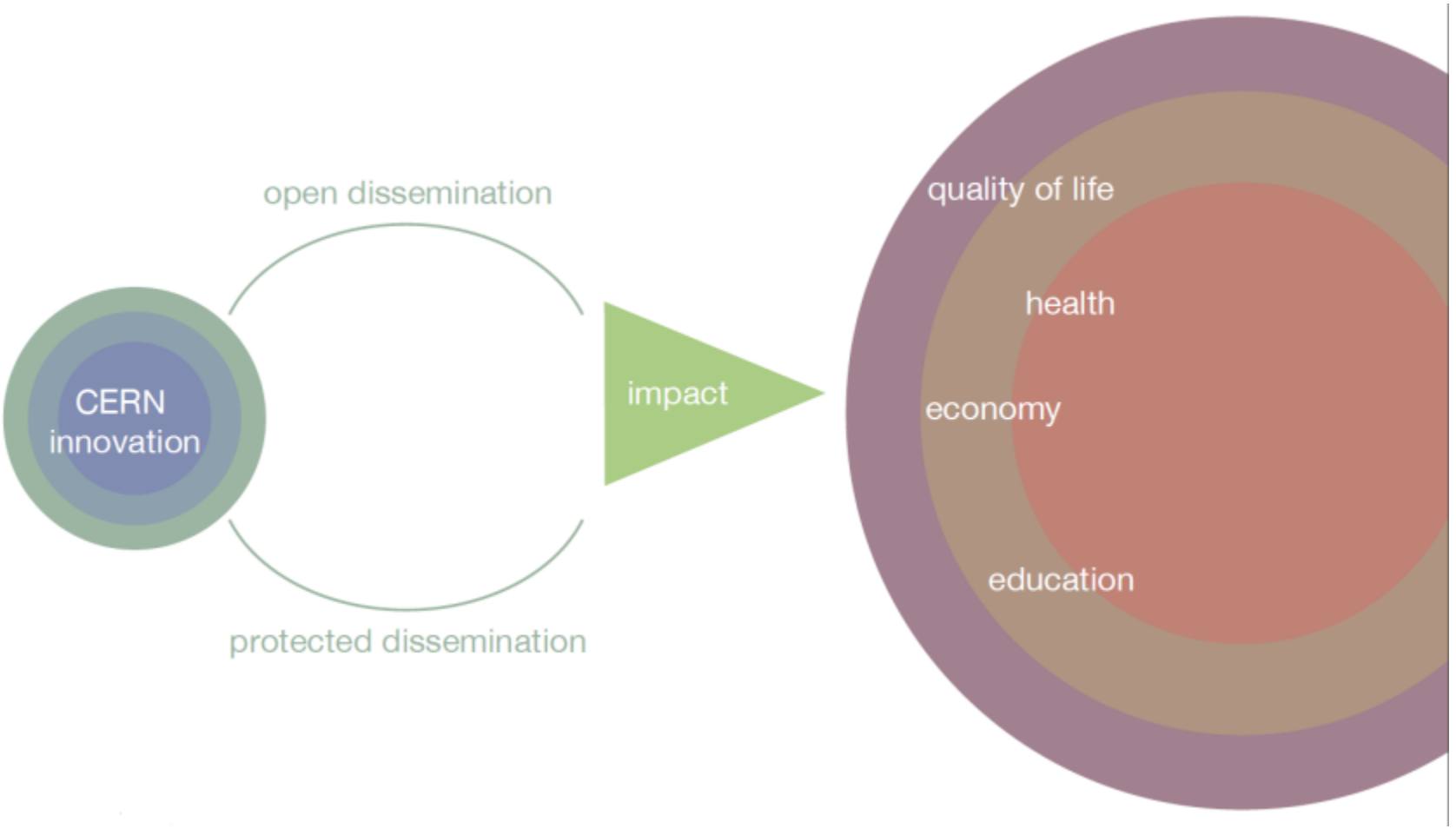
CERN, accelerating innovation

Nick Ziogas
Knowledge Transfer Group

Why Knowledge Transfer?



The WWW

Vague but exciting ...

CERN DD/OC

Tim Berners-Lee, CERN/DD

Information Management: A Proposal

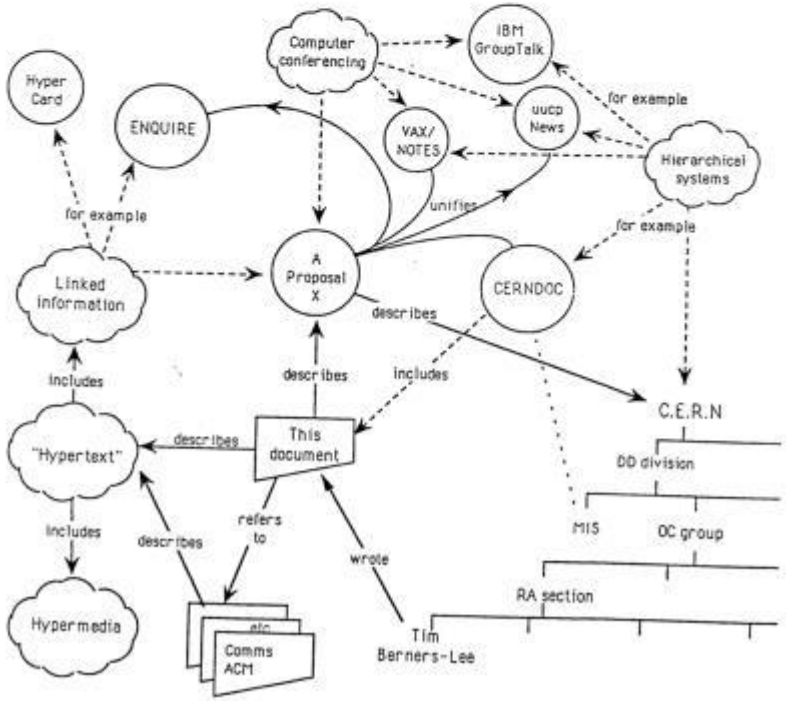
March 1989

Information Management: A Proposal

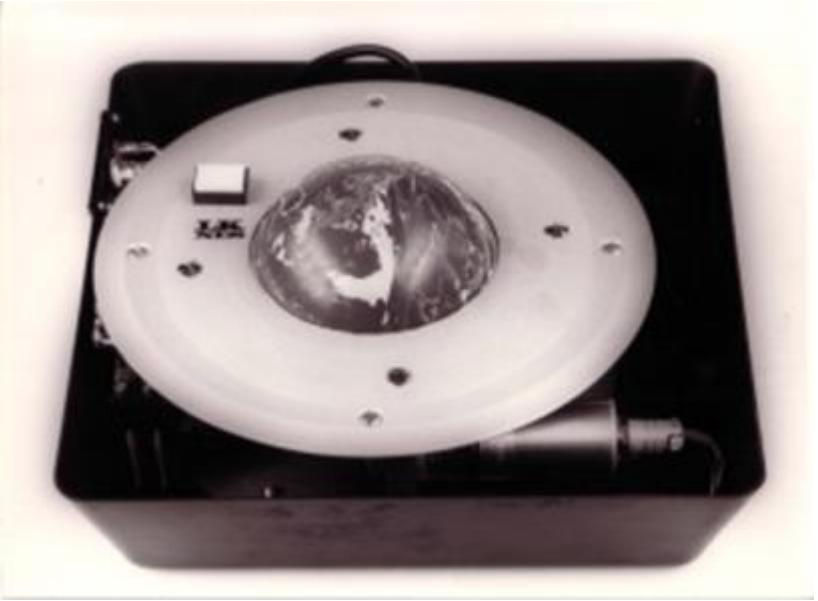
Abstract

This proposal concerns the management of general information about accelerators and experiments at CERN. It discusses the problems of loss of information about complex evolving systems and derives a solution based on a distributed hypertext sytstem.

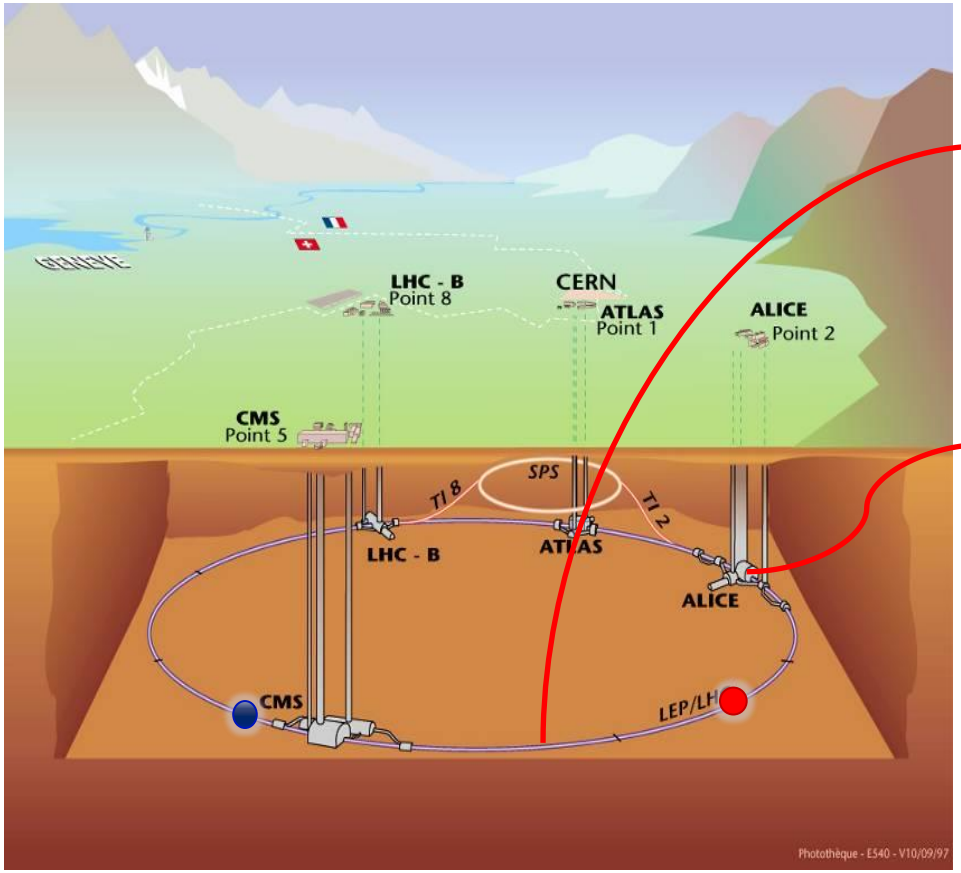
Keywords: Hypertext, Computer conferencing, Document retrieval, Information management, Project control



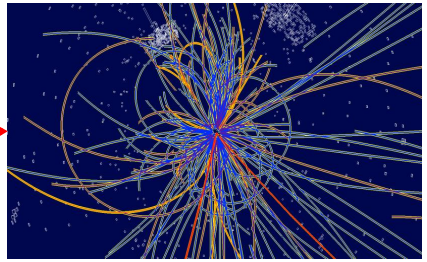
Did you know?



