O. PIROTTE
G. ROLANDO
M. SISTI
L. STEWART

Methods & Logistics
ML

Ph. GAYET

L. ALAUX
N. BONETTI
T. DUPONT
F. FERRAND
N. GUILLOTIN
S. KNOOPS
J.P. LAMBOY
J.J. MINGUILLON ACHA

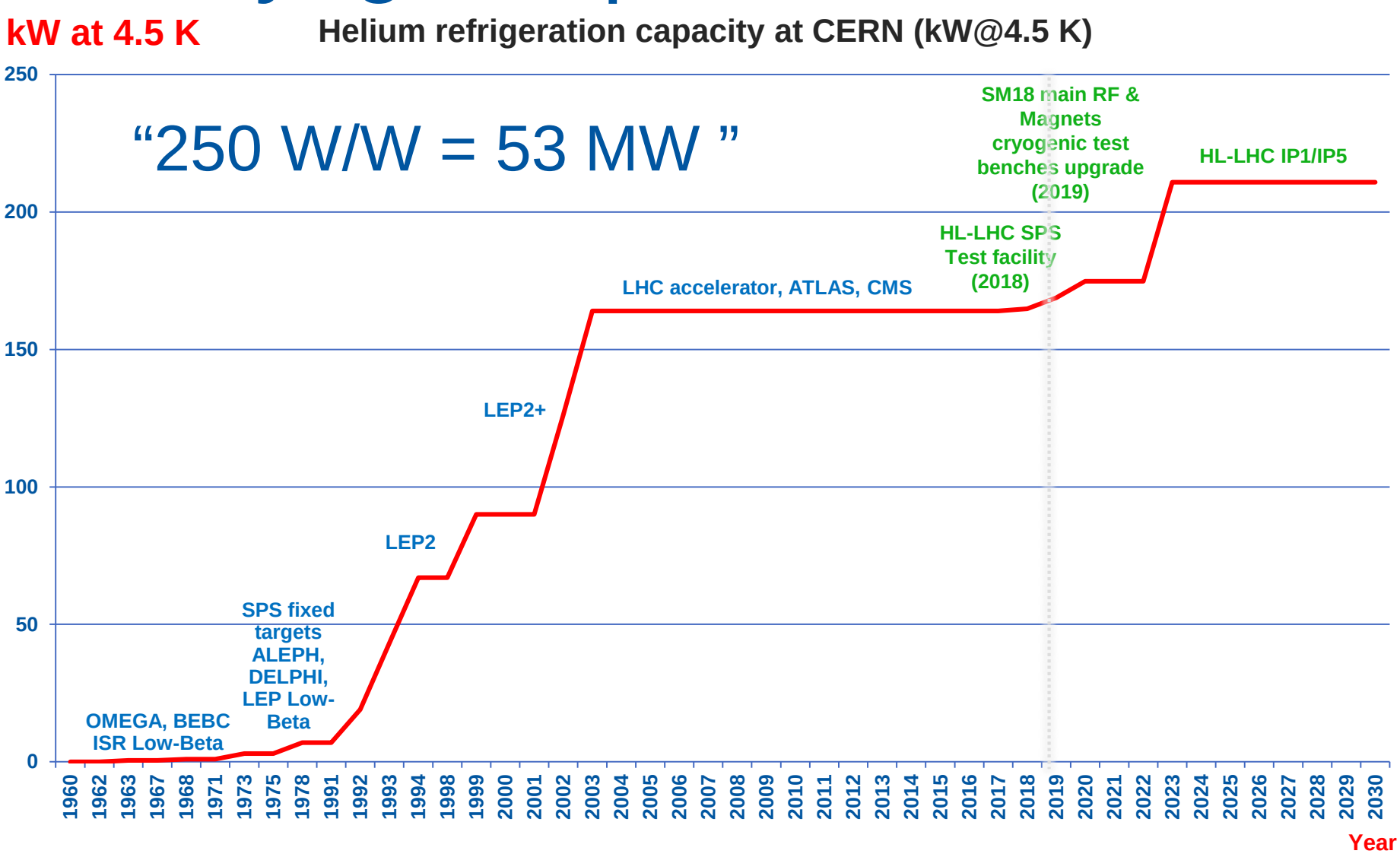
Operation
OP

G. FERLIN

K. BACKMAN
A. BALLI
B. BRADU
K. BRODZINSKI
M. COMBE
R. CONSENTINO
B. CWICKLINSKI
L. DELPRAT
E. DURET BOURGOZ
A. ESCOLEIRA
V. GAHIER
C. GUILLOU
K. HAFI
L. HERBLIN
G. JONES
D. MAJOURNAL
R. MAUNY
P. OWEN
A. PERRIER-CORNET
G. RAKOTONIAINA
A. SURACI
Y. VALSKAR
U. WAGNER
J. WOLFF
T. YTTERDAL

