



CERN Technology Department

Mar CAPEANS
CERN

Spain@CERN

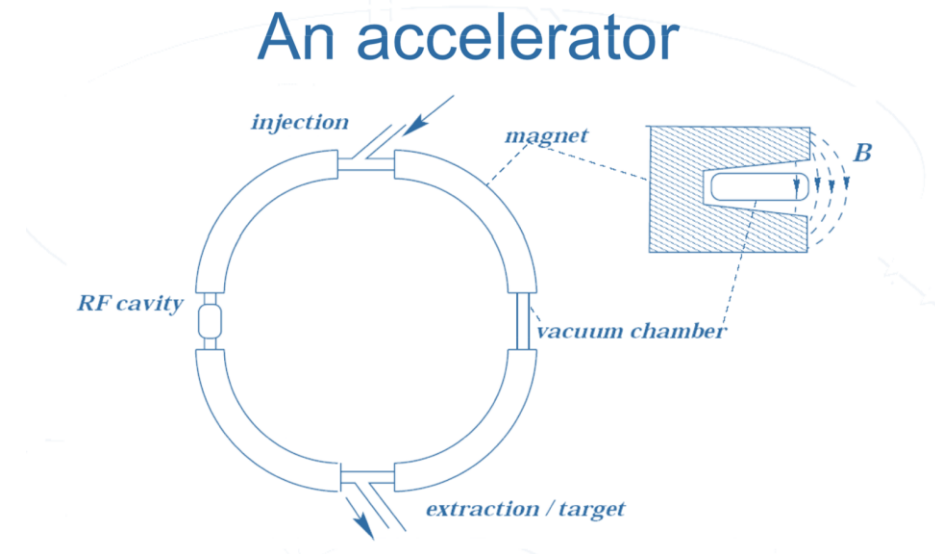
13-14 November 2018

Technology Department Mandate

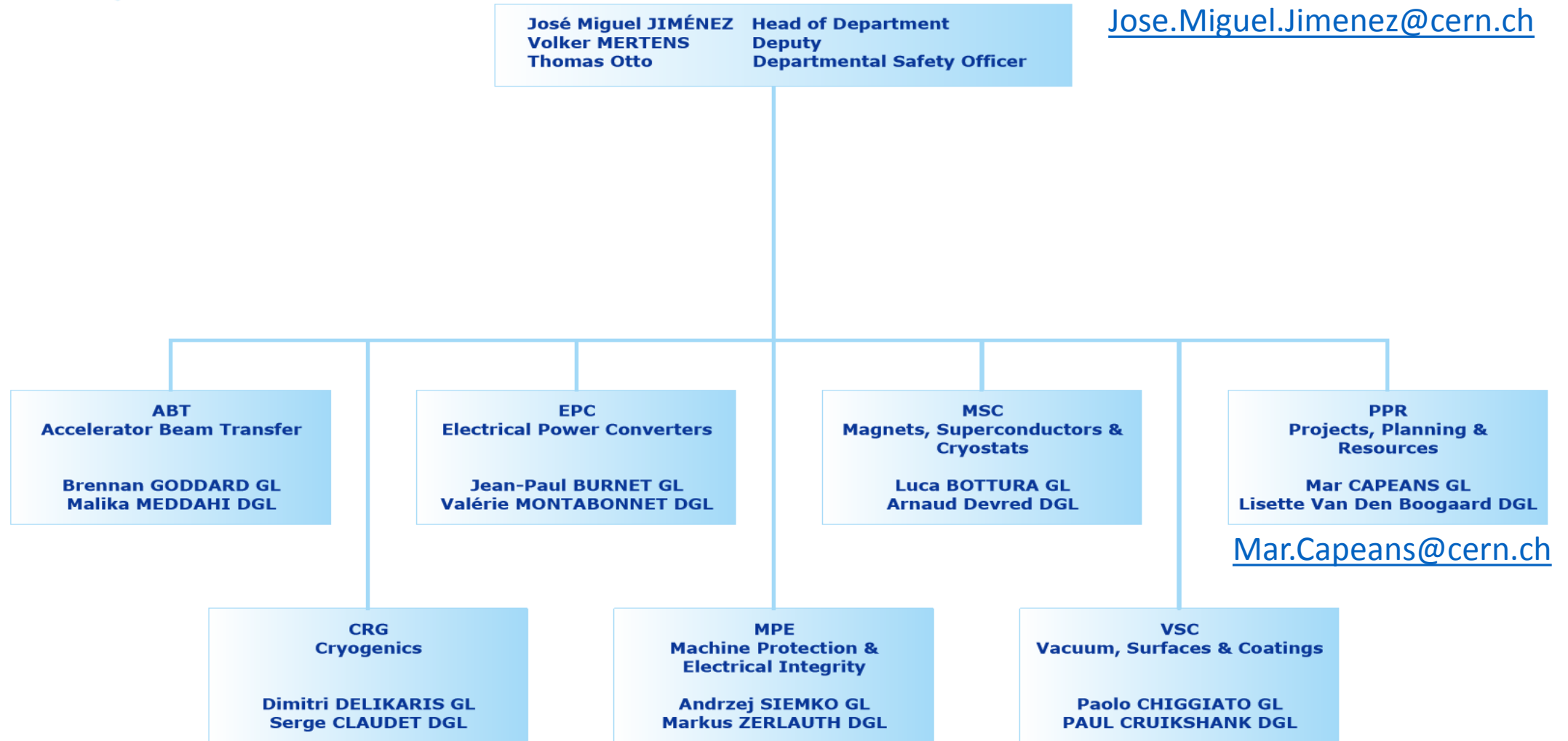
TE Department is responsible for technologies which are specific to existing particle accelerators, technical facilities, and future projects and studies.

