

# Knowledge Transfer @CERN

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Knowledge Transfer Group  
CERN

# KT: one of CERN's missions

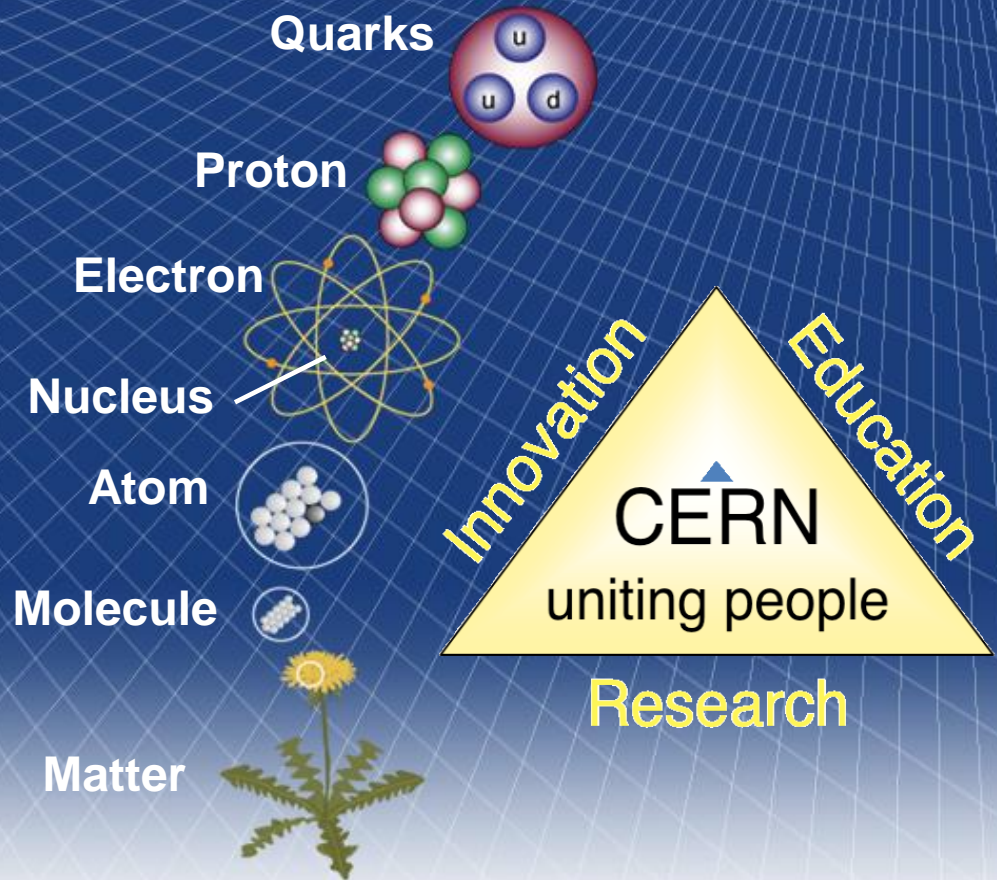
Push back the frontiers of knowledge in nuclear research