MARCH 2019

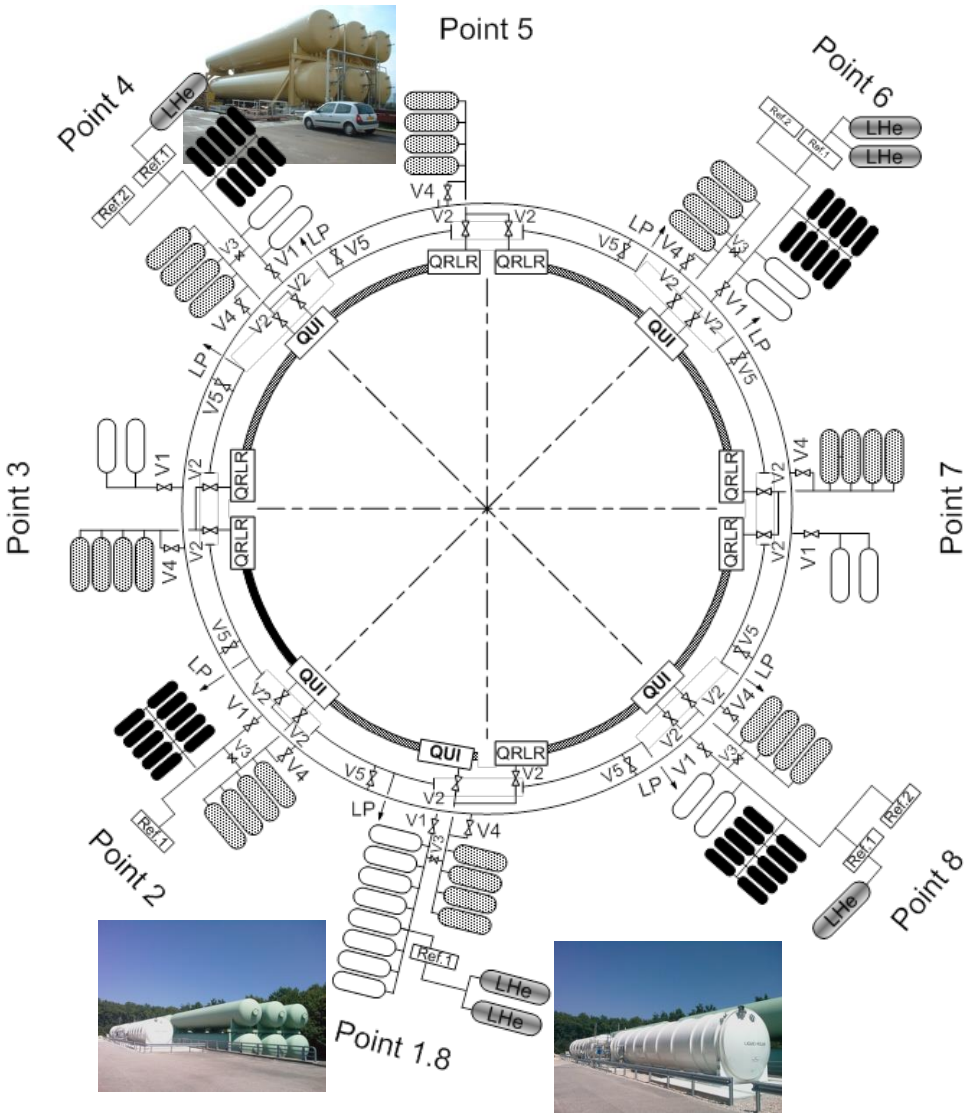
Cryogenic power at CERN



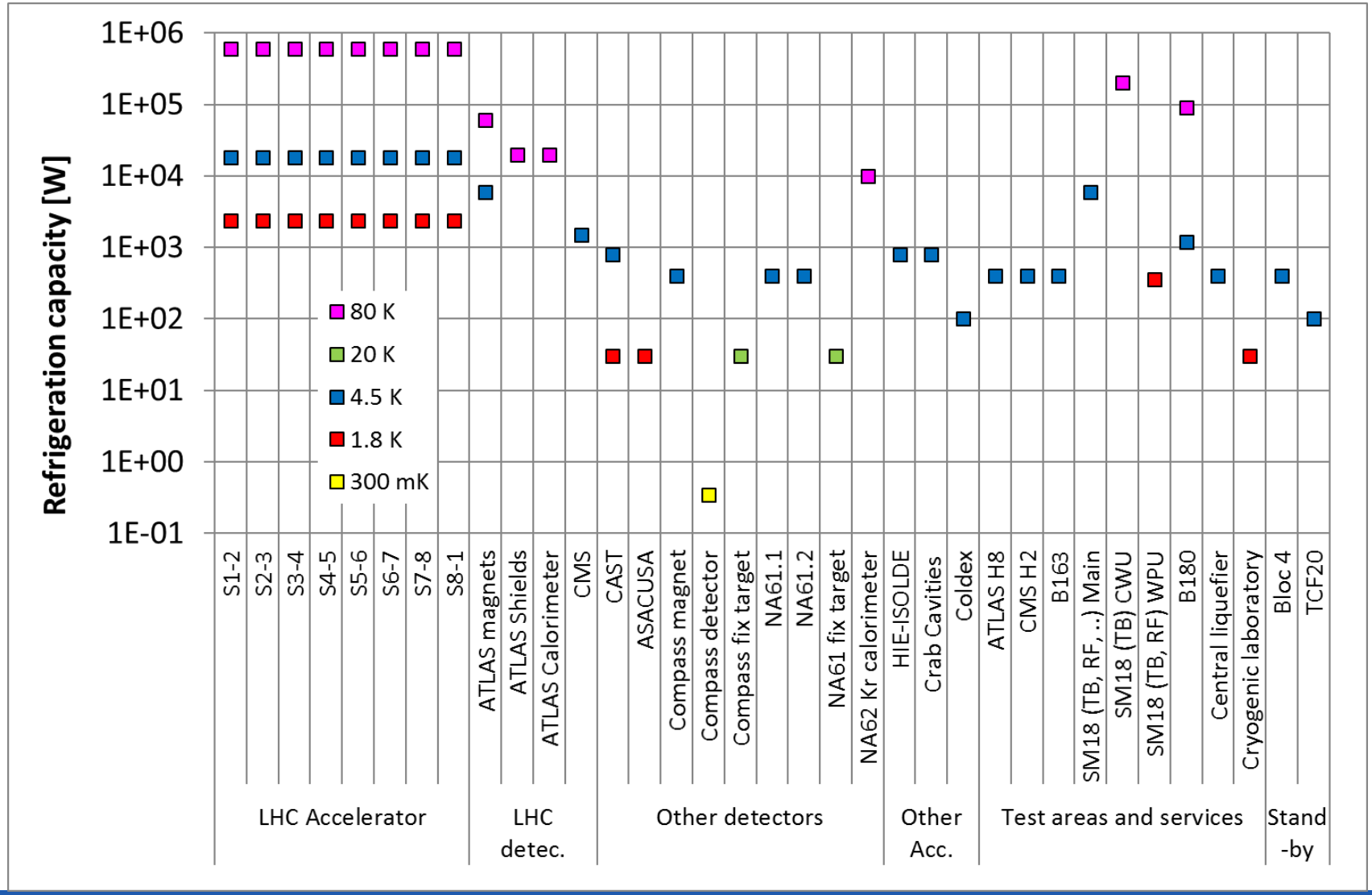
Helium Storage & Distribution

LHC helium storage & distribution (high grade helium ring line, 