



Practical Days @ CERN

Normal Conducting Magnets

Part 1: Magnet Technology, Production and Testing

Tuesday 11th & Wednesday 12th March 2025, 9:00 – 16:15

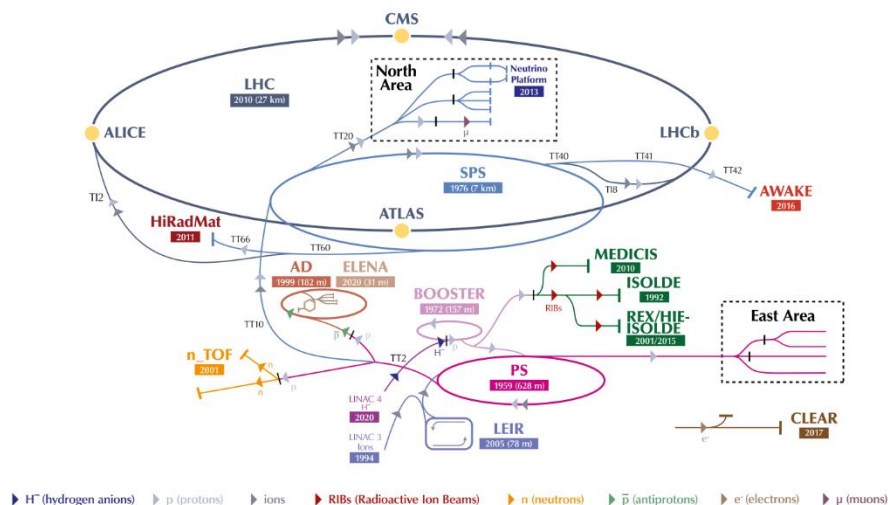
jeremie.bauche@cern.ch

Outline

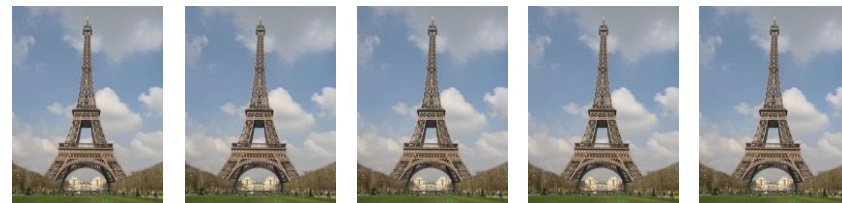
- Normal Conducting Magnets at CERN
 - Magnet group
 - Magnet patrimony
 - NCM mission and opportunities
- Program and Organization of Magnet Practical Works
 - Magnet Technology, Production and Testing
 - Magnetic Measurements (see next talk from L. Fiscarelli)

CERN Normal Conducting Magnets

The CERN accelerator complex
Complexe des accélérateurs du CERN



- About 20 km of beam lines in >20 different machines, all interconnected
- ~ 4500 installed magnets + ~ 2000 stored magnets → 50 000 tons



- Large variety: ~ 500 different types



LINAC4 DTL PMQ, < 1 kg



LEIR main dipole, 60 tons

LHC - Large Hadron Collider // SPS - Super Proton Synchrotron // PS - Proton Synchrotron // AD - Antiproton Decelerator // CLEAR - CERN Linear Electron Accelerator for Research // AWAKE - Advanced WAKEfield Experiment // ISOLDE - Isotope Separator OnLine // REX/HIE-ISOLDE - Radioactive Experiment/High Intensity and Energy ISOLDE // MEDICIS // LEIR - Low Energy Ion Ring // LINAC - LInear ACcelerator // n_TOF - Neutrons Time Of Flight // HiRadMat - High-Radiation to Materials // Neutrino Platform

The MNC Section

Design, procurement/manufacture, maintenance, consolidation, upgrade, disposal of the normal conducting magnets in the accelerators, transfer lines and experimental areas

- **Operation: maintenance and consolidation of existing machines**

2 dedicated radioactive workshops treating about 100 magnets/year

→ maintenance of installed magnets in the accelerators

→ interventions during physics run to minimize beam downtime

- **Projects: upgrades and new beam lines**

2 dedicated workshops for magnet and component production (prototyping)

