



Status of INFN contribution to HiLumi (and outlook for accelerator R&D for HEP)

P.Fabbricatore (INFN)

- CERN-INFN agreements
- HO Correctors
- D2 model and prototype (and series)
- Synchrotron radiation-based material studies
- Other activities
- Accelerator R&D for HEP
- INFN Infrastructures for applied superconductivity

OUTLINE

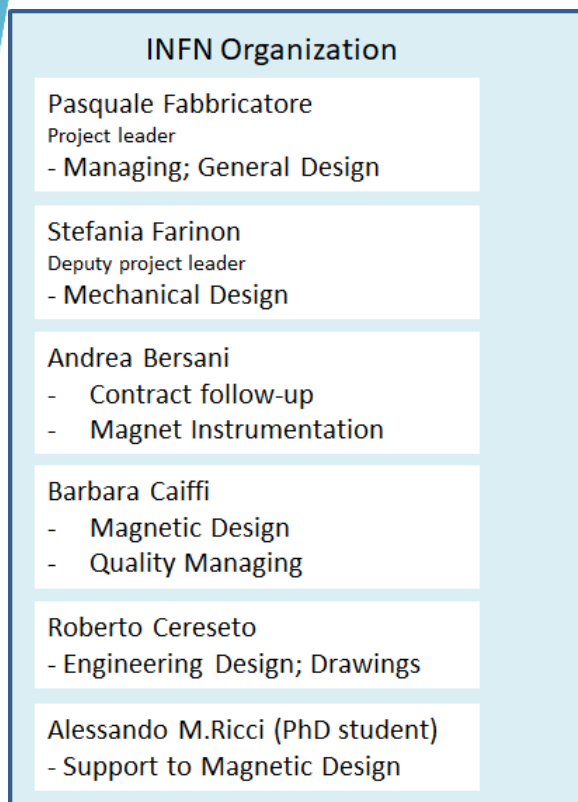
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CERN_INFN Agreements for Hi Luminosity LHC

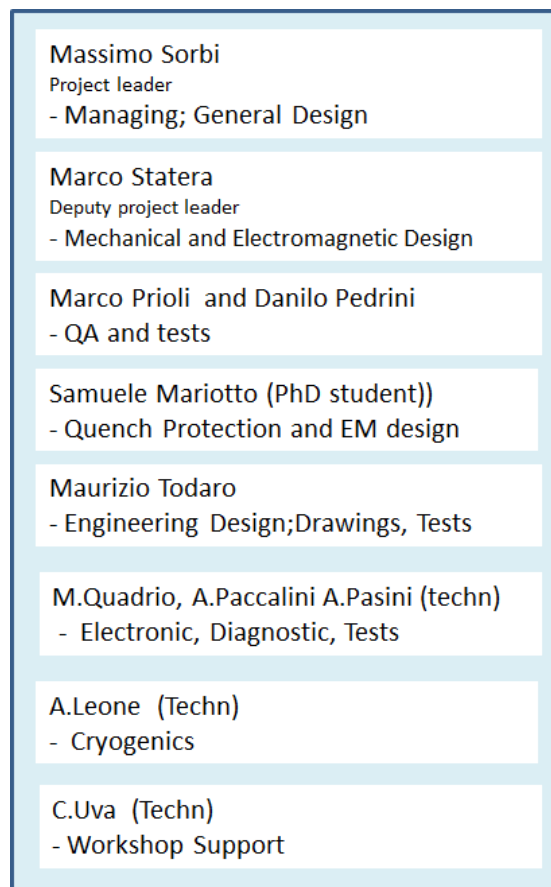
- KE 2291/TE/HL-LHC (Started: April 2014 – Deadline: Dec 2018)
 - SF Correctors design and Prototypes construction and test
Status- Almost completed.
 - D2 (MRBD) engineering design - *Status- Completed*
- KN 3083 Framework agreement
- Addendum n.1 KE3084 (Started: July 2016- Deadline: December 2019)
 - D2 Short Model (MRBDS1) (1.6 m) and Prototype (MRBDP1) (8 m) construction of cold mass. *Status- Short Model under construction*
- Addendum n.2 KE3085 (Start: December 2017- Deadline: June 2021)
 - SF Correctors- Construction (in industry) and cold test (at LASA) of all 54 magnets of HL-LHC line (Status: Tendering to Industry)
- Addendum n.4 KE3274 (Start:Aug. 2018 – Deadline August 2022)
 - Collaboration in synchrotron radiation studies
- Addendum XX
 - D2 Series (6 magnets) . (Status: In preparation)