2 MPa, 27 km long, for LHC operation)

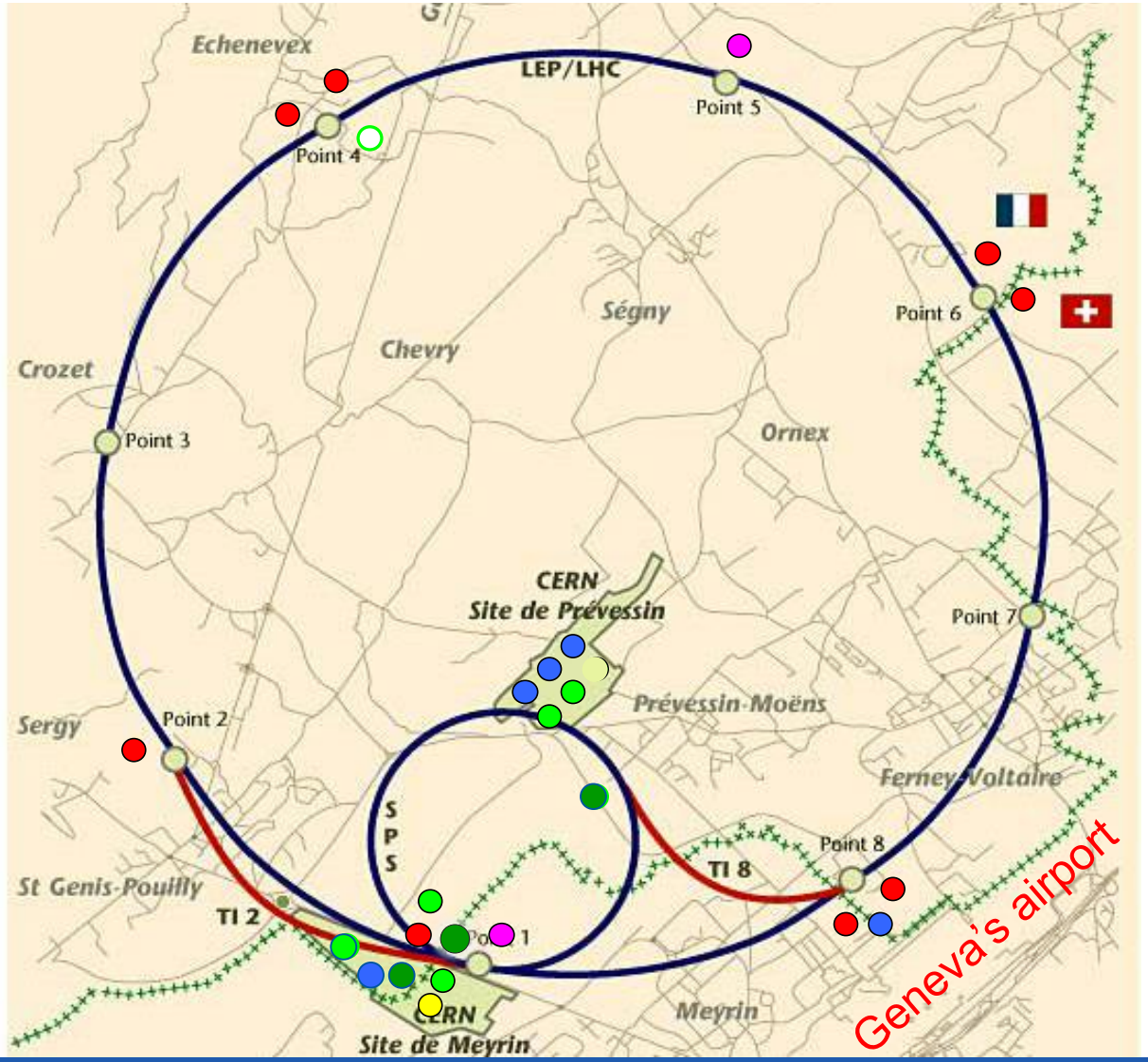
[Completing the existing CERN helium recovery system: high grade, 20 MPa, 5 km long and low grade, 3 kPa & 20 MPa, 3 km long each]



