



Discovering CERN:

Introduction to Knowledge Transfer

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Knowledge Transfer Officer

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What we do

- One of the world's leading research centres to answer fundamental physics question

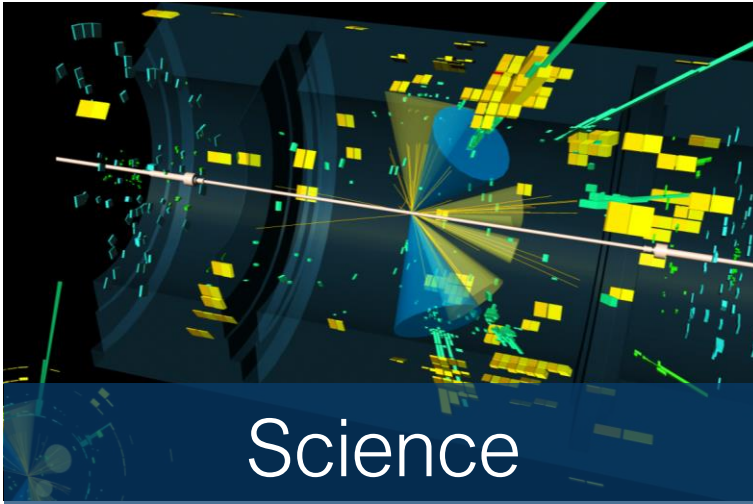
What is the Universe made of?

... we only know 4%...

- Analysis of microscopic big bangs
- Famous for 27km long Large Hadron Collider & discovery of Higgs Boson particle in 2012



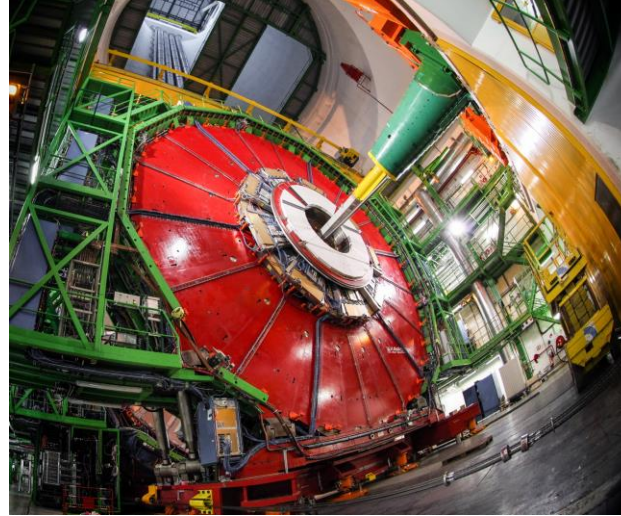
CERN's Mission



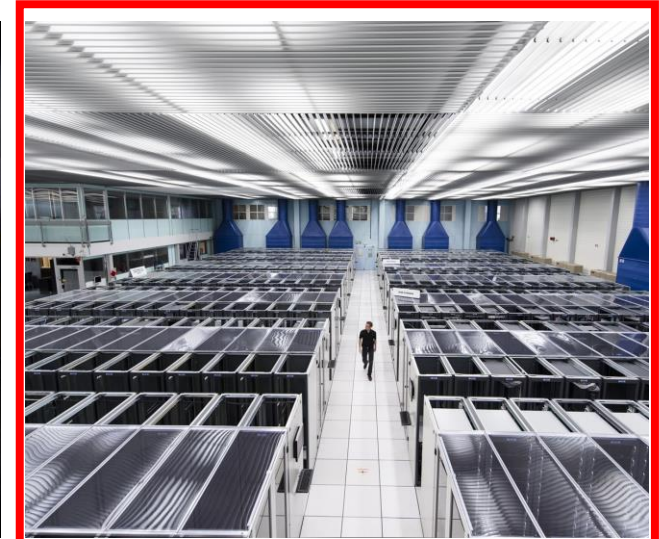
Three main areas of operation



Accelerators



Detectors



Computing

CERN is a treasure cove of know-how and technologies.