Develop new technologies for accelerators and detectors

Train scientists and engineers of tomorrow

Unite people from different countries and cultures in pursuit of this endeavour

Knowledge Transfer

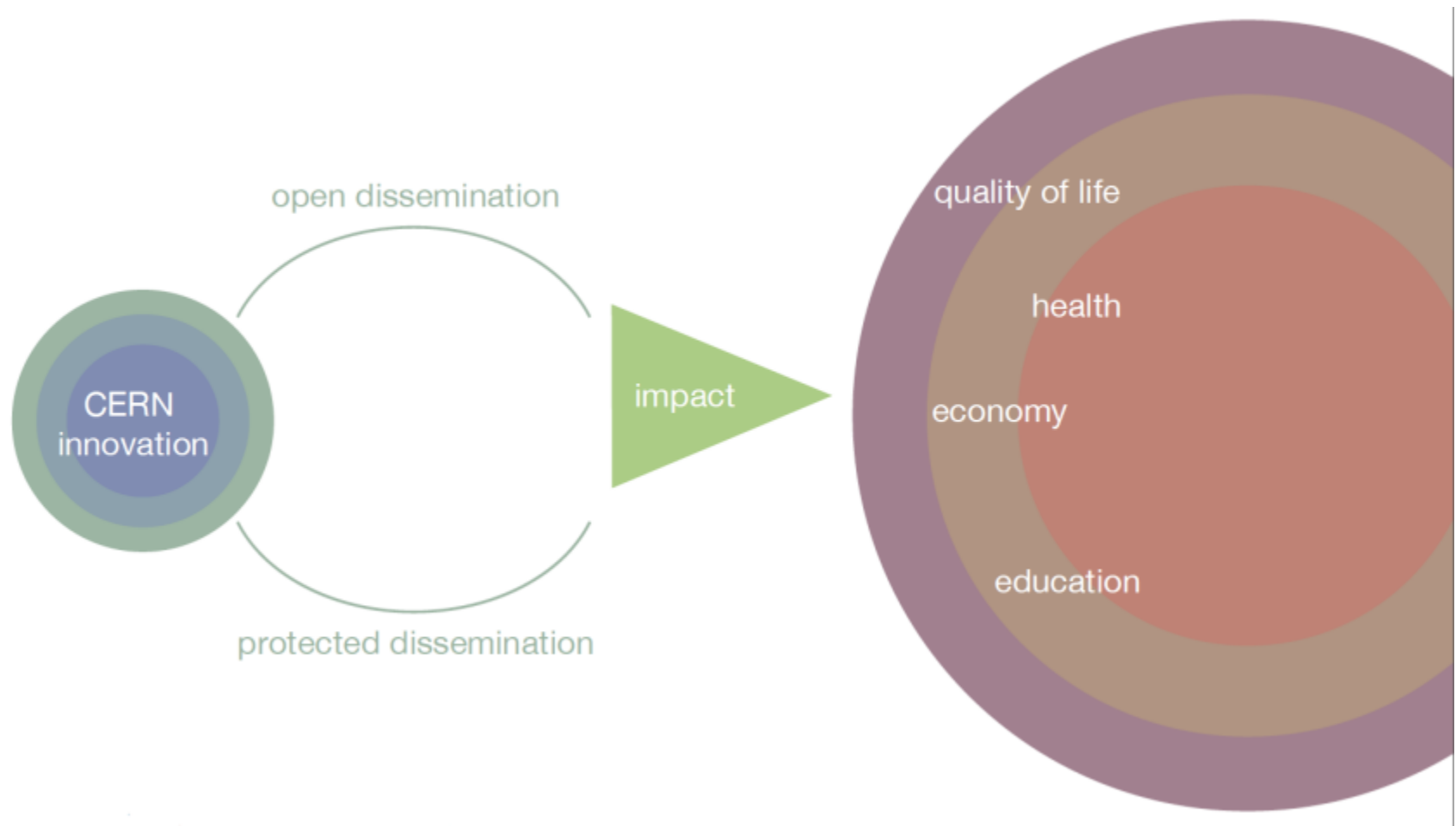


# The KT Group Mandate

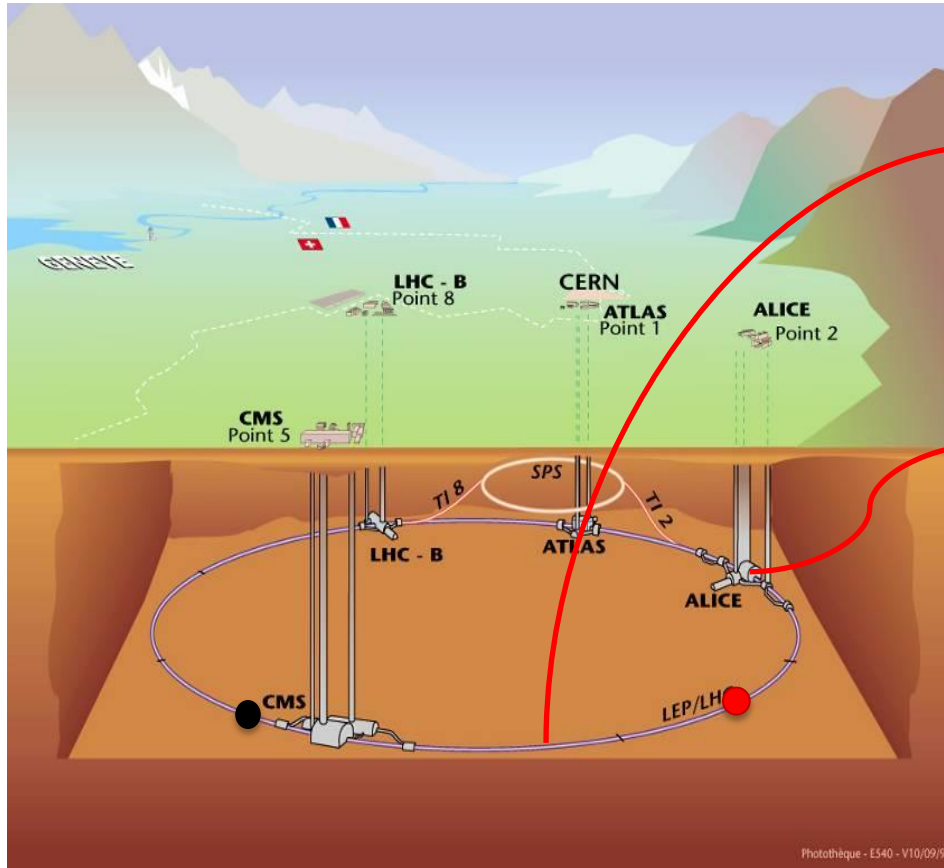
- Optimize the impact of CERN's science, technology and know-how on society and promote knowledge exchange with CERN's stakeholders.
- Function as a catalyst to foster knowledge transfer between the different stakeholders. Promote and sustain a culture of inventiveness and of knowledge and technology transfer.
- Promote, raise awareness and participate in multidisciplinary activities, in particular those relevant to life sciences application.

***Key words: dissemination and impact!***

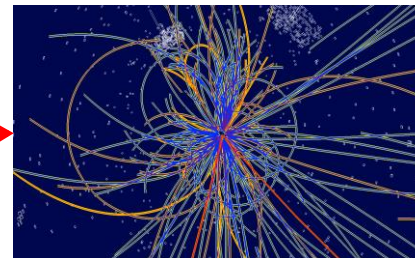
# Why Knowledge Transfer?



# CERN's areas of excellence



Accelerating  
particle beams



Detecting  
particles



IT technologies

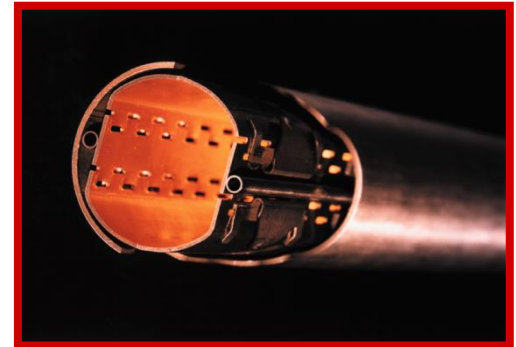


# CERN Core Competences

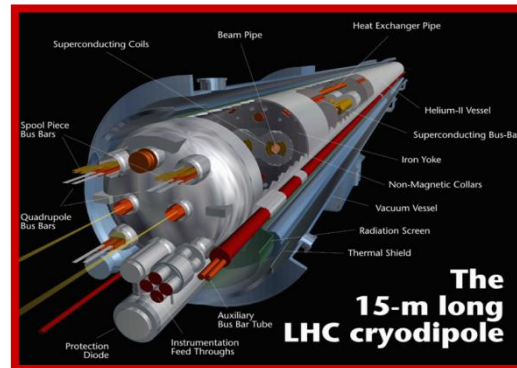
Cryogenics (1.9 K)



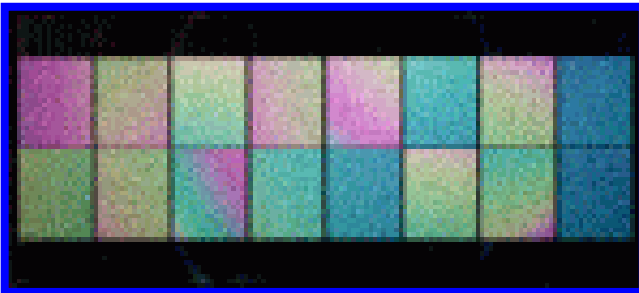
Vacuum (10<sup>-15</sup> bar)



Superconductivity (13 kA, 7M joules)



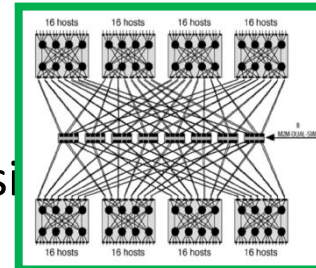
Magnets (10 T)