INFN Organization Charts for Hi-Lumi

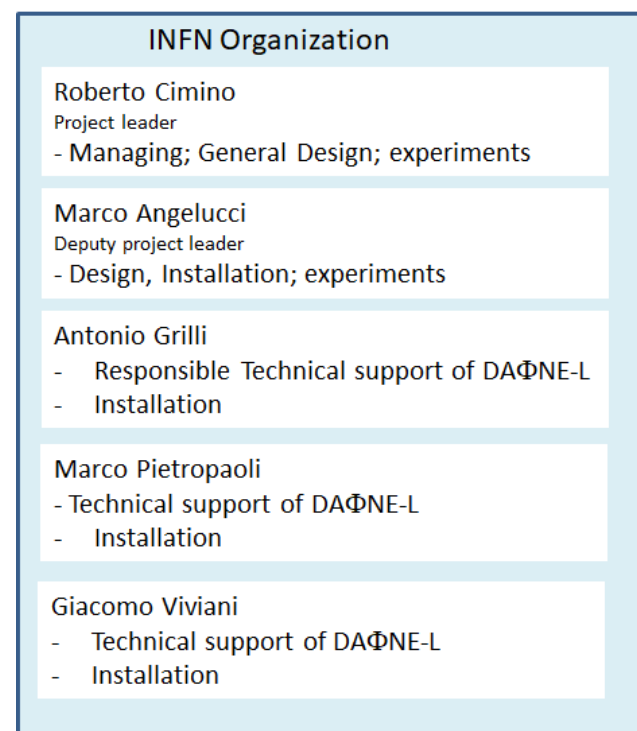
Addendum n.1 KE3084 to KN 3083 F. A.



Addendum n.2 KE3085 to KN 3083 F. A.



Addendum n.4 KE3274 to KN 3083 F. A.



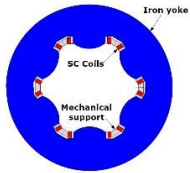
+ Administrative and technical infrastructures of Ge, Mi-LASA and LNF Laboratories

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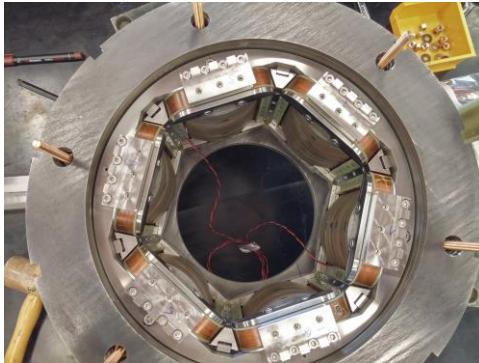
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LASA (Milan) activity