Focus: Data Analytics & Machine Learning

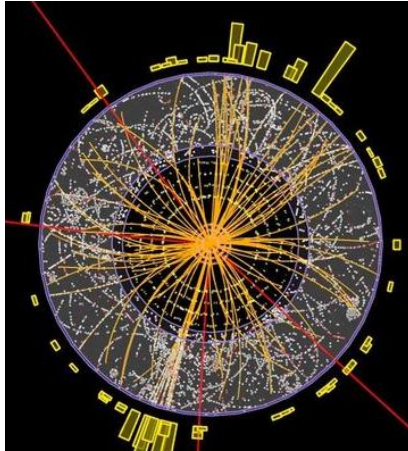


1) It is a lot of data

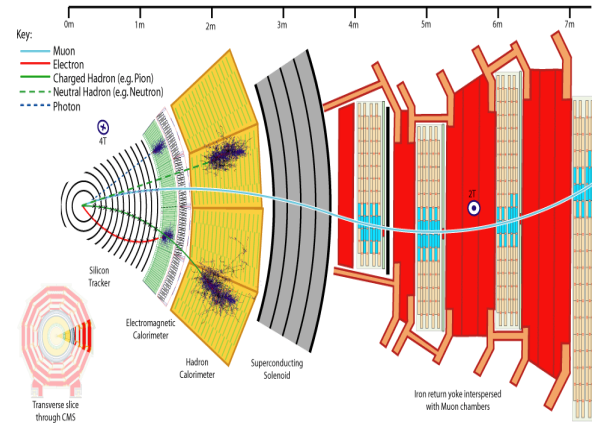
2) It happens very fast

3) We are looking for very small signals

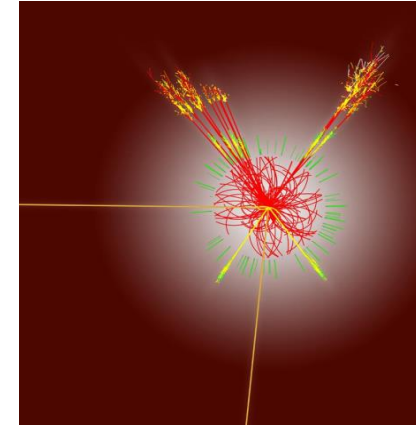
ML Application in high energy physics



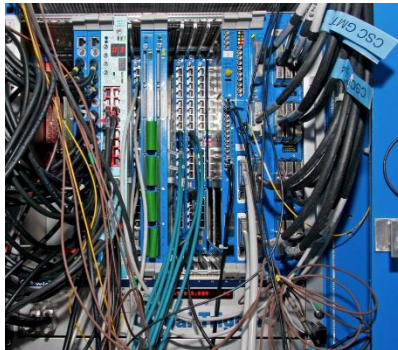
Tracking



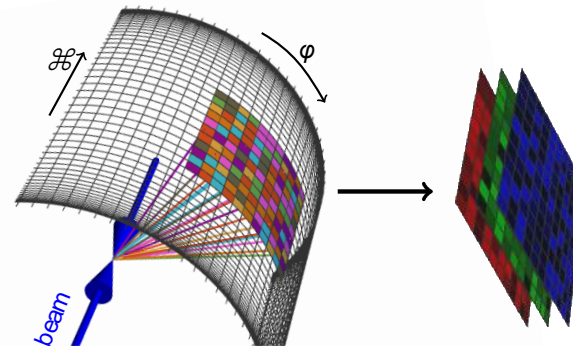
Object Identification



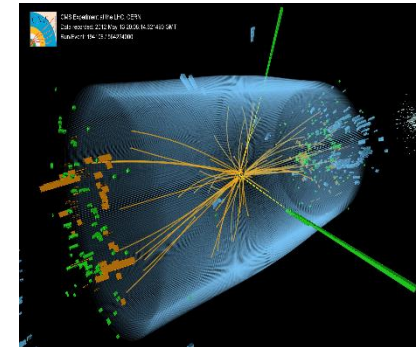
Fast Simulation



Trigger



Imaging Techniques



Event Level ID

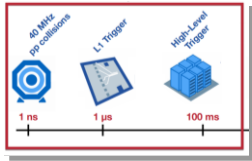
Data Analytics & Machine Learning

Proven CERN capability



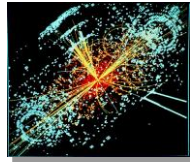
Use case specific

Fast ML



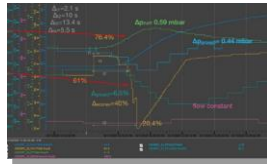
Ultra-fast on-edge inference under strict latency constraints

Anomaly detection



Object identification, classification, anomaly detection in big and noisy data sets

Industrial controls



Machine efficiency and predictive maintenance with industrial control systems

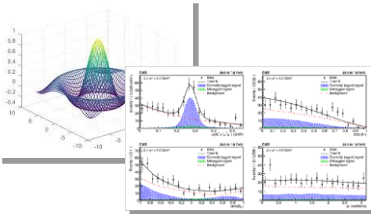
Distributed computing



Optimization of distributed computing, storage, and networks; fast I/O for large files