→ upgrade of existing magnet systems (e.g. ISOLDE 2GeV, HL-LHC)

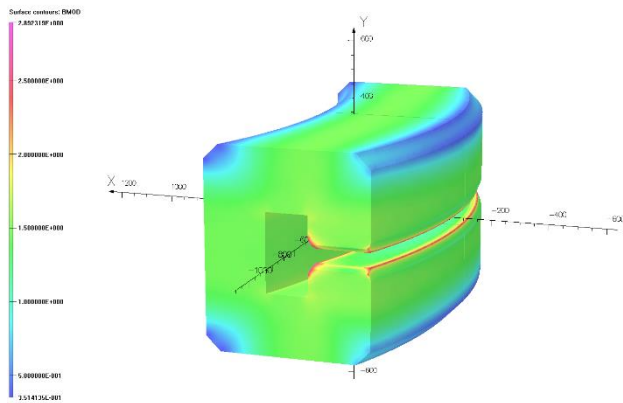
→ construction of new magnets (existing and future accelerators, like FCC-ee)

<https://te-msc-ncm.web.cern.ch/>

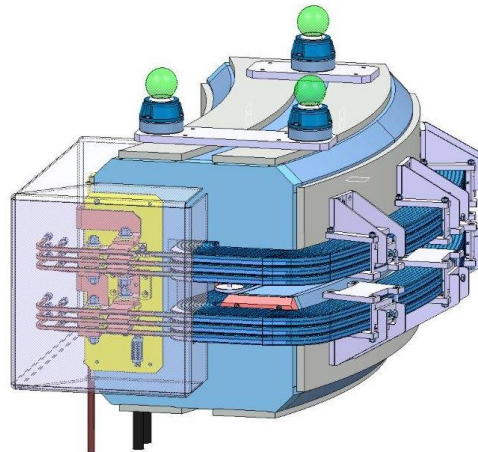
Operation and Maintenance



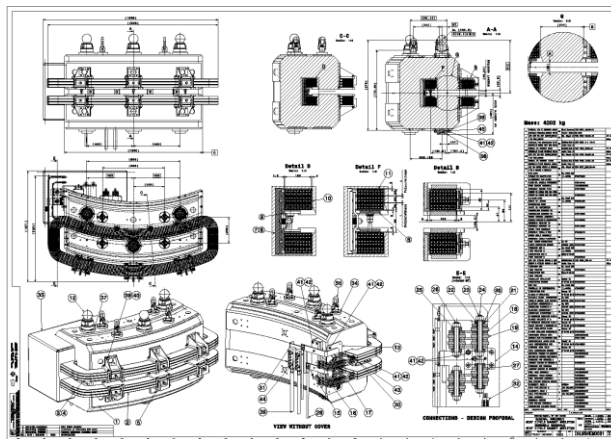
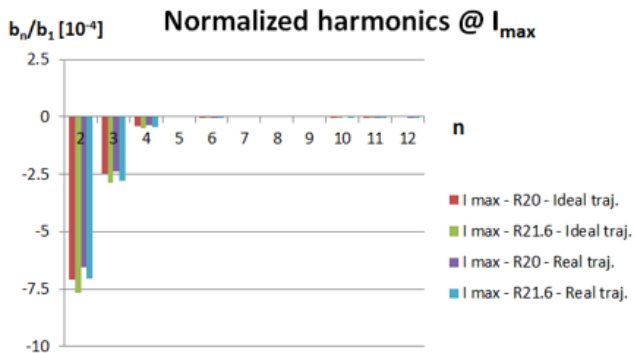
Design and Procurement



Magnetic design



Mechanical design



ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
 CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

EDMS N°: 1288334
HIE-ISOLDE Project Document Ref: HIE-MBHEM-CL0001

Group Code: TE4MSC-MNC
IT-3909 TE HIE-ISOLDE

The HIE-ISOLDE Project

Invitation to Tender

Technical Specification

Beam Transfer Line Dipole Magnets for the HIE-ISOLDE Facility

Abstract

This technical specification concerns the supply of four C-type dipole electromagnets, plus one set of spare coils for the HIE-ISOLDE high energy beam transfer lines. These magnets are made of laminated steel yokes and of water-cooled coils wound from hollow copper wire. Their mass is approximately 4200 kg per magnet. Delivery shall be completed within 14 months after placement of the contract.

