EuroHPC25 – Kraków

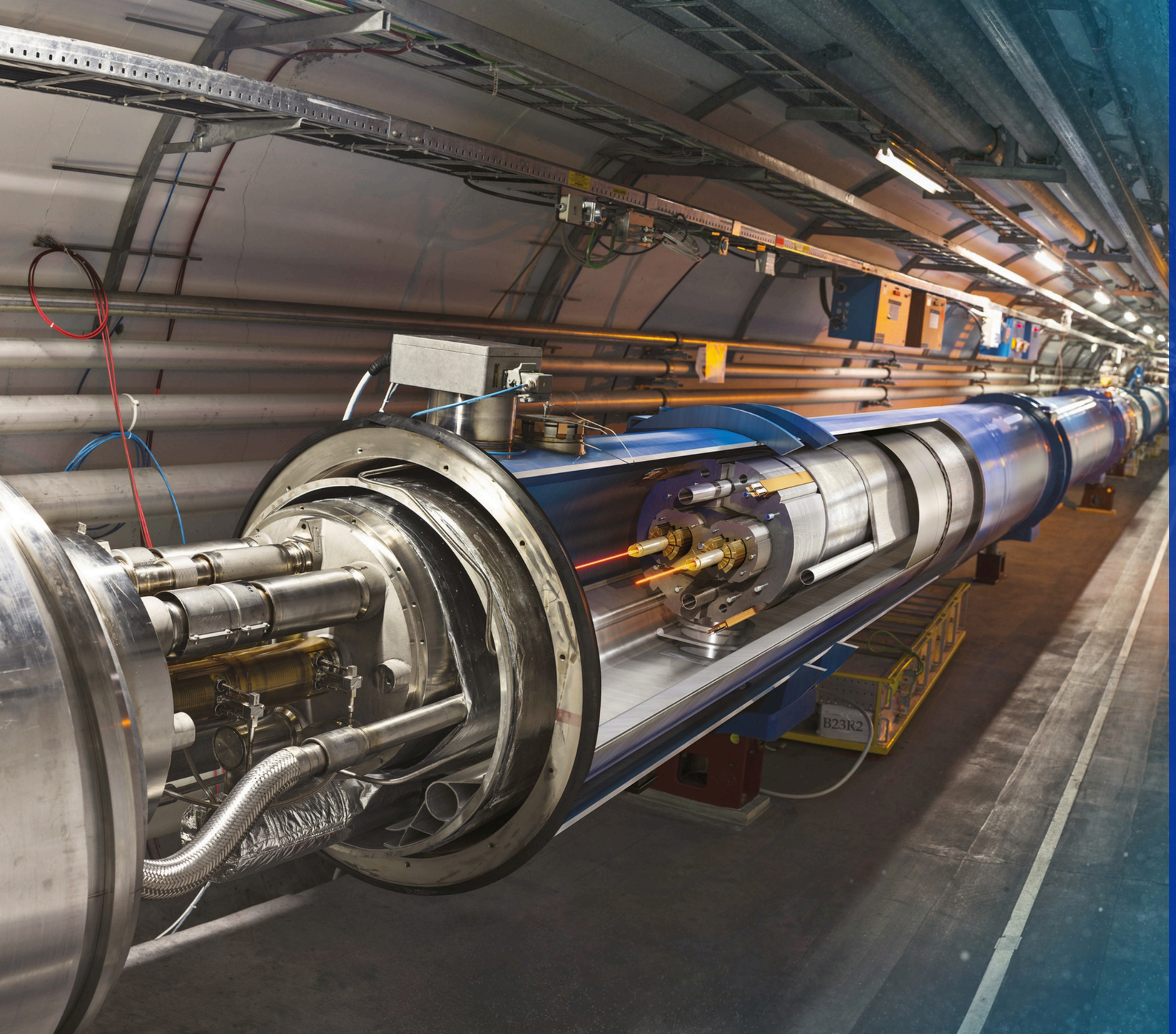
18-20 March 2025

Scientific & Societal Breakthroughs: the case of CERN

Enrica Porcari
Head of CERN IT Department

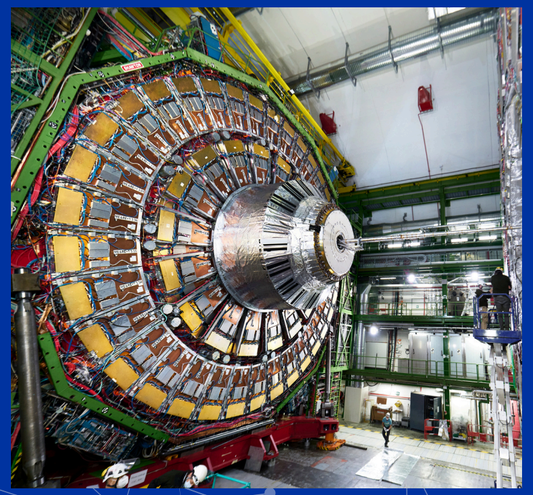
CERN is the world's biggest laboratory for particle physics

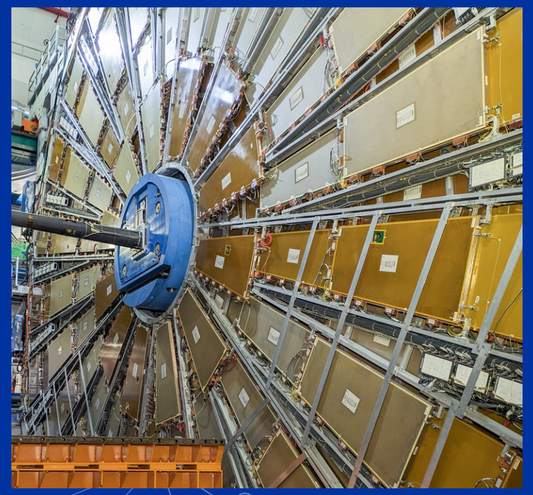
Our goal is to understand the most fundamental particles and laws of the universe

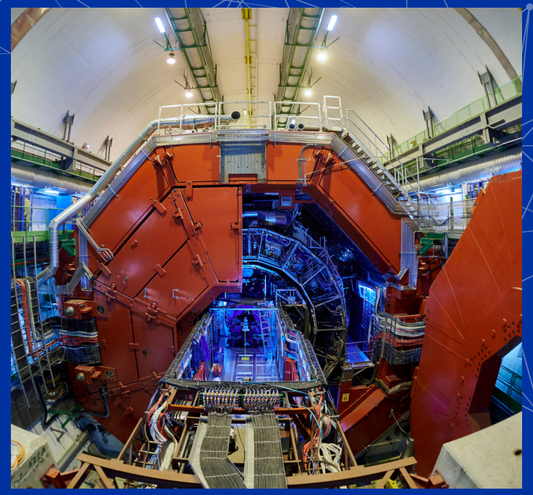


Large Hadron Collider (LHC)

- 27 km in circumference
- About 100 m underground
- Superconducting magnets steer the particles around the ring
- Particles are accelerated to close to the speed of light