Large scale, science grade data analytics and visualization

Cross use case

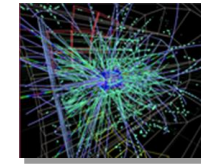


- Optimization and evaluation for science-grade precision of large data sets using advanced data analytics
- Data visualization, interactive plotting (e.g., statistical visualizations, uncertainties, distributions), model visualization
- Large-scale, quality-controlled CERN data as testbed/ benchmark (e.g., single data set with 100m examples, >1TB)

In development, opportunity for joint R&D

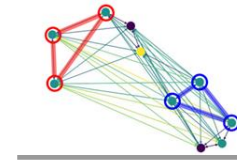


Simulation



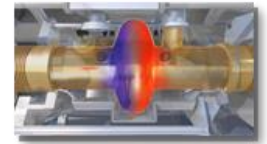
Simulation and reconstruction with generative DL for efficient computation

Graphs



Exploring Graph NNs for high-multiplicity problems with non-linear distances

Machine design



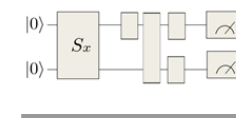
Determining optimal machine design and component configuration

ML in Robotics



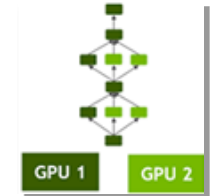
Remote maintenance and safety with autonomous robots and computer vision

Quantum ML



Research quantum algorithms to solve pattern recognition, classification and generation problems

