On behalf of Katy Foraz,
Head of the EN Department,

Welcome
to all of you!

The Engineering Department in a Nutshell

Katy Foraz

CERN | EN ENGINEERING DEPARTMENT

Where are we?

CERN: founded in 1954: 12 European States
"Science for Peace"
Today: 23 Member States

Employees: ~2 700 staff, 800 fellows
Associates: ~12 400 users, 1 300 others
Budget (2019) ~ 1 200 MCHF

Member States: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovak Republic, Spain, Sweden, Switzerland and United Kingdom

Associate Members in the Pre-Stage to Membership: Cyprus, Slovenia, Estonia, Latvia

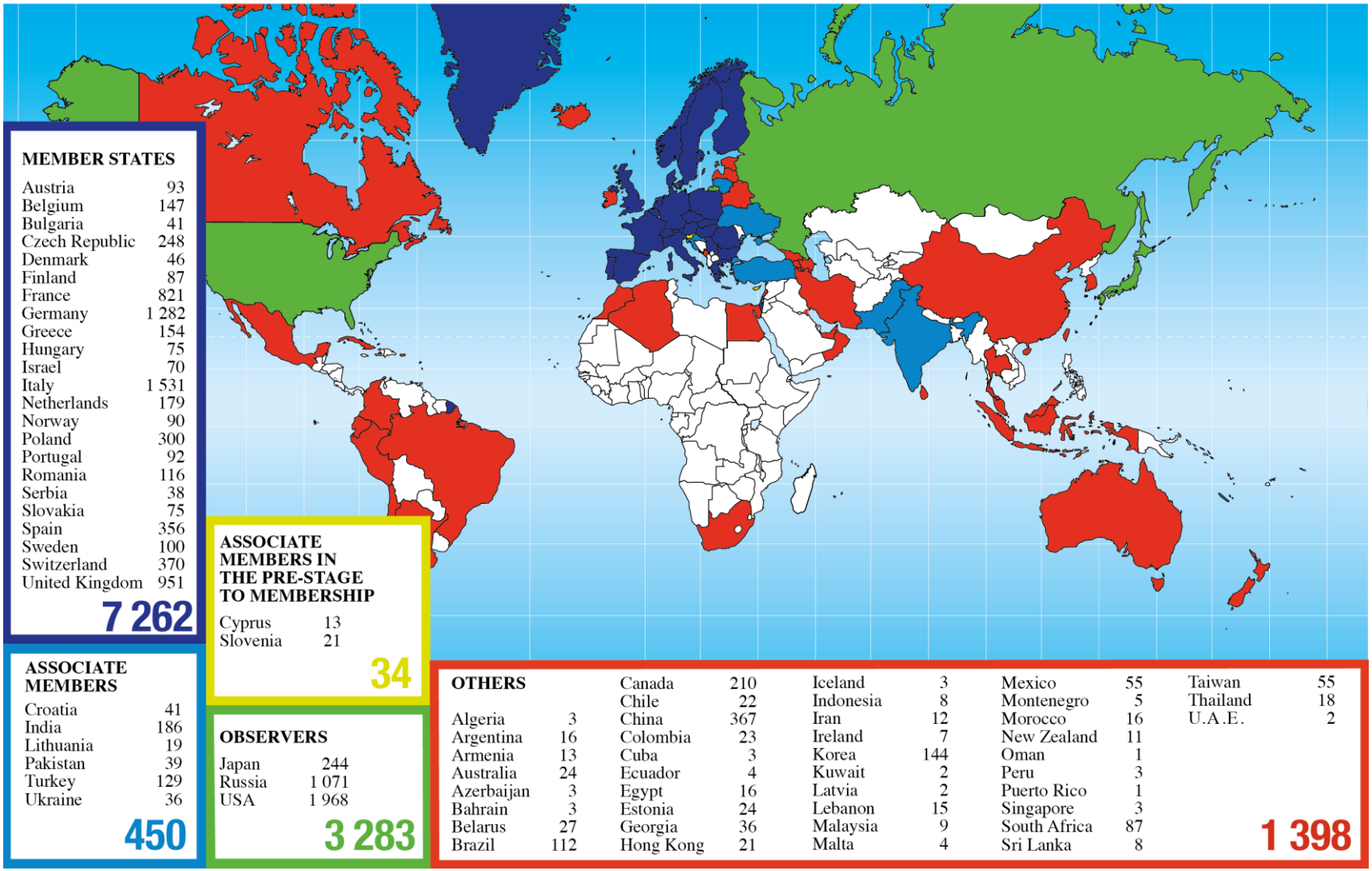
Associate Member States: Croatia, India, Lithuania, Pakistan, Turkey, Ukraine

Applications for Membership or Associate Membership:
Brazil

Observers to Council: Japan, Russia, United States of America;
European Union, JINR and UNESCO

Science is getting more and more global

Distribution of All CERN Users by Location of Institute on 31 December 2019



MEMBER STATES

Austria	93
Belgium	147
Bulgaria	41
Czech Republic	248
Denmark	46
Finland	87
France	821
Germany	1 282
Greece	154
Hungary	75
Israel	70
Italy	1 531
Netherlands	179
Norway	90
Poland	300
Portugal	92
Romania	116
Serbia	38
Slovakia	75
Spain	356
Sweden	100
Switzerland	370
United Kingdom	951

7 262

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP

Cyprus	13
Slovenia	21

34

ASSOCIATE MEMBERS

Croatia	41
India	186
Lithuania	19
Pakistan	39
Turkey	129
Ukraine	36

450

OBSERVERS

Japan	244
Russia	1 071
USA	1 968

3 283

OTHERS

Algeria	3	Canada	210	Iceland	3	Mexico	55	Taiwan	55
Argentina	16	Chile	22	Indonesia	8	Montenegro	5	Thailand	18
Armenia	13	China	367	Iran	12	Morocco	16	U.A.E.	2
Australia	24	Colombia	23	Ireland	7	New Zealand	11		
Azerbaijan	3	Cuba	3	Korea	144	Oman	1		
Bahrain	3	Ecuador	4	Kuwait	2	Peru	3		
Belarus	27	Egypt	16	Latvia	2	Puerto Rico	1		
Brazil	112	Estonia	24	Lebanon	15	Singapore	3		
		Georgia	36	Malaysia	9	South Africa	87		
		Hong Kong	21	Malta	4	Sri Lanka	8		

1 398

What are we doing?

The Missions of CERN

- Push forward the frontiers of knowledge

  e.g. the secrets of the Big Bang …
  what was the matter like within
  the first moments of the Universe's existence?

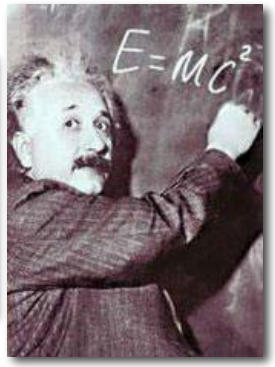
- Develop new technologies for accelerators and detectors

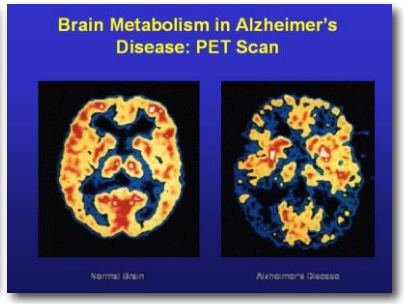
  Information technology - the Web and the GRID

  Medicine - diagnosis and therapy

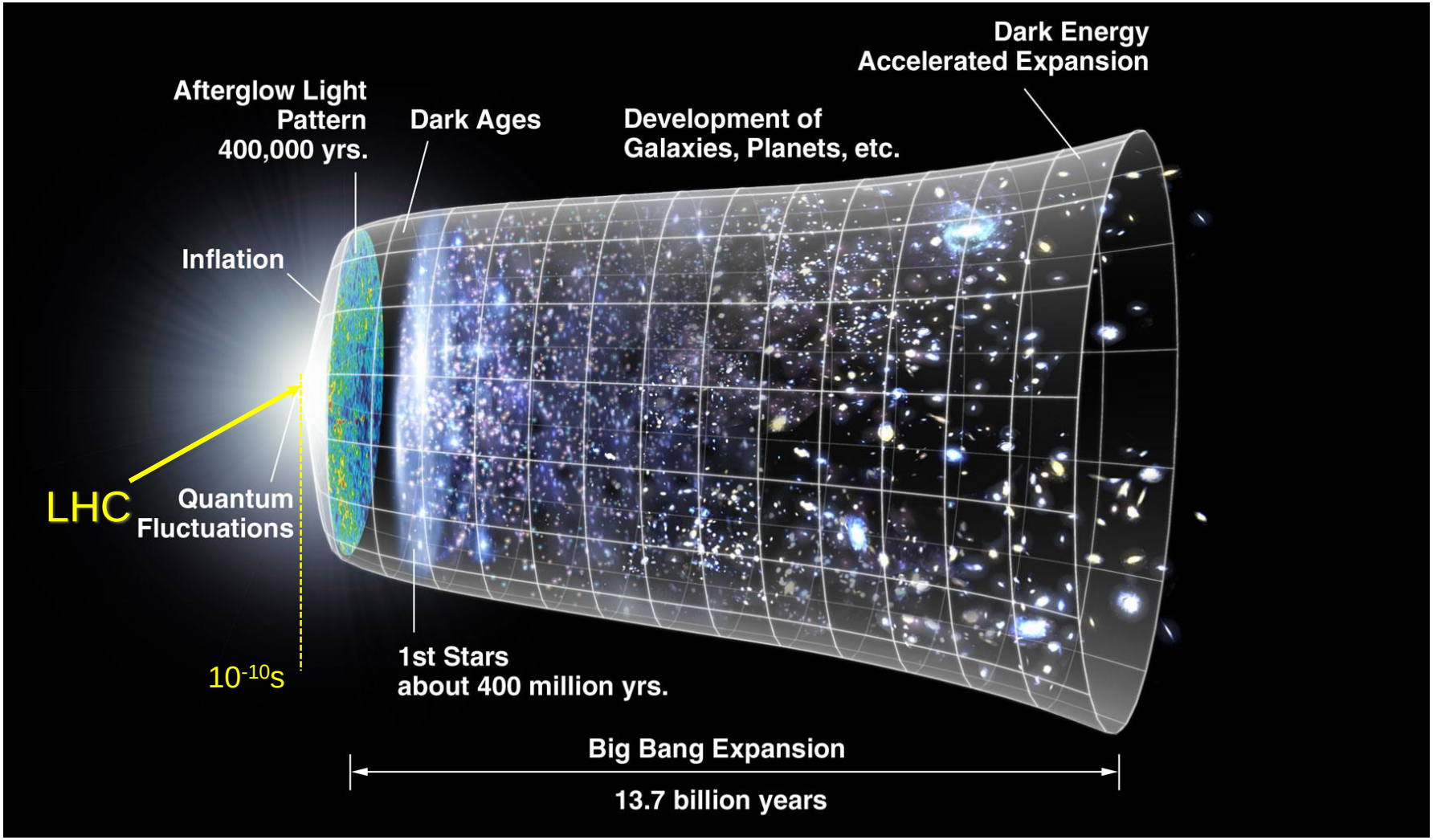
- Train the scientists and the engineers of tomorrow

- Unite people from different countries and cultures





The next scientific challenge is to understand the very first moments of our Universe after the Big Bang



How are we doing
what we are doing?