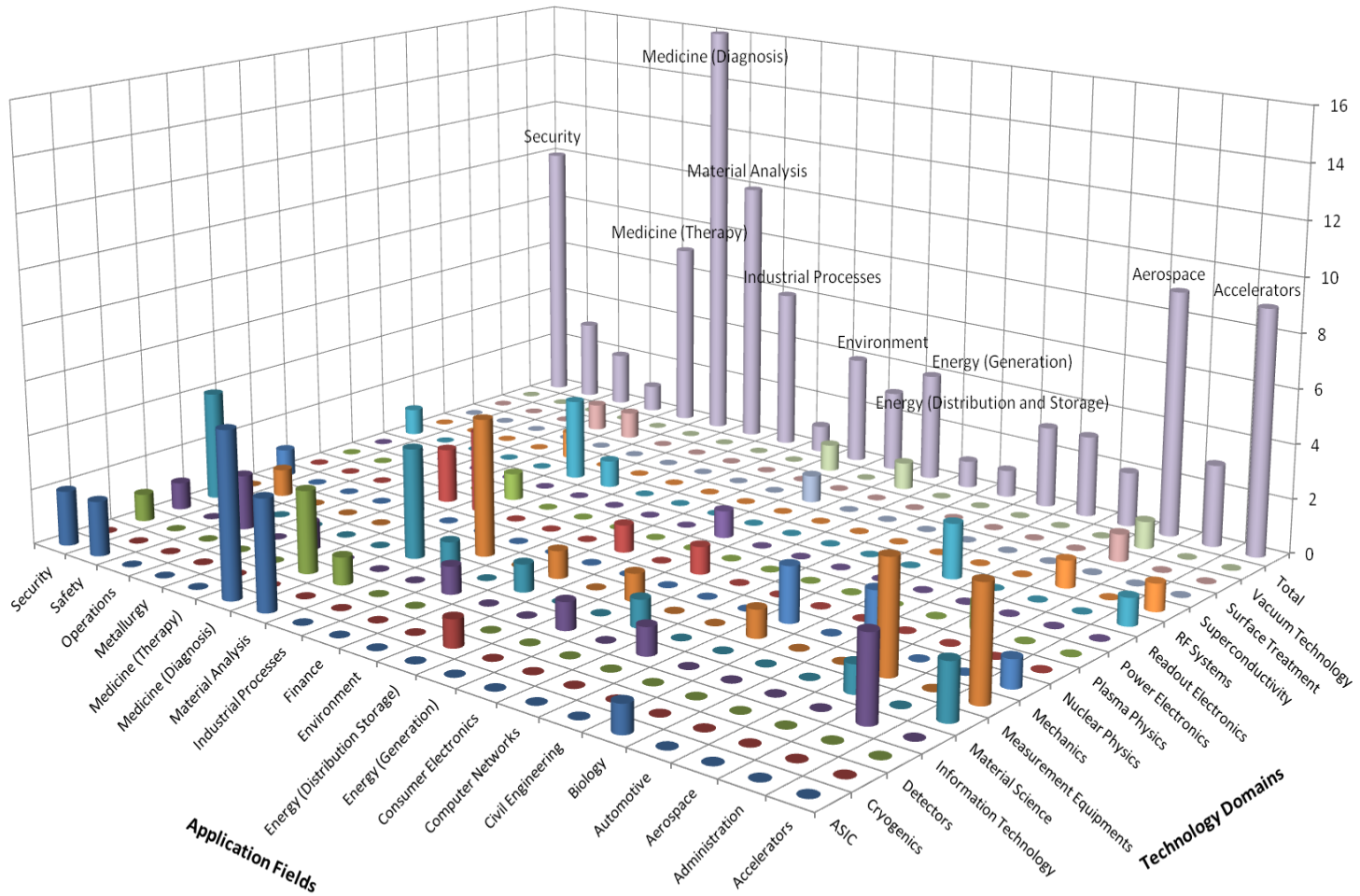
Very high performance detectors and electronics



Data processing



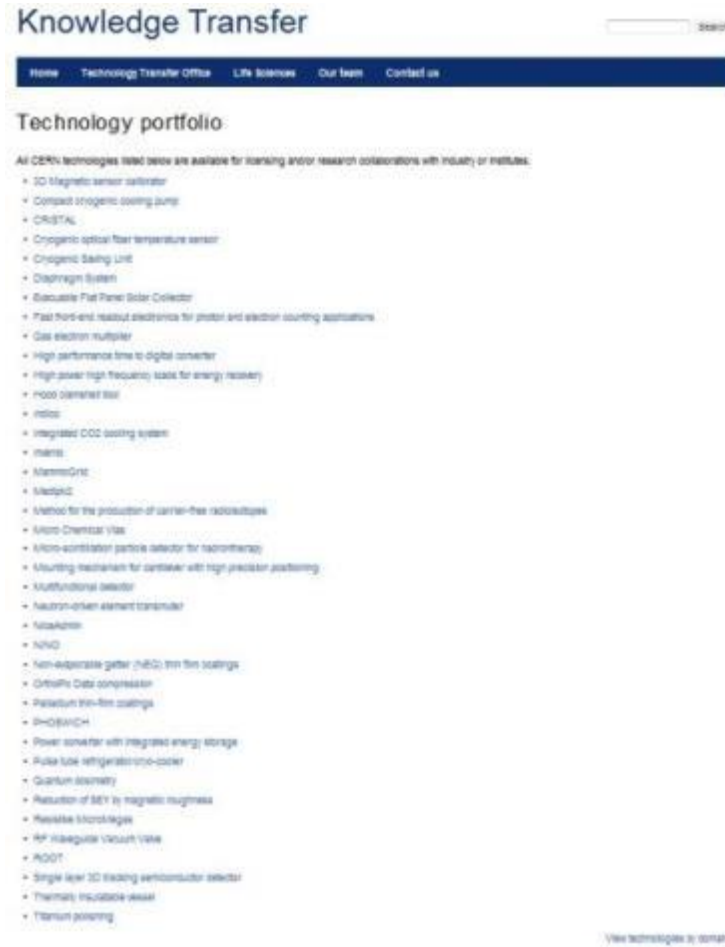
# CERN's Technology Portfolio



# Technology Portfolio Information

Visit our website to have a look at our technology portfolio in detail

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



The screenshot shows the 'Knowledge Transfer' website. At the top, there is a search bar and a navigation menu with links for 'Home', 'Technology Transfer Office', 'Life Sciences', 'Our Team', and 'Contact us'. Below the navigation is the 'Technology portfolio' section, which includes a sub-header 'All CERN technologies listed below are available for licensing and/or research collaborations with industry or institutes.' followed by a list of 35 technologies, each preceded by a plus sign. The technologies listed are: 3D Magnetic sensor calibration, Contact ohmic cooling pump, CRISTAL, Cryogenic optical fiber temperature sensor, Cryogenic Sealing Unit, Diaphragm System, Evacuable Flat Panel Solar Collector, Fast front-end readout electronics for proton and electron counting applications, Gas electron multiplier, High performance time to digital converter, High power high frequency loads for energy recovery, HOD Diamond Star, InPico, Integrated CO<sub>2</sub> cooling system, InPico, MammoGrip, Medipix, Method for the production of carrier-free radioisotopes, Micro Chemical Vial, Micro-contraction particle detector for hadrontherapy, Mounting mechanism for catheter with high precision positioning, Multifunctional detector, Neutron-driven element transducer, Nucleonix, NUCO, Non-weldable gasket (nHG) iron film coatings, OnChip Data compression, Parallel Wn-film coatings, SHOPI-CH, Power converter with integrated energy storage, Pulse tube refrigerator micro-cooler, Quantum Acoustics, Reduction of SEY by magnetic roughness, Resonate Micrologics, RF Irregular Vacuum Vial, ROOT, Single layer 3D tracking semiconductor detector, Thermally Insulated vessel, and Titanium plating. At the bottom right of the list, there is a link that says 'View technologies by domain >'. The website has a dark blue header and a light blue background.



