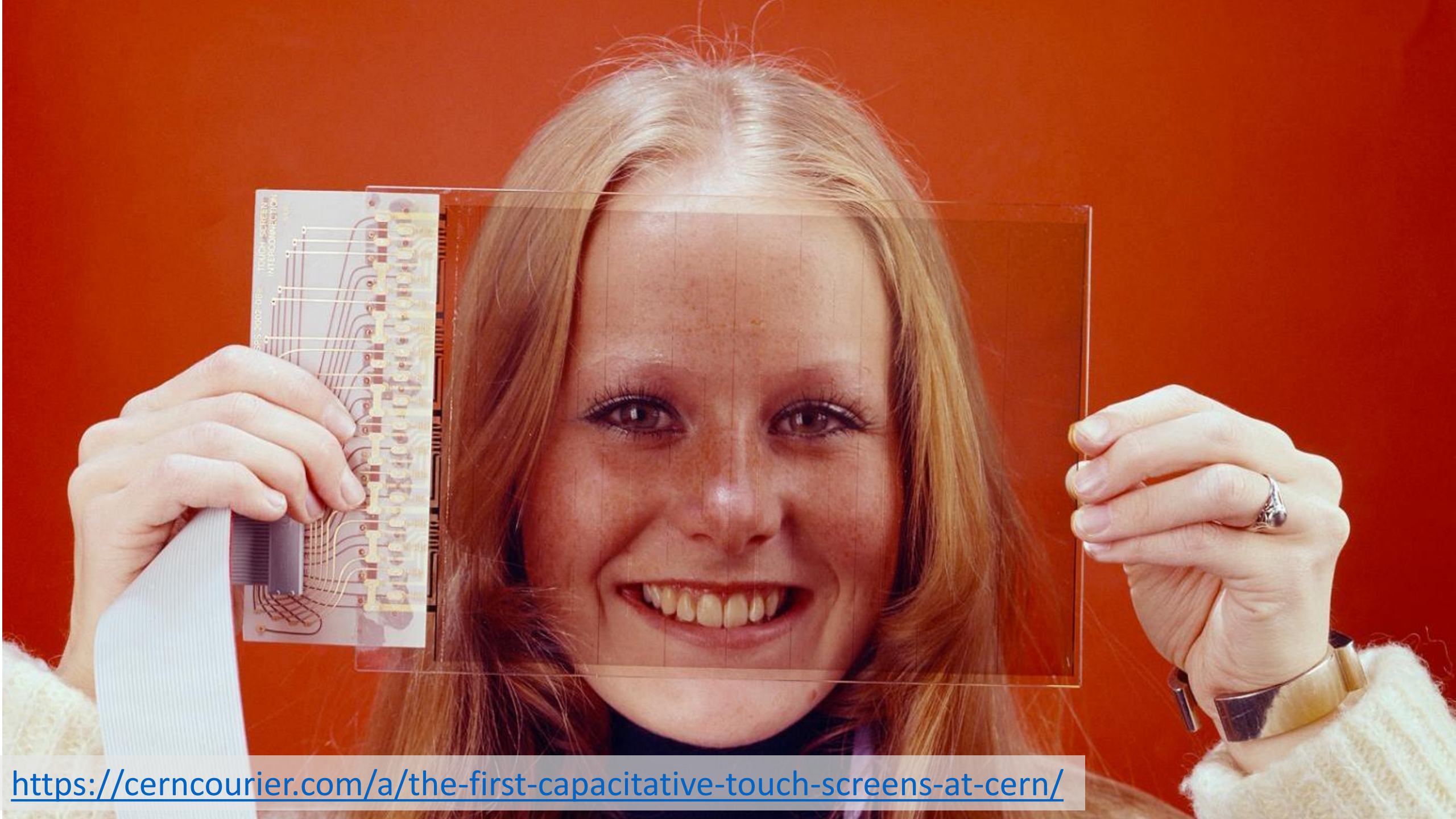


Accelerating Innovation @ CERN

Benjamin Frisch

Knowledge Transfer Group
CERN





<https://cerncourier.com/a/the-first-capacitive-touch-screens-at-cern/>



INTELLIGENT

TOUCH TERMINAL

ADP 11

SCOPE TRIGGER SELECTION

mS

TRIGGER 1

SCOPE TRIGGER SELECTION

mS

TRIGGER 2

HORN - 1 (LOAD/HORN)

