

A long, complex particle accelerator tunnel with various pipes and machinery. The tunnel is illuminated by overhead lights, and the machinery is primarily blue and silver. The perspective is from the side, looking down the length of the tunnel.

Accelerating Innovation

From CERN Technology to Society

Nick Ziogas

CERN Knowledge Transfer
ziogas@cern.ch

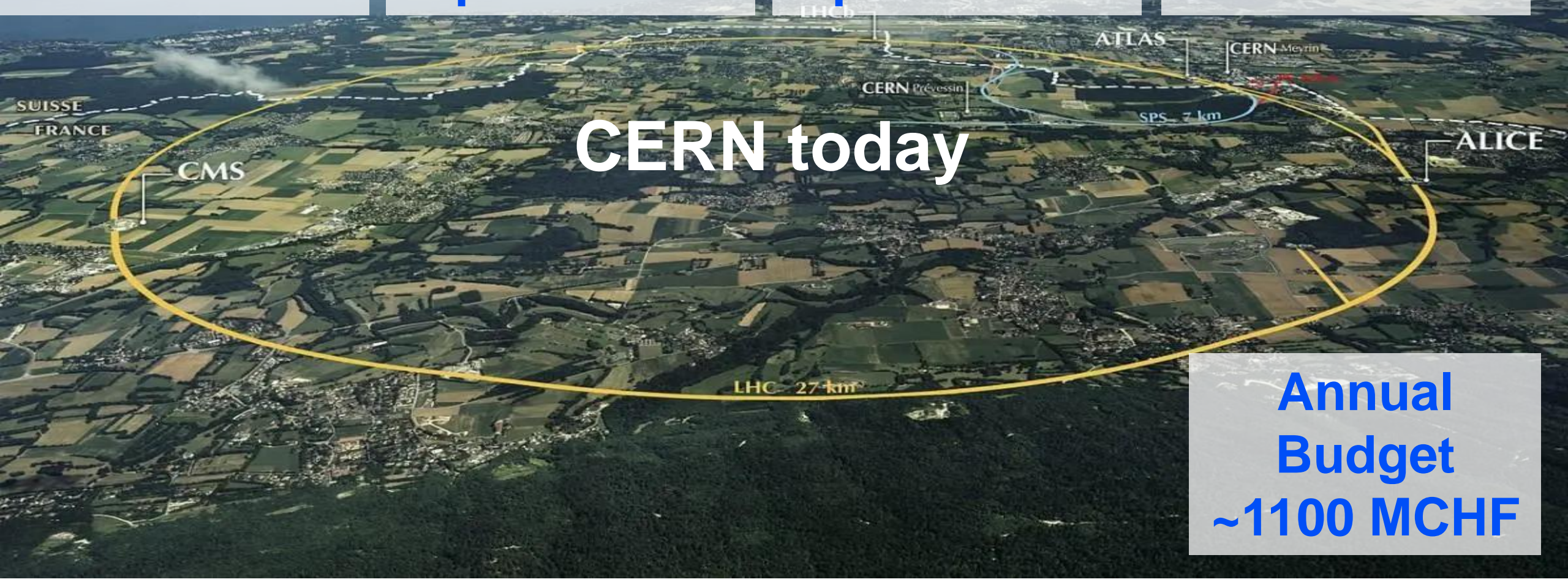
CERN: founded in 1954: 12 European States “Science for Peace”

23
Member
states

2500
Staff
positions

1600
Other
personnel

12700
Scientific
users



CERN today

Annual
Budget
~1100 MCHF



The Higgs Boson completes the Standard Model,
but the Model explains only what concerns ordinary atoms i.e, ~
5% of our Universe

Dark matter (~24%) and dark energy (~71%) make up the rest.
What are they really?

How does gravity really work?

Why there is no antimatter in nature?

