



**CERN**

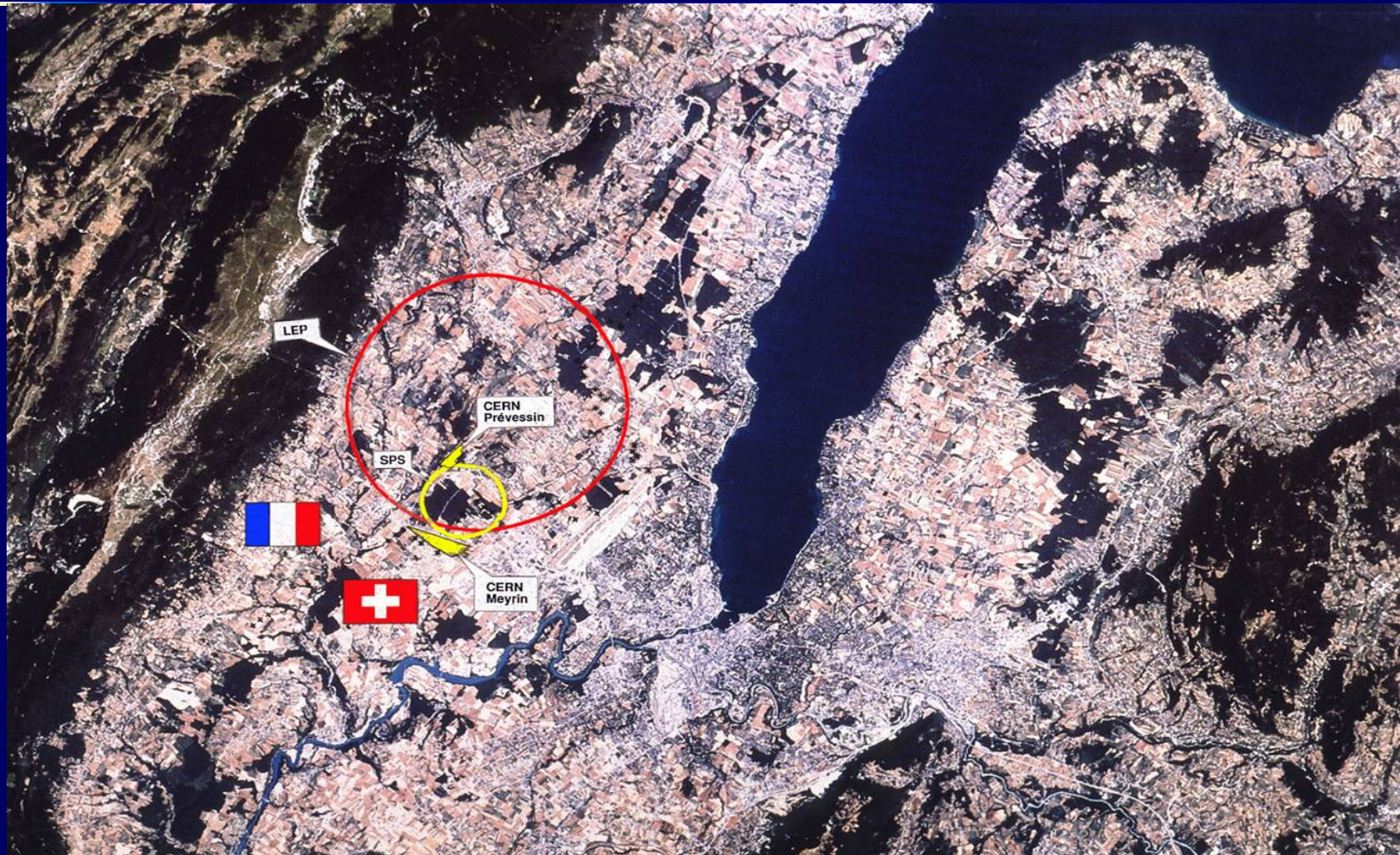
**European Organization for Nuclear Research**

**Dr. Sorin Ilie, Dr. Diana Ilie, Prof. Radu Setnescu**



# CERN

European Organization for Nuclear Research







# CERN

## European Organization for Nuclear Research



### What is CERN?

CERN is the European Organization for Nuclear Research, the world's largest particle physics centre.

Here physicists come to explore what matter is made of and what forces hold it together.

Founded in 1954, the laboratory was one of Europe's first joint ventures and includes now 20 Member States.

Size: 490ha F, 112ha CH

Budget : 1280 MCHF (~825MEuros)



2007: 20 Member States:

A, B, BG, CH, CK, D,  
DK, E, F, GB, GR, H,  
I, N, NL, PL, P, S, SF,  
SK.

### The Twenty Member States of CERN



Member States (Dates of Accession)

AUSTRIA (1959)	DENMARK (1952)	GREECE (1952)	NORWAY (1952)	SPAIN (1/1963, 12/1968, 1/1985)
BELGIUM (1953)	ENGLAND (1993)	HUNGARY (1992)	POLAND (1991)	SWEDEN (1992)
BULGARIA (1991)	FRANCE (1953)	ITALY (1953)	PORTUGAL (1984)	SWITZERLAND (1953)
CZECHIA (1993)	GERMANY (1953)	NETHERLANDS (1953)	SLOVAKIA (1993)	UNITED KINGDOM (1953)



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### Who works there?

CERN employs representatives of a wide range of skills - physicists, engineers, technicians, craftsmen, administrators, secretaries, workmen,...

**Staff members: ~2550:**  
~81 physicists in research  
~977 engineers  
~862 technicians  
~427 clerks and administratives  
~203 hand workers

**Fellows: 215**  
**Scientific associates : 293**  
**Users: ~ 6200**  
coming from 483 institutes  
and universities with 80 nationalities

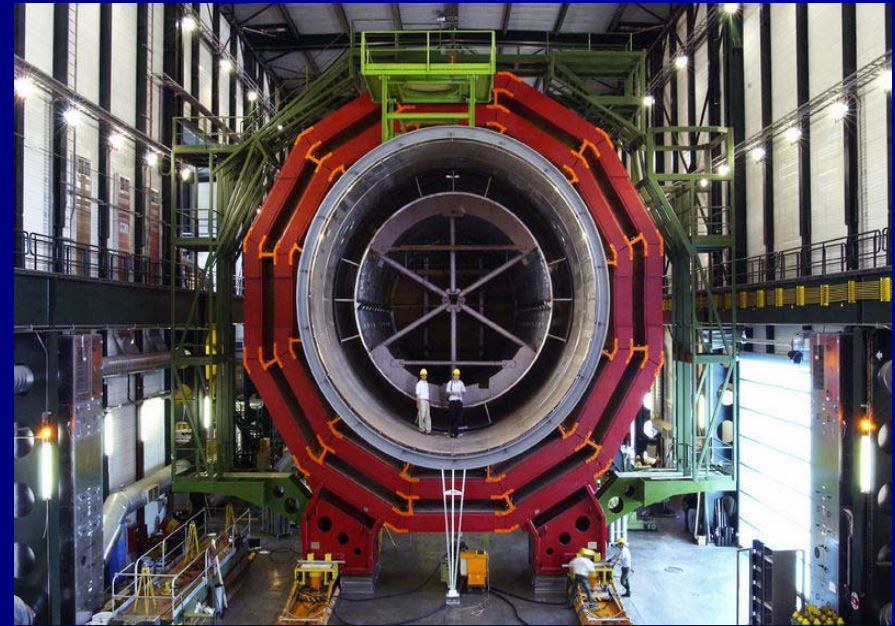
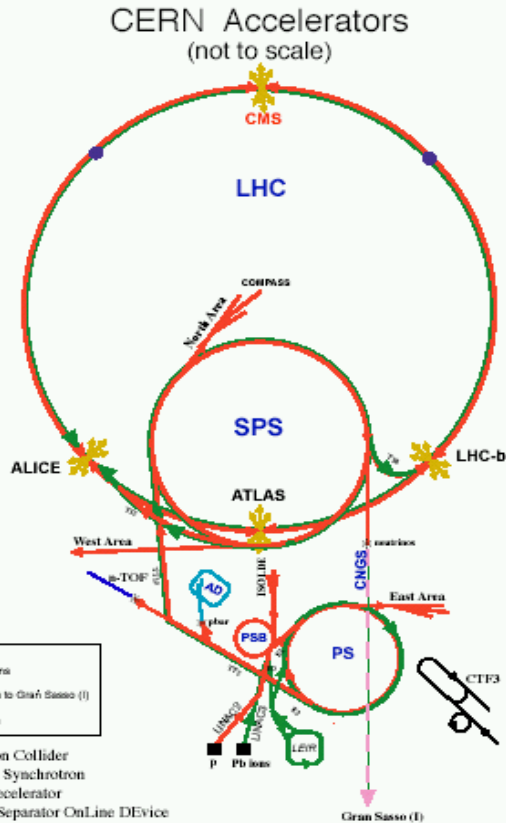
And about 2000 peoples from external enterprises