June 2013

Specifications for

manufacture;

Production

in house / in industry

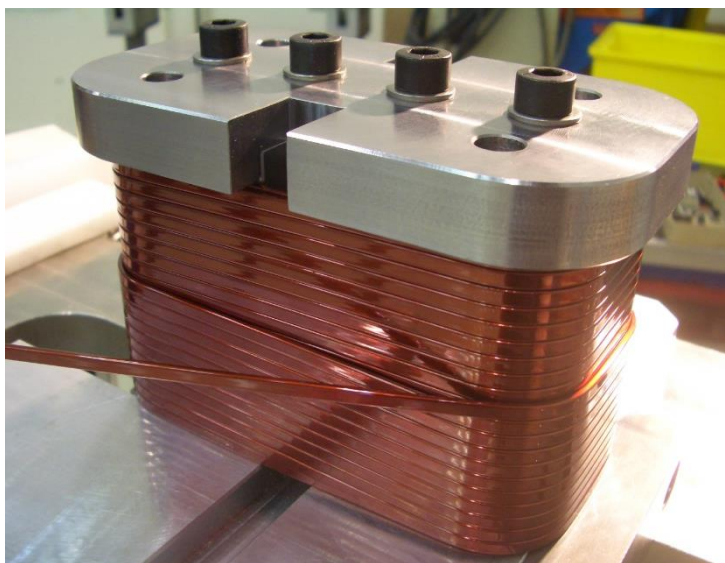
Manufacture and Tests



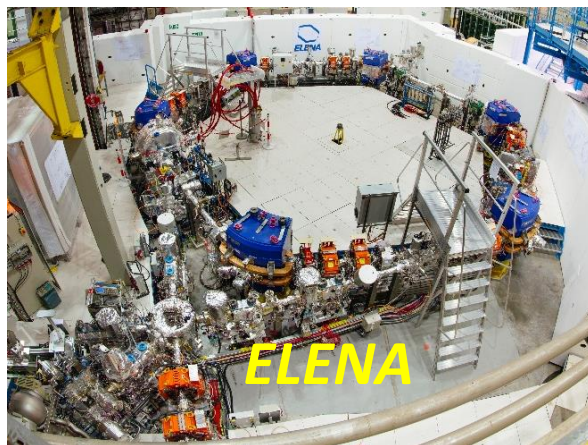
Manufacture