# How?- The Knowledge Exchange

- Collaboration agreements
  - Joint R&D
  - Others
- Service agreements
- Consultancy agreements
- Consortia & exploitation agreements
- Through Procurement

- Licensing
  - Open
  - Protected
- Patents
- Know-how exchange
- (Trade secrets)
- Spin out companies & Incubators

- Training
  - Research programs
  - Events & Conferences
  - Students & Outreach

# How cases come to KT at CERN

- Internal disclosures
- The KT Fund
- External requests for technology but very often R&D collaborations
- Procurement
- Spin out company initiatives & Incubators

# 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.



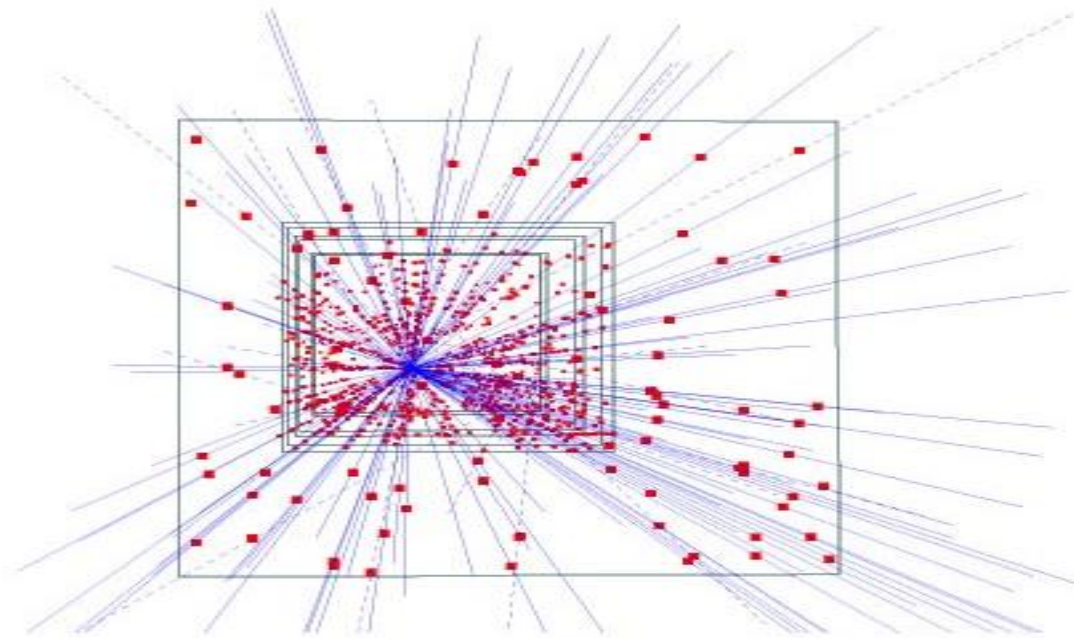


# Installation at GVA airport



# Silicon pixel detectors (SPDs)

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

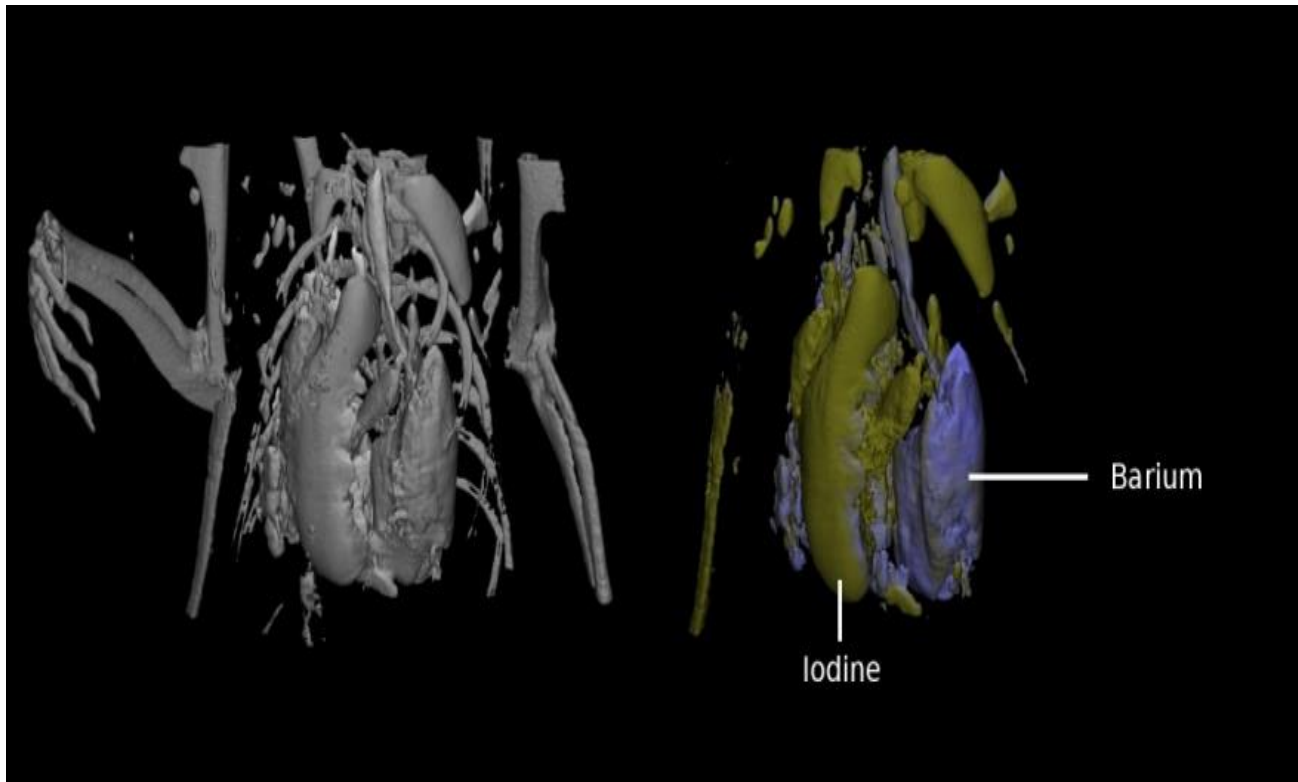


153 high energy particle tracks flying through a telescope of half a million pixels in the WA97 experiment back in 1995

# Application: Medical imaging

- **MARS project**

Colour CT X-ray scanner based on the Medipix technology



(courtesy of MARS Bioimaging Ltd)

