



**High
Luminosity
LHC**

Introduction to specifications refresher

Ofelia Capatina
on behalf of the CERN specification team

The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404.



2013-03-05

Contacts: Rama.Calaga@cern.ch,
Alick.Macpherson@cern.ch □

Functional Specifications of the LHC Prototype Crab Cavity System

P. Baudrenghien, K. Brodzinski, R. Calaga, O. Capatina, E. Jensen, A. Macpherson,
E. Montesinos, V. Parma

Keywords: Crab Cavity, cryostat, LHC, SPS

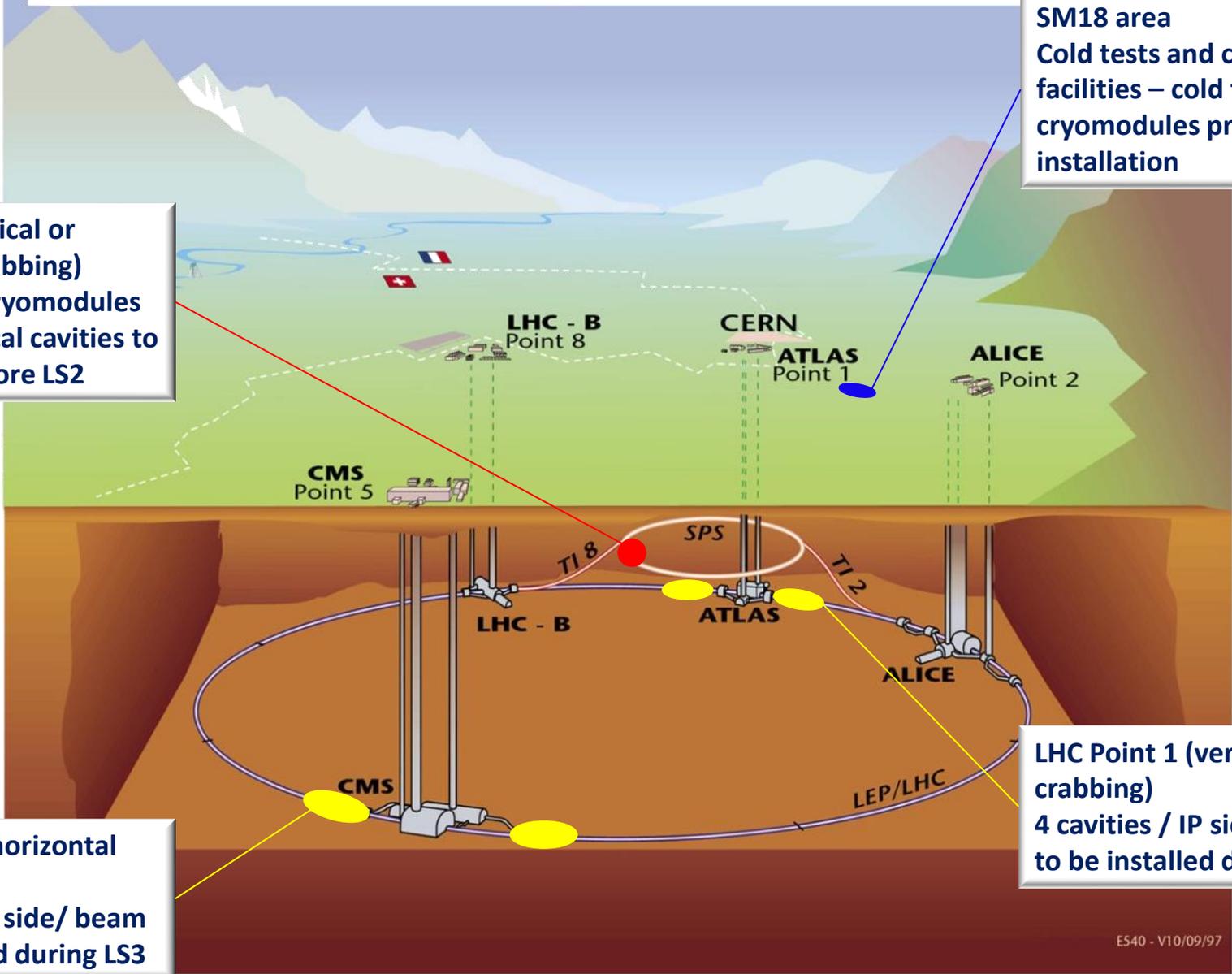
Summary

This document outlines the functional specifications for LHC prototype crab cavities to be tested in the SPS, and describes a first look at the RF system, cryomodule and cryogenic aspects. These guidelines are prepared with input from experts at CERN and the HiLumi collaboration, including EuCARD and USLARP.

<https://espace.cern.ch/HiLumi/WP4/Lists/Team%20Discussion/AllItems.aspx>

General

Overall view of the LHC experiments.



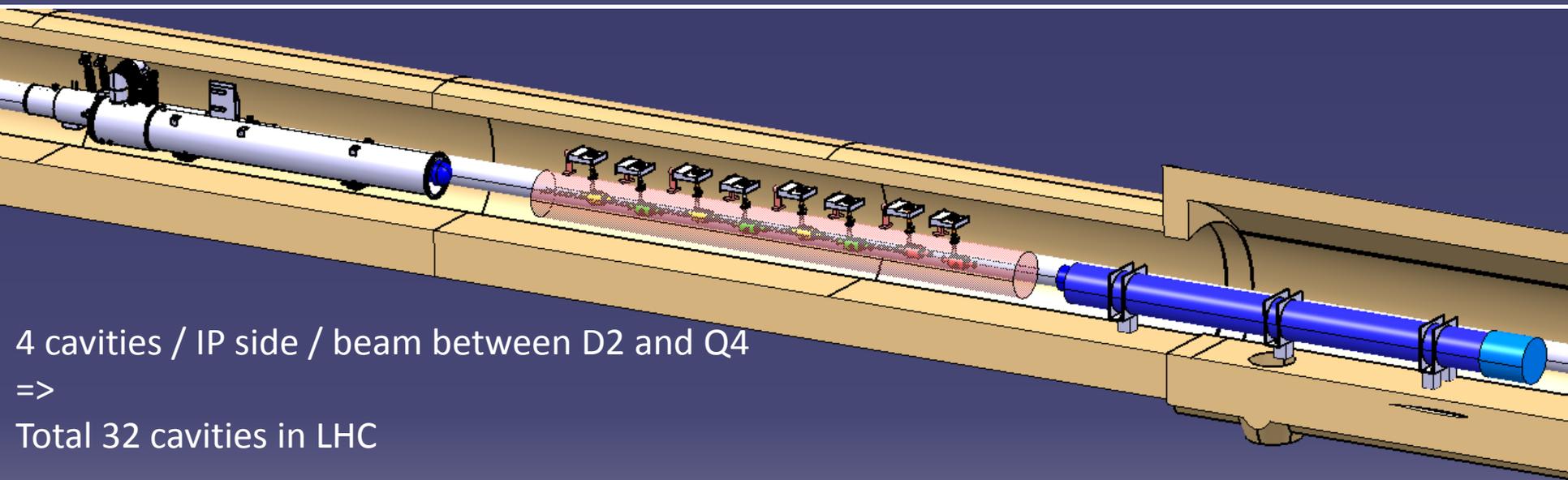
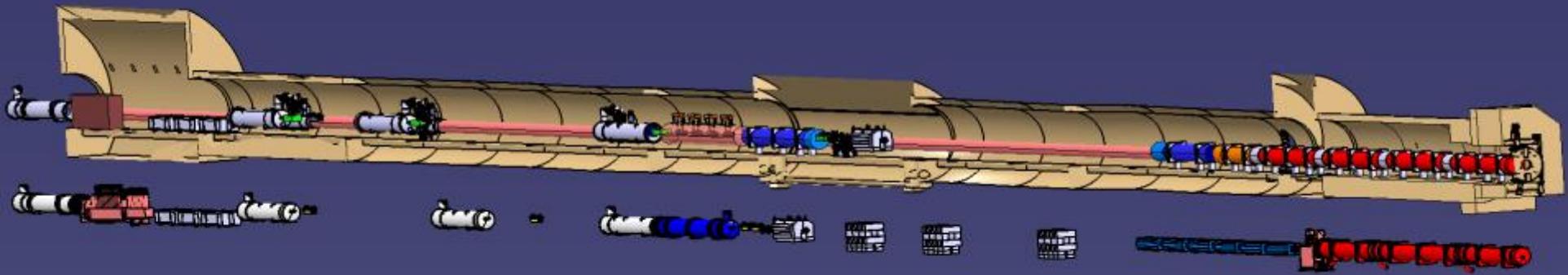
SM18 area
Cold tests and clean room facilities – cold test of cryomodules prior tunnel installation