# CERN

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CERN exists primarily to provide the users with the necessary tools. These are accelerators, which accelerate particles to almost the speed of light, detectors to make the particles visible and computers for simulations, controls and analysis

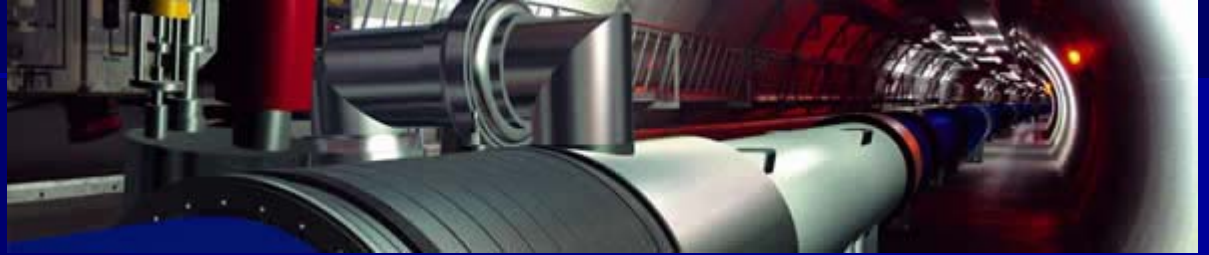






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## What's next at CERN?

In the world of particle physics, higher energy is one of the key word to allow further discoveries. What's the origin of the mass of particles? Are neutrinos really mass less?

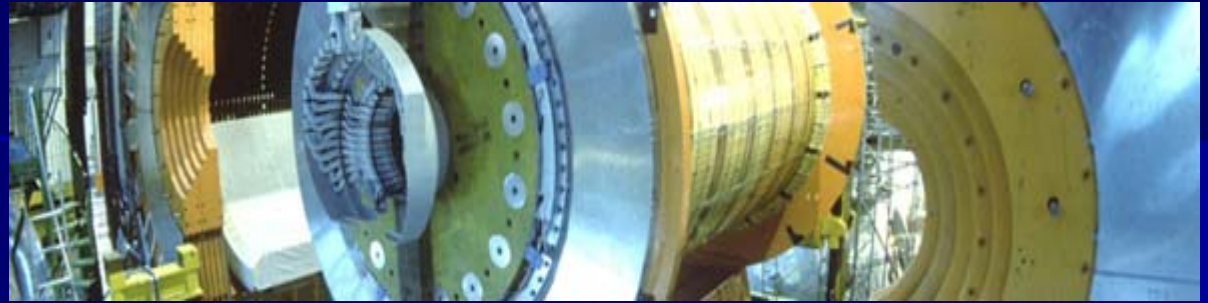
The Large Hadron Collider (LHC) will be the most powerful instrument ever built to investigate on particles proprieties.

On the quest for neutrinos mass, CERN Neutrino to Gran Sasso (CNGS) project will send a beam of high-energy neutrinos from CERN to the Italian Gran Sasso Laboratory, 730 km away through the Earth.



# CERN

## The LHC Project



### The LHC Project

The Large Hadron Collider (LHC), installed in a 27 km tunnel, is a particle accelerator which will probe deeper into matter than ever before. Due to switch on in 2008, it will ultimately collide beams of protons at an energy of 14 TeV . Beams of lead nuclei will be also accelerated, smashing together with a collision energy of 1150 TeV.

Some numbers:

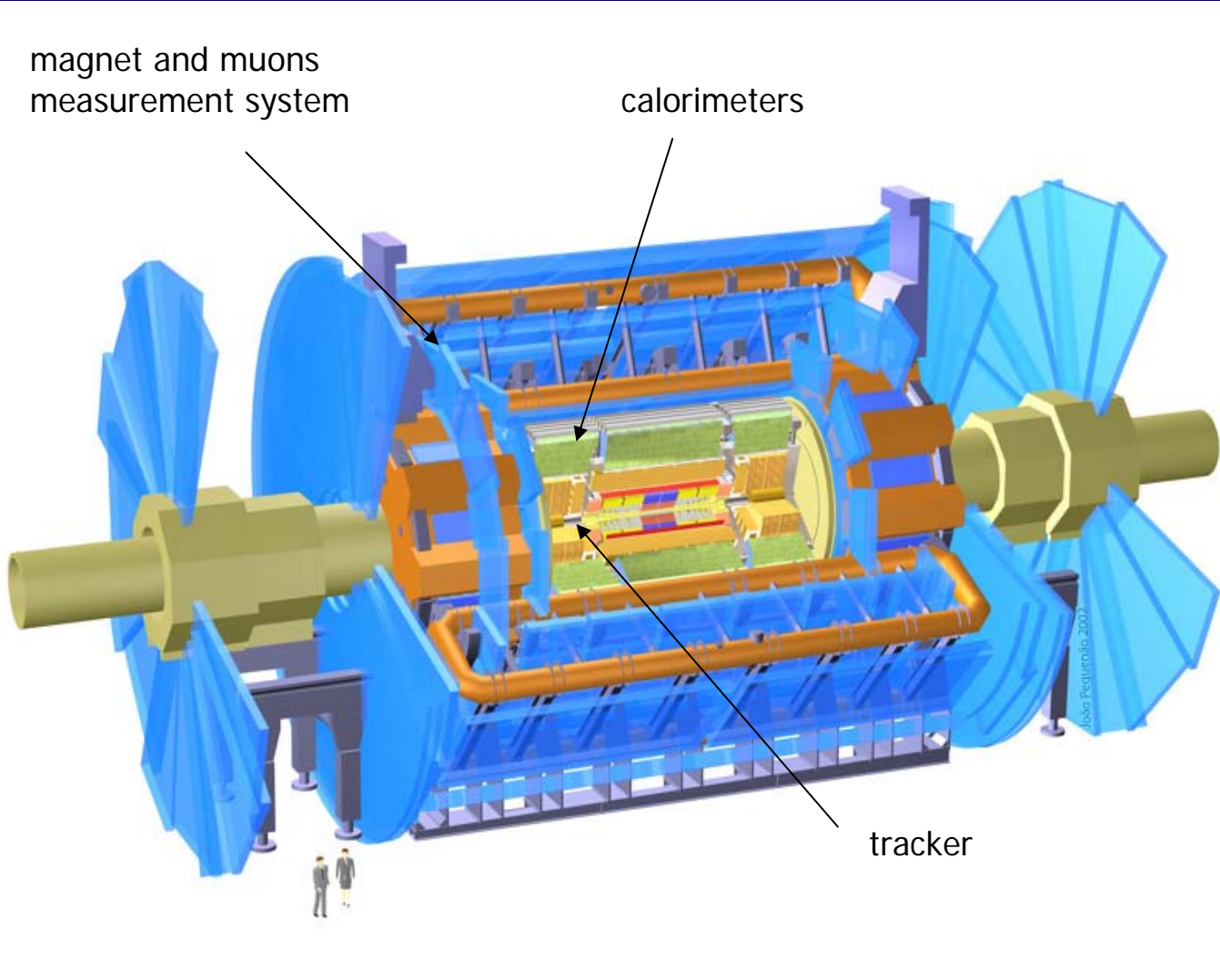
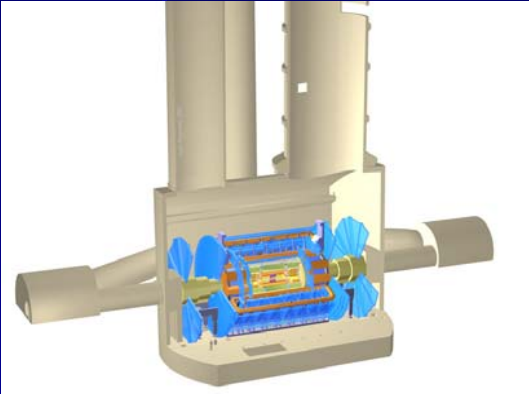
- ~ 5,000 LHC superconducting magnets, thereof 1,296 LHC dipoles (15m long each);
- ~ LHC cryogenics will need 40,000 leak-tight pipe junctions;
- ~ 12 million liters of liquid nitrogen will be vaporized during the initial cool down of 31,000 tons of material and the total inventory of liquid helium will be 700,000 liters.