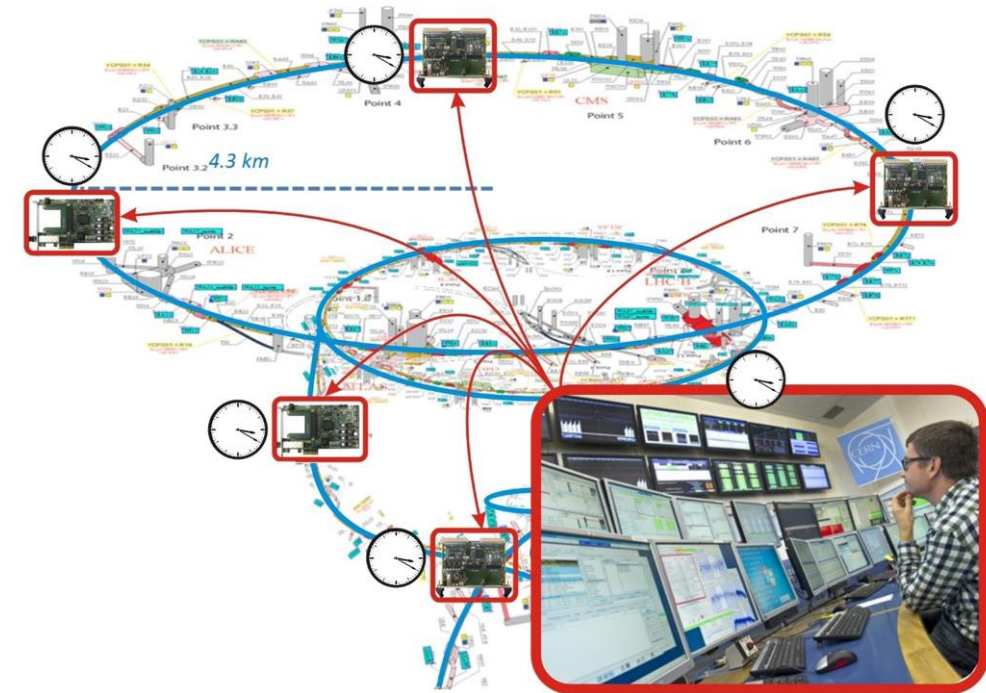
Computing parallelization



Training and optimization of complex NNs on parallelized GPU infrastructure

Focus: White Rabbit Technology

- sub-nanosecond accuracy & picoseconds precision of synchronization of control / data acquisition systems
 - Gigabit rate of data transfer
 - fully open and commercially available hardware, firmware and software
-
- Based on well-established standards
 - Ethernet (IEEE 802.3)
 - Bridged Local Area Network (IEEE 802.1Q)
 - Precision Time Protocol (IEEE 1588)
 - Extends standards to provide
 - Sub-ns synchronization (Now included in IEEE 1588-2019 High Accuracy Profile)
 - Deterministic data transfer
 - Initial specs: links ≤ 10 km & ≤ 2000 nodes



CERN Knowledge Transfer (KT)



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Group Leader



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Deputy Group Leader,
Section Leader IP
Management and KT
Policies & Legal Advisor



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Visiting Researcher



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Knowledge Transfer Officer

KT's Mission



Maximise the technological and knowledge return to society, in particular through Member States industry