CERN's areas of excellence



Accelerating particle beams



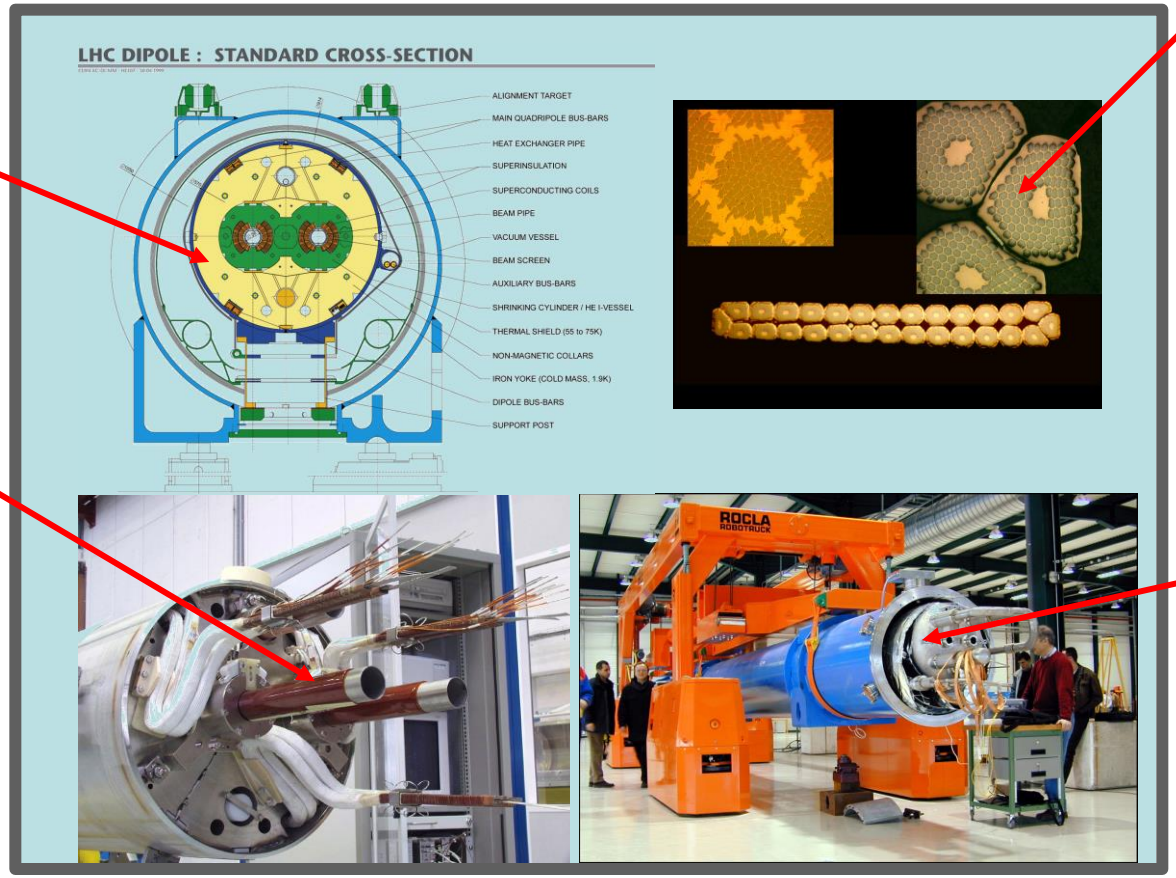
Detecting particles

IT technologies

Accelerator Technologies

Superconductivity
(12kA)

Cryogenics
(1.9 K)

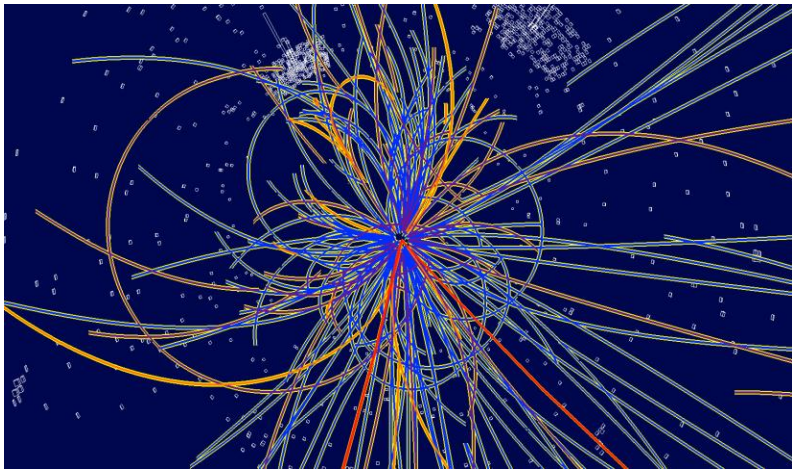


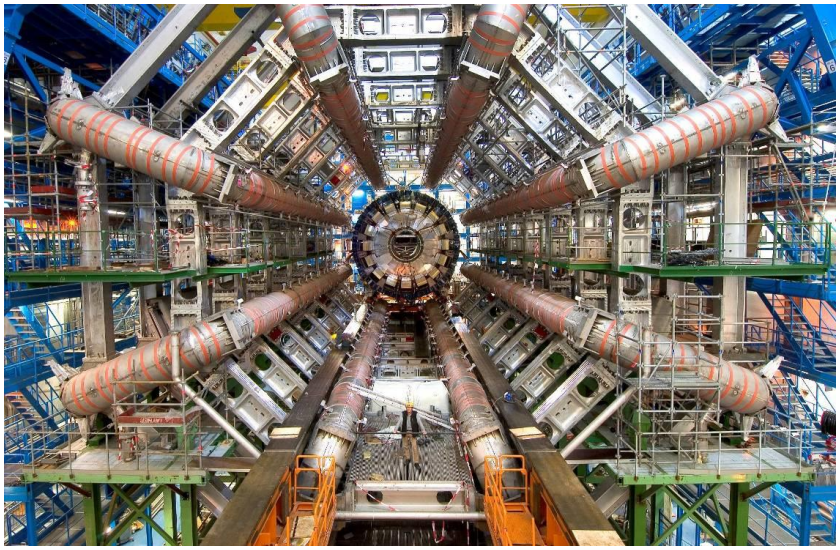
Vacuum
(10^{-13} atm)

Magnets
(8 T)

Detector Technologies

Challenge: sample the results of up to 600 million proton-proton collisions per second!





Οι ανιχνευτές του LHC διαθέτουν εξελιγμένα ηλεκτρονικά συστήματα ενεργοποίησης που μετρούν το **χρόνο διέλευσης ενός σωματιδίου με ακρίβεια μερικά δισεκατομμυριοστά του δευτερολέπτου**. Το σύστημα ενεργοποίησης καταγράφει επίσης, **τη θέση των σωματιδίων σε εκατομμυριοστά του μέτρου**. Αυτό είναι απαραίτητο για την εξασφάλιση ότι το **σωματίδιο που καταγράφεται σε διαδοχικά στρώματα ενός ανιχνευτή είναι ένα και το αυτό.**

Computing Technologies: the Grid

Detector data stream ~300 GByte/s of data. After filtering for "interesting events", ~ 300 MByte/s. This represents ~200 interesting collisions per second.

Several MBs of data to be stored for each collision...

→ more than 25 Petabytes/year of data!

8 Megabyte (8MB)
A digital photo

1 Gigabyte (1GB)
= 1000MB
A DVD movie

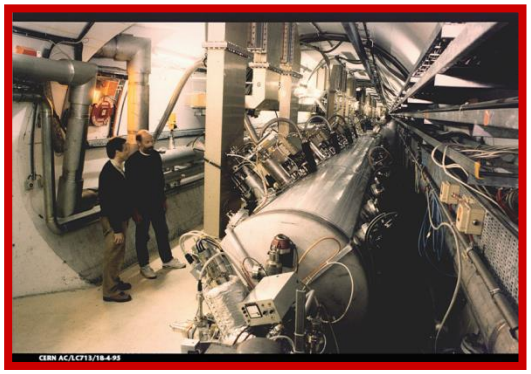
1 Terabyte (1TB)
= 1000GB
World annual
book production

> 25 Petabytes (25PB)
= 25000TB
Annual LHC data output

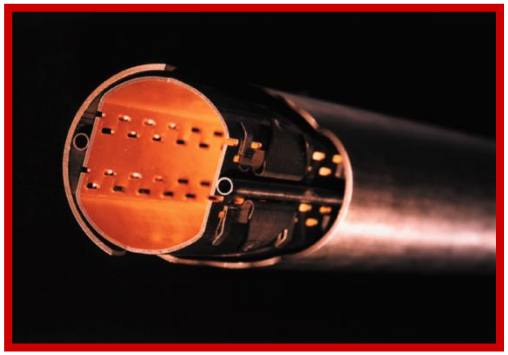
CERN, home of the World Wide Web, is a driving force in Grid Computing

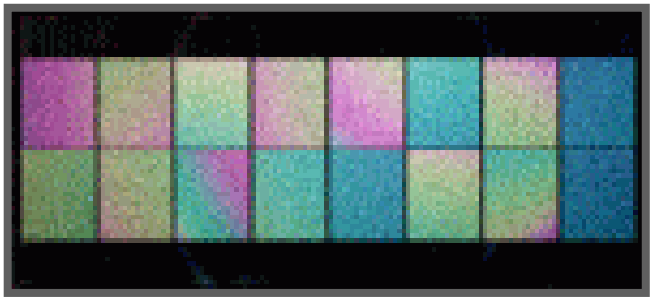
CERN Core Competences

Super-conductivity (13kA, 7MJoules)

