



# Knowledge Transfer @ CERN

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Giovanni Anelli  
Head of Knowledge Transfer Group



# KT group structure

## Knowledge Transfer Group

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graph LR; A[Knowledge Transfer Group] --- B[Technology Transfer and IP Management]; A --- C[Life Sciences];
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### Technology Transfer and IP Management

Section Leader:  
Enrico Chesta

### Life Sciences

Section Leader:  
Manjit Dosanjh

# The KT group mandate

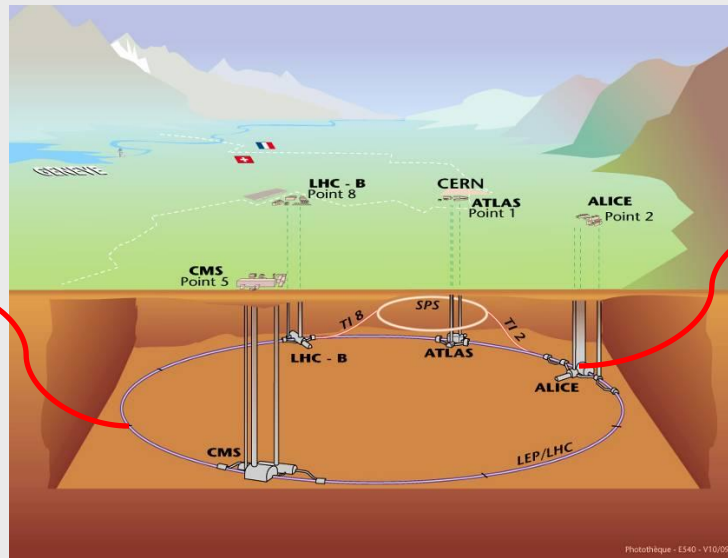
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- The Knowledge Transfer Group has the objective of promoting, supporting and maximising knowledge and technology transfer from CERN to society
- In particular, our relationship with **Industry** is very important!
- We want to move towards a “Market pull” approach (as opposed to “Technology push”)

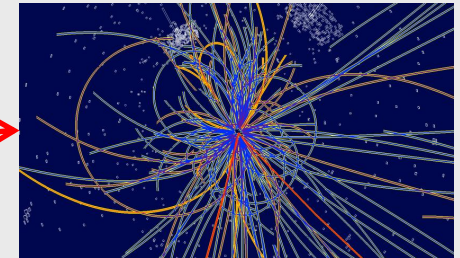
# CERN Technologies

## CERN innovates in three areas

Accelerating  
particle beams



Detecting  
particles



Large-scale computing (Grid)