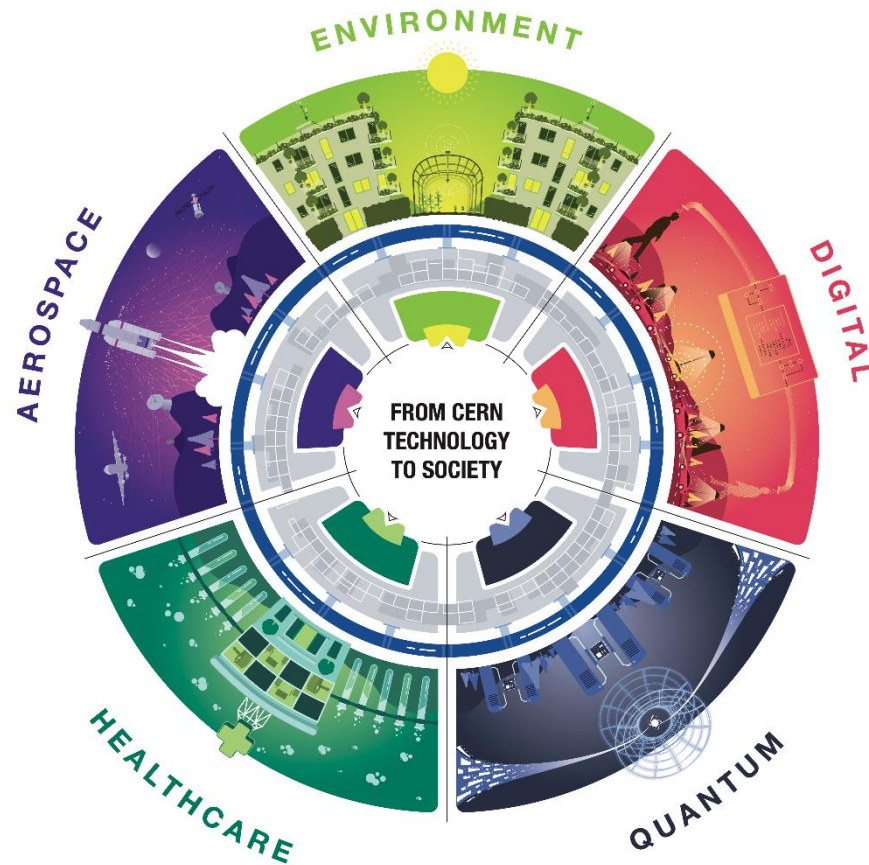


Promote CERN as a centre of excellence for technology and innovation



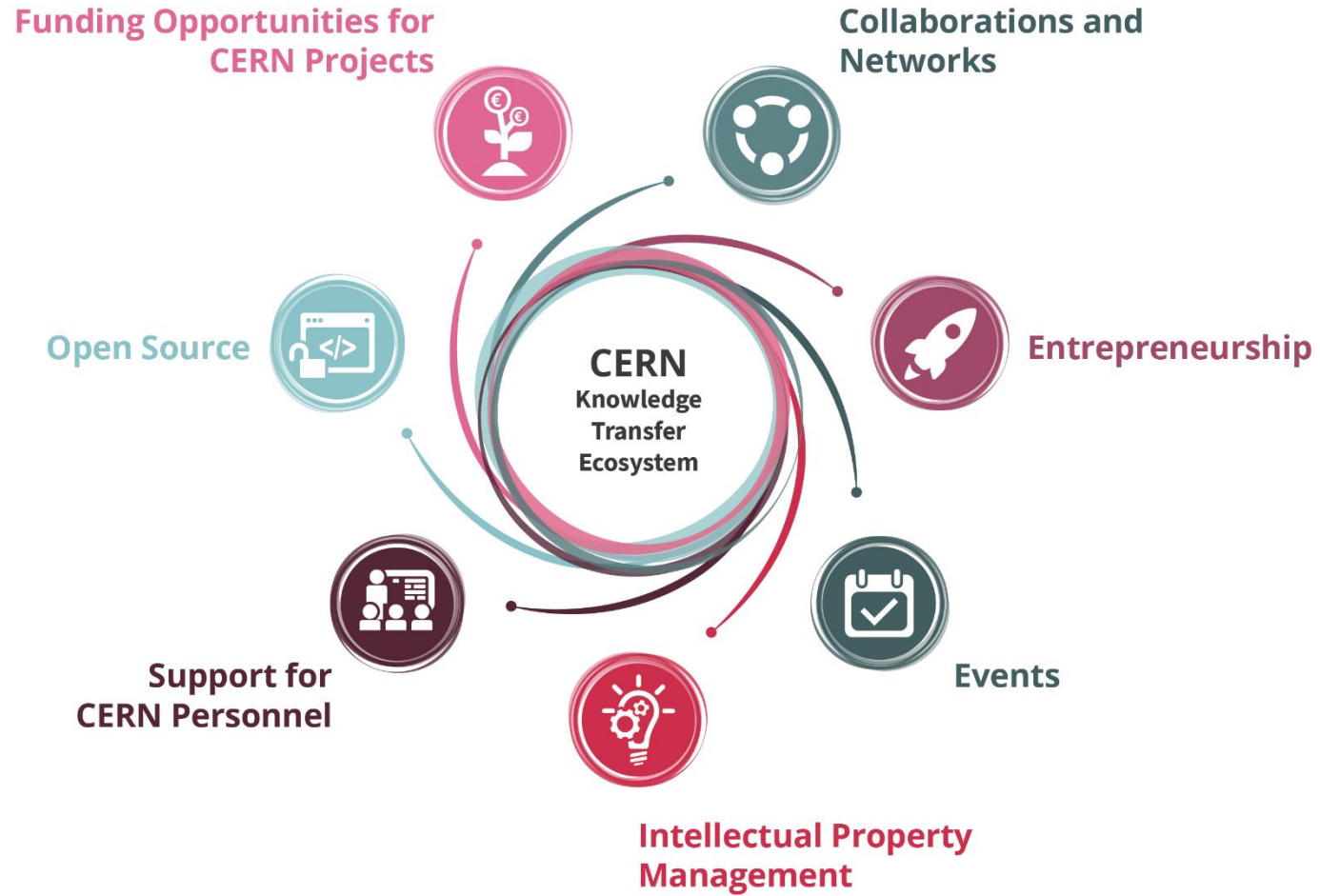
Demonstrate the importance and impact of fundamental research investments