SPS BA4 (vertical or horizontal crabbing)
One or two cryomodules with 2 identical cavities to be tested before LS2

LHC Point 1 (vertical crabbing)
4 cavities / IP side/ beam to be installed during LS3

LHC Point 5 (horizontal crabbing)
4 cavities / IP side/ beam to be installed during LS3

- LHC environment

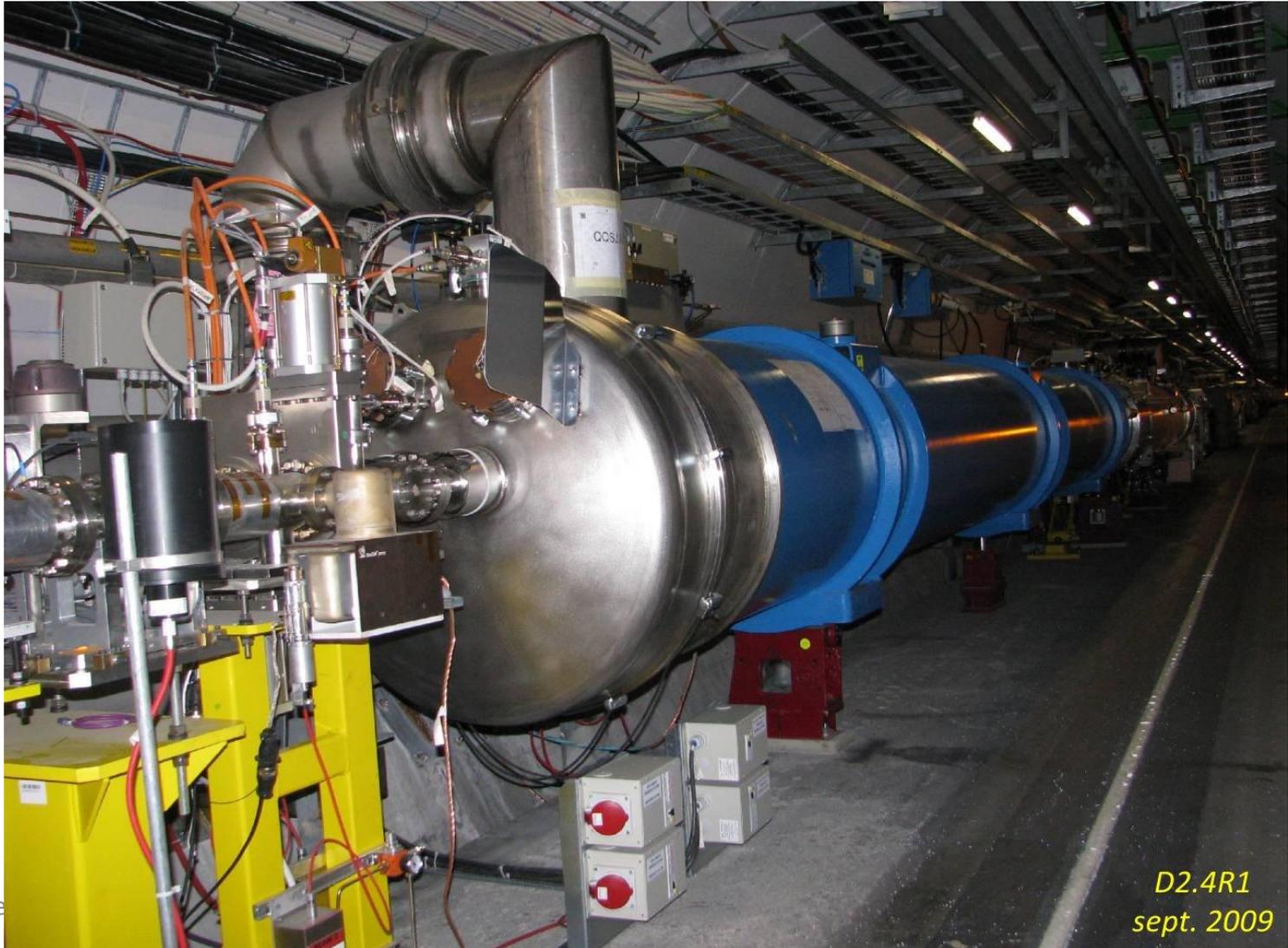


4 cavities / IP side / beam between D2 and Q4

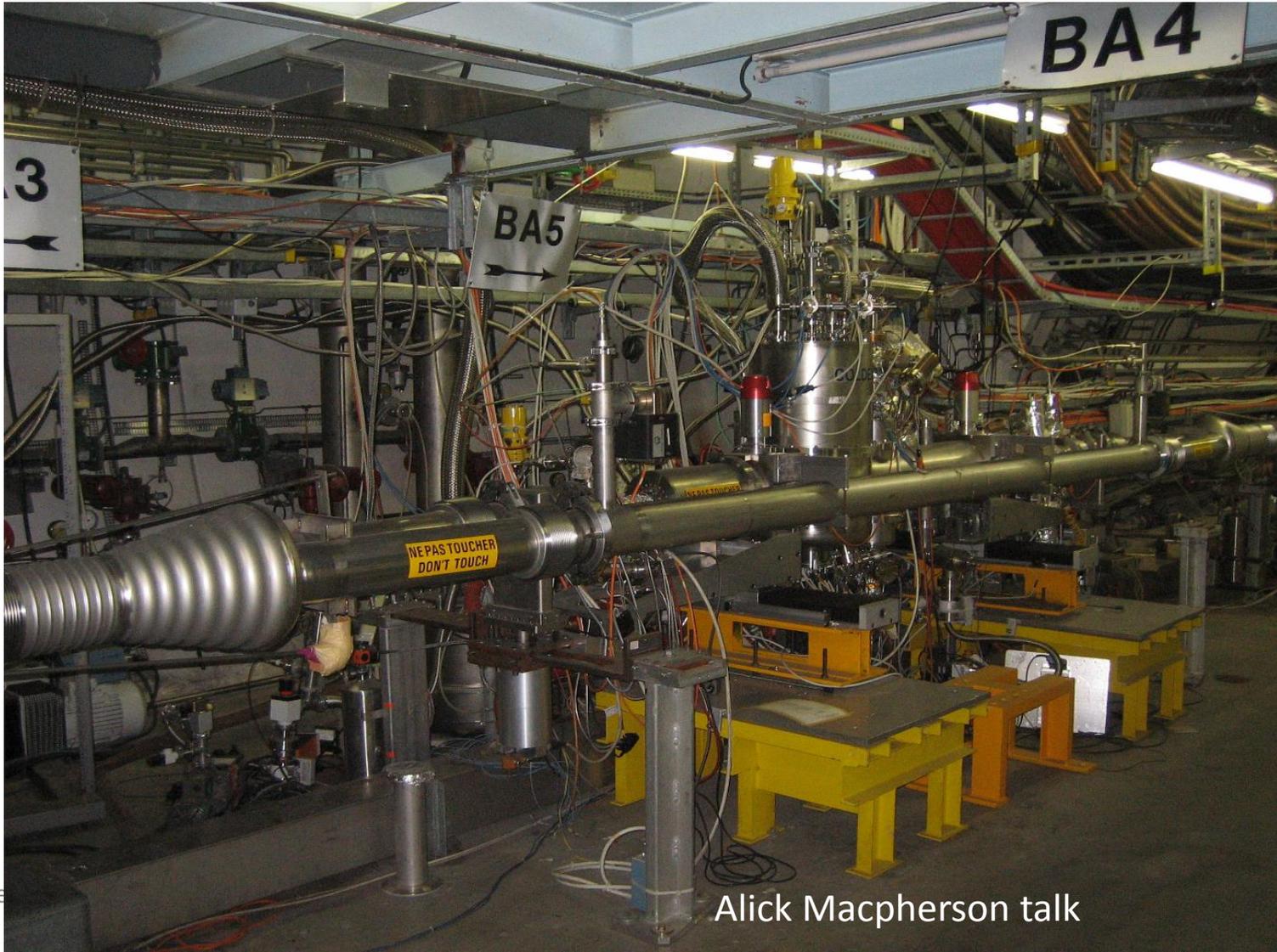
=>

Total 32 cavities in LHC

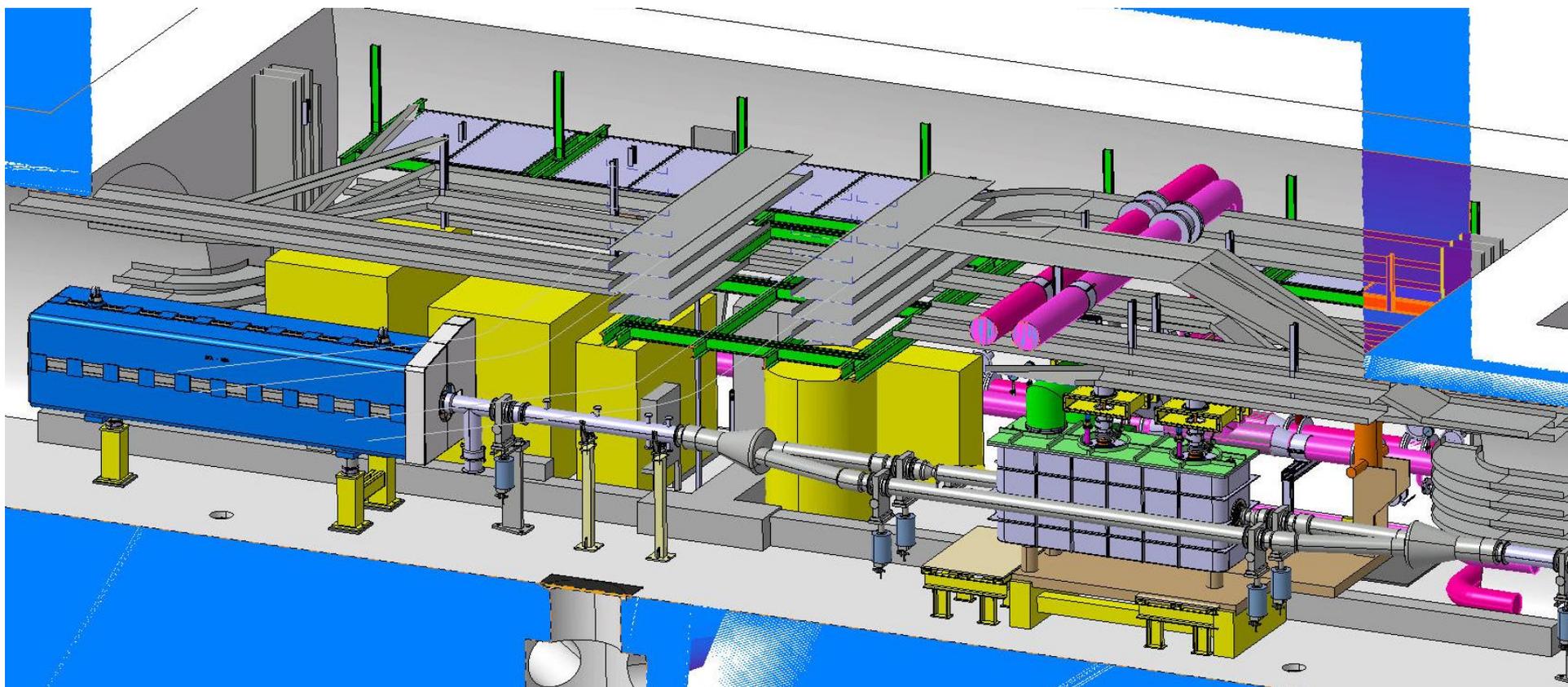
