Presentation to the event: «Lithuanians at IdeaSquare»

CERN Knowledge Transfer Accelerating Innovation

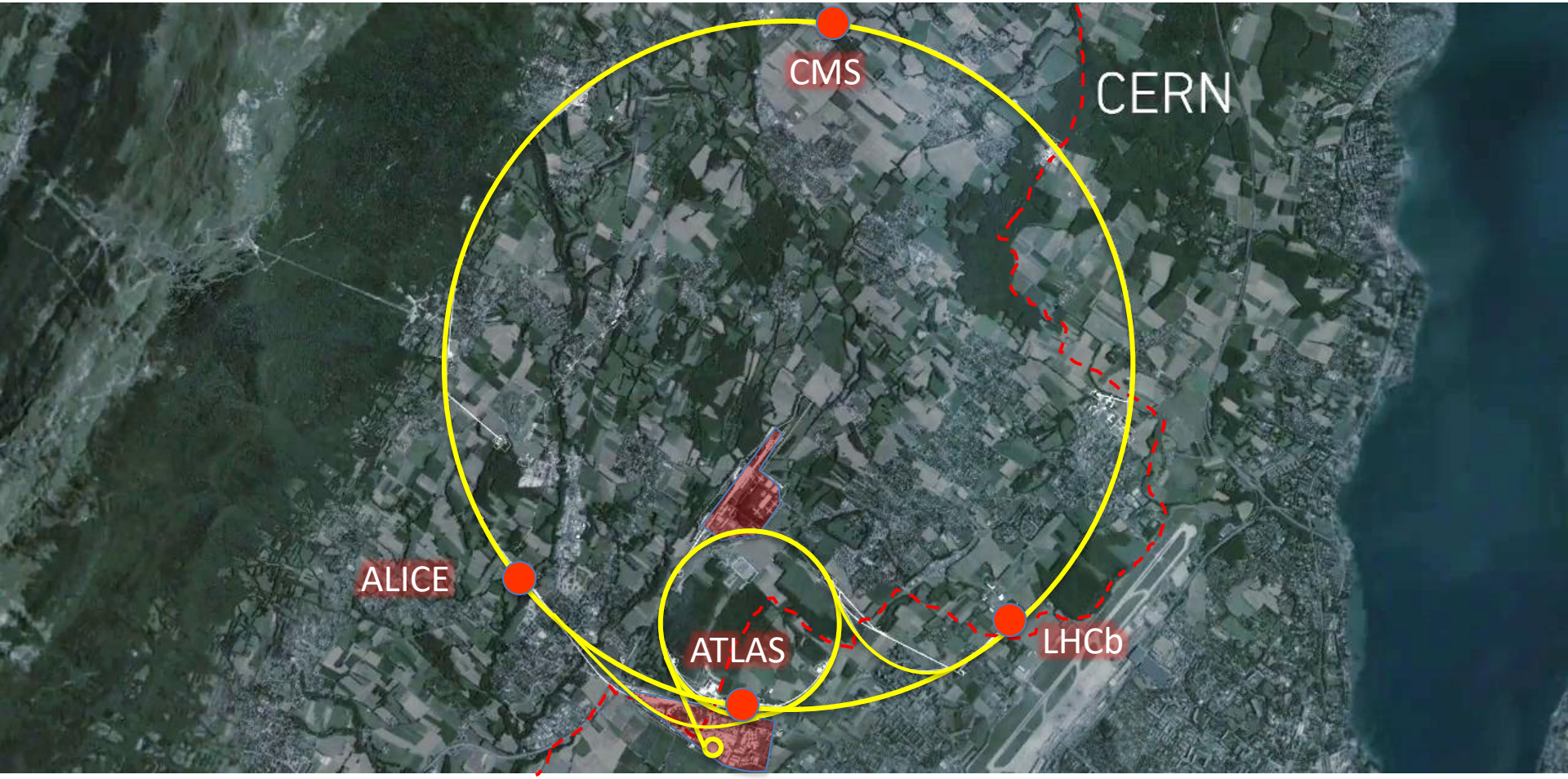
With focus on Environmental Applications

CERN | KT Knowledge Transfer *Accelerating innovation*

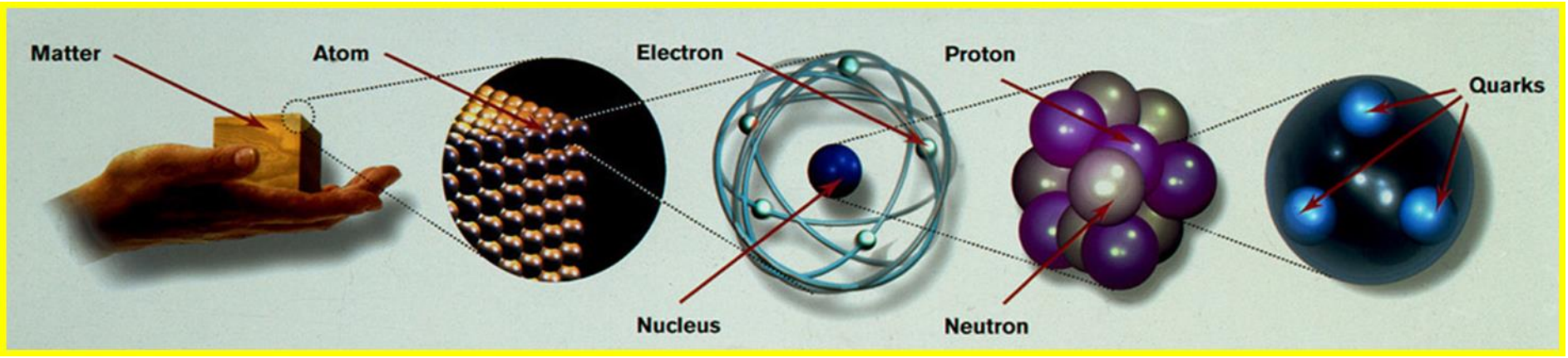
Enrico Chesta
Linn Kretzschmar

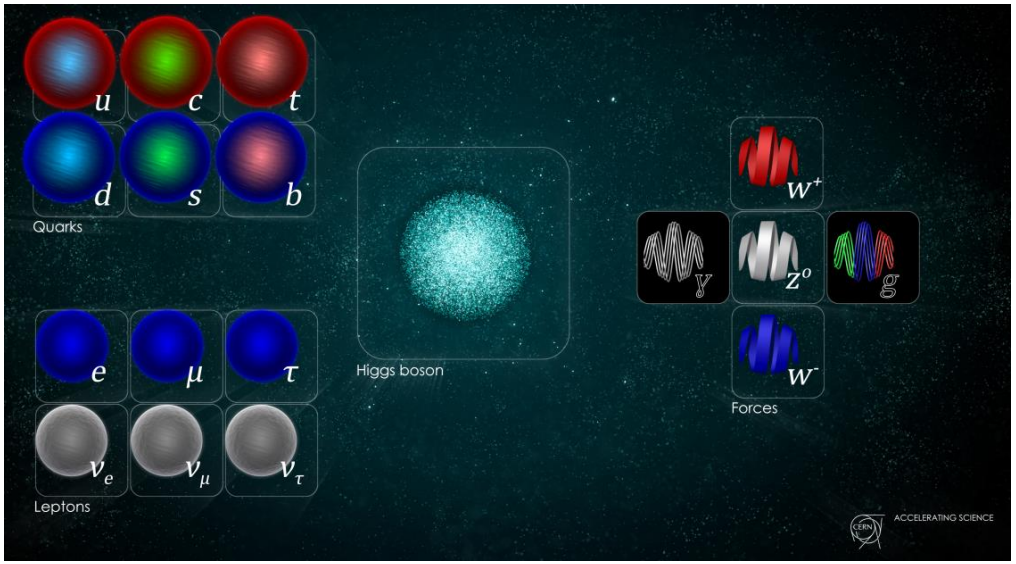
21/09/2023

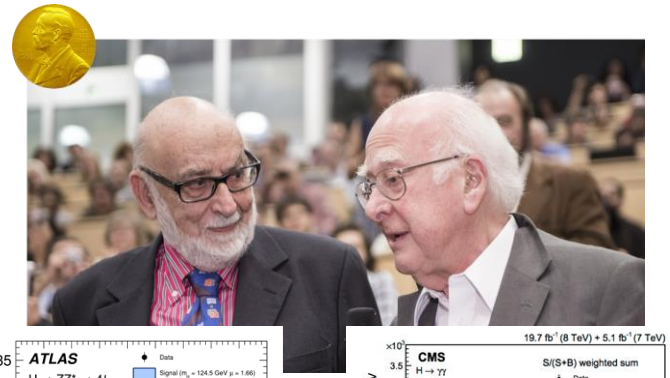
CERN at a glance...

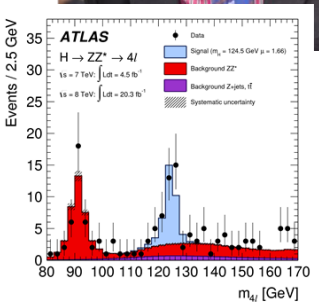


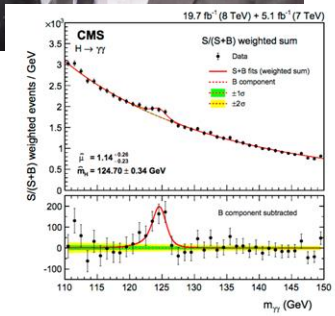
CERN main mission: fundamental physics







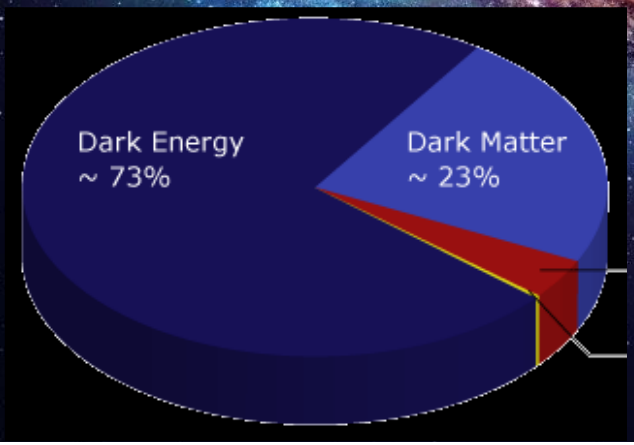




Answering questions…

What lays beyond the Standard Model?

