

CERN

European Organization for Nuclear Research

Organisation Européenne pour la Recherche Nucléaire

Keynote address on Safety of CERN underground research complex

F.Corsanego

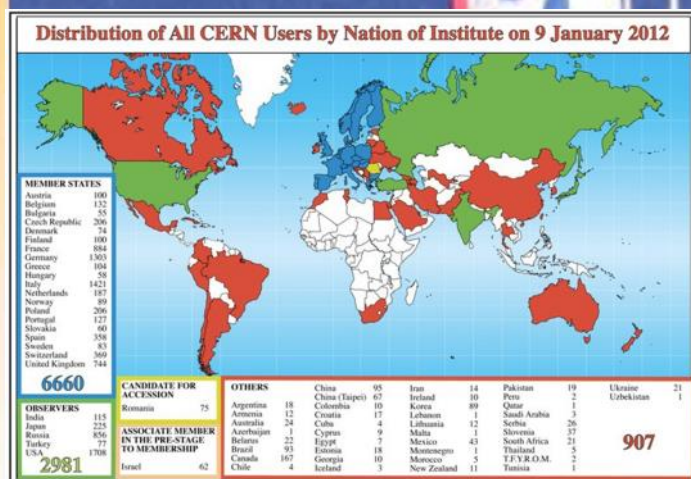
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CERN DGS—Occupational Health and Safety and
Environmental Protection Unit



« ..an institution where it would be possible to do scientific work beyond the framework and limits of national laboratories.» *L.De Broglie CERN 1st Proposal»1949*

2512 Staff,
912 Fellows and Associates,
10829 users,
Budget (2012) 1165.9 MCHF



Member States: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Observers to Council: India, Israel, Japan, the Russian Federation, the United States of America, Turkey, the European Commission and Unesco



The tool is particle accelerator (..a very powerful microscope)



Instruments

Big Bang

10^{-34}

10^{-30}

10^{-26}

10^{-22}

10^{-18}

10^{-14}

10^{-10}

10^{-6}

10^{-2}

10^2

10^6

10^{10}

10^{14}

10^{18}

10^{22}

10^{26}

10^{30}

Observables

SUSY particle?

Higgs?

Z/W

Proton

Nuclei

Atom

Virus

Cell

Earth radius

Earth to Sun

Galaxies

Radius of
observable Universe



Accelerators
LHC
LEP



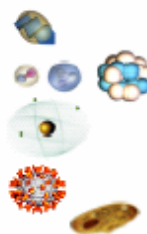
(Particle beams)
Electron
Microscope
Microscope



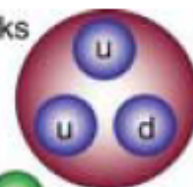
Telescope



Radio
Telescope



Quarks

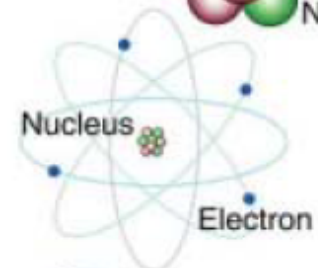


Proton



Neutron

Nucleus



Electron

Atom

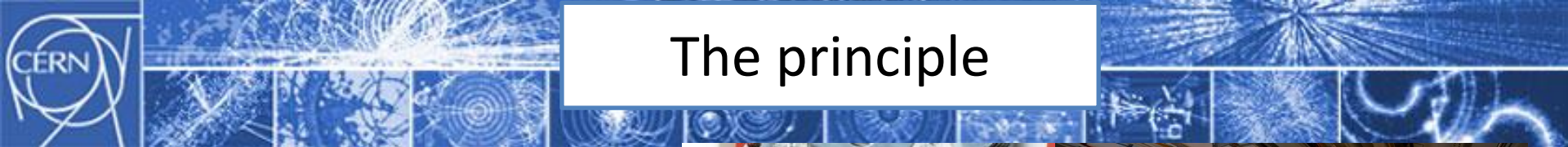


Molecule

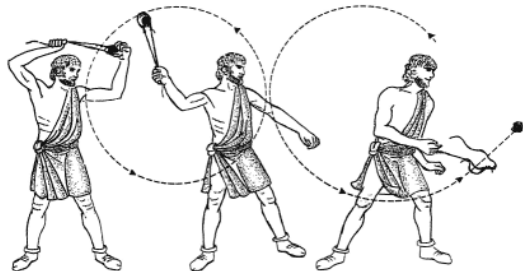


Matter

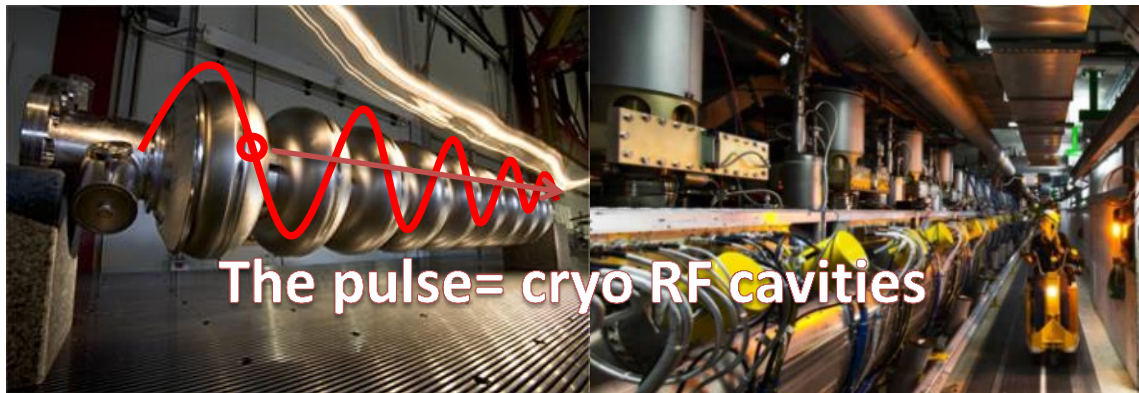




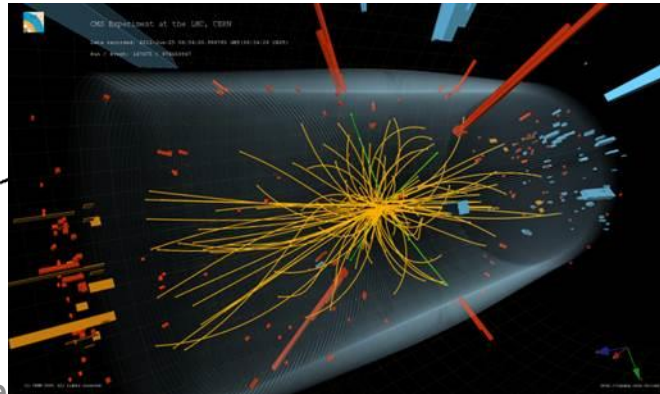
The principle



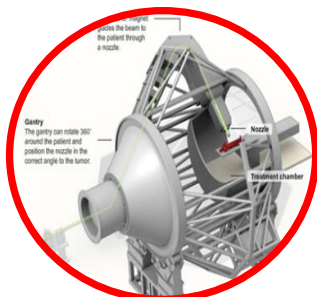
Ernest Lawrence – 1930:
“Whirling particles around to boost their energies, then casting them toward a target like stones from a slingshot is the most effective way to smash open atomic nuclei.”



