

# Knowledge Transfer at CERN

N.Ziogas

Knowledge Transfer Group



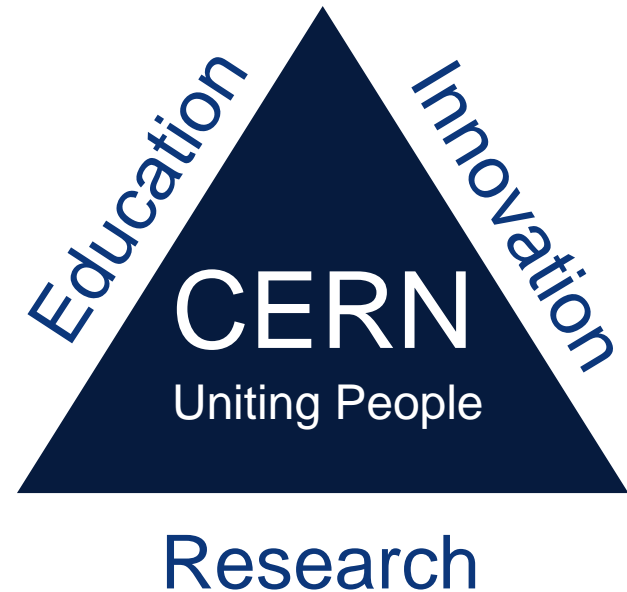
# KT: one of CERN's missions

Push back the frontiers of knowledge in nuclear research

Develop new technologies for accelerators and detectors

Train scientists and engineers of tomorrow

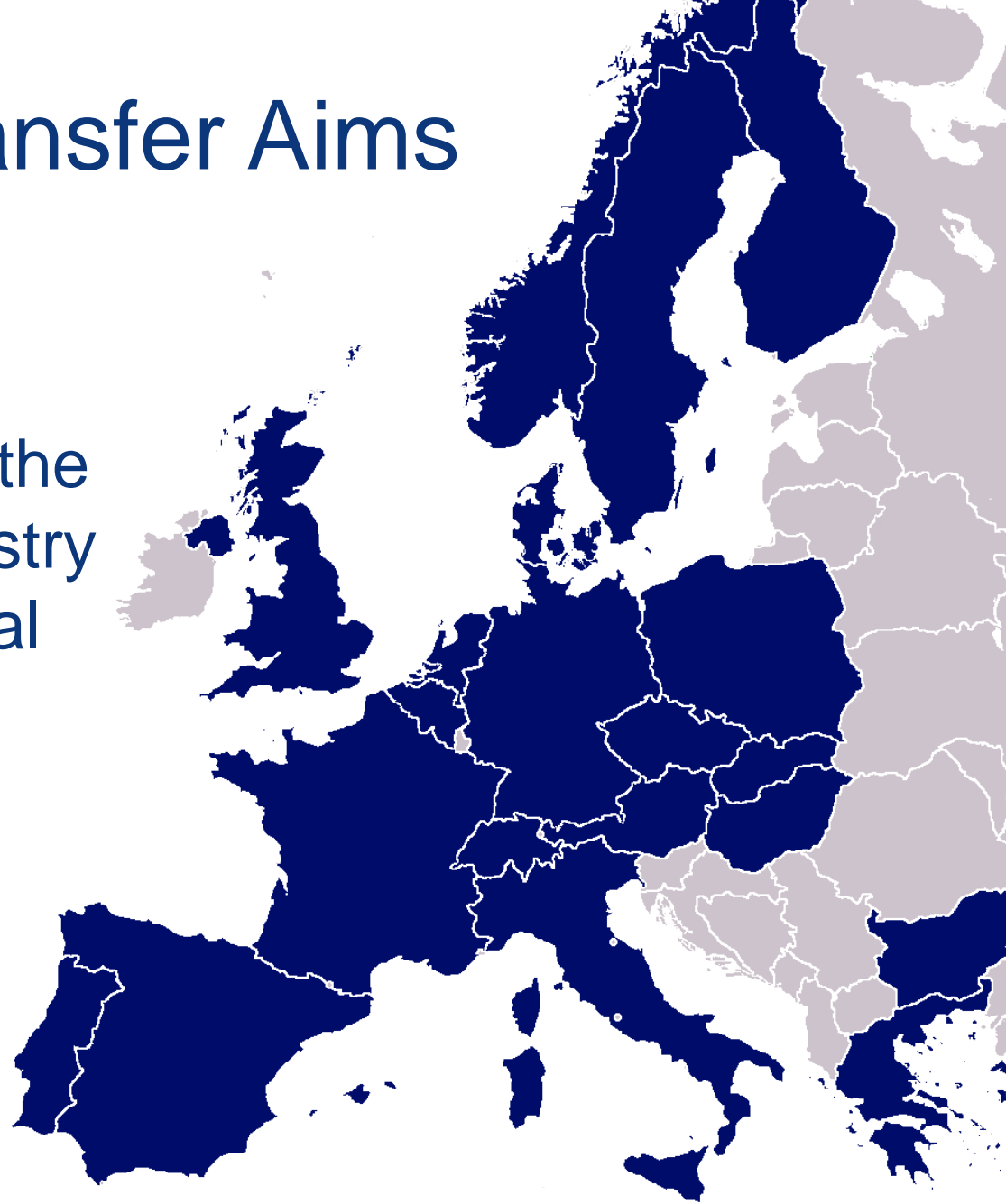
Unite people from different countries and cultures in pursuing this endeavour



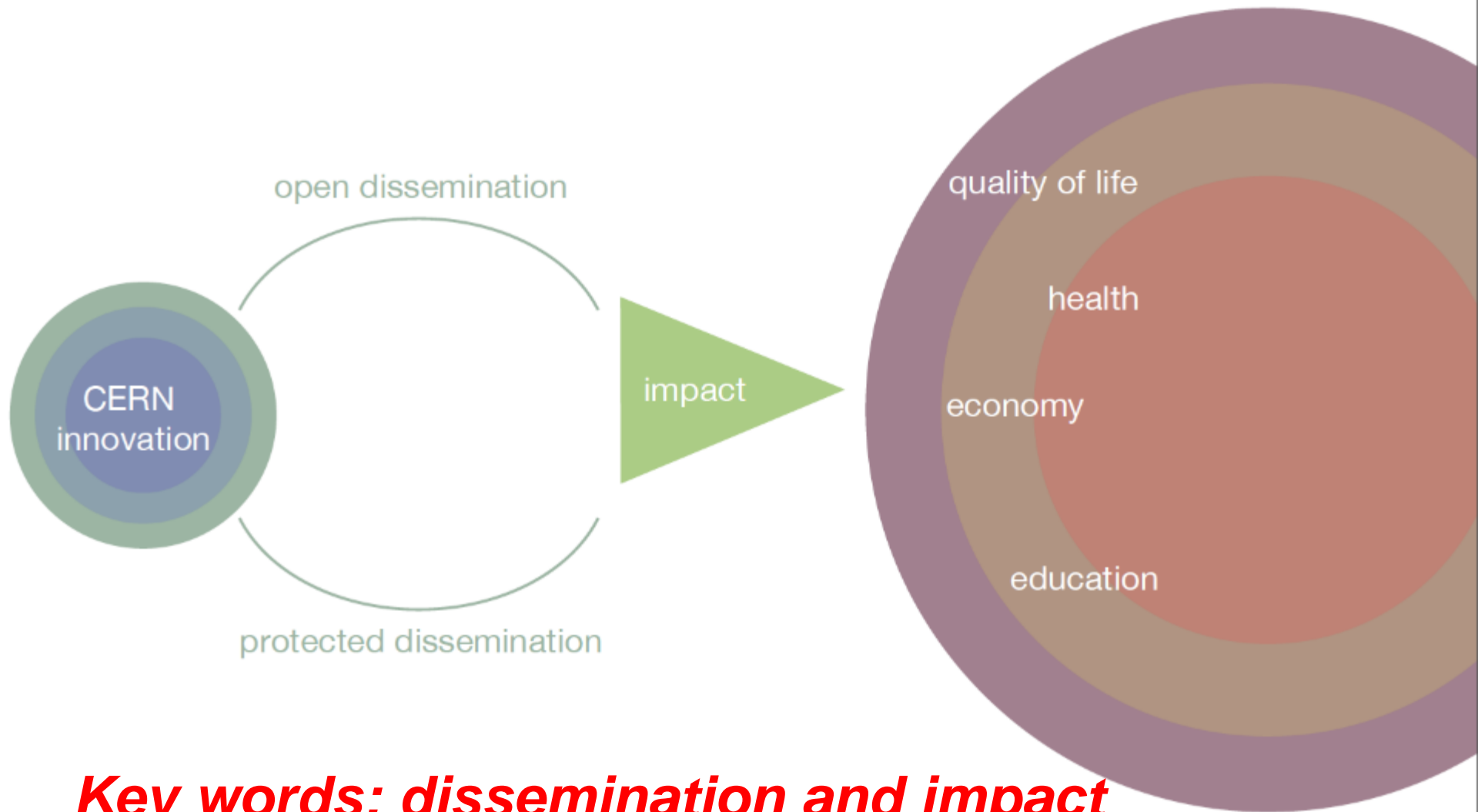
# Knowledge Transfer Aims

Maximizing the technological and knowledge return to the Member States industry and society in general