The instruments use

1. Particle accelerator :

Boost particles to high energies and make them collide

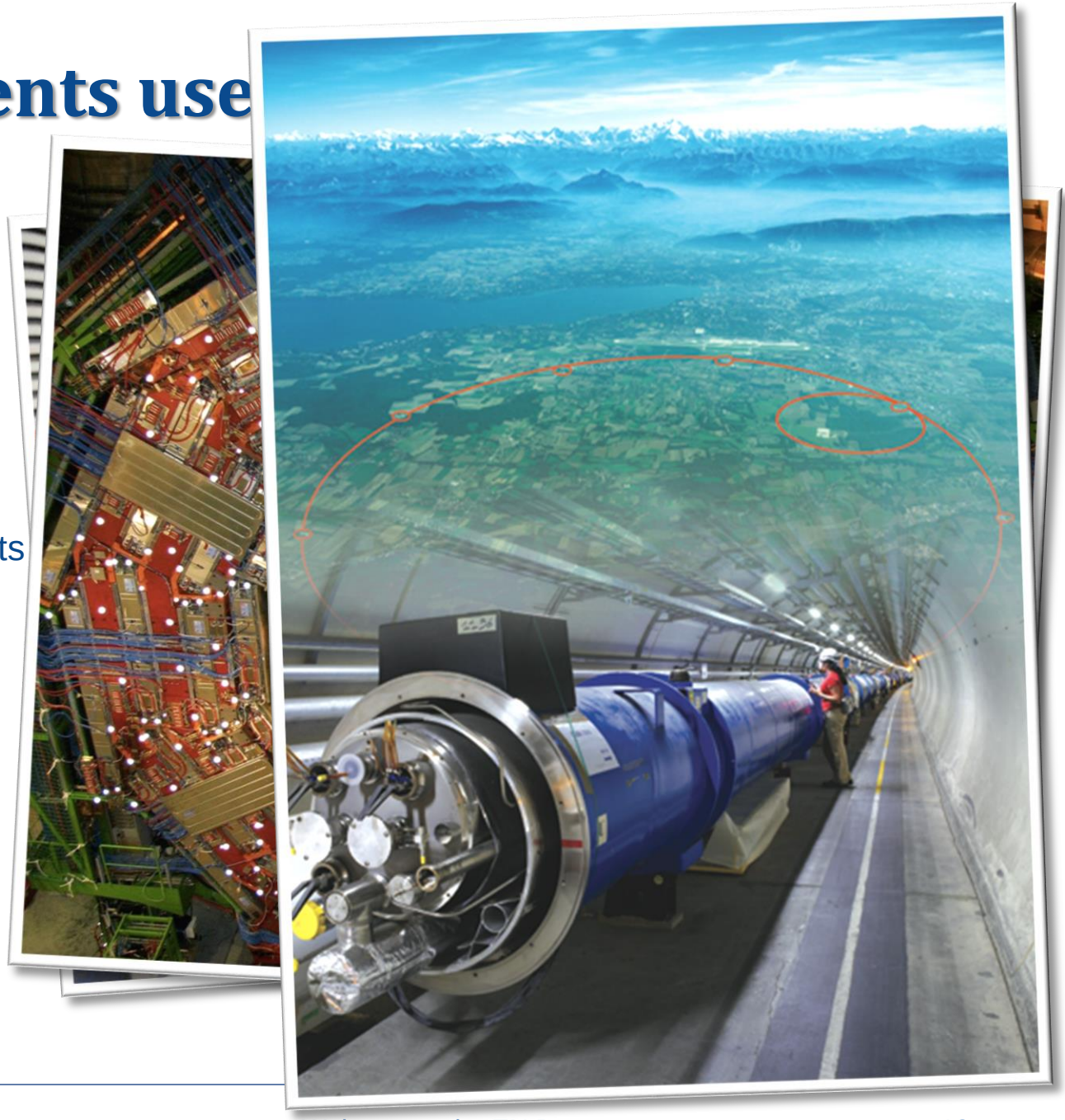
2. Detectors :

Gigantic instruments that observe and record the results of the collisions

(particle trajectories, energy, charge…)

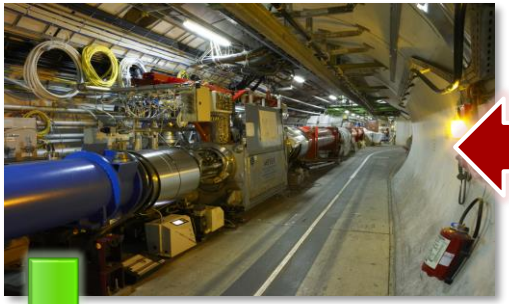
3. Computers :

Collect, store, and send around the world the big quantity of data received from the detectors for data analysis

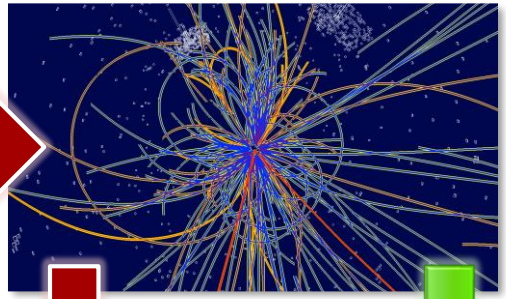


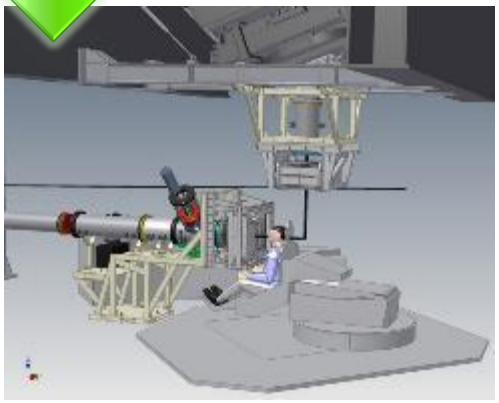
The technologies developed at CERN generate innovations

Accelerators



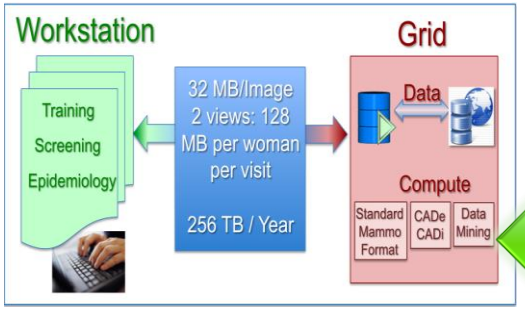
Detectors

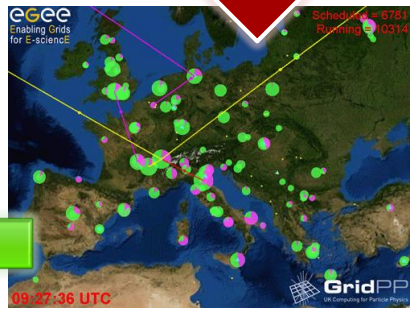




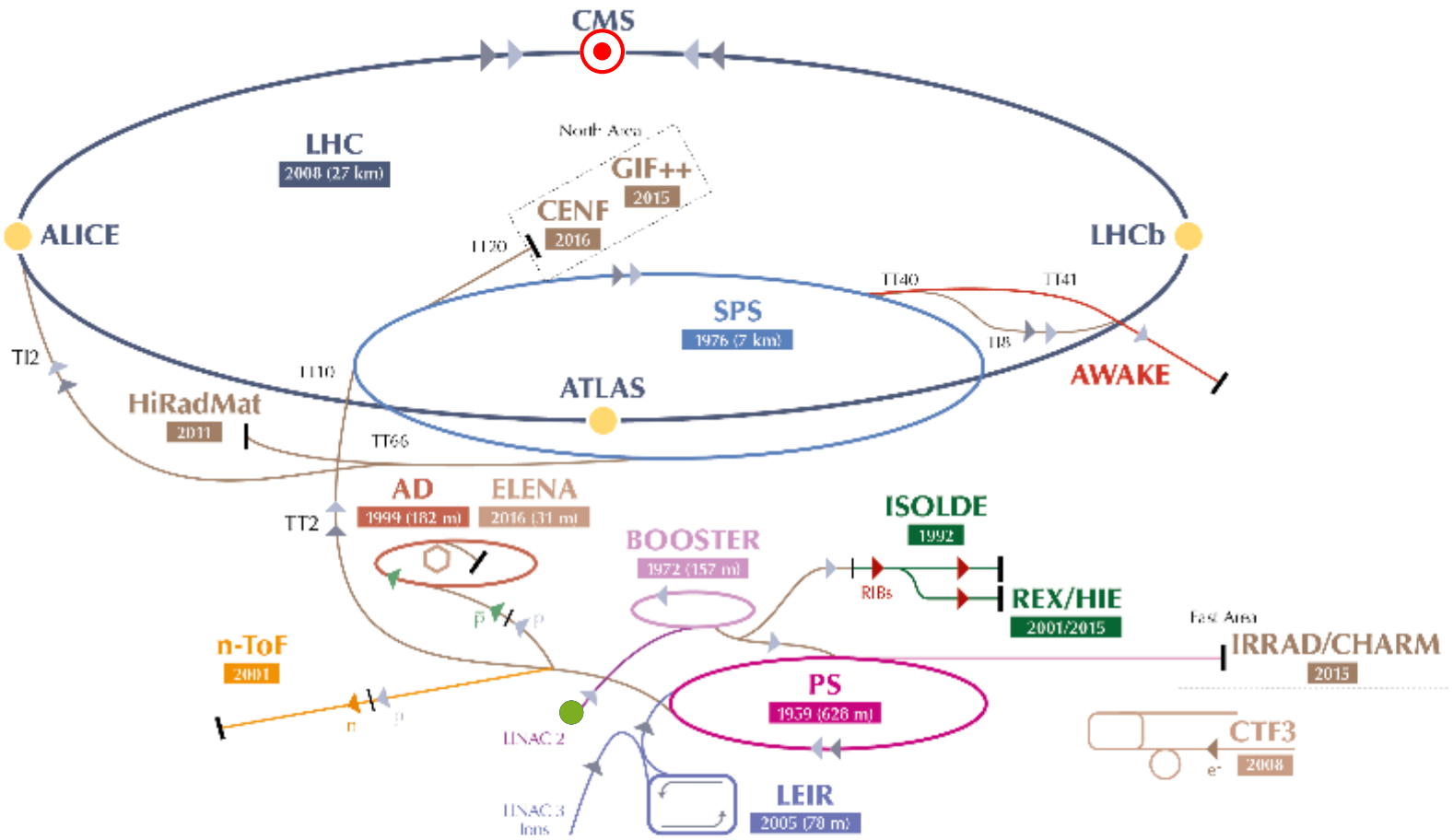
Hadron therapy

CAT





The Computing Grid

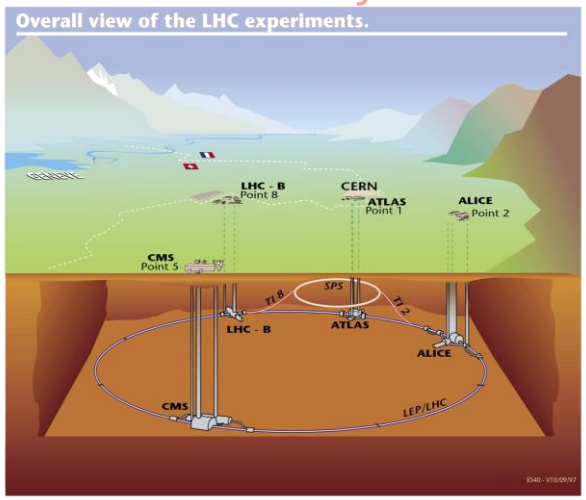

CMS
LHC
2008 (27 km)
North Area
GIF++
2015
CENF
2016
ALICE
LHCb
TI2
TI8
SPS
1976 (7 km)
AWAKE
ATLAS
HiRadMat
2011
AD
1999 (182 m)
ELENA
2016 (31 m)
TT2
BOOSTER
1972 (157 m)
ISOLDE
1992
RIBs
REX/HIE
2001/2015
East Area
IRRAD/CHARM
2015
n-ToF
2001
PS
1959 (628 m)
LINAC 2
LINAC 3
Ions
LEIR
2005 (78 m)
CTF3
2008
p (protons)
ions
RIBs (Radioactive Ion Beams)
n (neutrons)
p̄ (antiprotons)
e⁻ (electrons)
LHC Large Hadron Collider
SPS Super Proton Synchrotron
PS Proton Synchrotron
AD Antiproton Decelerator
CTF3 Clic Test Facility
AWAKE Advanced WAKefield Experiment
ISOLDE Isotope Separator OnLine
REX/HIE Radioactive EXperiment/High Intensity and Energy ISOLDE
LEIR Low Energy Ion Ring
LINAC LINear ACcelerator
n-ToF Neutrons Time Of Flight
HiRadMat High-Radiation to Materials
CHARM Cern High energy AcceleRator Mixed field facility
IRRAD proton IRRADiation facility
GIF++ Gamma Irradiation Facility
CENF CErn Neutrino platForm