- LHC environment



- SPS environment

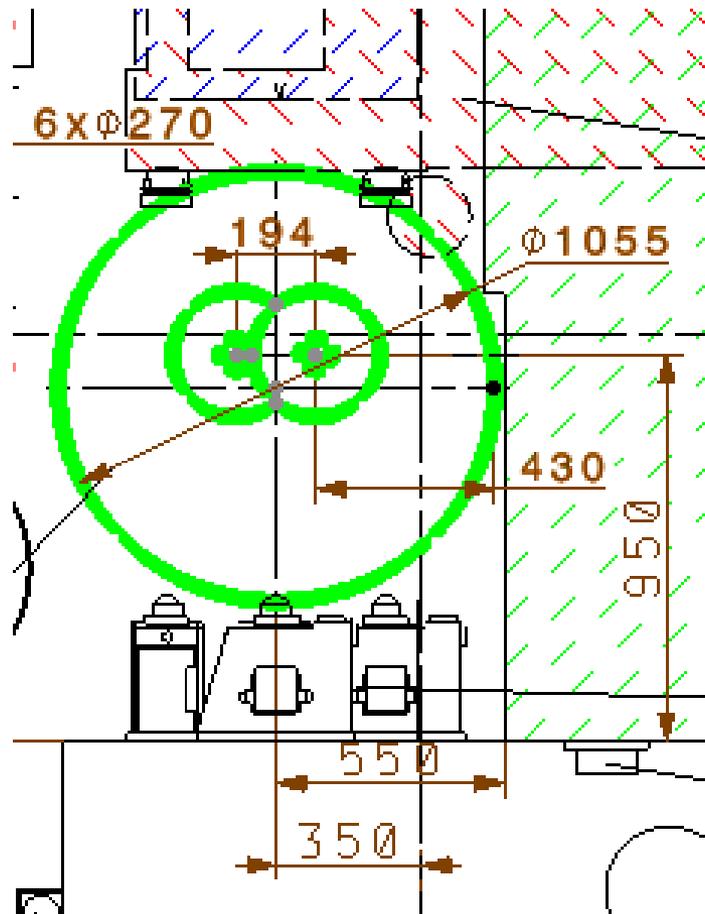


- SPS environment

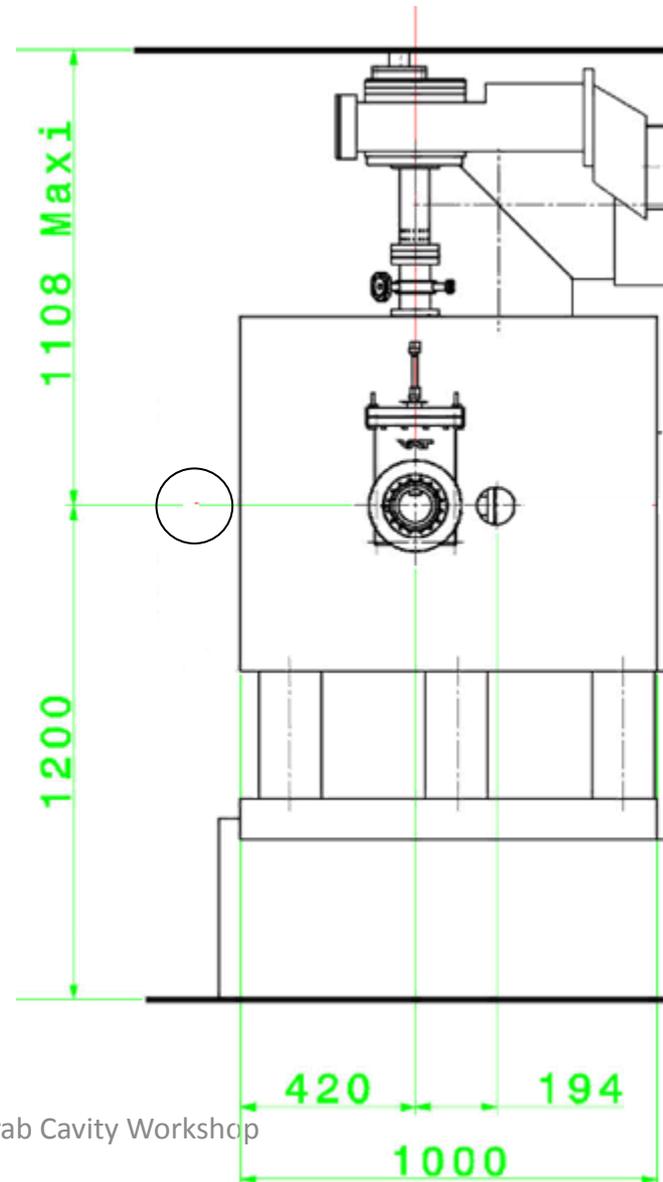


Cryomodule

LHC configuration

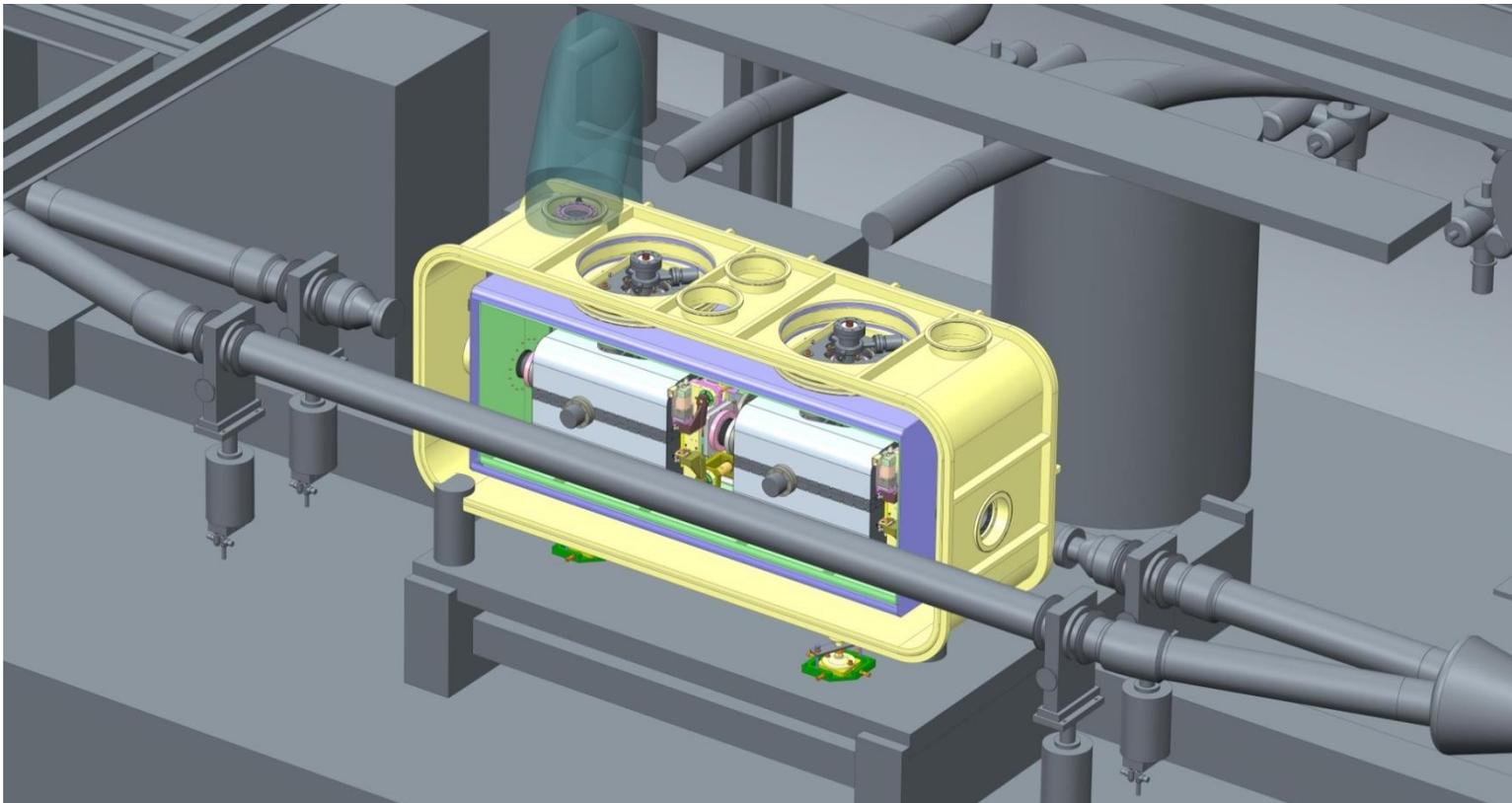


SPS configuration