Promoting CERN's image as a center of excellence for technology



# Impact-driven Innovation Approach

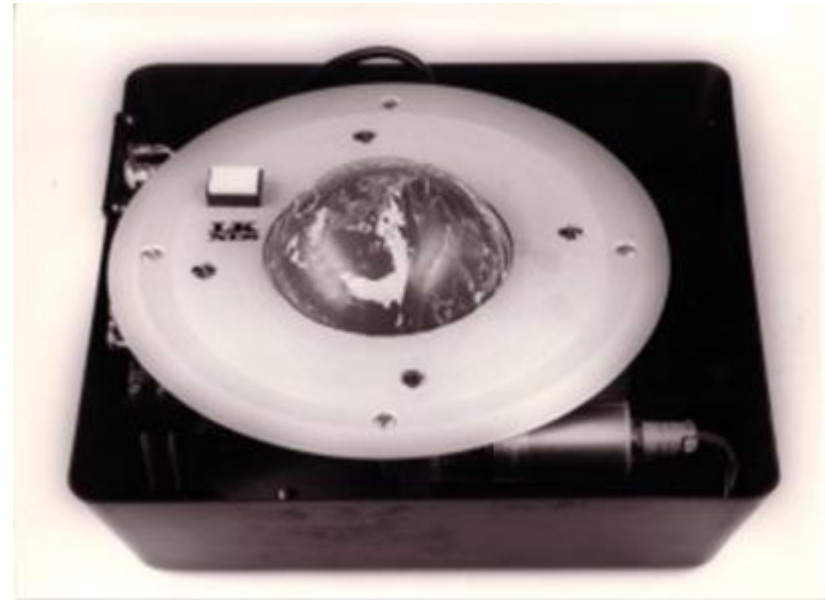


**Key words: dissemination and impact**





# Did you know?







# Is it a natural process?

Story of the capacitive touchscreen developed for the SPS control room

# The Knowledge Exchange





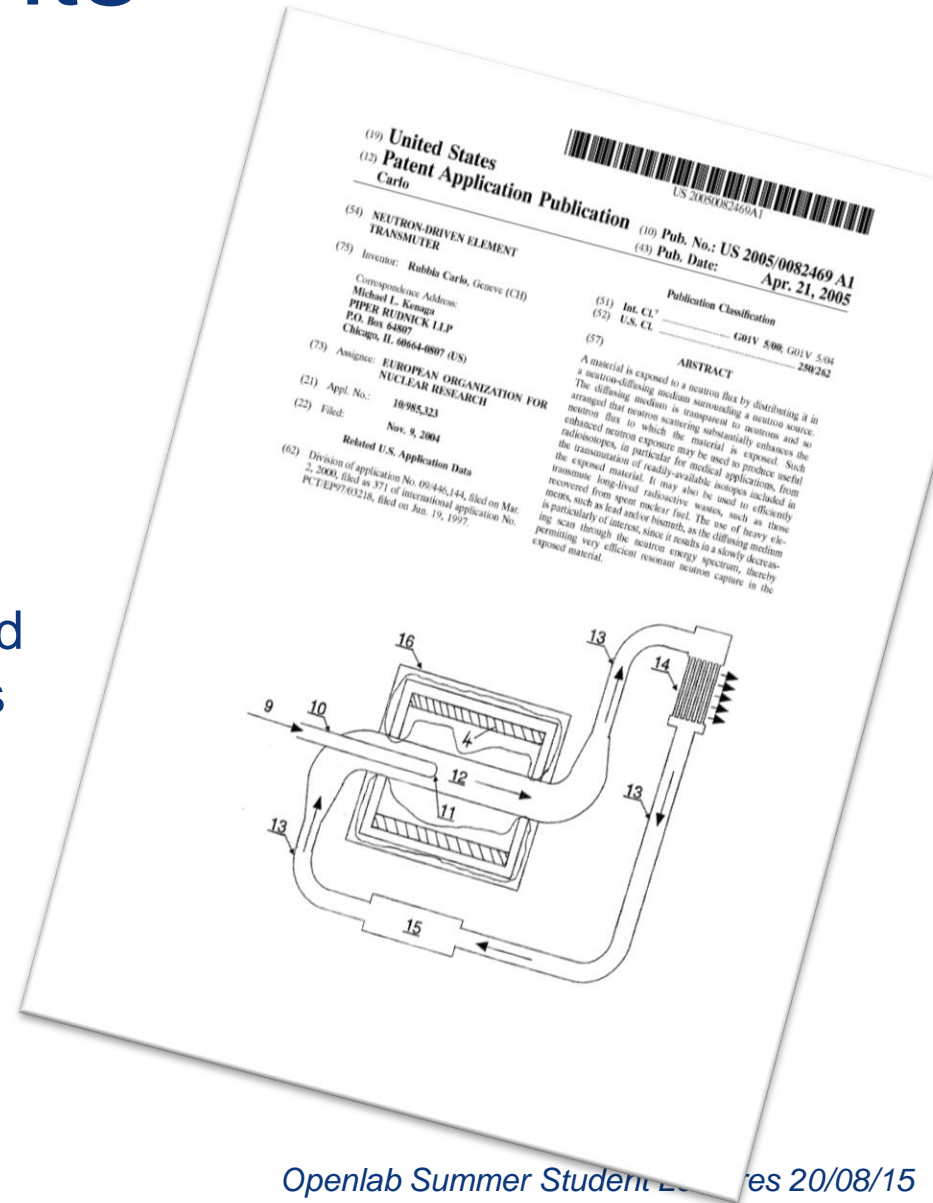
# CERN and patents

## Strategic motivation:

“Promote and enhance the image of the organization as a source of innovation and economic activities”

## Patents are taken when it:

- Increases the probability of having the technology transferred (justify development investments from industry)
- Significantly enhances the commercial value
- Is needed to ensure CERN's recognition as inventor

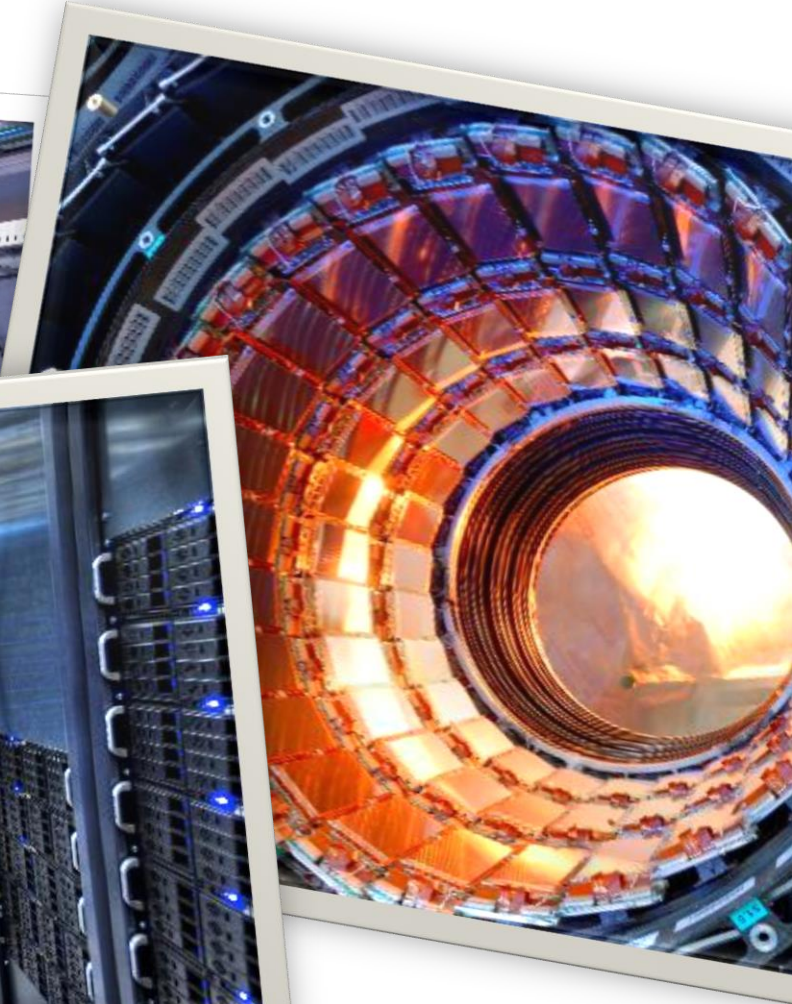
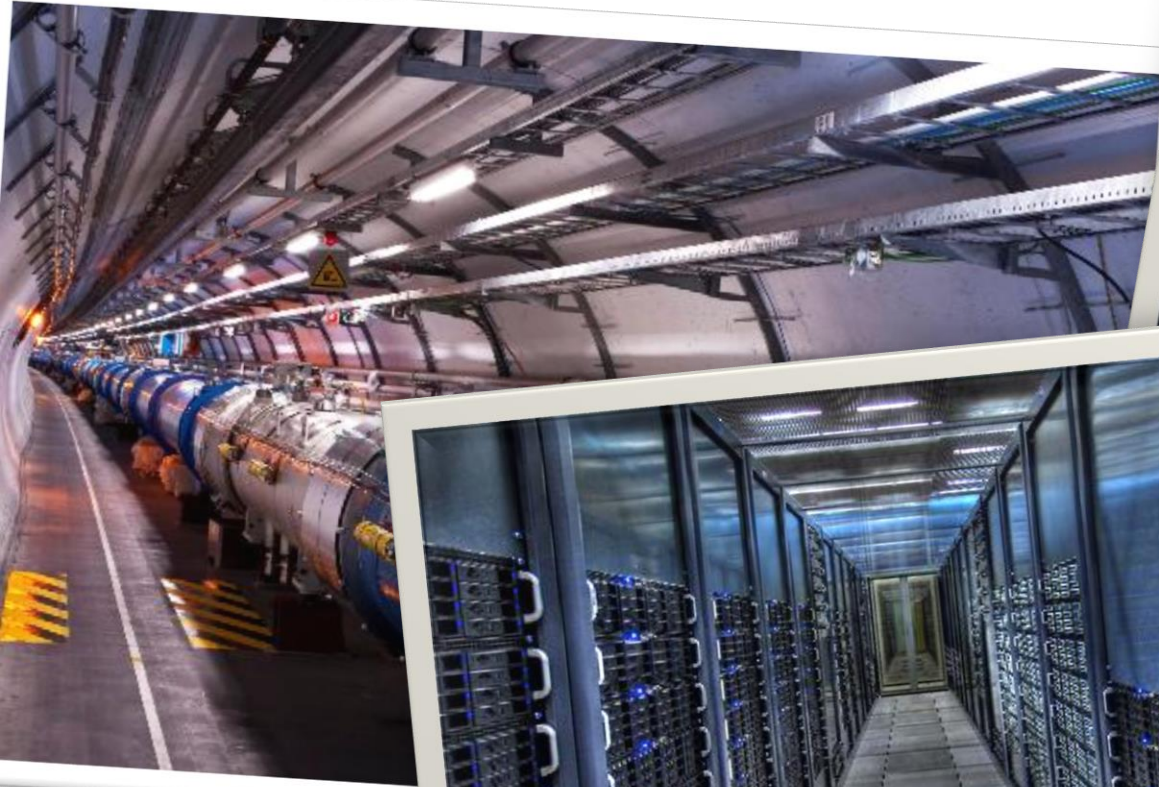