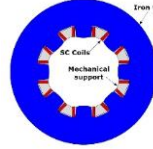
- Correctors prototyping-



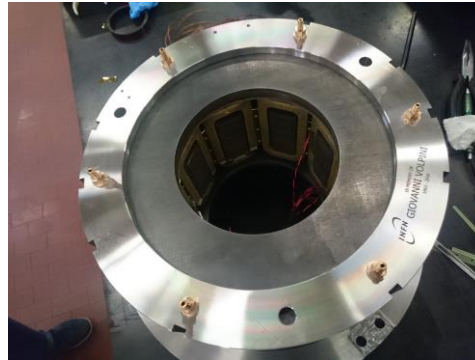
Sextupole
OD=320 mm



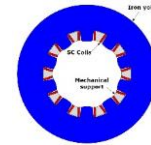
Completed & successfully tested



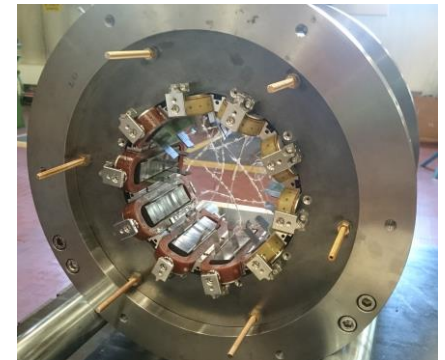
Octupole
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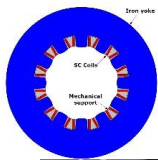
Completed & successfully tested



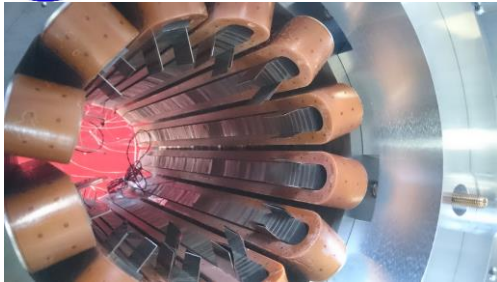
Decapole
OD=320 mm



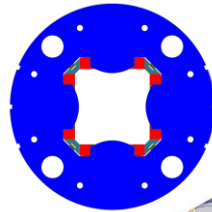
Completed & successfully tested



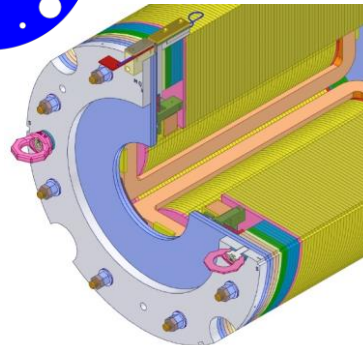
Dodecapole
OD=320 mm



Completed & in test phase



Skew quad
OD=460 mm



Construction phase

- The first 3 magnets built at LASA
- The last 2 magnets assigned to industry
- Completion in 2018

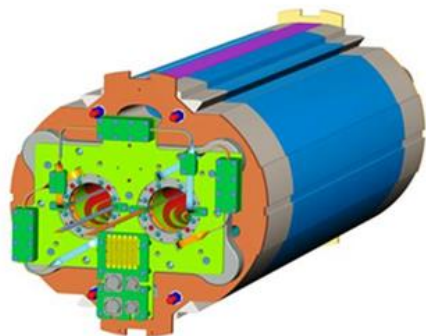
Starting the new phase...

- The new CERN-INFN agreement for the series construction has been defined (KE3085/TE/HL-LHC).
- Formal signature end 2017
- INFN-LASA is responsible for construction (in industry) and cold test (at LASA) of all 54 magnets of HL-LHC line.
- Schedule:
 - Engineering design for order of series (completed in **June 2018**) ✓
 - Award of the contract for conductor purchase (**Oct. 2018**) ✓
 - Launch of the tender for series construction (**Sept. 2018**) ✓
 - Award of the contract of the series construction in **Jan 2019**
 - First batch of magnets ready for test at LASA in **Nov 2019**
 -
 - Last batch of magnets delivered at CERN in **June 2021**