TURN HORSE ON

SET REFERENCE VALUE

STORE IN REFERENCE

RAISE LFT

SET LIGHT VALVE

STORE IN BUFFER

LOWER RFT

SET WATER VALVE

BACK

11 UNIT MINI CAMAC

SPS OPERATIONS

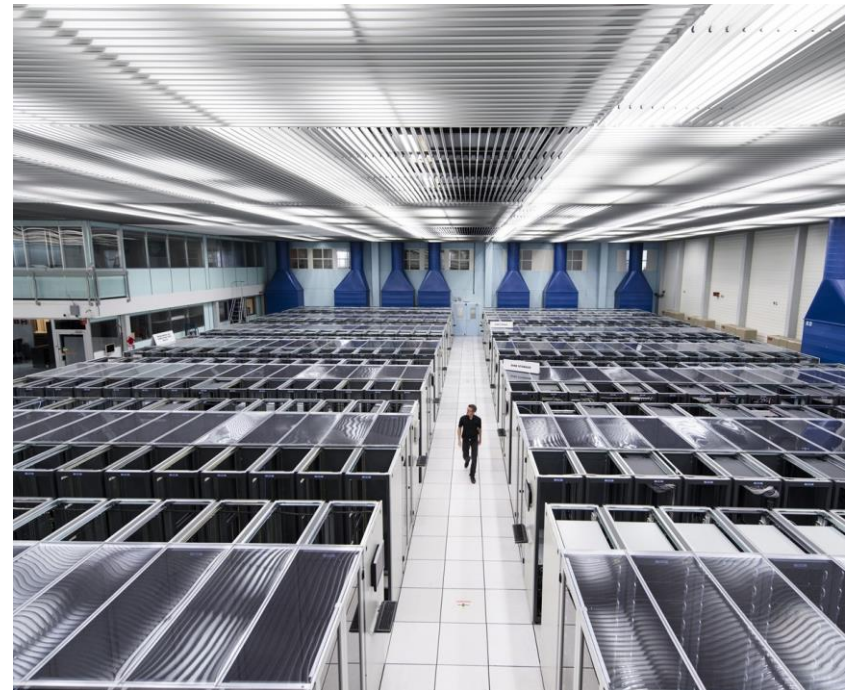
WHERE THE WEB WAS BORN

Wide Web were devised.

Started in 1980 from a group of researchers who were first funded under an office of the National Science Foundation (NSF) and later the European Commission (EC) at the University of Cambridge.

In 1989 the first computer network was set up in the UK and later in the US. Robert Callan, EC, was the first to use the term 'Computer Communications'.

At the end of the 1980s the European Commission (EC) funded a project to set up a network in Europe. This was the first step towards the creation of the Internet. The project was led by the European Commission and the MIT. The project was funded by the European Commission and the MIT.