# Patent Portfolio Overview

- 51 Patent Families
  - Radiation Detection
  - Materials
  - Radioisotope production
  - Linear Accelerators
  - Cryogenics
  - Vacuum technology

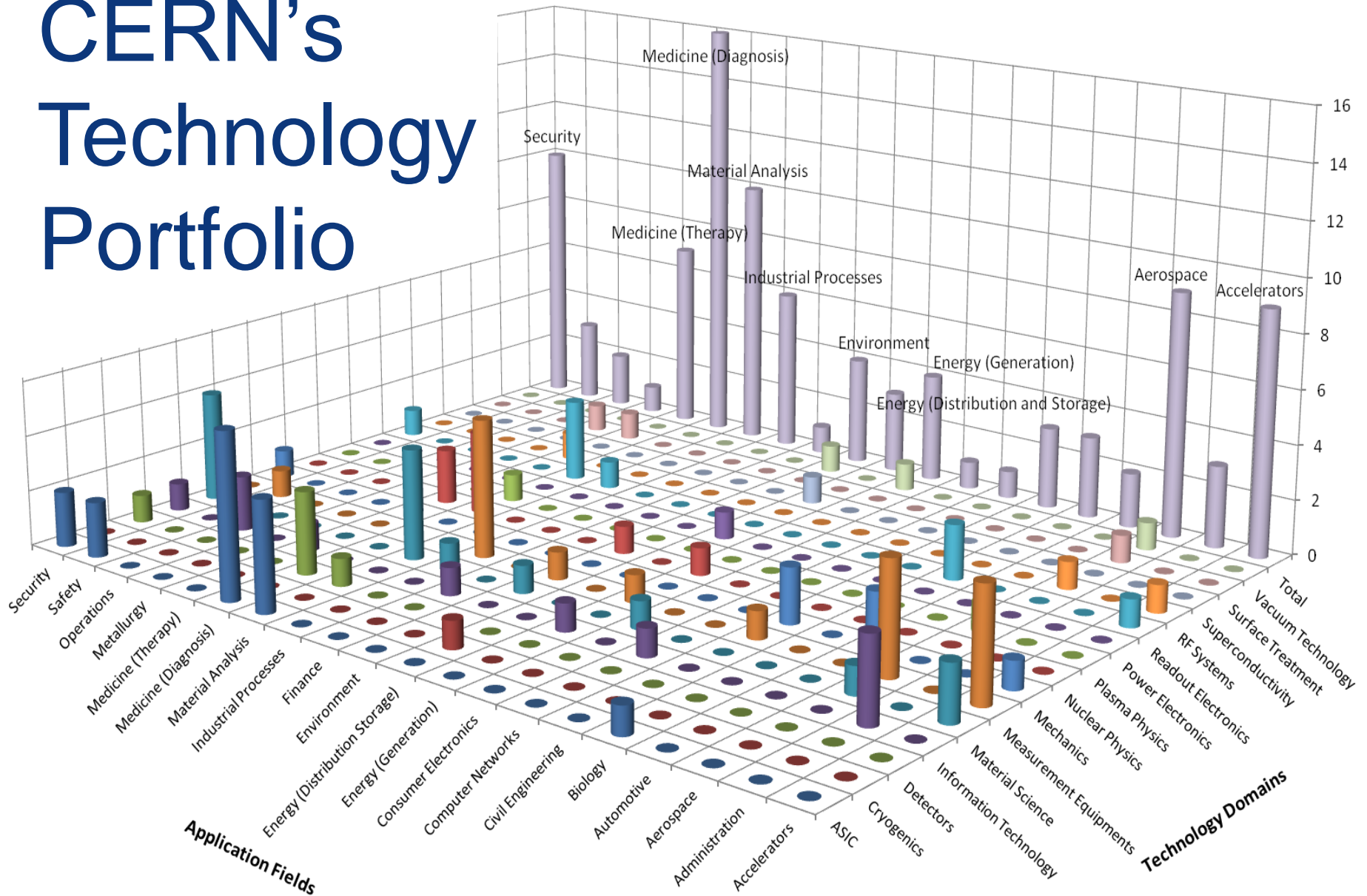


# CERN's areas of excellence



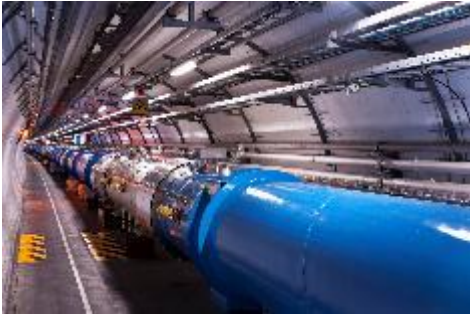


# CERN's Technology Portfolio





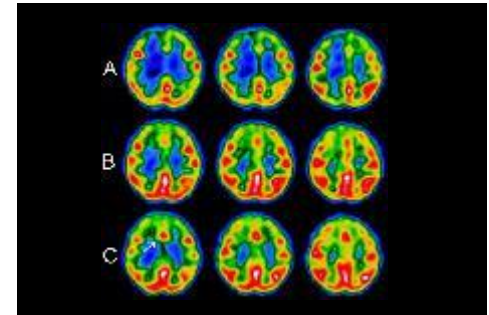
# Medical application examples



From particle accelerators to cancer therapy



From particle detectors to medical imaging

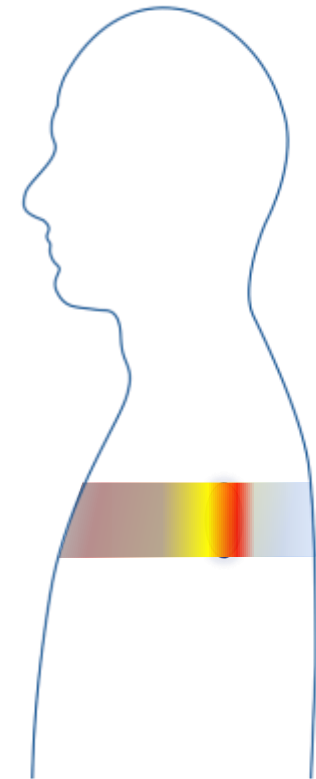
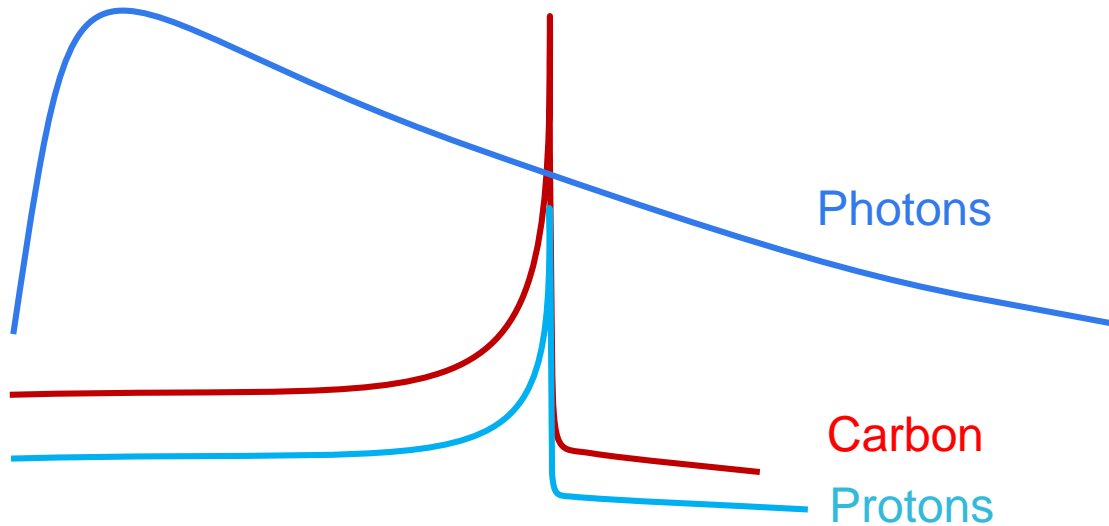


From grid computing to medical data management and analysis



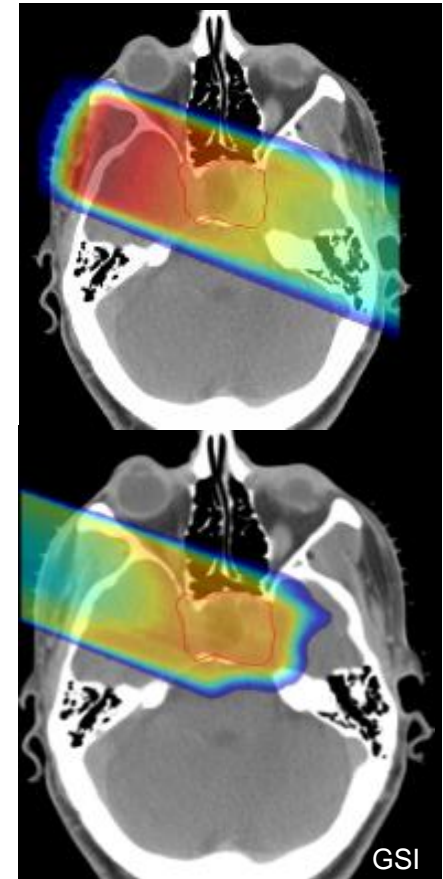
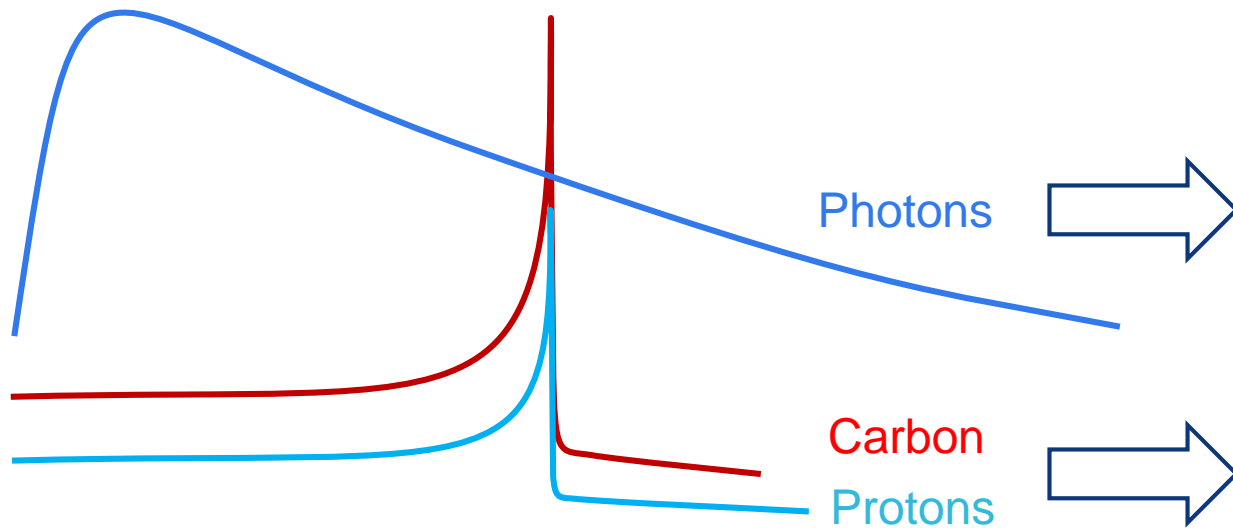
# Hadron Therapy