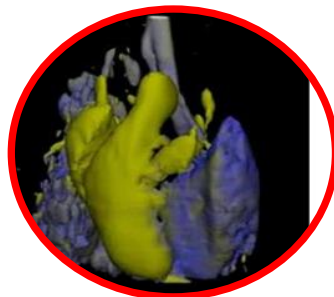
The bullet:
a charged particle
He source



The tools do not exist, scientist and engineers have to create them.
This technological effort has important return for everyday life:



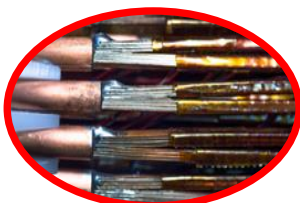
Beam:
Protontherapy



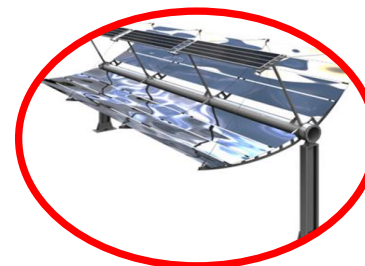
**Solid State Detectors: diagnostic
imagery (spectral radiography,
PET/CT, etc.)**



**IT: ww web,
supercomputing grid**



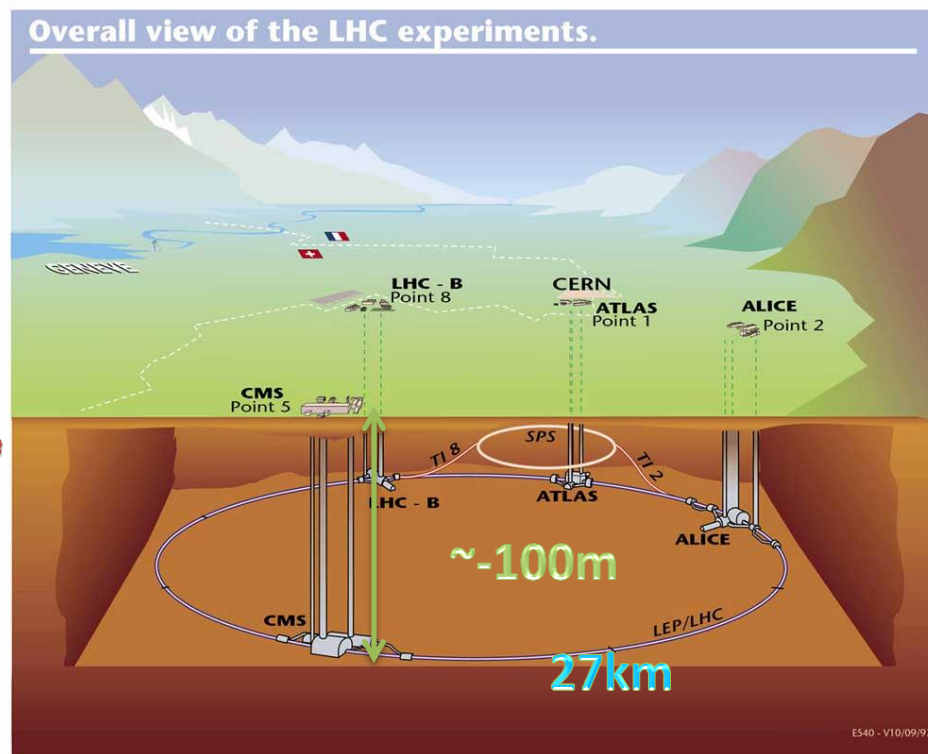
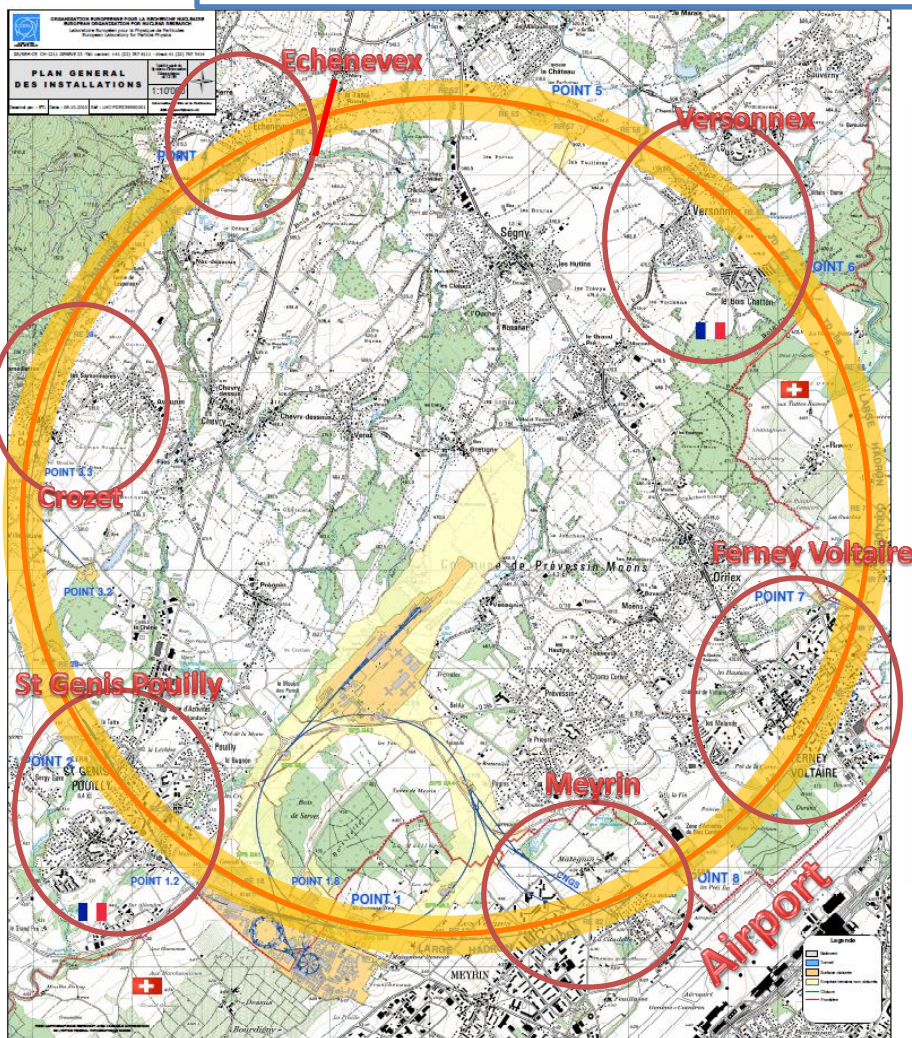
Superconductors:
lossless power transmission