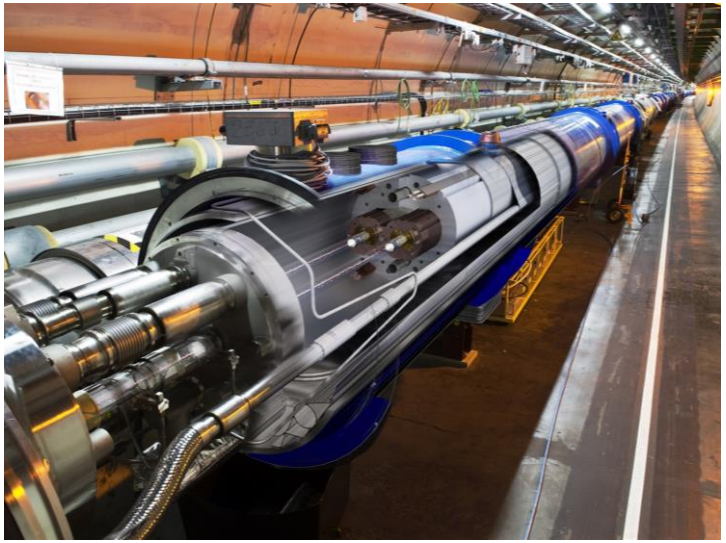
The LHC

A collider situated in an underground 27 km in an almost circular tunnel designed to accelerate two proton beams to 7 TeV

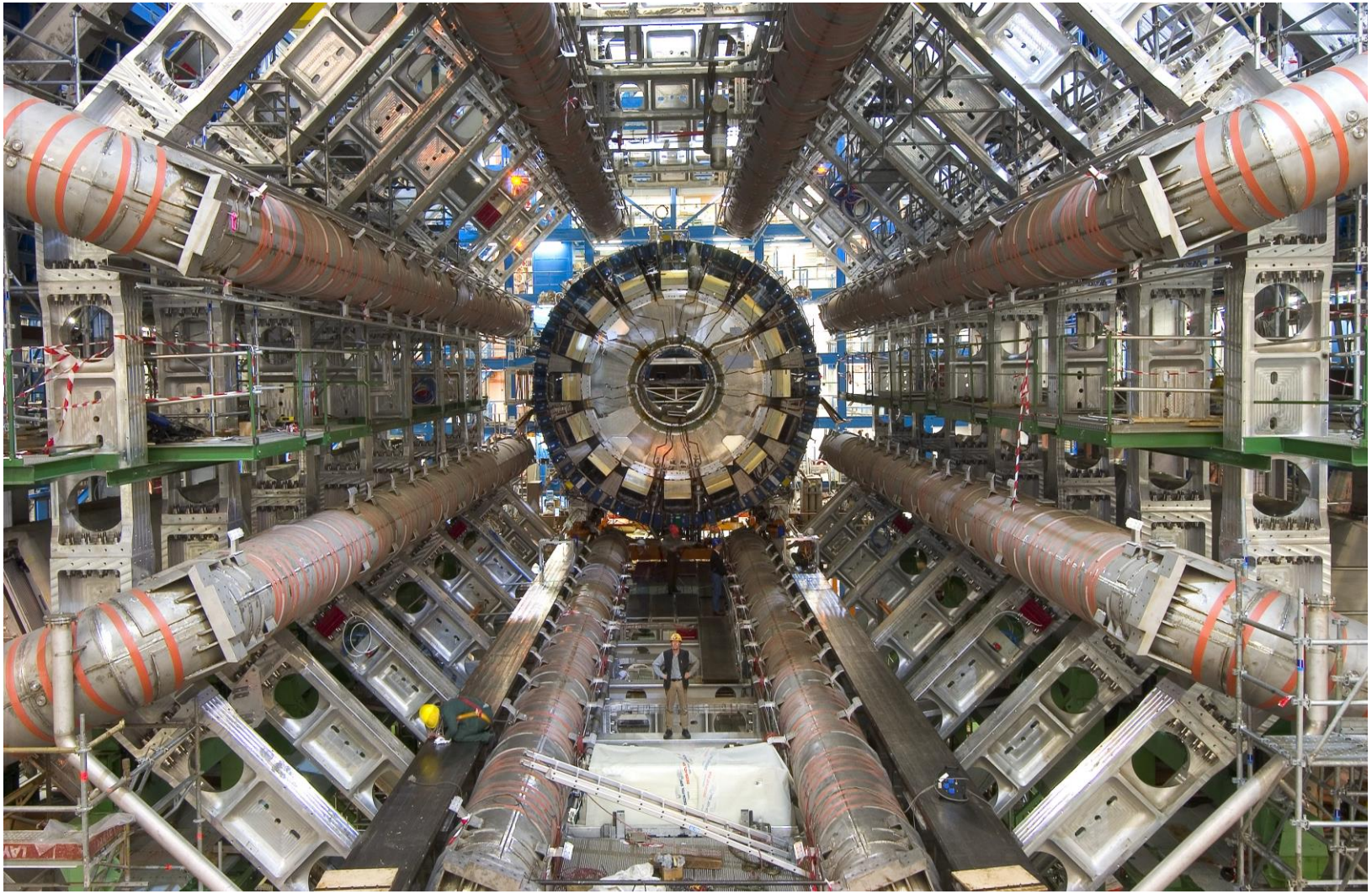
+ than 25 years

1982 : First studies
1994 : Project approved by the CERN council
1996 : Final decision and start of the construction
2004 : Installation starts
2006 : Hardware commissioning starts
2008 : End of hardware commissioning
2009-2030: Physics

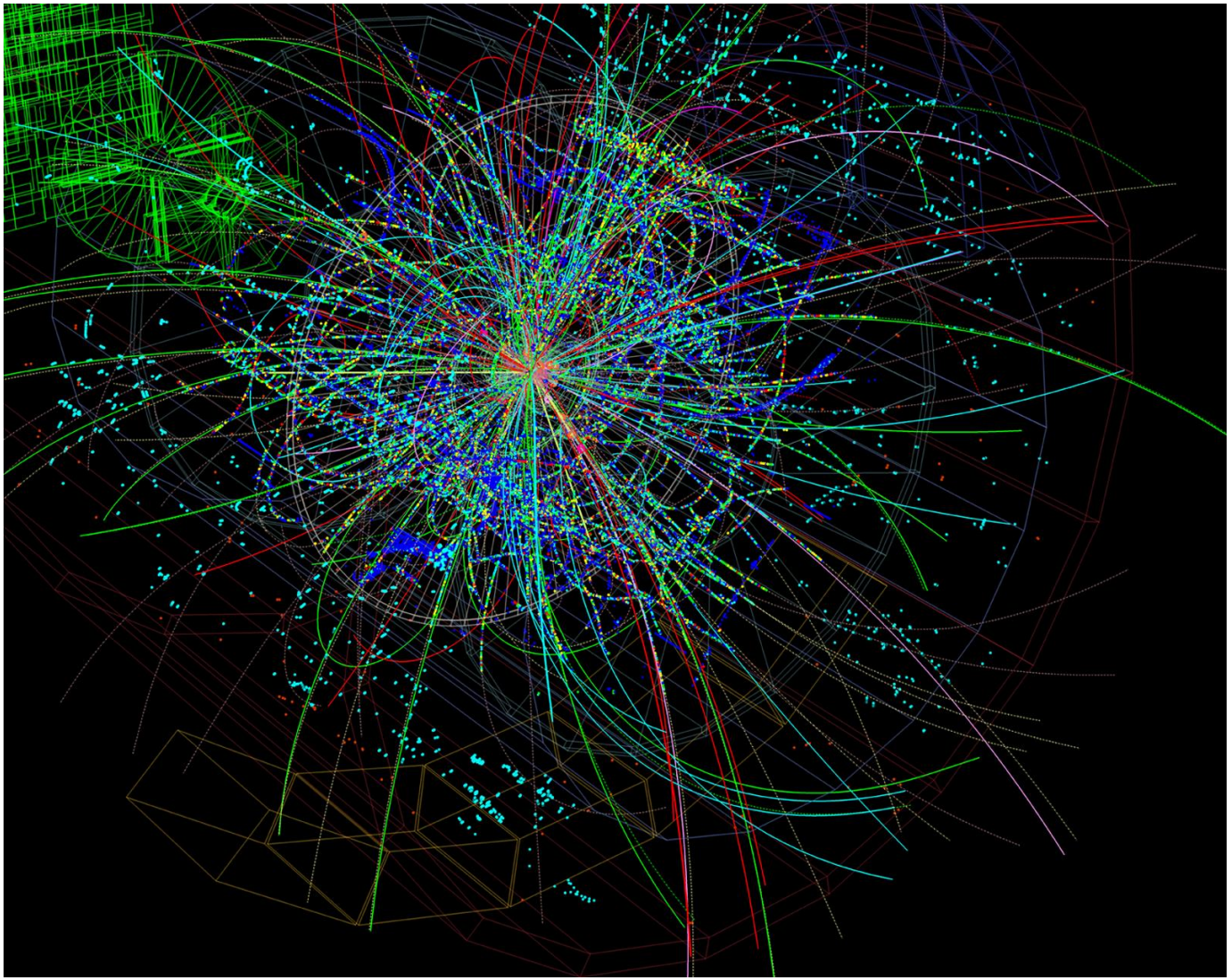




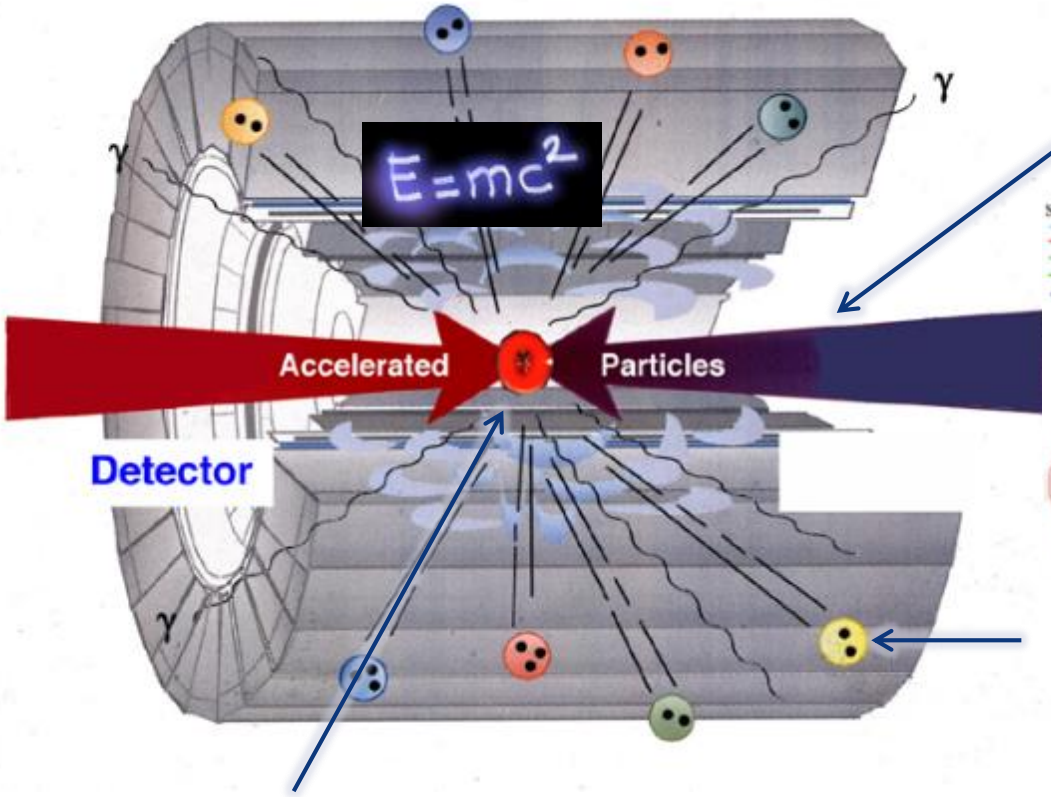
A big experiment at the LHC : ATLAS



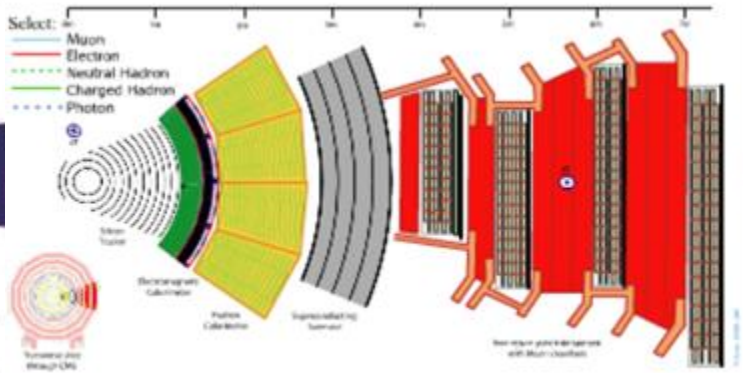
Taking pictures of particles: detectors



How do we study the elementary particles?