# ATLAS

A generic LHC experiment

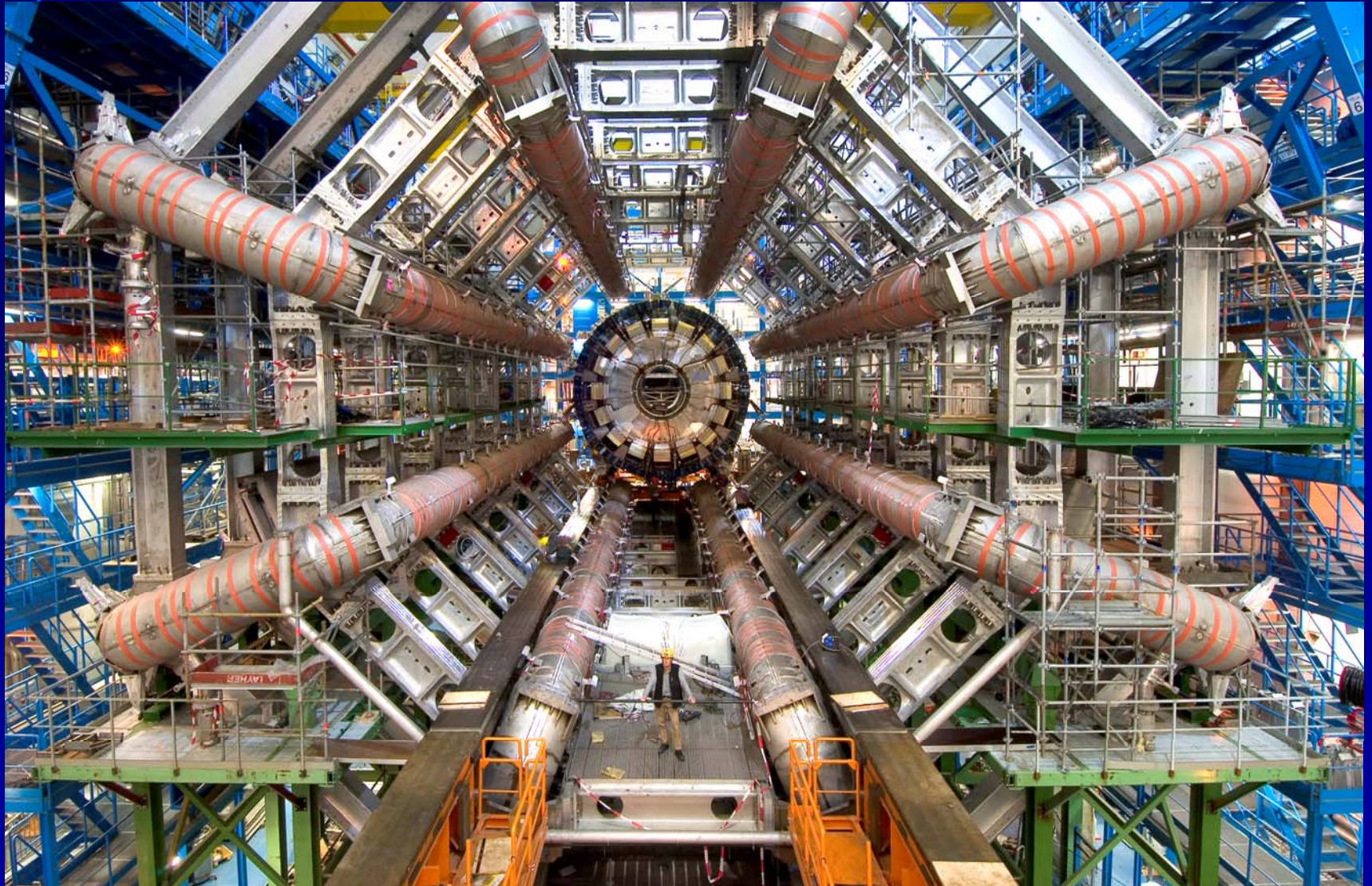






# ATLAS

A generic LHC experiment

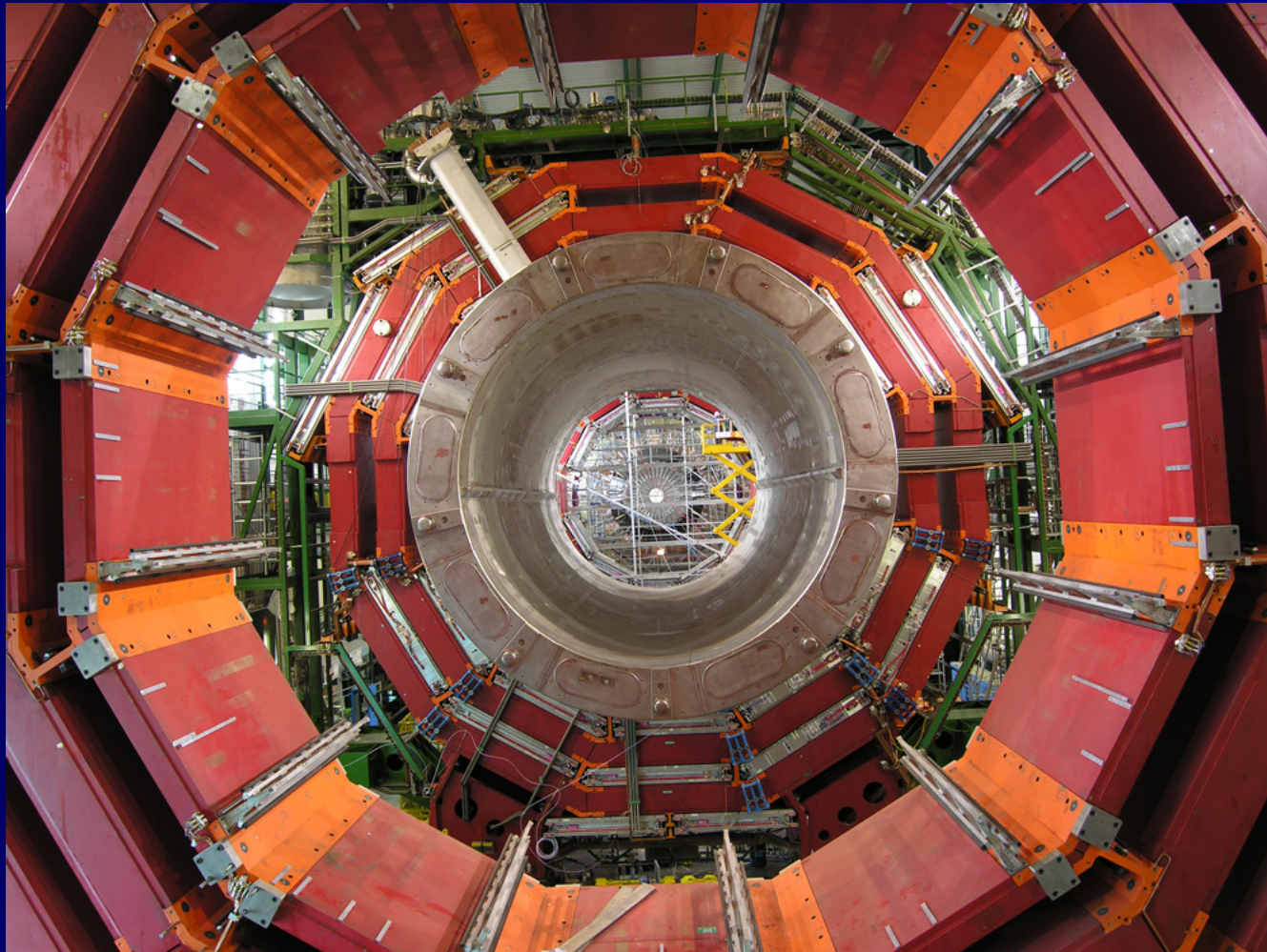
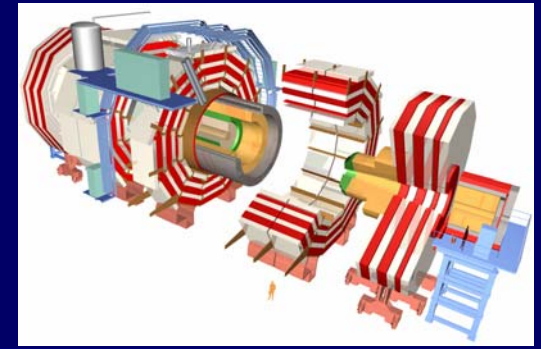