UHVacum: high efficiency solar panels

These technologies are available to industry: <http://knowledge-transfer.web.cern.ch>

Being underground is not a choice for us- it is a must

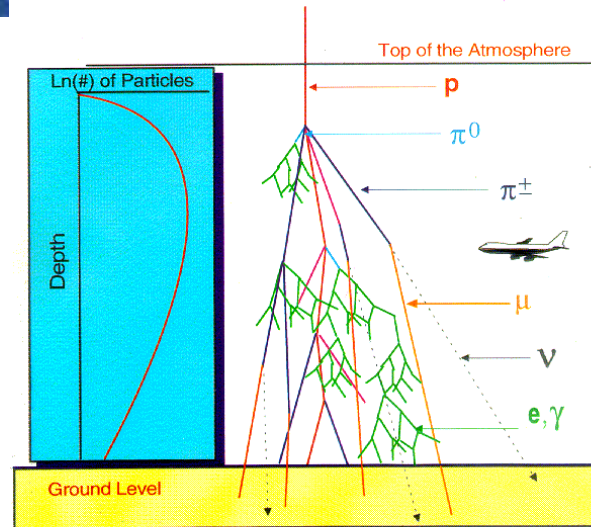


Putting the machine underground allows LHC to have a negligible environmental impact.

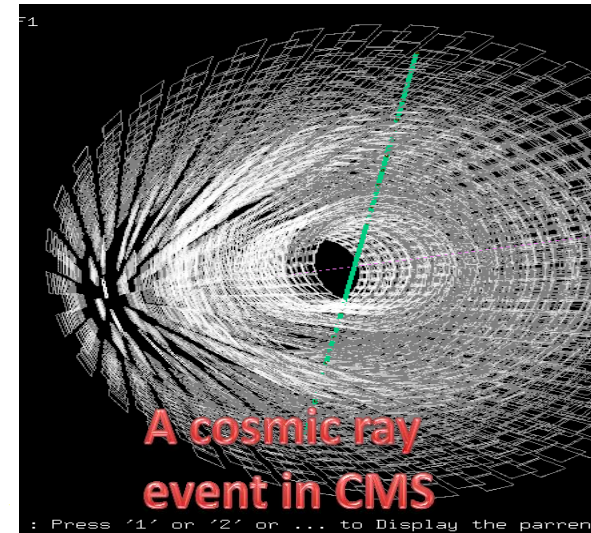
Why underground-2?

To screen the particle detectors from cosmic rays (high energy protons of cosmic origin)

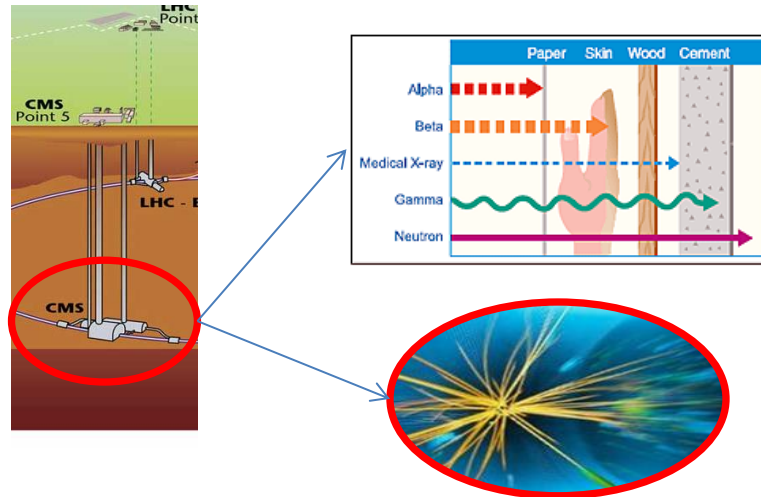
For 1 GeV particles, the rate is about 10,000 per square meter per second