1) Accelerate protons or ions to high energy

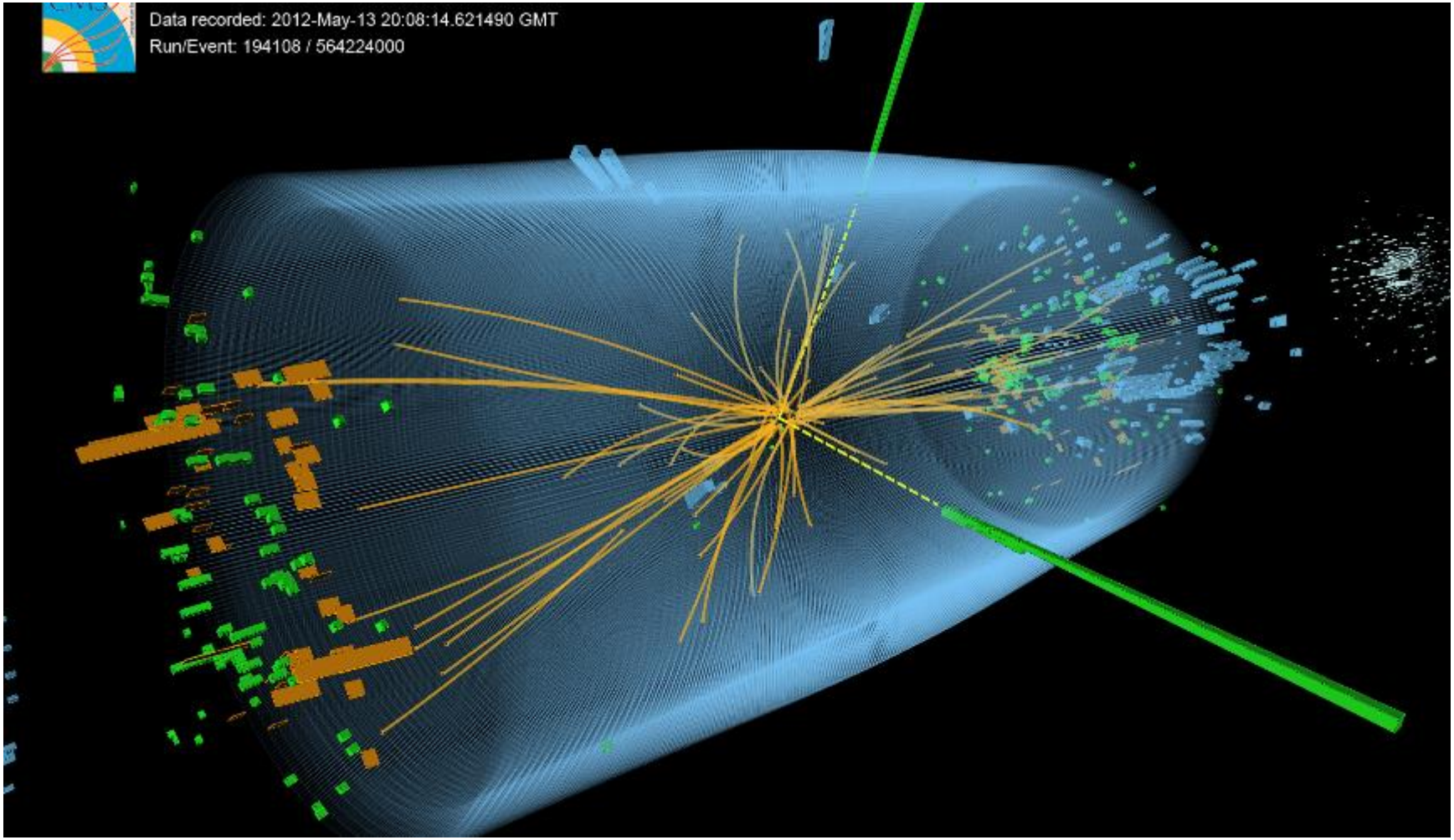


3 Identify the particles generated by the collisions

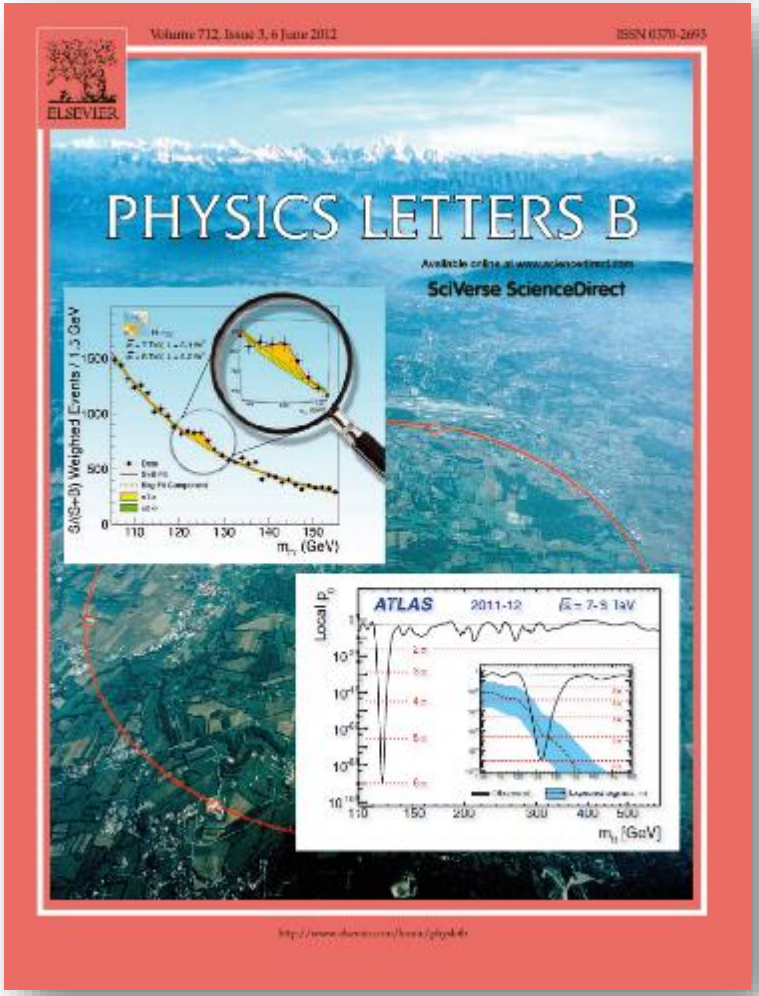
2) Collide these head-on

4) Collect and analyze the data from many collisions

H → γ γ

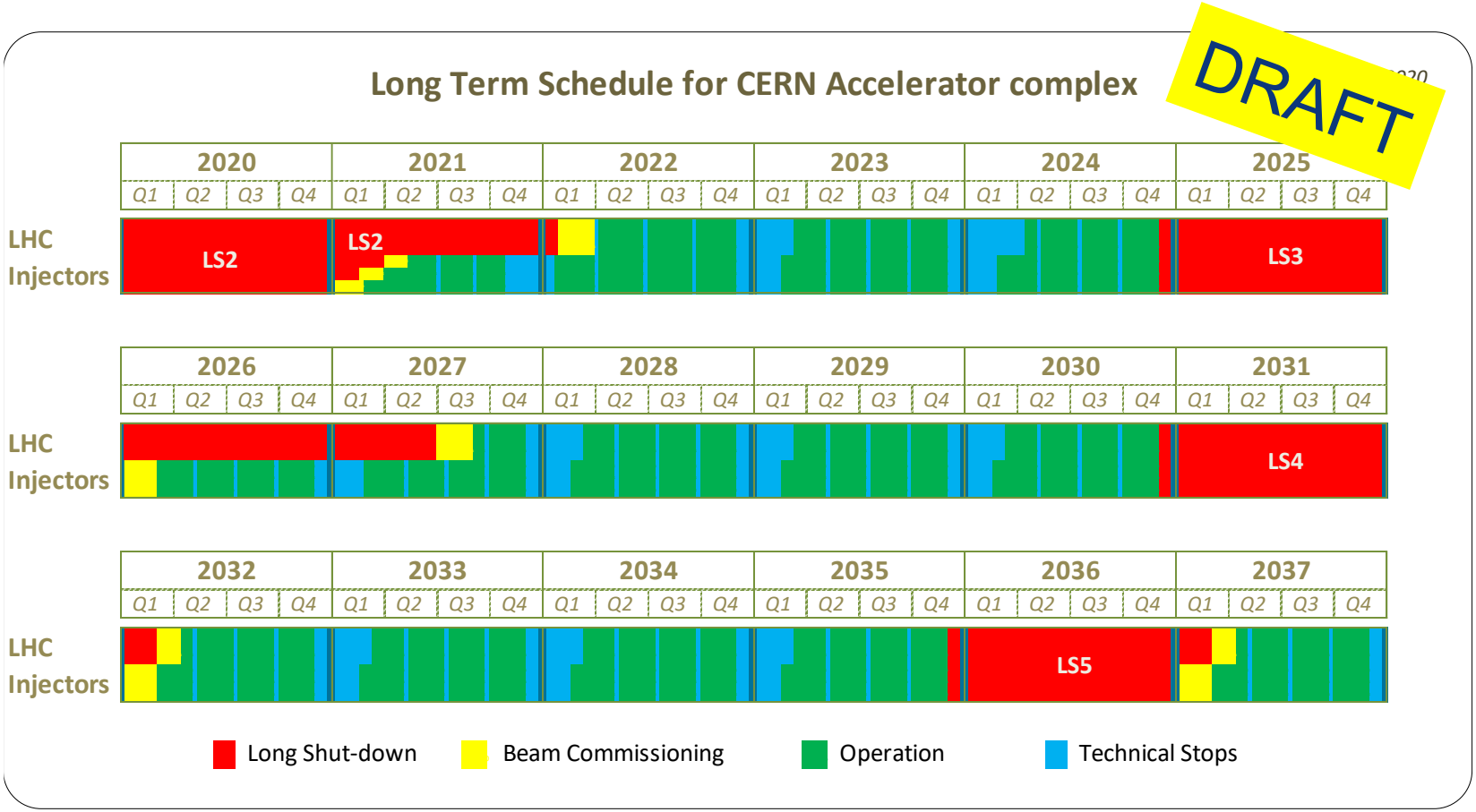

Data recorded: 2012-May-13 20:08:14.621490 GMT
Run/Event: 194108 / 564224000

2012 : The year of the Higgs Boson



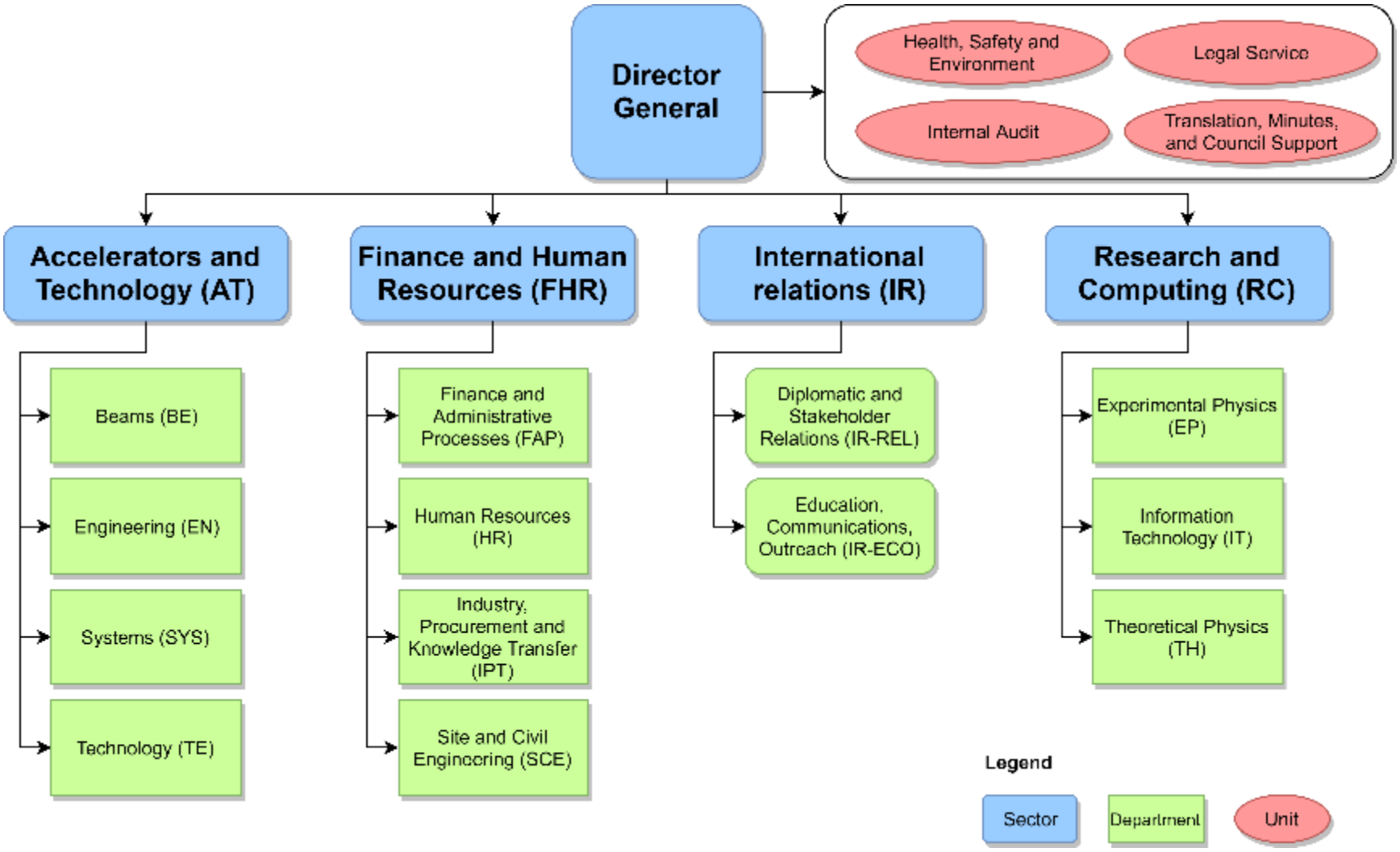
When will we be doing
what we are expected to do?

A long-term perspective



Who are we?

CERN Structure



CERN Structure

Directorate	
Director-General	Fabiola Gianotti
Director for Finance and Human Resources	Raphaël Bello
Director for Accelerators and Technology	Mike Lamont
Director for Research and Computing	Joachim Mnich
Director for International Relations	Charlotte Warakaulle

CERN Structure

Heads of departments	
Accelerator Systems	Brennan Goddard
Beams	Rhodri Jones
Engineering	Katy Foraz
Experimental Physics	Manfred Krammer
Finance and Administrative Processes	Florian Sonnemann
Human Resources	James Purvis
Industry, Procurement and Knowledge Transfer	Christopher Hartley
Information Technology	Enrica Porcari
Site and Civil Engineering	Mar Capeans Garrido
Technology	José Miguel Jiménez
Theoretical Physics	Gian Francesco Giudice

Department Head: Katy Foraz

Head of Department: *K. Foraz*
Deputy: *M. Nonis*

Department Head Office
(EN-HDO)
Assistant: *S. Escaffre*

Access and Alarms
(EN-AA)
GL: *P. Ninin*
DGL: *R. Nunes*

Accelerator Coordination & Engineering
(EN-ACE)
GL: *J.-Ph. Tock*
DGL: *S. Chemli*

Planning, Administration & Safety
(EN-PAS)
GL: *M. Nonis*
DGL: *S. Knoops*

Cooling & Ventilation
(EN-CV)
GL: *I. Ruehl*
DGL: *S. Deleval*

Information Management
(EN-IM)
GL: *D. Widegren*
DGL: *J. de Jonghe*

Electrical Engineering
(EN-EL)
GL: *N. Bellegarde*
DGL: *D. Ricci*

Handling Engineering
(EN- HE)
GL: *C. Colloca*
DGL: *C. Bertone*

Mechanical & Materials Engineering
(EN-MME)
GL: *S. ATIEH*
DGL: A. Bertarelli

- Operation
  - Infrastructure
  - Accelerators
- Projects
  - Consolidation
  - Upgrades
  - New facilities
  - Design & Manufacturing
- Studies

Who are we in EN?

24 Nationalities

AT	BE	BG	BR	CH	DE	DK	ES	FI	FR	GB	GR	HU	IN	IT	NL	NO	PK	PL	PT	RO	RU	SE	SK
3	18	3	1	19	9	3	34	8	184	10	3	3	1	42	4	3	2	17	17	3	1	2	1

Professional Category

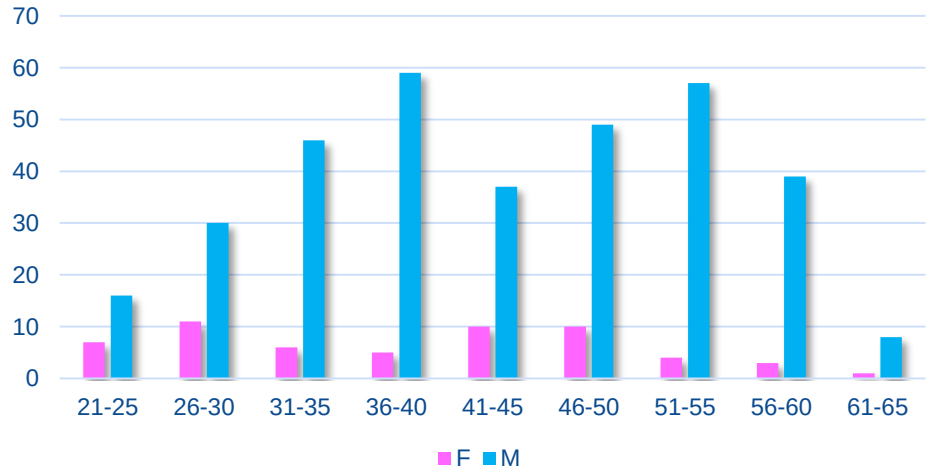