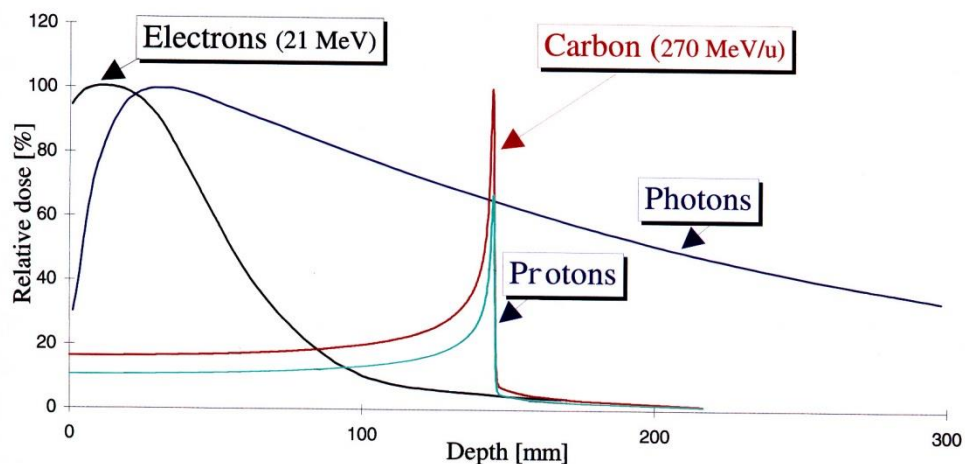
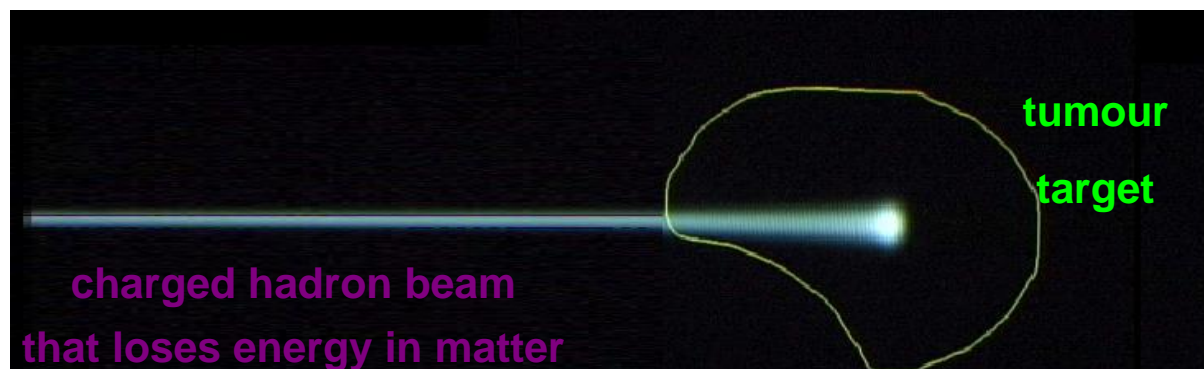
# Application: Material analysis

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



# Hadrontherapy

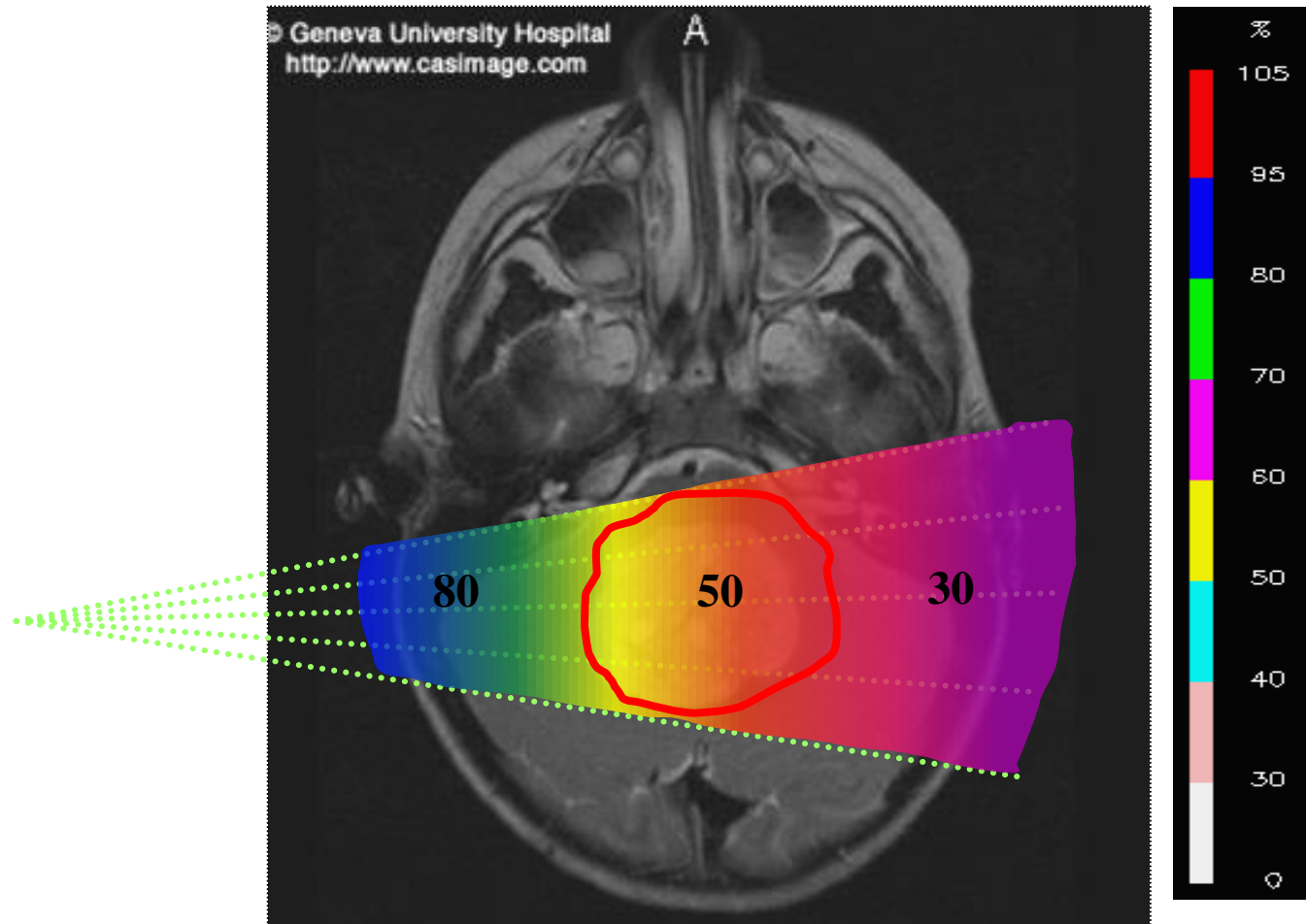
Hadron beams:  
new treatment  
opportunities for  
deep-seated tumours