The main domains of activities cover:

- Magnets (superconducting, normal conducting) including magnetic measurements
- Fast pulsed magnets, electrostatic and magnetic septa
- High and ultra-high vacuum systems
- Machine protection and electrical integrity
- Power converters and compensators
- Cryogenics
- Coatings, surface treatments and chemistry analysis
- Polymer laboratory

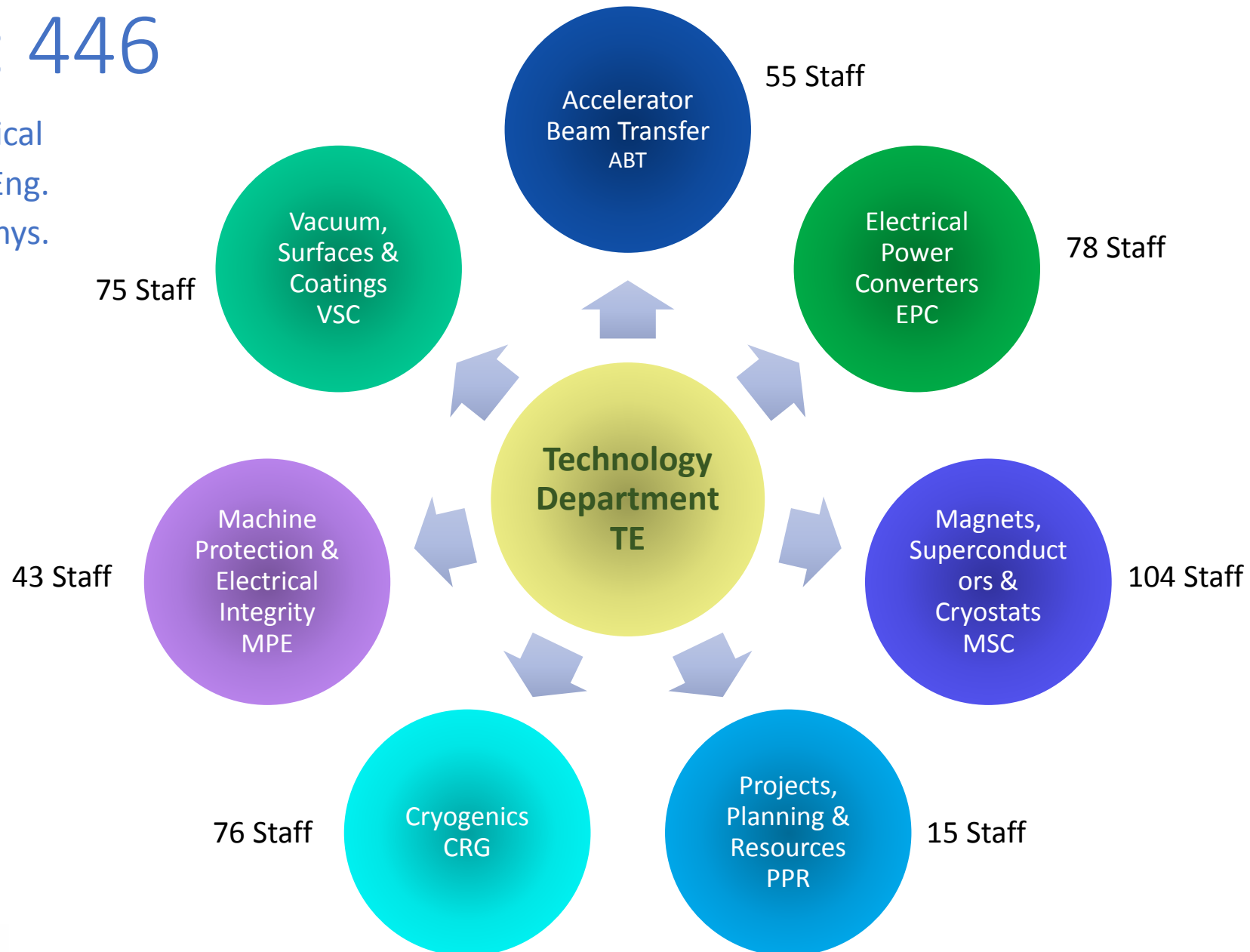


Technology Department Organization



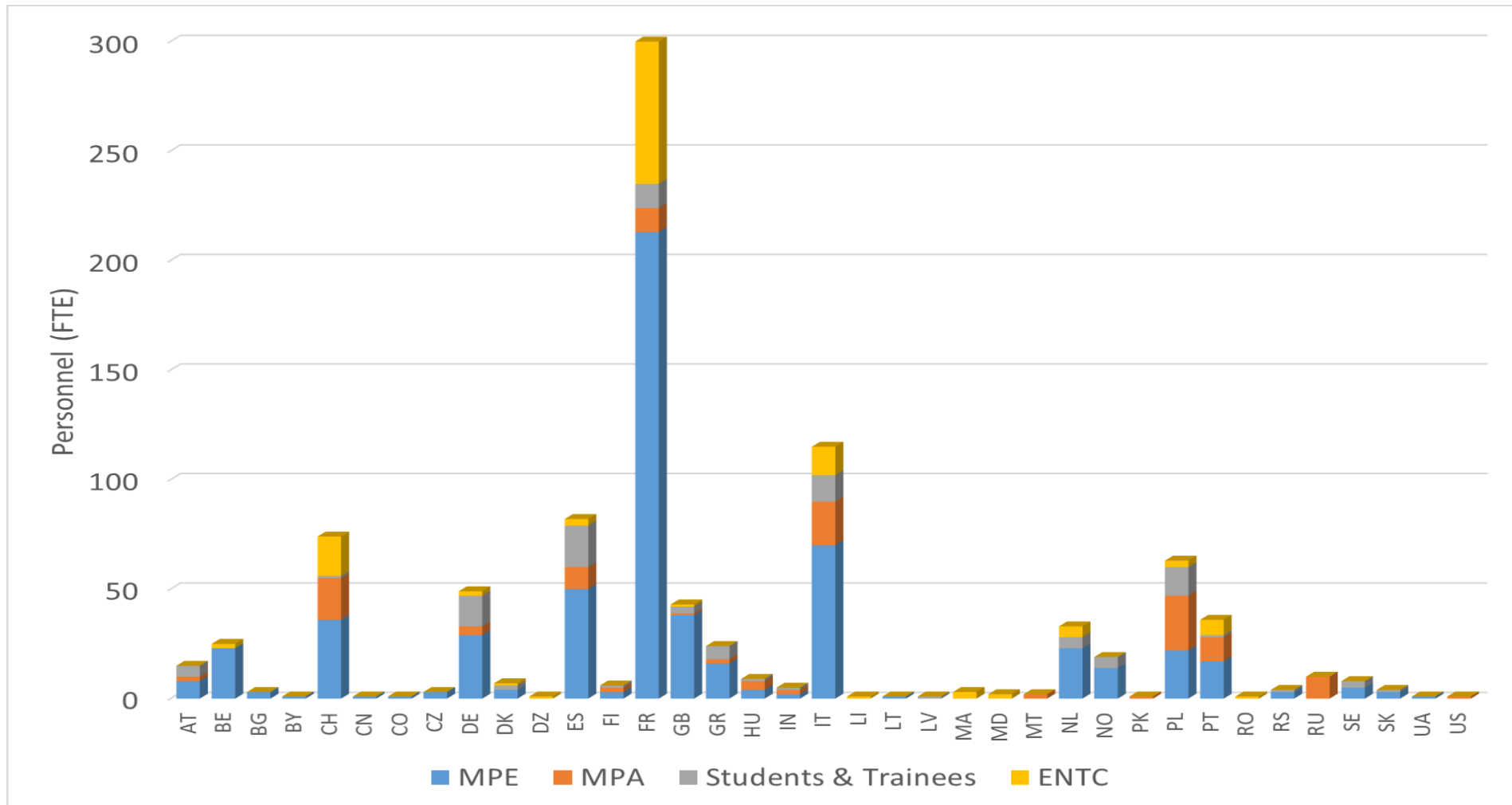
Staff: 446

- 1/3 Technical
- 1/3 Tech-Eng.
- 1/3 Eng-Phys.