Fundamental research is our driver, what this lab is all about



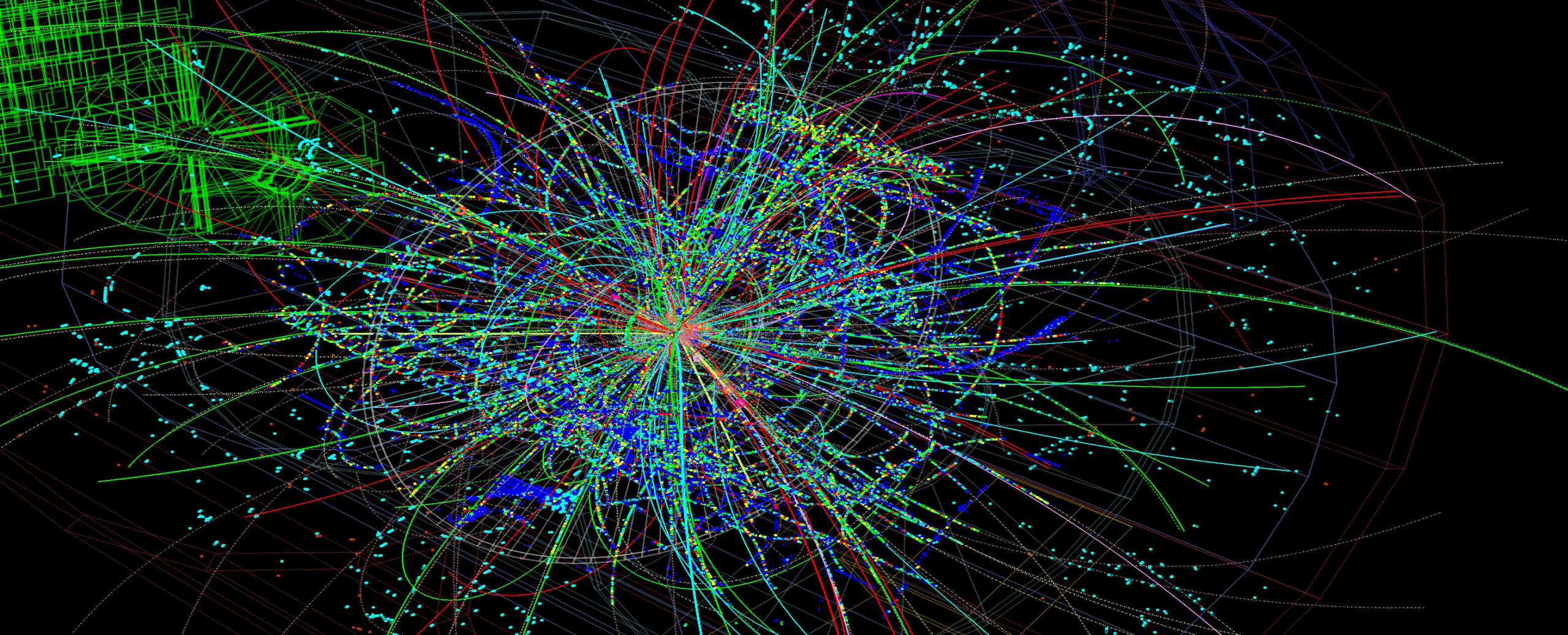
Accelerators



Detectors



Computing



FACTS

- The LHC collides protons at unprecedented energy, equivalent to 13,000 times their mass
- 40 Million collisions/sec, one every 25 ns. About 40 collisions per event. (40 MHz collision rate)
- Thousands of particles emerge from each collision
- 1 MB of data recorded by the detectors at each collision. It represents 40 TB/sec! Too much to be stored.
- Only 5% of those are stored after filtering. About 80 Pb of derived data per run.



The LHC Big Data Challenge – HL LHC - 2029

High Luminosity LHC - 2029

- ~200 collisions per event vs ~40 today. Need to disentangle 200 collisions happening at once.
- Event complexity grows non linearly
- A HL-LHC run would need to store about 900 Pb of derived data. A data deluge!
- Even taking into account HW progress (storage & processing), we are off by a factor of 10, projecting to 2029