New treatment opportunities for deep-seated tumours



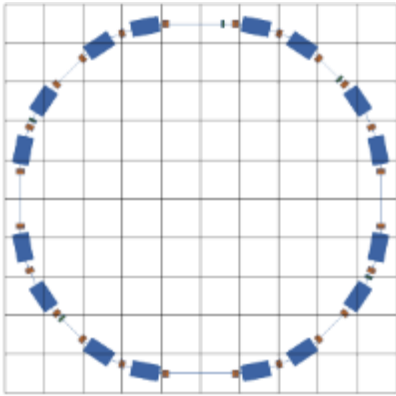
# Hadron Therapy

New treatment opportunities for deep-seated tumours



# Hadron Therapy

## Contributions from CERN



PIMMS Proton-Ion Medical Machine Study

Coordinated by CERN

PIMMS was then modified by the TERA foundation in Italy

CNAO in Italy and MedAustron in Austria are based on the modified PIMMS and also collaborated with CERN on the accelerator development



# Hadron Therapy

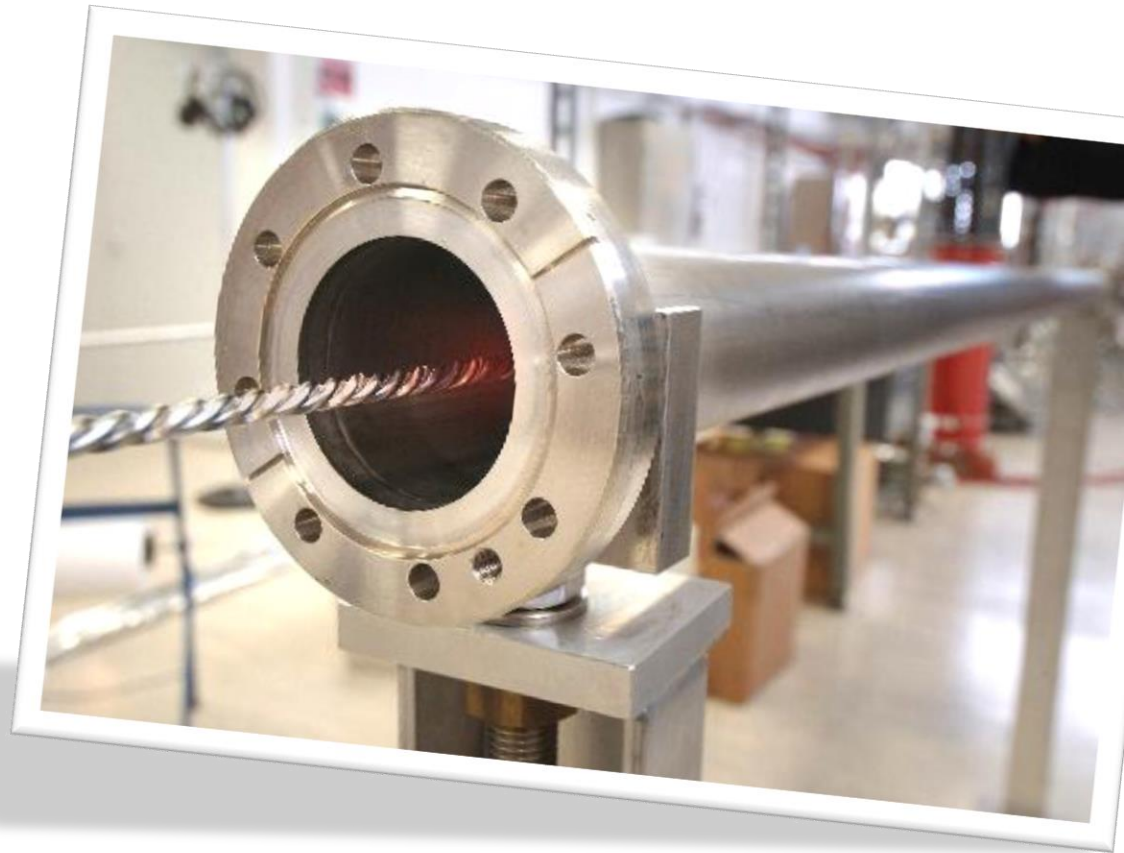
CNAO



# From high vacuum...

NEGs - Non-Evaporable Getter thin film coatings

Technology used to create and maintain ultra-high vacuum in the accelerator vacuum chambers.



# ... to solar energy collectors

The innovative technology within the collectors was developed at CERN and commercialized by the CERN spin-off company, SRB Energy.

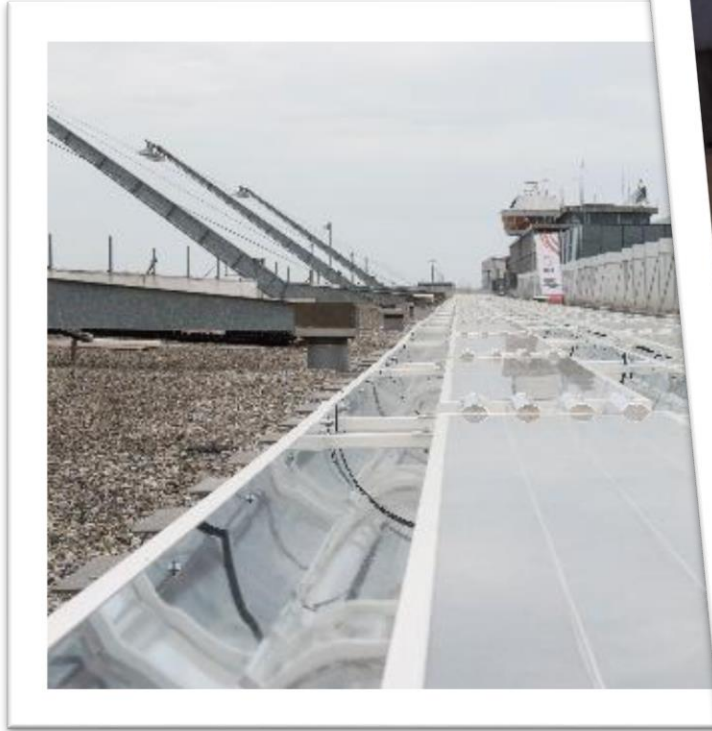


Here you can see thermal solar collector panels on the roof of Geneva airport



# ... to solar energy collectors

Vacuum acts as an Excellent insulator!