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

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

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

More information: <https://kt.cern/>

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

**FROM CERN
TECHNOLOGY
TO SOCIETY**

BETTER
PLANET

AEROSPACE

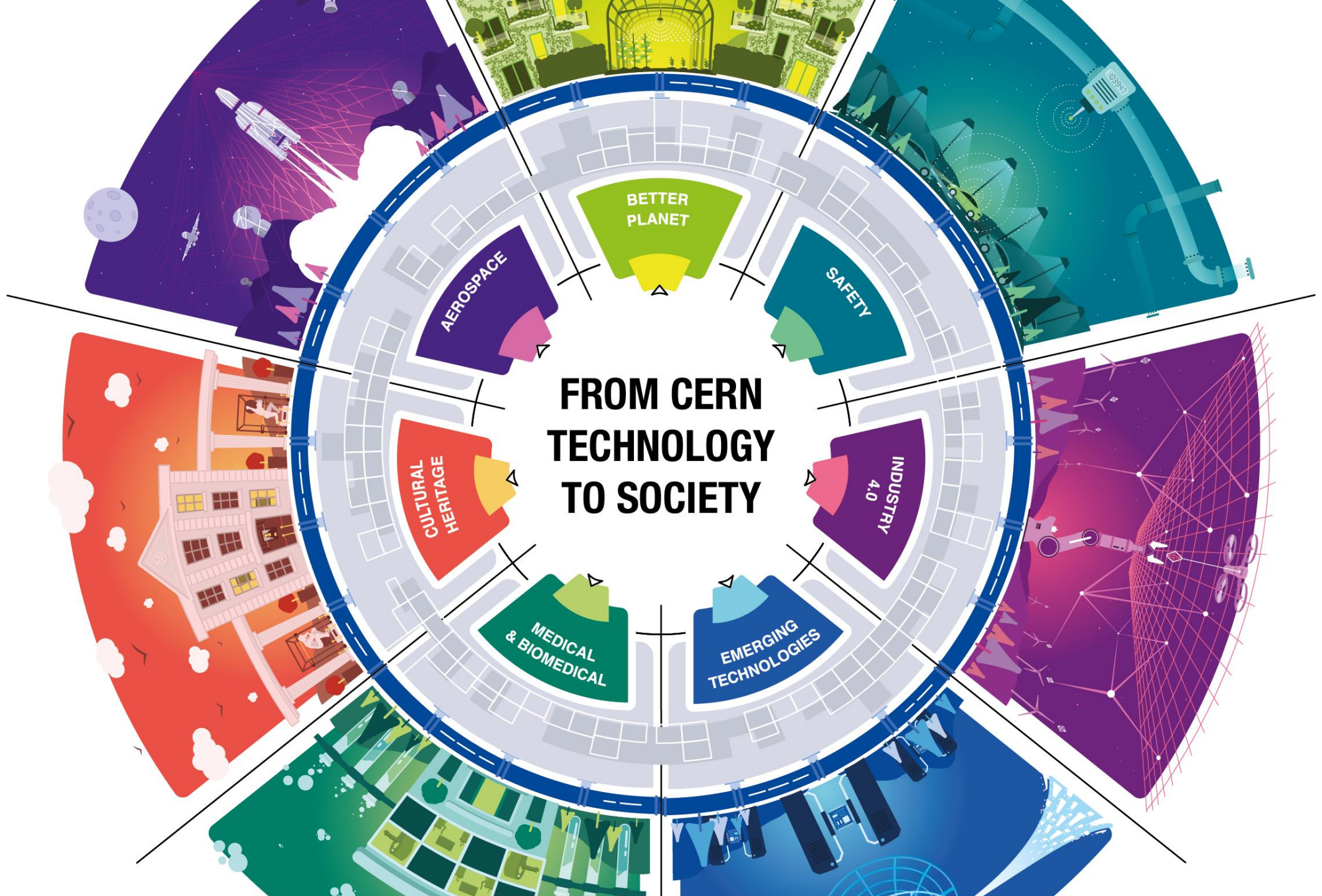
SAFETY

CULTURAL
HERITAGE

INDUSTRY
4.0

MEDICAL
& BIOMEDICAL

EMERGING
TECHNOLOGIES



A success story with Austria: MedAustron

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
CERN - PS DIVISION

CERN/PS 2000-007 (DR)

PROTON-ION MEDICAL MACHINE STUDY (PIMMS) PART II

Accelerator Complex Study Group*
supported by the Med-AUSTRON, Onkologie-2000 and the TERA Foundation
and hosted by CERN

ABSTRACT

The Proton-Ion Medical Machine Study (PIMMS) group was formed following an agreement between the Med-AUSTRON (Austria) and the TERA Foundation (Italy) to combine their efforts in the design of a cancer therapy synchrotron capable of accelerating either light ions or protons. CERN agreed to support and host this study in its PS Division. A close collaboration was also set up with GSI (Germany). The study group was later joined by Onkologie-2000 (Czech Republic). Effort was first focused on the theoretical understanding of slow extraction and the techniques required to produce a smooth beam spill for the conformal treatment of complex-shaped tumours with a sub-millimetre accuracy by active scanning with proton and carbon ion beams. Considerations for passive beam spreading were also included for protons. The study has been written in two parts. The more general and theoretical aspects are recorded in Part I and the specific technical design considerations are presented in the present volume, Part II. An accompanying CD-ROM contains supporting publications made by the team and data files for calculations. The PIMMS team started its work in January 1996 in the PS Division and continued for a period of four years.

*Full-time members: L. Badano¹⁾, M. Benedikt²⁾, P.J. Bryant²⁾ (Study Leader), M. Crescenti³⁾, P. Holy³⁾, A. Maier^{2)†4)}, M. Pullia¹⁾, S. Reimoser^{2)†4)}, S. Rossi¹⁾,
Part-time members: G. Borri¹⁾, P. Knaus^{1)–2)}
Contributors: F. Gramatica¹⁾, M. Pavlovic⁴⁾, L. Weisser⁵⁾
1) TERA Foundation, via Puccini, 11, I-28100 Novara.
2) CERN, CH 1211 Geneva-23.
3) Oncology-2000 Foundation, Na Morani 4, CZ-12808 Prague 2.
4) Med-AUSTRON, c/o RIZ, Prof. Dr. Stephan Korenstr.10, A-2700 Wr. Neustadt.
5) Sommer & Partner Architects Berlin (SPB), Hardenbergplatz 2, D-10623 Berlin.

Geneva, Switzerland
May 2000

From PIMMS (Proton Ion Medical Machine Study) @ CERN, with TERA and INFN, to the CNAO and MedAustron hadrontherapy centers



Image credit: MedAustron

A strategy for CERN: Next Ion Medical Machine Study (NIMMS)

Why ions?

- **Proton** therapy is now **commercially** available.
- **Ion** therapy (mainly carbon) still **bespoke** facilities.

What is NIMMS?

- **R&D programme** based at CERN for critical technologies related to ion therapy accelerators
- **strong societal impact** building on existing CERN competences
- **without competing** with ongoing activities in Member States

How to proceed?

Focus on the development of few key technologies (a **toolbox**) corresponding to CERN core competences.

Four NIMMS workpackages

1. Small synchrotrons for particle therapy

Reduced dimensions with improved performance (injection, extraction)