Machine Learning and Deep Learning

Industrial Controls and Automation

Data Analytics

Metrology

High and Ultra High Vacuum Systems

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

Robotics

Sensors

Material Science

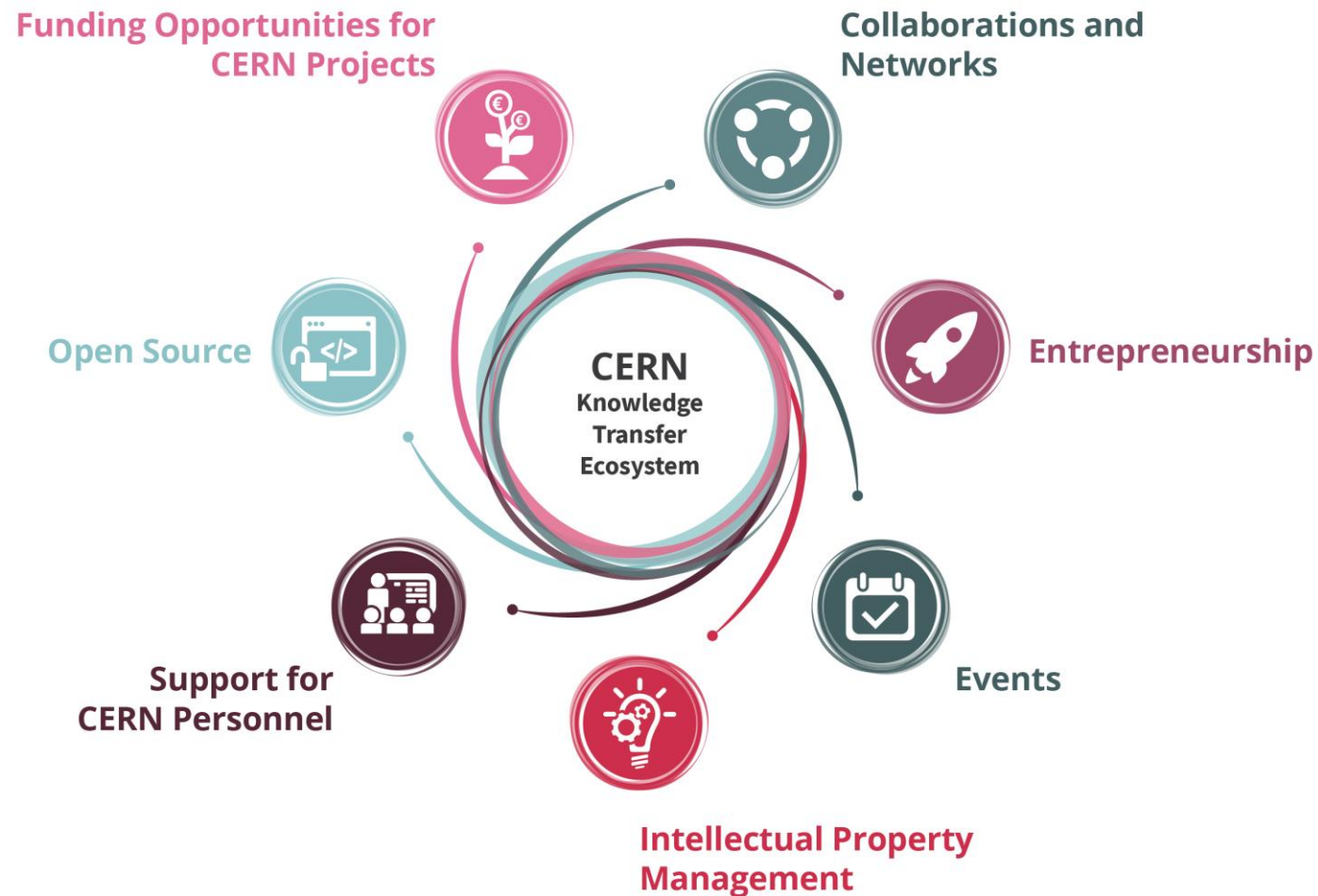
Cooling and Ventilation

Collaboration Tools

Radio Frequency Technology

Manufacturing and Mechanical Processes

Our toolbox to accelerate innovation



CERN as trusted non-commercial innovation partner



HEALTHCARE



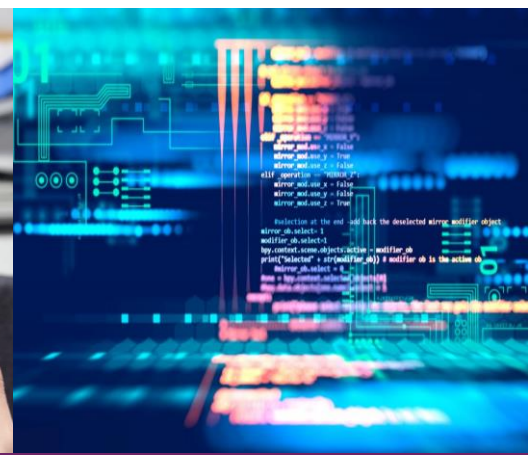
ENVIRONMENT



DIGITAL

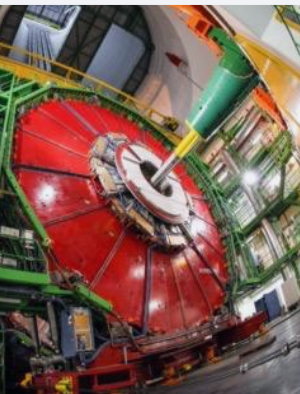


AEROSPACE



QUANTUM

Hybrid strategy: tech push & market pull



Mobilize tech experts

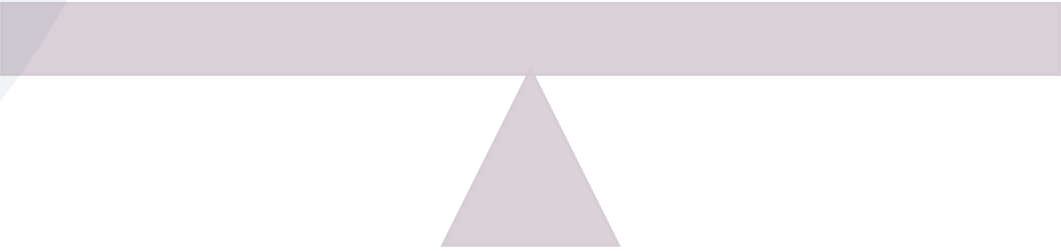
Mobilize innovation partners

Create tech and IP dossiers