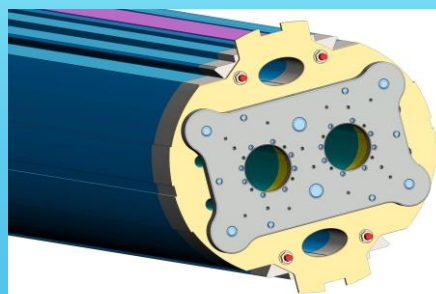
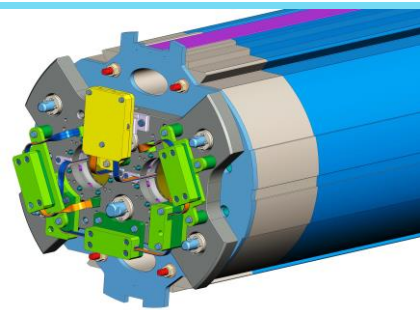
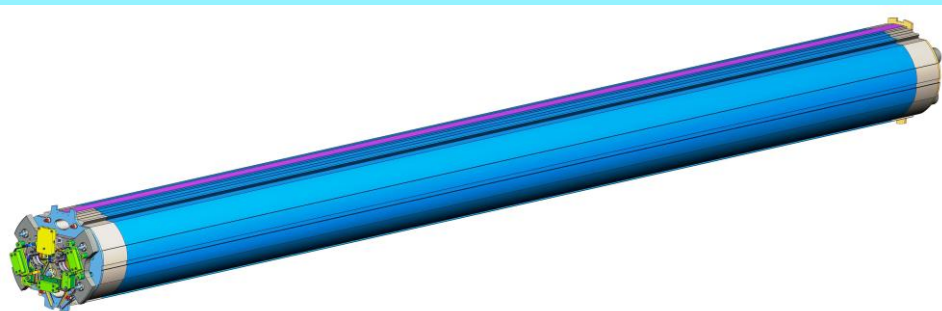
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The D2 development – INFN Genova



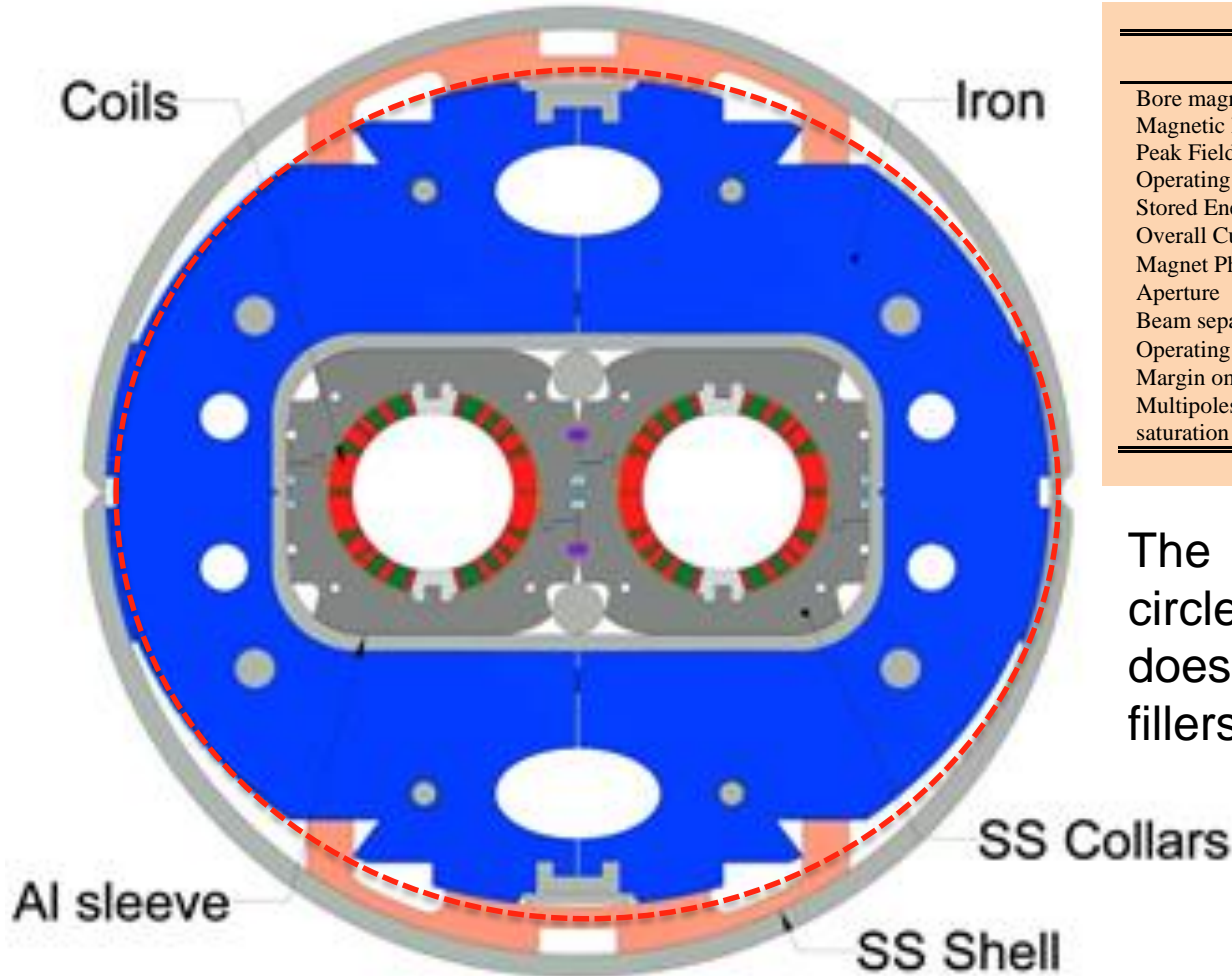
Short model (1.6 m) in construction in industry . INFN Genova performed the engineering design and it is now involved in the follow-up and QA activities in industry.