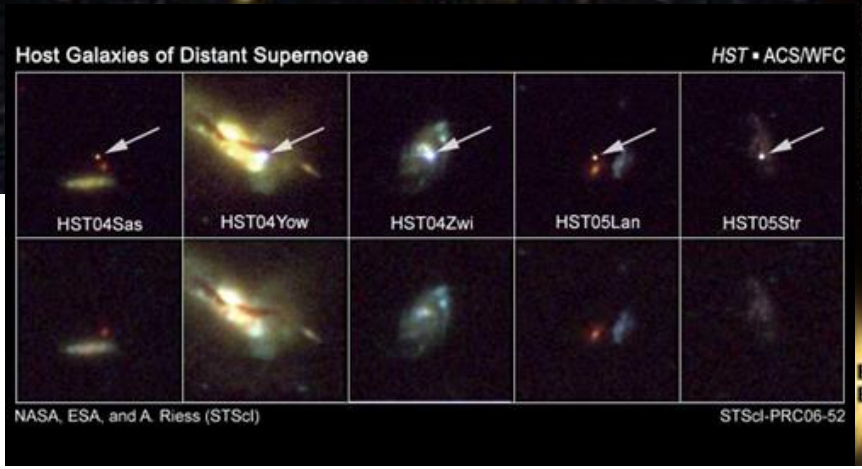
Answering questions…

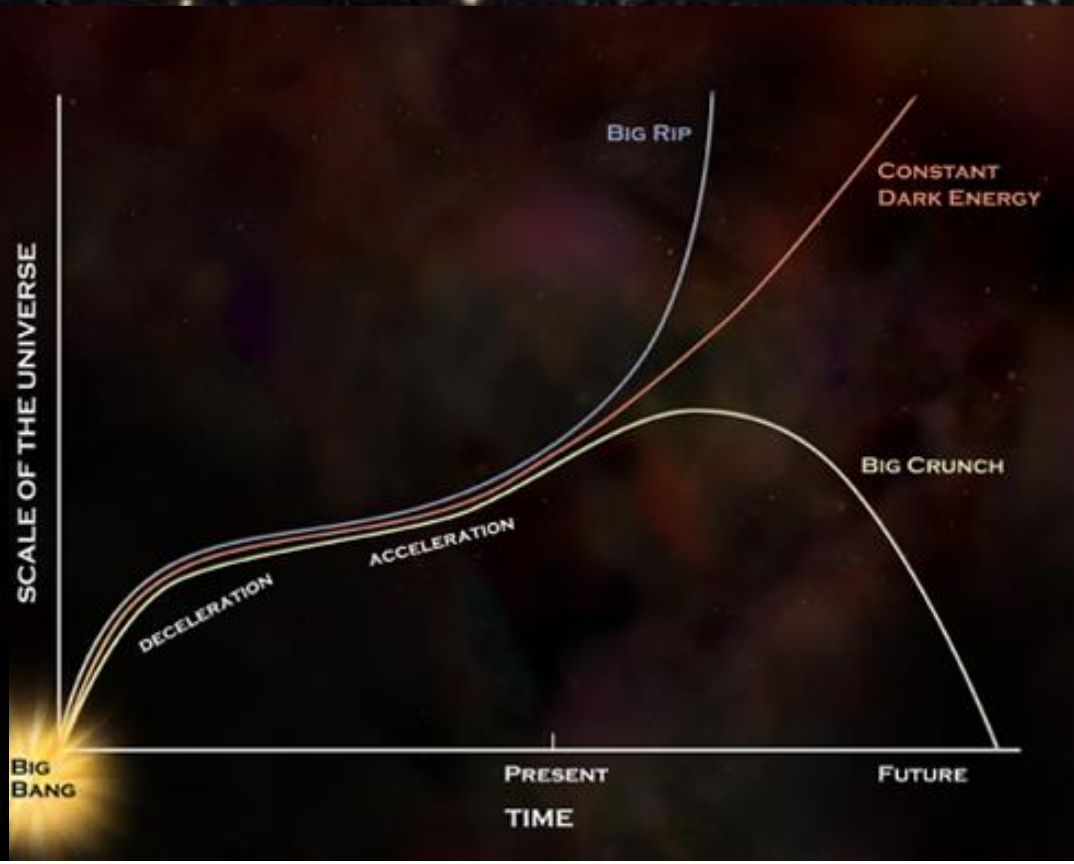


What is dark matter?

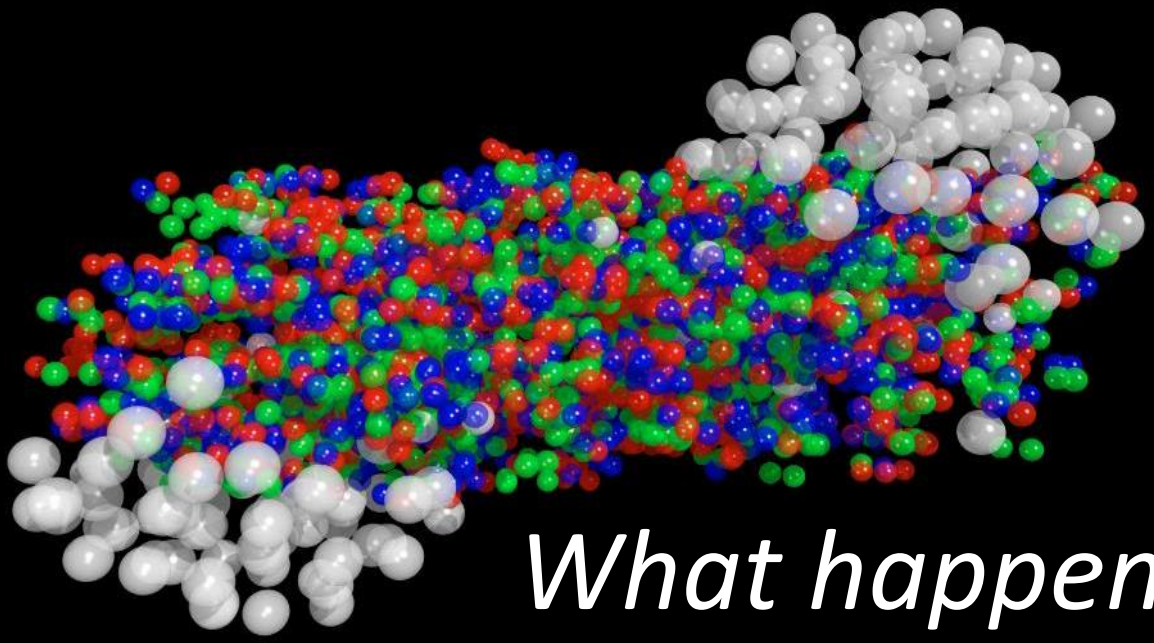
Answering questions…

What is dark energy?





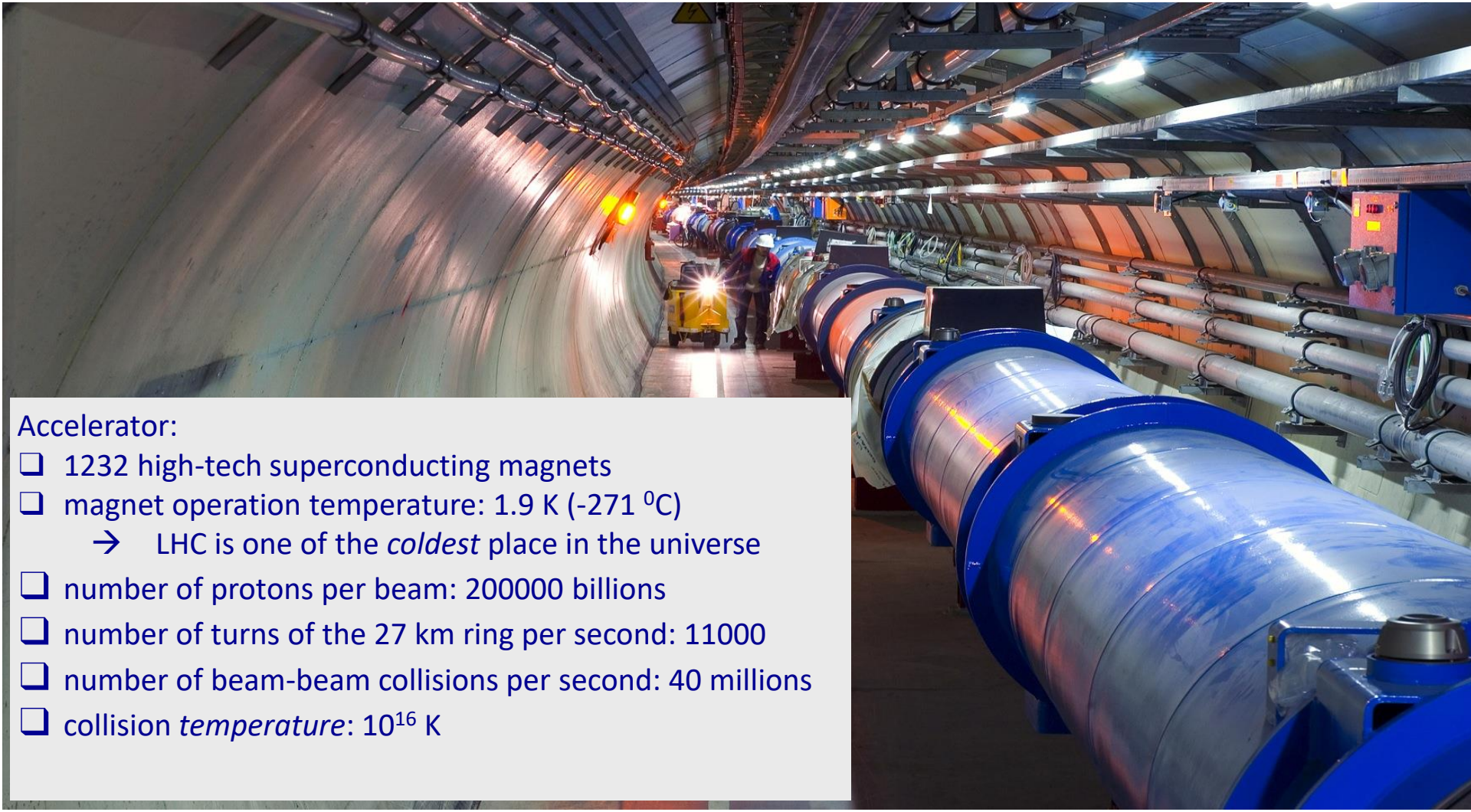
Answering questions…



What happened short after the Big Bang?

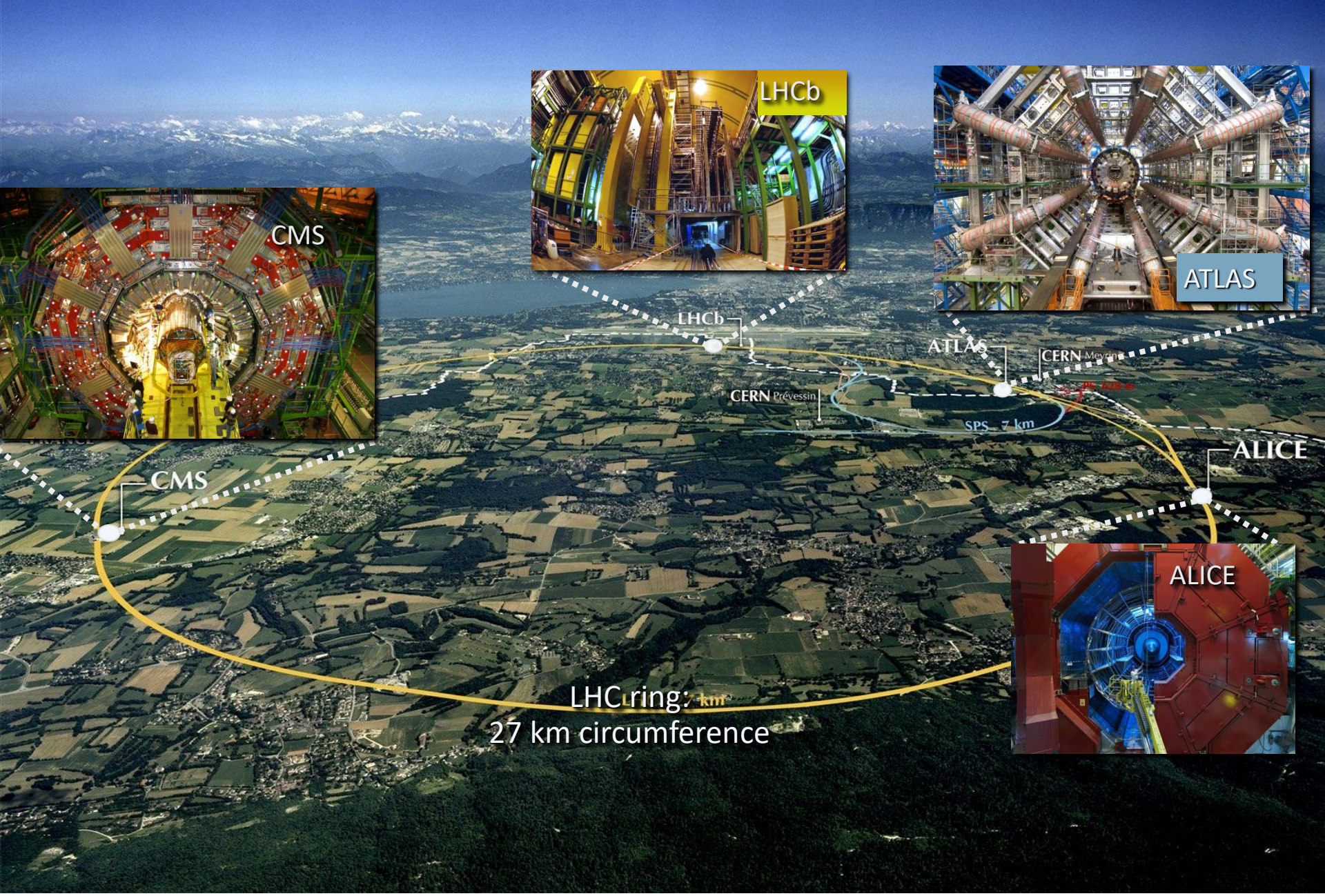

Answering questions…
Where has antimatter gone ?