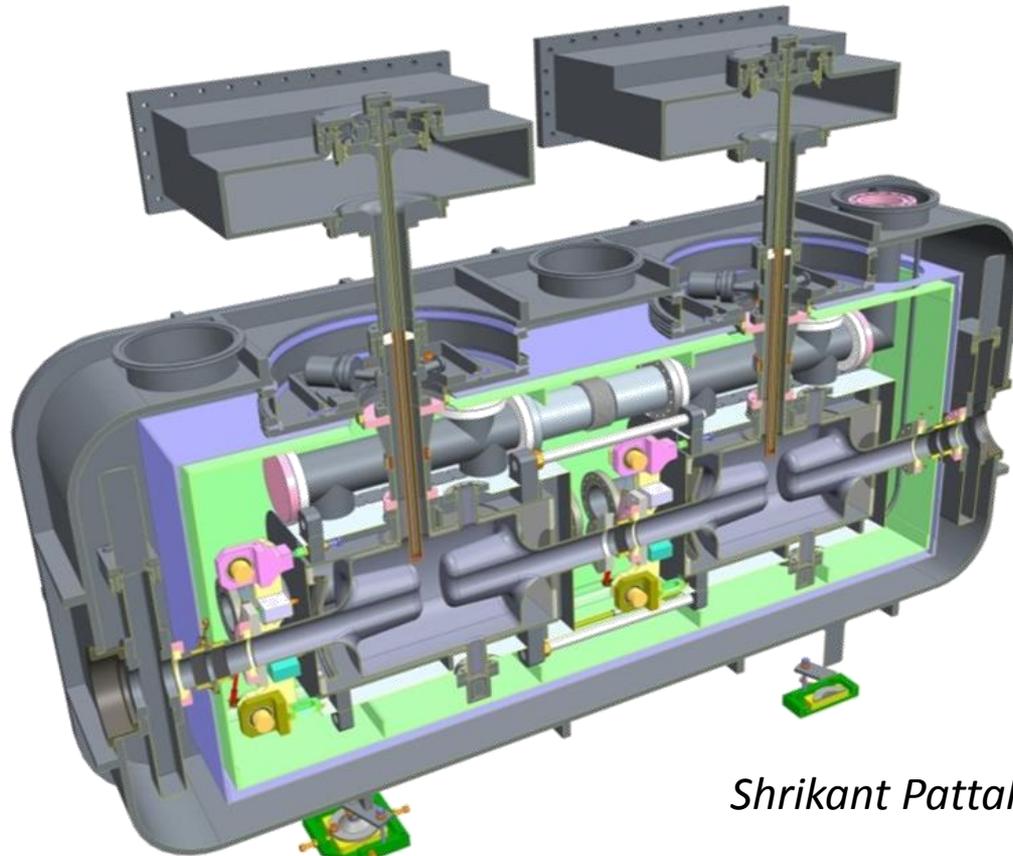
Cryomodule

- SPS :
 - 2 (identical) cavities in a cryomodule
 - 3 different cryomodules



Cryomodule

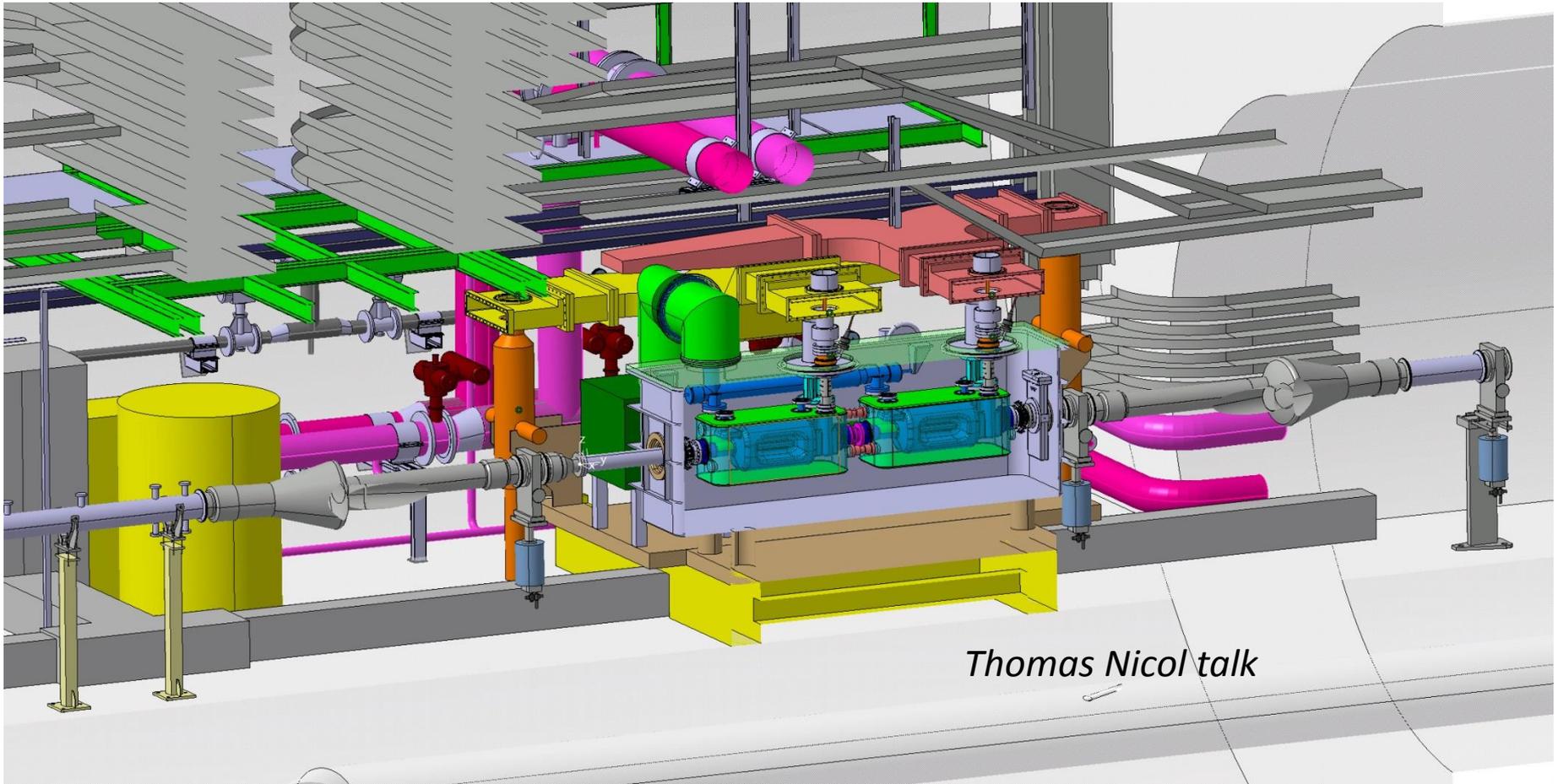
- SPS :
 - 2 (identical) cavities in a cryomodule
 - 3 different cryomodules