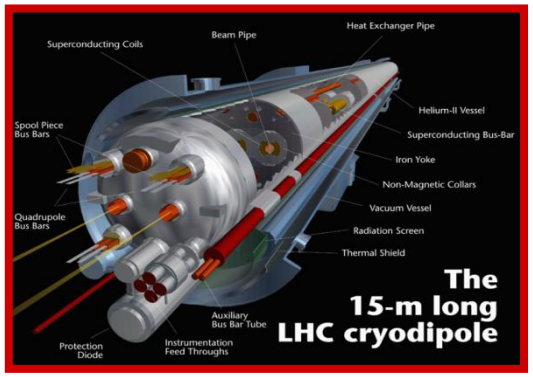


Vacuum (10^{-12} Torr)



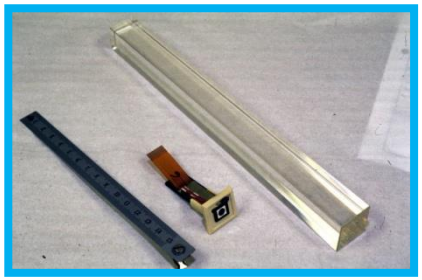


Cryogenics (1.9 K)

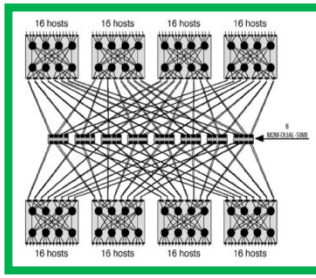


Magnets (10 T)

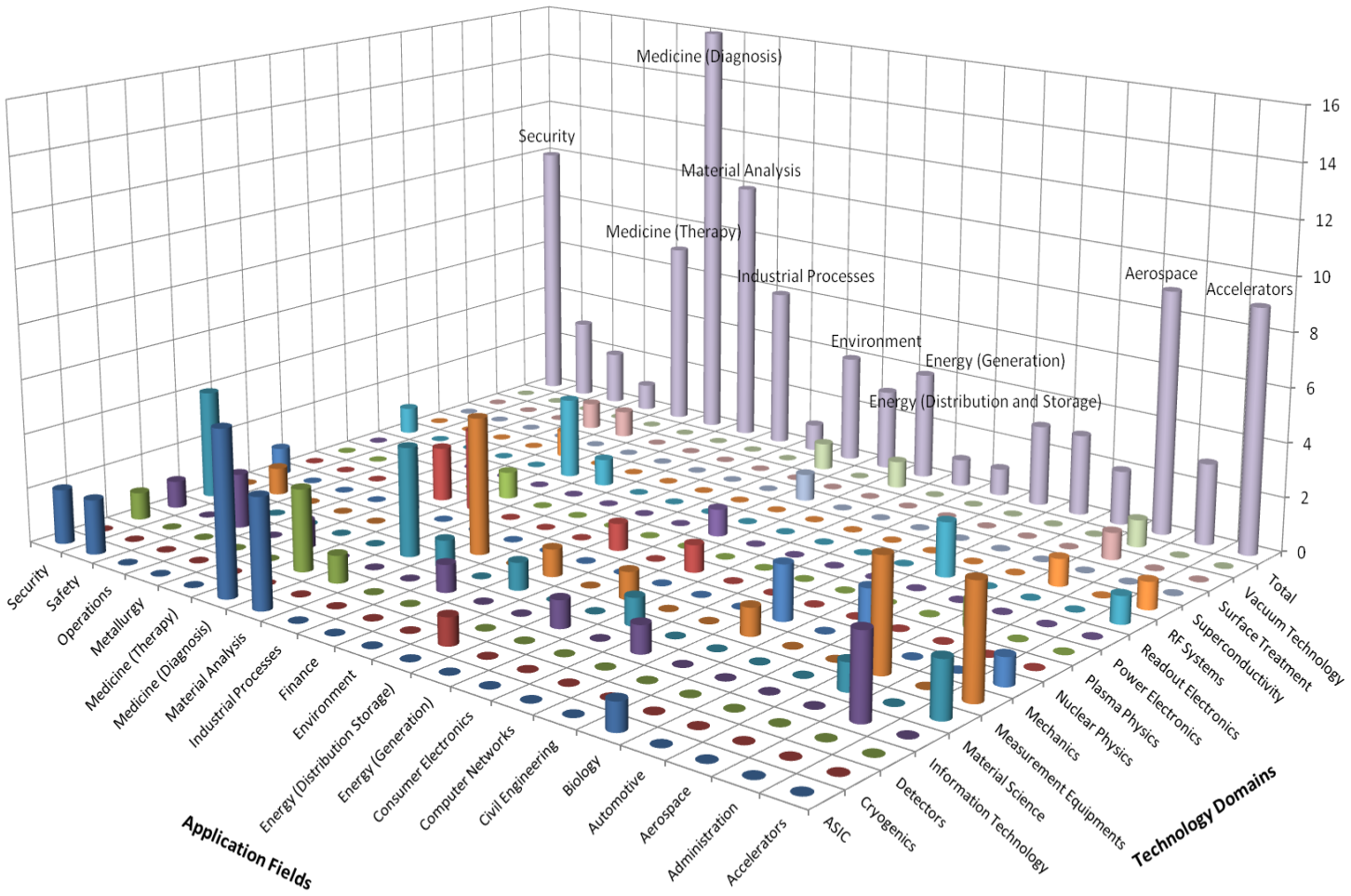
Very high performance detectors and electronics



Data processing



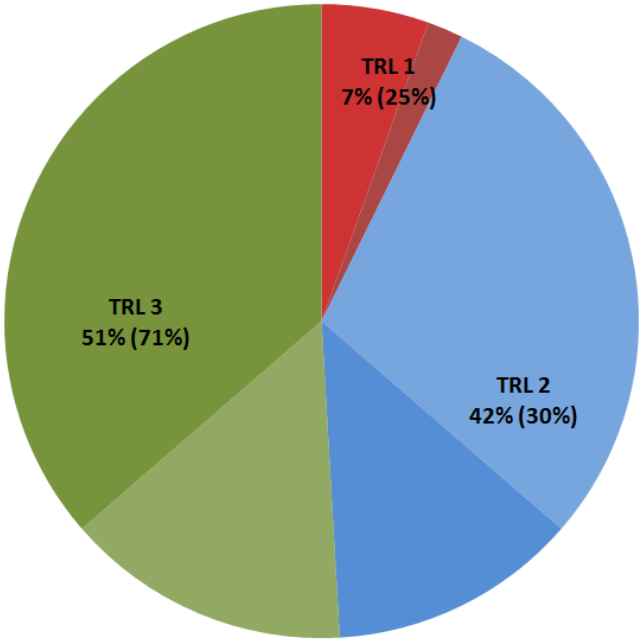
CERN's Technology Portfolio



Technology Portfolio - statistics

Technology Portfolio - General Statistics

- ~200 TT cases (40% open, 20% protected by patent)
- ~40 new disclosures per year
- Exploitation level: ~50%

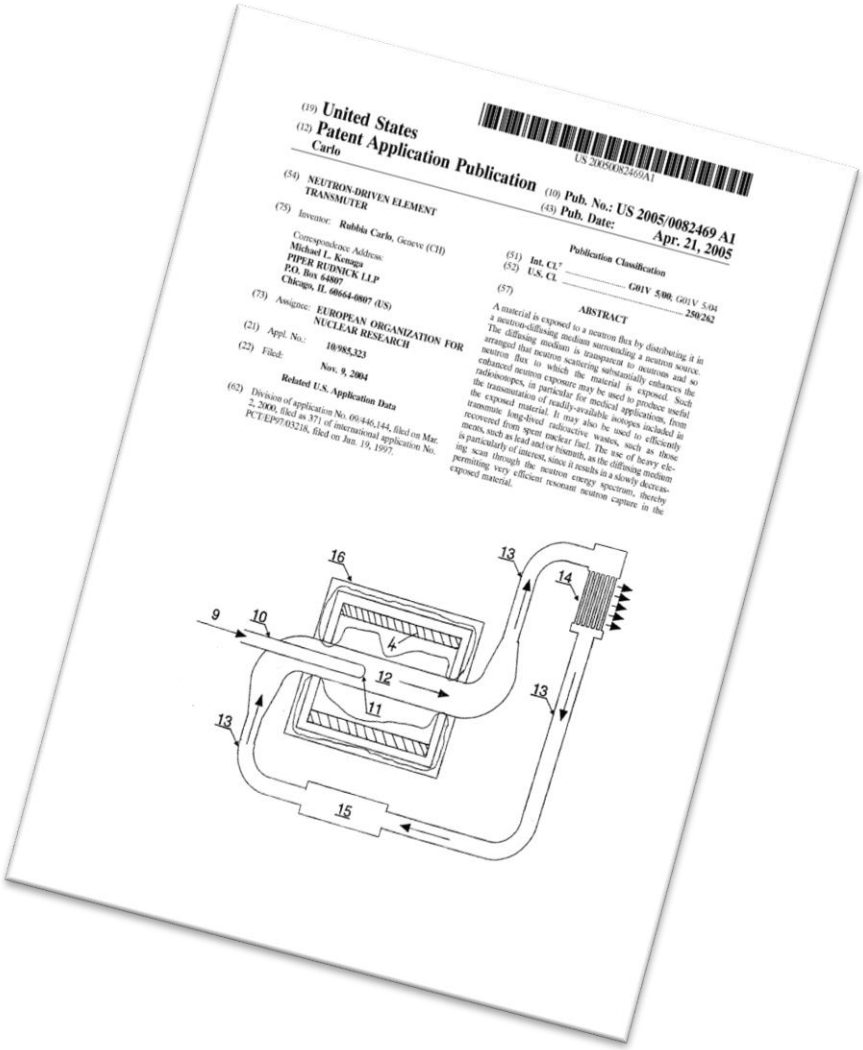


TRL	Simplified Definition
1	Technology application formulated and basic concept demonstrated
2	Functional validation in laboratory environment
3	Representative prototype fully qualified (technology ready to transfer)

CERN and Patents

Patents are taken in order to:

- Increase the probability of having the technology transferred (justify development investments from industry)
- Significantly enhance the commercial value of the technology
- Ensure CERN's recognition as the originator of an exceptional invention



From high vacuum…

- NEG (Non-Evaporable Getter thin film coatings)

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

… to solar energy!