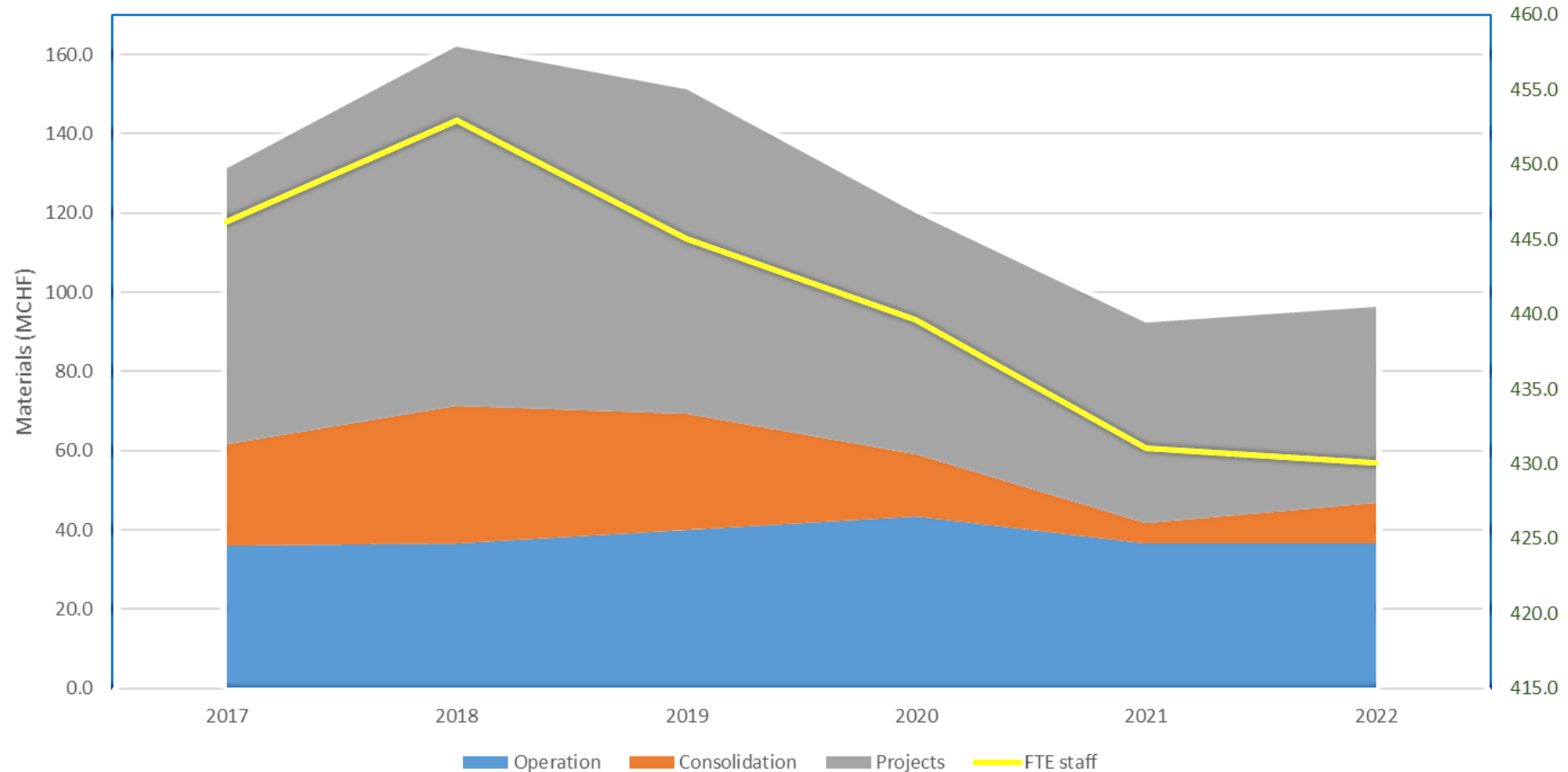
~600 MPE: Staff & Fellows

~135 MPA, 111 Students & Trainees, 407 ENTC



TE: materials and personnel

Materials (MCHF) & staff (FTE) evolution : MTP 2017-2022



Accelerator & Beam Transfer (ABT)

Group Leader: Brennan.Goddard@cern.ch

- **The ABT group is in charge of the design, development, construction, installation, exploitation and maintenance of injection and extraction related equipment:**
 - **Fast pulsed magnets** with associated high voltage pulse generators and transmission lines
 - **Electric field deflectors** and magnetic septa, including HV power supplies for electrostatic septa
 - **Protection devices** and other specialised injection/extraction related systems
 - Associated equipment-level **control systems and software**
- The group conceives, studies and designs injection and extraction processes and systems in the accelerator complex and **beam transfer lines** between accelerators and targets.
- It contributes to **operational follow-up** of beam transfer systems, and is in charge of the commissioning of the LHC transfer lines, injection and beam dumping systems together with their potential upgrades.
- It performs **R&D** on related technologies and also manages external relations with other institutes/labs/universities, teaching/student supervision and dissemination of expertise.

Accelerator & Beam Transfer (ABT)

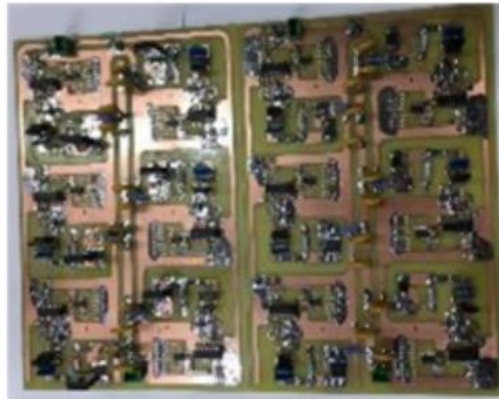
ABT - Pulsed Power Engineering



Cr2O3 coated alumina tube (MKI)



Ferrite ring assembly for MKI upgrade

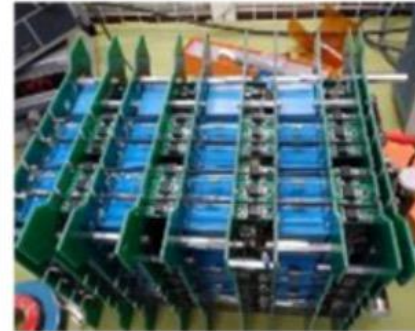


Successful SEB tests for LHC and FCC (CHARM)

Inductive Adder full scale prototype (CLIC)



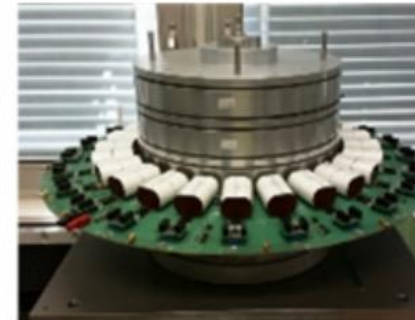
FCC: 1st Prototypes for:



Marx Generator...



New MKD trigger transformer



...and Inductive Adder



2 GeV PS injection kicker

Cryogenics (CRG)

Group Leader: Dimitri.Delikaris@cern.ch

- **The CRG group is responsible of the design, construction, operation & maintenance of cryogenic systems for accelerators and detectors.**
 - Operation, maintenance and upgrade of cryogenic test facilities
 - Support for low-temperature developments and tests at the Central Cryogenic Laboratory
 - Consultancy and support in cryogenic design and cryogenic instrumentation
 - Supply of cryogenic fluids on the CERN site



Electrical Power Converters (EPC)

Group Leader: Jean-Paul.Burnet@cern.ch

- The TE-EPC group is in charge of the design, development, procurement, construction, installation, operation and maintenance of **electrical power systems for all accelerators, transfer lines, experimental areas and tests facilities at CERN.**
 - Power converters for normal conducting and superconducting magnets
 - Solid state klystron modulators
 - Static VAR compensators
- The group provides expertise in the fields of power electronics, power quality, analogue and digital electronics, control system, high-precision current and voltage measurements.