Shrikant Pattalwar talk

Cryomodule

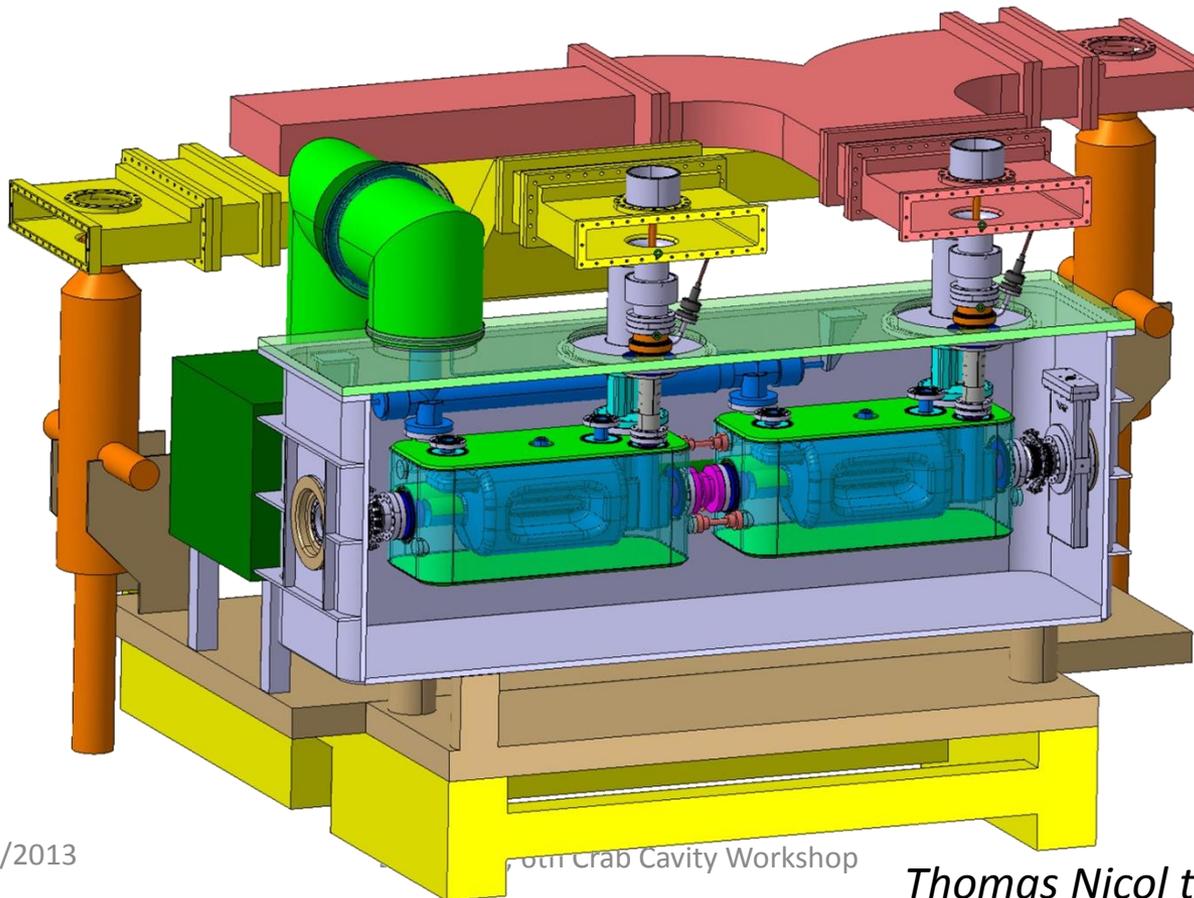
- SPS :
 - 2 (identical) cavities in a cryomodule
 - 3 different cryomodules