From CERN technology...



... to society

Knowledge Transfer Tools



Internal Funding Opportunities

37-900k CHF funding received per project

> 3M CHF total funding allocated for projects taking CERN tech into society



CERN Knowledge Transfer Fund

>60

Projects funded since 2011

7

Projects funded in 2022



CERN Medical Applications Budget

56

Projects funded since 2014

4

Projects funded in 2022

2022 HIGHLIGHTS AT A GLANCE

OUR DOMAINS

HEALTHCARE



AEROSPACE

QUANTUM



DIGITAL

ENVIRONMENT



INTELLECTUAL PROPERTY AND LICENSING

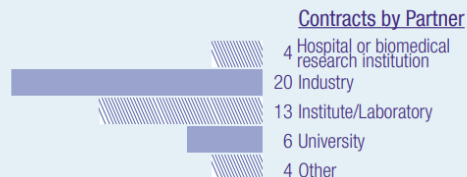
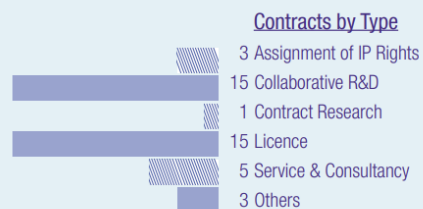


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New technologies
disclosed internally

42

Knowledge Transfer
contracts signed



CERN Innovation Programme
on Environmental Applications

RENEWABLE AND LOW-CARBON ENERGY

Production
Transformation
Distribution
Storage

CLEAN TRANSPORTATION AND FUTURE MOBILITY

Aviation
Shipping
Rail
Automotive

CERN KNOW-HOW

Superconductivity
High Field Magnets
High Vacuum
Cryogenics
Materials
Artificial Intelligence
Advanced Sensors
Rad-Tol Systems
Thermal Control
Radioprotection
...