2. Curved superconducting magnets for synchrotrons and gantries

Canted Cosine Theta, NbTi or HTS

3. Superconducting gantries

Precise beam delivery on multiple angles

4. High-frequency ion linacs

Compact bent layout

HITRIplus EU project

IFAST EU project

EU supporting initiatives



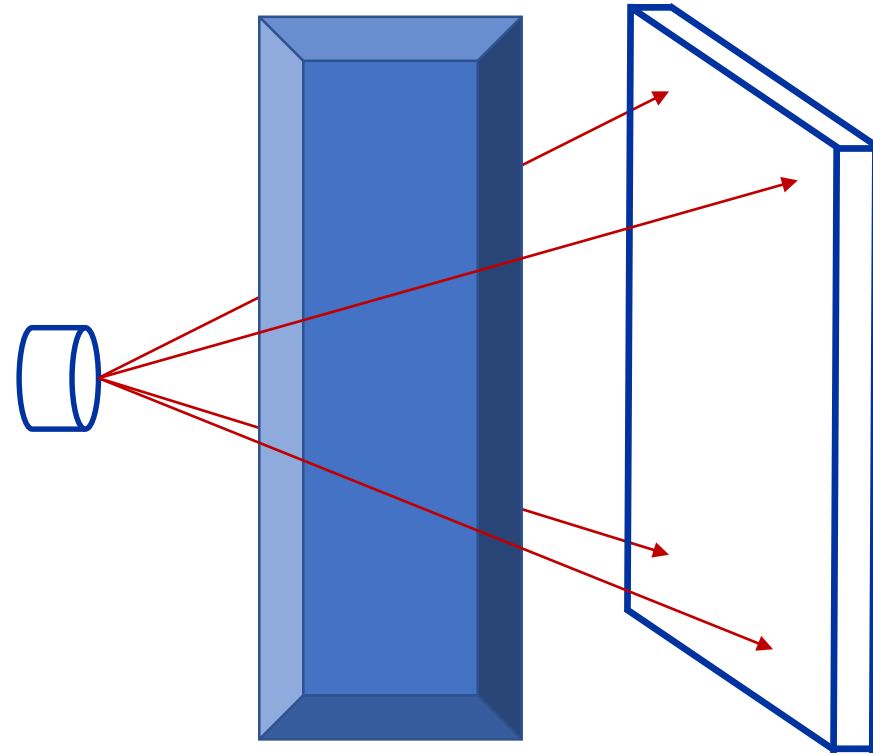