Thomas Nicol talk

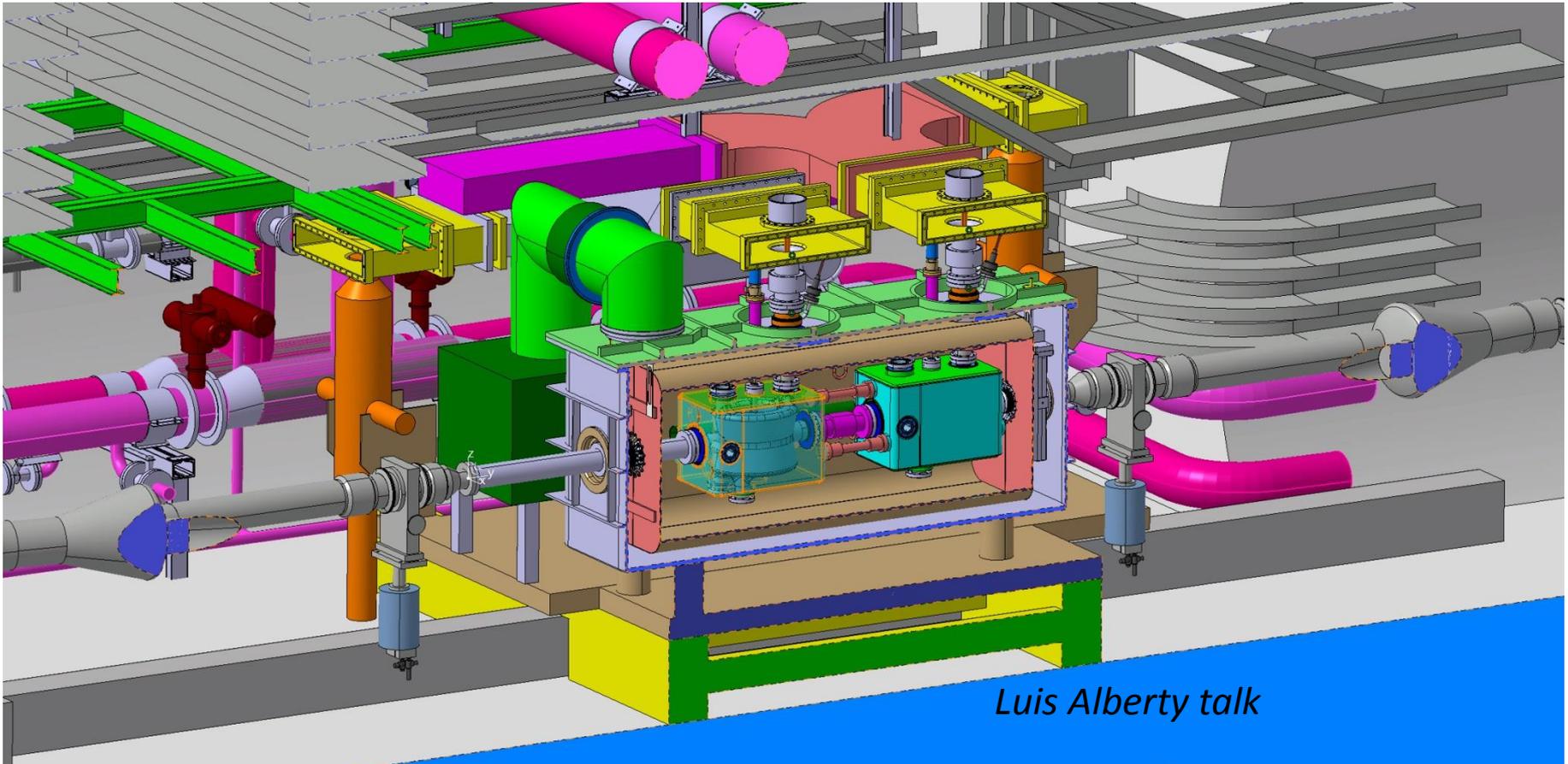
Cryomodule

- SPS :
 - 2 (identical) cavities in a cryomodule
 - 3 different cryomodules



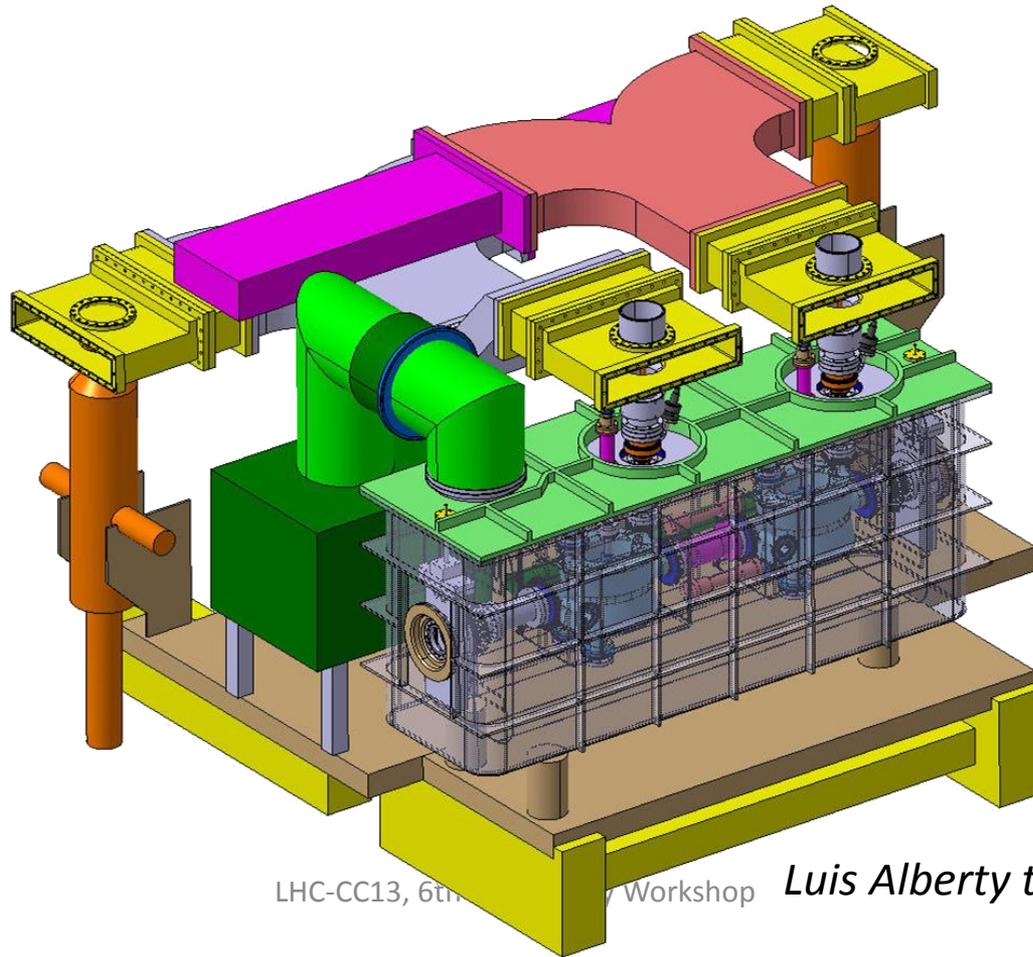
Cryomodule

- SPS :
 - 2 (identical) cavities in a cryomodule
 - 3 different cryomodules



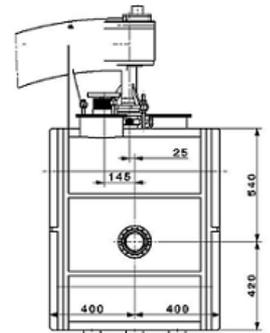
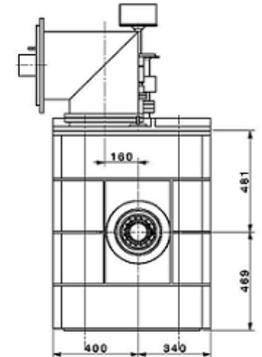
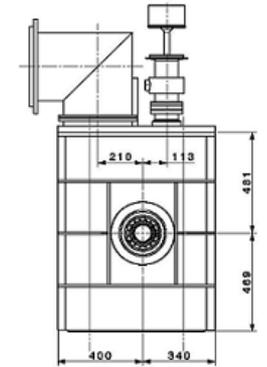
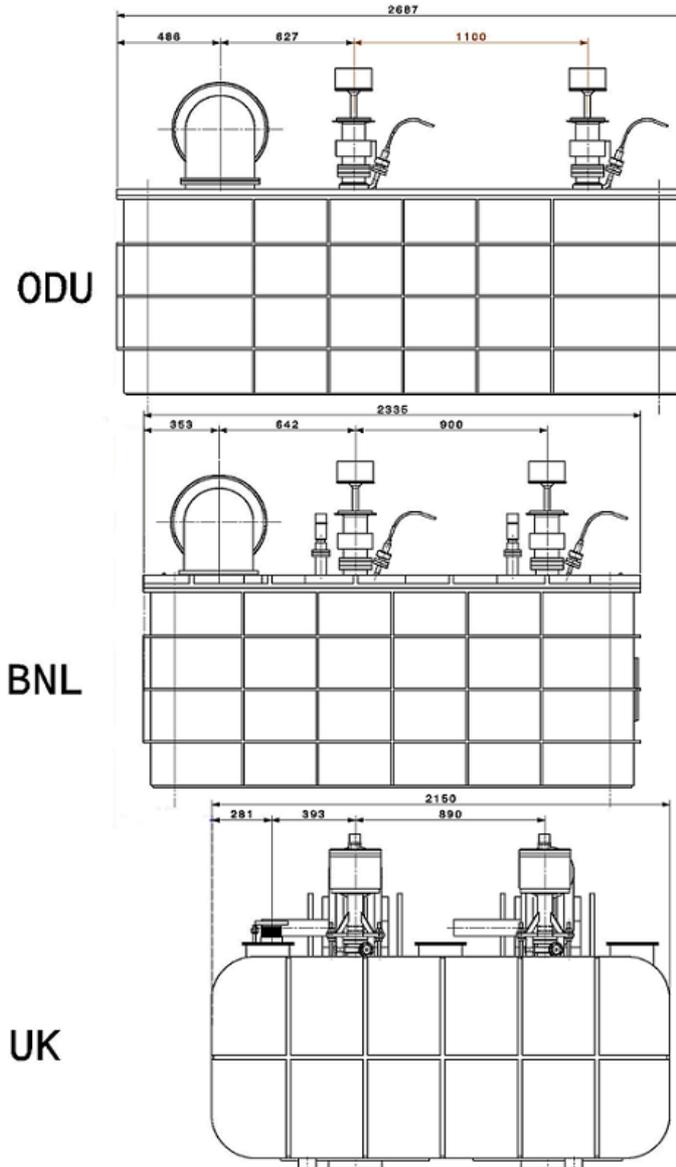
Cryomodule