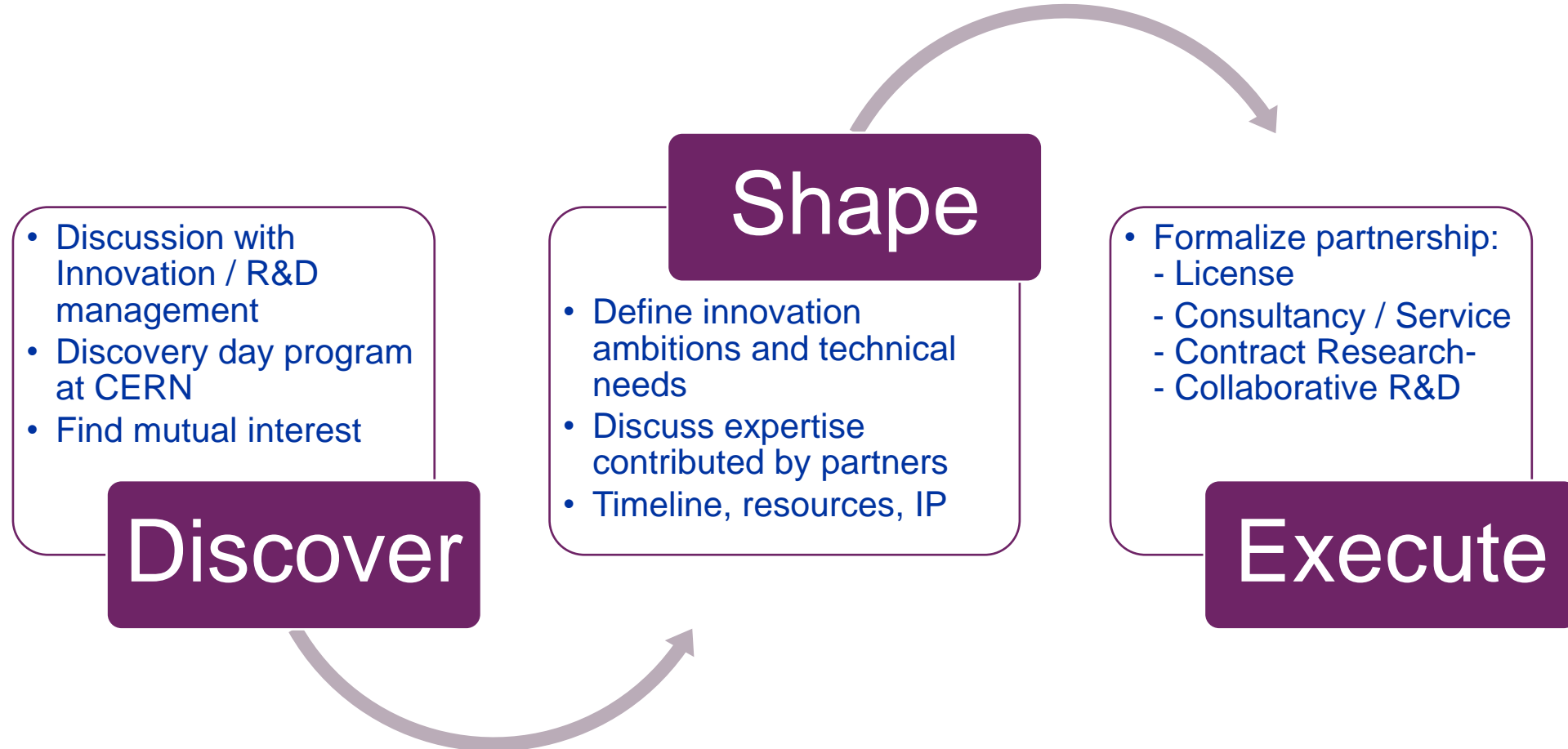
Create value propositions

Scout for technologies

Search unmet needs



Shaping innovation partnerships



Licence

- Access to existing solution
- Support to implement

Consultancy/Service

- Specific issue
- Time of experts
- Time of facilities

Contract research

- Specific solution
- Outsource its development to CERN

Collaborative R&D

- General issue
- Jointly find solution
- Jointly develop solution

How much time does it take to
create a R&D Partnership?

What is the % of partnerships that
typically make it to the execution
phase?



Collaborative R&D

MedAustron and CNAO offer hadron therapy using CERN technology.

Collaborative R&D



MedAustron and CNAO offer hadron therapy using CERN technology.

License

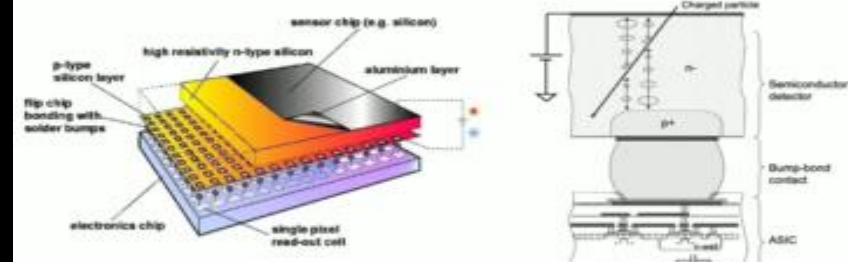


MEDIPIX Read-out chips for particle imaging



MARS Bio Imaging:
next generation X ray
finally in color using
CERN chips

Hybrid Silicon Pixel Detectors



ZENSEACT (Volvo Cars Company) teams up with CERN on extremely fast machine learning/deep learning using FPGAs.



CEVA and CERN joined R&D on neural network weight and activation compression algorithms aiming make them run more efficiently. Wireless comms & computer vision applications

Collaborative R&D

- Jointly develop solution



Machine learning/Deep learning

EU Funded project

The Project ▾

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AGENIUM
SPACE



ENDUROSAT



Edge @ SpAIce

A blue satellite icon with solar panels and a central body, positioned to the right of the 'Edge @ SpAIce' text.