The Medipix Collaboration

Medical imaging, space dosimetry, education, and material analysis

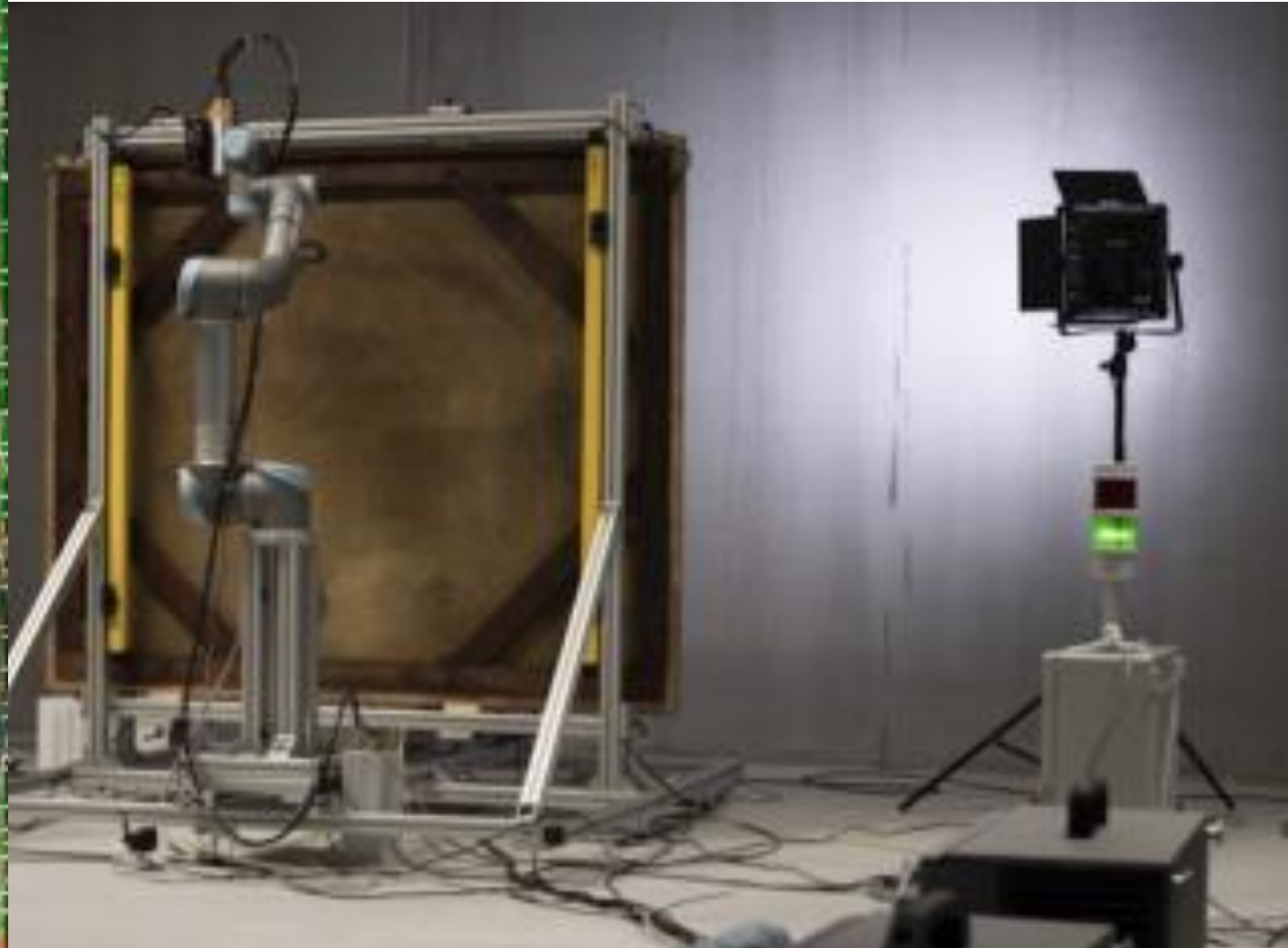


ESA and NASA: using Timepix for space radiation monitoring

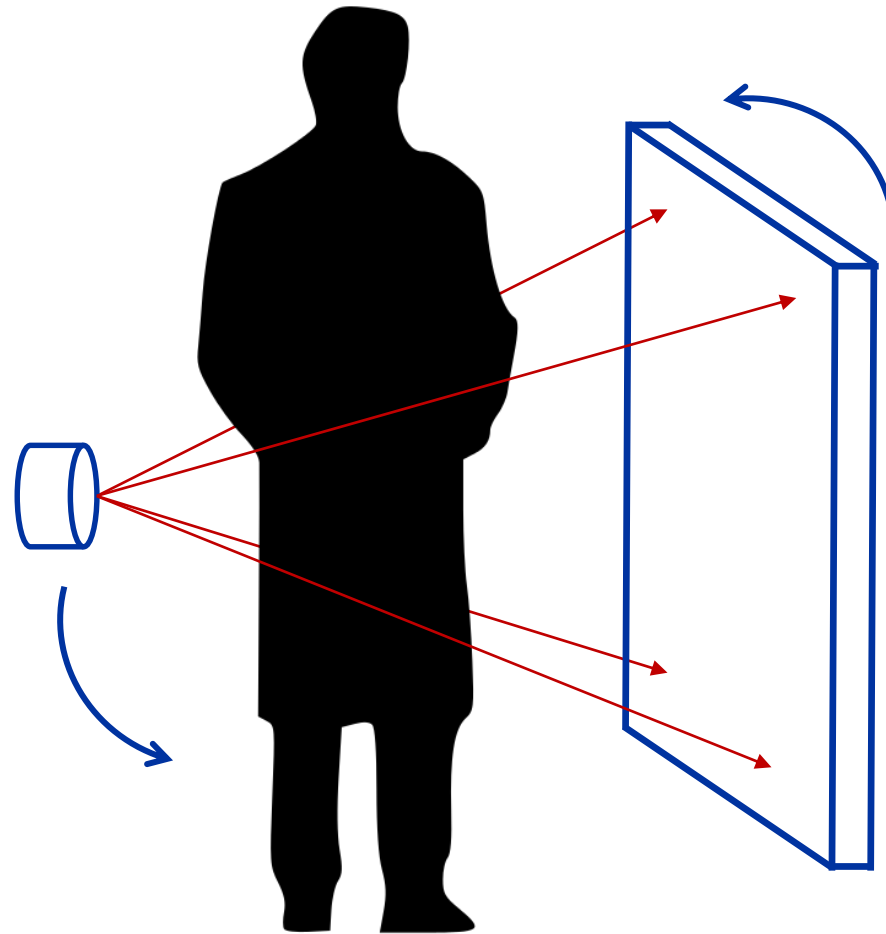
<https://www.nasa.gov/feature/nasa-cern-timepix-technology-advances-miniaturized-radiation-detection>