# CMS

A generic LHC experiment



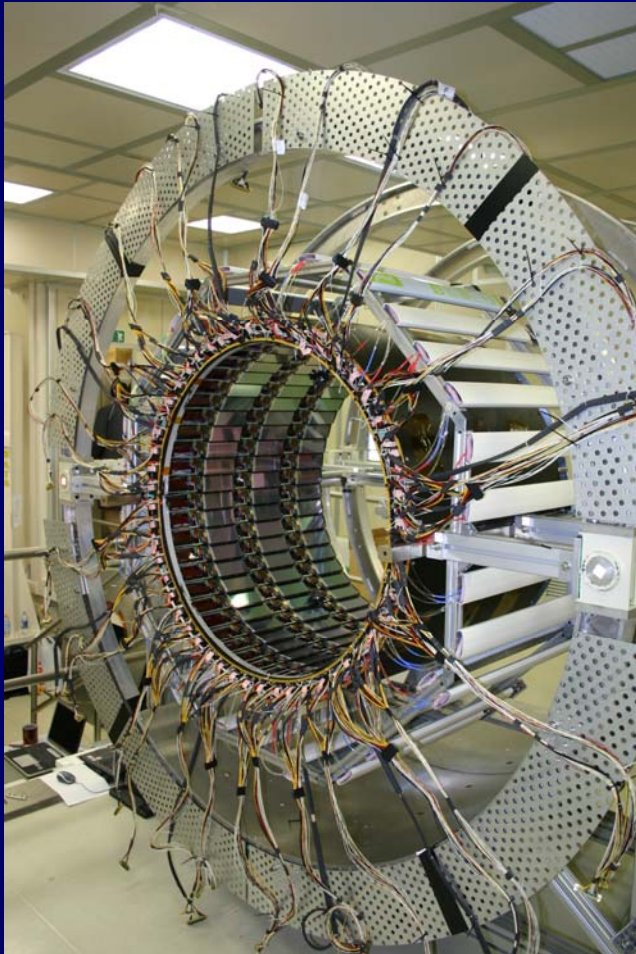




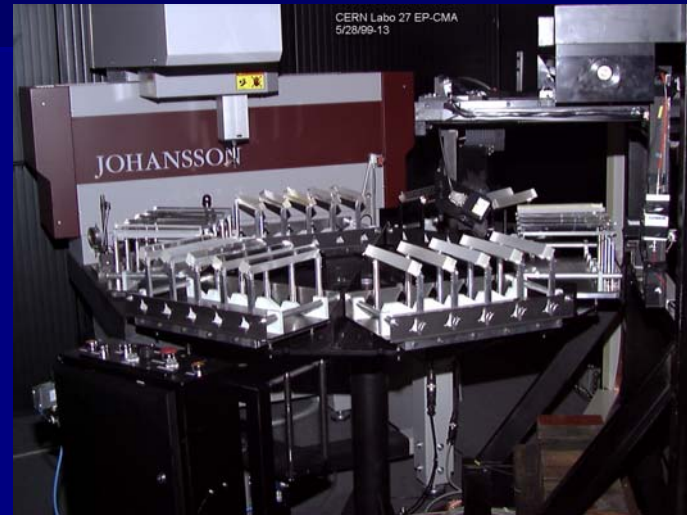
# CMS

A generic LHC experiment

tracker



crystals



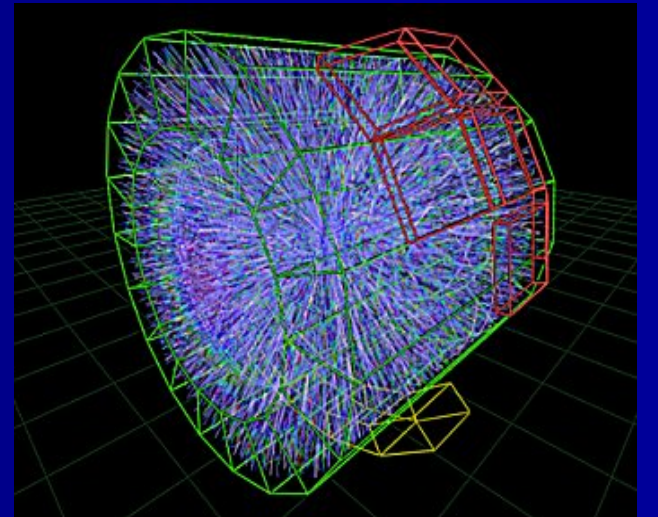
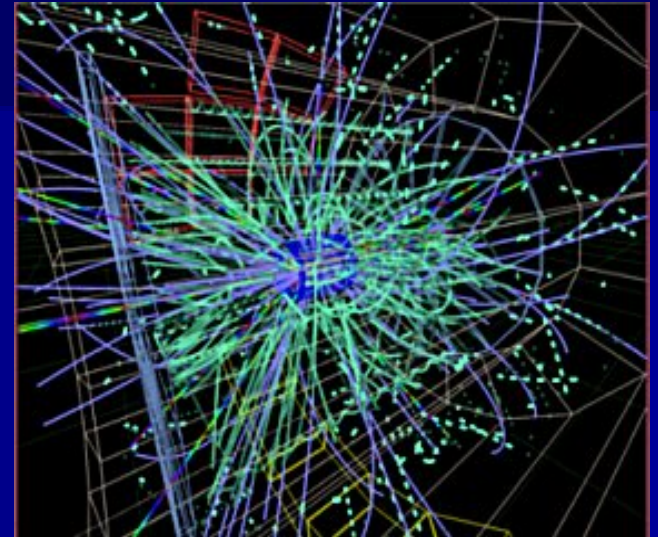