Tests and measurements



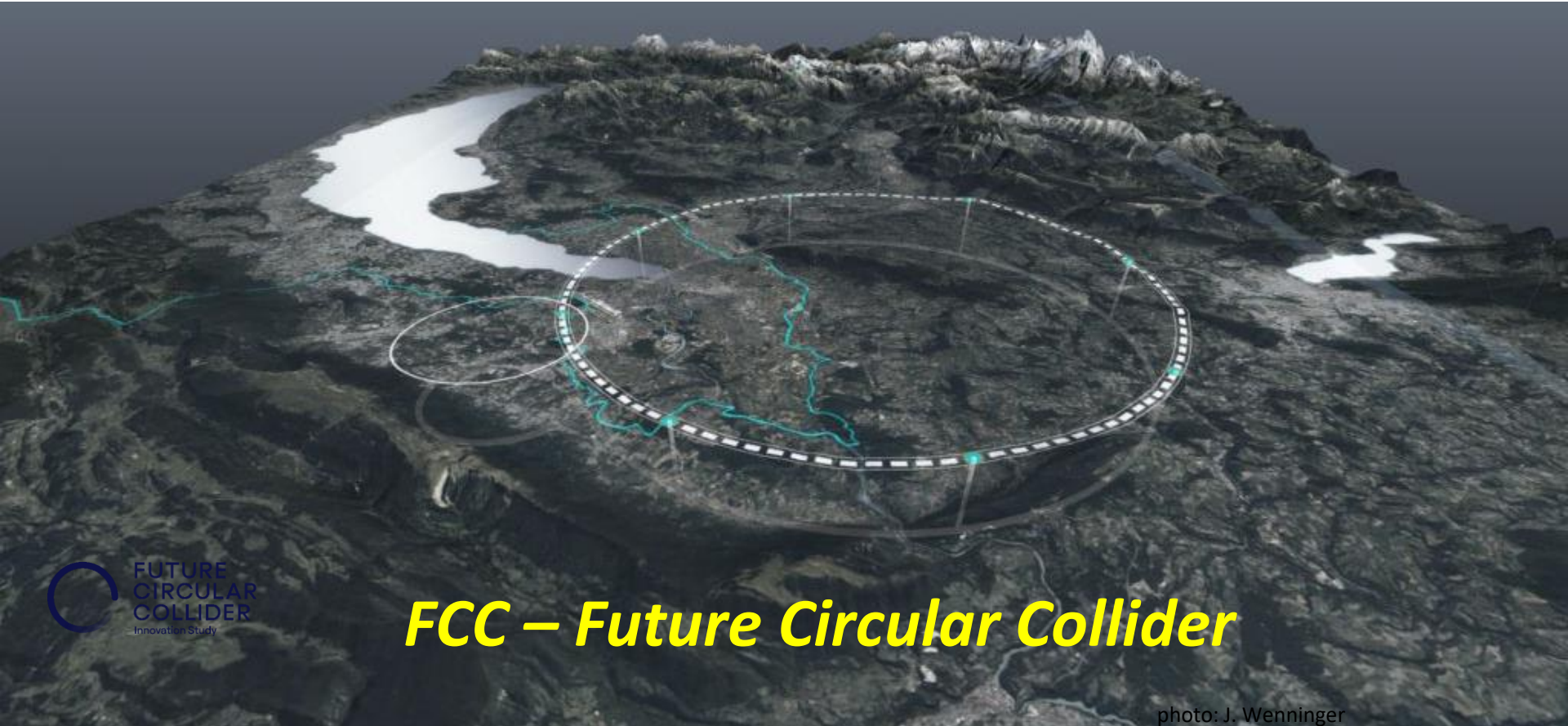
Projects – at CERN



Projects – outside CERN



Projects – The Future

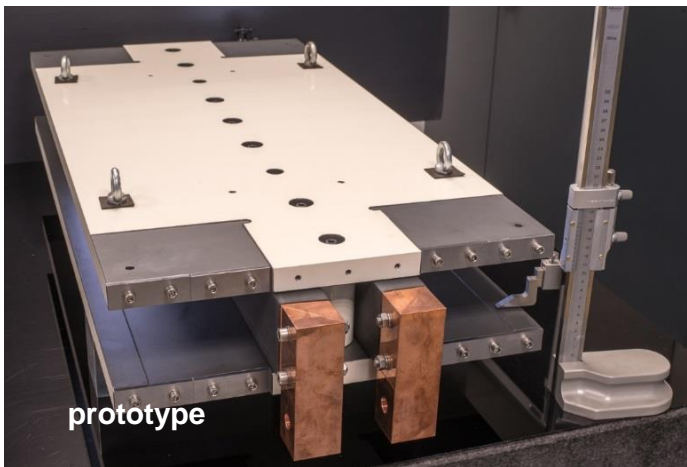
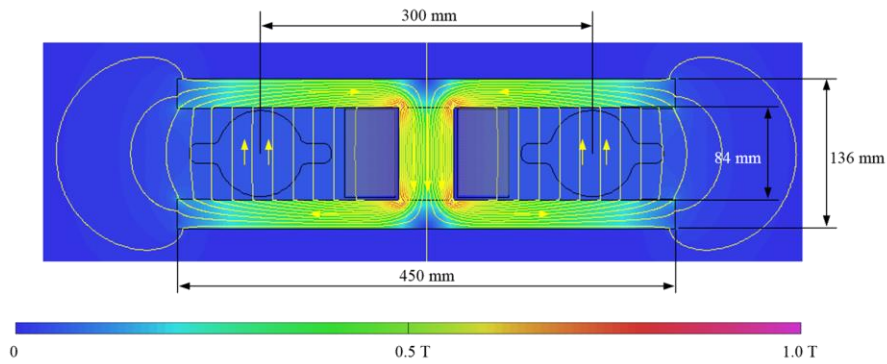