Extensive Air Showers

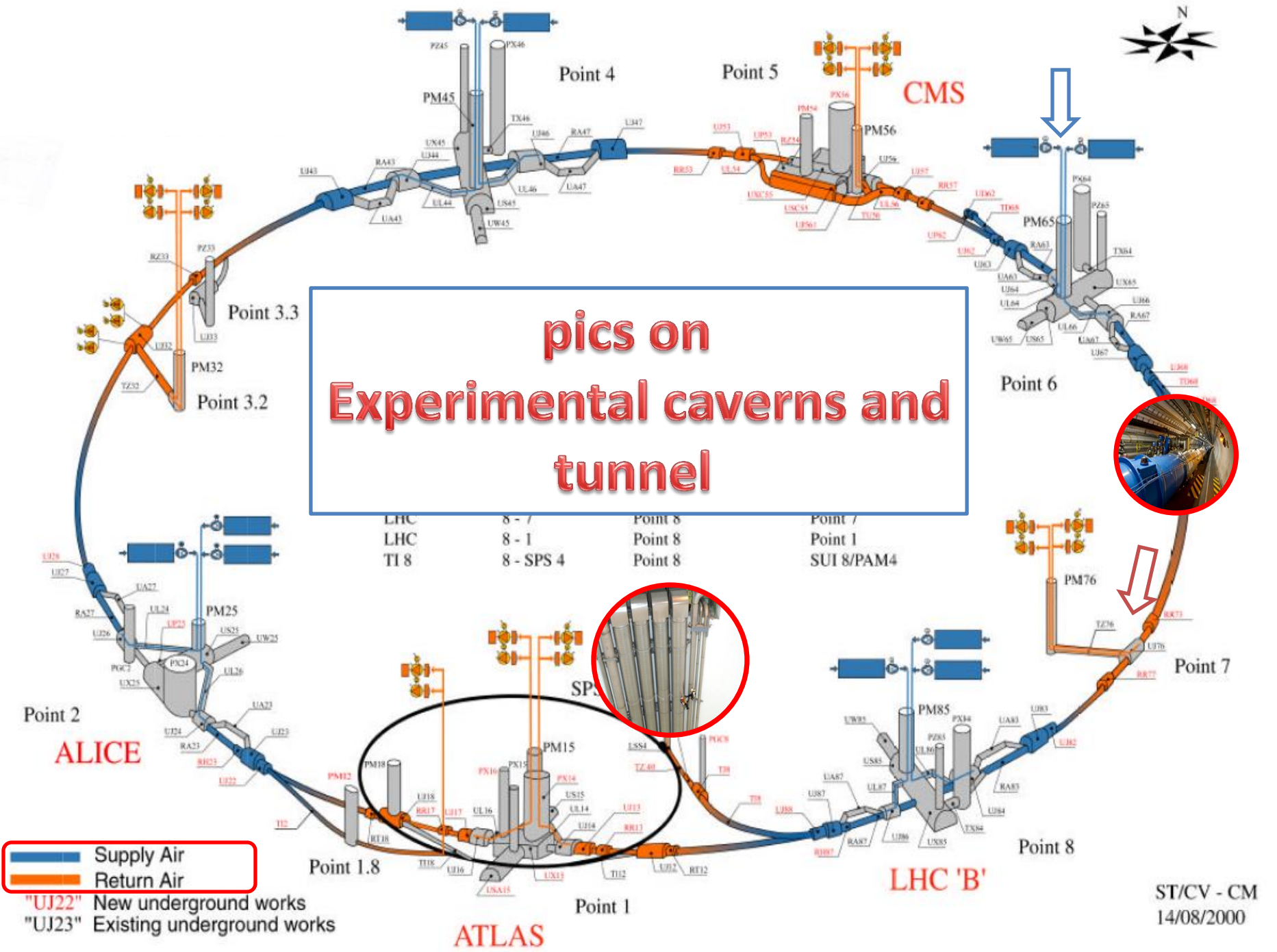


- To stop the particle produced by the collision





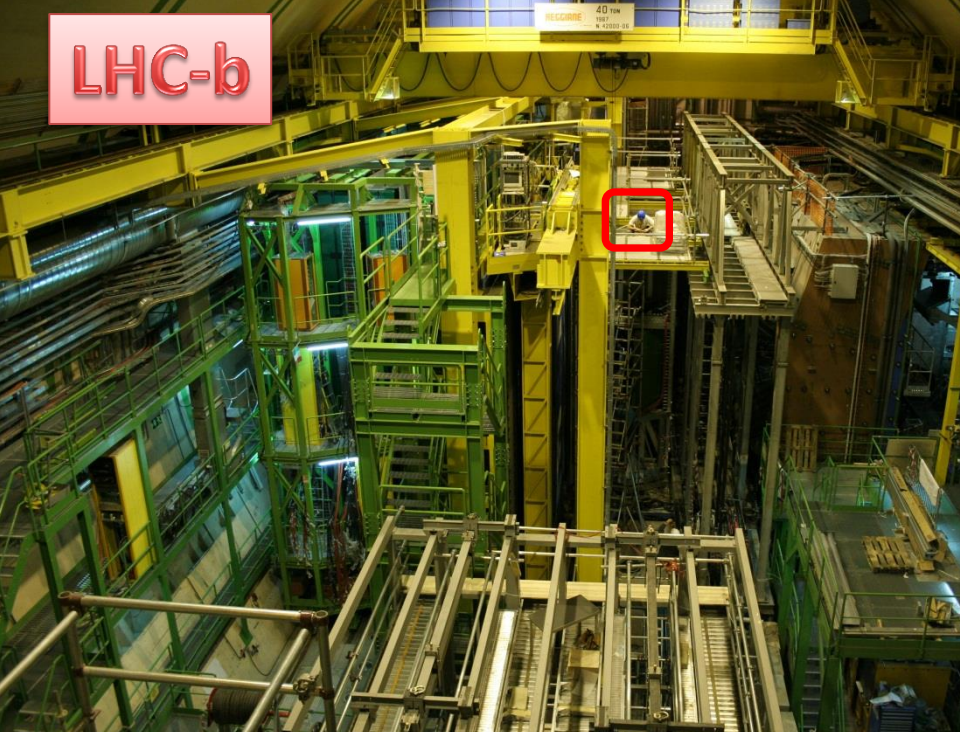
**pics on
Experimental caverns and
tunnel**