# ALICE

LHC experiment for heavy ions physics

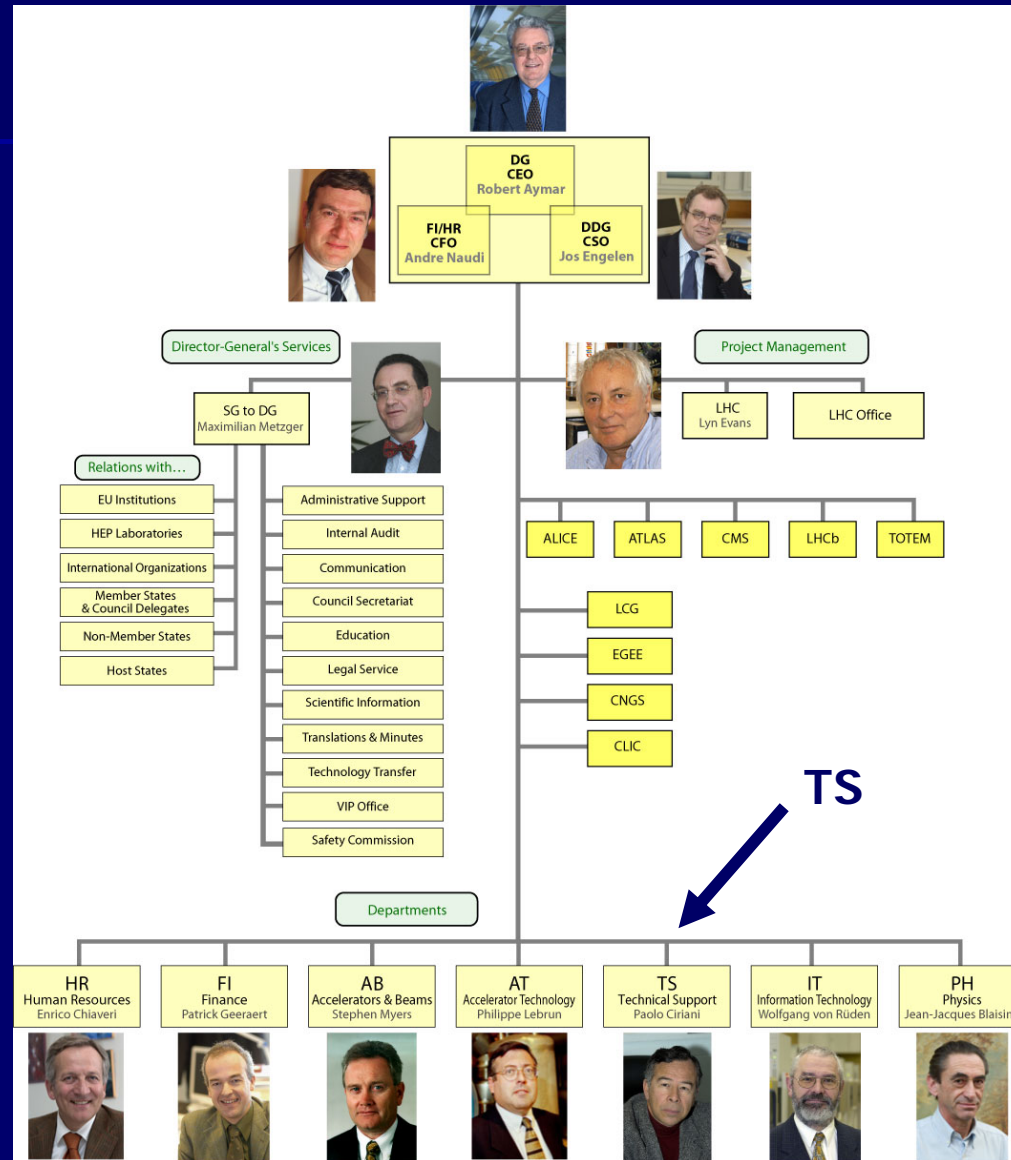
simulation of events





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# CERN

## Technical Support Department [TS]



### **The Technical Support Department [TS Department ]**

The mandate of the Technical Support Department is to provide support for the technical infrastructure of CERN, accelerators, experiments and services related to the site operation and maintenance.

The Department has the responsibility to ensure monitoring and operation of the technical infrastructure of the whole site 365 days per year and 24h/24. It is in charge of the maintenance of sites and buildings, cleaning, gardening and access surveillance to sites and provides general services as transport, mail and housing.

### **The Mechanical & Materials Engineering group [TS-MME Group]**

The MME group is in charge of engineering support for the maintenance of CERN facilities and the manufacturing of prototypes as required for CERN projects. This encompasses various activities such as the mechanical design and manufacturing, as well as the selection, the characterization and the treatments of surfaces and materials.

The drawing tools that we are using are : AUTOCAD<sup>®</sup> Mechanical, EUCLID<sup>®</sup> and CATIA<sup>®</sup>





# CERN

## The Mechanical & Materials Engineering group TS/MME

**The Group comprises the following technologies:**

- **Design office**
- **CERN main mechanical workshop**
- **Assembly techniques (welding, brazing, electron-beam welding, laser, sheet metal work)**
- **Metrology**
- **Metallurgy**
- **Non-destructive tests (ultra-sounds, X-rays, traction)**
- **Microscopy, surface analysis**
- **Thin-film surface deposition**
- **Chemistry (gas and liquids)**
- **Polymers workshop**
- **Surface cleaning and coating**



# CERN

## TS-MME: Projects

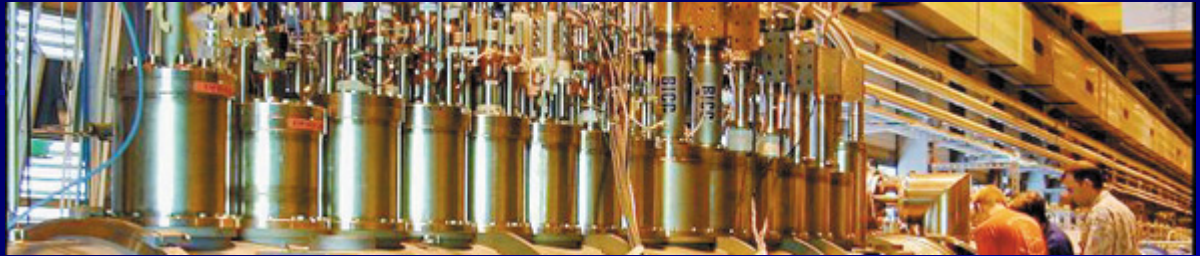
**LHC Cryogenic Line**  
**DFB and ATM**  
**LSS**  
**Connecting cryostats**  
**Collimators**  
**Beam instrumentation**  
**Beam screens**  
**PS septum magnets**  
**LEIR**  
**CAST**  
**SSS diodes**  
**Accelerating cavities**  
**PS chambers, ZL tanks**

**TOTEM Roman Pots**  
**CLIC**  
**ATLAS (welding, ID, ...)**  
**CMS (magnet, ECAL, pipe)**  
**Special cryostats**  
**RFQ and multiple brazing**  
**CNGS decay tube**  
**LHC vacuum chambers**  
**Magnets measurements devices**  
**Experimental beam pipes**  
**120 A current leads**  
**SMA18 support**  
**Future commissioning LSS in tunnel**

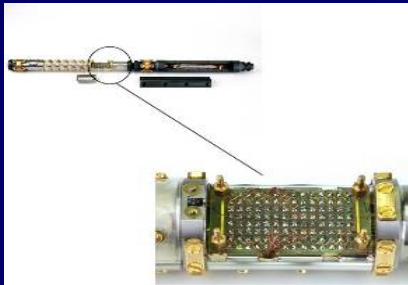


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## TS-MME Design Office



### Some of the design office activities



Multipole measurement shaft



Storage of cold masses for Cryo dipoles



Measurement structure for a magnet



Tooling for prototype assembly of dipoles





# CERN

## TS-MME Design Office

CTF Module

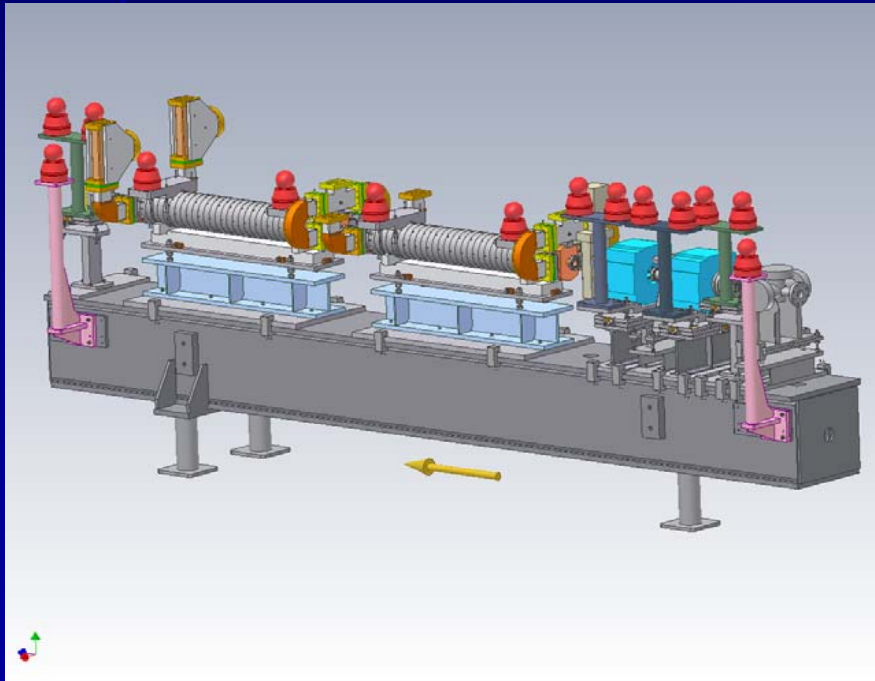
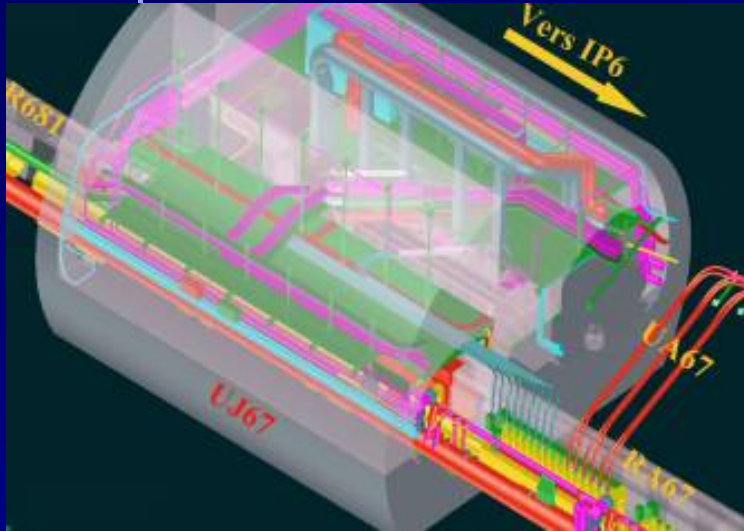