Electrical Power Converters (EPC)

Production of 60 converters 6kA

Production of 152 converters 600A

Production of 2752 Output filters and 2752 HF Transformers



Production of 100 Earth modules and 100 Aux PSU modules



Market Survey started for the production of 342 Input Modules and 684 Output Modules



Electrical Power Converters (EPC)

Magnetics Production

Production of 2752 filters and 2752 HF-transformers

For new 4-6-8kA LHC power converters (R2E)

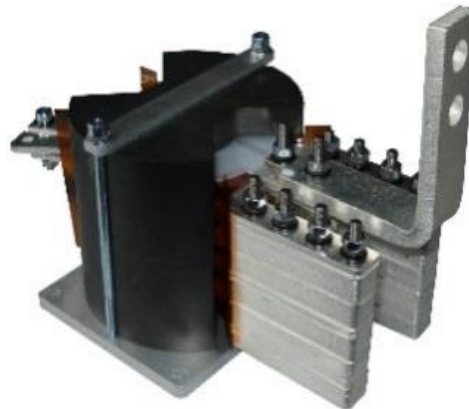
IT-4336 – 1.7MCHF



<https://www.tryo.es/rymsarf/>



Output Filter



Transformer



Electrical Power Converters (EPC)

Power Supply Production

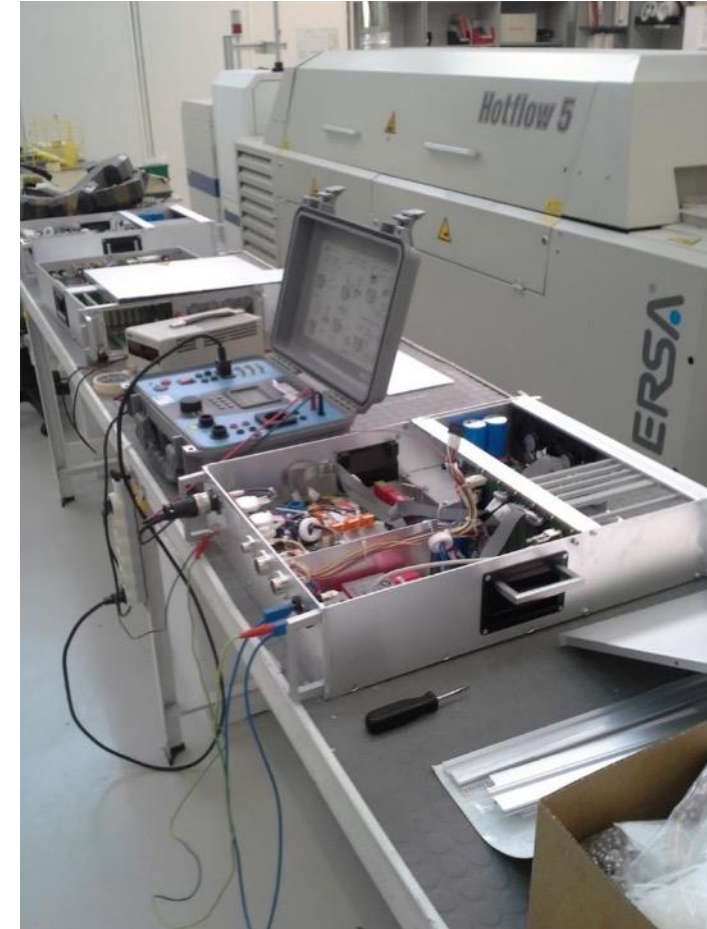
Production of 139 MACAO power supplies

For SPS orbit corrector consolidation

IT-4237/TE – 375kCHF



<http://www.inabensa.com>



Electrical Power Converters (EPC)

Container production

Production of 2 special containers for POPS with mechanical and electrical installation

DO-30160/TE – 217k€



<http://www.proinsener.com/>



Machine Protection & Electrical Integrity (MPE)

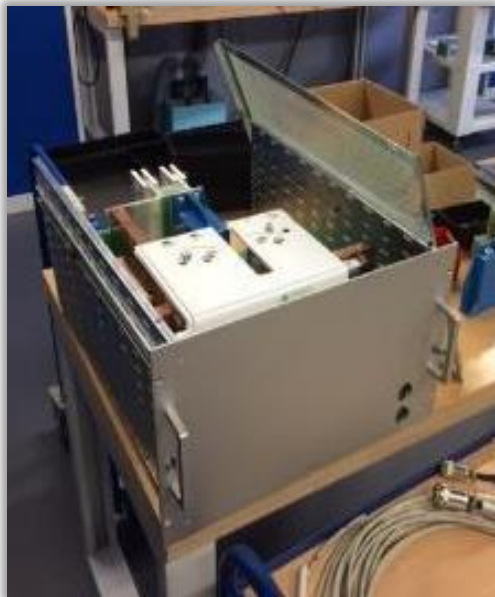
Group Leader: Andrzej.Siemko@cern.ch

- **Support LHC operation and maintain state-of-the art technology for magnet circuit protection and interlock systems CERN-wide.**
 - Responsibility for the electrical integrity of magnet circuits
 - Coordination of LHC protection systems (HC) and magnet circuit performance evaluation
 - Electrical quality assurance (ELQA) during magnet interconnections and HC as well as for electrical diagnostics and interventions during operation
 - Magnet protection system and machine interlocks for the CERN accelerator complex, during design, construction and exploitation
 - Functional operation of DFBs, DLSs and their auxiliary equipment
 - Specific studies related to machine protection for topics that go across different systems
- Provide a CERN central service for electronics modules including fine pitch detector specific technologies. Make available expertise where CERN is at the forefront.