Cryogenic power at CERN

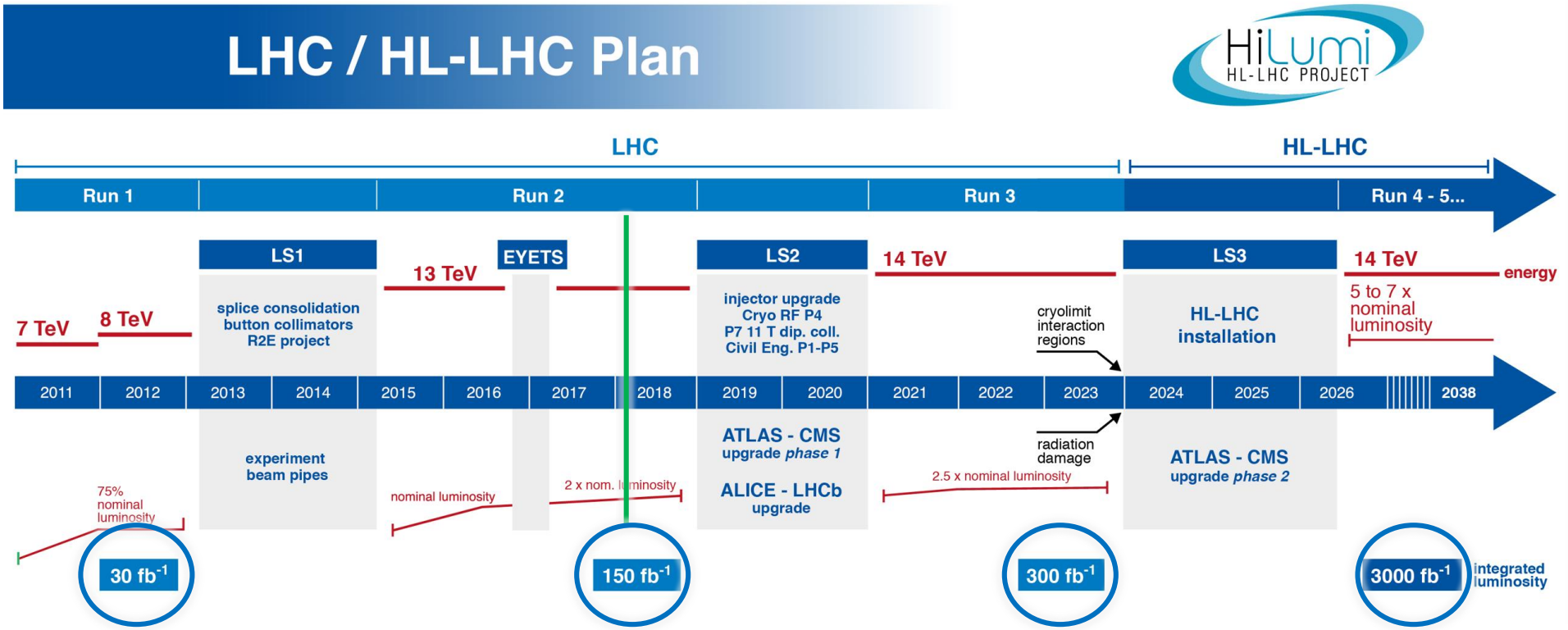


Cryogenic Plants at CERN



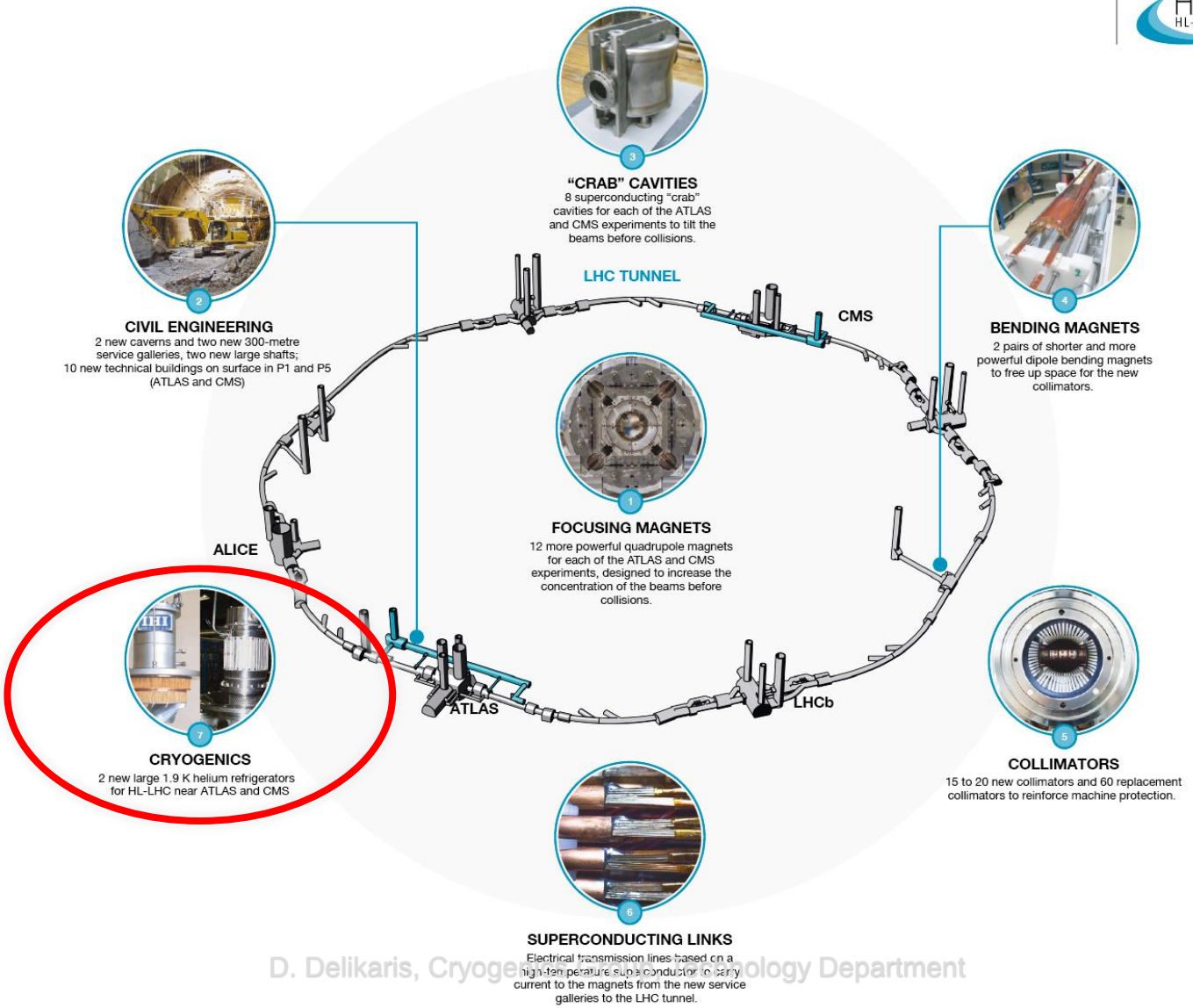
- LHC accelerator
- LHC detectors
- Other detectors
- Other accelerators
- Test areas
- Central services
- Standby