Administrative work	2	4%
Office & Administrative work	13	
Scientific & Engineering Work	182	47%
Scientific Work (Experimental & Theoretical Physics)	5	
Technical work	195	49%
Manual work, Crafts & Trades	1	

F	M
14%	86%

Status

Cooperation Associates	7
Doctoral Students	4
Fellows	37
Project Associates	17
Staff	320
Technical Students	6
Trainees	6
Administrative Student	1
TOTAL	**398**

Gender & Age



AA : Access and Alarms

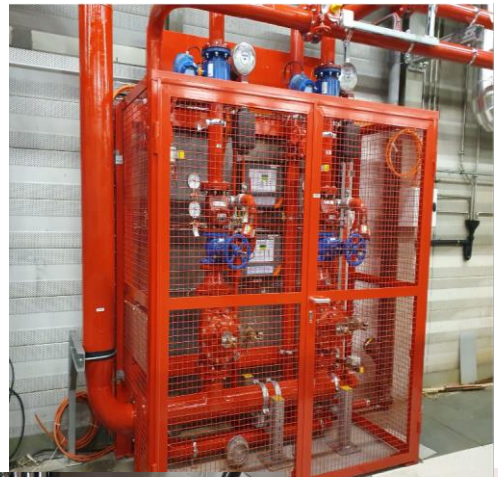
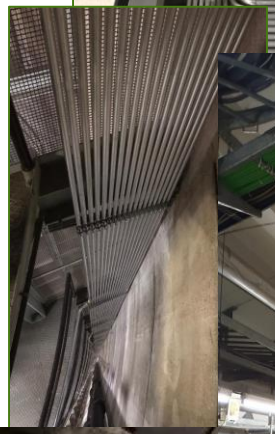
The AA group is in charge of the specification, engineering, installation and maintenance of the systems that ensures the Safety of the CERN Personnel, Users and Visitors, on all its site and facilities.
The Safety Systems concerns:

- *Fire and Gas/ODH detection, emergency phones and evacuation, alarm transmission and monitoring,*
- *Interlocks to protect people radioactivity, X rays, lasers, electricity and cryogenics hazards,*
- *Access control to all CERN conventional or nuclear facilities and sites,*
- *Video surveillance, protection and intrusion detection,*
- *Access data management applications.*

Group Leader
Pierre Ninin

SPS-FIRE Safety Project: new automatic fire detection & fire protection

SPS-ACCESS Project: new access and safety system to the SPS underground areas







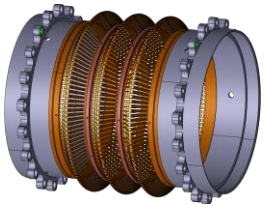


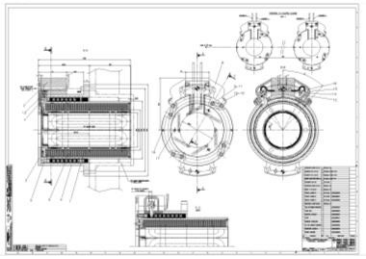
IM : Information Management

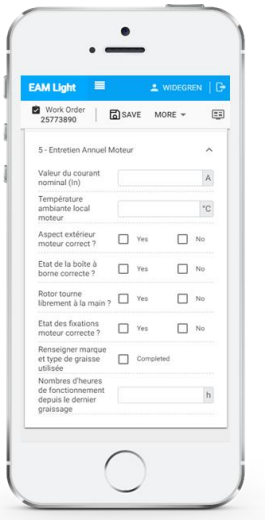
The IM group provides applications and support for engineering information management throughout the whole Organization and its different projects.

This includes for example mechanical CAD tools (such as CATIA), Product Lifecycle Management systems (Smarteam / Aras), the Engineering Data Management Service (EDMS) as well as the Enterprise Asset Management platform (Infor EAM).

The group helps implementing and configuring these tools according to user needs while ensuring that coherent processes are applied and provides user training.



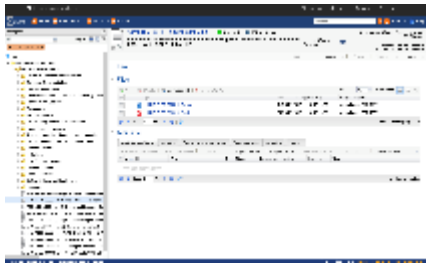


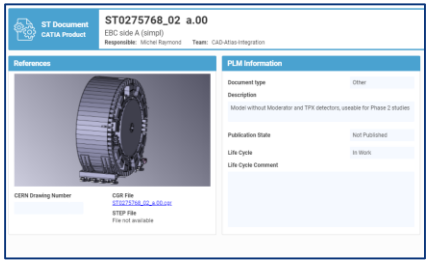


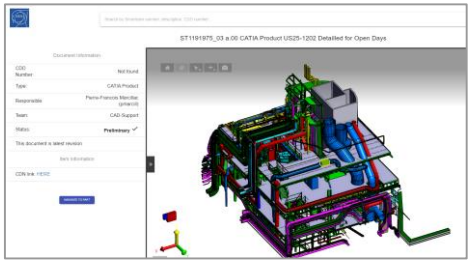
Group Leader
David Widegren

IM : Information Management

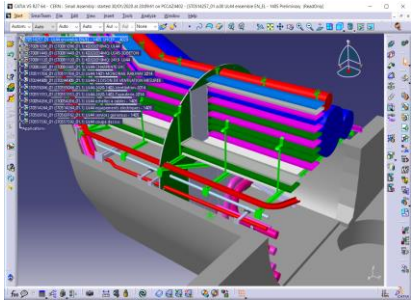
A key goal is to provide the tools required to manage and document the entire lifecycles of CERN's equipment and installations – also known as "Digital Thread".