FCC – Future Circular Collider

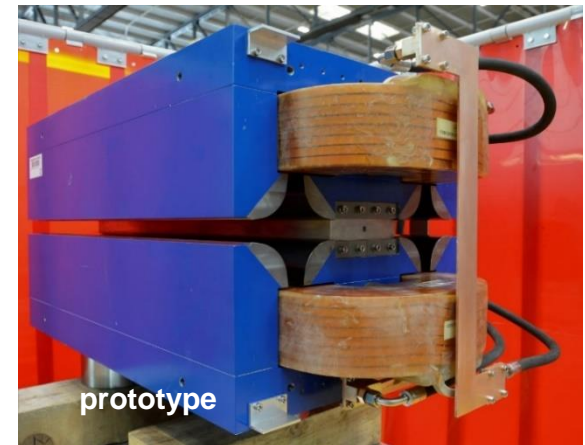
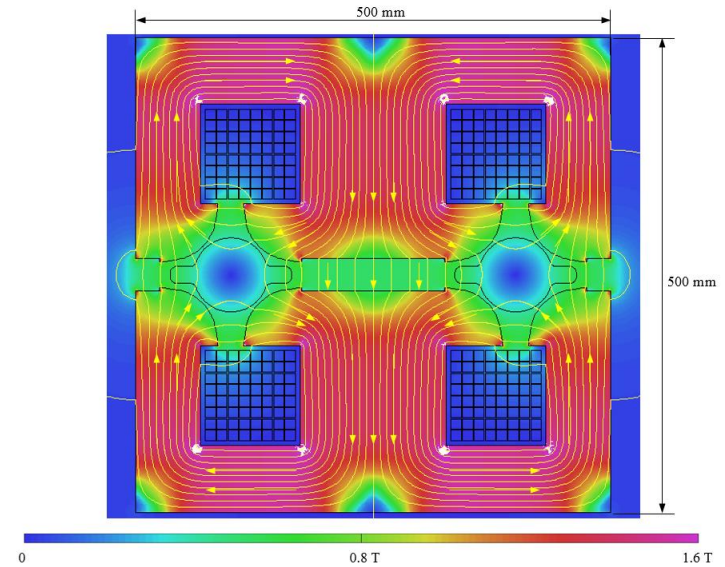
photo: J. Wenninger