Accelerating particles: the LHC

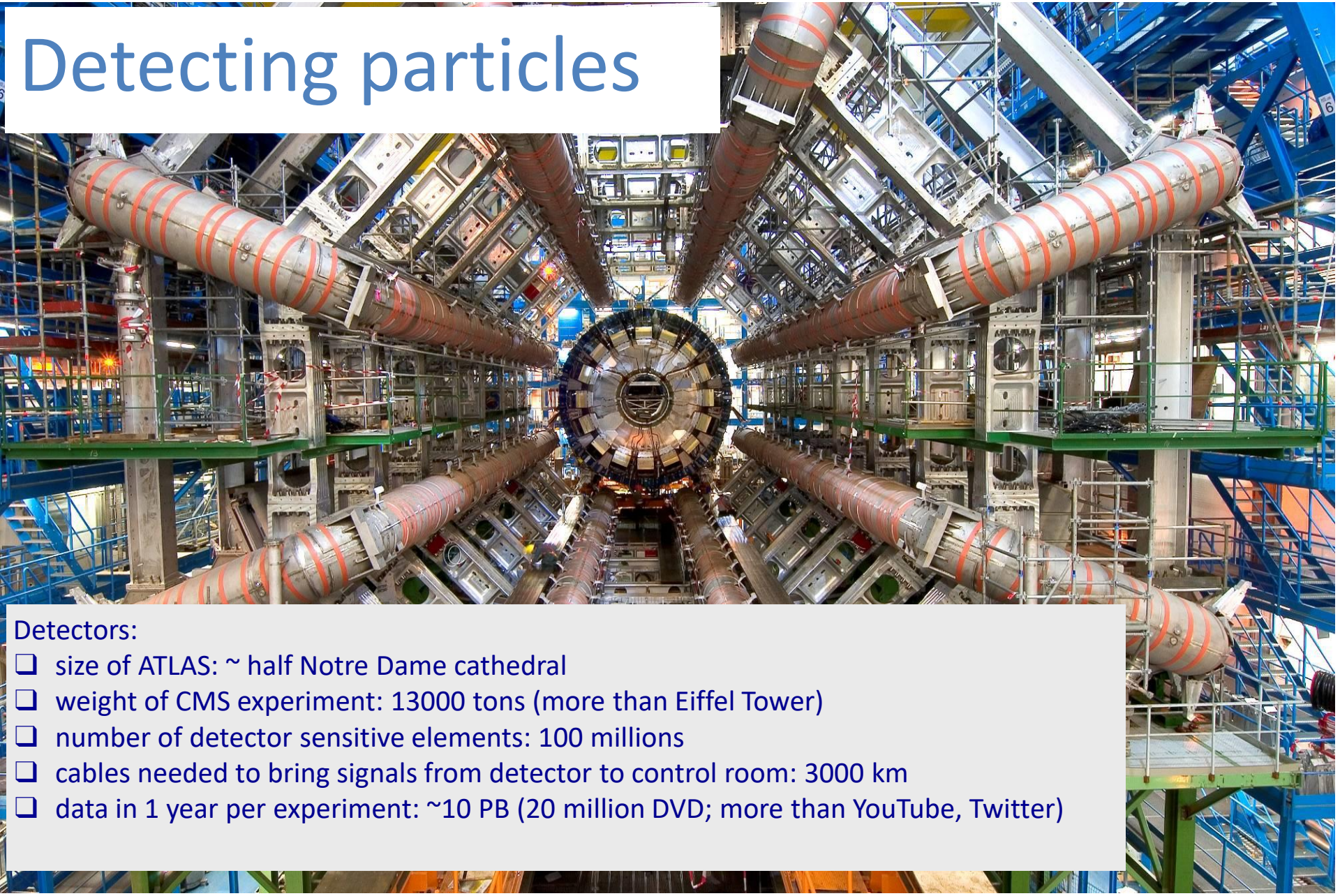


Accelerator:

- ❑ 1232 high-tech superconducting magnets
- ❑ magnet operation temperature: 1.9 K (-271 ^{0}C)
  - → LHC is one of the *coldest* place in the universe
- ❑ number of protons per beam: 200000 billions
- ❑ number of turns of the 27 km ring per second: 11000
- ❑ number of beam-beam collisions per second: 40 millions
- ❑ collision *temperature*: 10^{16} K


LHCb
CMS
ATLAS
ALICE
LHCb
ATLAS
CERN Meyrin
CERN Prévessin
SPS 7 km
CMS
ALICE
LHC ring: 27 km
27 km circumference

Detecting particles

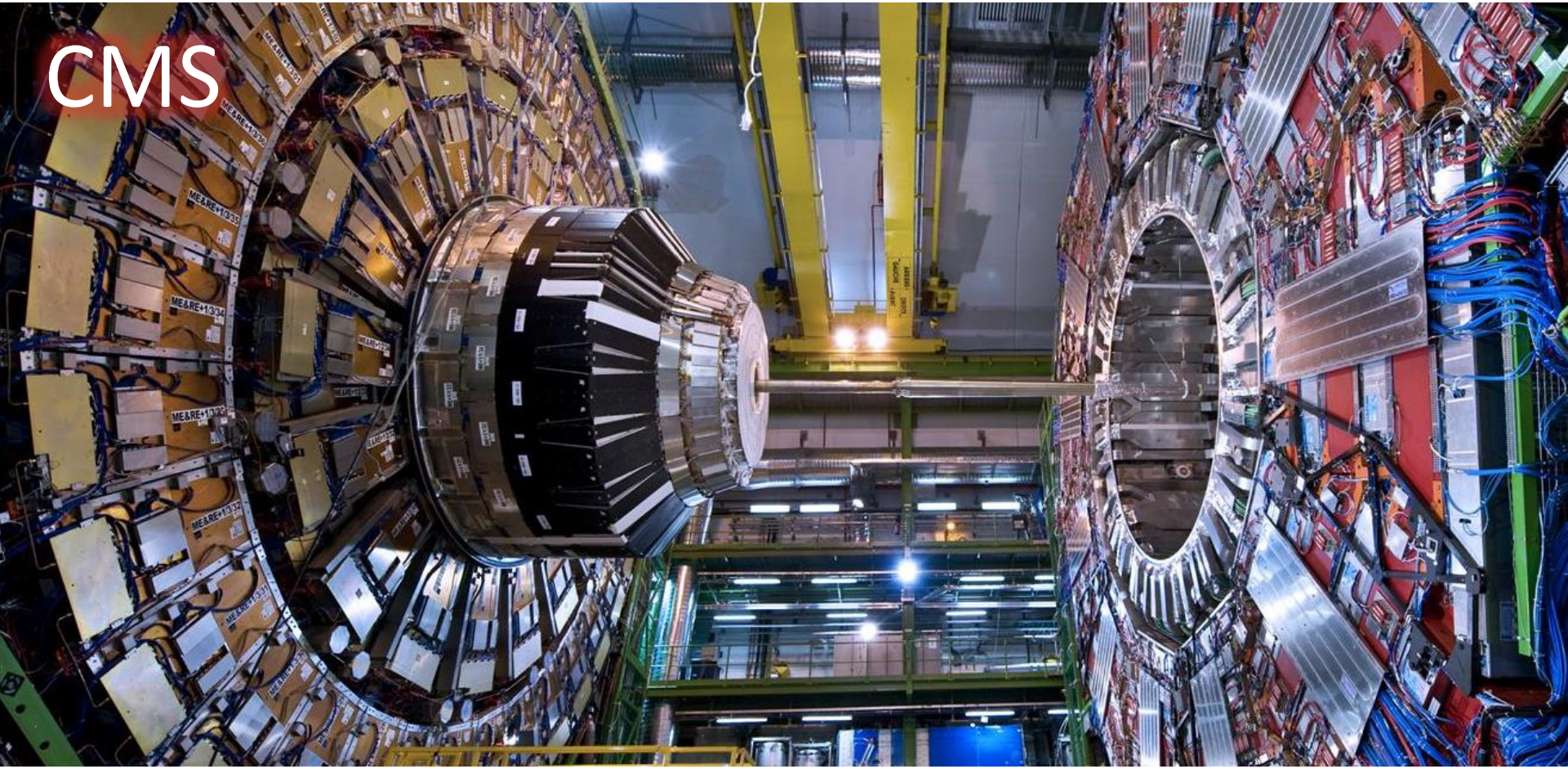


Detectors:

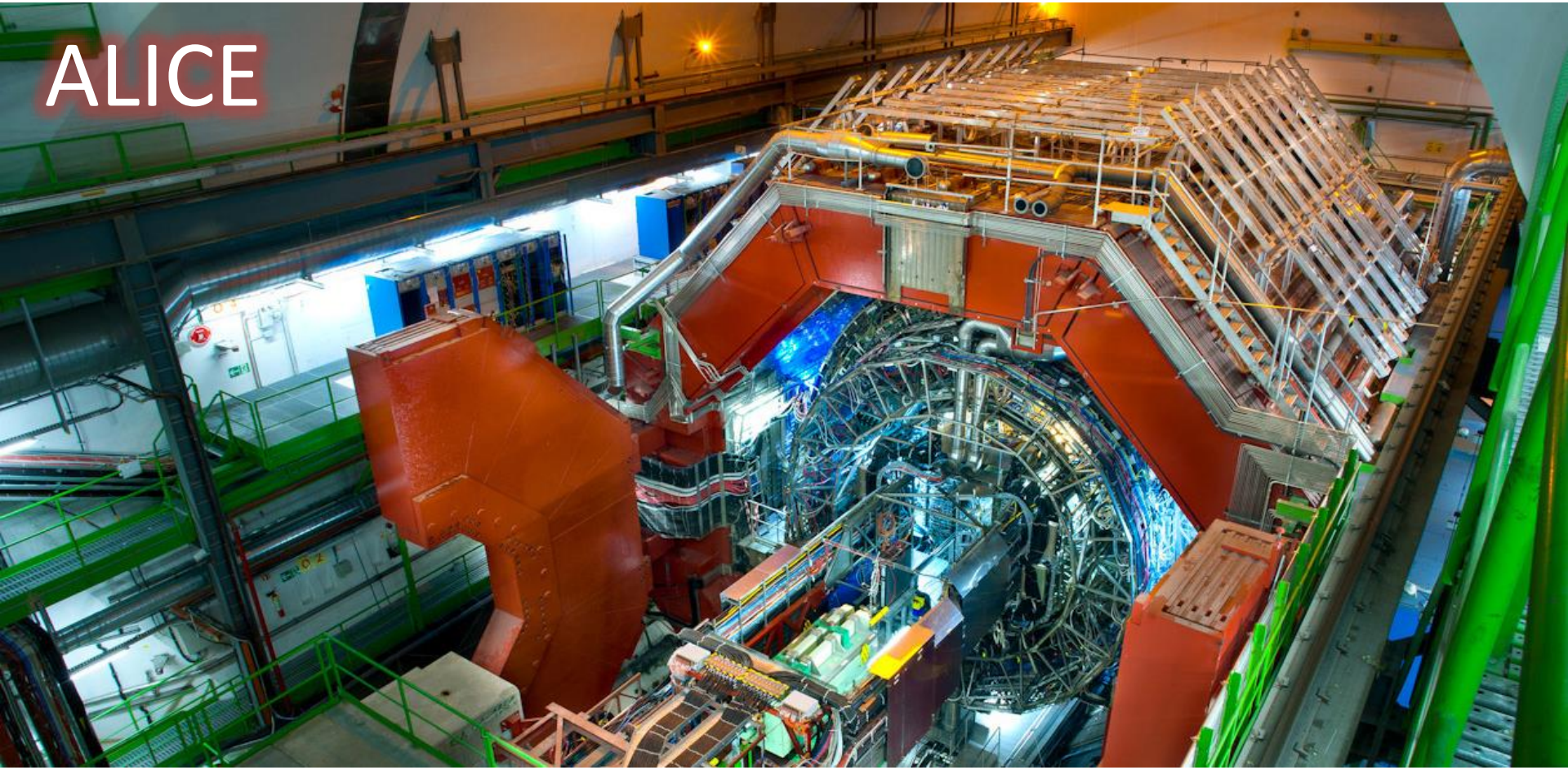
- size of ATLAS: ~ half Notre Dame cathedral
- weight of CMS experiment: 13000 tons (more than Eiffel Tower)
- number of detector sensitive elements: 100 millions
- cables needed to bring signals from detector to control room: 3000 km
- data in 1 year per experiment: ~10 PB (20 million DVD; more than YouTube, Twitter)


ATLAS

CMS



ALICE



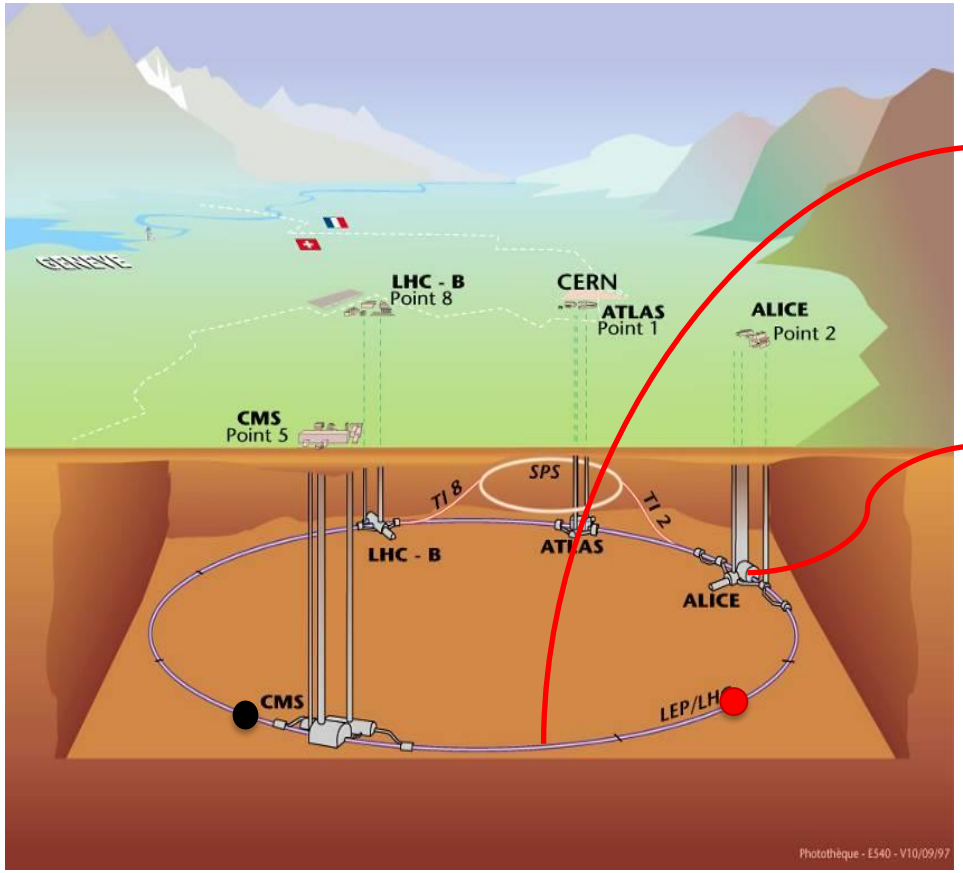

LHCb

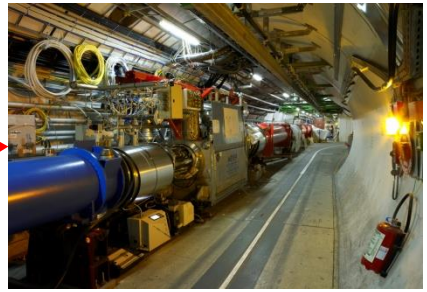
How can CERN have an impact beyond fundamental physics?

KT Mission

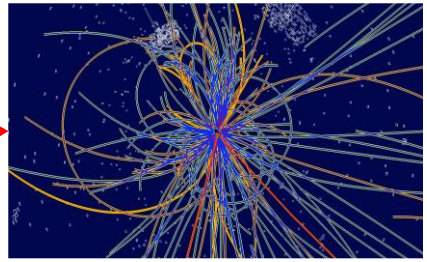
- **Maximise** the technological and knowledge return to society, in particular through Member States industry
- **Promote** CERN as a centre of excellence for technology and innovation
- **Demonstrate** the importance and impact of fundamental research investments

Key competences in cutting edge technologies for extreme environments





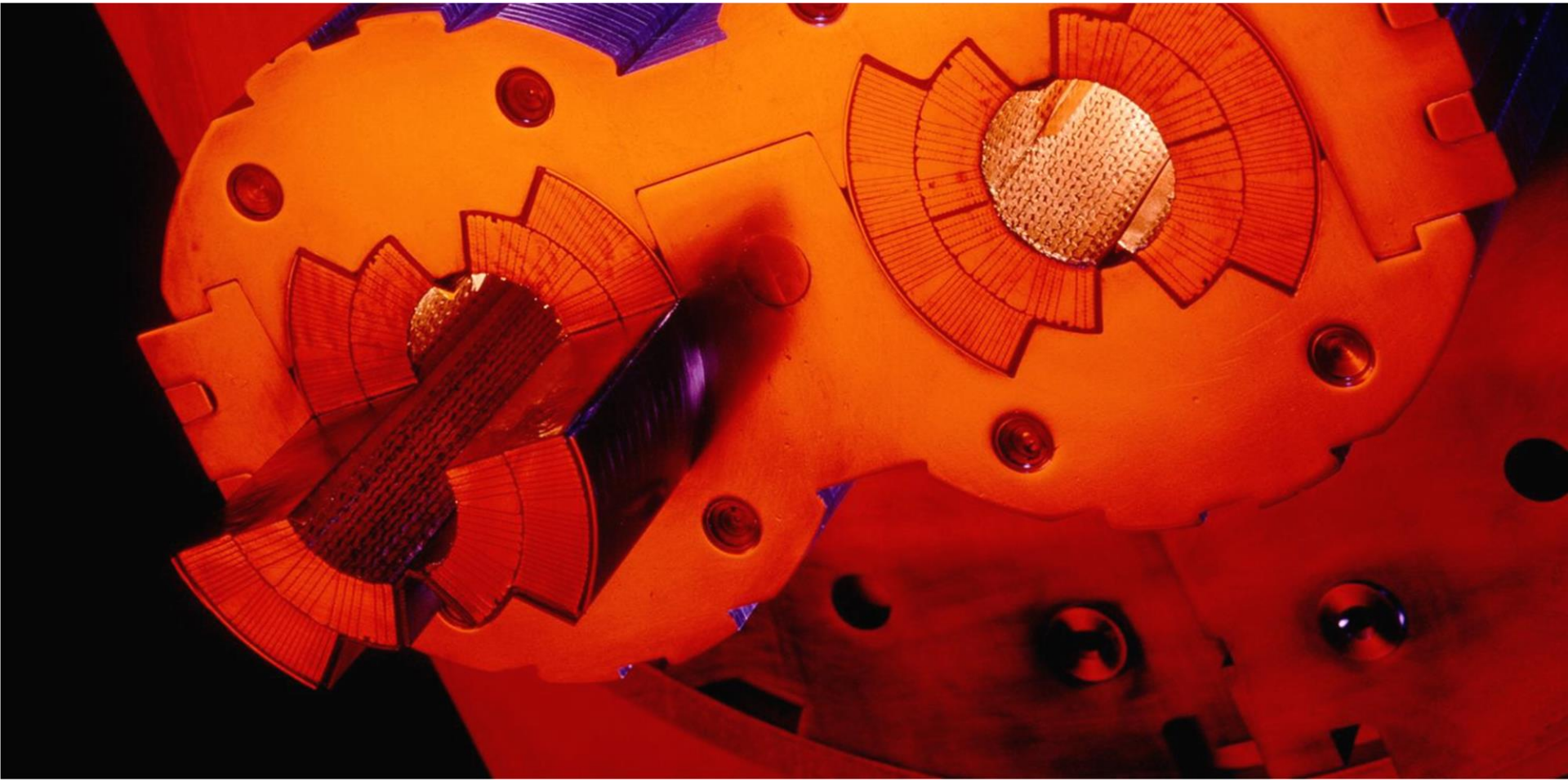
Accelerating
particle beams



Detecting
particles

Large-scale
computing
(Grid)