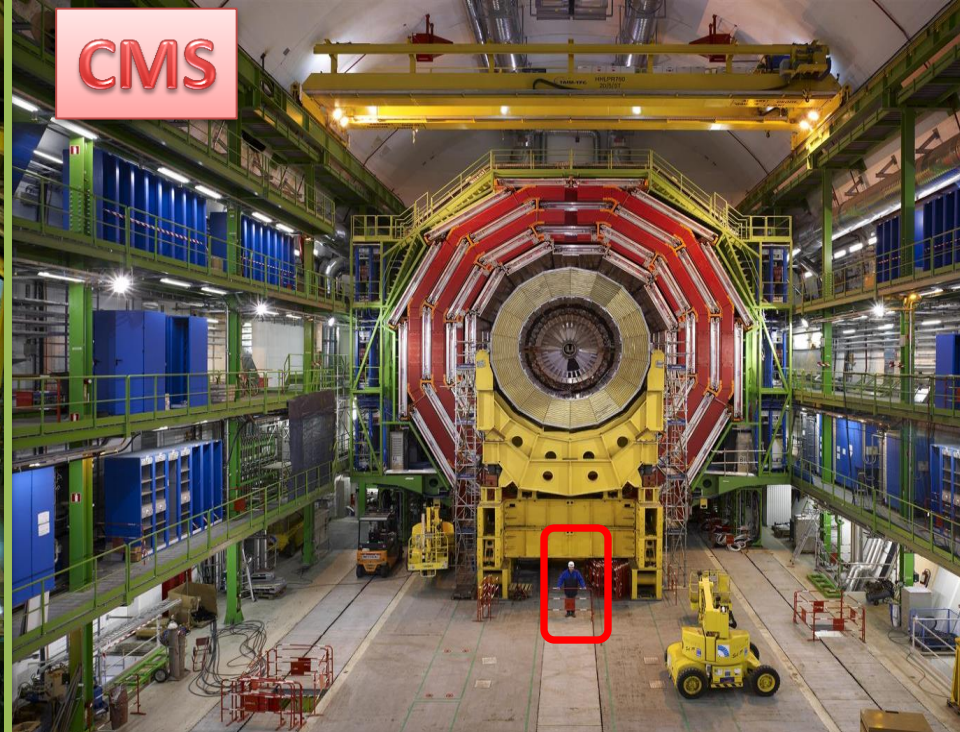
Supply Air
Return Air

"UJ22" New underground works
"UJ23" Existing underground works

LHC-b



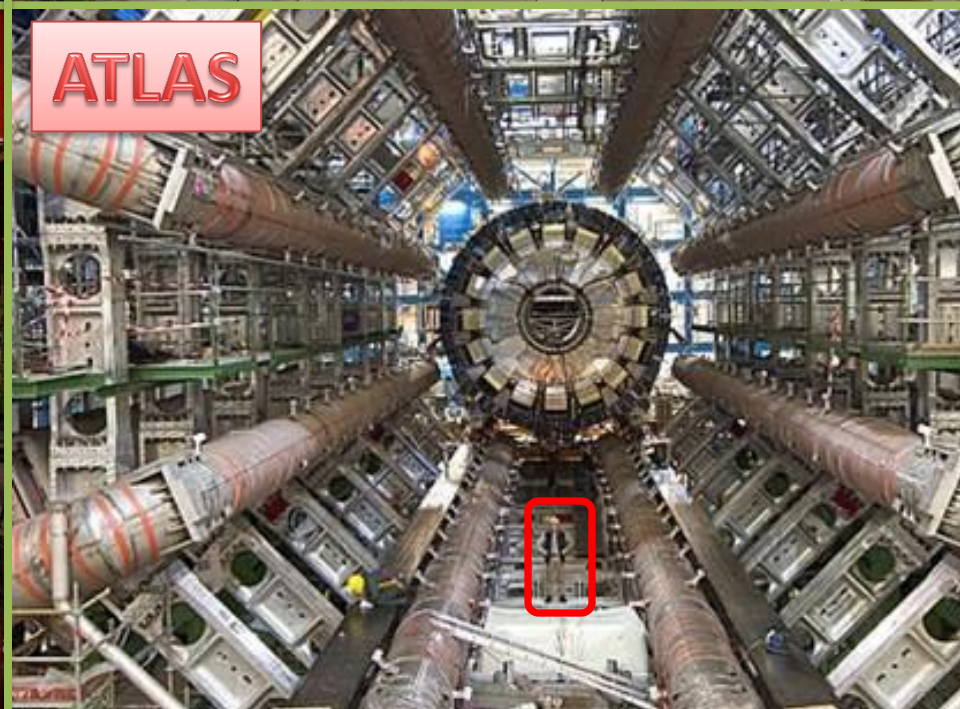
CMS



ALICE

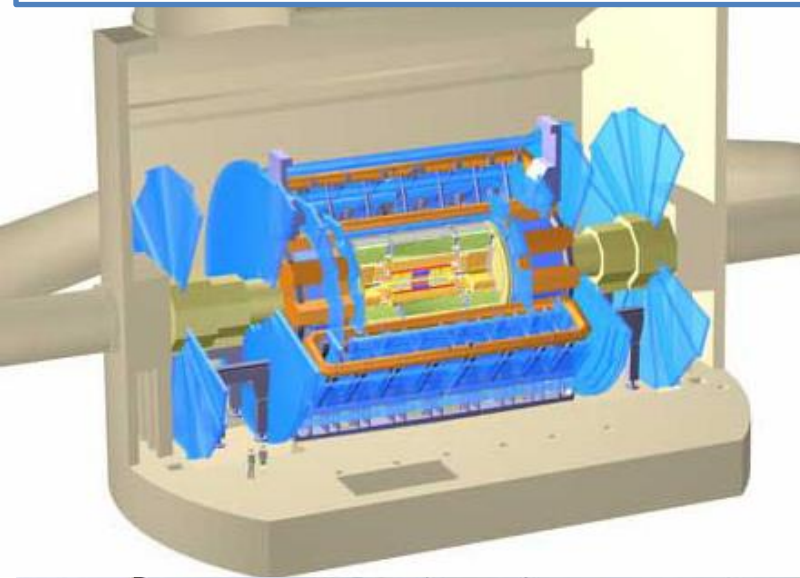


ATLAS

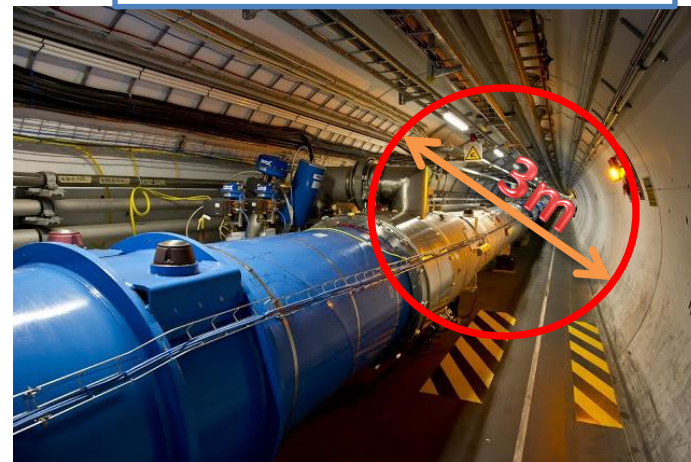


Dimensions of the caverns

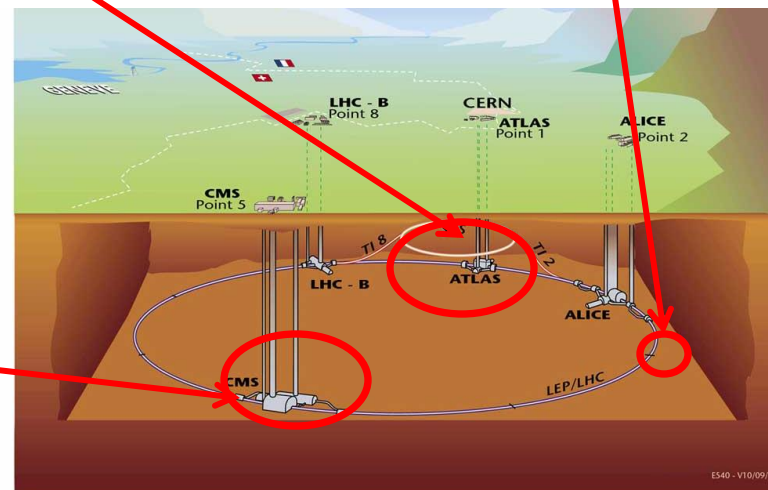
ATLAS: 55 m long, 35 m wide, and 40 m high;



LHC Standard Section



CMS: 53 metres long, 27 metres wide and 24 metres high.