Prototype (8m) Development
INFN Genova has managed the international tender for the industrial procurement. Start of industrial contract January 2019. Delivery within 15 months.

Series (6 magnets). Option to be applied after the construction and test

The D2 cross section



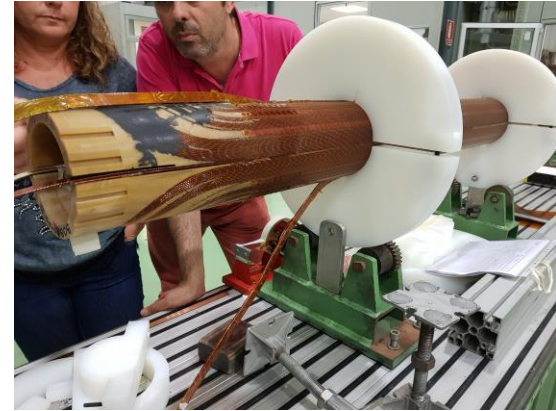
MAIN CHARACTERISTICS OF THE D2 DIPOLE

Characteristics	Unit	Value
Bore magnetic Field	T	4.50
Magnetic length	m	7.78
Peak Field	T	5.26
Operating current	kA	12.34
Stored Energy	MJ	2.28
Overall Current Density	A/mm ²	443
Magnet Physical Length (overall)	m	8.213
Aperture	mm	105
Beam separation (cold)	mm	188
Operating temperature	K	1.9
Margin on load line	%	33
Multipoles variation due to iron saturation		<10 unit

The INFN scope of work, circled in the red dashed line, does not include magnet fillers and shell