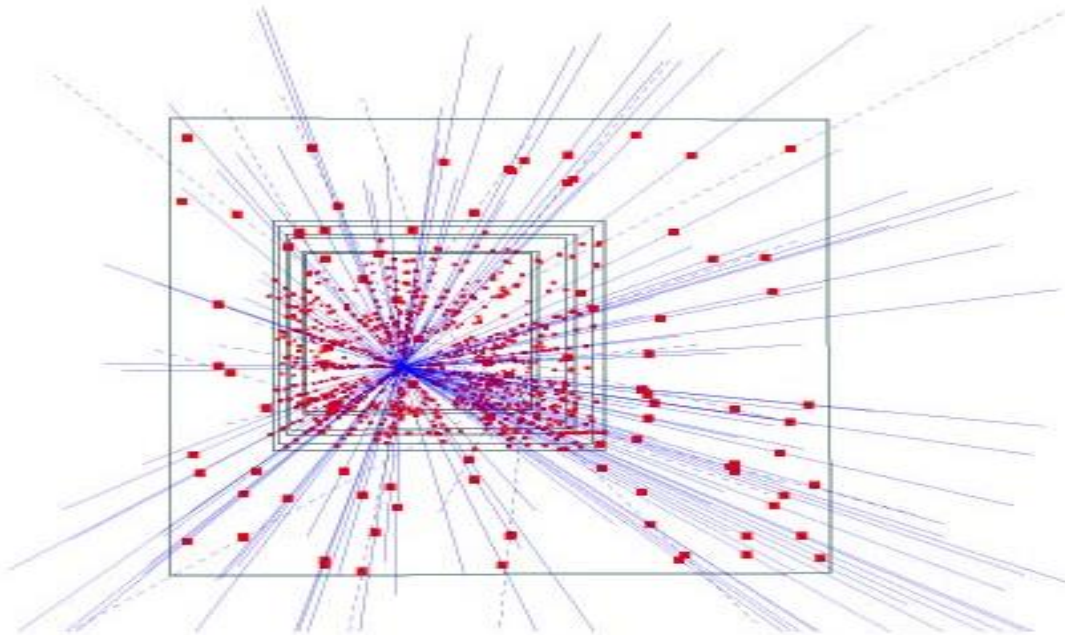




# Silicon pixel detectors (SPDs)

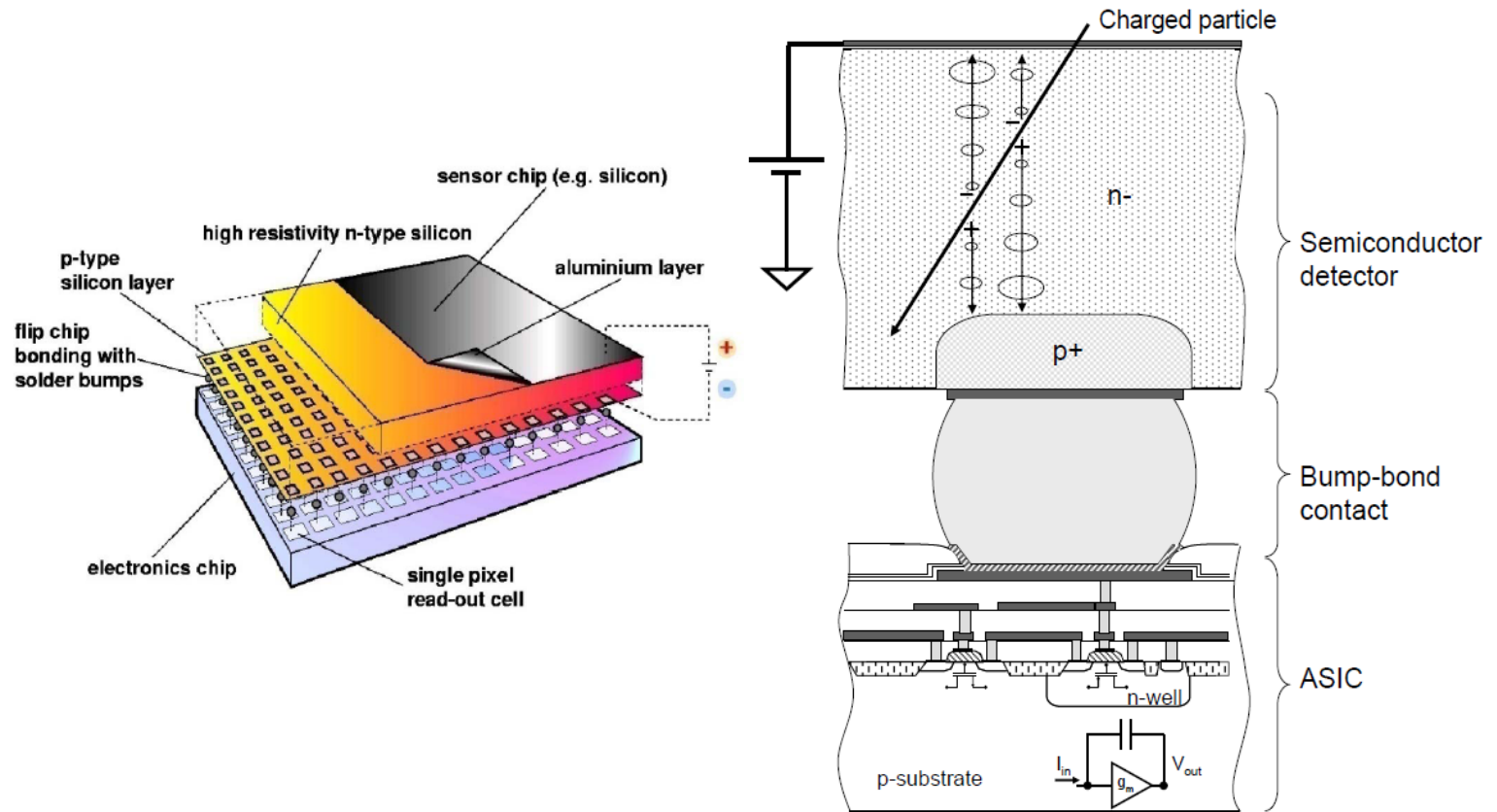
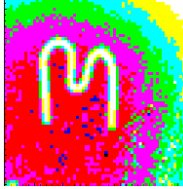


Hybrid silicon pixel detectors for tracking applications in High Energy Physics

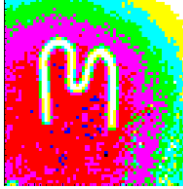


153 high energy  
particle tracks flying  
through a telescope  
of half a million pixels  
in the WA97  
experiment back in  
1995

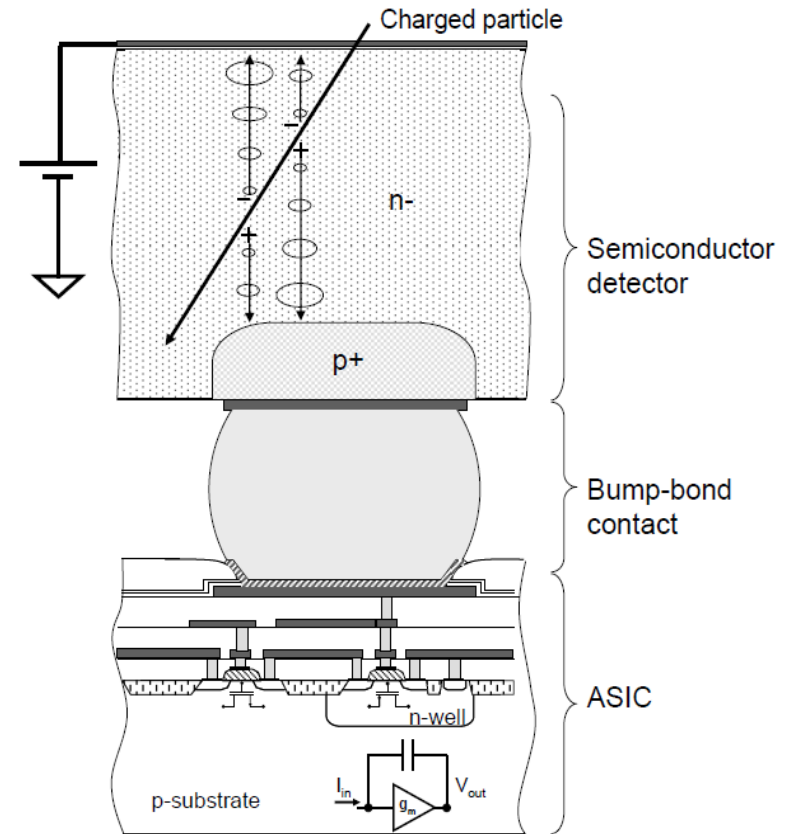
# Medipix



# Medipix



- A family of single photon counting integrated circuits used in Hybrid Silicon Pixel Detectors
- The Medipix collaborations (close to 20 institutes) contributed to the development and dissemination of the technology
- A good example of how (fundamental) science fosters innovation which can be transferred to society... and back!

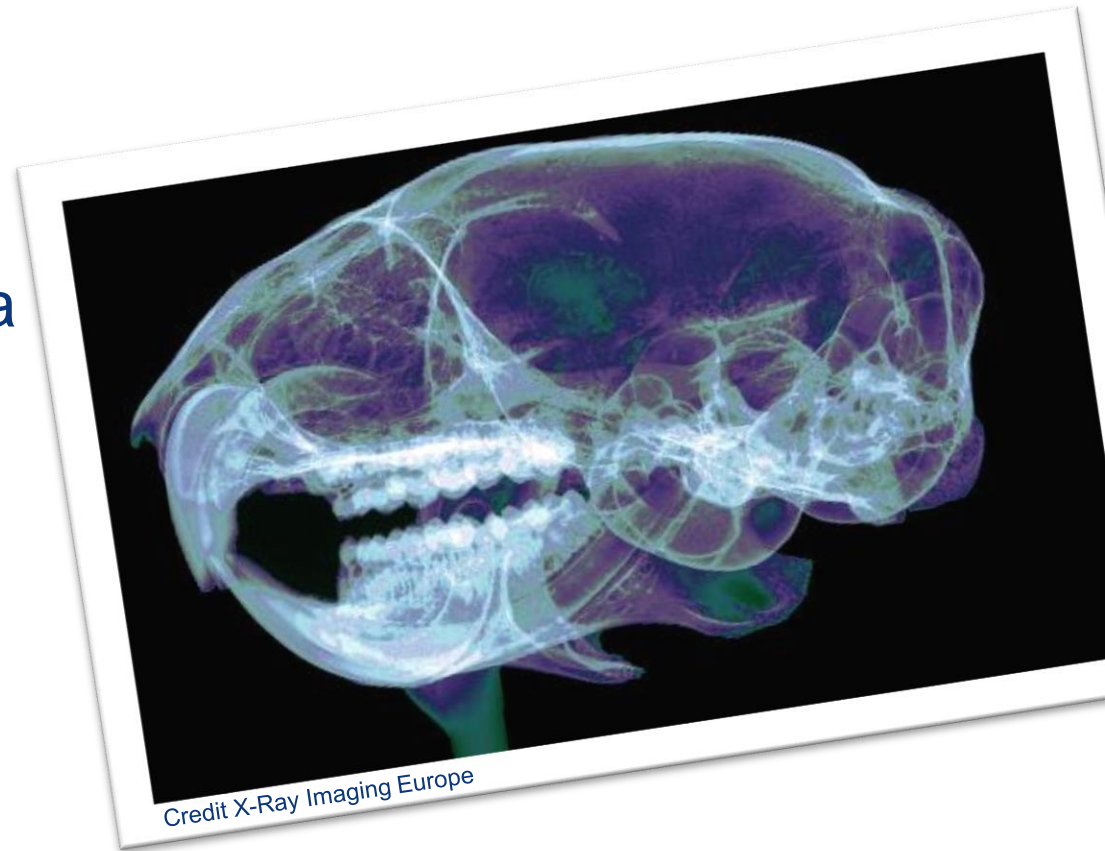




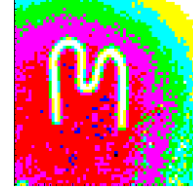
# Application: X-Ray

Medical and industrial X  
Ray imaging

Picture is from X-Ray  
Imaging Europe GmbH a  
start-up company selling  
Medipix2 and Timepix  
detectors and detector  
systems





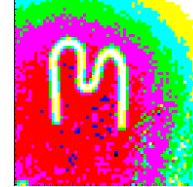


# Application: Material analysis

PANalytical is a Dutch company that develops and produces scientific instruments

Medipix is used in their range of for x-ray diffractometers





# Application: Radiation monitoring

Medipix is used for radiation monitoring in space and other types background radiation monitoring and dosimetry





# Application: Research

## Research applications:

- Synchrotron radiation
- Electron microscopy
- Detection of low energy particles
- Adaptive optics
- Neutron imaging
- and more