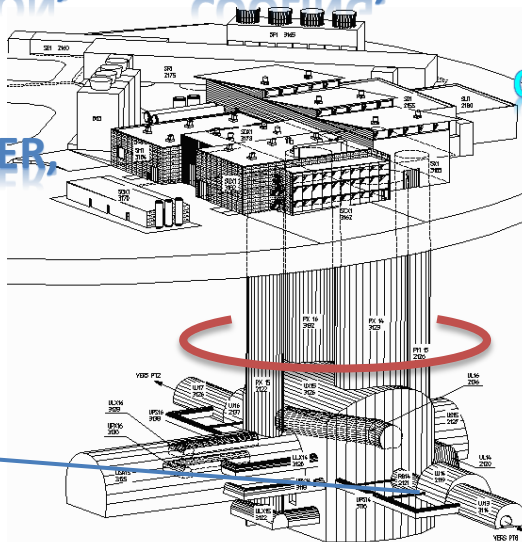
The accerator has also service infrastructures on surface



Example point 1/8



ACCESS CONTROL
VENTILATION, COOLING,
POWER, OPERATION CONTROL



Power & control lines,
pressurized lifts,
stairs, ducts, etc.



F.Corsanego

What is operation for us? 1/2



What is operation for us? 1/2

Beam on- data acquisition:

- Everybody out, access prevention;
- Monitoring effluents levels against environmental limits,
- Monitoring the machine and react to anomalies or incidents.



What is operation for us? 2/2



What is operation for us? 2/2

Beam off – maintenance:

- Plan before doing;
- Access restrictions;
- Personal radiological dosimetry;
- Training for emergencies.

Two main hazards- cryogenic spill and fire



Criogenic leak > risk of Oxygen lack

- 96 t of liquid Helium in the accelerator tunnel
- ~ 100 t of liquid Argon, Helium, Nitrogen in the 4 experiments

Risk of lung cold burns and risk of asphyxiation

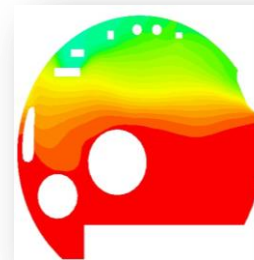


Amongst the measures:

Helium spills simulations and test,

Oxygen lack sensors,

Personal breathing equipment.



Training on Emergency Self-Contained Breathing Apparatus

Eloignement de la source :
120 mètres / 50 secondes

**We control the access.
No p.p.e. or no training?
no entry**

8. Mettre les lunettes

4. Vérifier le sens du masque,

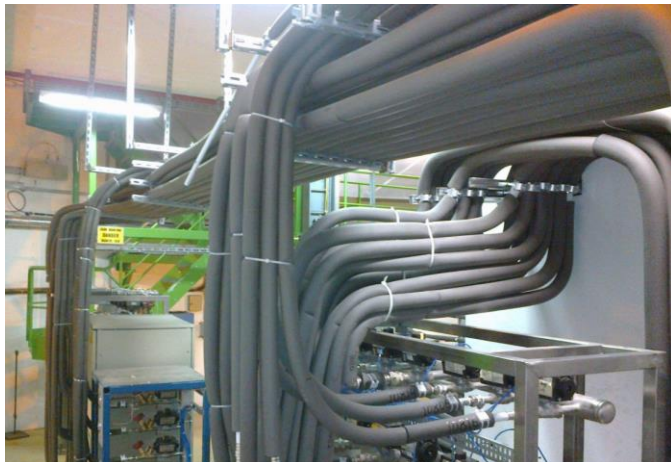
LA MISE EN PLACE DU MASQUE
SE FAIT **CALMEMENT**
EN MOINS DE **40 SECONDES**

Fire hazard



Standard LHC sections have quite low fire load

The largest fire load in experiments & facilities is made by hundreds thousands km of cables.



Pipes insulation



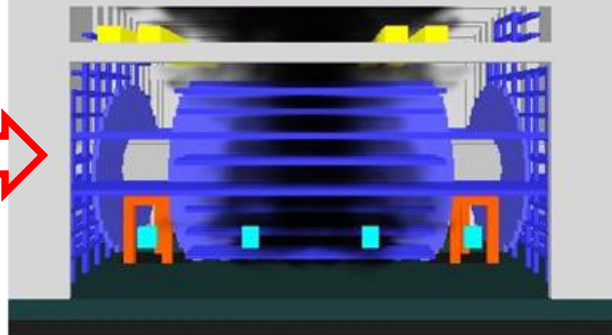
F.Corsanego



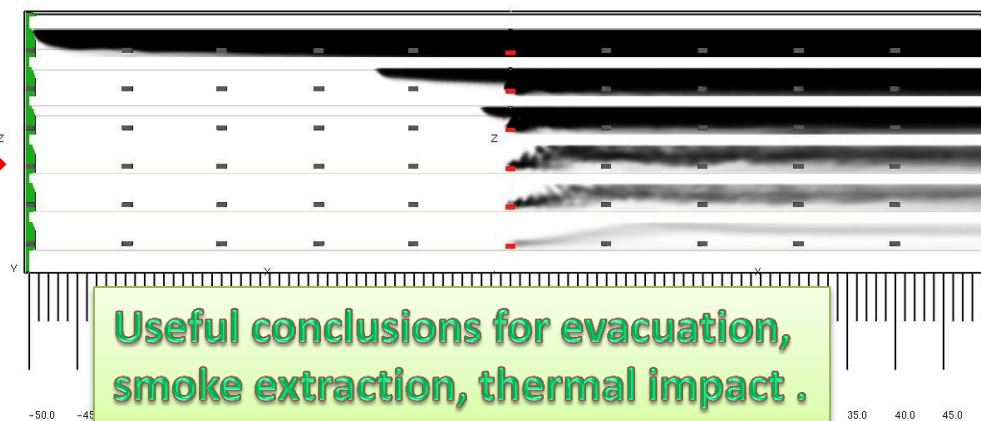
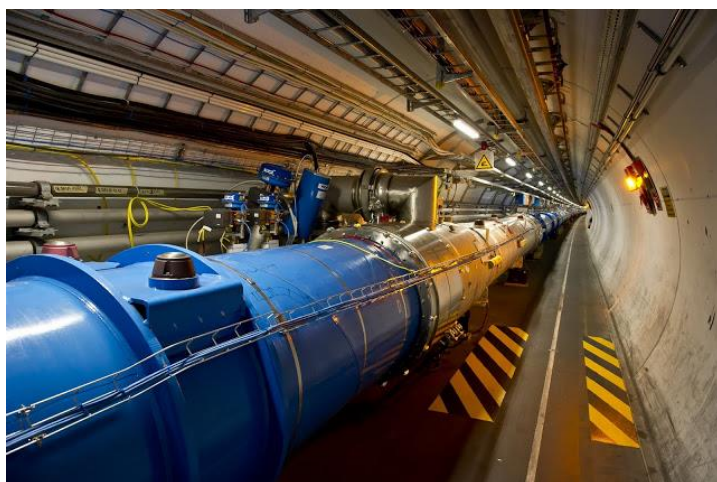
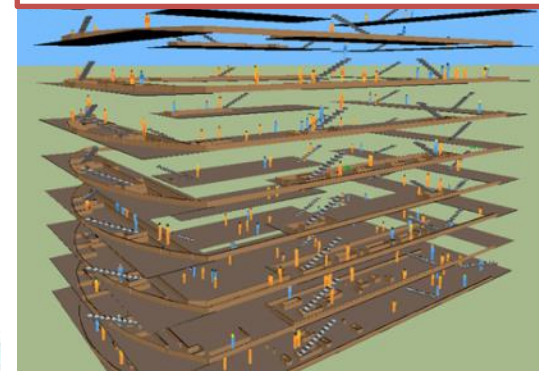
Fire scenarios are assessed with the help of CFD