Very high vacuum

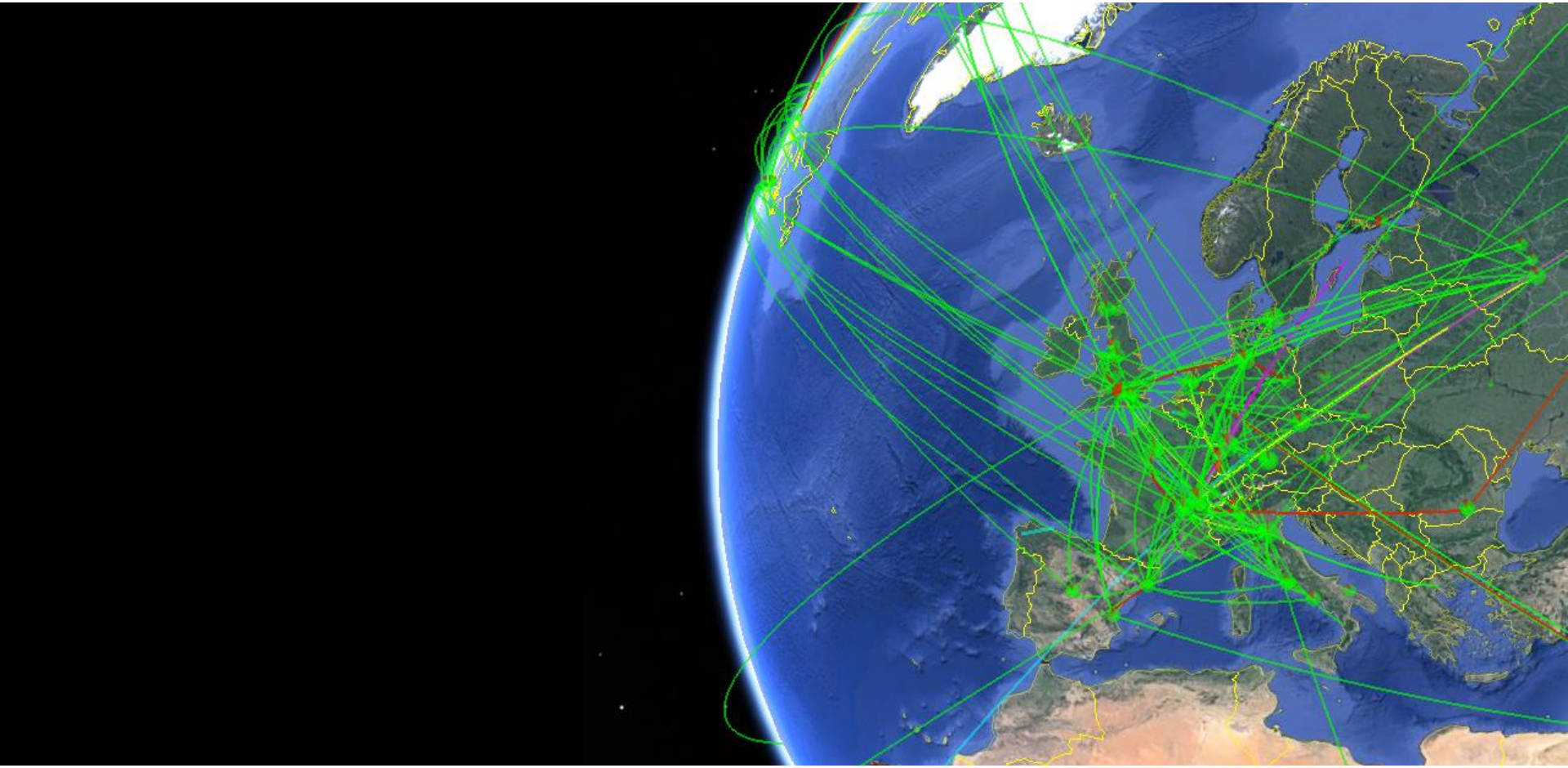


Extreme temperatures

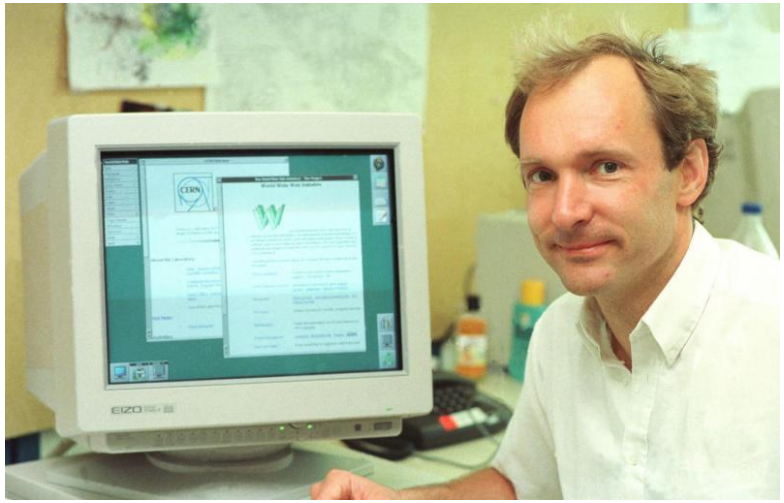
Radiations

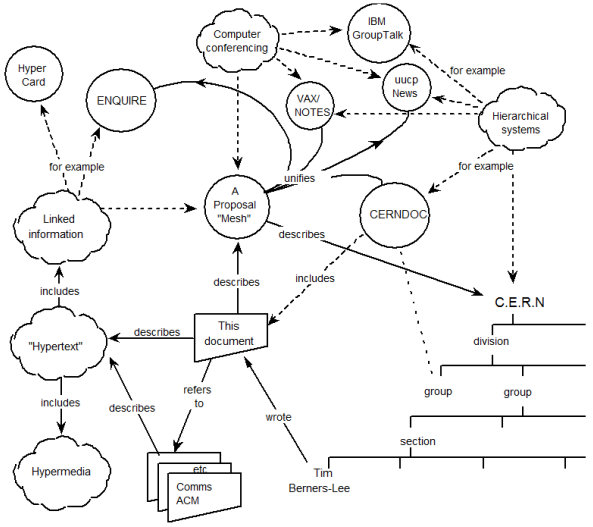

RADIATION
ZONE
SURVEILLÉE
SUPERVISED
AREA
Dosimeter obligatory
Dosimètre obligatoire
Radiation Protection
Radioprotection
72504

Big data



Where the World Wide Web was born





Not always a trivial process…

First «Touch-Screen»

First «Mouse»

KT Tools


Collaborations and Networks
Knowledge transfer networks
Strengthening links with Member States (KT Forum)
Relations with International Organisations
Knowledge transfer in EC co-funded projects
Funding Opportunities for CERN Projects
CERN Knowledge Transfer Fund
CERN Medical Applications Budget
Entrepreneurship
Start-ups & Spin-offs
Entrepreneurship Meet-Ups
Business Incubation Centres
Entrepreneurship Programmes
Open Source
Open Source Software
Open Hardware Licence
CERN
Knowledge Transfer Ecosystem
Support for CERN Personnel
Formal and practical training in business, entrepreneurship & knowledge transfer
Legal, business & intellectual property support
Events
Knowledge Transfer Seminars
Conferences with a significant contribution by the Knowledge Transfer group
Intellectual Property Management
R&D collaborations
Patent portfolio
Licence, service & consultancy agreements