# Application: Education

Medipix 2 technology  
used in an educational  
toolkit

Allows students to use a  
Timepix chip in the lab to  
visualise radiation

CERN has recently  
adopted this toolkit as  
part of its new SchoolLab

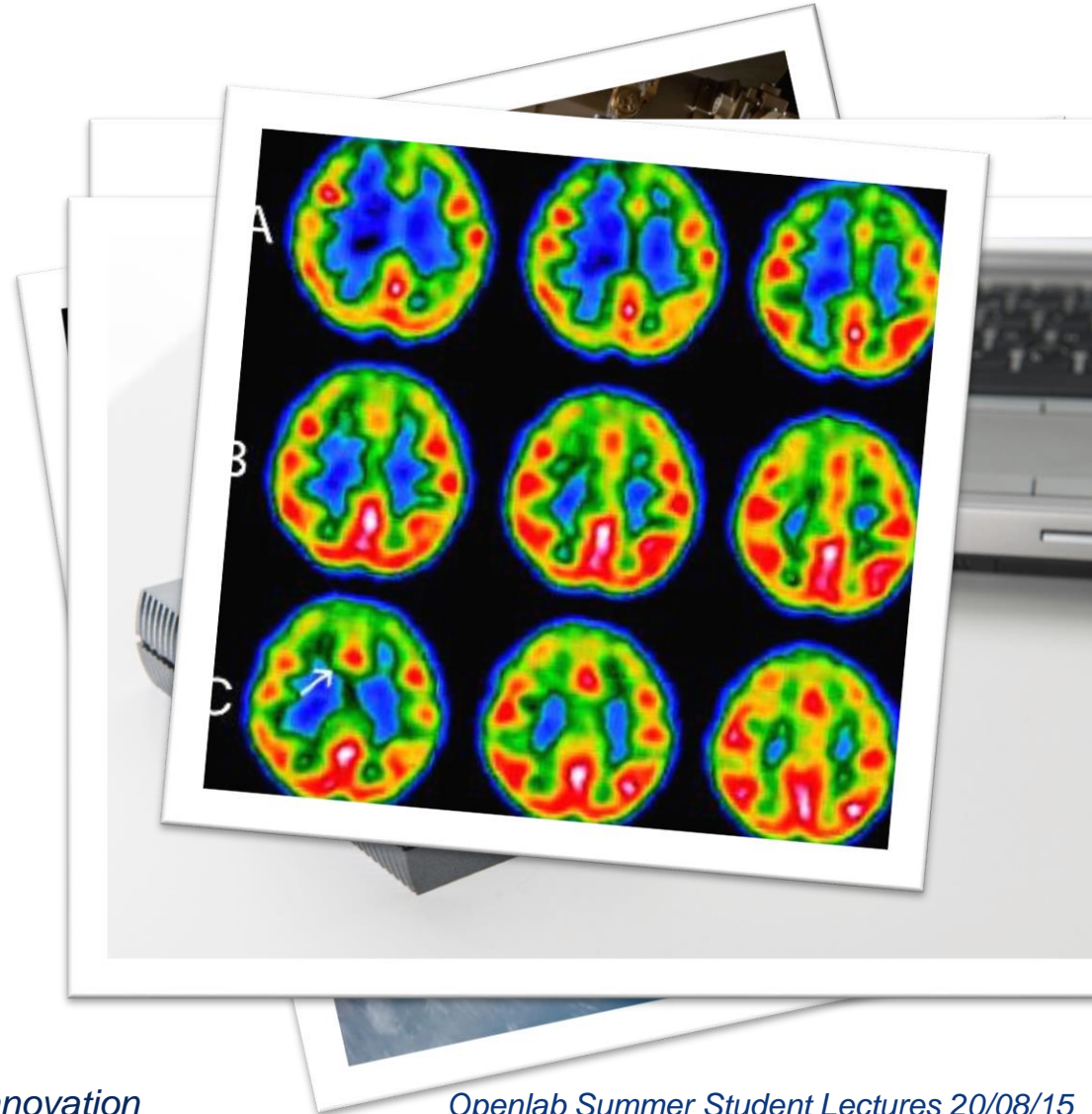






# Application: Medical Imaging

- Computed Tomography (CT)
- Radiography,
- Mammography,
- SPECT,
- Dental radiography,
- Angiography,
- PET
- and more



# CERN Open Hardware licence

A legal framework to facilitate knowledge exchange across the electronic design community.



# Open Hardware Repository – ohwr.org

The screenshot shows the Open Hardware Repository website. At the top, there is a navigation bar with links for HOME, PROJECTS, LICENSES, and DONATIONS. The main header features the Open Hardware Repository logo (a penguin) and the text "OPEN HARDWARE REPOSITORY". Below this is a "PROJECTS" banner with a right-pointing arrow. A "HELP" button is visible on the left side. The "FEATURED PROJECTS" section lists several projects:

- CERN DC-CO-IT contribution to K-Cad**: The project home documentation and code to be contributed by CERN's DC-CO-IT section to the K-Cad PCB design tool. [More info at the Wiki page](#)
- CERN Open Hardware Licence**: A project devoted to discussing and discussing the CERN Open Hardware Licence. [More info at the Wiki page](#)
- FMC ADC 10CM 14b 4ch**: FMCAD0100M14b4ch is a 4 channel 100MSPE 14 bit ADC low pin count FPGA Mezzanine Card (VITA 67). Input ranges: +/- 60mV, +/- 0.6V, +/- 0V. The offset correction by +/- 0V is possible for each gain range. Commercially available. [More info at the Wiki page...](#)
- FMC DEL 1ns 4cha**: A fine delay generator in FMC format with 1 input and 4 outputs. The resolution is 1 ns. Commercially available. [More info at the Wiki page](#)
- FMC TDC 1ns 5cha**: An FPGA Mezzanine Card (FMC) with a Time to Digital Converter chip to perform one-shot sub-nanosecond time interval measurements. Commercially available. [More info at the Wiki page](#)
- CHR Meet Project**: A media project used to discuss and present information about Open Hardware and related subjects. [More info at the Wiki page](#)  
[More info about the CERN Open Hardware licence](#)  
[More info about the CHR.org site support...](#)
- Simple PCIe FMC carrier (SPEEC)**: A simple 4-lane PCIe carrier for a low pin count FPGA Mezzanine Card (VITA 67). It has memory and docking resources and supports the White Rabbit timing and control network. Commercially available. Linux and Labview drivers available for some mezzanine cards...
- Simple PCIe FMC Carrier (SPEX)**: A simple 4-lane PCIe carrier for a low pin count FPGA Mezzanine Card (VITA 67). It has memory and docking resources and supports the White Rabbit timing and control network. Design based on the SPEEC. Commercially available. Labview driver available for Fine Delay and TDC mezzanines...
- Simple VME FMC Carrier (SVEC)**: A simple VME64x carrier for low pin count FPGA Mezzanine Cards (VITA 67). It has memory and docking resources and supports the White Rabbit timing and control network. Commercially available. [More info at the Wiki page](#)

On the right side, there is a "WELCOME" section with a search bar and a list of links:

- Browse the Projects list
- Read about the Open Hardware Repository
- Check out the CERN Open Hardware Licence
- Visit the Getting Started page

Below this is a "Latest news" section with several entries:

- White Rabbit: 13-06-2014: WR Calibration Procedure v1.6 is out**  
Added by [Grzegorz Daniluk](#) on 13 Aug 2014 at 16:01
- White Rabbit Switch - Software: WR Switch firmware release v4.0 is out**  
We are happy to announce that the stable v4.0 release of the WR Switch firmware is out. As usual you can find all the links to download the firmware binaries and manuals on our release web page:  
<http://www.ohwr.org/projects/white-rabbit-switch-software/firmware>  
Added by [Grzegorz Daniluk](#) on 28 Aug 2014 at 15:03
- PPSI: PPSI release 2014.07**  
We released 2014.07, with the new archdev and a much better error for non-archdev operations  
Added by [Alessandro Rusini](#) on 03 Aug 2014 at 11:47
- White Rabbit Switch - Software: wr-switch-sw release 4.0 rc1**  
release candidate 1 for v4.0 is ready, with a new and better installation, a new and better filesystem, a new and better gateway, and old-fashioned horrible crap. So it's all good now.  
Added by [Alessandro Rusini](#) on 10 Jul 2014 at 10:26



# Open Source Software

Software developed at CERN is often released as open source

Some examples of the use of CERN's open source software are:





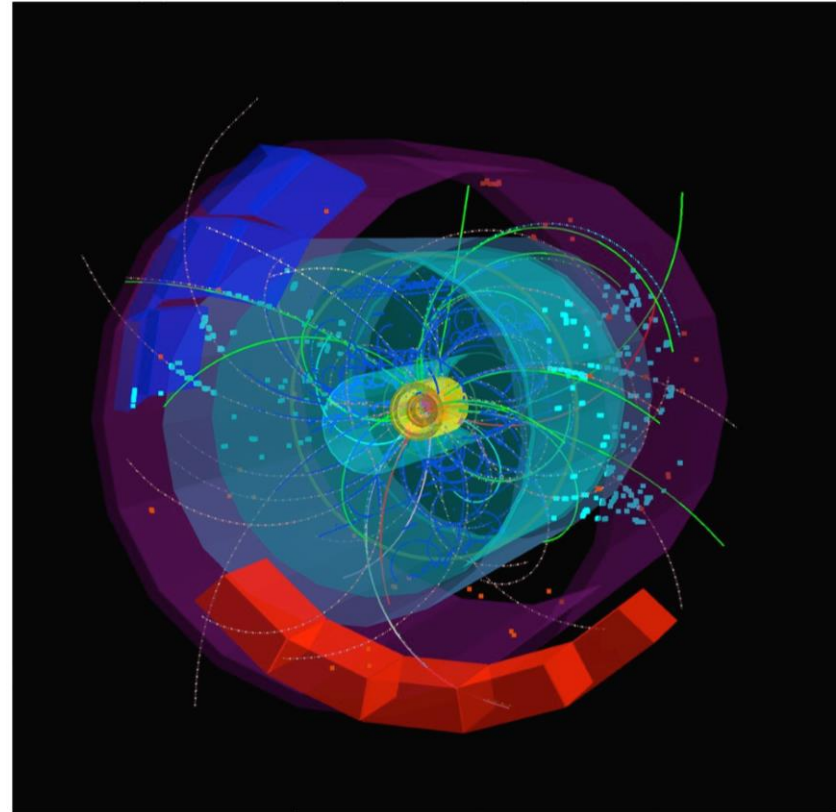
# OSS example

## ROOT

Powerful tool developed for handling big data in the CERN experiments

Widely adopted by the physics community and has found other applications such as:

- Finance
- Aerospace
- Telecom
- Automobile and more

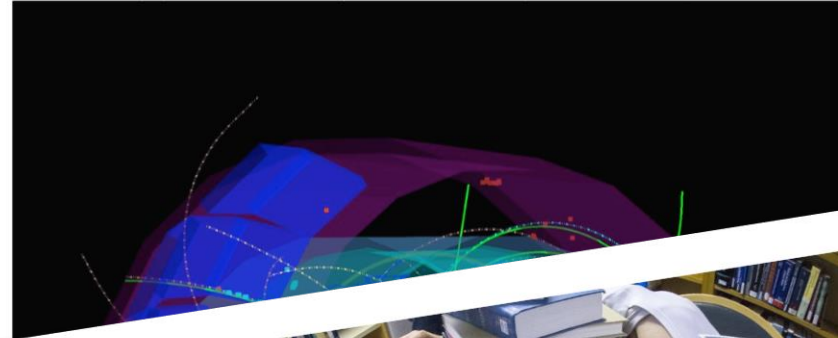


# OSS example

## Invenio

Software developed for running the digital library at CERN

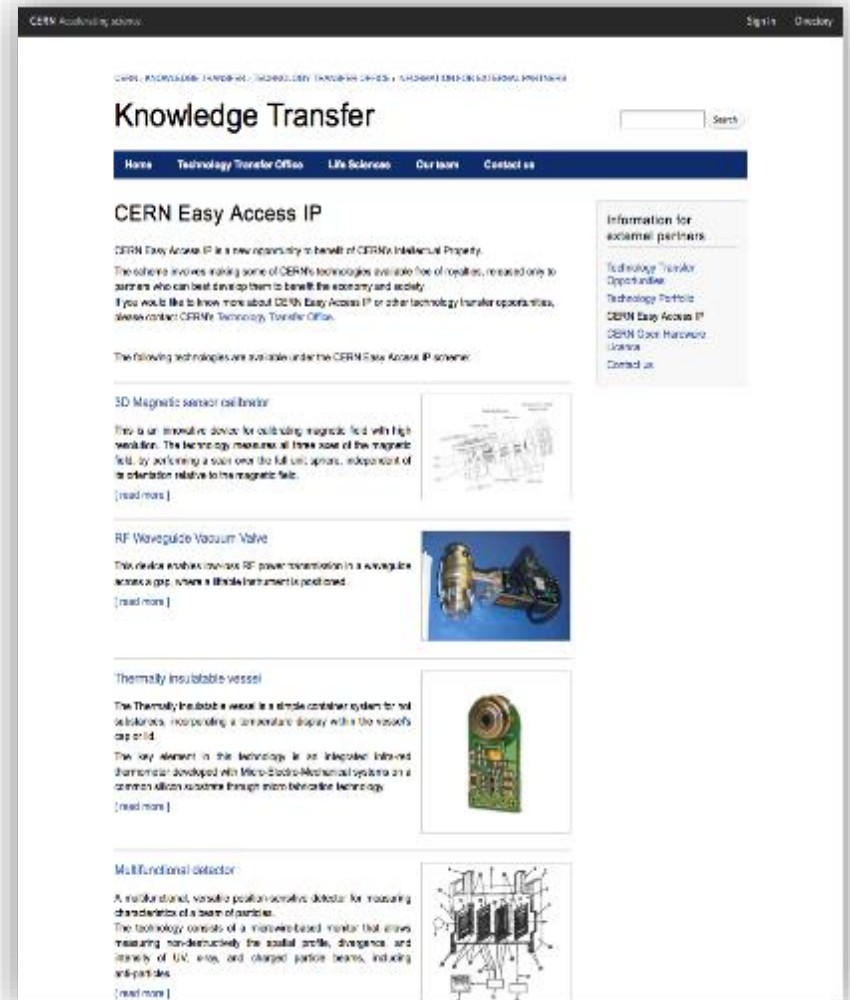
Invenio is widely adopted outside CERN and a spin-off company has been created for delivering service, support and customisation



# CERN Easy Access IP

Scheme pioneered by the University of Glasgow

For some of our technologies free licences are given to companies who will demonstrate that they can turn it into a product



The screenshot shows the CERN Knowledge Transfer website. The main heading is "Knowledge Transfer" with a search bar. Below it is a navigation menu with links for Home, Technology Transfer Office, Life Sciences, Our team, and Contact us. The main content area is titled "CERN Easy Access IP" and includes a brief description of the scheme, a list of available technologies, and a sidebar for "Information for external partners".

**CERN Easy Access IP**

CERN Easy Access IP is a new opportunity to benefit of CERN's Intellectual Property. The scheme involves making some of CERN's technologies available free of royalties, reserved only to partners who can best develop them to benefit the economy and society. If you would like to know more about CERN Easy Access IP or other technology transfer opportunities, please contact CERN's Technology Transfer Office.

The following technologies are available under the CERN Easy Access IP scheme:

- 3D Magnetic sensor calibration**  
This is an innovative device for calibrating magnetic field with high resolution. The technology measures all three axes of the magnetic field, by working in a scan over the full unit sphere, independent of its orientation relative to the magnetic field.  
[\[read more\]](#)
- RF Waveguide Vacuum Valve**  
This device enables to pass RF power transmission in a waveguide across a gap, where a flexible instrument is positioned.  
[\[read more\]](#)
- Thermally insulatable vessel**  
The Thermally insulatable vessel is a simple container system for hot liquids/gases, incorporating a temperature display within the vessel's cap and lid. This key element in this technology is an integrated infrared thermometer developed with Micro-Electro-Mechanical systems on a common silicon substrate through micro fabrication technology.  
[\[read more\]](#)
- Multifunctional detector**  
A multi-channel, versatile position-sensitive detector for measuring characteristics of a beam of particles. The technology consists of a microsensor-based monitor that allows measuring non-destructively the spatial profile, divergence and intensity of UV, x-ray, and charged particle beams, including anti-particles.  
[\[read more\]](#)

**Information for external partners**

- Technology Transfer Opportunities
- Technology Portfolio
- CERN Easy Access IP
- CERN Open Hardware Licence
- Contact us

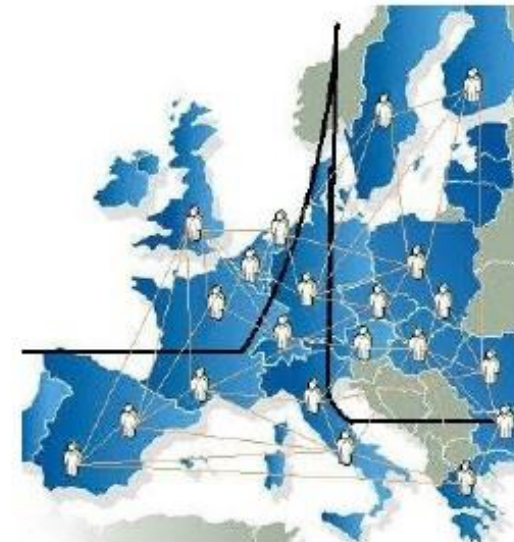


# 12 years of ENLIGHT Collaboration



CERN philosophy into health field

- Common multidisciplinary platform
- Identify challenges
- Share knowledge
- Share best practices
- Harmonise data
- Provide training, education
- Innovate to improve
- Lobbying for funding



> 150 institutes

> 400 people

> 25 countries

(with >80% of MS involved)

Coordinated by CERN







- Marie Curie Initial Training Network
- 12 institutions
- 29 trainees

2008-2012



- Infrastructures for hadron therapy
- 20 institutions

2009-2014



- R&D on medical imaging for hadron therapy
- 16 institutions

2010-2014



- Marie Curie ITN
- 12 institutions
- 16 trainees

2011-2015

# ICTR-PHE 2014

*Uniting physics, biology and medicine for better healthcare*



February 10 – 14, 2014 (CICG, Geneva)

2 days devoted to physics, 2 days to medicine, 1 day of overlapping topics

Chairs: Jacques Bernier (Genolier) and Manjit Dosanjh (CERN)

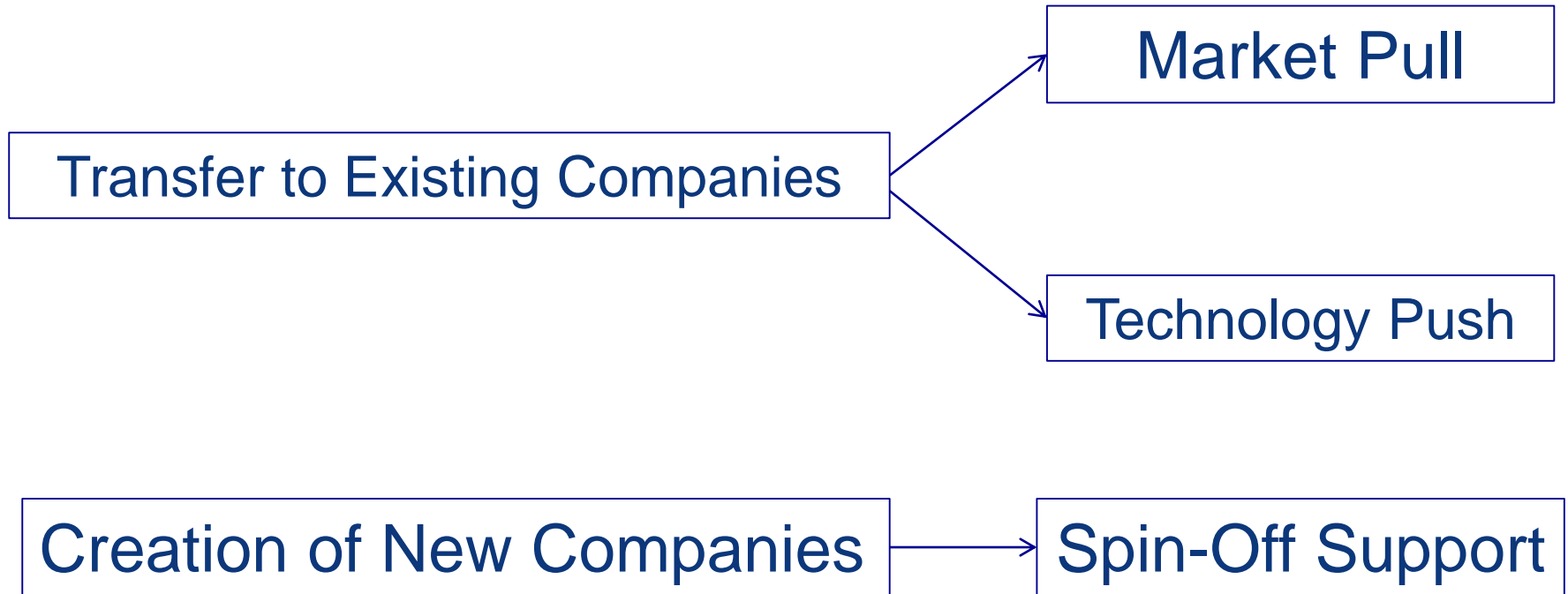
## Key Subjects:

- Biology
- Pre-clinical & clinical strategies
- Nuclear medicine
- Detectors & Imaging
- New Technologies
- Radiotherapy

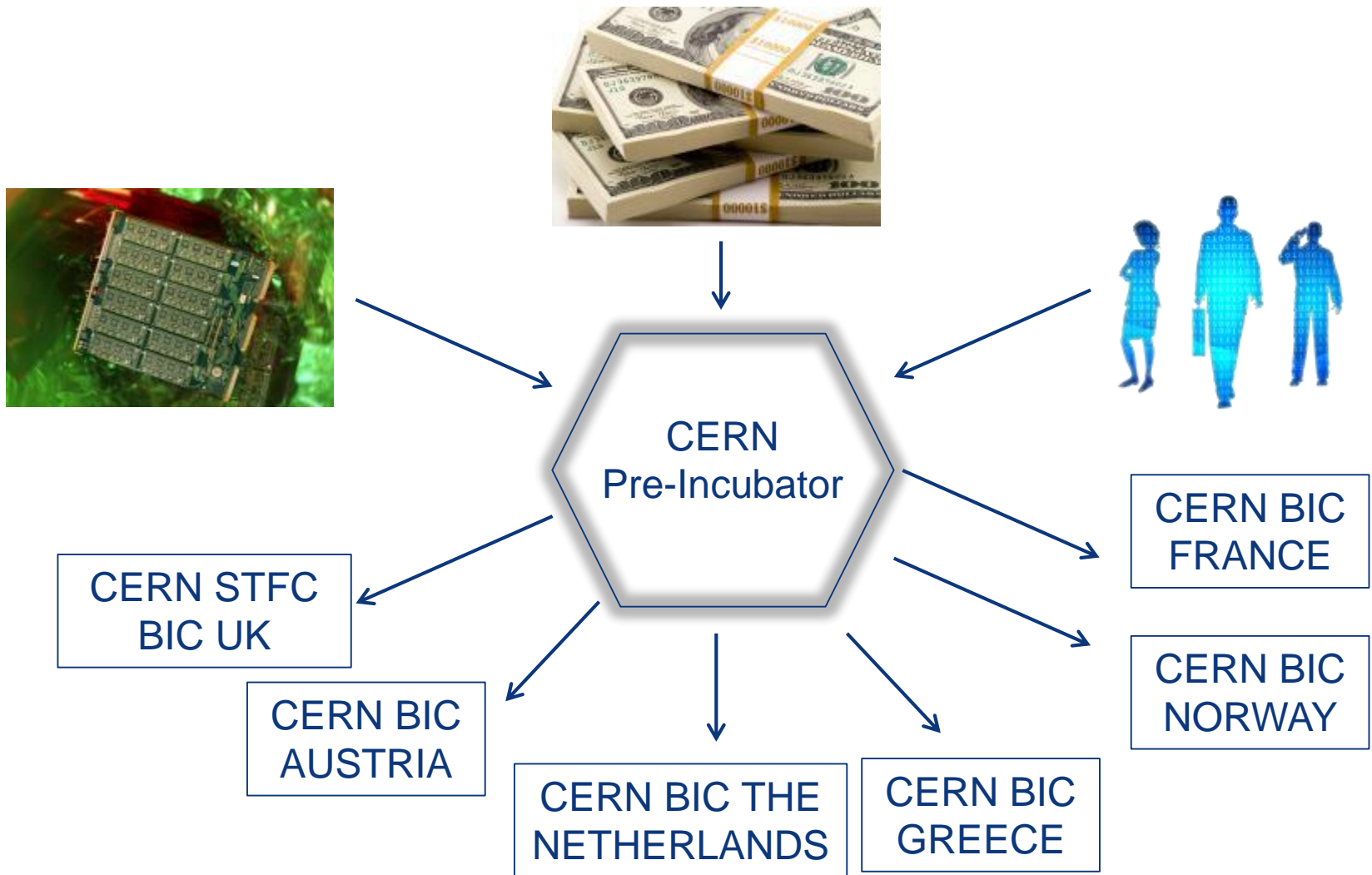


400 participants from 31 countries

# KT implementation ways



# CERN Business Ideas Accelerator





# Turning CERN technologies into new business opportunities

Search Go   
**STFC CERN Business Incubation Centre** technology

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[STFC CERN BIC Home](#)

[About us](#)

[What we offer](#)

[How to apply](#)

[News and events](#)

[Our successes](#)

[Location](#)

[Contact us](#)

## Welcome to the STFC CERN BIC

### High energy physics accelerating business

**Creating innovative new products, services and business opportunities from high energy physics technologies**

The STFC CERN Business Incubation Centre (BIC) offers funding, business support and technical assistance to entrepreneurs and small high-tech companies seeking to accelerate their innovative business concepts.

Focused on developing new products and services using technologies originally developed for use in high energy physics research, this pilot scheme draws on the world-leading capabilities of the Science and Technology Facilities Council (STFC) and the European Organization for Nuclear Research (CERN), home of the Large Hadron Collider.

The BIC combines the incubation experience of STFC with the unique opportunity to access STFC and CERN intellectual property (IP), technologies and expertise. It will help businesses to grow from technical concept to market reality, from small start-ups into thriving high-tech companies.

There is an open call for applicants to join the scheme and the deadline for applications is **June 2013**.

For all the latest news, information and opportunities at the STFC CERN BIC, follow us on twitter [@STFC\\_B2B](#).





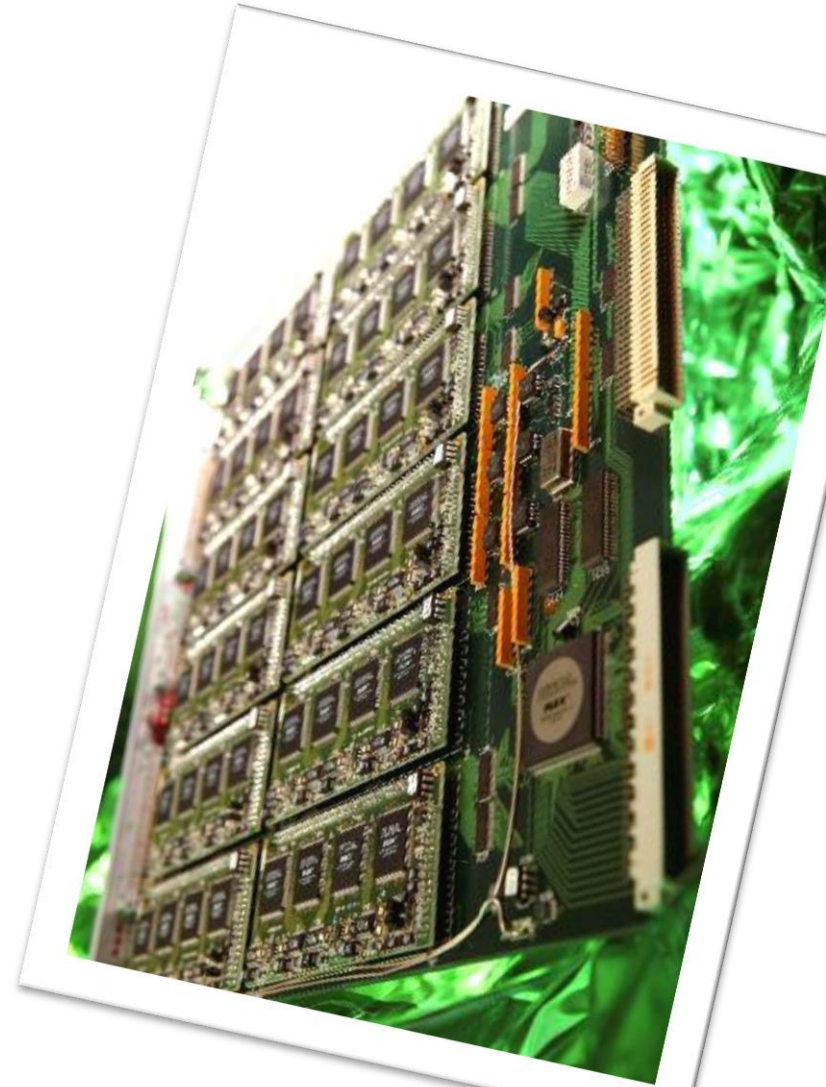
# Knowledge Transfer through Procurement

Survey of companies involved in technology-intensive procurement contracts with CERN.

- 178 questionnaires analyzed
- 503 MCHF procurement budget

## Results:

- 44% indicated technological learning
- 42% increased their international exposure
- 38% developed new products
- 36% indicated market learning
- 13% started new R&D teams
- 52% would have had poorer sales performance without CERN
- 41% would have had poorer technological performance



# Knowledge Transfer through People

Every year hundreds of students come to CERN to contribute to our research programs

An opportunity for young people to learn in a multicultural environment

Not only for physicists!  
Also engineers, computer scientists, administrative students...



# European Knowledge Transfer Networks



Forum for European Intergovernmental Research Organisations



EEN, Enterprise Europe Network



TTN, Technology Transfer Network



TTO Circle - European Technology Transfer Offices Circle



The European Network for LIGHT ion Hadron Therapy





# Conclusions

KT is integral part of CERN's mission

CERN technologies have applications in several domains with high relevance to society.

Significant contribution to innovation in medical sciences over the last 10-15 years

Impact which delivers tangible benefits to mankind



# More info / Contacts

[www.cern.ch/knowledgetransfer](http://www.cern.ch/knowledgetransfer)

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[Nick.Ziogas@cern.ch](mailto:Nick.Ziogas@cern.ch)



## Questions ?