Photo of a transport device in action with a 15m long dipole of 30t



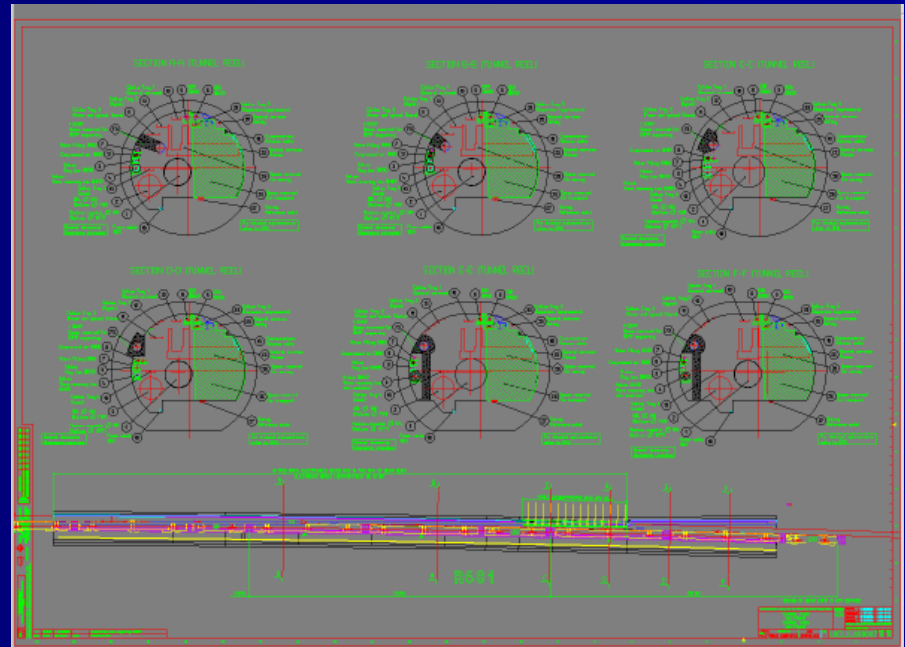


## INTEGRATION WORK



View 3D in cavern

Drawing of integrations in the tunnel

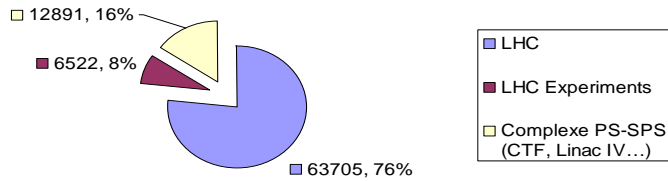




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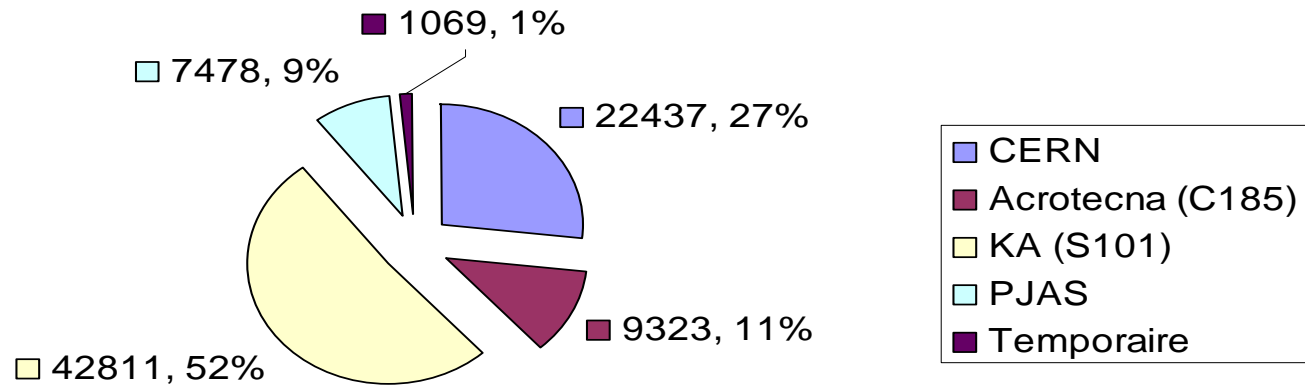
## TS-MME Design Office: sharing of activities

Nbre d'heures par projet(s)



mainly LHC

Nbre d'heures par type de personnel

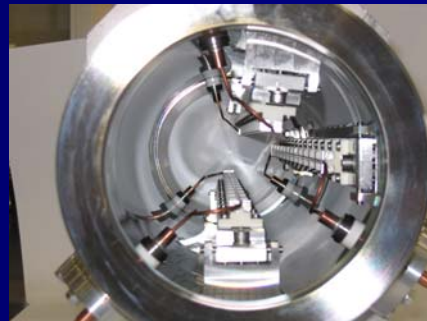
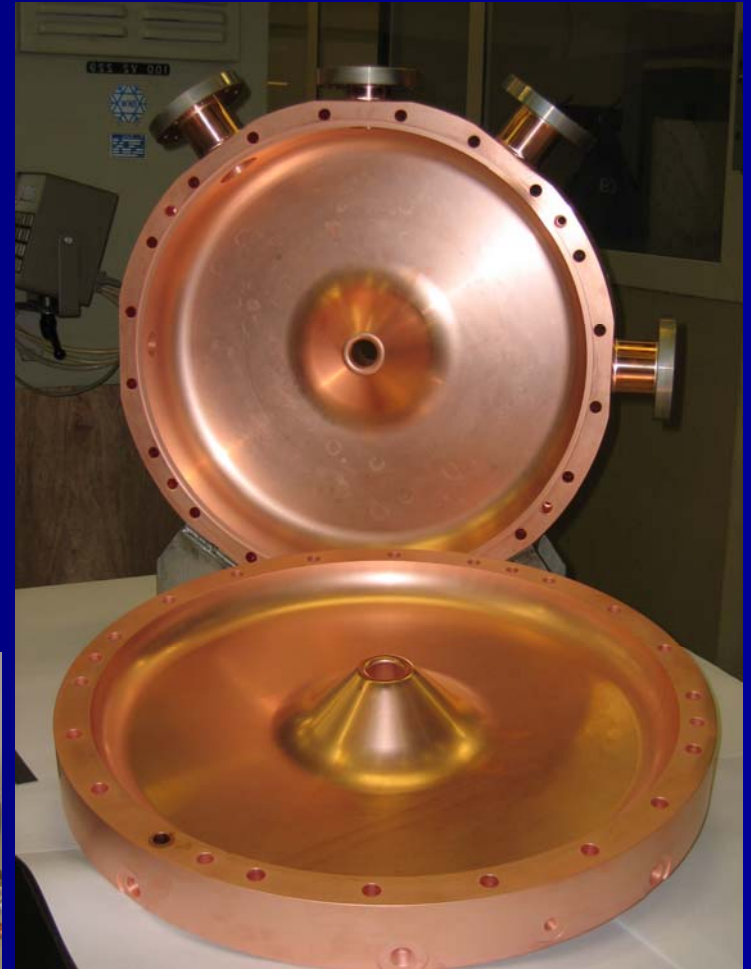