Difficult magnet for the magnetic cross talk between the two apertures

Short Model under construction at ASG Superconductors



First aperture

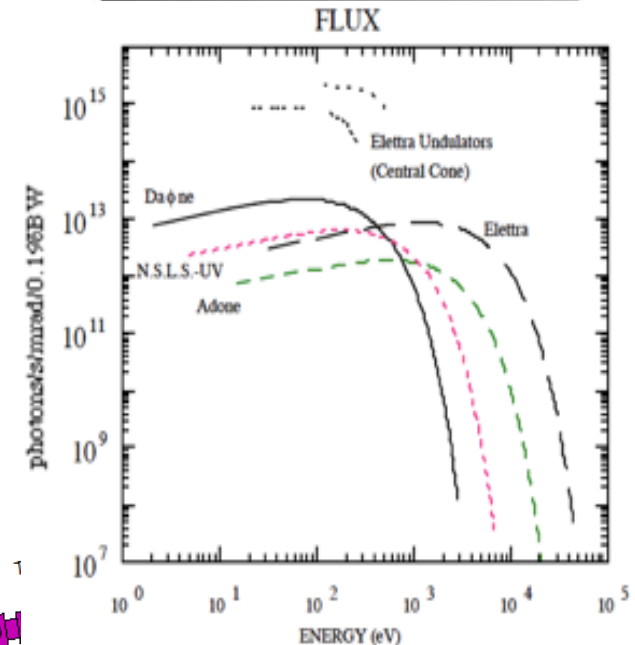


Second aperture

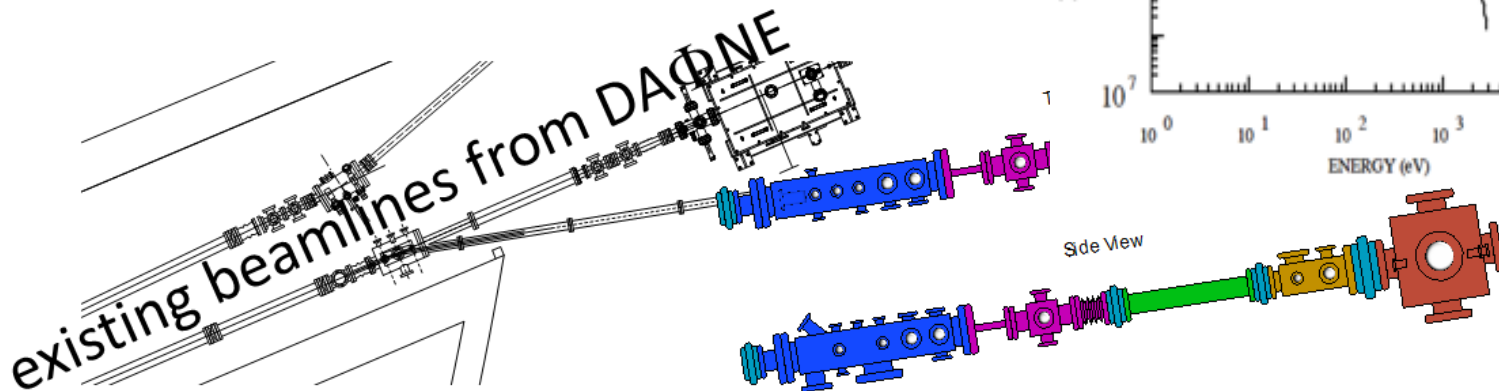
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The goal (within a collaborative effort with CERN) is to have a “White light” irradiation test facility to study desorption properties **on long and real beam-pipes** and to correlate such results with the one obtained on small samples



New Beamline

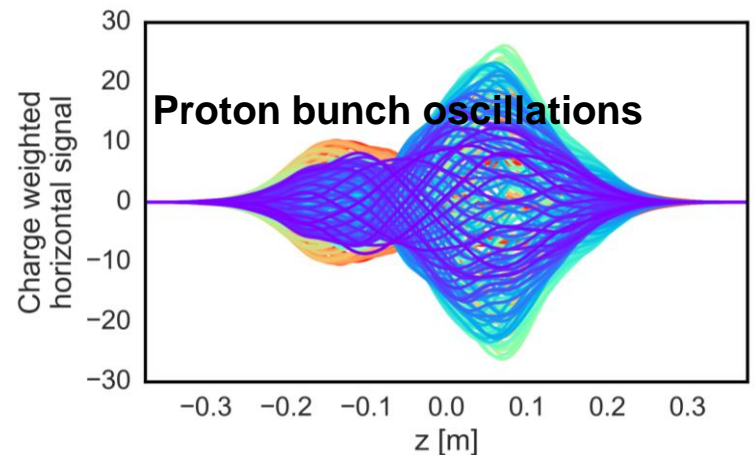
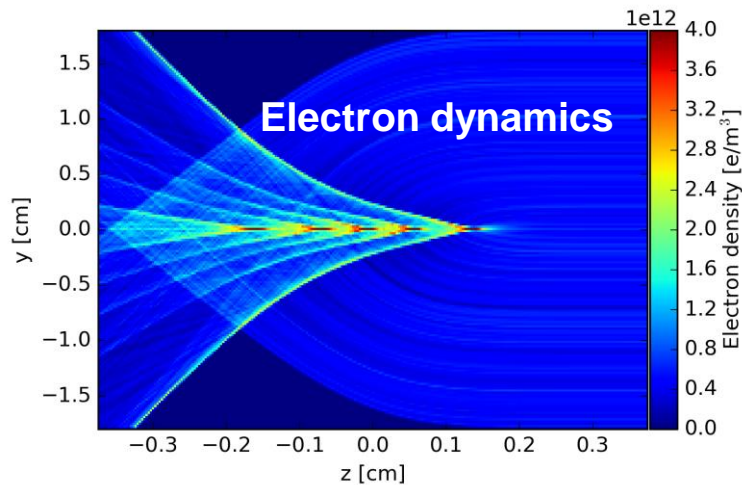