SUSTAINABILITY AND GREEN SCIENCE

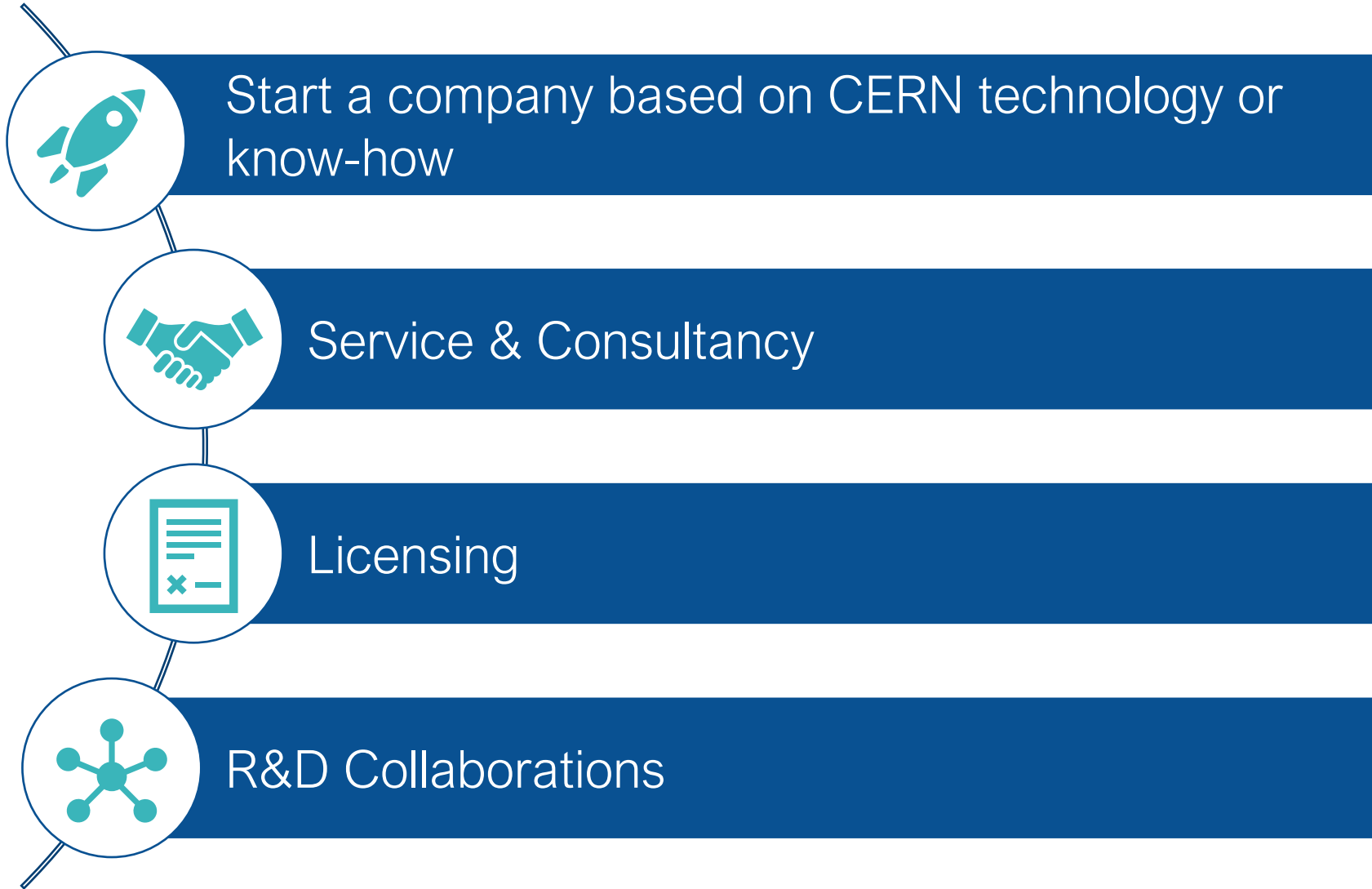
Power Management
Heat Management
Industrial Processes

CLIMATE CHANGE AND POLLUTION CONTROL

Monitoring
Modelling
Mitigation



How to collaborate with CERN



Examples



CERN and Airbus partnership on future clean aviation

CERN and Airbus UpNext sign a collaboration agreement to assess the use of superconducting technologies for future low-emission aeroplanes.

Knowledge sharing | 01 December, 2022



CERN to partner with industry on innovation to reduce environmental impact of large-scale facilities

In its commitment to minimising its environmental impact and developing technologies that can help society towards a better planet, CERN has formed an innovation partnership with ABB, with the aim of reducing the Laboratory's energy consumption

Knowledge sharing | 14 June, 2022



Timepix: from CERN's galleries to the Moon

The renowned Timepix detector celebrates its 10-year anniversary on the International Space Station by flying to the Moon: the chip features in NASA's future lunar programme