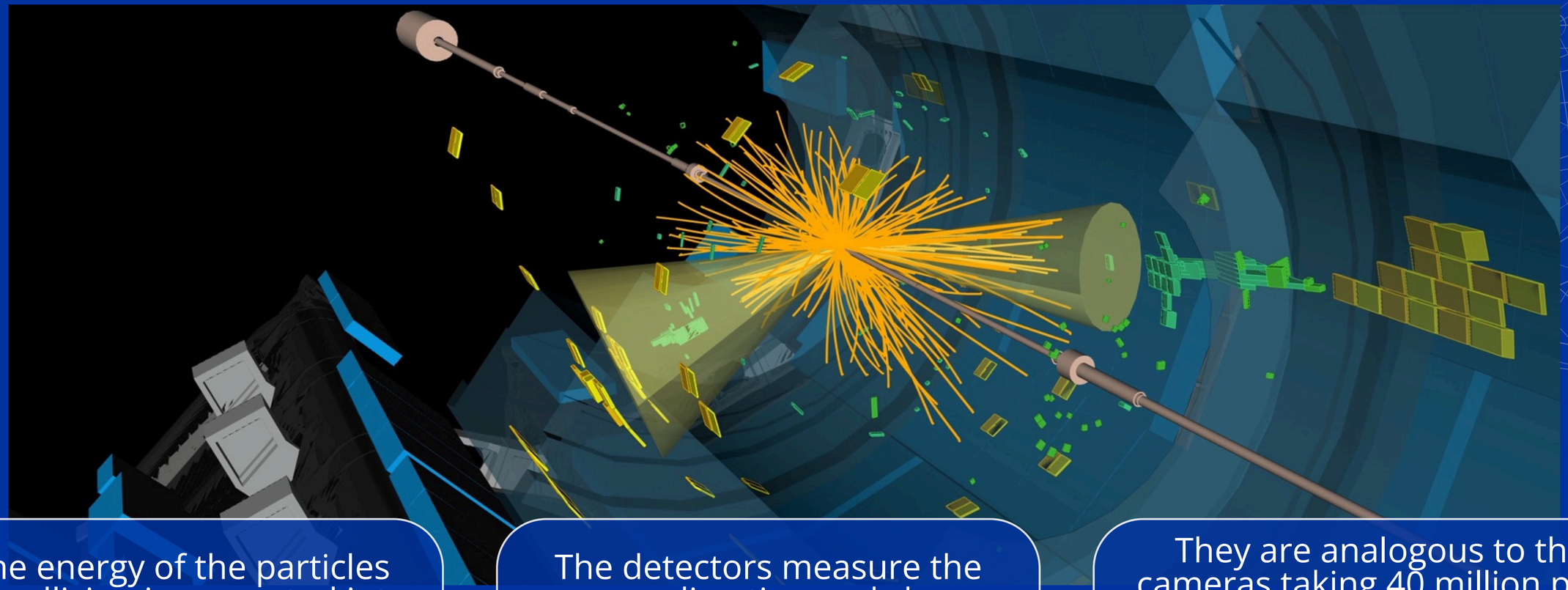




Giant detectors record the particles formed at the four collision points

We use them to reply to fundamental questions!

The LHC produces more than 1 billion particle collisions per second, resulting in 1TB/minute stored in our Data Centre

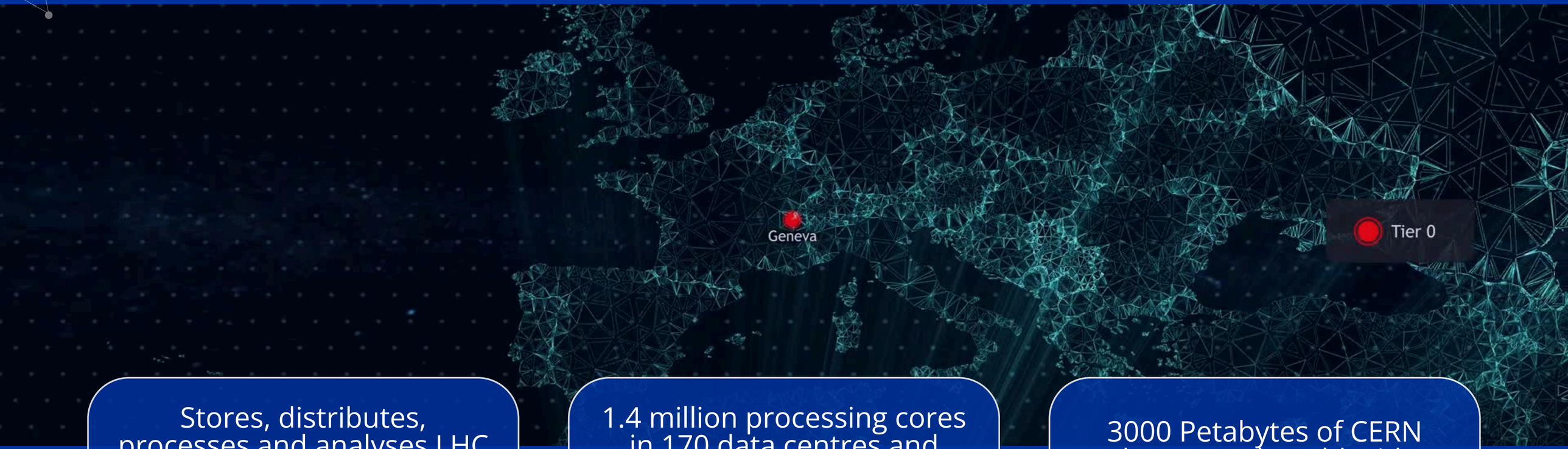


The energy of the particles in collision is converted into new particles

The detectors measure the energy, direction and charge of new particles formed

They are analogous to the 3D cameras taking 40 million pictures a second, of which 1000 are selected and recorded