Machine Protection & Electrical Integrity (MPE)

Next generation of Energy Extraction systems

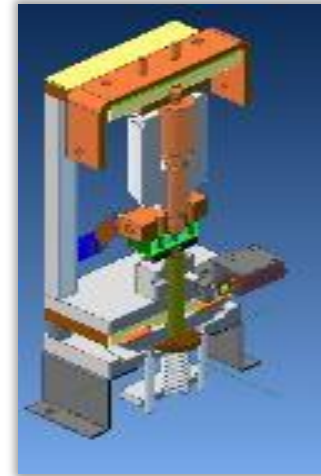
- 2 kA and 600 A Energy Extraction systems using vacuum switches
- 1 kA and 2 kA Energy Extraction systems using IGBT switches



The first 1kA IGBT module



The rack with busbars and cooling water pipes



Vacuum Interrupters



Two vacuum breaker sliding cassettes

Magnets, Superconductors and Cryostats (MSC)

Group Leader: Luca.Bottura@cern.ch

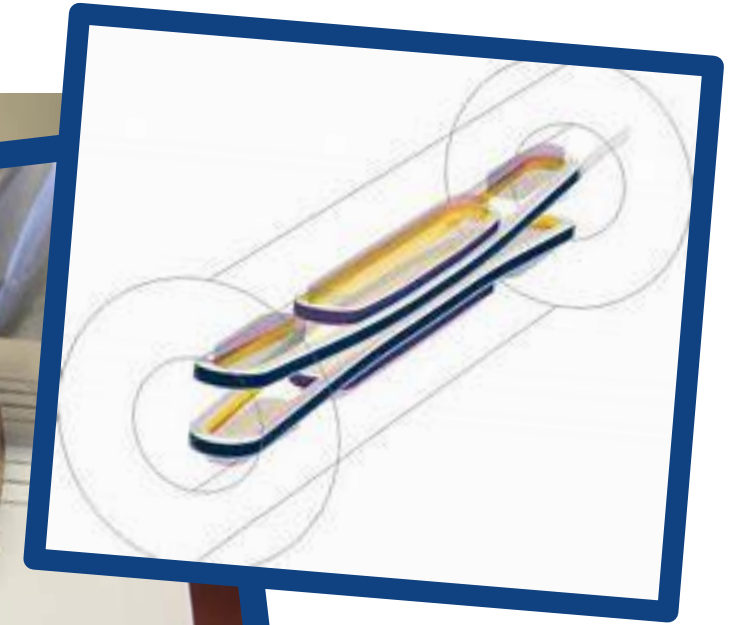
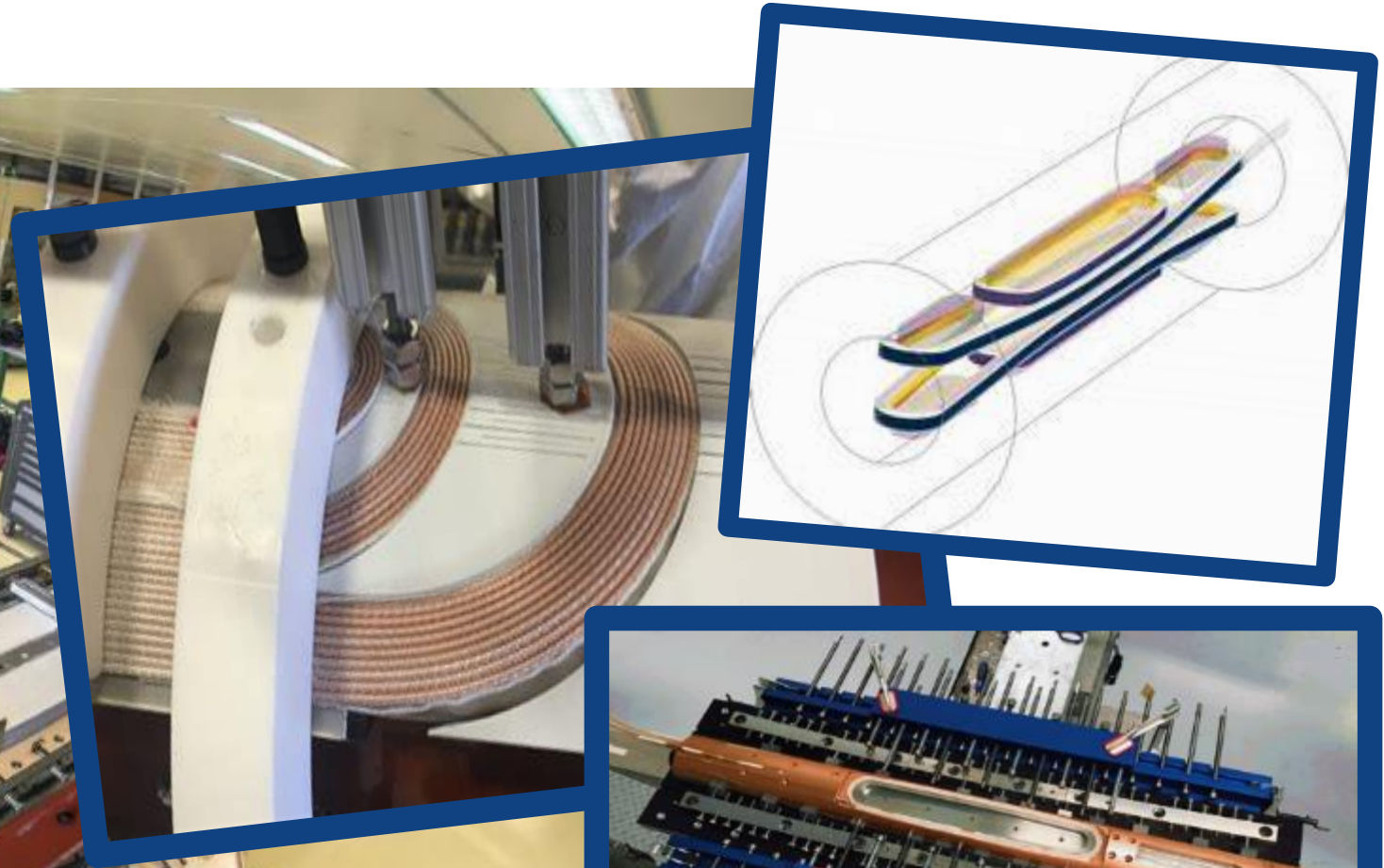