- License and partnership with a start-up company

Development of a commercial product able to use diffused or indirect light and reach very high temperatures of up to 300 degrees
Development of a prototype production chain

Solar panels plant

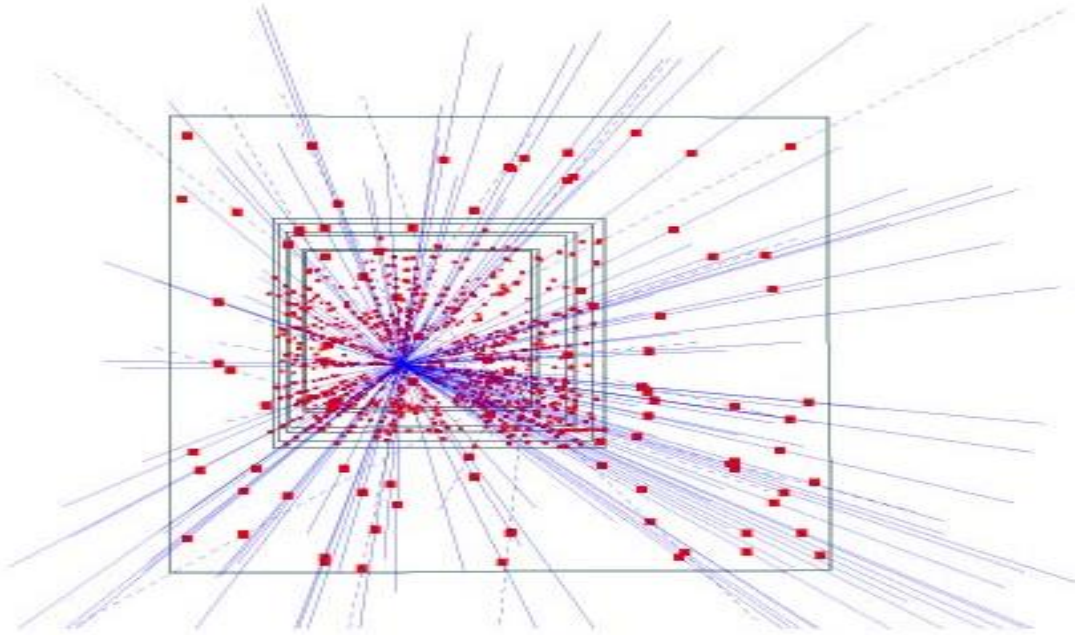
- Civil-engineering company opened a new solar power plant

  Environmentally friendly "solar field" heats close to 80,000 cubic metres of bitumen to 180 degrees.

Installation at GVA airport

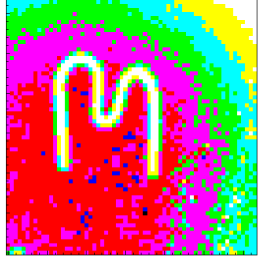
Silicon pixel detectors (SPDs)

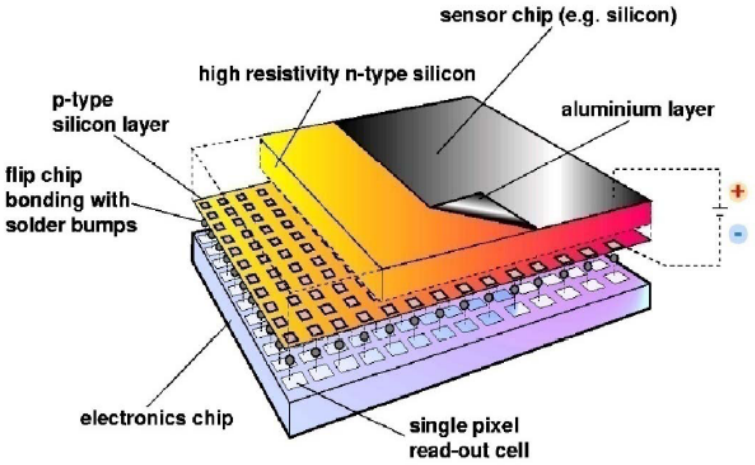
- Hybrid silicon pixel detectors for tracking applications in High Energy Physics

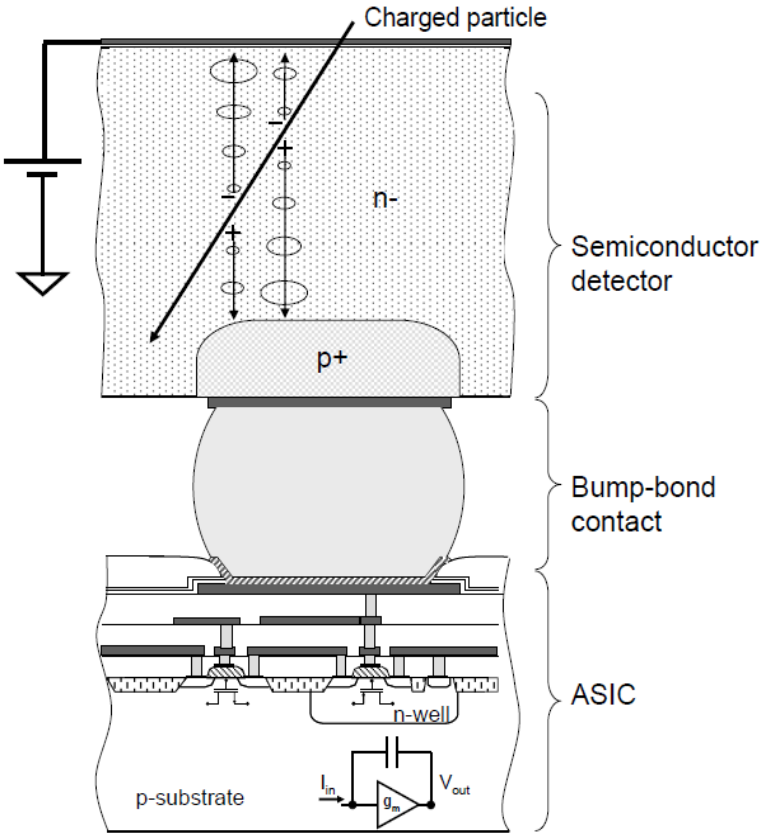


153 high energy particle tracks flying through a telescope of half a million pixels in the WA97 experiment back in 1995

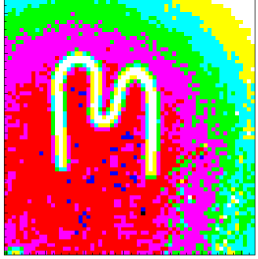
Medipix




sensor chip (e.g. silicon)
high resistivity n-type silicon
p-type
silicon layer
aluminium layer
flip chip
bonding with
solder bumps
electronics chip
single pixel
read-out cell


Charged particle
n-
p+
Semiconductor
detector
Bump-bond
contact
ASIC
n-well
p-substrate
I_{in}
V_{out}
g_m

Medipix

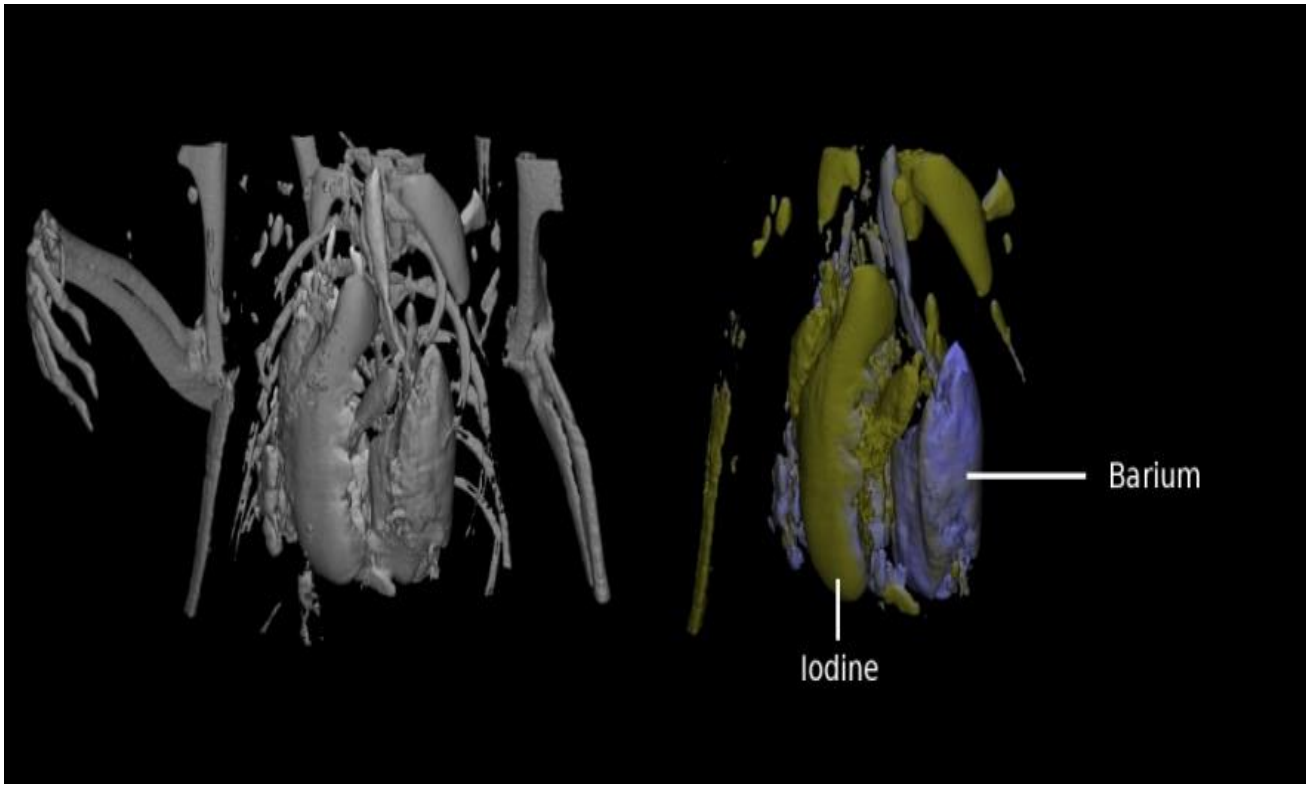


- A family of single photon counting integrated circuits used in Hybrid Silicon Pixel Detectors
- The Medipix collaborations (close to 20 institutes) contributed to the development and dissemination of the technology
- A good example of how (fundamental) science fosters innovation which can be transferred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