Fire CFD simulation



Evacuation simulation





CERN Alarm System

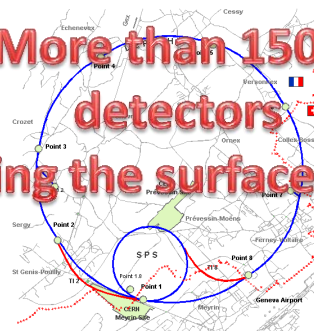


Fire Brigade bld.65 (AI3)



CERN Control
Centre Prevessin

**More than 15000
detectors
(including the surface facilities)**



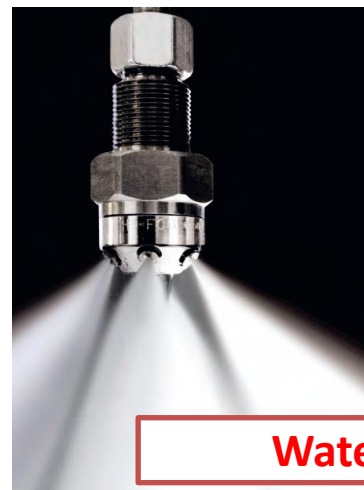
Map of CERN sites and LHC access points

**High sensitivity optical
smoke detectors**

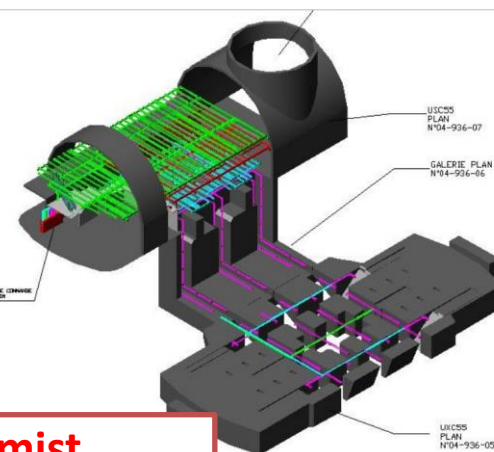


Fire fighting

Onsite fire brigade



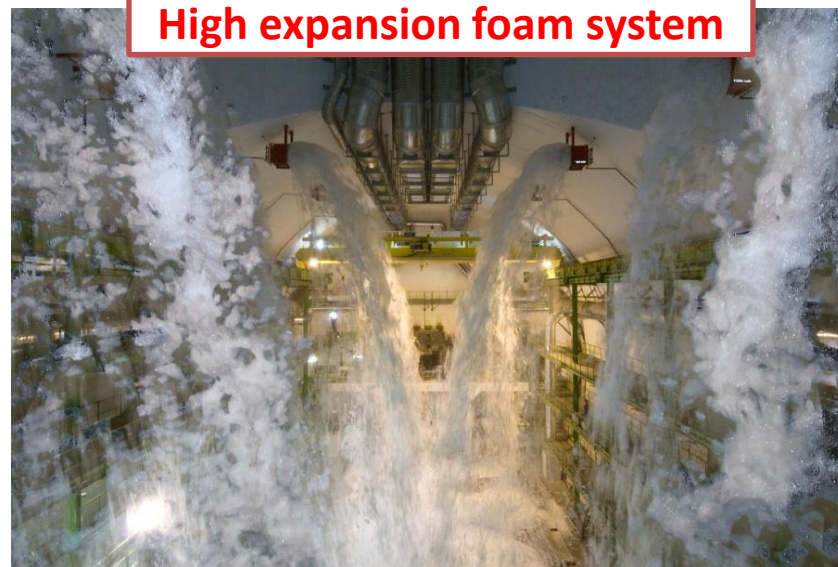
Watermist



CO₂



High expansion foam system



Communication warning systems

evacuation alarm



Mobile telecom, leaky feeder cable



Red phones



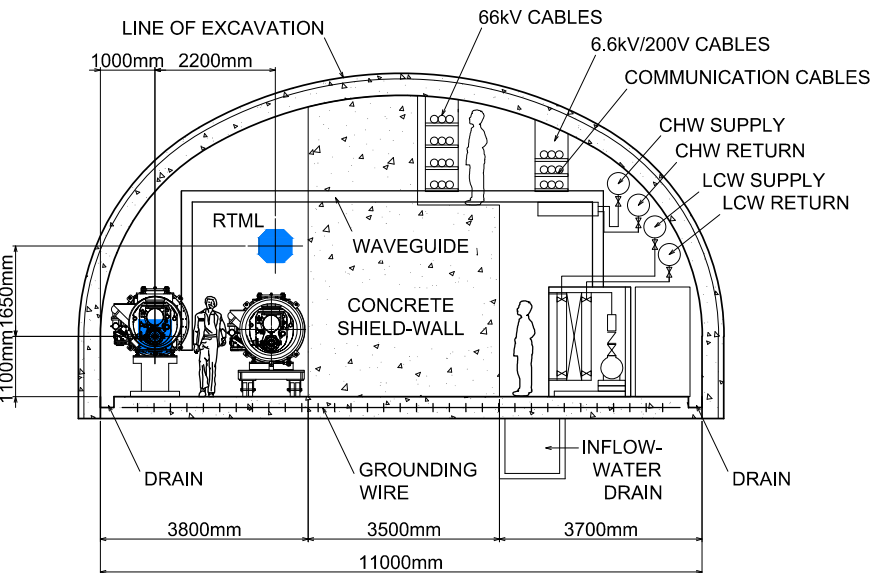
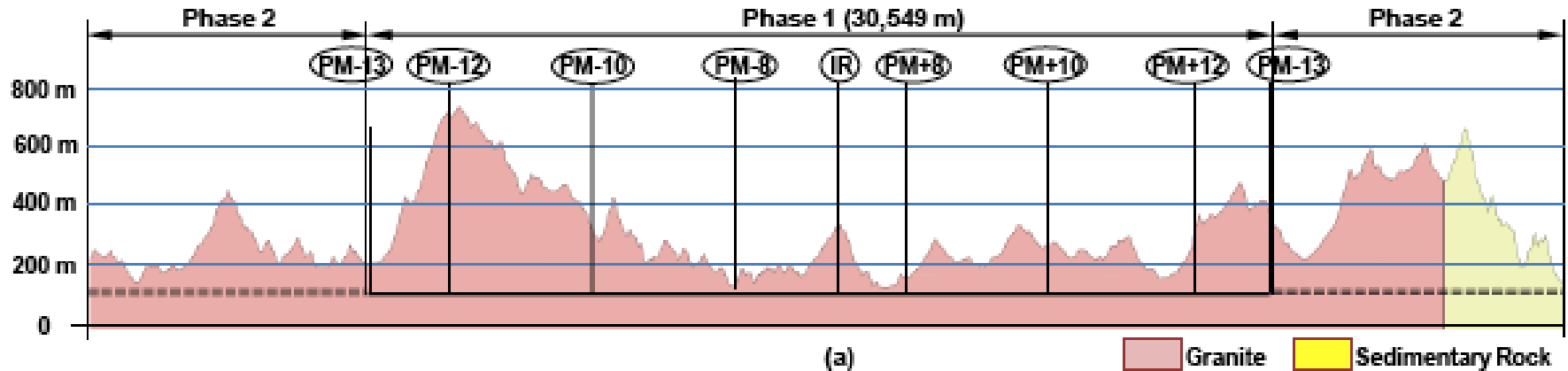
**Terrestrial
trunked radio**