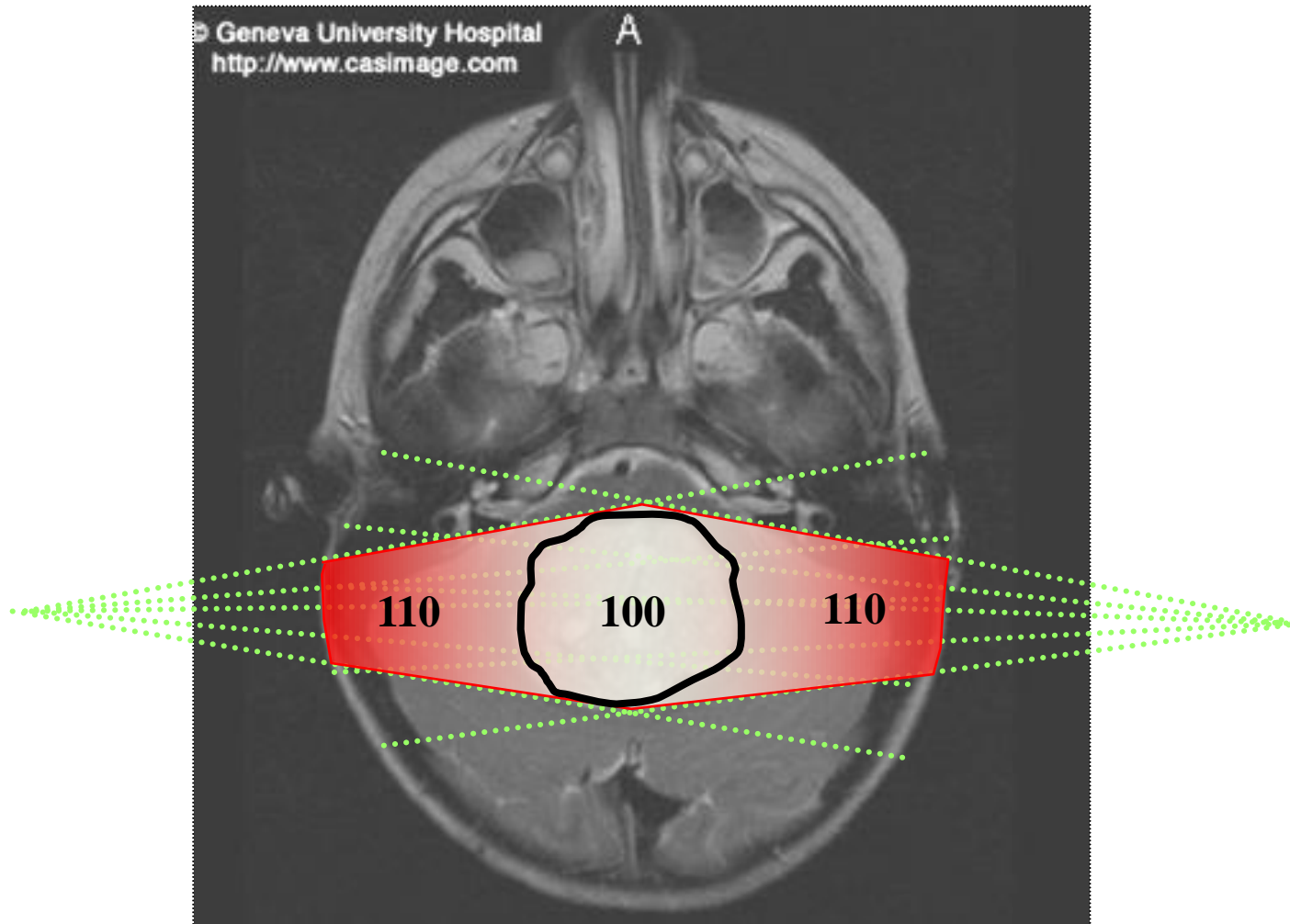
C ions: 24 times more energy than protons



# X-rays therapy

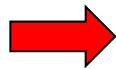
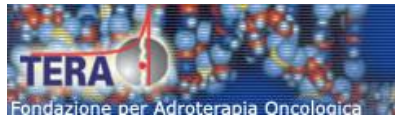
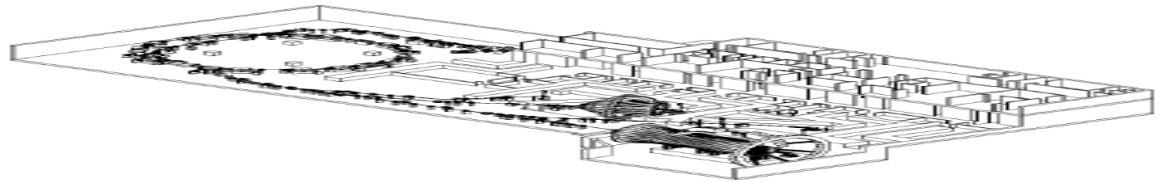


# X-rays therapy



# CERN's PIMMS Study

PIMMS 2000  
(coordinated by CERN)  
has led to:



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

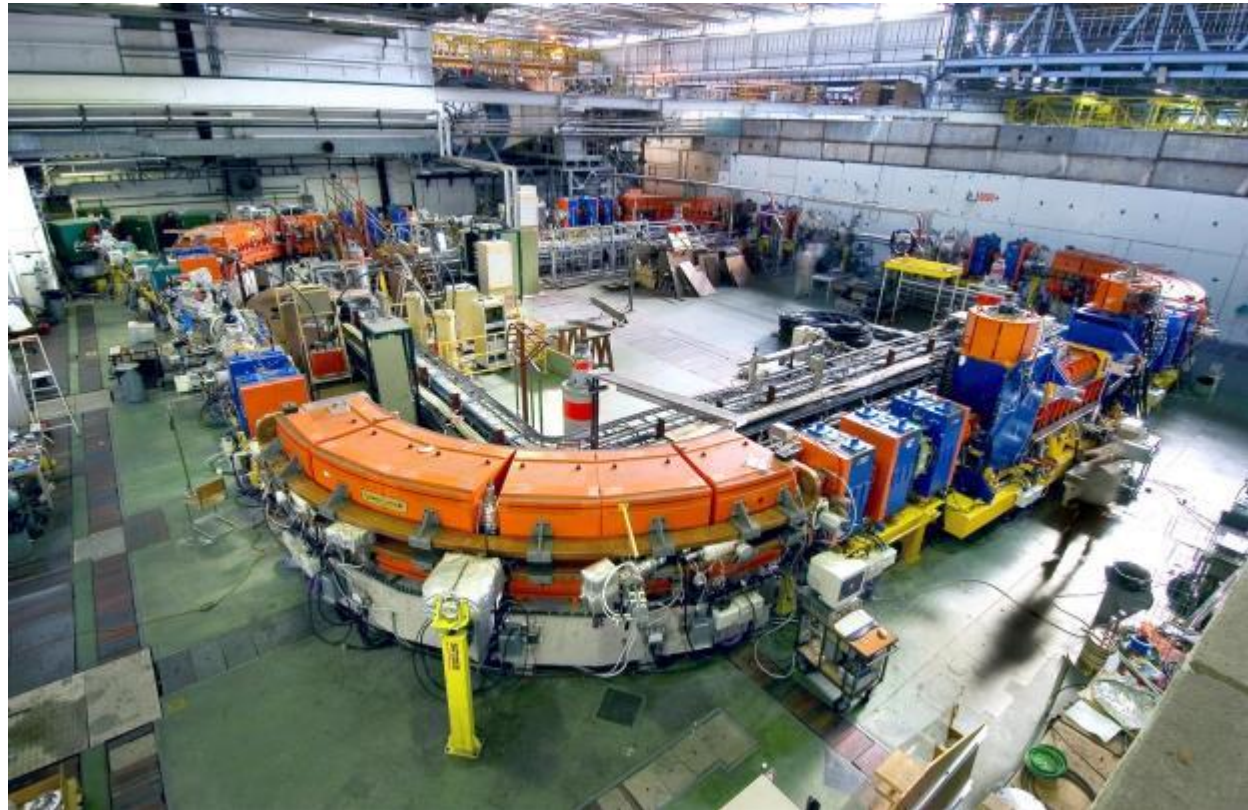




# Growing interest in Hadron Therapy

Interest / plans for new facilities in Bulgaria, Greece, Norway, Denmark, the Netherlands, Spain and UK

Need more research and biomedical studies with different ions (BioLEIR)





# Growing interest in Hadron Therapy

- These are not turn key facilities. A lot of know how is involved and a lot of new know how produced.
- Actively involved with the MedAustron and CNAO partners to clarify the IP landscape.
- The aim is to allow/encourage two dissemination paths, Research and Commercial.
- CERN know how is in every part of such a project. Major part of the controls systems. Software and software protocols.