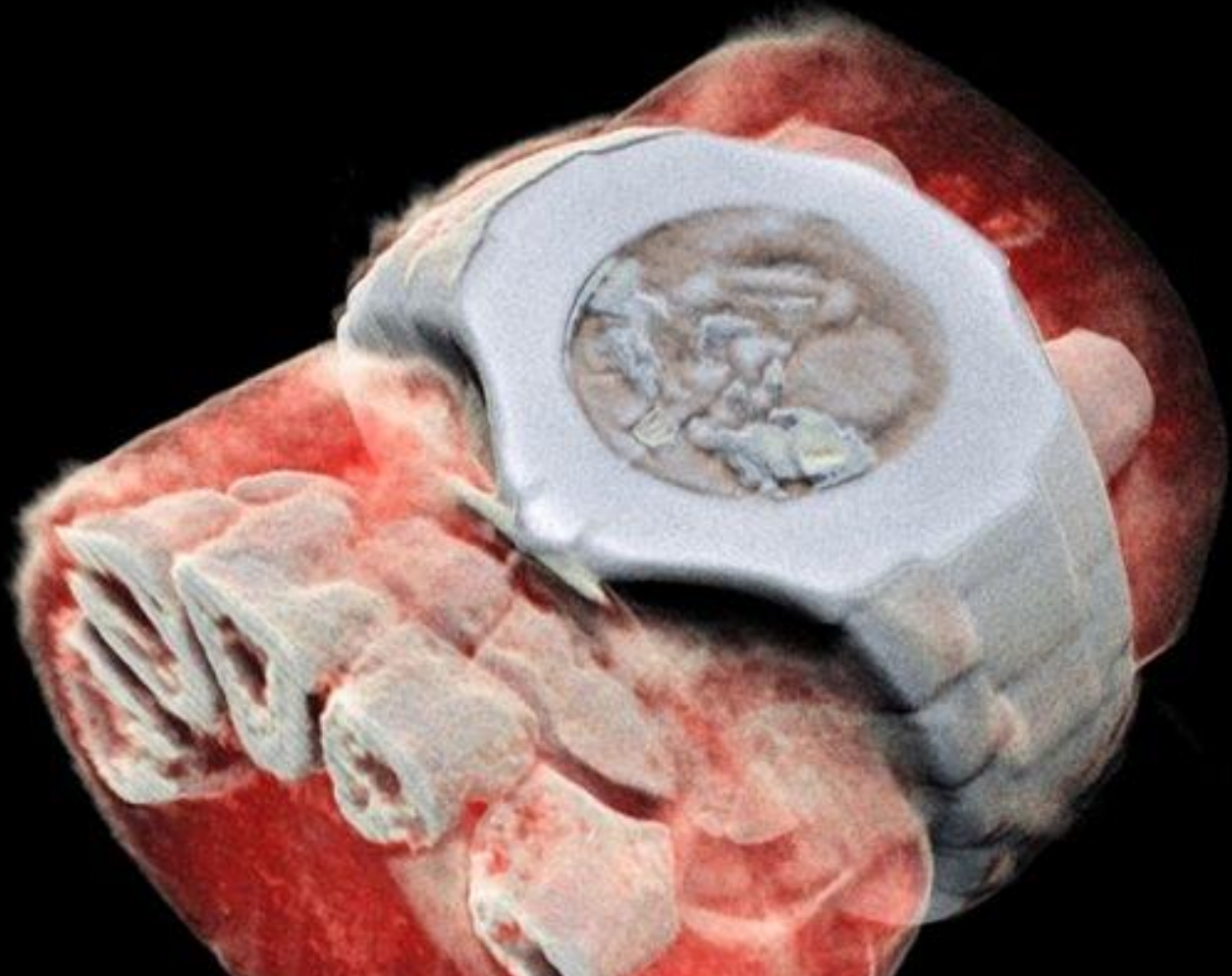
Artwork



InsightArt: using Medipix for cultural goods analysis:
<https://home.cern/news/news/knowledge-sharing/cern-technology-helps-rediscover-lost-painting-raphael>

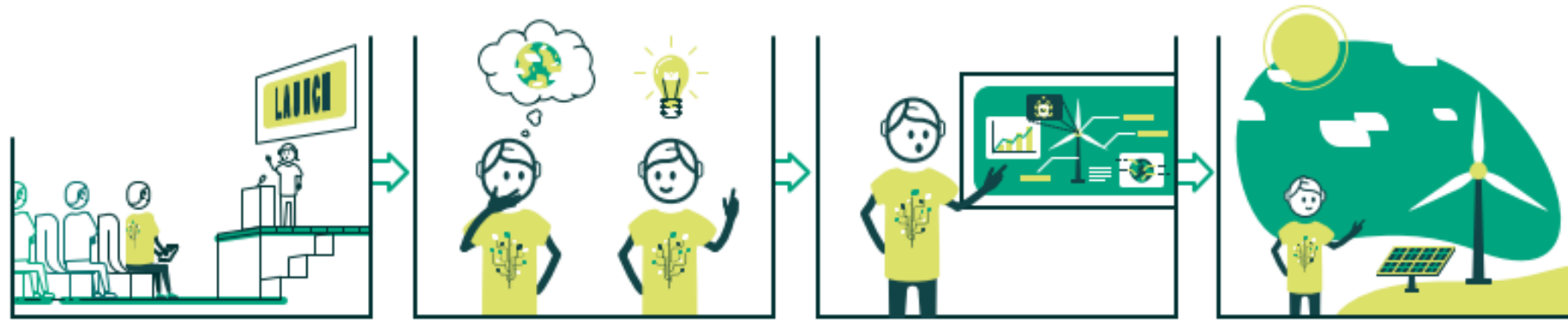


Transmission Imaging: Radiology



MARS Bio Imaging: next generation X ray finally in color using CERN chips <https://home.cern/news/news/knowledge-sharing/spectroscopic-x-ray-imaging-now-certified-medical-use>