The Worldwide LHC Computing Grid (WLCG)



Stores, distributes, processes and analyses LHC experiments' data

1.4 million processing cores in 170 data centres and more than 40 countries

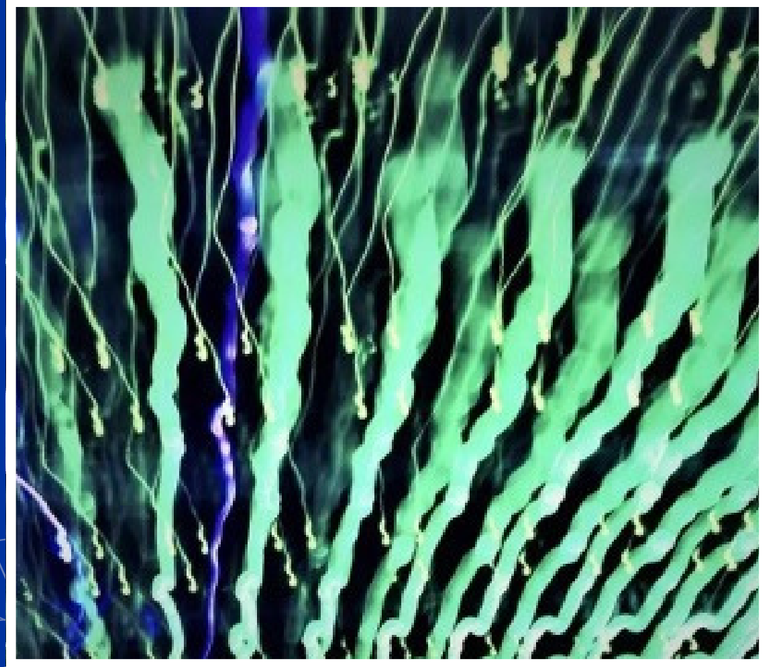
3000 Petabytes of CERN data stored world-wide