# Training – part of our mission

## ENLIGHT platform projects



- 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

# Overview of few current projects (1)

- **Control systems for medical accelerator facility**
- **ADS-AR software - help Autistic children**
  - Work with a University & an Institute for the study of human behaviour.
  - Testing after the summer
  - Next step – VR
- **Radship**
  - Specialized application for Tracking & Shipping of Radioactive material.
  - Provides regulatory compliance to all international regulations.
  - Research labs, Hospitals, national authorities
- **Nucleonica** - leading internet resource in the nuclear sciences
  - knowledge creation and competence building for the worldwide nuclear science community.
  - aimed at scientists, engineers working in nuclear power, health physics, radiation protection, nuclear and radiochemistry, decommissioning, nuclear medicine, etc.
  - Used for everyday calculations, testing, validating & verifying complex computer models.
  - Uses software developed at CERN's Radiation Protection unit (e-Ship)
- **Actiwiz**
  - Safety. Aims to reduce material activation by making the right choice.
  - Simplifies & optimizes the material selection to minimize activation levels
  - Improves safety & maintenance cycle.
- **GRID middleware technologies** – from the GRID to Rotary Universe
  - Open Source technologies for secure information sharing
  - Very large storage systems
  - Vast application area

# Overview of few current projects (2)

- TCP IP core
  - IP core for a low cost FPGA to used in Front End Readout boards
  - Fully tested 10Gb rate
  - No CPU required, the complete protocol runs on the FPGA
- OPC-UA Server –Industrial controls
  - CERN will implement an ‘Enhanced OPC-UA toolkit’
  - 3 Power supplies companies involved – opens new markets
  - Collaborative effort. Reduce maintenance & cost, unified environment, increased reliability.
- FLUKA – Monte Carlo simulation software
  - interaction and transport of particles and nuclei in matter
  - applications outside particle & high energy physics: Engineering, shielding, detector & telescope design, dosimetry, medical physics & radiobiology.
  - Recently hadron therapy
- GARFIELD++
  - Gas detector simulation software – developed within the RD51 collaboration (90 inst & CERN)
  - Strong interest from a large industrial company
- ROOT – Data Analysis Framework (see next presentations)
- Geant4 (see next presentations)
- Indico (see next presentations)
- Invenio & Zenodo (see next presentations)

# IT related spin out companies

- TIND technologies
  - Established in 2013 based on Invenio OSS technology
  - Provides Digital library services
  - From Institutional repository to single library via the Cloud
  - Win-Win. Dissemination, new markets & off loading developers at CERN
- BlogForEver – Under consideration
  - Based on Invenio technology
  - Archiving and analysing blogs
  - Memory Institutions but also
  - Commercial applications
    - Analytics & Marketing



# CERN Open Hardware Licence (OHL)

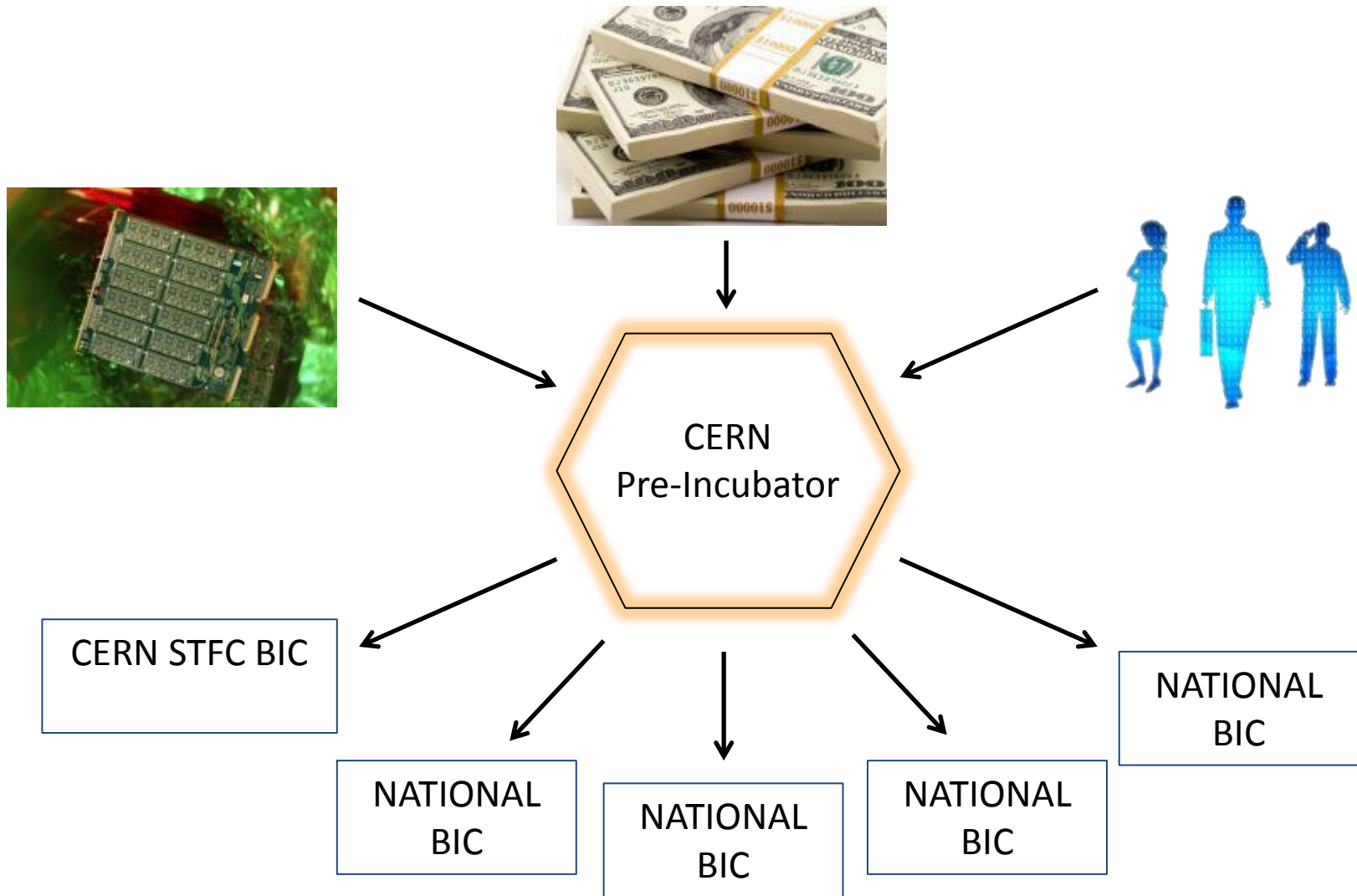
A legal framework to facilitate knowledge exchange across the electronic design community.

CERN OHL was created by KT

- to govern the use, copy, modification and distribution of hardware design documentation, including the manufacture and distribution of products.
- In the spirit of knowledge and technology dissemination
- KICAD a KT Fund project. (<http://www.kicad-pcb.org>)
- A FOSS tool for PCB design. Already large contributions from CERN. The project aims to make it the universal tool for PCB design
  - No vendor lock
  - Re –use of designs
  - Linux like model – commercial support
  - Aims to be the gcc of PCBs!