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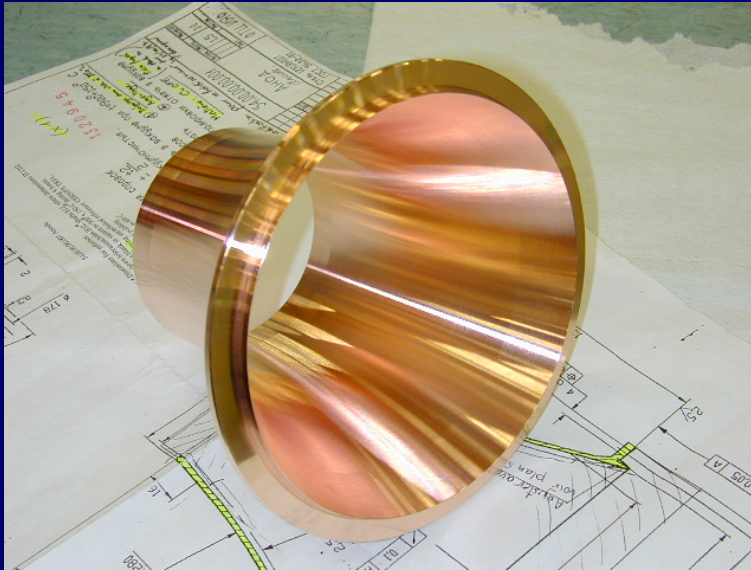
## TS-MME Main Mechanical workshop





# CERN

## TS-MME Main Mechanical workshop

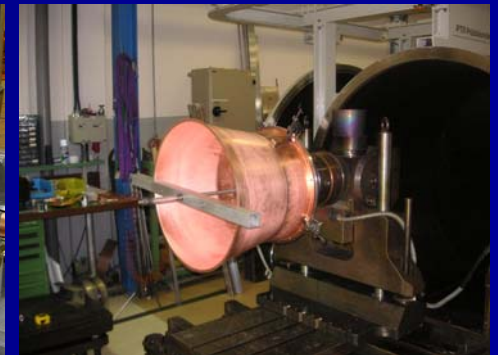






# CERN

## TS-MME Assembly Techniques

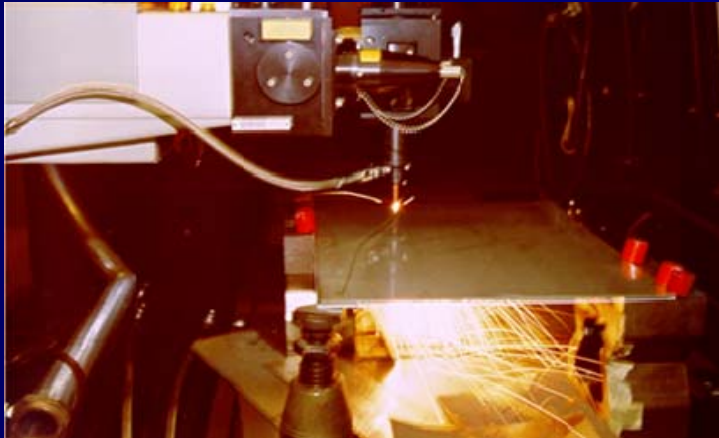






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## TS-MME Assembly Techniques: laser, EB welding, brazing





**CERN**

**The Mechanical & Materials Engineering group TS/MME**

**“Chemistry activities”:**

**Realize qualitative and quantitative inorganic and/or organic chemical analyses, develop new analytical procedures and methods, provide support on general chemistry for MME Group and CERN community.**

**Assures a complex range of metallic surface treatments: cleaning for UHV applications; chemical & electrochemical degreasing, plating, etching and polishing, etc.**

**Produce prototypes, pieces or parts in different types of resins and special gluing for cryogenic, magnetic or high voltage applications for LHC and/or HEP detectors.**

**Offers expertise and consultancy in radiation chemistry, ageing and materials compatibility and reactivity, purification of gaseous mixtures and fluids.**



# CERN

## The Mechanical & Materials Engineering Group

### Chemistry lab.



GC -TCD HP 5890A



AAS Perkin Elmer AAnalyst 300



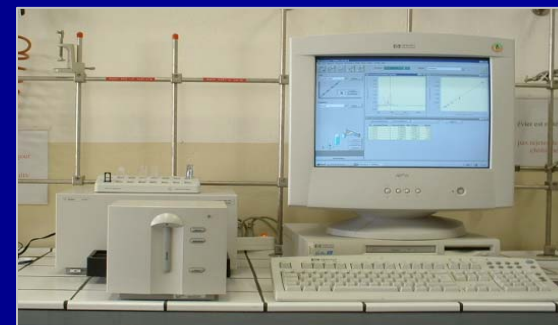
ICP-OES Perkin Elmer Optima 2000



GC Agilent 6890 – MS  
Agilent 5973



FT-IR spectrometer Bruker Vertex 70



UV-Vis spectrophotometer Agilent 8453





# CERN

## The Mechanical & Materials Engineering Group

### Polymers workshop



*Facilities for vacuum casting*

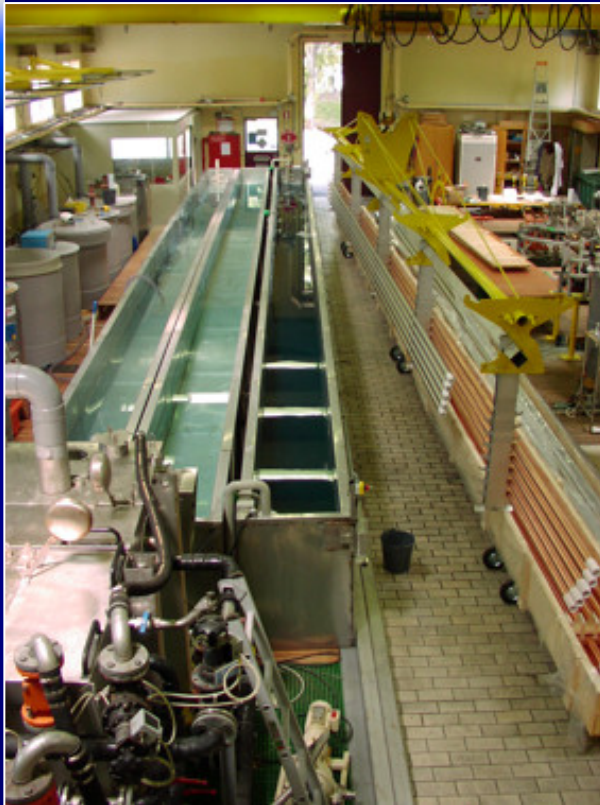


*Vacuum mixer for resins and compounds*



# CERN

## TS-MME Surface treatment



*Solvent cleaning facilities for silicon contaminants*



*Electrochemical polishing installation*



*High pressure rinsing*



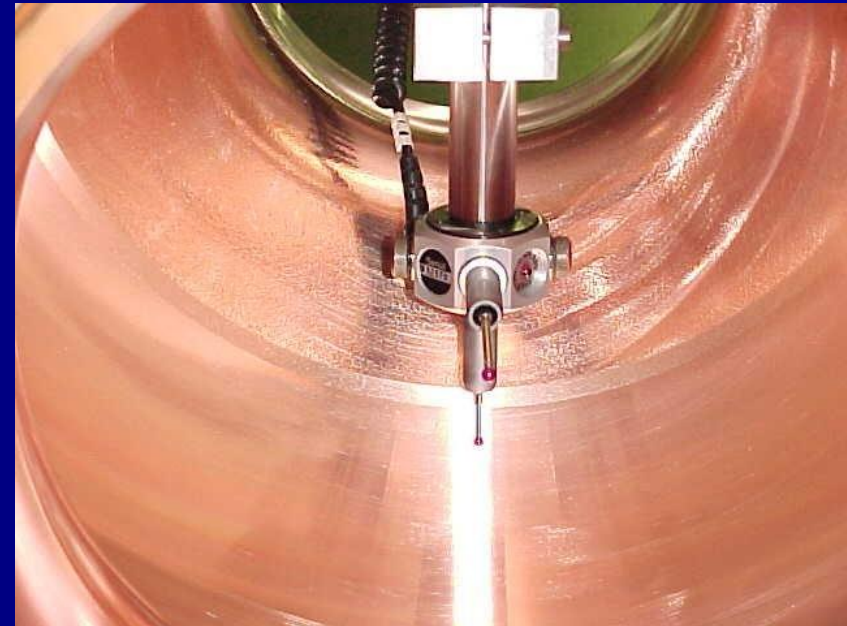
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## TS-MME Metallurgy and Metrology