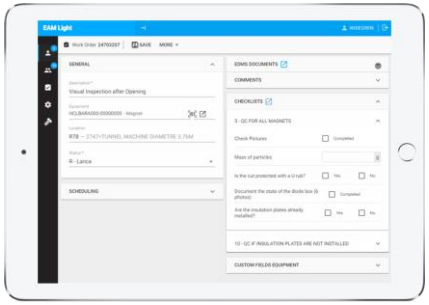






Specification & Requirements → Design → Manufacturing → Installation & Commissioning → Operation & Maintenance → Dismantling & Waste management





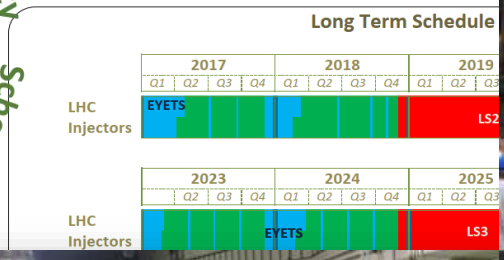
ACE : Accelerator Coordination & Engineering Group

The group coordinates the activities for the interventions and changes to the LHC and its injectors. This includes configuration & layout management, integration studies and maintenance of the related 3D-CAD representations, organization and scheduling of programmed stops, management of the mid- and long-term schedule, worksites follow-up and management of the LHC sites, management of electrical lock-out in LHC and operational safety coordination.

The group is responsible for the ATS Quality Service, giving support to the stakeholders of the ATS.

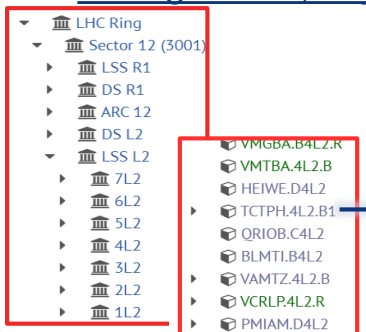
The group also provides support and/or advices in its key competencies.

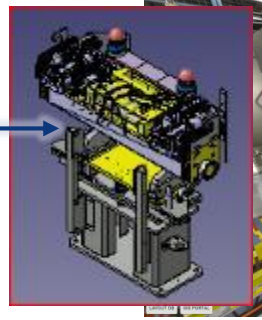
Group Leader
Jean-Philippe Tock

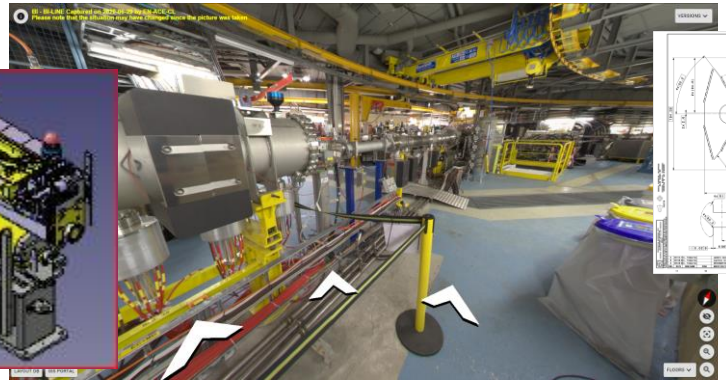


ACE : Accelerator Coordination & Engineering Group

Configuration, Layout, Naming and Integration

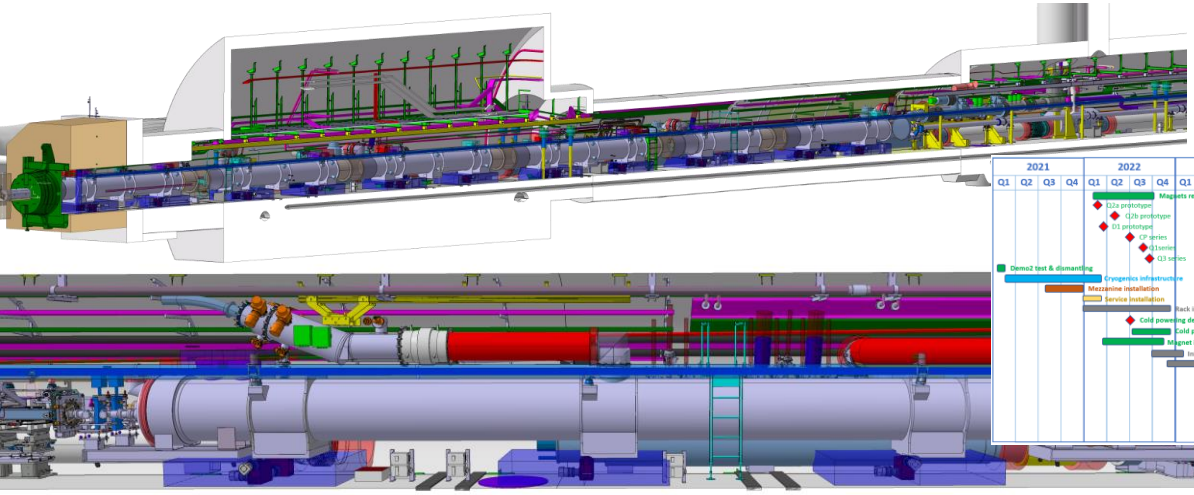


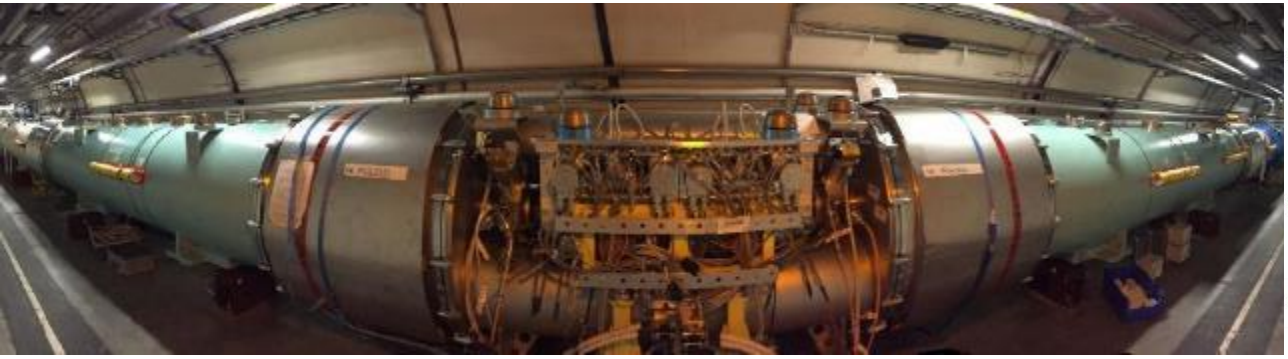


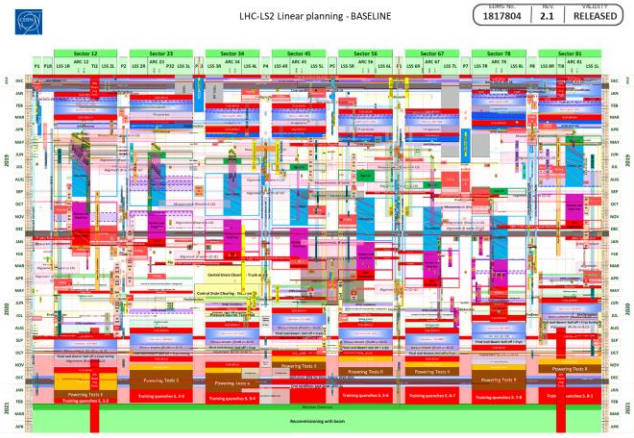


Specification Committee

Organisation and Scheduling



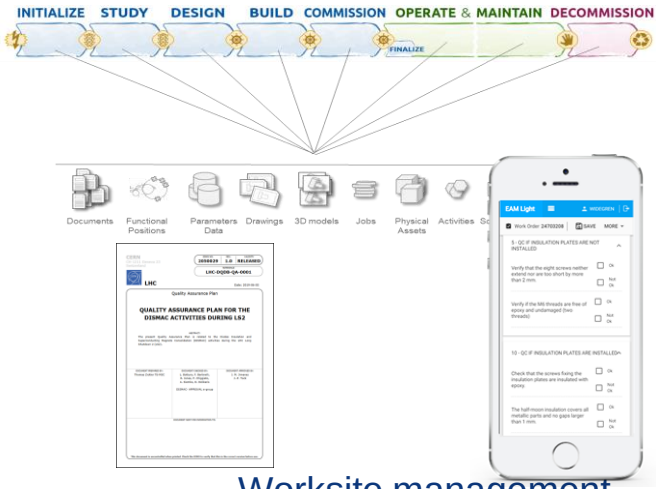




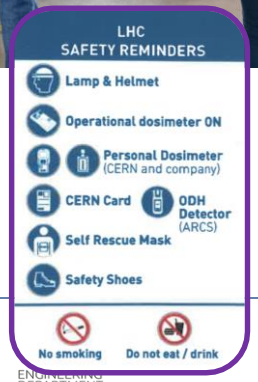
ACE : Accelerator Coordination & Engineering Group