Application: Medical imaging

- MARS project

  Colour CT X-ray scanner based on the Medipix technology



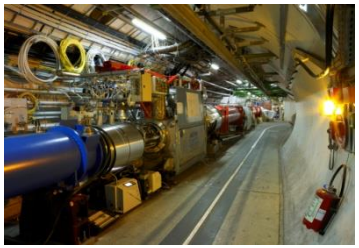
(courtesy of MARS Bioimaging Ltd)

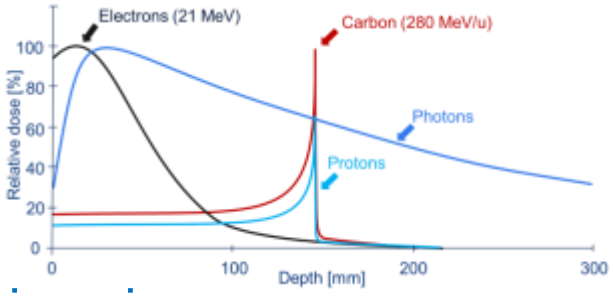
Application: Material analysis

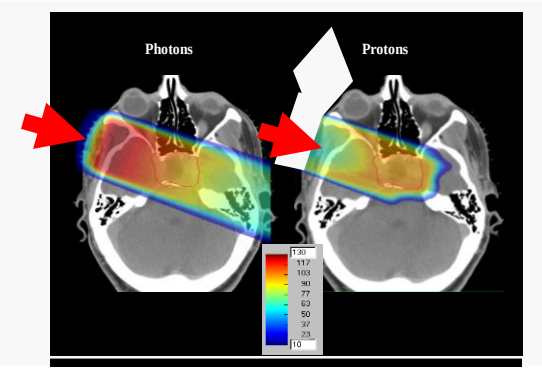
- Partnership and license agreements with a company to build a X-ray diffractometer

Example: medical applications

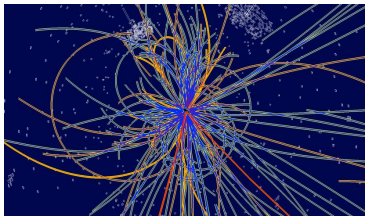
Particle accelerators for hadron therapy

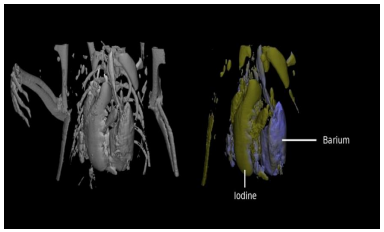


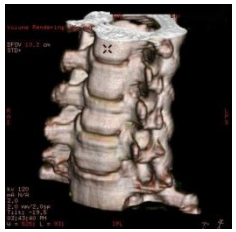


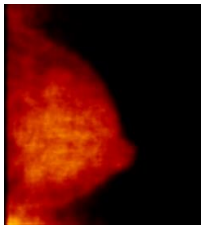


Particle detectors for medical imaging

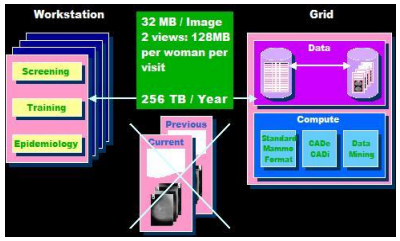






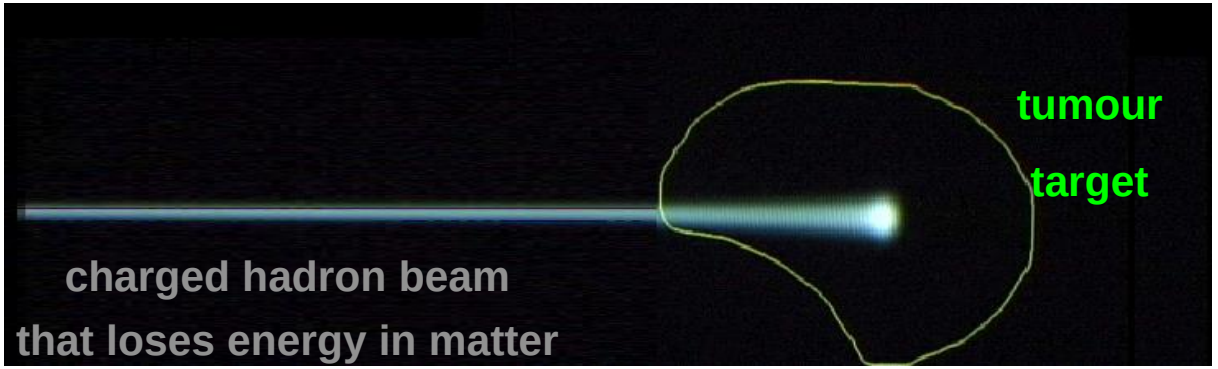


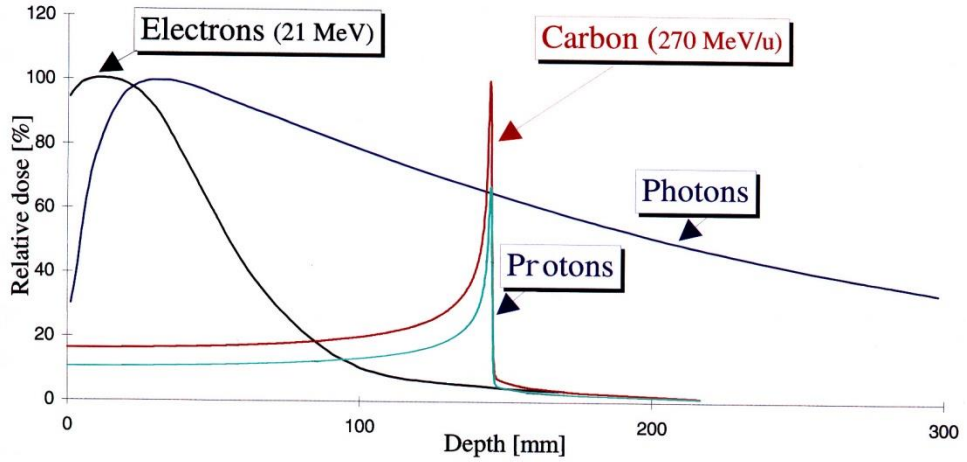
Grid computing for medical data management and analysis