Outlook on future projects

Outlook on Potential Future Physics Projects e.g. ILC Japan



Two Candidate Site in Asian Region - Japanese Mountainous Sites -

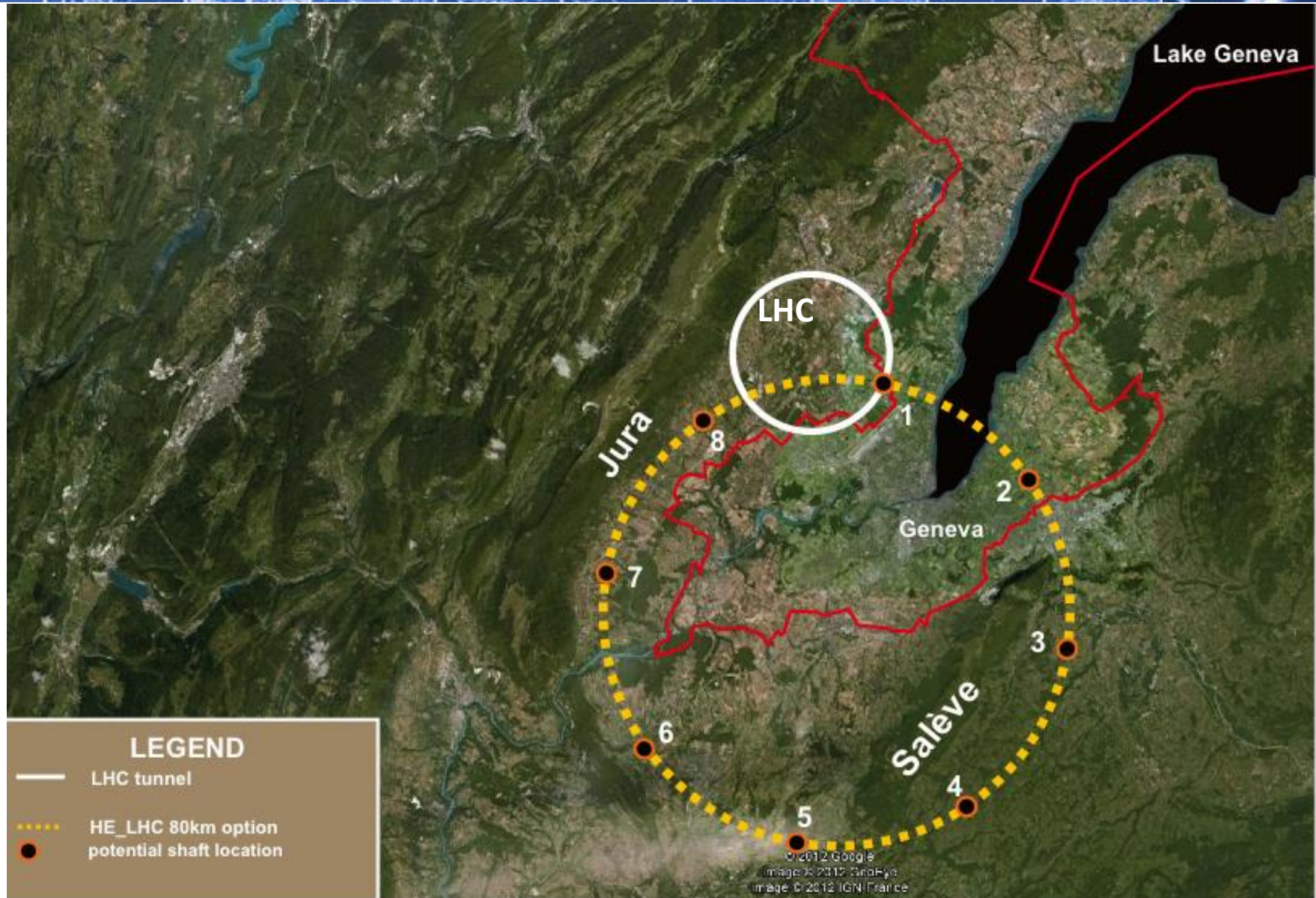


Contact :

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Potential Future Physics Projects

e.g. CERN High Energy LHC 80km tunnel in Geneva Region

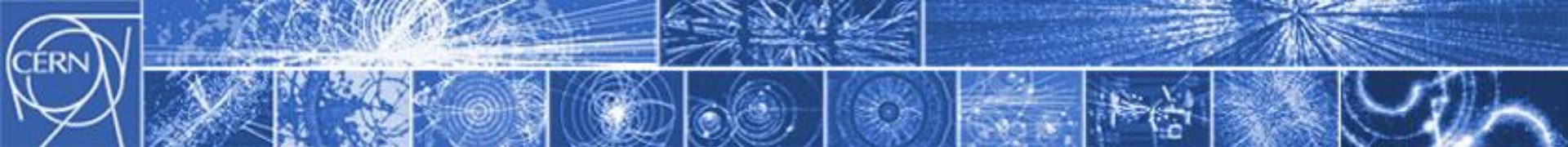


Contact :

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conclusion

- A large underground facility with complex multidisciplinary safety challenges;
- Most of the time no people underground;
- World wide collaborations in different disciplines of physics and engineering to develop new technologies.



Thank you. Questions?

Geneva, September 28th – 29th

CERN OPENDAYS

Our Universe is Yours
Notre Univers est le vôtre



<http://opendays2013.web.cern.ch/>