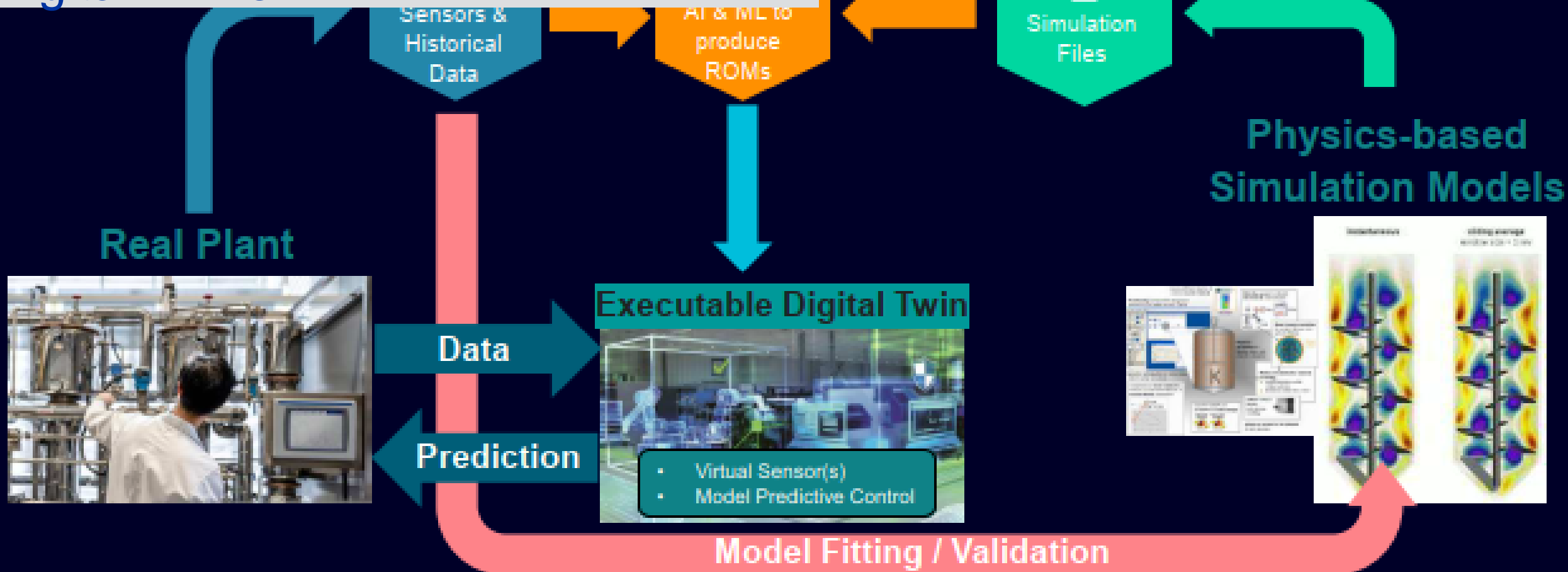
NOVEL EDGE-AI SYSTEM FOR ACCURATE AND NEAR REAL-TIME
PLASTIC DETECTION AND MONITORING
IN MARINE ENVIRONMENT

Machine learning/Deep
learning

On board inference of Earth Observation images:
Application: Detection of plastic litter at sea.
Next generation EO applications

Real-time Digital Twin example

AI enhanced autonomous condition monitoring for Septa magnets, using Digital Twins





Contract Research

- Use case and requirements by the company
- Code contributed to the OS project
- Development @CERN, benefit for HEP applications

ROCHE is using CernVM-FS for application and library distribution worldwide.

Contract Research for a Company in the financial services sector. JumpTrading has strong interest in this tech for fast reliable worldwide file distribution.



Collaborative R&D

Collaboration with CORMEC and WUR to support national banks and regulators to detect trading anomalies in stock market.

Specialised Facilities

Collaborative R&D

SCIENCE & EXPLORATION

juice

Jupiter Icy Moons Explorer

High energy beam for testing radiation hardness with ESA.

Before embarking on its journey, critical components of ESA's interplanetary mission were tested in the only facility on Earth capable of replicating Jupiter's harsh radiative environment.