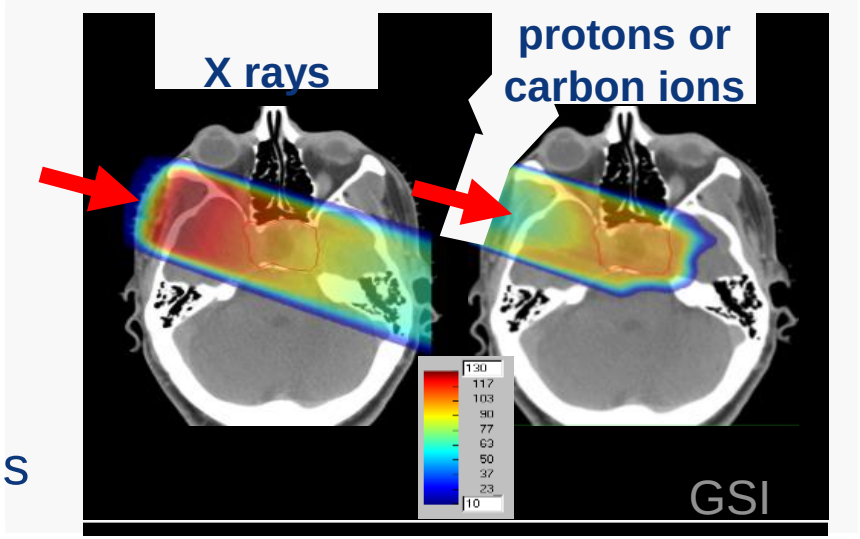


Hadrontherapy

Hadron beams: new treatment opportunities for deep-seated tumours

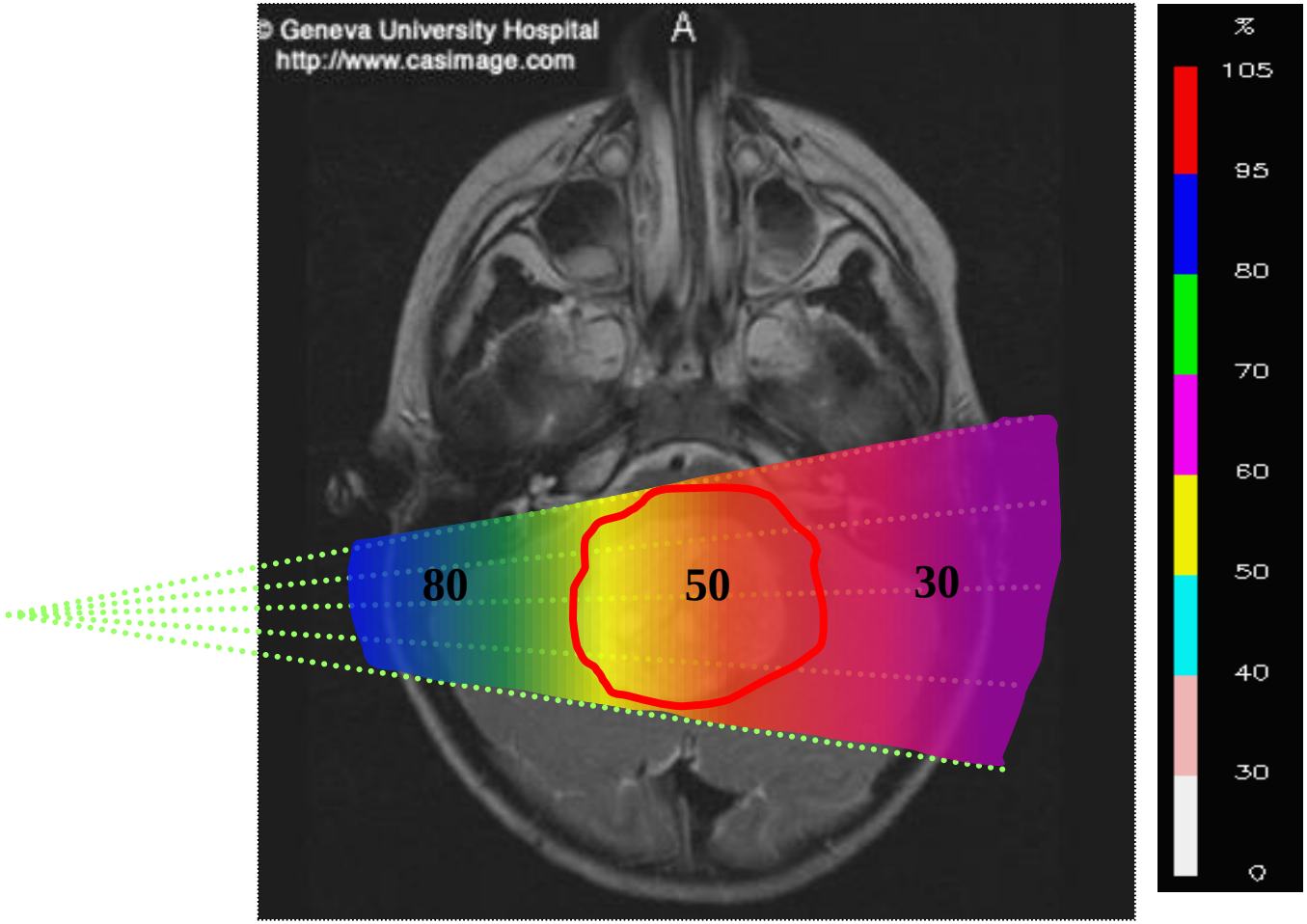






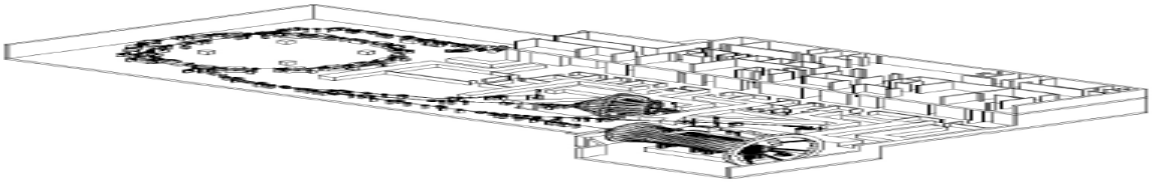
C ions: 24 times more energy than protons

X-ray therapy



CERN's PIMMS Study

PIMMS 2000 (coordinated by CERN) has led to:



TERA Fondazione per Adroterapia Oncologica → fondazione CNAO

Treatment centre in Pavia, Italy.

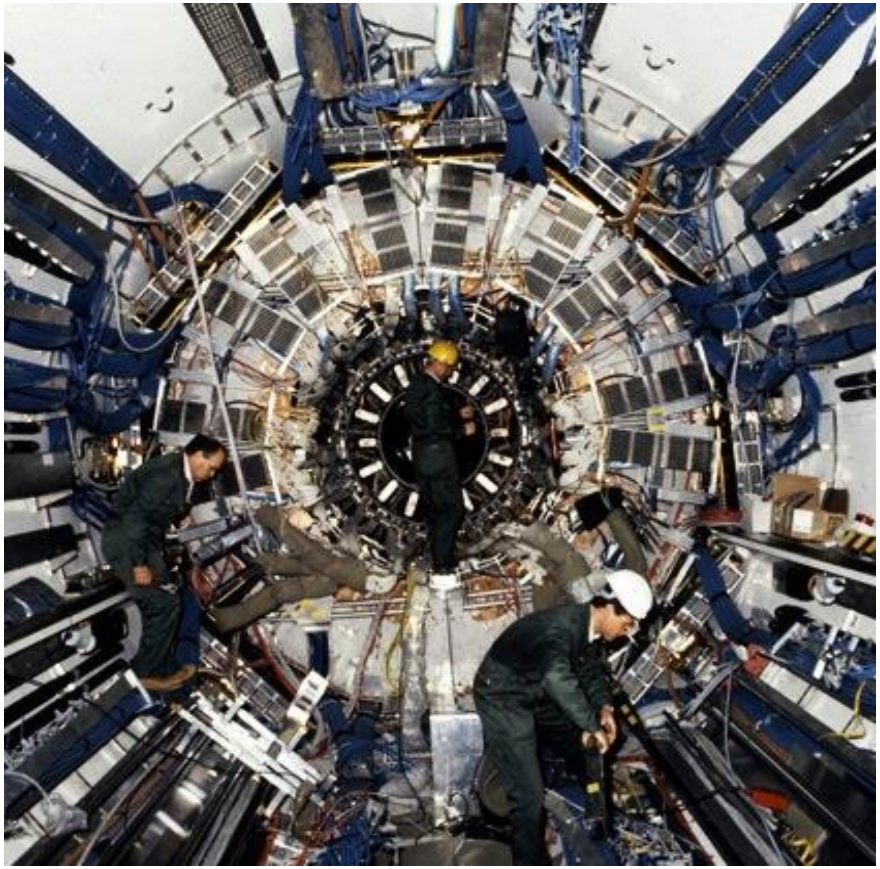
First patient treated with Carbon ions in November 2012!

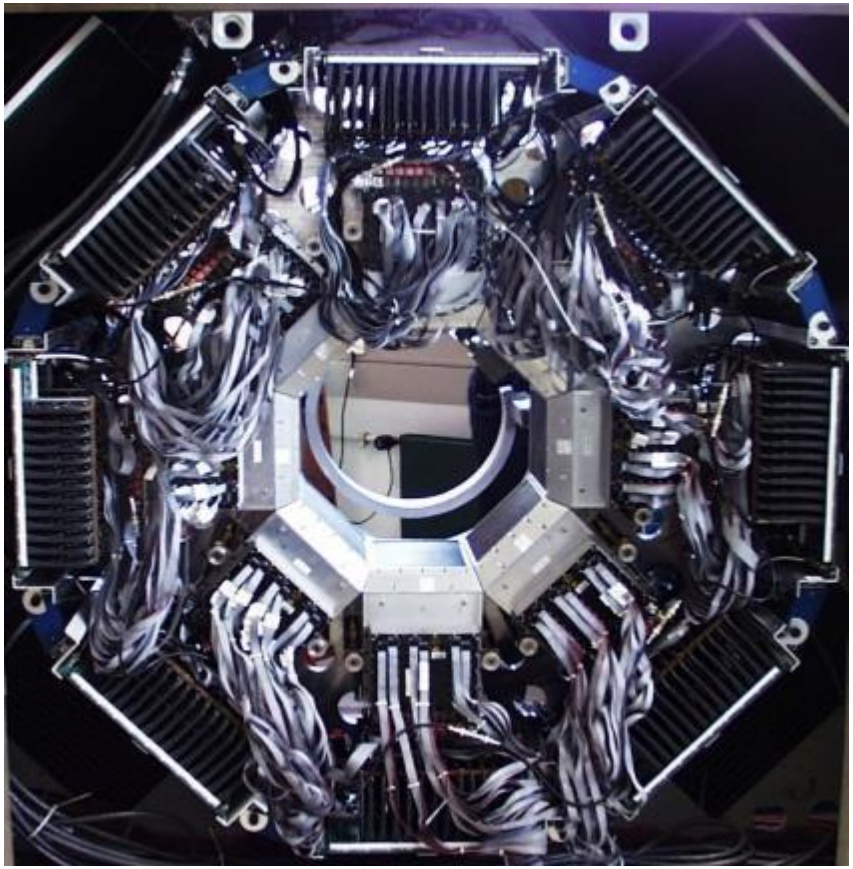
ebg MedAustron

Treatment centre in Wiener Neustadt, Austria, foundation stone 16 March 2011, will be ready in 2015