- SPS :
 - 2 (identical) cavities in a cryomodule
 - 3 different cryomodules

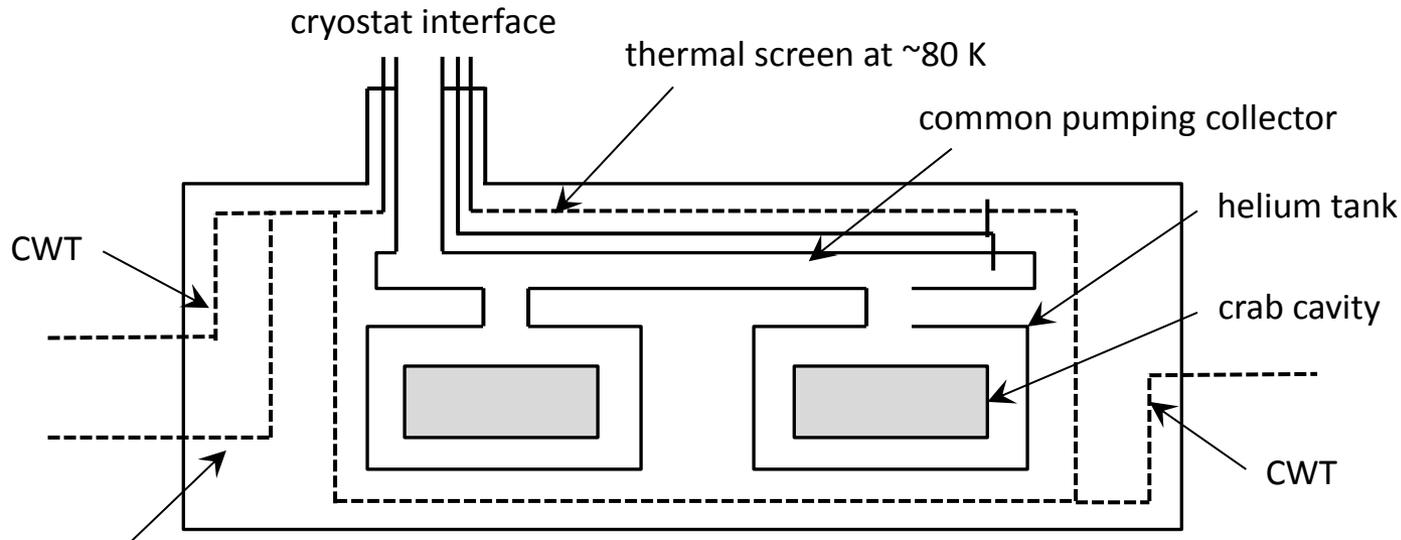


Cryomodule

- Design principle, dimensions and interfaces (RF, cryo) to be standardized as much as possible
- Metric system !



- SPS:
 - Two circuits: 2 K and 80 K
 - Operated at 2 K saturated helium bath -> ~30 mbar
 - **Strong requirement to reduce static heat losses at 2K**
 - Screening at 80 K provided with LN2
 - Main interface from the top



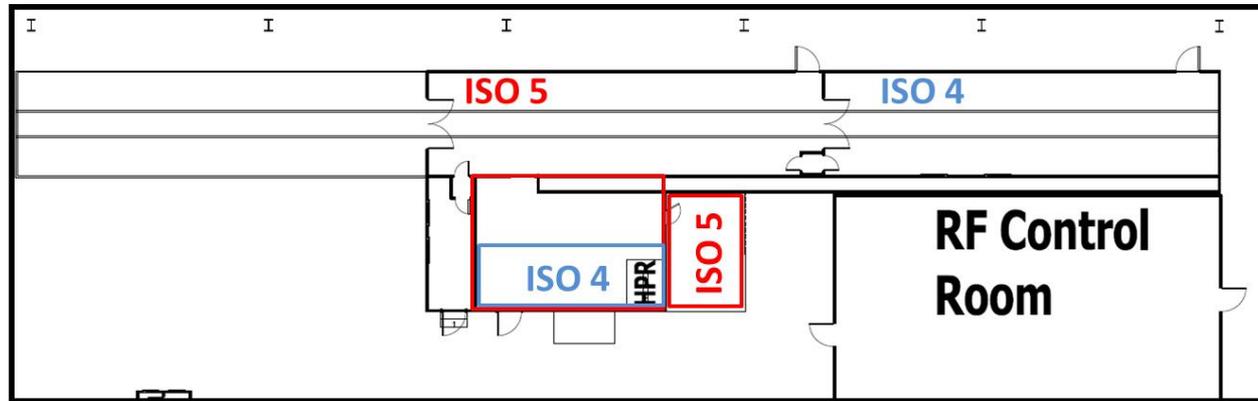
- LHC - Alignment requirements (position accuracy and position stability) – based on general beam dynamics considerations:
 - Transverse rotation per cavity should be less than 5 mrad
 - Transverse misalignment per cavity (in both planes) should be less than 0.7 mm
 - Cavity tilt with respect to the longitudinal axis should be less than 1 mrad
 - Cavity longitudinal misalignment should be less than 10 mm

- SPS
 - Alignment required for operation less than LHC
- To limit SPS crymodule complexity (win time and limit risk)
 - No active alignment needed for SPS tests
 - Foresee a system for monitoring the cavity positions instead

Cryostating

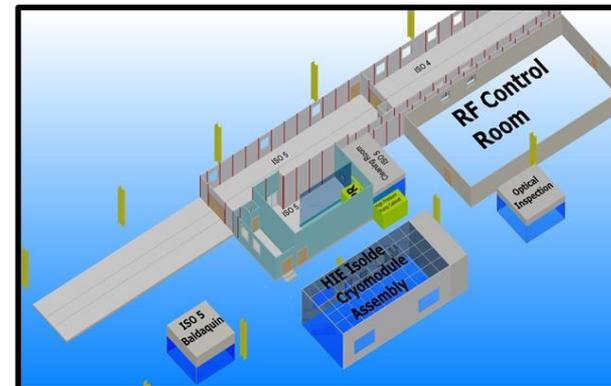
- Integration into cryostat at CERN - most likely location SM18

Vittorio Parma talk



Top view of cleanroom upgrade

Réfection à terminer avant fin 2013



- Cold tests of full cryomodules in SM18 prior tunnel installation

Mathieu Therasse talk

- Fundamental Power Couplers
 - Talk by Eric Montesinos today

- Impedance budget and HOM power & couplers
 - Talk by Benoit Salvant today

Summary

- Bare cavities for SPS designed to be the same as for the LHC
- Dressed cavity for SPS tests design as much as possible compatible with LHC
- Conceptual design of SPS cryomodule for the 3 cavities
 - 2 identical cavities in 3 different cryomodule
 - Effort to standardize interfaces, basic choices in-between the 3 cryomodules
- The 3 SPS cryomodules could be tested in SM18 (if no down-selection since then)
- 1 or 2 cryomodules to be tested in SPS, after test in SM18
- SPS cryomodule design as much as possible compatible with the LHC