Cryogenics for the HL-LHC project

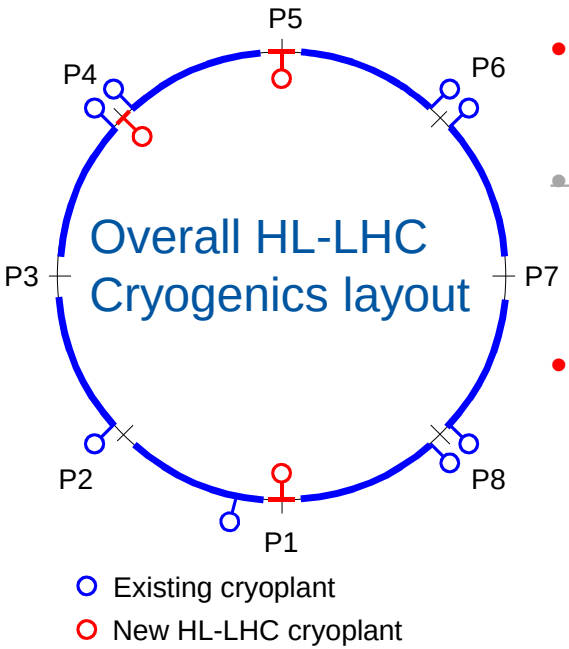


Cryogenics for the HL-LHC project

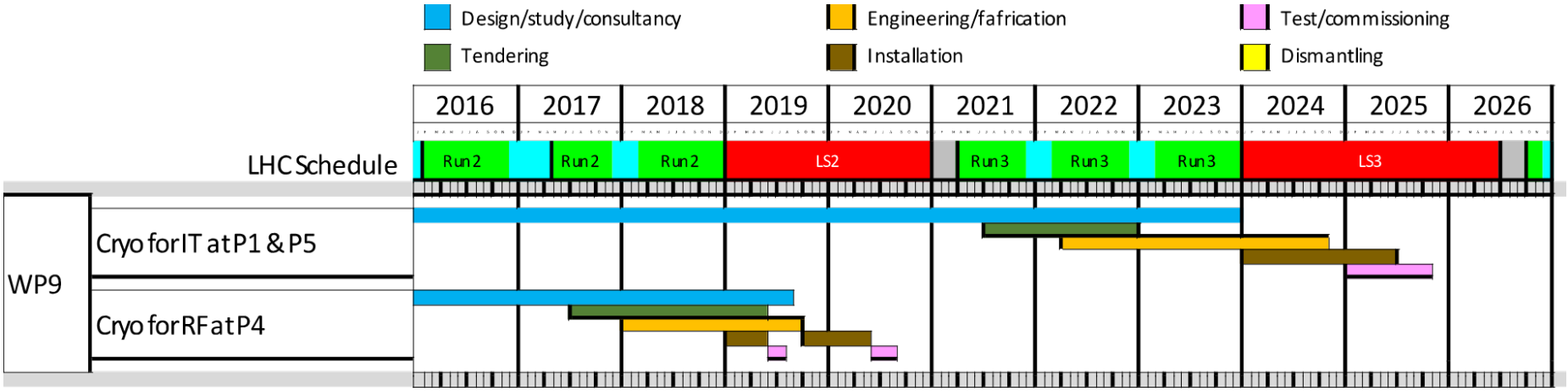
for physics by means of a technology advancement



Cryogenics for the HL-LHC project



- 2 new cryogenic plants (18 kW @ 4.5 K) at P1 and P5 for high-luminosity insertions
- ~~1 new cryogenic plant (4 kW @ 4.5 K) at P4 for RF cryogenic modules;~~ (retained alternative: upgrade of 1 existing LHC cryogenic plant)
- 1 new cryogenic plant (0.8 kW @ 4.5 K) as RF cold test facility with LHC beam type at SPS-BA6 (Crab-Cavities program): successfully commissioned, crab cavities at 2 K