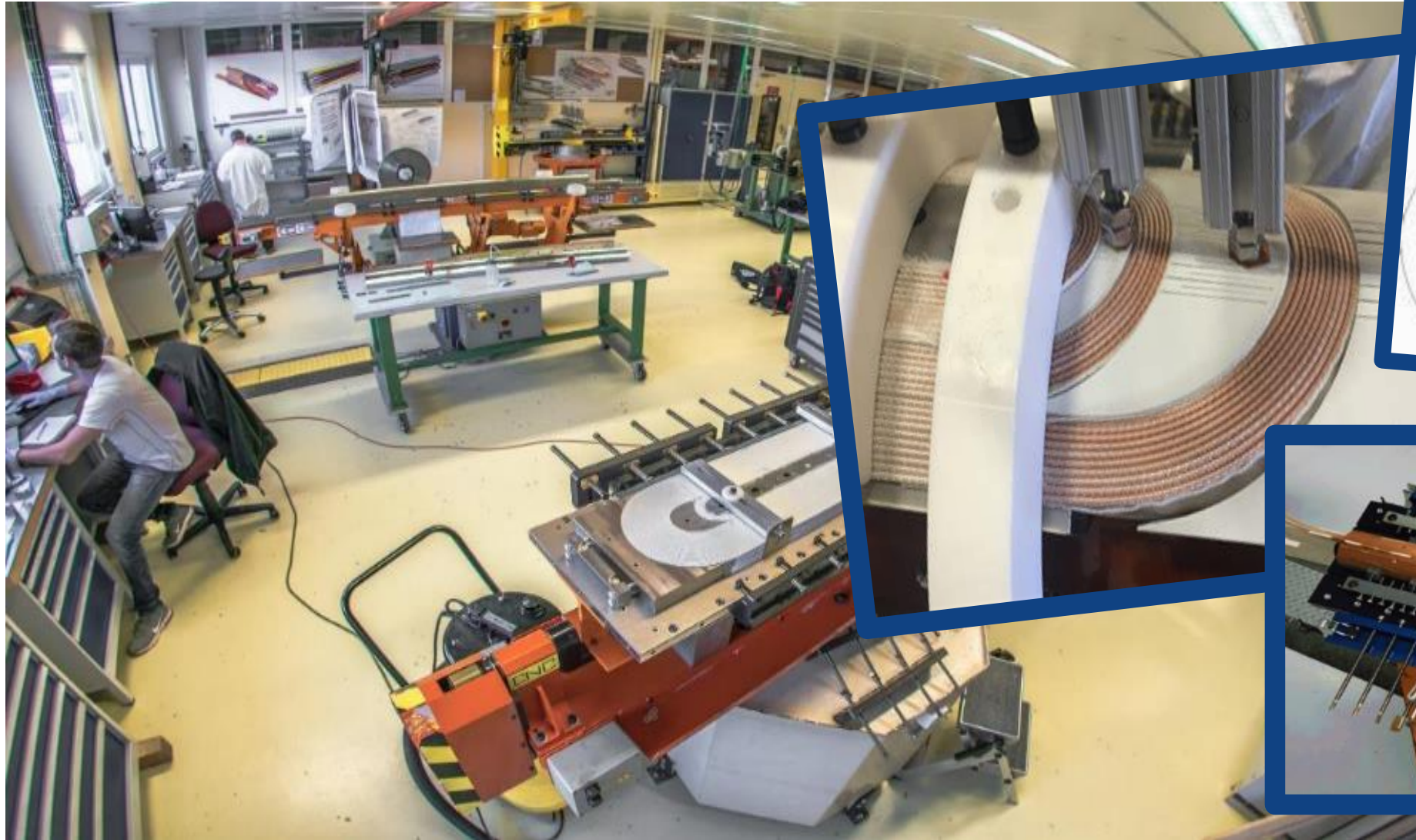
- Design, construction and measurements of **superconducting and normal conducting Magnets** for the CERN accelerator complex
- Integration in the CERN accelerator complex, magnet cryostats and magnet quality control
- Support to operation of the accelerators for magnets, magnet performance, devices (current leads)
- Development of associated technologies, namely superconductors, insulation and polymers, superconducting electrical devices and magnetic measurements for present and future accelerators