Metallurgy of powders



Metrology

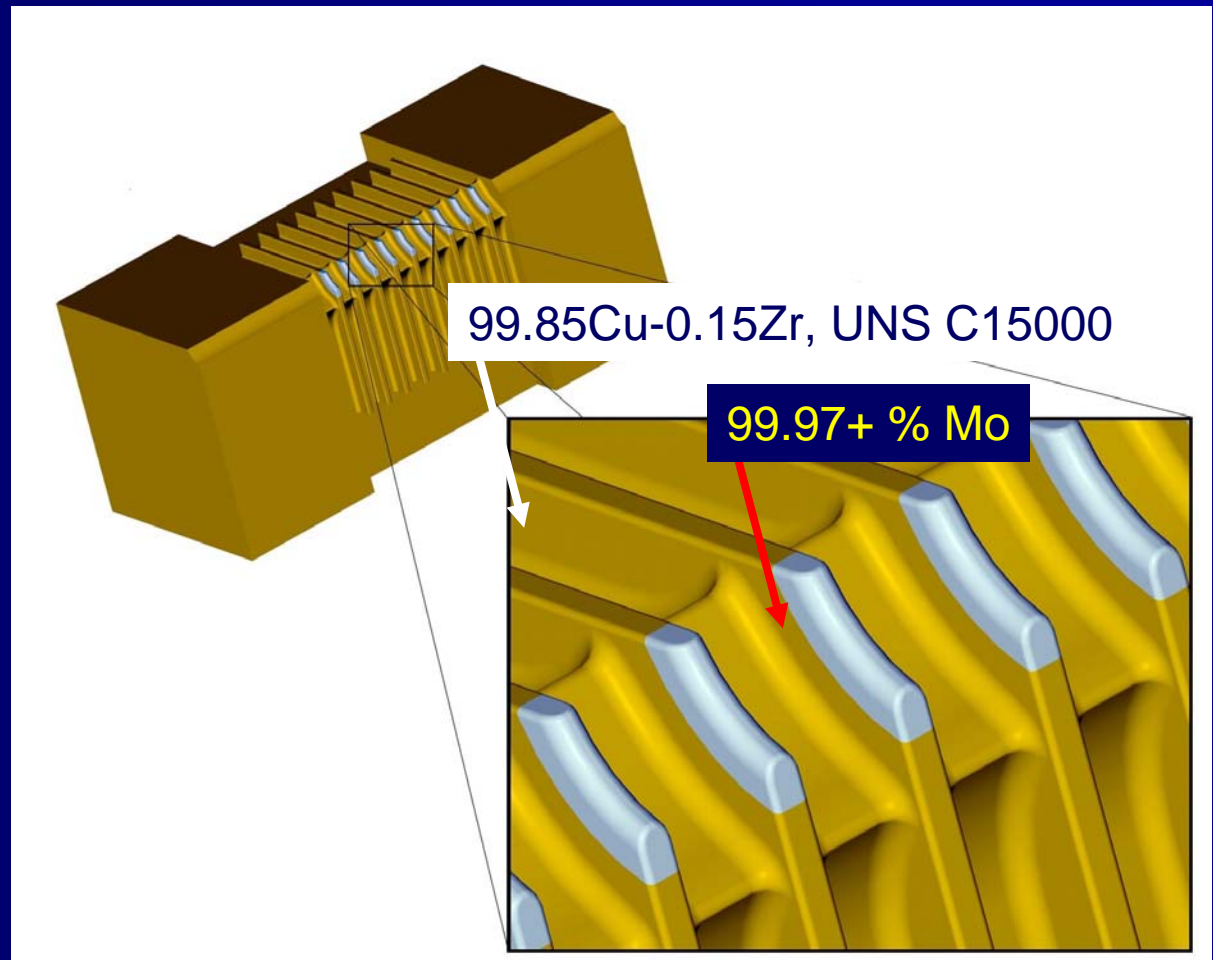






# CERN

## TS-MME Metallurgy



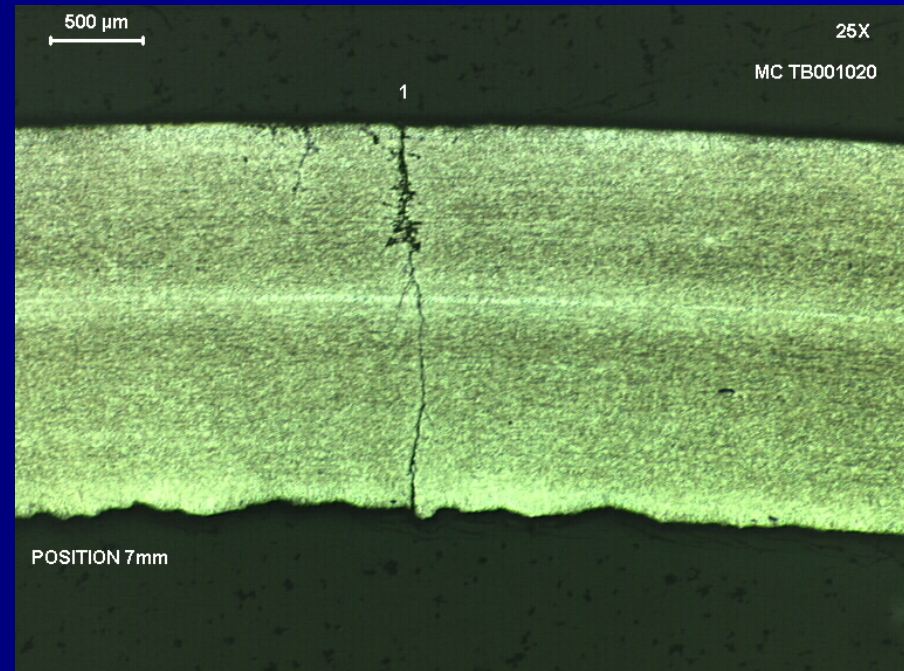
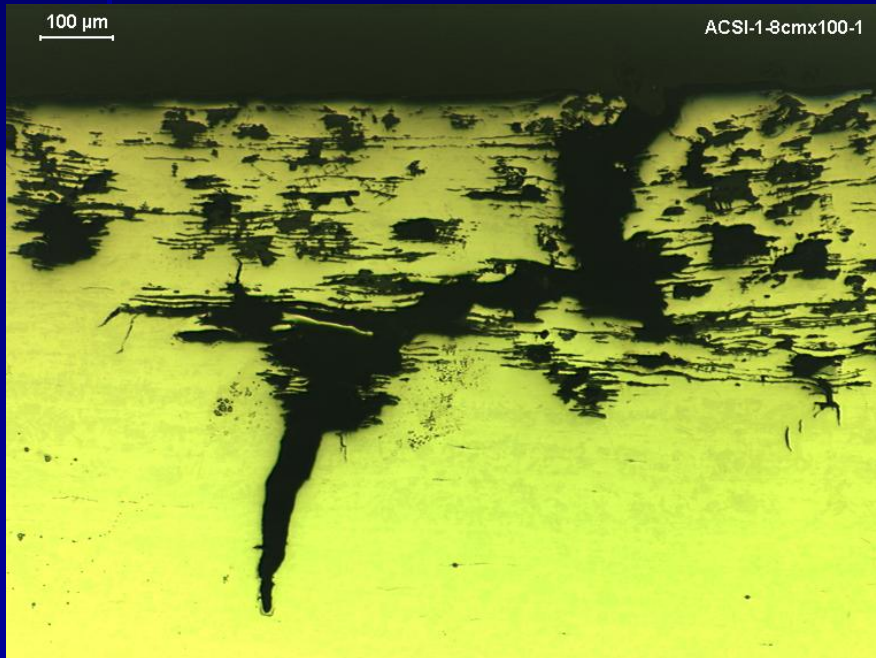
✓ R&D CLIC



**CERN**

**TS-MME Metallurgy and Surface analysis**

corrosion





# CERN

## Technology Transfer

### CERN's usefulness

Fundamental research

Technological leaps

Technology transfer to the European industry

Examples:

(non-exhaustive list):

superconductivity

synchrotron light

medical accelerators and detectors

control systems

supercomputers

New ideas:

W W W

Energy amplifier





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**Thank you for your attention !**

**For more information you can visit our Web Page**

**at**

**[www.cern.ch](http://www.cern.ch)**