<http://cern.ch/fcc>

FCC energy efficient magnets



Twin-aperture dipole



Twin-aperture quadrupole

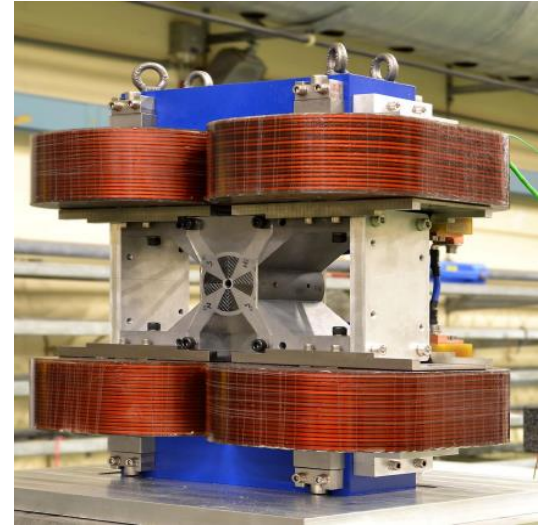
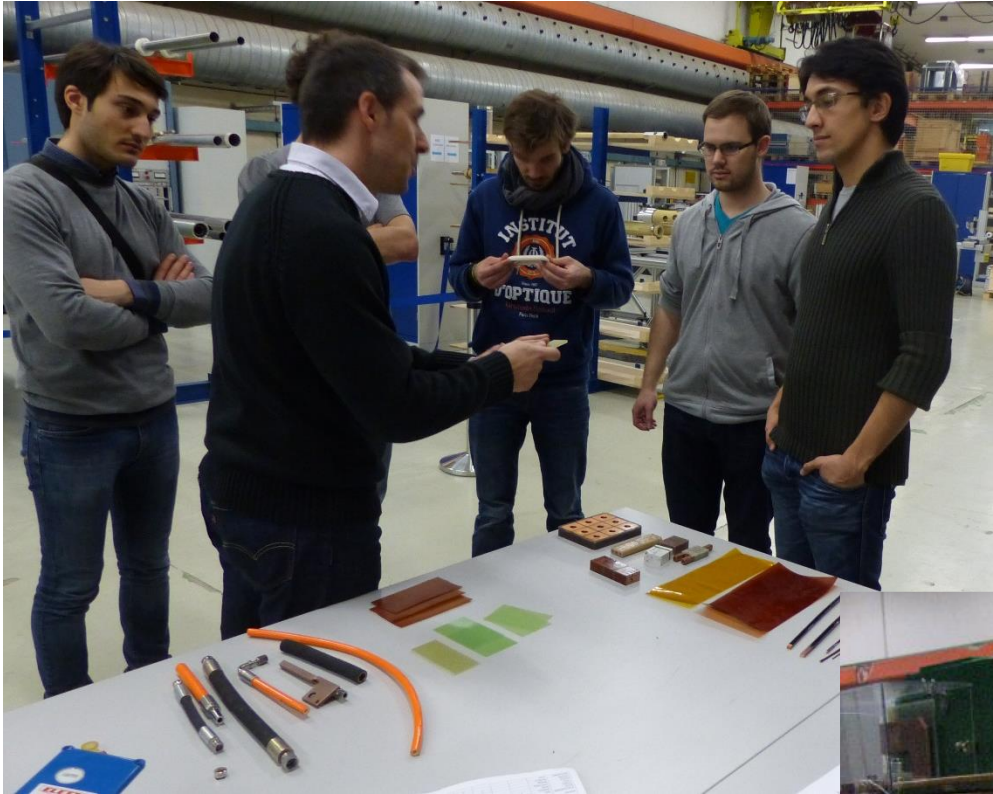
Program and Organization of Practical days

- Up to 12 participants/days, shared in two groups
- Split into two half-day sessions
 - Magnet manufacture and testing
 - Magnetic measurements
- Hands-on practical work in CERN laboratories
- Guided by CERN magnet engineers

Magnet Manufacture and Testing

- Introduction to magnet manufacture (1h)
 - Materials for magnets
 - Magnet components
 - Manufacturing technologies
 - Yoke manufacturing
 - Coil winding and impregnation
 - Testing and measurement techniques
- Practical work in magnet test facility (2h30')
 - Participants will perform tests and measurements on magnets
 - Measurements on systems and apparatus using instruments and formulae learned during the theoretical courses