RENEWABLE AND LOW-CARBON ENERGY

Production
Transformation
Distribution
Storage

SUSTAINABILITY AND GREEN SCIENCE

Power Management
Heat Management
Industrial Processes



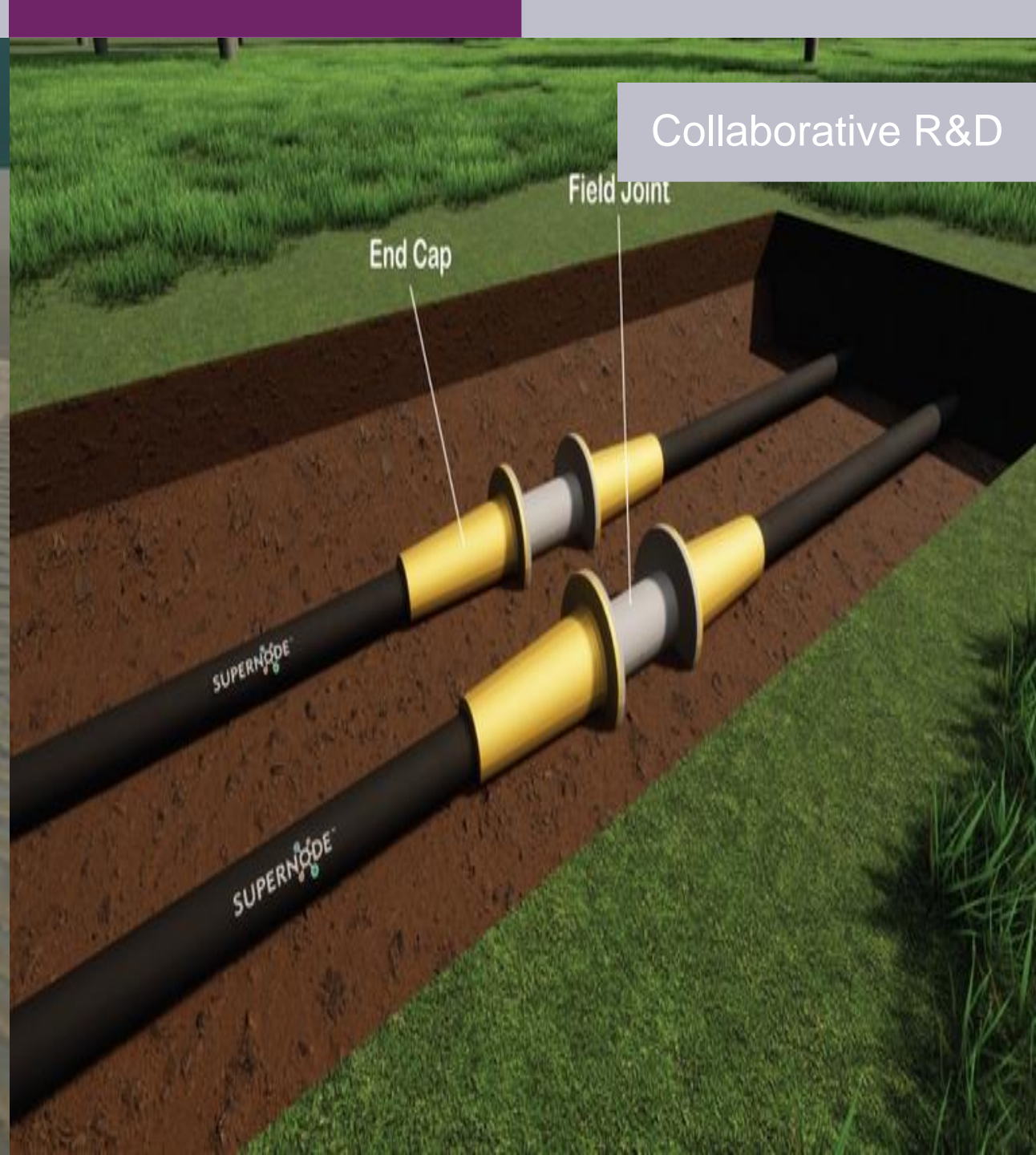
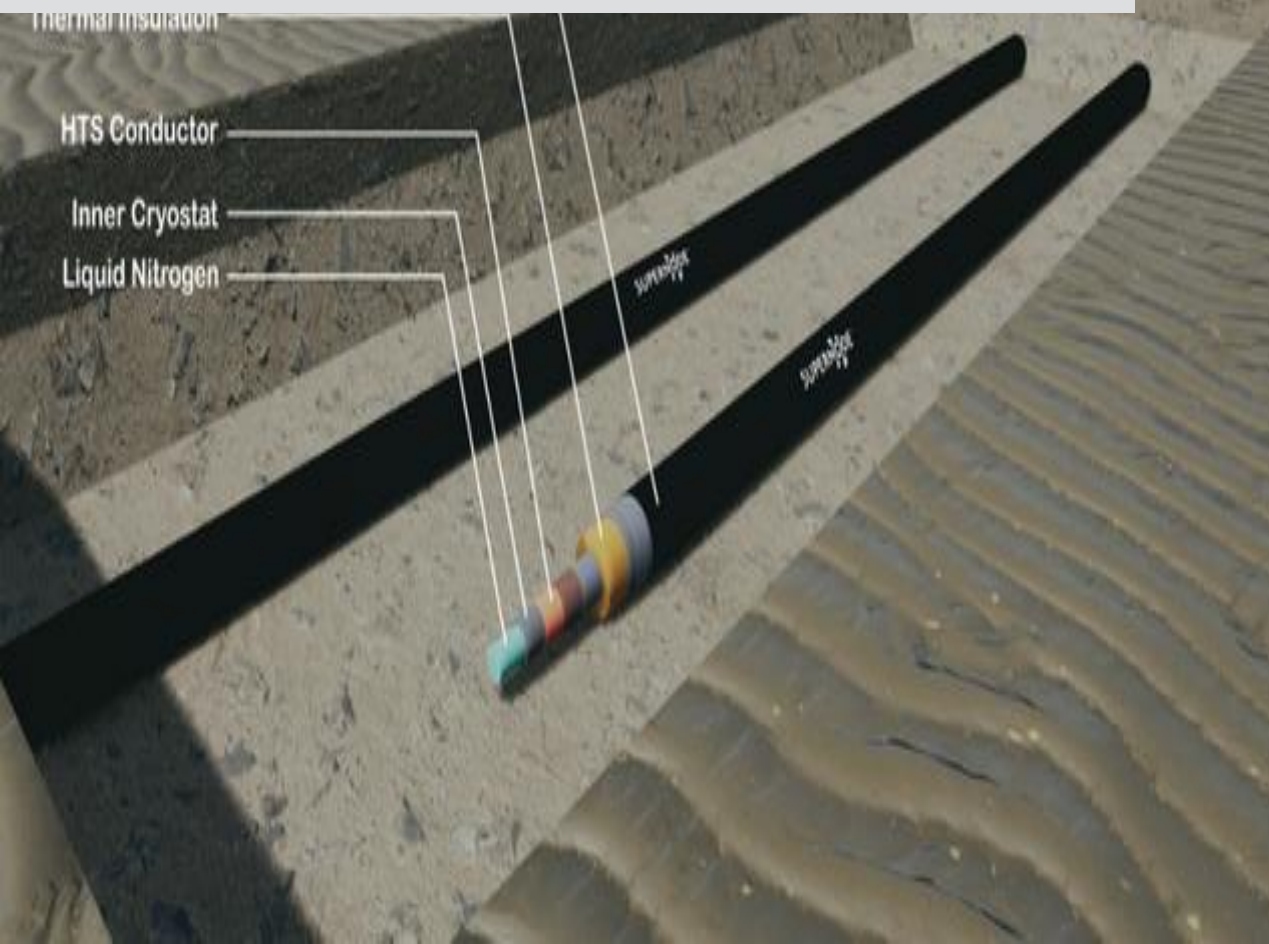
CLEAN TRANSPORTATION AND FUTURE MOBILITY

Aviation
Shipping
Rail
Automotive

CLIMATE CHANGE AND POLLUTION CONTROL

Monitoring
Modelling
Mitigation

SUPERNODE an IE startup working with CERN on superconducting tech for HVDC transmission



Consultancy

Tokamak Energy (fusion power) taps into expertise of CERN on simulation of currents and magnetic fields.

Collaborative R&D

CERN and ABB team up on reducing electricity in cooling and ventilation.

Key lessons learned when innovating with Industry

- CERN is strong in the 'extremes' of the technology scale
- You need passionate experts on both sides to succeed
- Need to identify a concrete project & clear business case
- Keep in mind differences in culture, language, and pace
- Driving deep tech innovation requires courage, commitment & time

But, results can be way beyond expectations!



Thank you for your attention

**Nick Ziogas@cern.ch
kt.cern**





WHAT IF WE BUILD A STEM EDUCATION PROGRAM FOR HIGH SCHOOLS, USING OUR PIXELATED RADIATION DETECTORS?

4 QUALITY
EDUCATION