CERN Value Proposition

Machine Learning and Deep Learning

Industrial Controls and Automation

Metrology

High and Ultra High Vacuum Systems

Data Analytics

Health, Safety and Environment Management

Cryogenics

Optoelectronics and Microelectronics

High Volume Data Management & Storage

Superconducting Magnets

Particle Acceleration and Control

Radiation Protection and Monitoring

Particle Tracking and Calorimetry

Sensors

Material Science

Cooling and Ventilation

Robotics

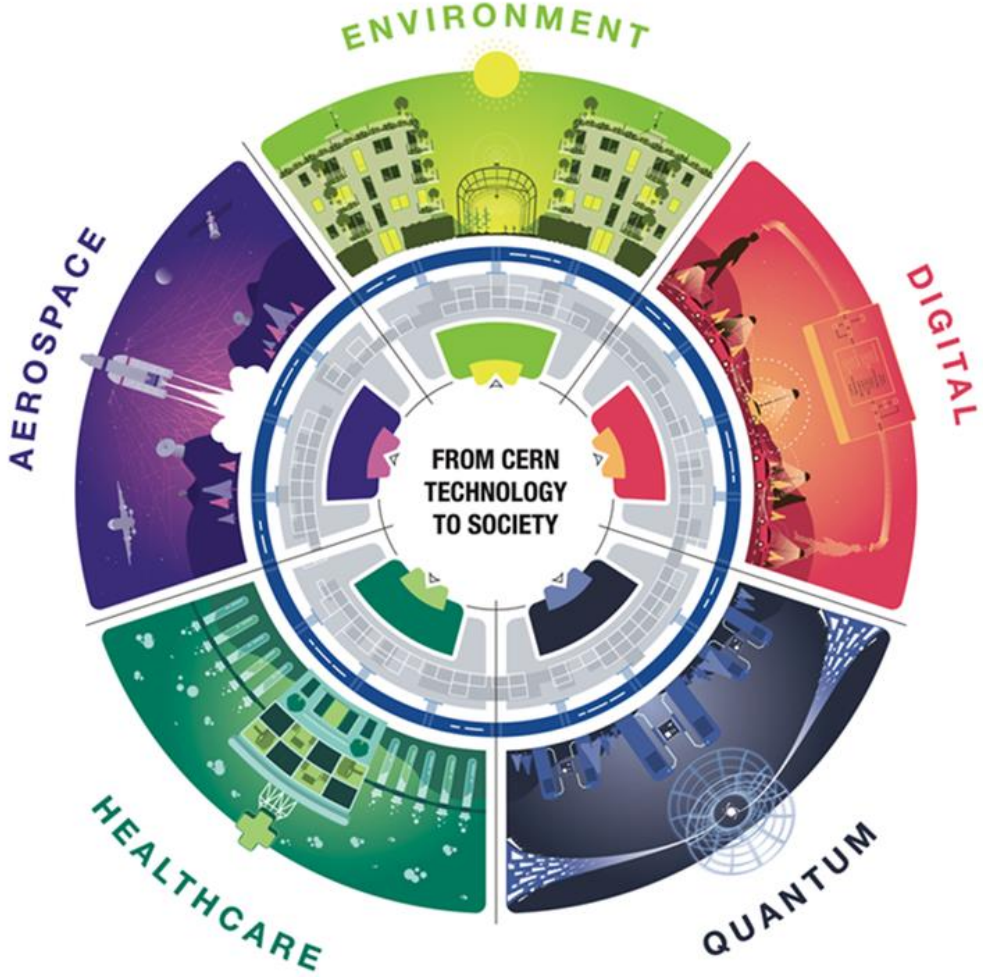
Collaboration Tools

Radio Frequency Technology

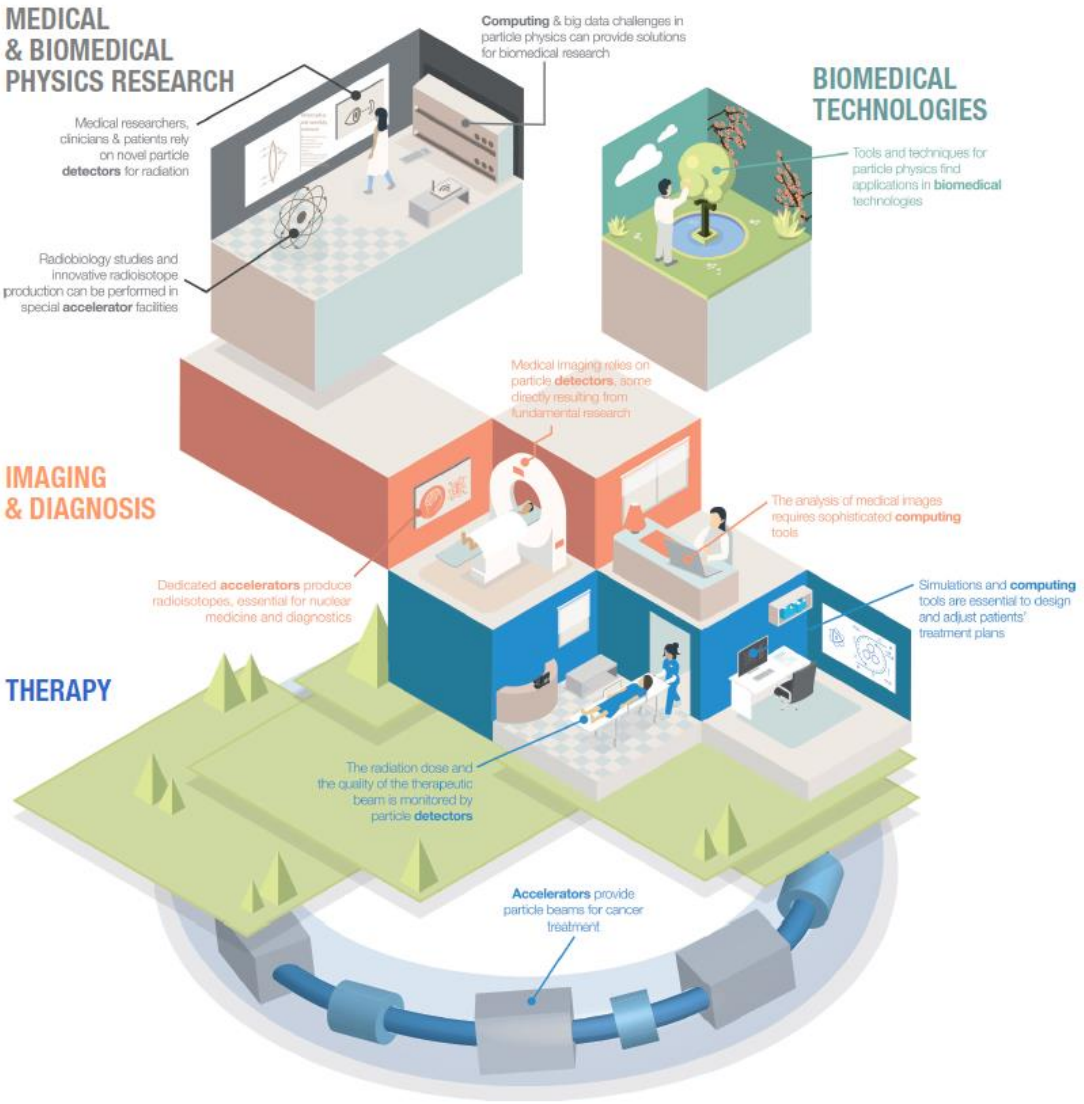
Manufacturing and Mechanical Processes

Link to CERN Value Proposition

KT strategy: thematic areas of focus

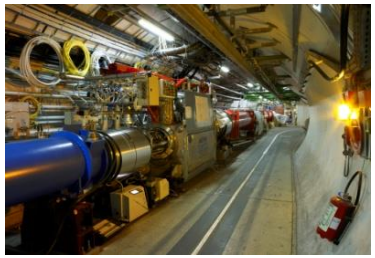


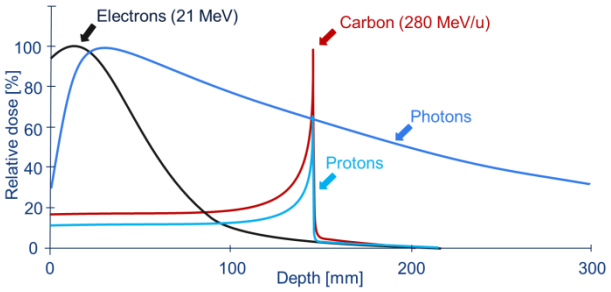
Medical Applications - Strategy

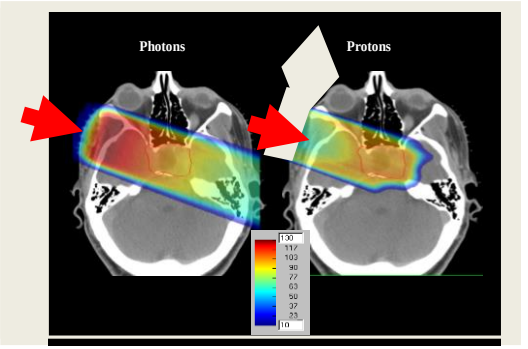


Medical Applications - Examples

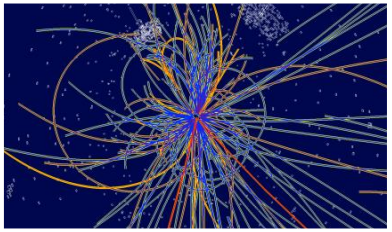
Particle accelerators for hadron therapy

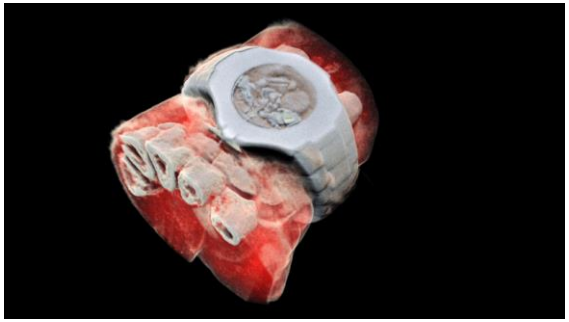


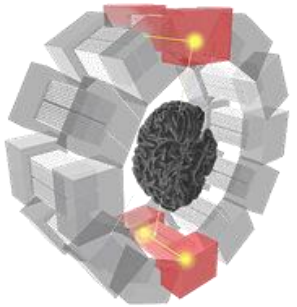




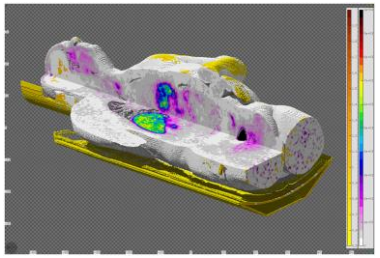
Particle detectors for medical imaging

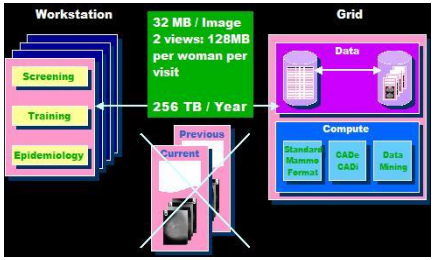




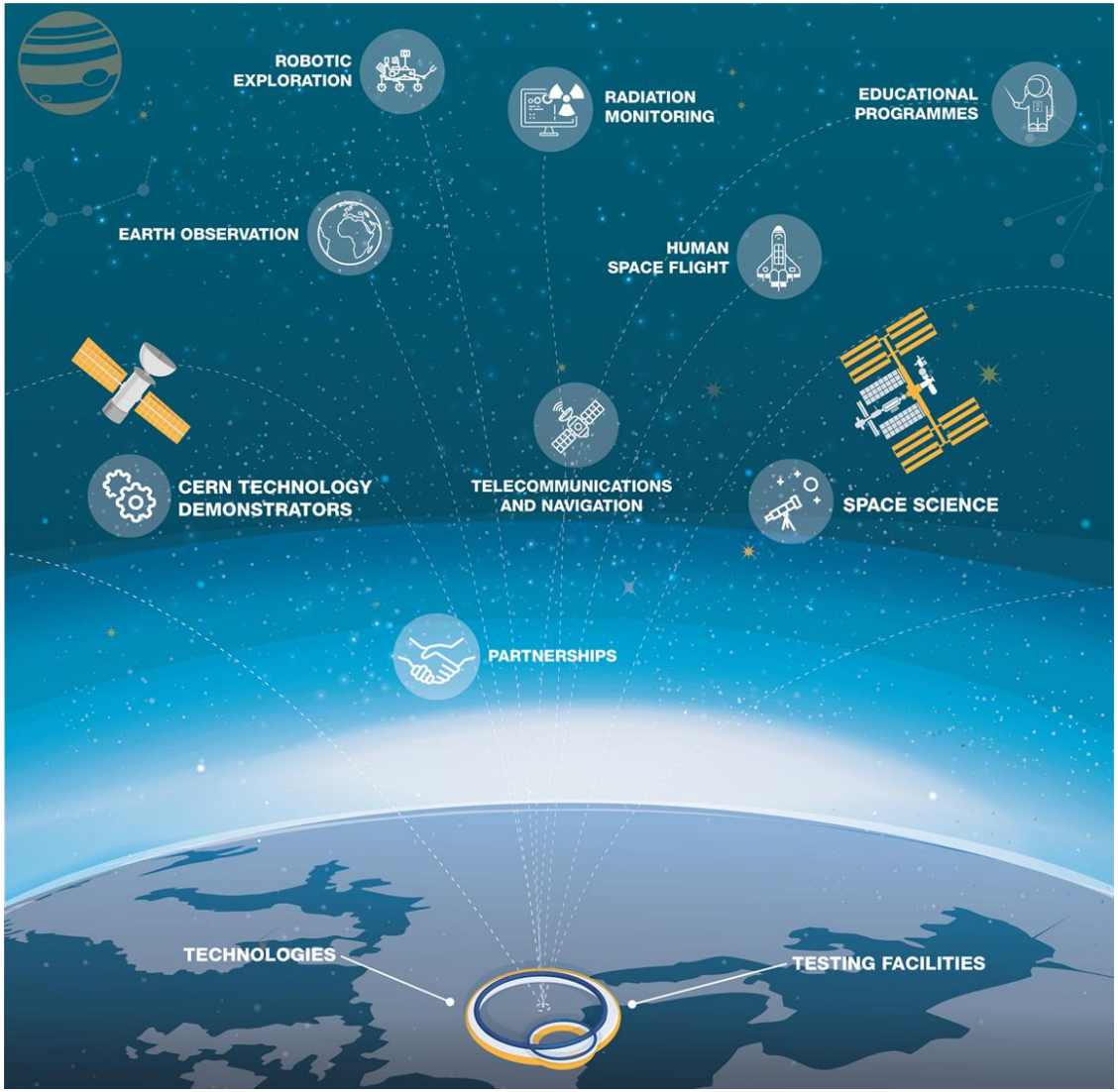


Computing for simulations and medical data management and analysis





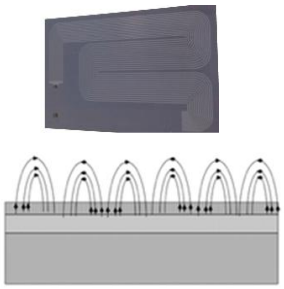
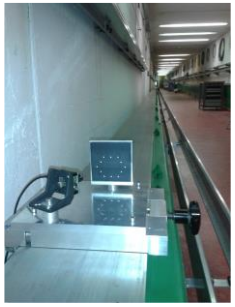
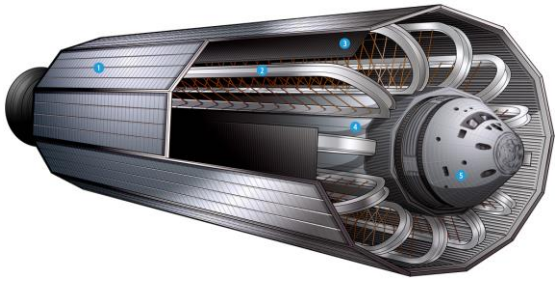
Aeropace Applications - Strategy



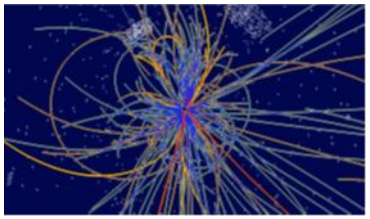
Aeropace Applications - Examples

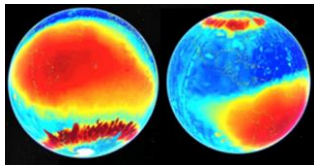
Accelerator technologies for thermal control, surface treatment, alignment, shielding



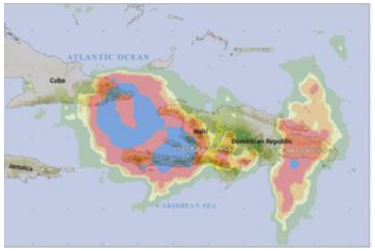
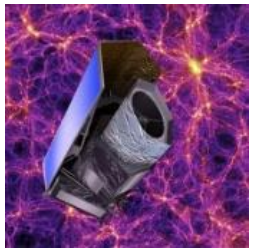
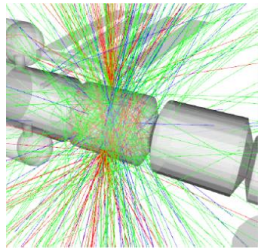