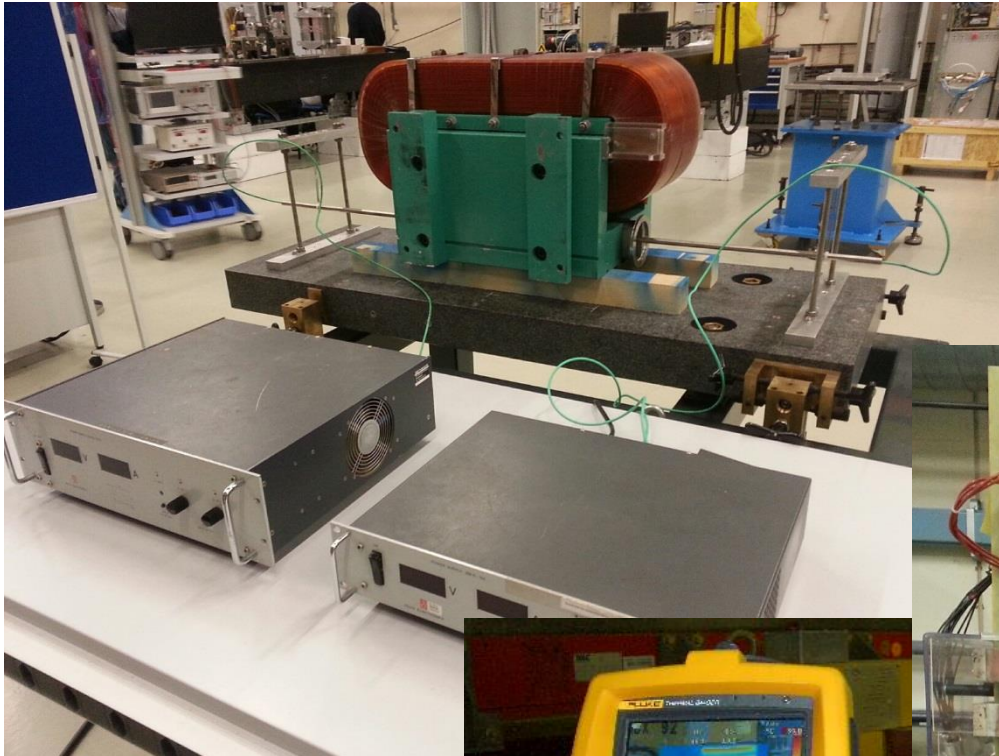
Magnet Manufacture



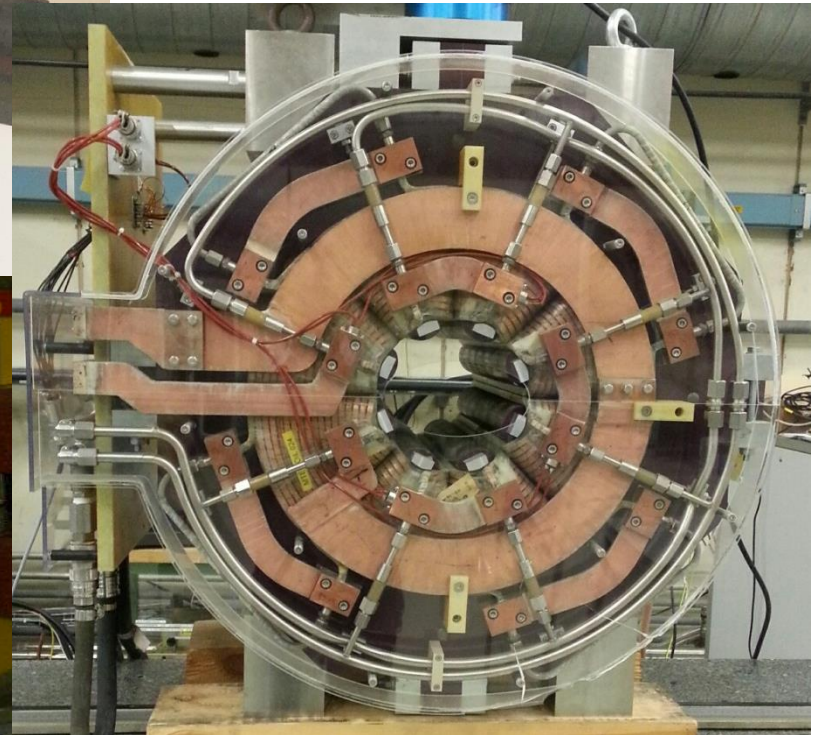
Materials, technologies,
components, manufacturing
processes, and assembly
techniques

Magnet Testing and Practical Applications

Use of analytical formulae and measurements systems to calculate magnet parameters



Testing magnets to assess their functionality and reliability



We are
looking
forward...



...to welcome
you at CERN

... and
unravel the
mysteries of
the magnets

...in a *relaxed* atmosphere!