Electrical lock-out

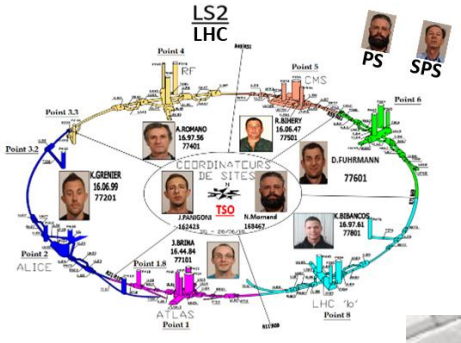
Quality Assurance Service

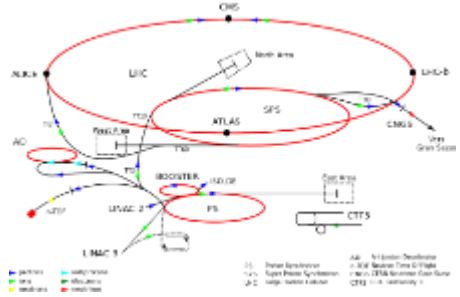


Operational Safety



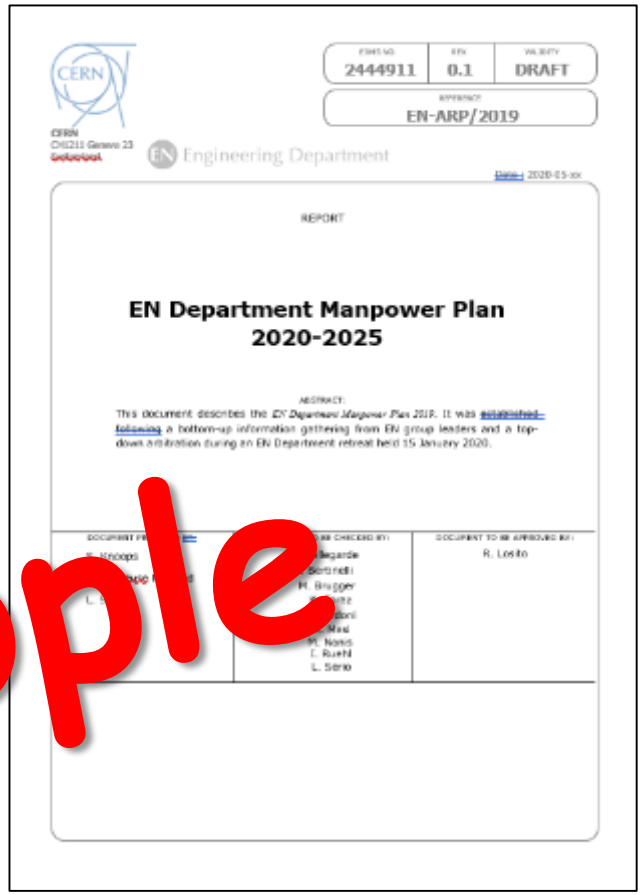
Worksite management





PAS : Planning, Administration and Safety

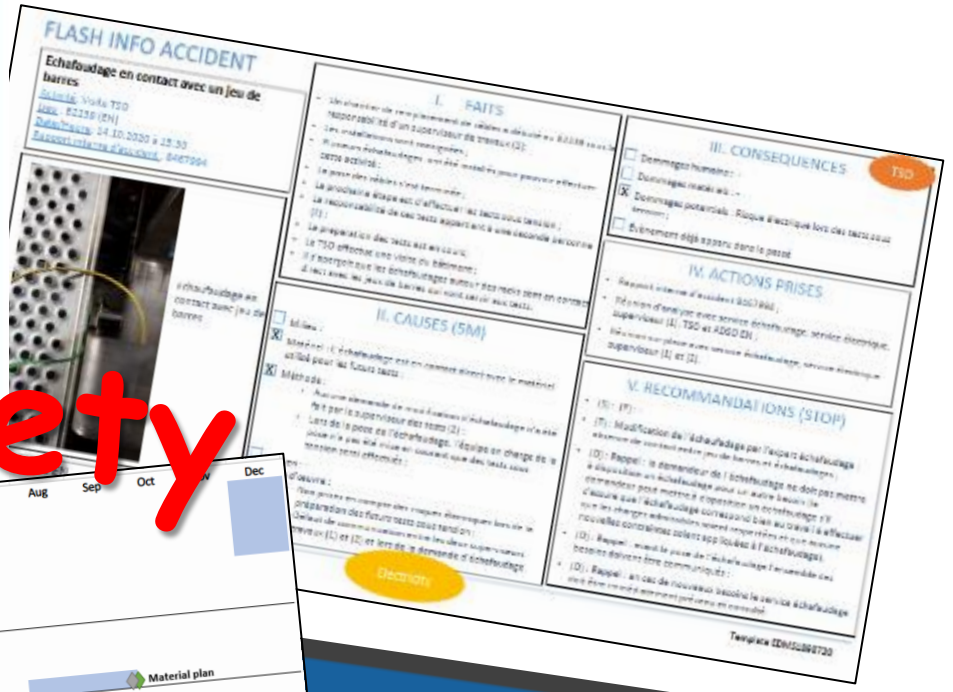
The group is responsible for supporting the Department Head in the management and planning of the department's **material and personnel resources**, as well as for all matters related to **safety and environment**. It represents the department in CERN-wide or inter-departmental bodies dealing with administrative, personnel, budget and safety matters. It also defines and implements safety and administrative procedures, for both the personnel and the material within the Department.



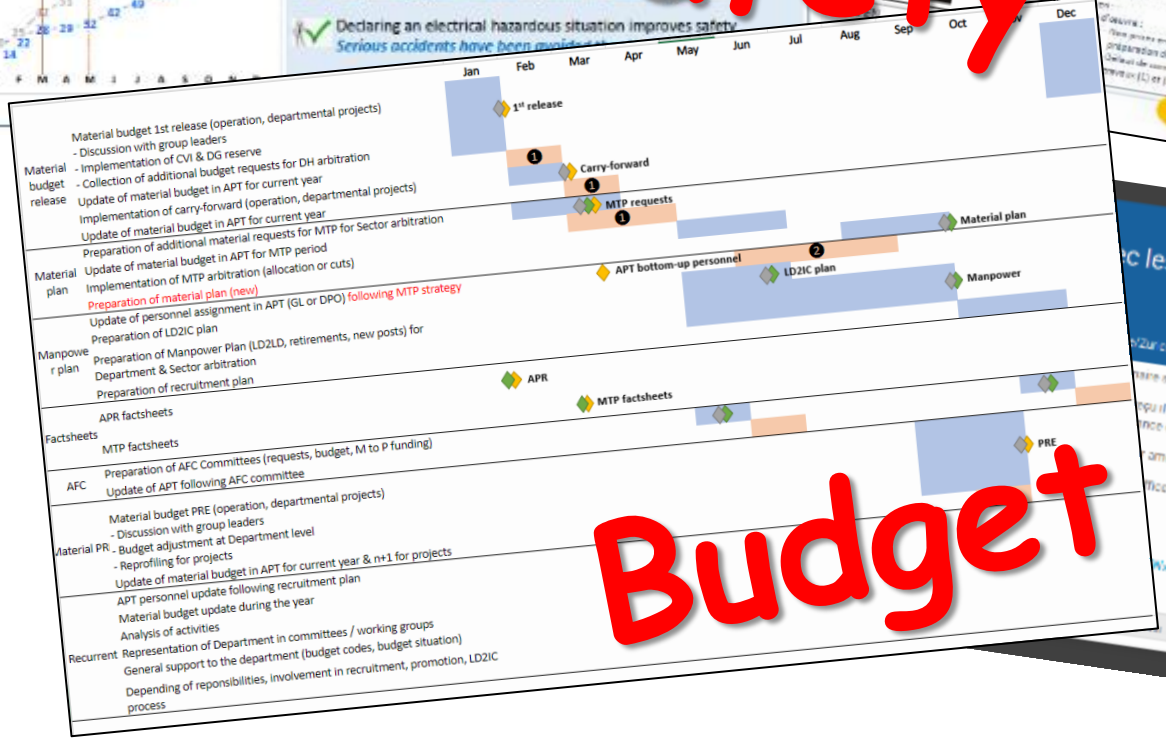
People

Group Leader
Mauro Nonis

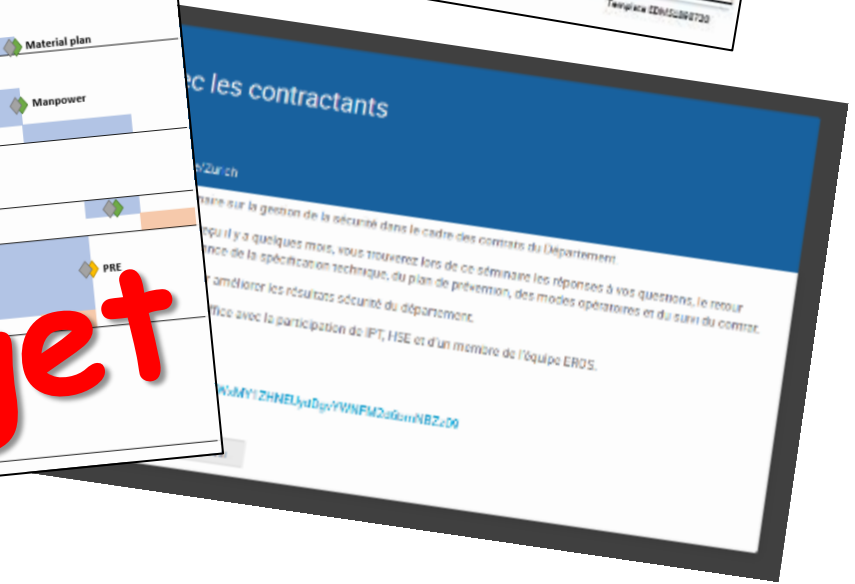
PAS : Planning, Administration and Safety



Safety



Budget



CV: Cooling and Ventilation Group

The group is in charge of:

- Design, installation, commissioning, operation and maintenance of the cooling systems, pumping stations, air conditioning plants and fluid distribution systems of all accelerators, their experimental areas and some of the special cooling systems of LHC sub-detectors.
- Computational fluid dynamics (CFD) simulations, as well as studies on fluid dynamics, ventilation, heat transfer, smoke behavior, gas and radio nuclides propagation are performed by the group.

Group Leader
Ingo Ruehl

Cooling

Cooling plants (raw, demin. water, C_3F_8, C_6F_{14})	150
Pipelines	800 km
Hydrants	800 points
Cooling towers (450 MW)	22
Chilled water plants 6-12 °C (73 MW)	35
Water consumption (peak)	1’260 m^3/h
Water network (3 pumping stations)	5’400 m^3/h

Equivalent to a small town of 25’000 inhabitants.
Annual consumption reduced by 40% in last 8 yrs.

Ventilation

Heating, ventilation and air conditioning	> 1’500 units from 2’000 to 120’000 m^3/h each
Compressed air	14 stations 200 km network

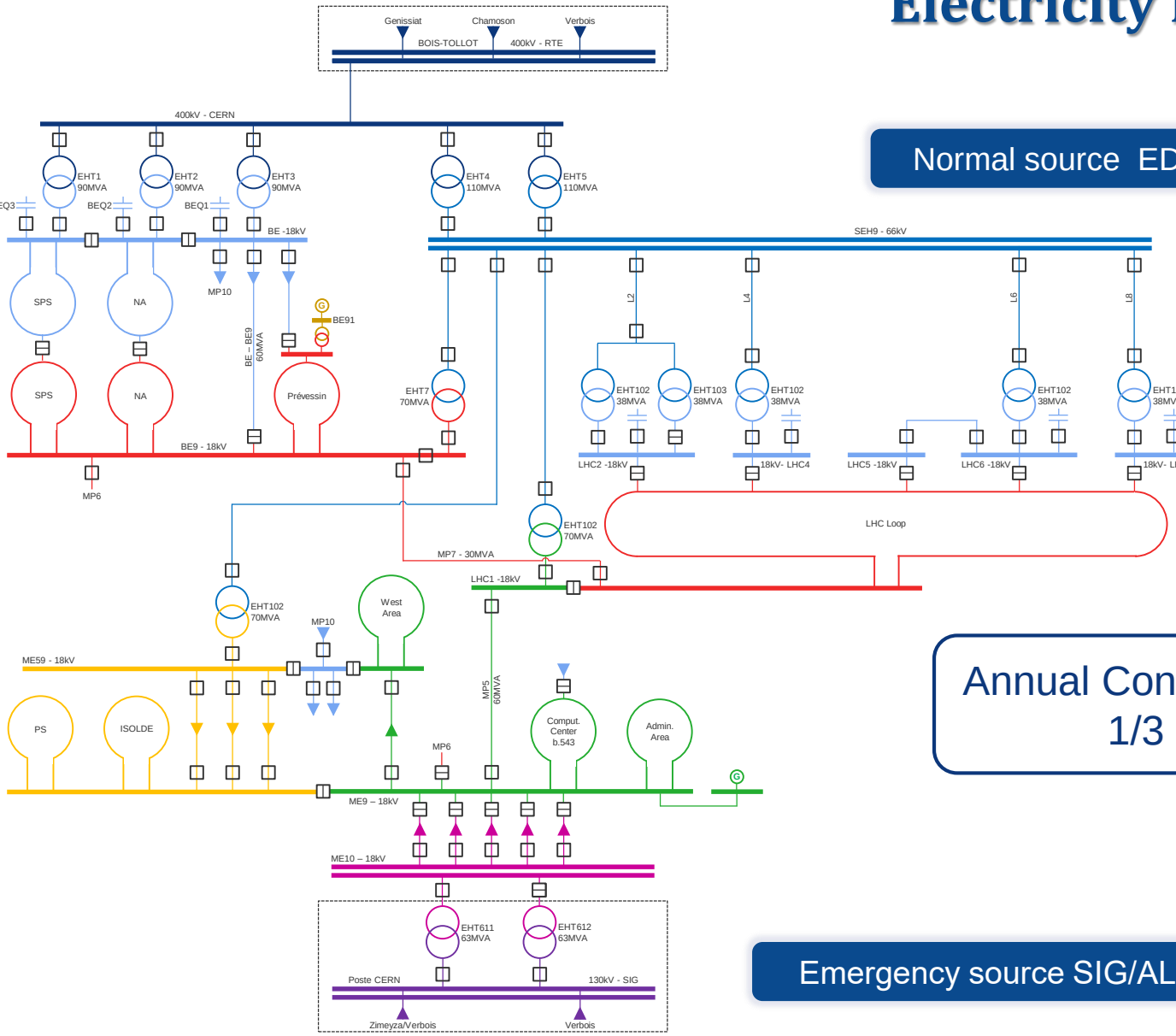
	km	m^3/h
Eurotunnel	50	*540’000*
LHC	27	*290’000*

EL : Electrical Engineering Group

The mandate concerns the **electrical distribution network** from 400 kV to 400/230 V. Its main missions are to operate, maintain, extend and renovate the network, analyse and make projections for CERN electrical energy consumption and manage relations with the energy suppliers.