Particle detectors for dosimetry, radiation monitoring, rad-hard electronics, science





Advanced computing for earth observation or astrophysics data handling, simulations

CELESTA

CERN Latchup and Radmon Experiment Student Satellite

A ground-breaking project:

- First CERN technology demonstrator in space
- First flight test of SpaceRadMon technology
- First full satellite tested for radiations at system level in CHARM

A complex, long and risky project:

- Started in 2014, KT funded, supported by EN, SY, BE, R2E
- Collaboration with CSUM (Robusta platform) and ESA (launch)
- Vega-C maiden flight on 13/07/2022, 6000km orbit

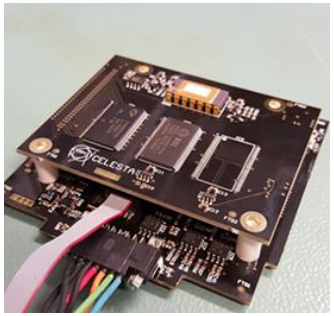
A quite successful project:

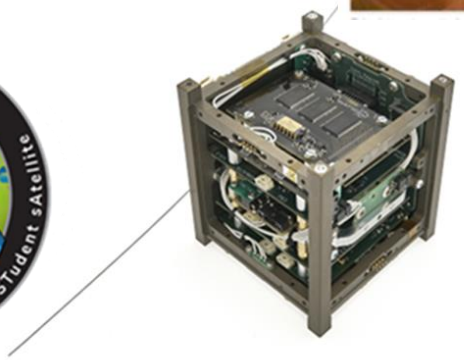
- All technical, scientific and educational goals reached by end 2022
- Plenty of scientific data collected, good statistics, analysis ongoing
- Triggered external requests for payload units and testing time
- Possibility to use the SpaceRadMon for predictive maintenance
- RM and EQM will hopefully be showcased in the Science Gateway
- FM will fly for centuries…

CERN tech in space: the first CERN-driven satellite has been successfully launched

With the launch of the CELESTA satellite for radiation monitoring in space, CERN shows its expertise in the field of radiation effects on electronics

15 JULY, 2022 | By Antoine Le Gall





Environmental Applications - Strategy

Environmental Applications - Examples

RENEWABLE AND LOW-CARBON ENERGY

Agreement with **GTT** to support the design of large cryostats for the maritime transportation of liquid hydrogen

GTT Technology for a Sustainable World

CLEAN TRANSPORTATION AND FUTURE MOBILITY

Partnership with **Airbus** to assess SC power distribution options for future electric/hybrid airplanes using liquid hydrogen

AIRBUS

CLIMATE CHANGE AND POLLUTION CONTROL

Collaboration with **ESA** Phi-lab to develop AI algorithms to analyse Earth Observation space images for climate monitoring

esa

SUSTAINABILITY AND GREEN SCIENCE

Project with **ABB** to improve energy efficiency of CERN cooling and ventilation with smart sensors and digital twins

ABB

Environmental Applications
CIPEA Call for ideas 2022

CIPEA CERN Innovation Programme on Environmental Applications

News › News › Topic: At CERN

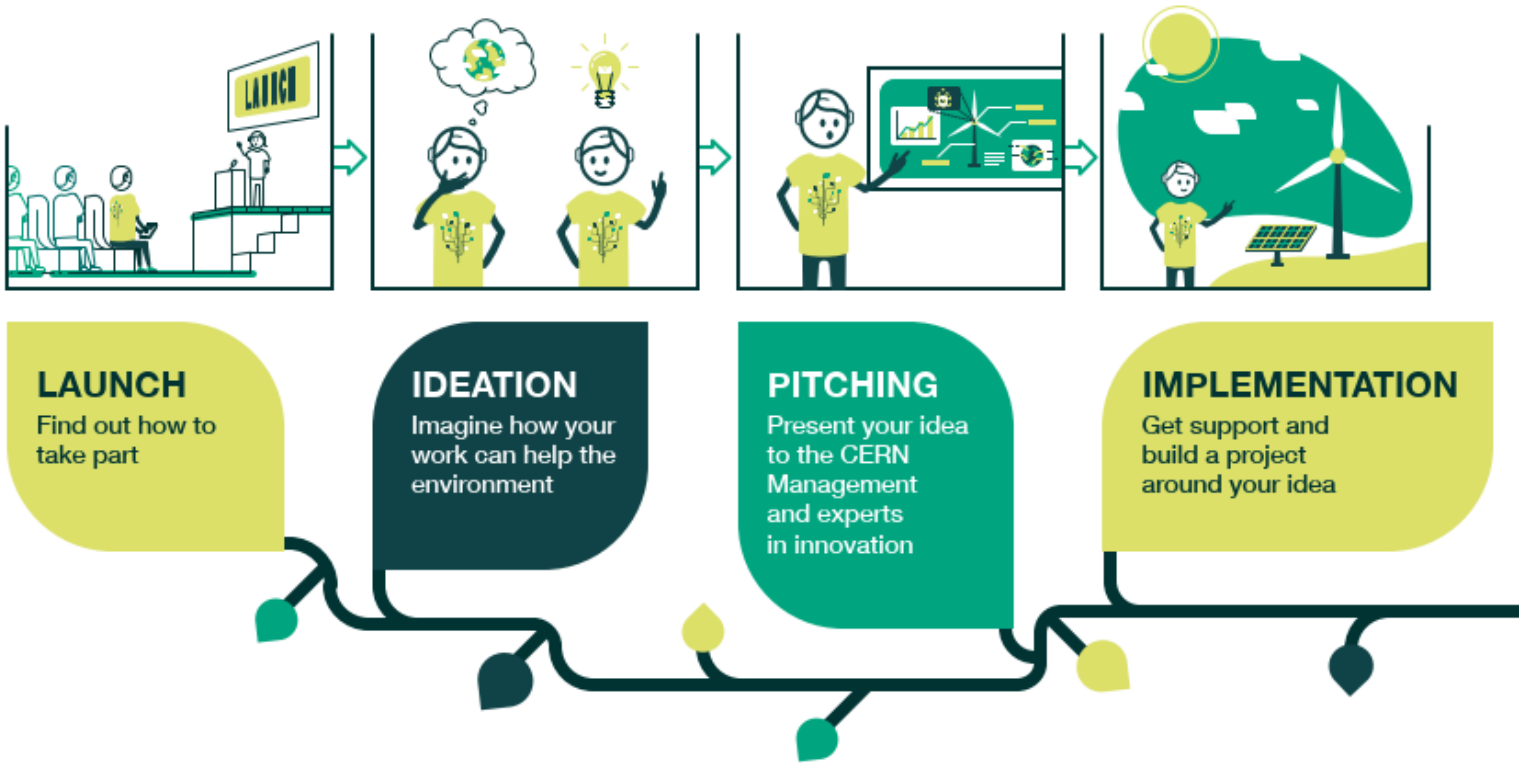
Promising start for future environmental applications of CERN technologies

On 27 June, the CIPEA Innovation Day welcomed 15 innovative project proposals reflecting the CERN community's commitment to tackling environmental challenges

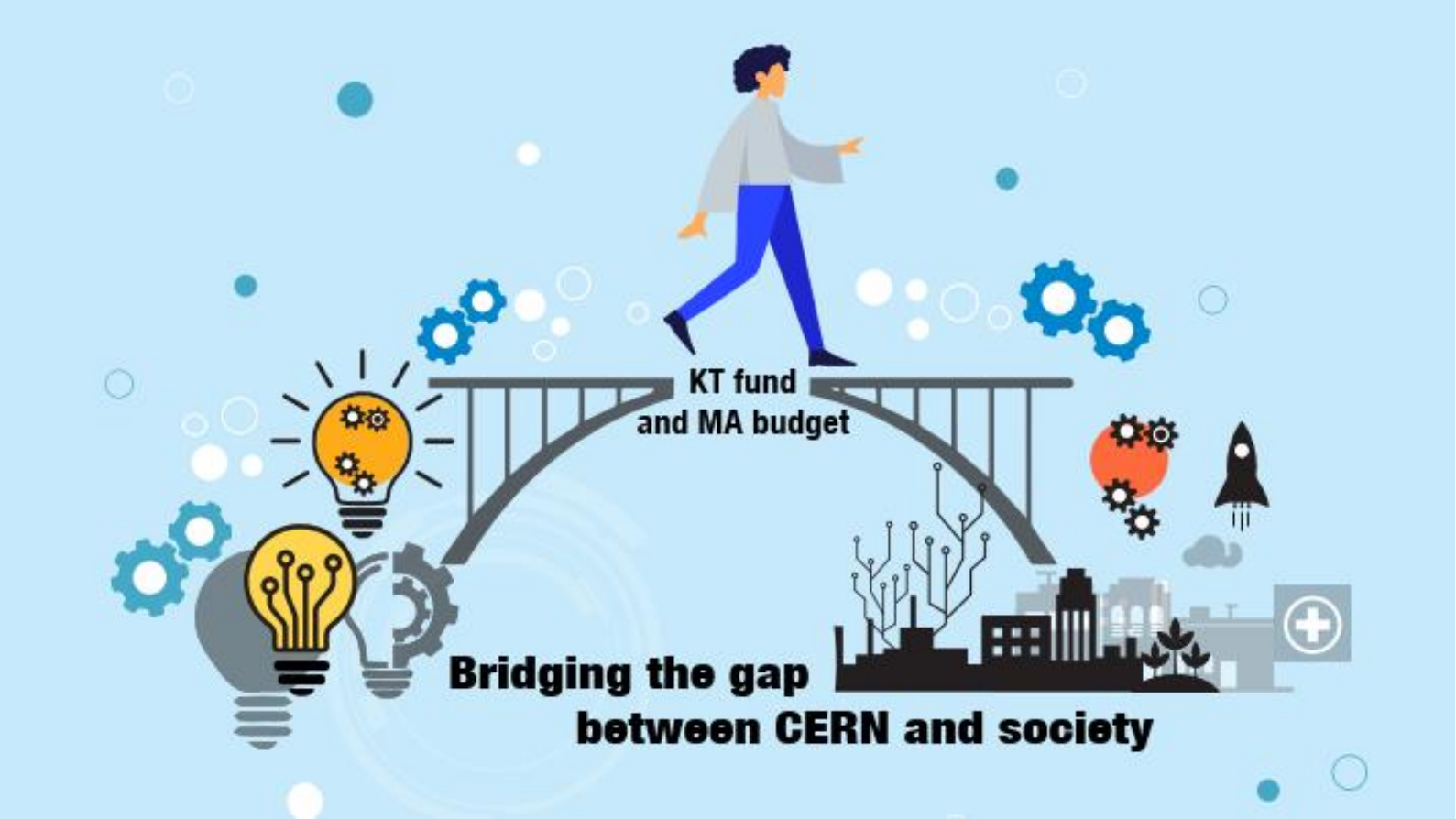
12 JULY, 2022 | By Antoine Le Gall

The CIPEA Innovation Day brought together experts from all CERN technical departments. (Image: CERN)