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HPC simulations at INFN-CNAF

- **High Performance Computing (HPC)** cluster at **INFN-CNAF** in **Bologna** is used to estimate the effect of **electron-clouds** on the HL-LHC beams
 - Requires simulating the **coupled dynamics** of the electrons and the proton bunch
 - **Computationally very heavy:** electron dynamics requires very short time steps, impact on the beam visible only on accumulated effect on much longer time scales
- HL-LHC simulation scenarios can be efficiently covered only using **large computing capacity >800 CPU cores**



Courtesy of G.Arduini and G.Rumolo

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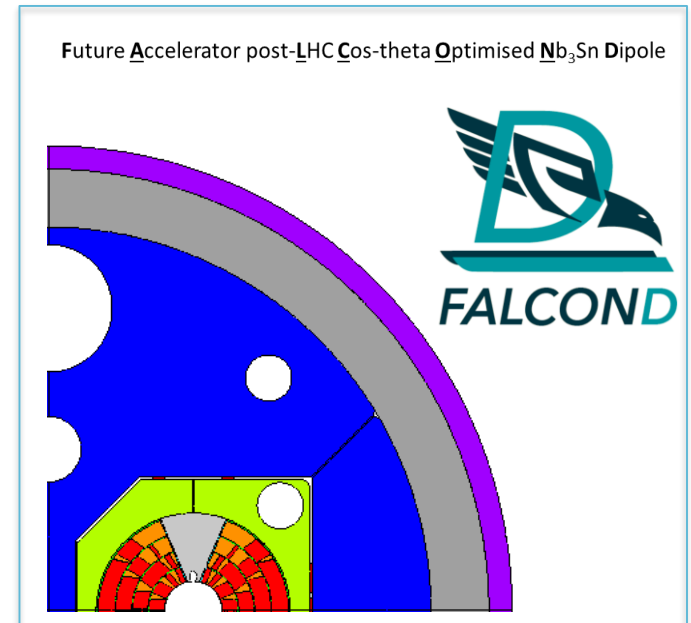
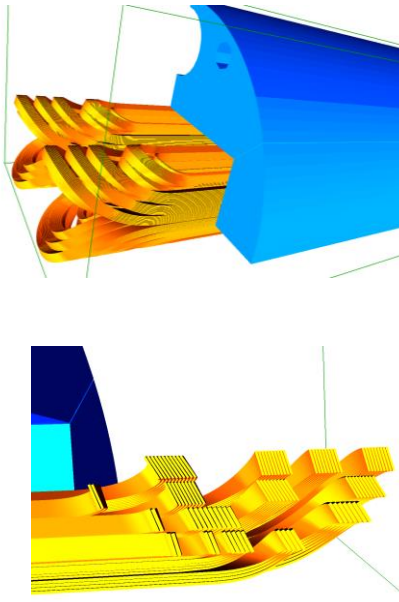
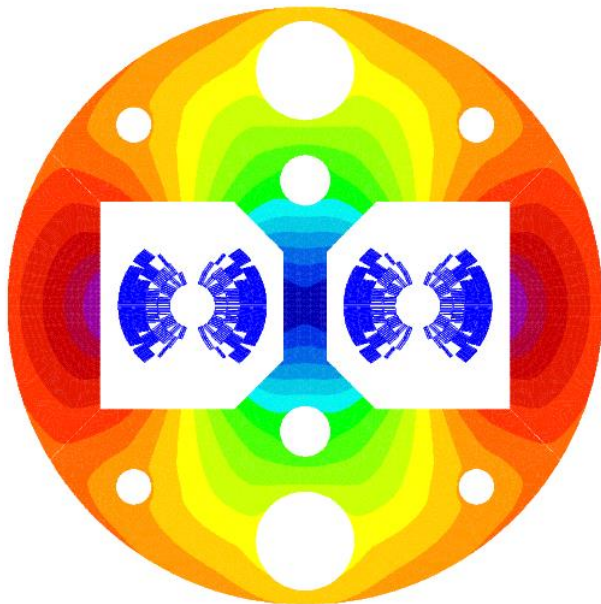
Development of High Field Magnets (HE-LHC or FCC)