A constant need to become smarter…

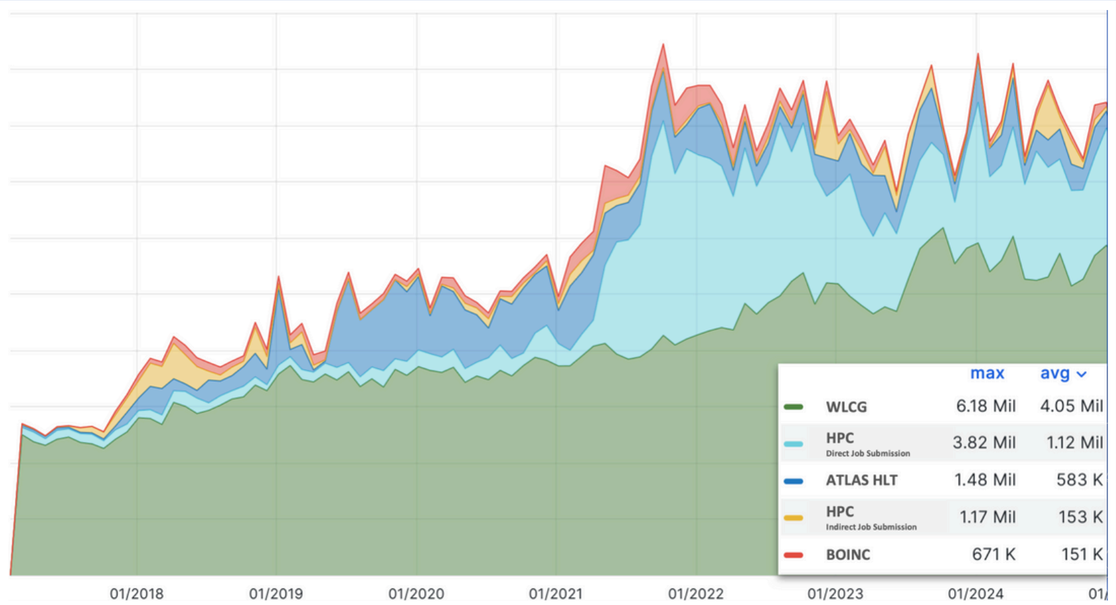
Explore quantum technology capabilities

Nurture worldwide collaboration

Faster data selection and analysis with AI techniques

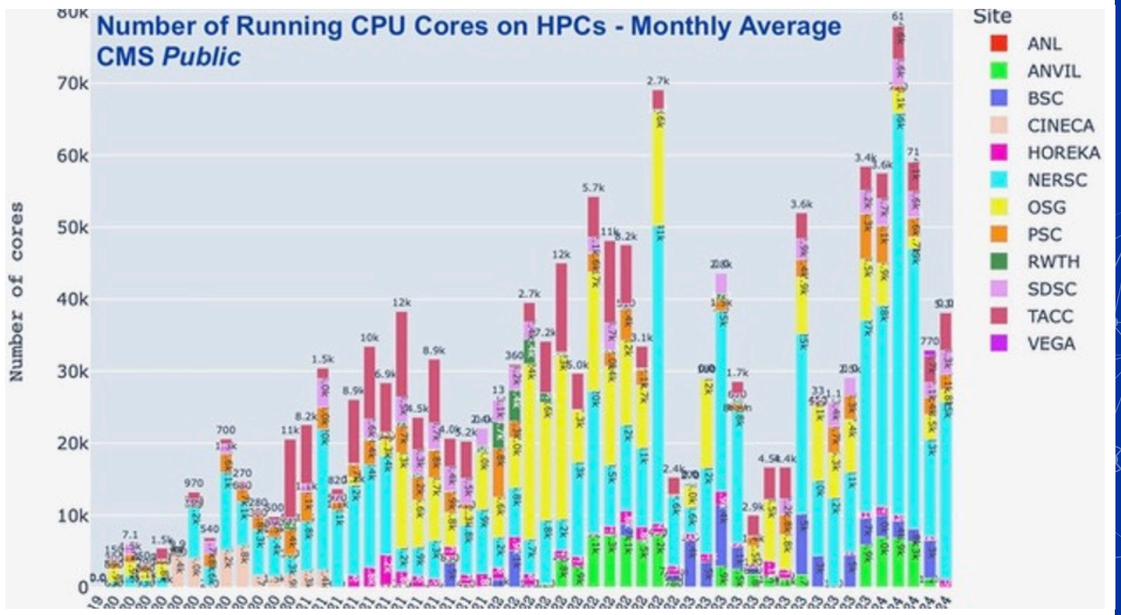


...and to leverage all opportunities



ATLAS HEPSCORE23
by resource type

CMS and HPC number of cores and data centres



High-energy physics: turning complexity into new opportunities

EuroHPC Joint Undertaking

CERN roadmap for HPC includes a **stronger collaboration** with EuroHPC

OSCARS
Open Science Clusters' Action for Research & Society

CERN works with other scientific communities on **ensuring interoperability** for computing requirements

SPECTRUM

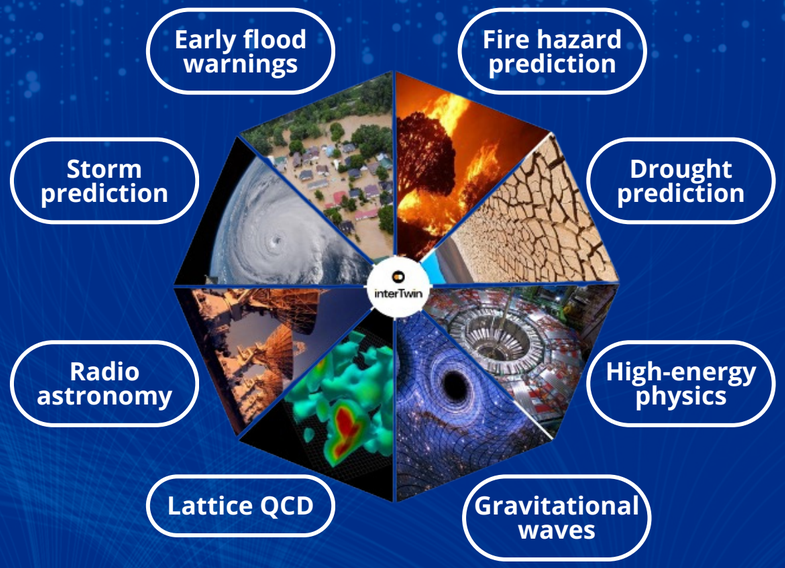
CERN leverages **common visions and challenges** to help deliver a Strategic Research, Innovation and Deployment Agenda (SRIDA) and a Technical Blueprint for a European compute and data continuum