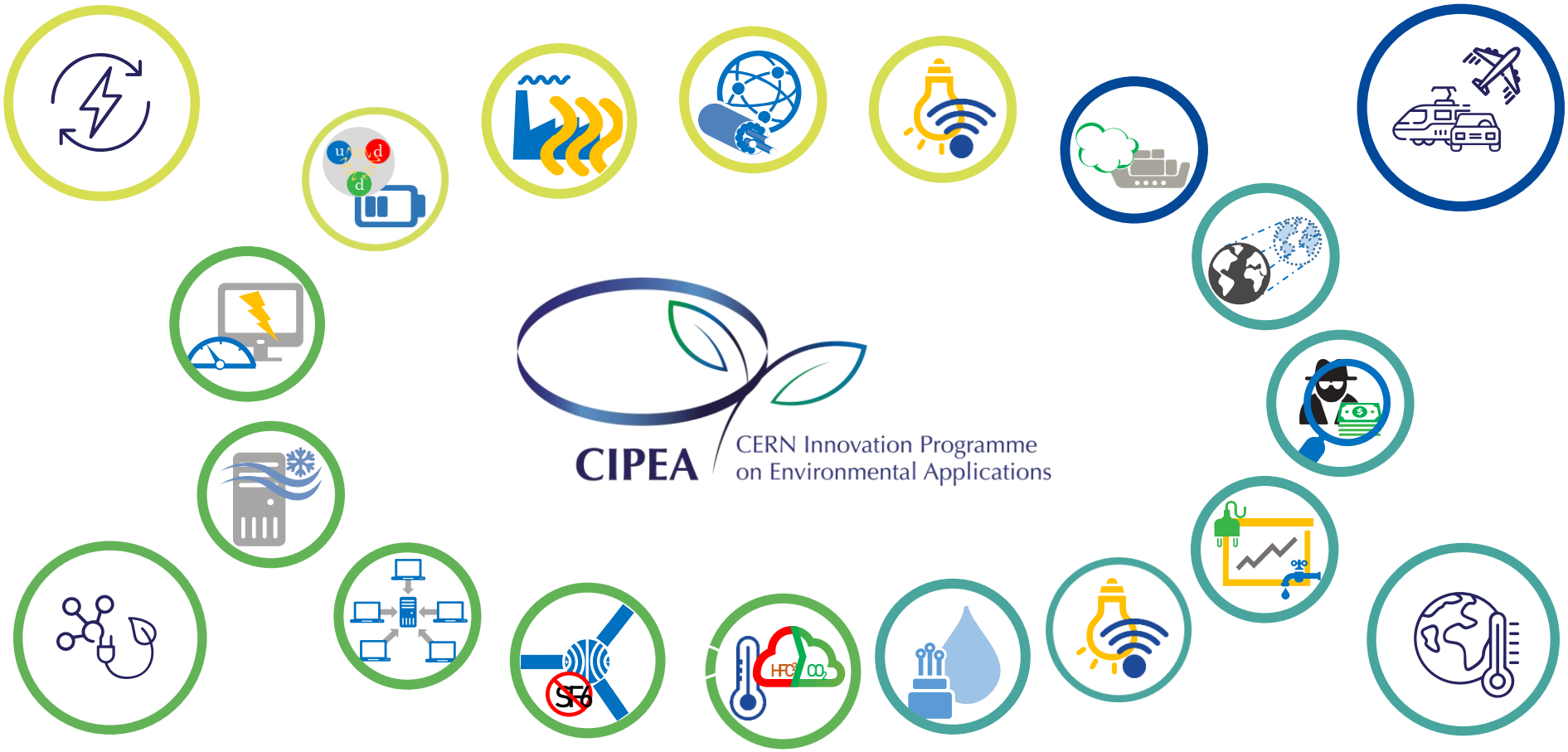
CIPEA call for idea concept



CIPEA MEETS KT FUND



CIPEA submitted proposals



~30 ideas discussed → 15 proposals received → 10 KT Fund requests submitted → 6 CIPEA proposals funded

Injection locked magnetrons for particle accelerators and industrial dielectric heating

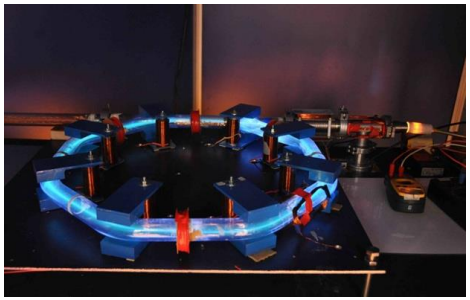
SolidWatts

Aim: Demonstrate the injection locking of a single magnetron and the combination of power of multiple, injection-locked magnetrons at 2.45GHz and a few kilowatts of CW RF power for application in the industrial heating industry

meets

Compact Material Analysis for Batteries & Fast Fuel Cell Development

Aim: Develop a compact pulsed neutron facility, suitable for implementation in an industrial environment, and optimized for in-situ analysis of battery and fuel cell electrodes

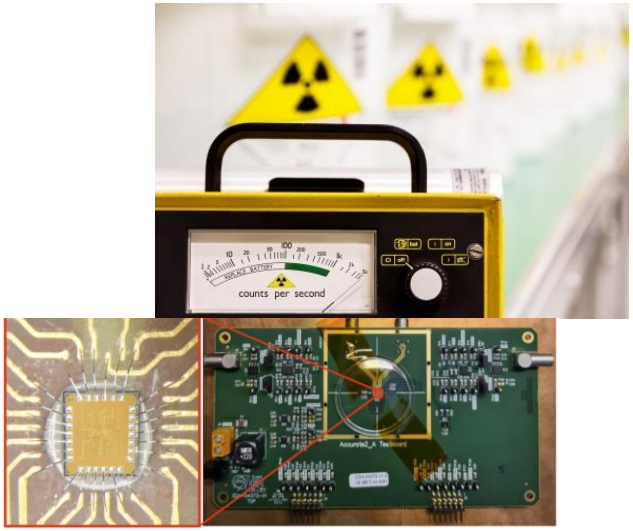


meets

ALPHA - ACCURATE Lightbox for Photovoltaic Harvesting Analysis

lightricity

Aim: Development of a characterisation tool for indoor-light harvesting photovoltaic cells with the help of the ACCURATE chip

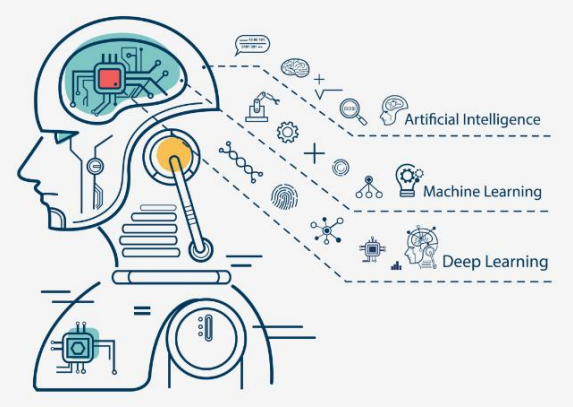


meets

EMP2: Environmental Modelling and Prediction Platform

JÜLICH Forschungszentrum

Aim: Develop a proof of concept for an observation-based machine learning digital twin of the dynamics of the atmosphere for environmental applications that encapsulates spatio-temporal interactions for forecasting and monitoring of (extreme) weather events.



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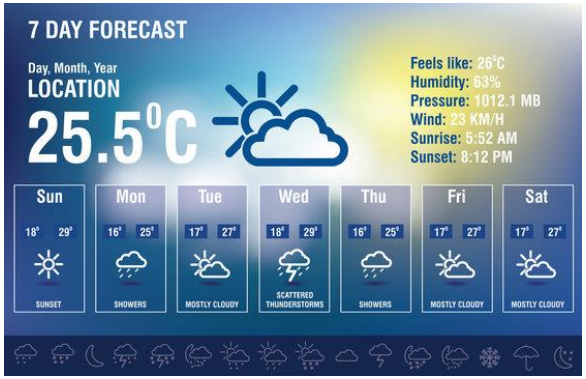
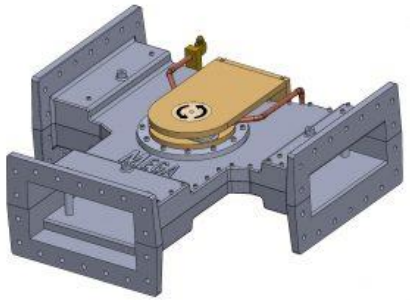


SF6-free S-band circulator for photo injectors

AFT microwave

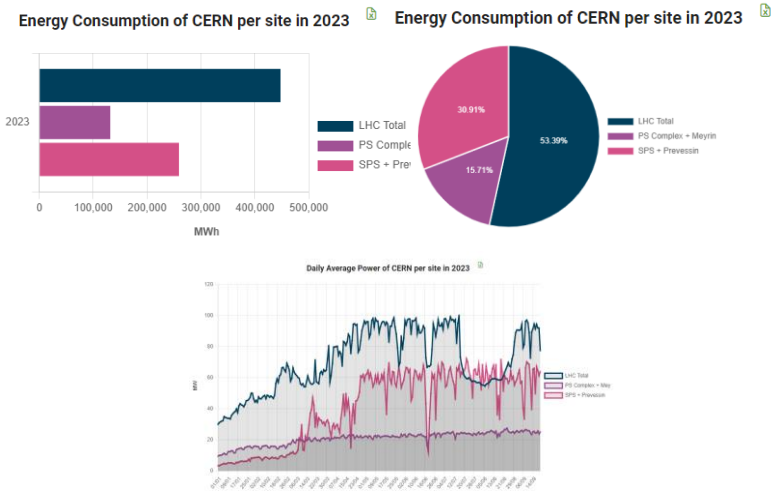
Aim: Develop a vacuum-compatible high-power waveguide circulator operable without SFC6 (highly harmful greenhouse gas).

meets



Web Energy: Energy, water and gas monitoring and forecasting platform

Aim: Further development of the web-based front end for energy management tool Web Energy to enable application outside of CERN

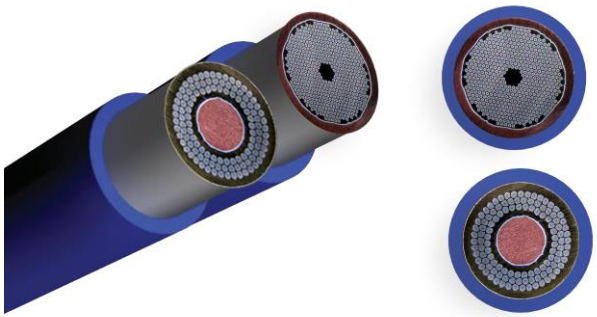


meets

IVAC-RED: Insulation Vacuum of SC Cables for Renewable Energy Distribution

SUPERNODE™

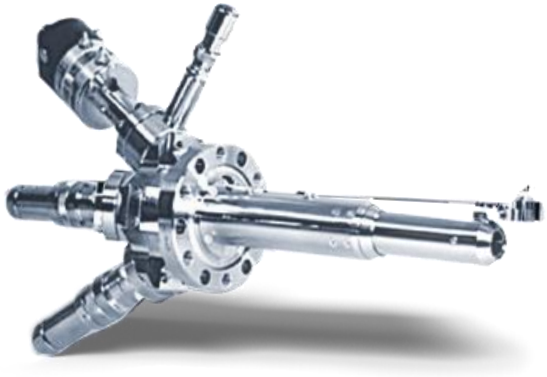
Aim: Design of a cryostat that allows an optimized operation of company's superconducting power links



meets

UTMOST CLEEN: Development of membranes for ships EBFGT

Aim: Develop a compact and durable Electron Beam Flue Gas Treatment (EBFGT) technology (beam window) for the maritime industry to remove pollutants (particularly NOX) by converting and filtering out harmful by-products before exhaust gas is released



meets

Thank you!

https://kt.cern/environment/CIPEA