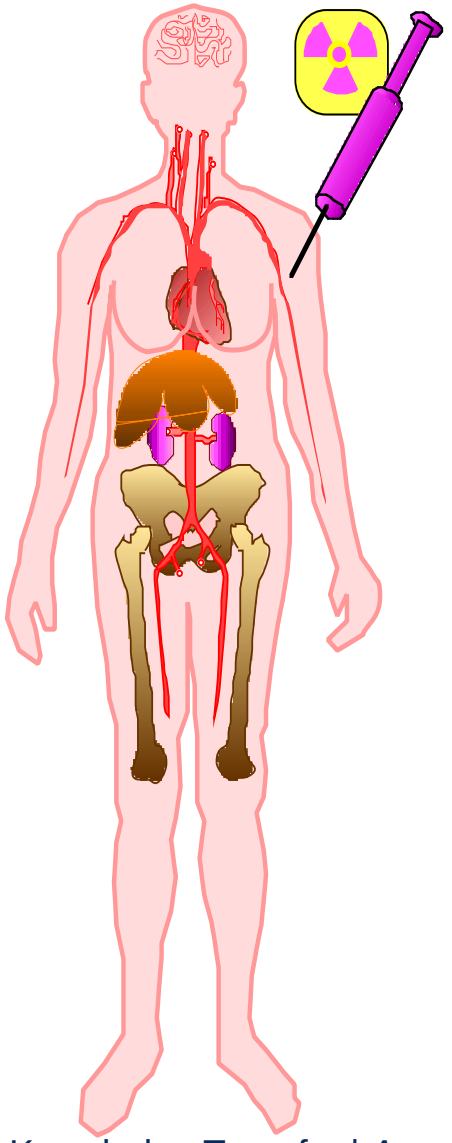
CNAO

Medical imaging and particle physics



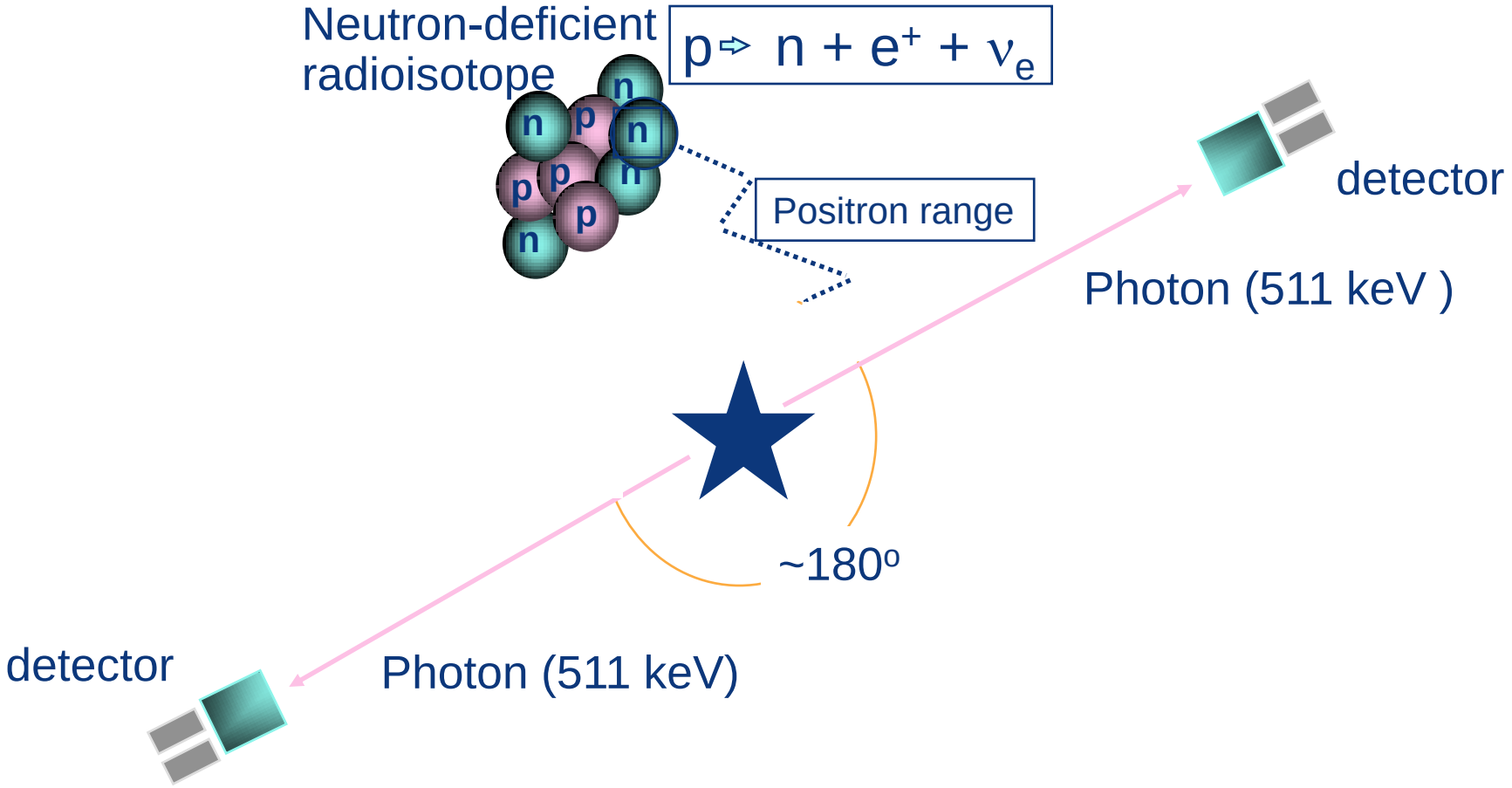


PET: How does it work



- Drug is labeled with positron (β^+) emitting radionuclide.
- Drug localizes in patient according to metabolic properties of that drug.
- Trace (pico-molar) quantities of drug are sufficient.
- Radiation dose fairly small (<1 rem = 0.01 Sv).

PET detection



Crystals for HEP and … PET

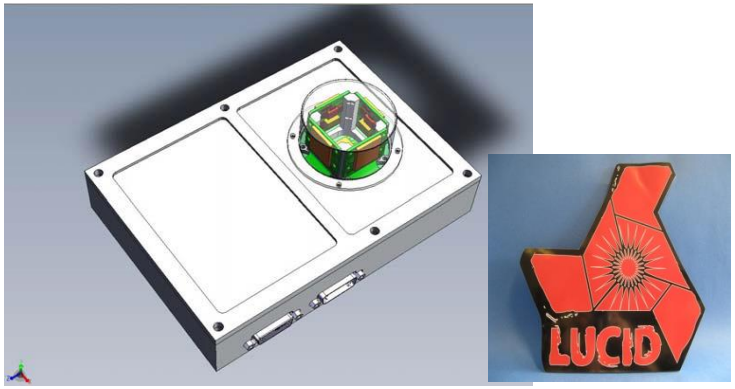
Other ways of dissemination

- The Technology Transfer process:

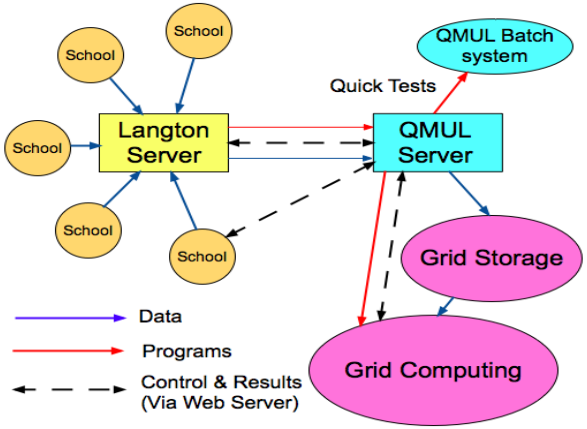
  invention disclosure → IP protection → license to a company

  is difficult, especially for the world of particle physics. Collaborative R&D (with industry and other research institutes) is key for a successful transfer.
- Other ways of dissemination are also very important for the Organization

CERN@school allows students to use a Timepix chip in the lab to visualise radiation

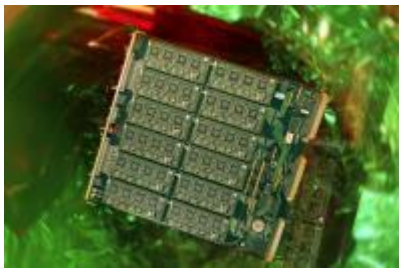


Langton Ultimate Cosmic ray Intensity Detector uses 5 Timepix chips to monitor the radiation environment in Space



Data from LUCID and CERN@school detectors will be uploaded to the Grid and made available for students to analyse

CERN Business Ideas Accelerator



CERN
Pre-Incubator

CERN STFC
BIC

NATIONAL
BIC

NATIONAL
BIC

NATIONAL
BIC

NATIONAL
BIC

Turning CERN technologies into new business opportunities

STFC

Search Go

CERN technology

STFC CERN Business Incubation Centre

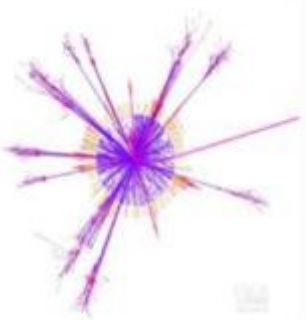
- STFC CERN BIC Home
- About us
- What we offer
- How to apply
- News and events
- Our successes
- Location
- Contact us

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

Results from a survey of companies involved in technology-intensive procurement contracts with CERN.
178 questionnaires analyzed, related to 503 MCHF procurement budget.

Results:

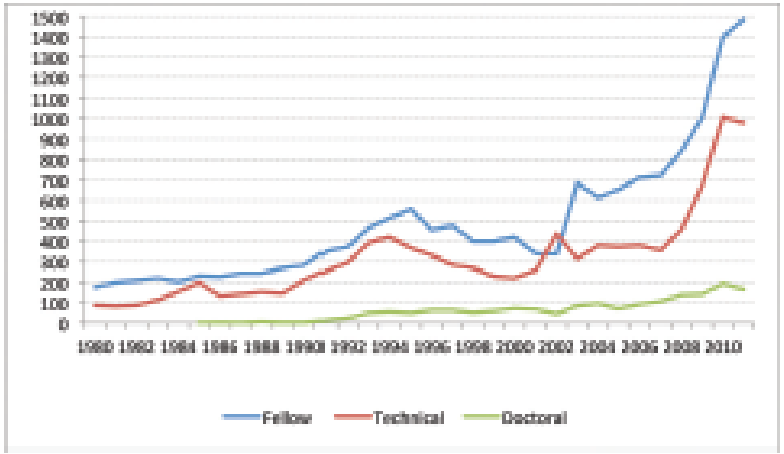
- 44% indicated technological learning
- 42% increased their international exposure
- 38% developed new products
- 36% indicated market learning
- 13% started new R&D teams
- 52% would have had poorer sales performance without CERN
- 41% would have had poorer technological performance

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…



More info / Contacts

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Ευχαριστώ για την προσοχή σας

Ερωτήσεις ;

Incubators in the MS

- The STFC CERN BIC is a pilot scheme which we plan to replicate in other Member States
- Integration into existing structures is crucial
- To “fill” these incubators, we are working on a “pre-incubator” concept: CERN technologies + (external) fundings + (external) entrepreneurs → new companies generation

CERN Open Hardware Licence

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

In the spirit of knowledge and technology dissemination, the CERN OHL was created to govern the use, copying, modification and distribution of hardware design documentation, and the manufacture and distribution of products.

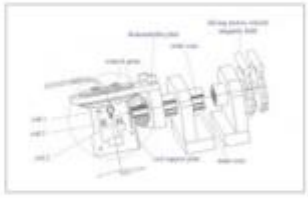
CERN Easy Access IP

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, released 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 calibrator



This is an innovative device for calibrating magnetic field with high resolution. The technology measures all three axes of the magnetic field, by performing 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 low-loss RF power transmission in a waveguide across a gap, where a liftable instrument is positioned.