Beyond HEP: we leverage HPC resources

interTwin → To co-design and implement the prototype of an interdisciplinary Digital Twin Engine

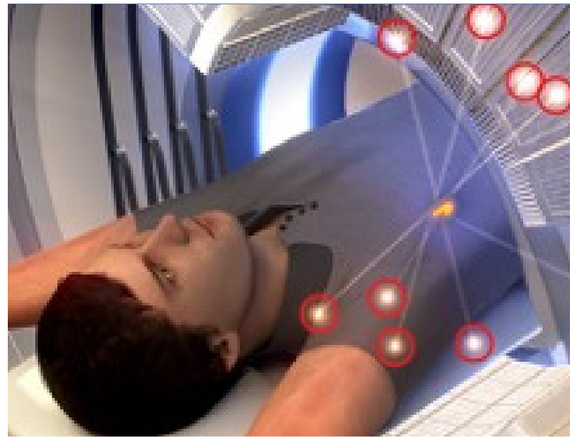
BioDynaMo.org → To build a software that supports scientists to easily create, run, and visualise multi-dimensional agents-based simulations

AI Partnership for Humanity → To leverage AI technologies to speed up progress towards a world with Zero Hunger. This will be done harnessing CERN's AI algorithms and weather modelling framework, LIST's AI for Earth Observation (EO) and crop modelling expertise, with WFP's programmes capabilities, to tackle challenges around food insecurity and acute hunger

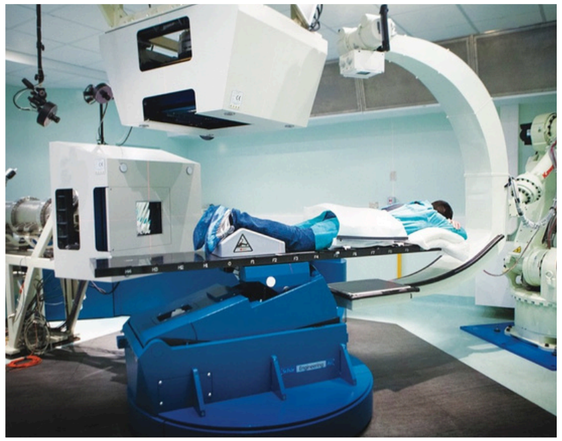


All computer resources enable us to support the scientific community and create a positive impact on society

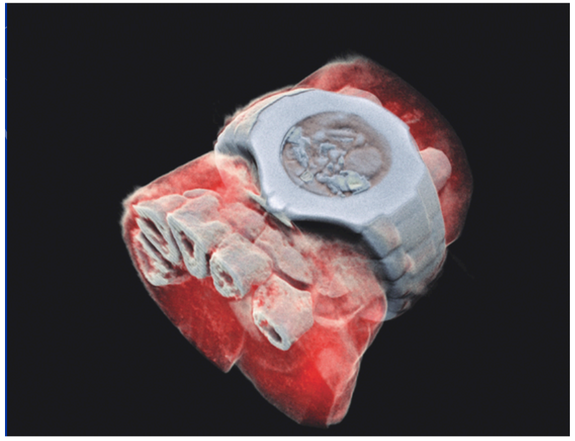
Accelerator technologies are applied in cancer radiotherapy with protons, ions and electrons



Pixel detector technologies are used for high resolution 3D colour X-ray imaging



Technologies applied at CERN are also used in PET, for medical imaging and diagnostics



CERN produces innovative radioisotopes for nuclear medicine research

There are many unanswered questions in fundamental physics (the 95% of the universe is made of unknown matter and energy)

There are many challenges ahead in the computing landscape (geopolitics, procurement, energy sustainability)

We need to build a common vision and believe in the power of collaboration

EuroHPC25 – Kraków

Thank you

18-20 March 2025

Enrica Porcari
Head of CERN IT Department