Magnets, Superconductors and Cryostats (MSC)



Magnets, Superconductors and Cryostats (MSC)

First steps towards 16T and beyond

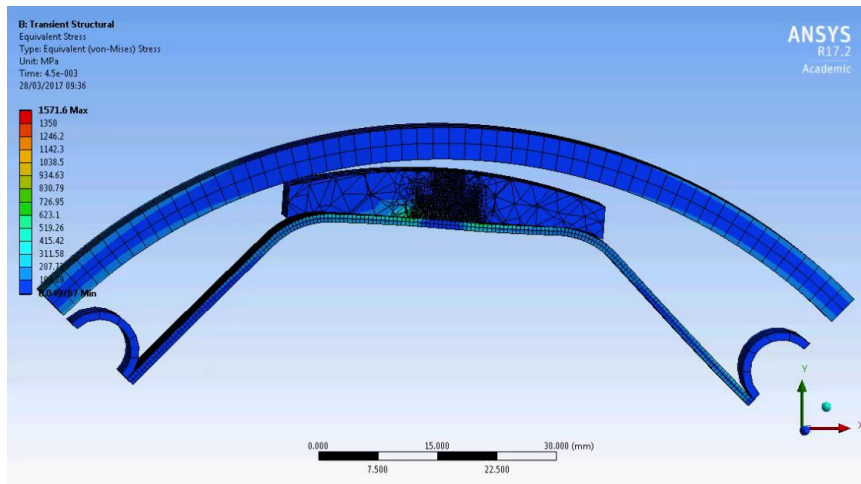
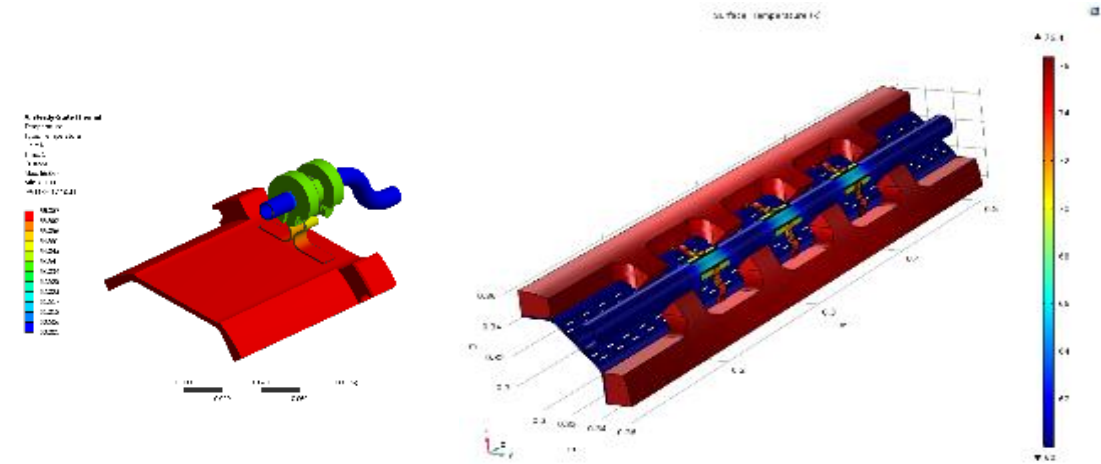
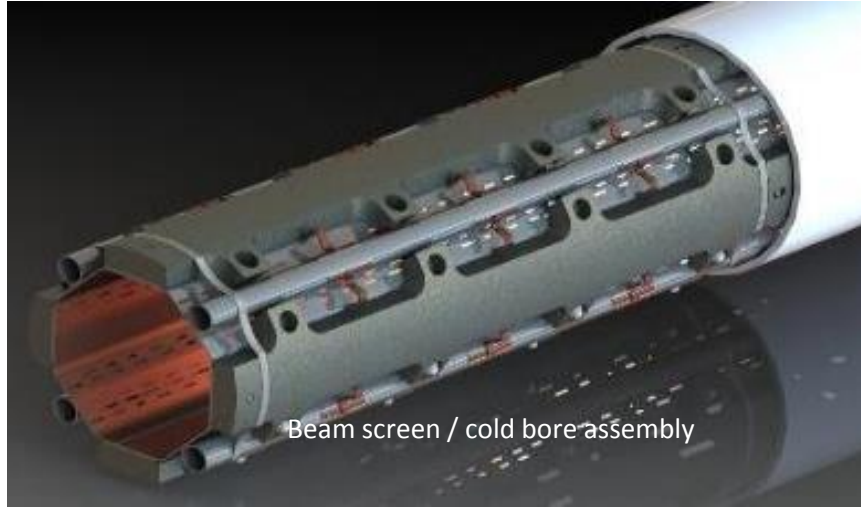


Vacuum, Surfaces and Coatings (VSC)

Group Leader: Paolo.Chiggiato@cern.ch

- **Design, construction, operation, maintenance and upgrade of high & ultra-high vacuum systems for Accelerators and Detectors**
 - Expertise and support on thin-walled vacuum chambers, windows and bellows compensation systems
 - Expertise in vacuum sealing and leak-tightness technology
 - Expertise in dynamic vacuum phenomena
 - Management of the industrial support contract for vacuum work in accelerators
 - Expertise in vacuum control systems, vacuum interlocks and monitoring tools
- **Coatings, surfaces treatments, surface and chemical analysis for Accelerators and Detectors**
 - Coatings, electroplating and surface cleaning techniques
 - UHV characterization and of material and surfaces
 - Degassing analysis and treatments

Vacuum, Surfaces and Coatings (VSC)



Prototyping and testing

TE Infrastructures

Group	Service
ABT	<ul style="list-style-type: none"> • Access to specialized infrastructure: clean room
EPC	<ul style="list-style-type: none"> • Qualification of industrial electrical equipment (PSU Lab) • Power converters rental
CRG	<ul style="list-style-type: none"> • Cryogenic test facilities from 120 K to mK temperatures • Low temperature material property tests: thermal conductivity, RRR, Tc, Splice resistance, Dilatation
MPE	<ul style="list-style-type: none"> • Design, manufacturing assembly electronic circuit boards • Electronics WS for repair of radioactive equipment
MSC	<ul style="list-style-type: none"> • Magnetic measurements • Polymer Lab • High Voltage Lab • Access to SM18 Facility
VSC	<ul style="list-style-type: none"> • Electroplating, surface cleaning techniques, chemical characterization, vacuum firing • Coatings • Heat treatments for outgassing • UHV characterization of materials • Gas permeability test stands



CERN SM18

Opportunities

- The solutions and **main industrial partners are identified early** in the development cycle, as they provide the basis for a technical evaluation, costs, schedule, risk analysis
- From a national perspective it is important that researchers and industries **work together** –and with international partners– to establish competitive expertise and construction capabilities
- The **early (R&D) stages are also a very productive** phase for involvement, providing basis for later spin-off and also international exposure and competition
- Many of the **spin-offs** and educational/training aspects will be there whether the specific technology and industry are/are not chosen for a final implementation
- R&D for world class instrumentation involving Spanish industry should be a priority for national funding at early stages

Bonus

144 Fellows
111 Students
135 Associates