[read more]

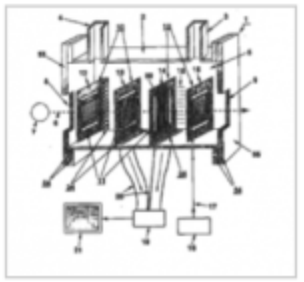
Thermally insulatable vessel

The Thermally insulatable vessel is a simple container system for hot substances, incorporating a temperature display within the vessel's cap or lid.

The key element in this technology is an integrated infra-red thermometer developed with Micro-Electro-Mechanical systems on a common silicon substrate through micro fabrication technology.

[read more]

Multifunctional detector



A multifunctional, versatile position-sensitive detector for measuring characteristics of a beam of particles.
The technology consists of a microwire-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]

Cryogenic optical fiber temperature sensor

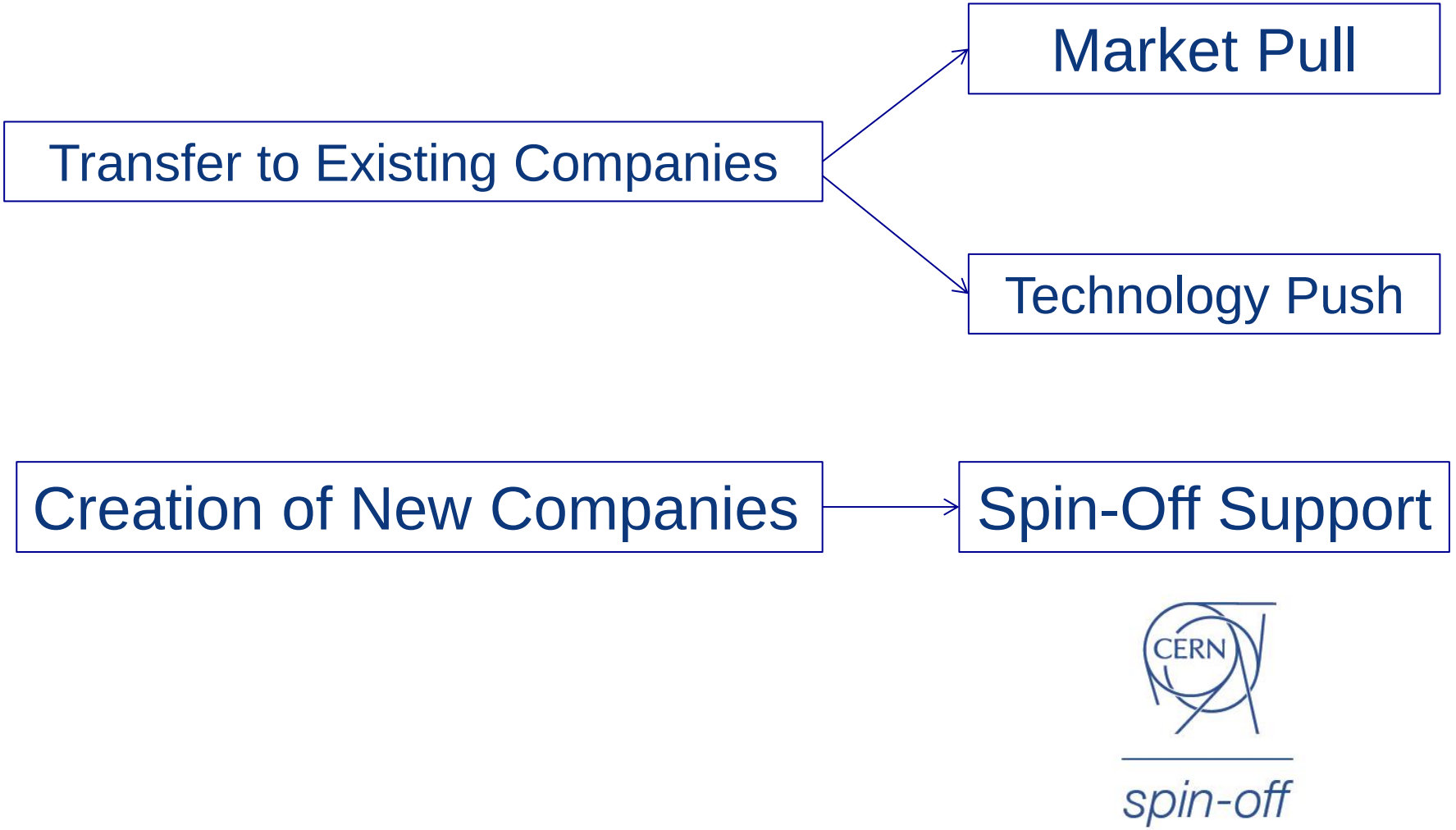
The technology consists in a simple and relatively cheap cryogenic temperature sensor, composed of an optical fiber and a Brillouin spectral analyzer for measuring one or more temperature dependent Brillouin scattering parameters.

[read more]

Easy Access IP was first trialled by Easy Access Initiative, a collaborative project between the University of Glasgow, King's College London and the University of Bristol.

CERN Easy Access IP Exclusive Licence agreement
CERN Easy Access IP Non-Exclusive Licence agreement

KT implementation ways



10 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

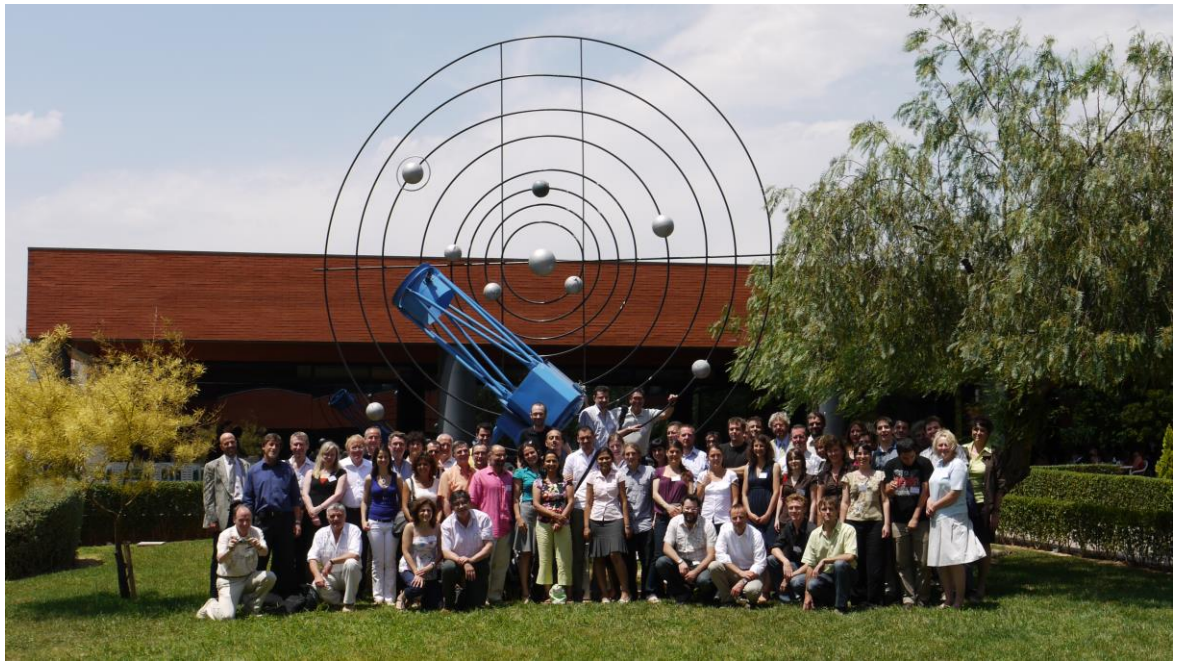
(with >80% of MS involved)

Coordinated by CERN

One of the ENLIGHT platform projects: PARTNER

Particle Training Network for European Radiotherapy

- 4-year Marie Curie Training project
  - Funded by the EC with 5.6 M Euros
  - 2008 - 2012
- Aimed at the creation of the next generation of experts



- Brought together key academic institutes and research centres and IBA and Siemens
- Research and training opportunities for 25 young biologists, engineers, physicians and physicists
- PARTNER research published in Open Access Journal of Radiation Research

Envision and Entervision

Accurate positioning is a crucial challenge for targeting moving organs during particle treatment

- R&D in real-time medical imaging for more precise and effective hadron therapy
- Now in its last year
  - 2 demonstrators for real time imaging have been constructed and are being tested
  - More than 40 scientific publications and 80 conference talks/posters

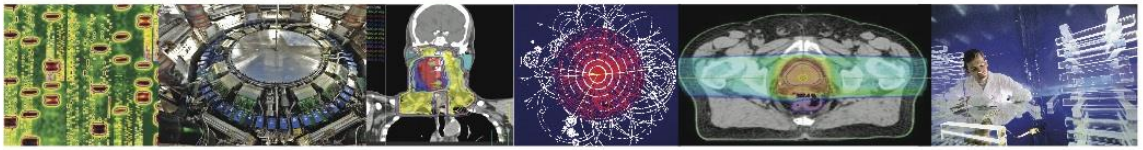
- Marie Curie ITN for young scientists
  - Uses ENVISION as training platform
- 15 researchers recruited so far
  - 12 Early Stage, 3 Experienced
  - 9 nationalities
  - From medical physics, engineering, nuclear physics, HEP, biological physics

ULICE

- Transnational access to beam time at HIT and CNAO successfully implemented
- Joint research activities: New gantry design being finalized
- Training courses at HIT and CNAO
  - For physicians and physicists already working in hadron therapy
  - For physicians, physicists, biologists who want beam time for their experiments

ICTR-PHE 2012

Uniting physics, biology and medicine for better healthcare



International Conference on Translational Research in Radio-Oncology

&

Physics for Health in Europe

February 27 – March 2, 2012 at CICG, Geneva

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

Over 700 people registered, nearly 400 Abstracts

Chairs: Jacques Bernier (Genolier) and Manjit

Four physics subjects :

- Radiobiology in therapy
- Detectors and m
- Radioisotc and therapy
- Novel technolo es

Next ICTR-PHE Conference 10-14 February 2014

LEIR based biomedical facility