# CERN Business Ideas Accelerator



# Turning CERN technologies into new business opportunities

   
**STFC CERN Business Incubation Centre** technology

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- [What we offer](#)
- [How to apply](#)
- [News and events](#)
- [Our successes](#)
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## 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](#).





## Medical scanners



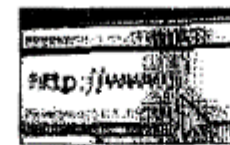
Cern has been at the forefront of the technology behind PET and MRI medical imaging machines since building prototype scanners with Geneva's hospital in the 1970s. Electronics developed for Cern's atom-smashing Large Hadron Collider are offering fresh promise of combined PET/MRI scanners that would provide more detailed images of the human body.

## Touch screens



More than three decades before the technology became ubiquitous, the first touch screen control pad was developed at Cern in the 1970s by Bent Stumpe, a Danish engineer. He had been asked to come up with a system to replace the thousands of buttons, knobs and switches needed to operate Cern's Super Proton Synchrotron particle accelerator.

## World wide web



Tim Berners-Lee developed the world wide web in 1989 as part of a Cern project to improve information sharing between its network of 8,000 scientists working in universities and institutes around the world. The achievement was celebrated in Mr Berners-Lee's appearance in the opening ceremony of the London Olympics.

# Greater commercial returns sought from Cern

By Andrew Bounds, North of England Correspondent

Britain is spearheading an effort to extract bigger commercial returns from the \$8bn invested by the world's governments in Cern, the European physics research laboratory.

Cern is best known as home to the Large Hadron Collider, the most powerful atom smasher, where scientists in July discovered the Higgs boson "God particle", which explains matter.

Its research also helped create the world wide web and MRI scanning since its inception in 1954.

Yet, the UK believes more can be done to harness commercial value.

"We want to get technology from inside the ivory tower into the economy,"

says John Womersley, chief executive of the Science and Technology Facilities Council, the UK research body. "Cern understands this is something it needs to get better at."

Cern and the STFC are opening a competition this week for five companies to receive funding and technical help from scientists at the laboratory near Geneva.

Prof Womersley said the collaboration would help develop findings from Cern's atom-smasher in a way that "can impact on people's lives".

He said small companies were often best at exploiting new technology, noting how touch screens were first used at Cern but not commercialised by it.

Winning companies will receive £40,000 funding, up

to 40 hours technical support from Cern and 40 hours form the STFC, access to intellectual property at preferential rates and cheap incubator space at Sci-Tech Daresbury, the council's innovation campus near Warrington.

Paul Vernon, head of campus development at STFC, said possible spin-

offs could include airport security scanners - as Cern has developed technology to detect radiation - or treatments for conditions such as osteoporosis. But he added: "It is as likely to be something we didn't expect. That is why we are opening it up to these innovative companies."

Winning companies will

also be able to collaborate with universities from Liverpool and Manchester as well as the 100 or so other businesses on the Daresbury site, which include IBM and Dell.

The STFC contributes £100m a year to Cern, a sixth of the council's budget. UK companies receive about £15m annually in contracts in return.

Steve Myers, Cern's director of accelerators and technology, said: "Cern is committed to maximising the benefit to society of Cern technology through the development and exploitation of innovative ideas."

The STFC's Rainbow venture capital fund could also become involved.

STFC Innovations, the commercialisation company, has created more

than 16 spinouts worth £50m.

The STFC is collaborating with the European Space Agency on a similar model. There are some 15 businesses at its Harwell campus near Oxford, including Radius Health, which is working on a portable X-ray machine that could be used by paramedics at accident scenes. Another company is working on a drone that can map the condition of crops and then network with a tractor's GPS system to ensure the right amount of fertiliser is spread in the right place.

The space agency has seven technology transfer centres across Europe and Cern hopes to follow suit. The competition is open to companies from the 20 countries that pay for Cern.

### Technology and trophies

£40,000

Funding winning companies will receive

40hrs

Technical support from Cern winners will receive

£100m

Sum the STFC contributes to Cern each year

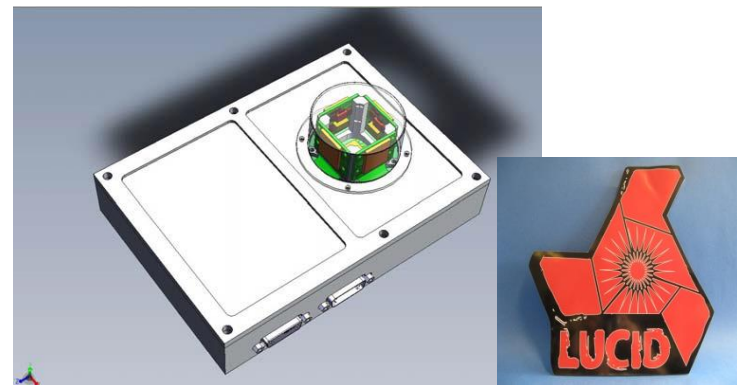
£15m

Value of Cern contracts UK companies receive annually

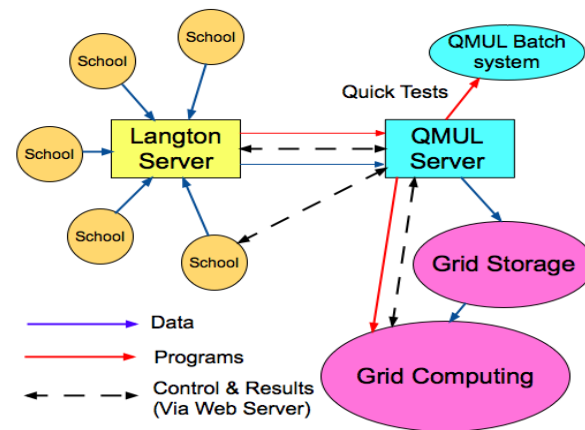
Financial Times, 19.10.2012



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

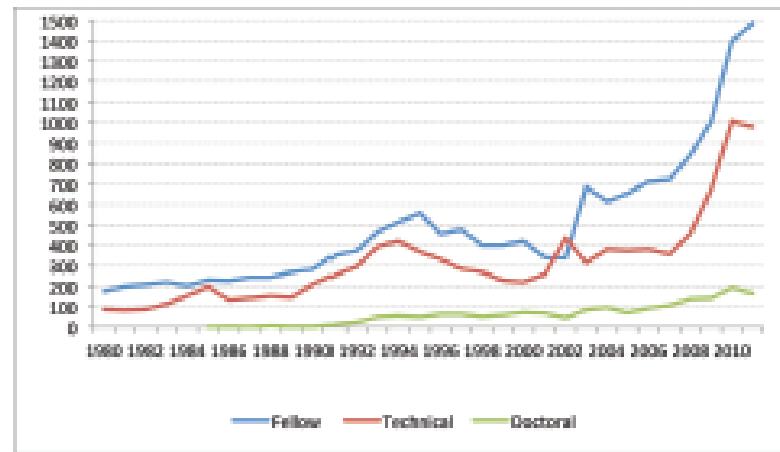


# Knowledge Transfer through People

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

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

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Thank you for your attention.

Questions ?