CERN Innovation Programme for Environmental Applications



LAUNCH

Find out how to take part

IDEATION

Imagine how your work can help the environment

PITCHING

Present your idea to the CERN Management and experts in innovation

IMPLEMENTATION

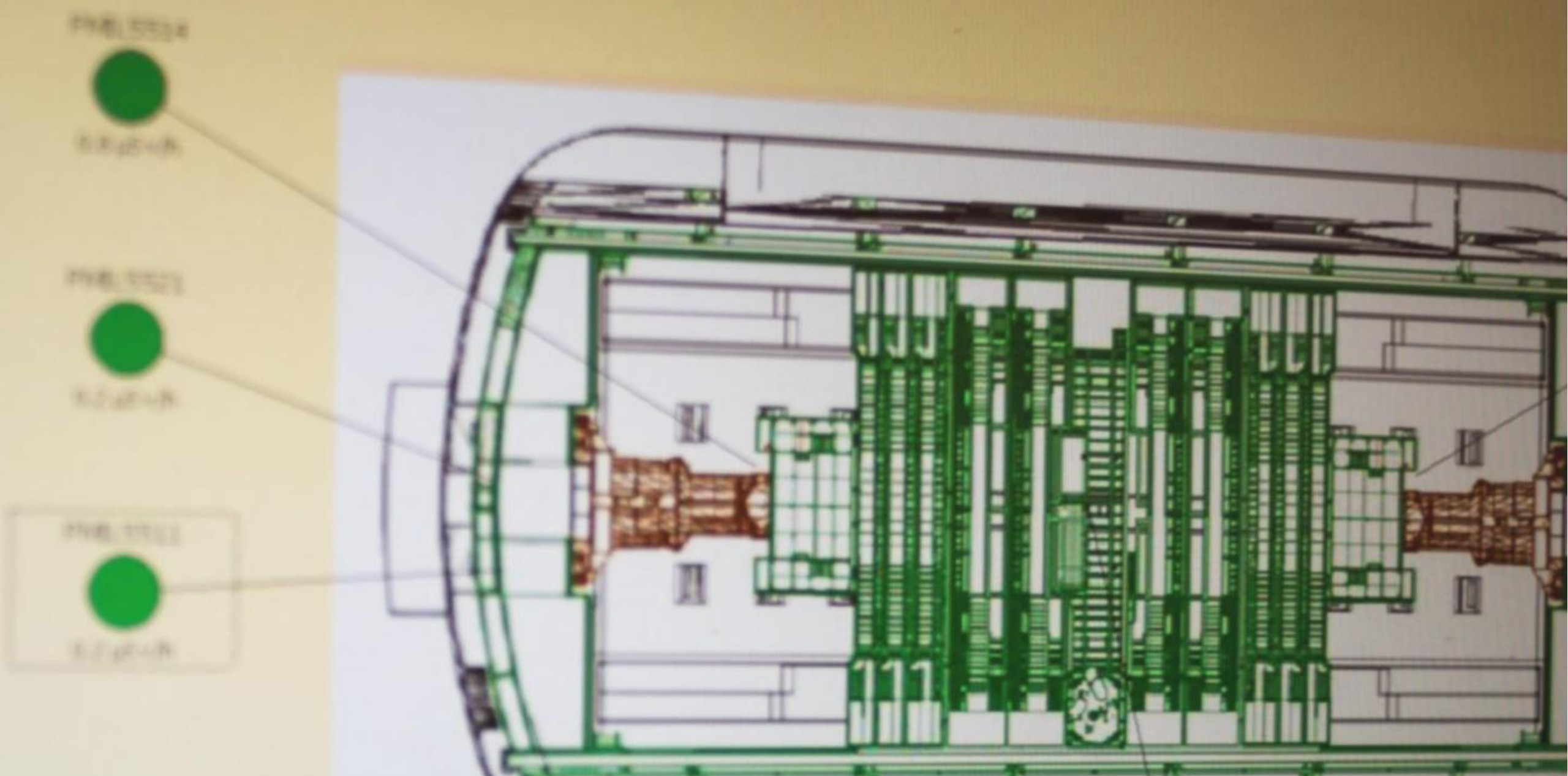
Get support and build a project around your idea

08 March 2022

March-May 2022

June 2022

Starts in July 2022



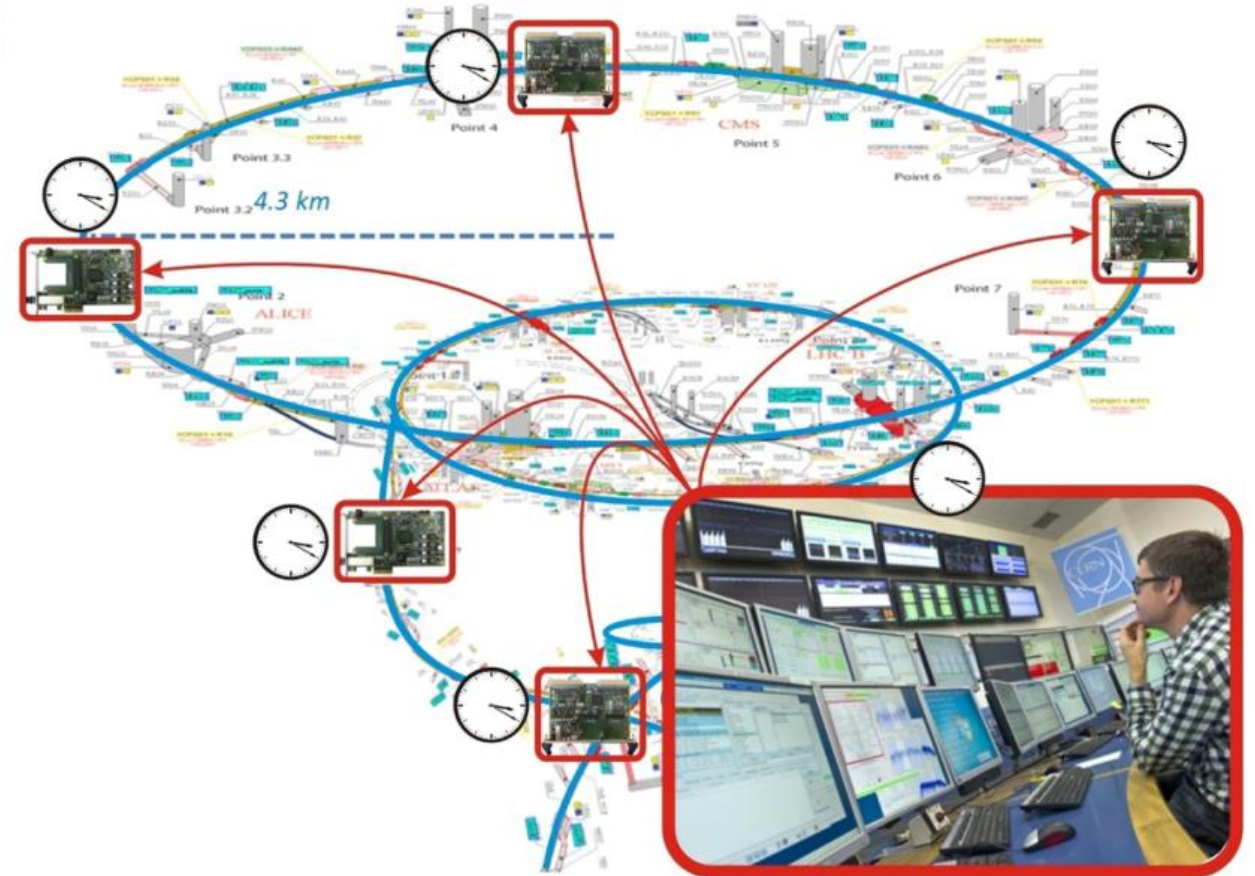
REMUS: scalable, adaptable SCADA (Supervision, Control and Data Acquisition) for heterogeneous devices: <https://kt.cern/technologies/remus>