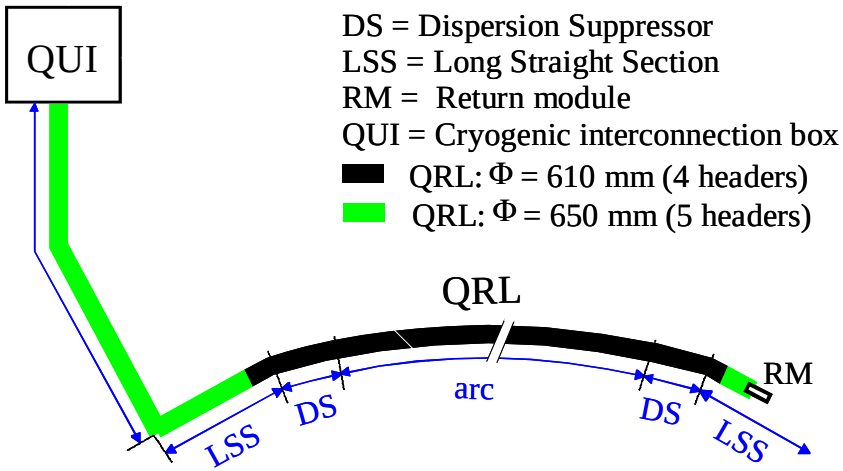


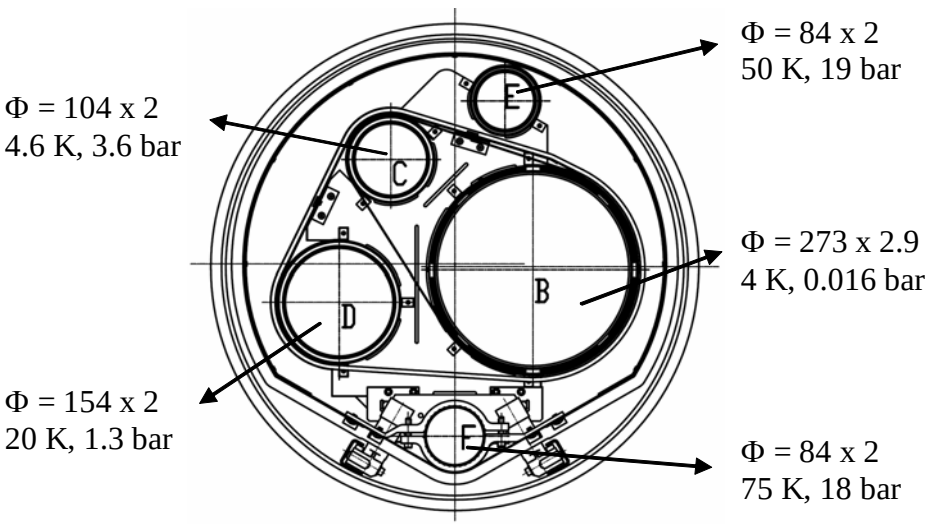
Cryogenics at CERN forthcoming procurement

Activities / Year	2019	2020	2021	2022	2023
Supply of 40'000 t of liquid nitrogen for the 2019-2023 operational period (renewal)					
Supply of 240 t of liquid helium for the 2021-2025 operational period (renewal)					
Maintenance & Operation industrial support services for the 2022-2026 period (renewal)					
HL-LHC: -Procurement of two 18 kW @ 4.5 K cryogenic plants and cold compressors units -Procurement of the 1.5 km cryogenic distribution infrastructure (multiple-lines)					

Invitation to tender Existing contract Operational

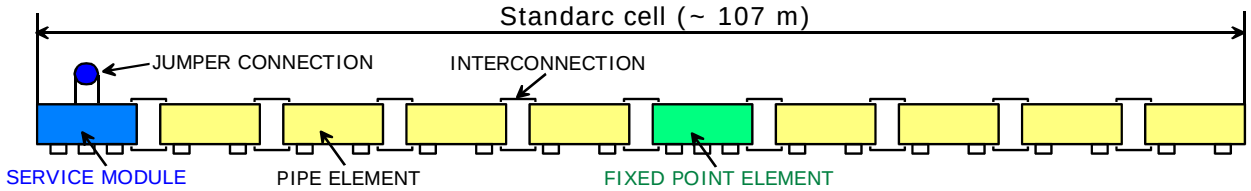
QRL Layout and Cross-Section

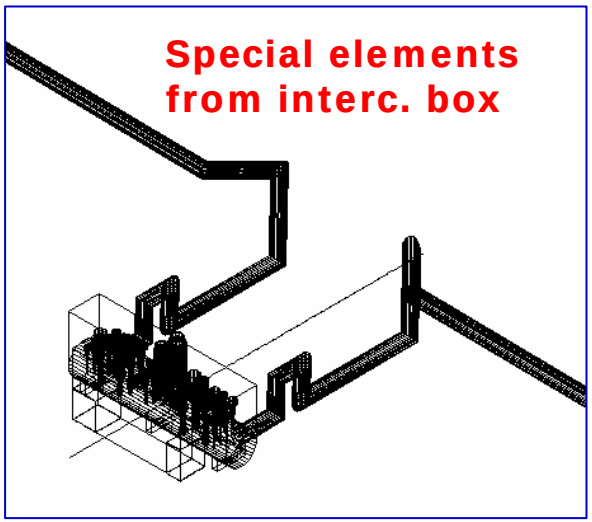


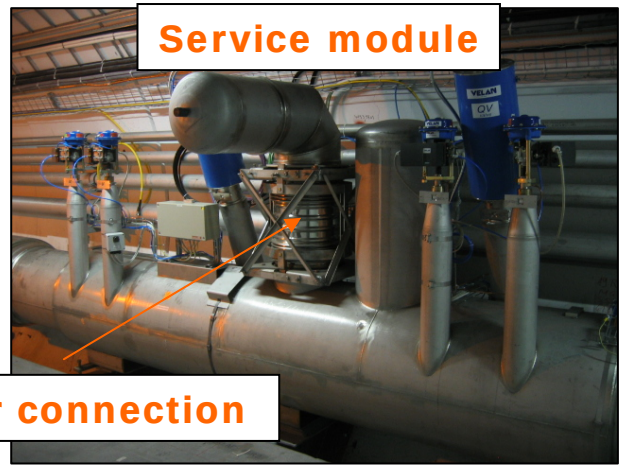


- 8 QRL sectors
- each QRL sector
  - continuous cryostat of ~3.2 km length: from the cryogenic interconnection box to the return module
  - no header (4 or 5) sectorization
  - 9 vacuum sub-sectors
  - repetitive pattern of straight pipe elements and service modules
  - connection to the superconducting magnets every 107 m