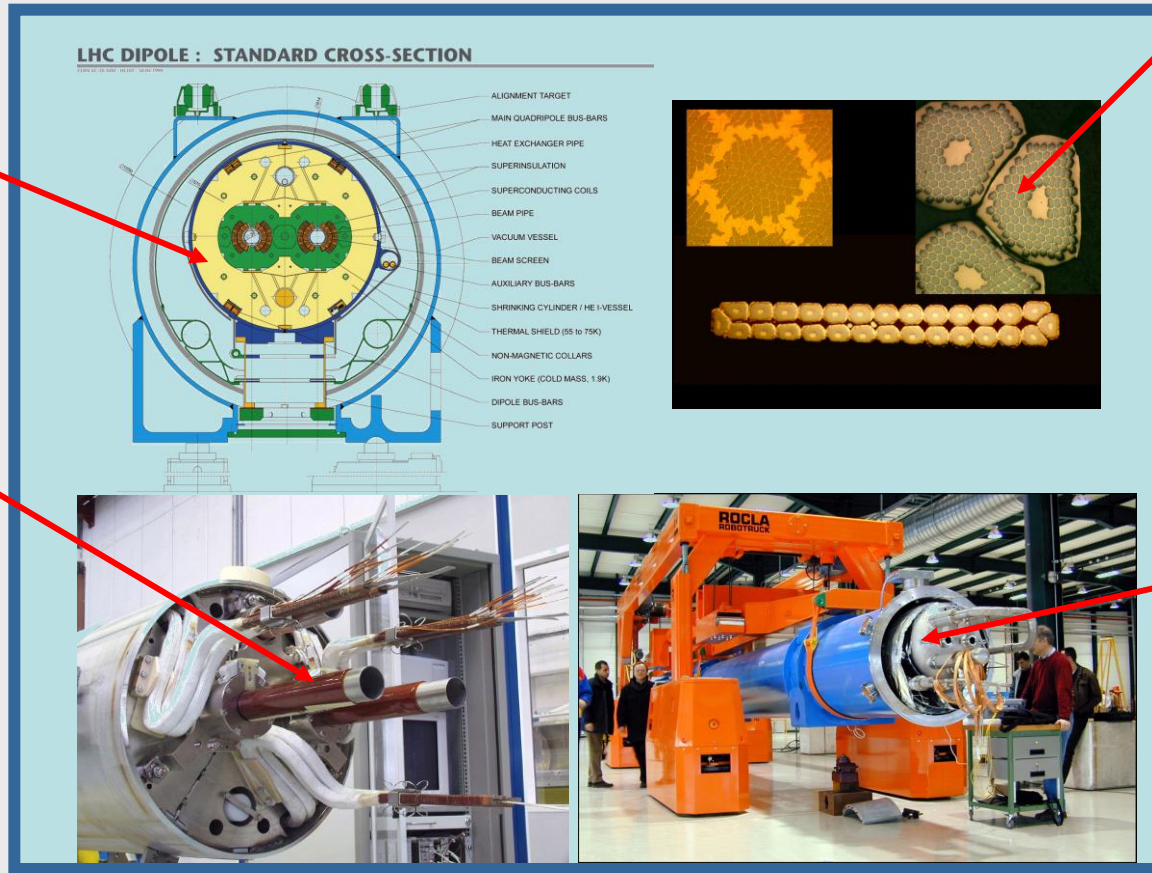
# Accelerator Technologies

Cryogenics  
(1.9 K)

Vacuum  
( $10^{-13}$  atm)

Superconductivity  
(12kA)

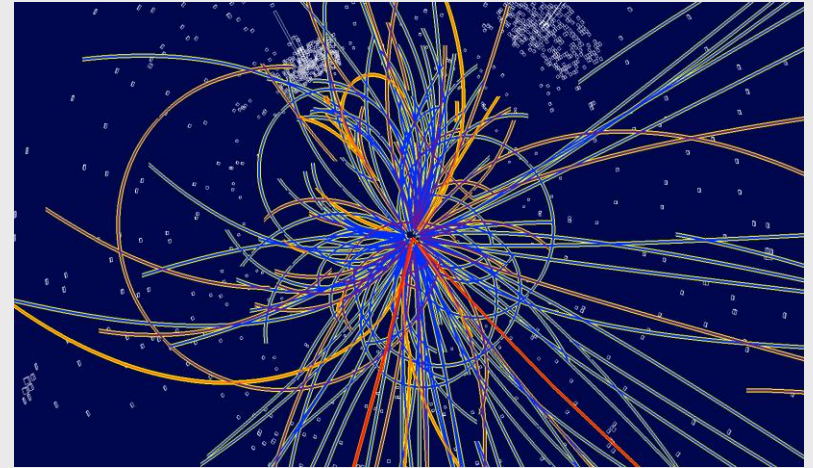
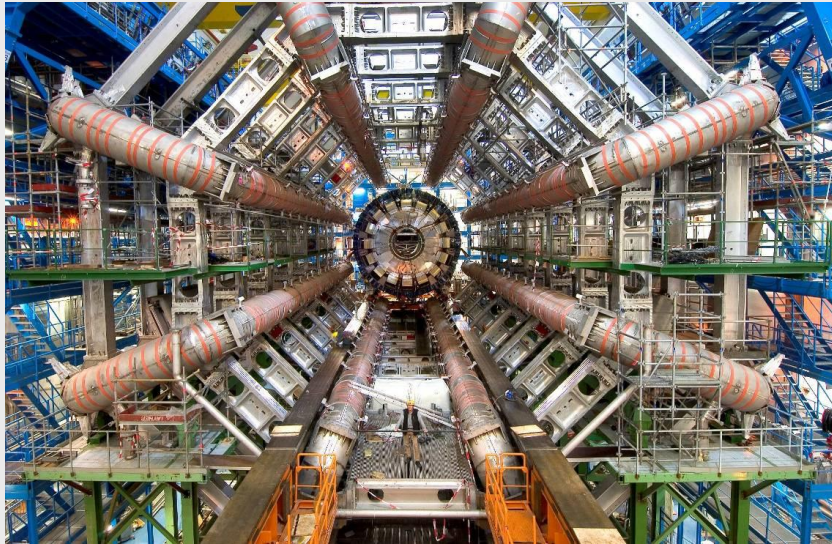
Magnets  
(8 T)





# Detector Technologies

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



LHC detectors have sophisticated electronic trigger systems that precisely measure the passage time of a particle to accuracies in the region of a few billionths of a second. The trigger system also registers the location of the particles to millionths of a metre. This is essential for ensuring that the particle recorded in successive layers of a detector is one and the same.

# Computing Technologies: the Grid

After filtering, CERN detectors select  $\sim 100$  interesting collisions per second.

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

**→ up to 15 Petabytes/year of data!**

## LHC Computing Grid:

Integrate over 100,000 processors from over 170 sites in 34 countries into a global computing resource.