White Rabbit Time Synchronisation

How it started

Need to distribute in real-time the magnetic field along the accelerator

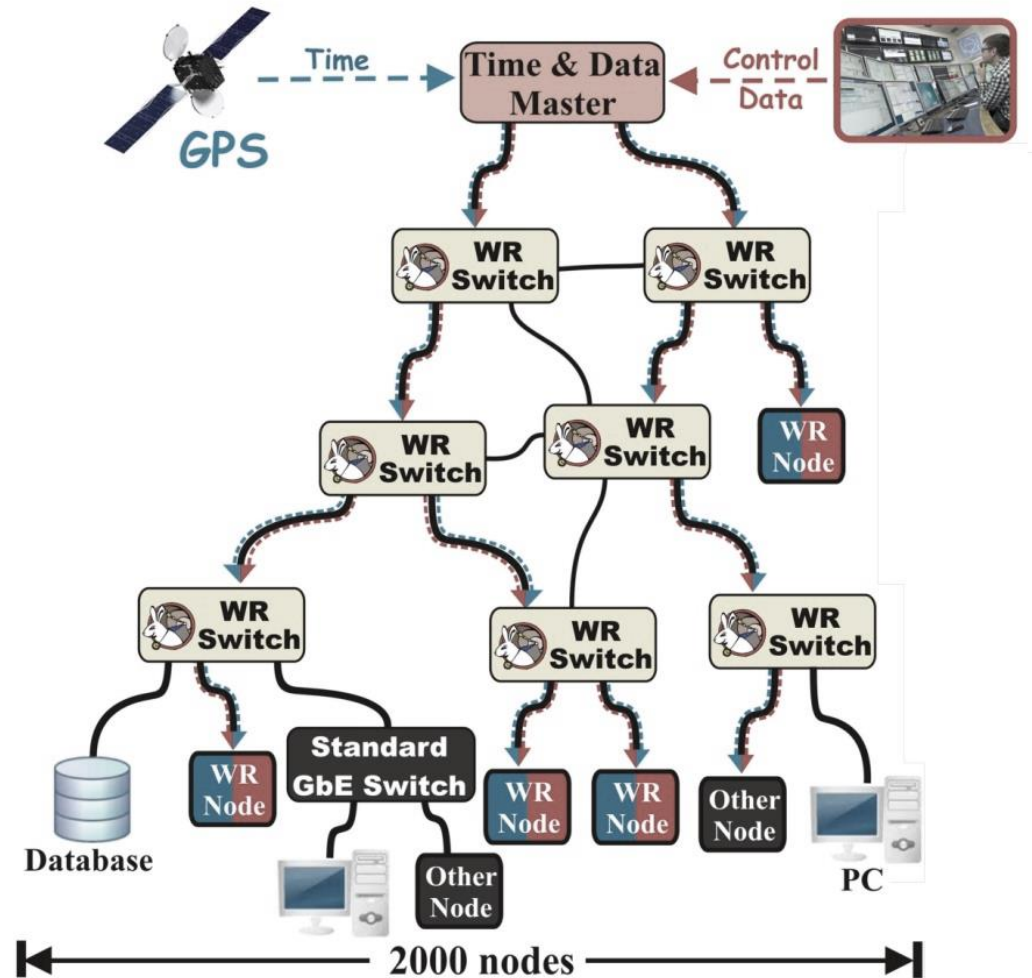
Need to have precise timestamps on each event in detector



White Rabbit Time Synchronisation

What it does

- 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 synchronisation (included in IEEE 1588)
 - Deterministic data transfer
- Initial specs: links ≤ 10 km & ≤ 2000 nodes



White Rabbit Time Synchronisation

Where it's used?

National Time Labs
(NL, FI, FR, US, UK, IT)

Cubic Kilometre
Neutrino Telescope

German Stock Exchange

<https://white-rabbit.web.cern.ch/>



Modified from: Innenansicht der Frankfurter Börse nach Renovierung (DesertEagle, Wikimedia Commons, PD)



ZENSEACT (formerly Zenuity) teams up with CERN on fast machine learning using FPGAs:

<https://kt.cern/news/news/software-solutions-autonomous-driving>

- Involve passionate experts on both sides
- Free yourself from your constraints
- Believe in the power of serendipity

→ Magic will happen





THANK YOU!

benjamin.frisch@cern.ch