FCC agreement no. KE4102 concerning the collaboration on 16 T – Nb₃Sn
Short Model Magnet Production in the framework of the FCC Study
(Status: Under signature)

This activity (done at Genova and Milano-LASA) is based on H2020- EuroCirCol project finalised to develop a design.

INFN has developed the design of a cos-theta 16 T magnet double-aperture

The next step is now the construction in collaboration with industry of a short model (2 m) model with single aperture (FALCOND project)

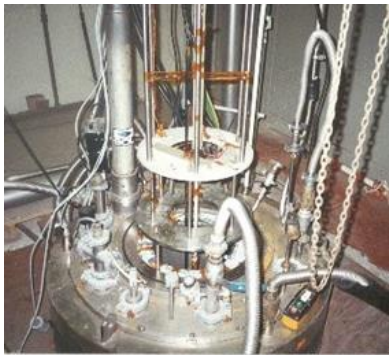


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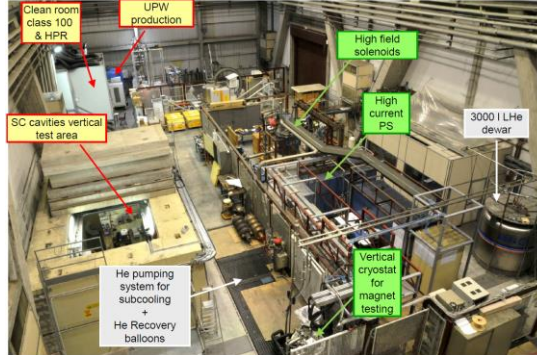
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INFN infrastructures for applied superconductivity

INFN can count on a **distributed large technical infrastructure for applied superconductivity** (about 40 years experience) dedicated to coordinated developments and tests of **superconducting magnets for accelerators and accelerating superconducting cavities**. The infrastructure based on large cryogenic facilities is located in four different sections and laboratories: **Genova, Laboratori di Legnaro, Milano-LASA and Salerno (New one)**.



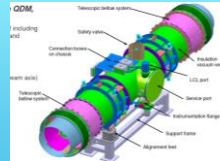
Genova



Milano LASA

The just born facility in Salerno has been set-up by a consortium including INFN and is dedicated to the test of (accelerator) magnets. The tests of 83 SIS100 quadrupole modules for FAIR will be done next years

Salerno→





Thank you for your attention

SPARE SLIDES

LASA TEST-STATION UPGRADE

- New cryostat for cold test
- New power supply for magnet test (200 A, 50 V)
- New main switch for power supply (fast solid state switch, $\Delta t < 1$ ms)
- New acquisition system for test monitoring
- **Commissioning and test with LHe in Sept. 2018**
- To be completed: installation of system for magnetic measurement at low/room temperature (to be supplied by CERN)