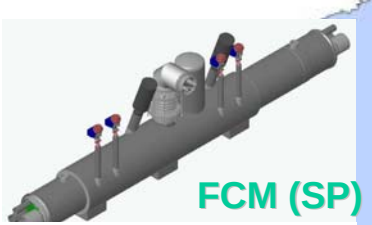
QRL Main Elements







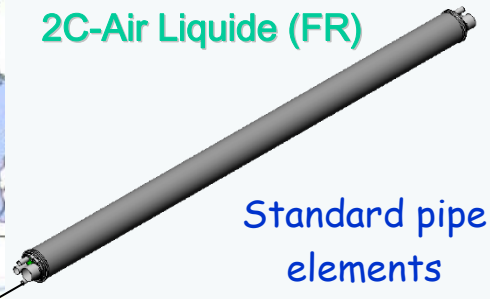
Air Liquide Industrial Organization



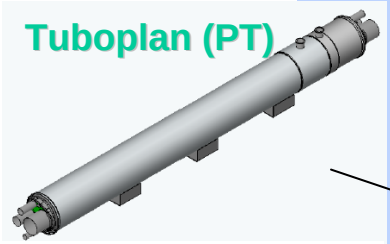
FCM (SP)

Service modules

2C-Air Liquide (FR)



Standard pipe elements



Tuboplan (PT)

Fixed points/ vacuum barriers, non-standard pipe elements and steps/elbows

Air Liquide (FR)

Service modules and cryog. extensions

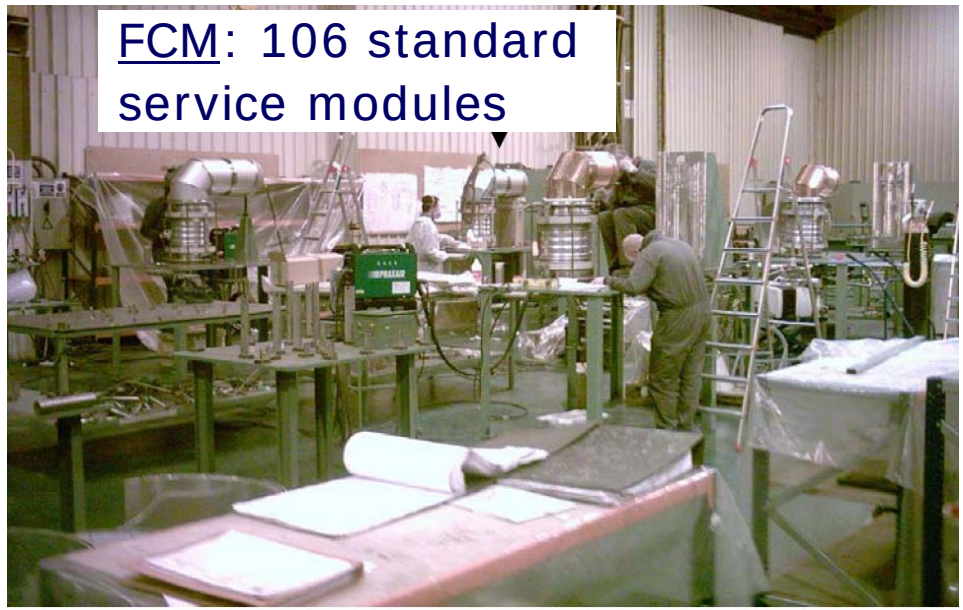
Simic (IT)

Service modules

Service Module Production at Simic and FCM

SIMIC: 168 standard and special service modules

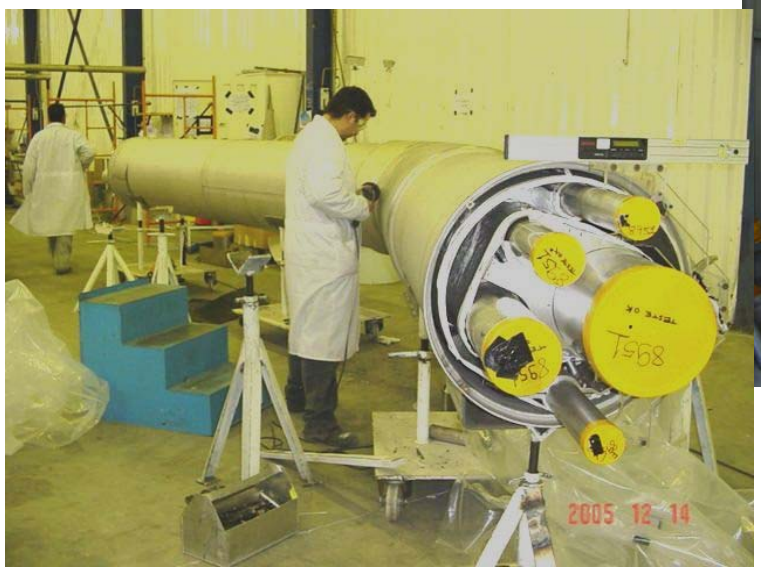
FCM: 106 standard service modules



L = ~6.6 m, vacuum vessel in stainless steel

Production of Fixed Points / Vacuum Barriers, Special Pipe Elements and Steps / Elbows at Tuboplan

- 239 fixed point/vacuum barrier elements (L = ~ 6.6 m)
- 204 special pipe elements (L = ~3-13 m)



- 70 singularities: steps and elbows