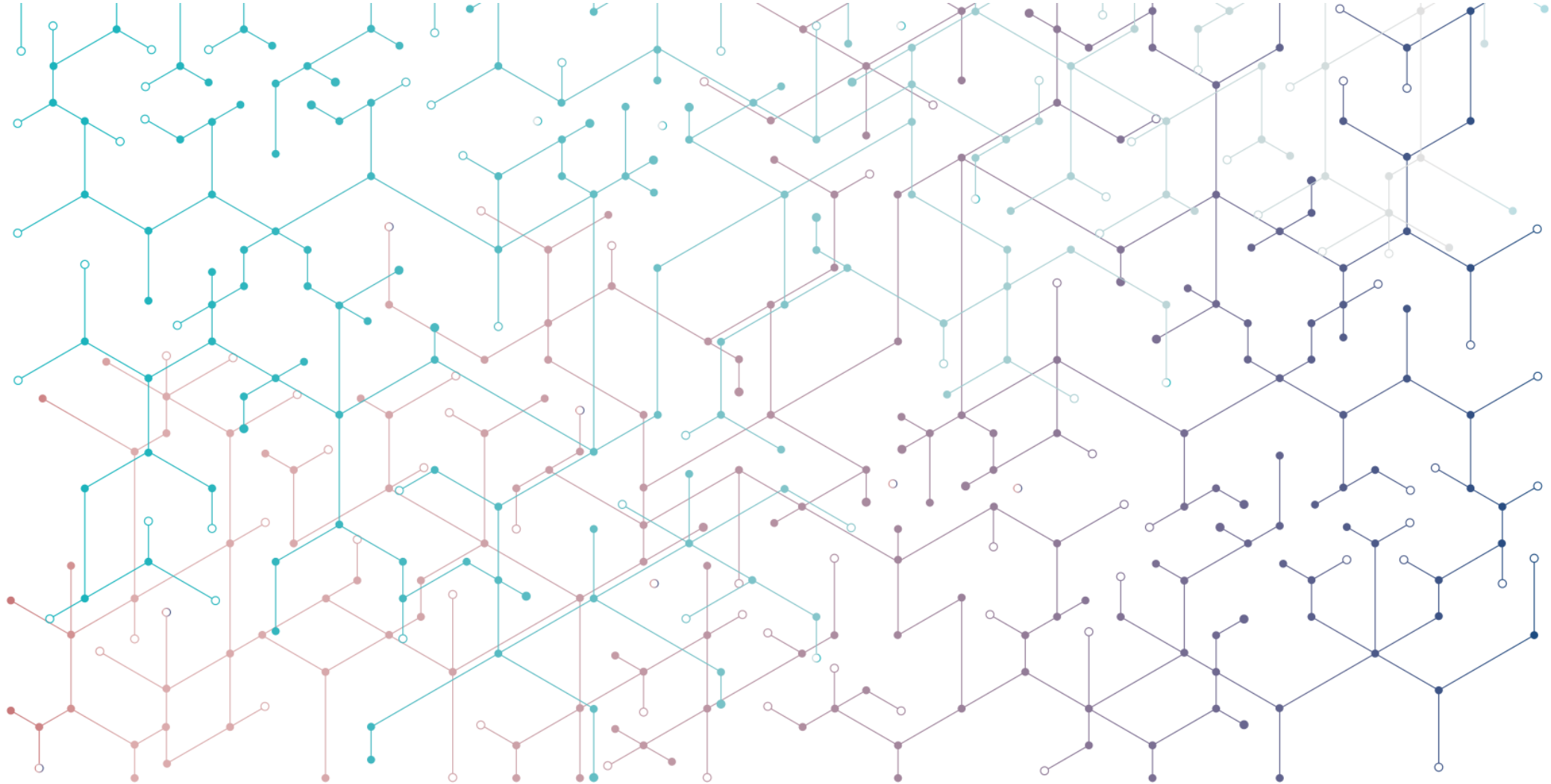
| 16 November, 2022



CERN and CNAO, a long-standing collaboration in the fight against cancer

On November 24, the CNAO (Centro Nazionale di Adroterapia Oncologica) hadrontherapy centre in Pavia, Italy, will organise a special event to celebrate twenty years of CNAO.

Knowledge sharing | 22 November, 2021



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