Group Leader
Nicolas Bellegarde

Electricity Distribution



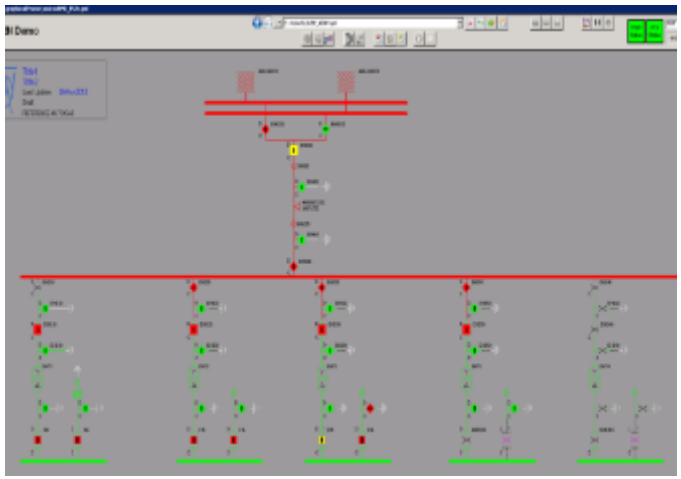
Normal source EDF > 200 MW

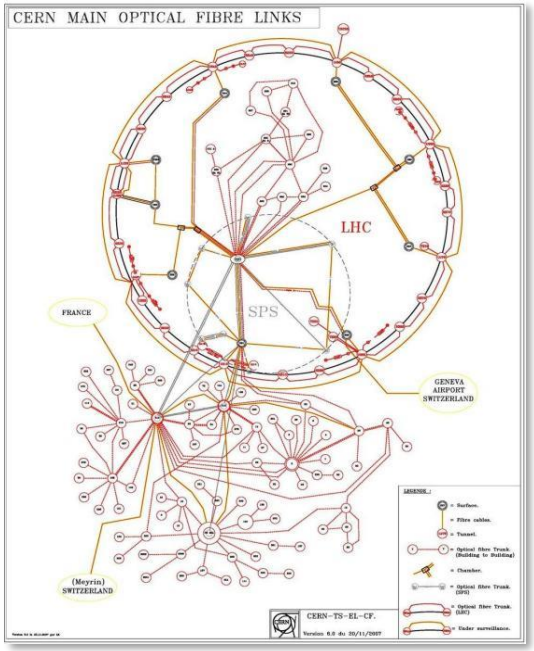
Annual Consumption 1.2 TWh
1/3 of Geneva

Emergency source SIG/ALPIQ ≤ 60 MW

EL : Electrical Engineering Group

The mandate also concerns the **cabling activities**. Its main missions are to install control cables, water cooled cables, and fibre optics for users. This activities include the management of infrastructures (cable trays, ducts, patch panels,etc.) and the necessary removal of old and unused installations.
EN-EL is also in charge of the controls of their distribution network.





HE : Handling Engineering Group







From enormous pieces of equipment with unconventional shapes, to extremely delicate detector parts, the careful handling and transportation of components is essential at CERN.

The Handling Engineering (HE) Group prepares, organizes and coordinates all transport and handling operations for the CERN accelerators and experiments as well as the transport of thousands of conventional items, chemical and radioactive products per year.

The Group is specialized in the design, integration and feasibility studies related to the transport and handling operations. Both standard industrial and custom-built transport and handling equipment is being procured, installed and commissioned.

The Group manages and maintains all the industrial transport, handling and lifting equipment to ensure the perfect performance all along its lifecycle.

With the accelerator complex deep underground and about 700 buildings on surface, both passenger and goods lifts are very important. The HE Group is responsible for the purchase, installation and maintenance of all of them, regularly checking their performance.

Group Leader
Cristiana Colloca



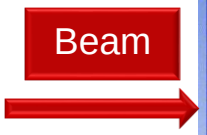


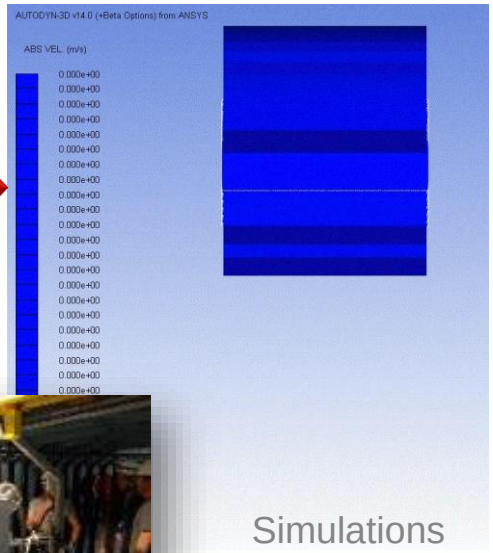

HE : Handling Engineering Group

MME: Mechanical and Materials Engineering Group

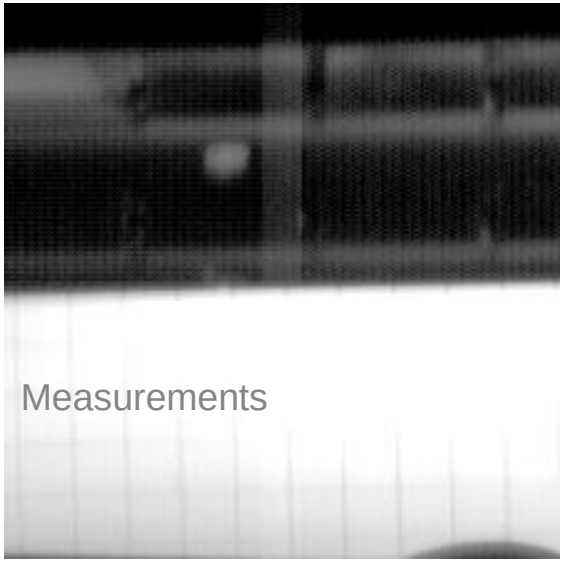
The mandate of the MME group is to provide to the CERN community specific engineering solutions combining mechanical design, fabrication and material sciences, using in-house and industry facilities, for beam accelerator components and physics detectors.

➲Prototypes and development work

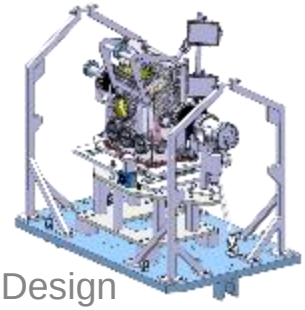




Simulations



Measurements

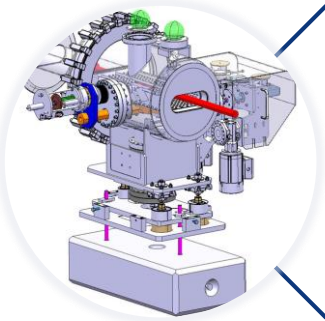


Design

Fabrication & Assembly

Group Leader
Said ATIEH

MME : Domains of activities



Design

- **Design Office**
  - 50+ designers and 15+ engineers
  - CATIA v5 / SmarTeam, ANSYS, LS-Dyna
- **Mechanical Measurements Lab.**

Fabrication

- **Mechanical workshop** (4000 m^2)
  - 60+ technicians and 10+ engineers
  - CNC machining
  - Assembly & metal forming
  - Metal Additive Manufacturing
  - Welding (TIG, MIG, electron beam, laser, vacuum brazing)
- **Technical Subcontracting unit**

Materials

- **Material science consultancy**
  - metallurgical analyses, microscopy including FIB, mechanical tests
- **NDT:** UT, radiography, microtomography
- **Metrology:** 350 m^2 Lab., several CMM

What are our priorities?

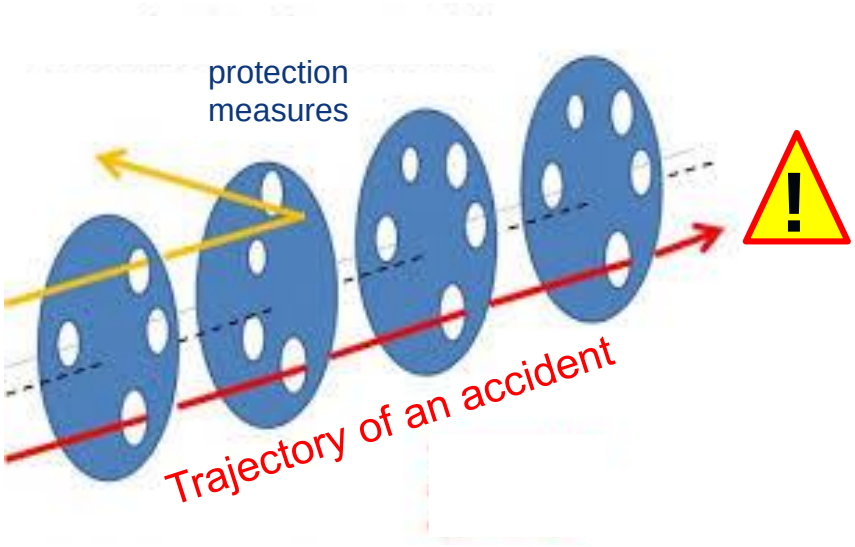
Our priorities

SAFETY: What do we mean?

Occupational Health, Safety and Environmental protection

We mean…

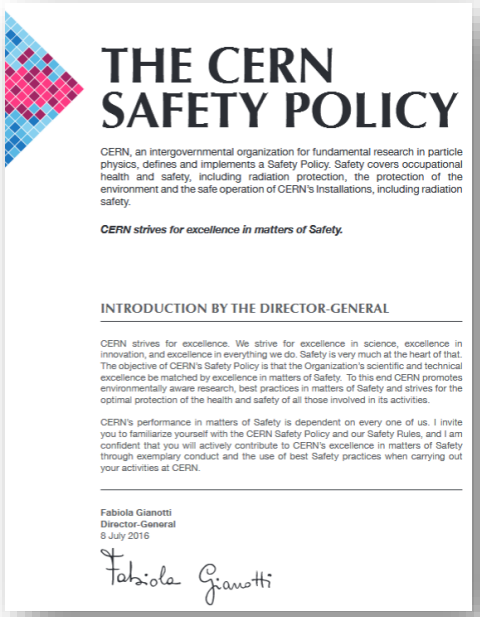
- Put in place all possible measures to prevent:
  - Accidents
  - Illnesses
  - Impact to the environment



Reason Swiss Cheese Model

RESPONSIBILITIES

- The Director General takes appropriate measures to ensure safety of all participating in the activities of CERN or present in its site
- Each Member of Personnel shall actively contribute to the implementation of CERN Safety Policy through an exemplary conduct, in particular:
  - Comply with Safety Rules and Safety Objectives
  - Actively seek information to minimize risks
  - Avoid hazardous situations



THE CERN SAFETY POLICY

CERN, an intergovernmental organization for fundamental research in particle physics, defines and implements a Safety Policy. Safety covers occupational health and safety, including radiation protection, the protection of the environment and the safe operation of CERN's installations, including radiation safety.

CERN strives for excellence in matters of Safety.

INTRODUCTION BY THE DIRECTOR-GENERAL

CERN strives for excellence. We strive for excellence in science, excellence in innovation, and excellence in everything we do. Safety is very much at the heart of that. The objective of CERN's Safety Policy is that the Organization's scientific and technical excellence be matched by excellence in matters of Safety. To this end CERN promotes environmentally aware research, best practices in matters of Safety and strives for the optimal protection of the health and safety of all those involved in its activities.

CERN's performance in matters of Safety is dependent on every one of us. I invite you to familiarize yourself with the CERN Safety Policy and our Safety Rules, and I am confident that you will actively contribute to CERN's excellence in matters of Safety through exemplary conduct and the use of best Safety practices when carrying out your activities at CERN.

Fabiola Gianotti
Director-General
8 July 2016

Fabiola Gianotti

RESPONSIBILITIES in matters of safety **CANNOT BE DELEGATED**

MAGIC OF CERN

- Science is an extraordinary human endeavor
- Our understanding of nature at the fundamental level has reached astounding results
- The complexity of science requires a combined effort **technology + experiments + theory**

- CERN is a superb example of this combined effort at work

The scientific success of CERN belongs to all of us

Warm welcome again!