8 Megabyte (8MB)  
A digital photo

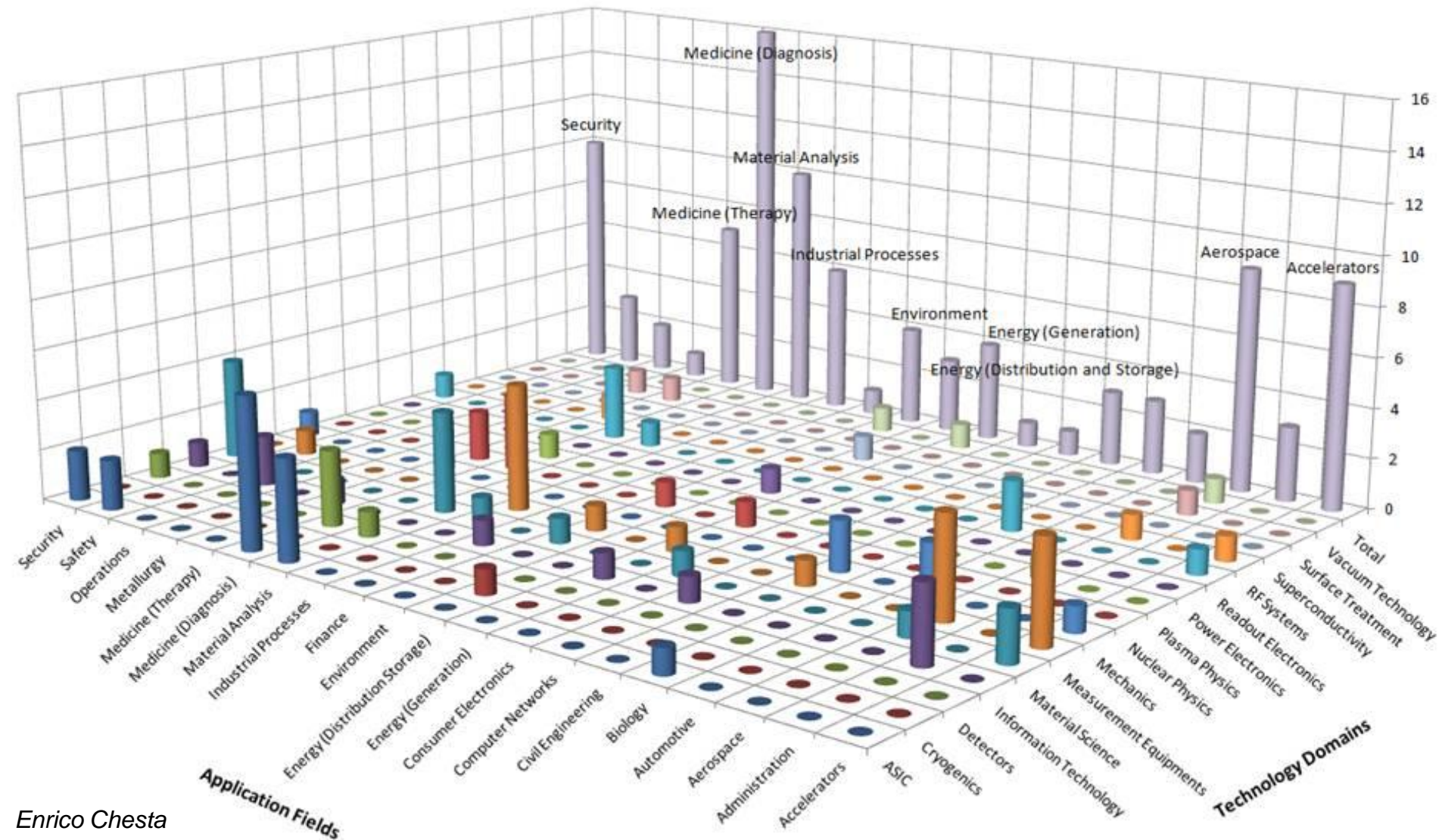
1 Gigabyte (1GB)  
= 1000MB  
A DVD movie

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

15 Petabytes (15PB)  
= 15000TB  
Annual LHC data output

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

# Portfolio of CERN Technologies



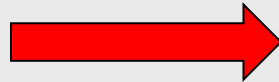
Enrico Chesta



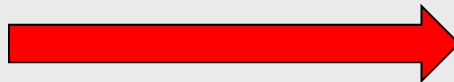
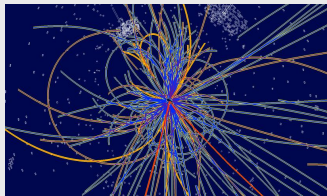


# Medical applications

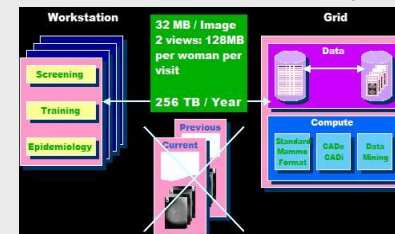
## Particle accelerators for **hadron therapy**



## Particle detector for **medical imaging**

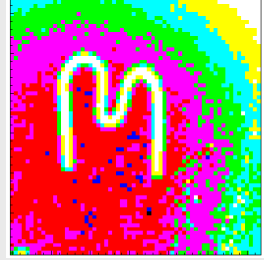


## Grid computing for **medical data management and analysis**



# Medipix

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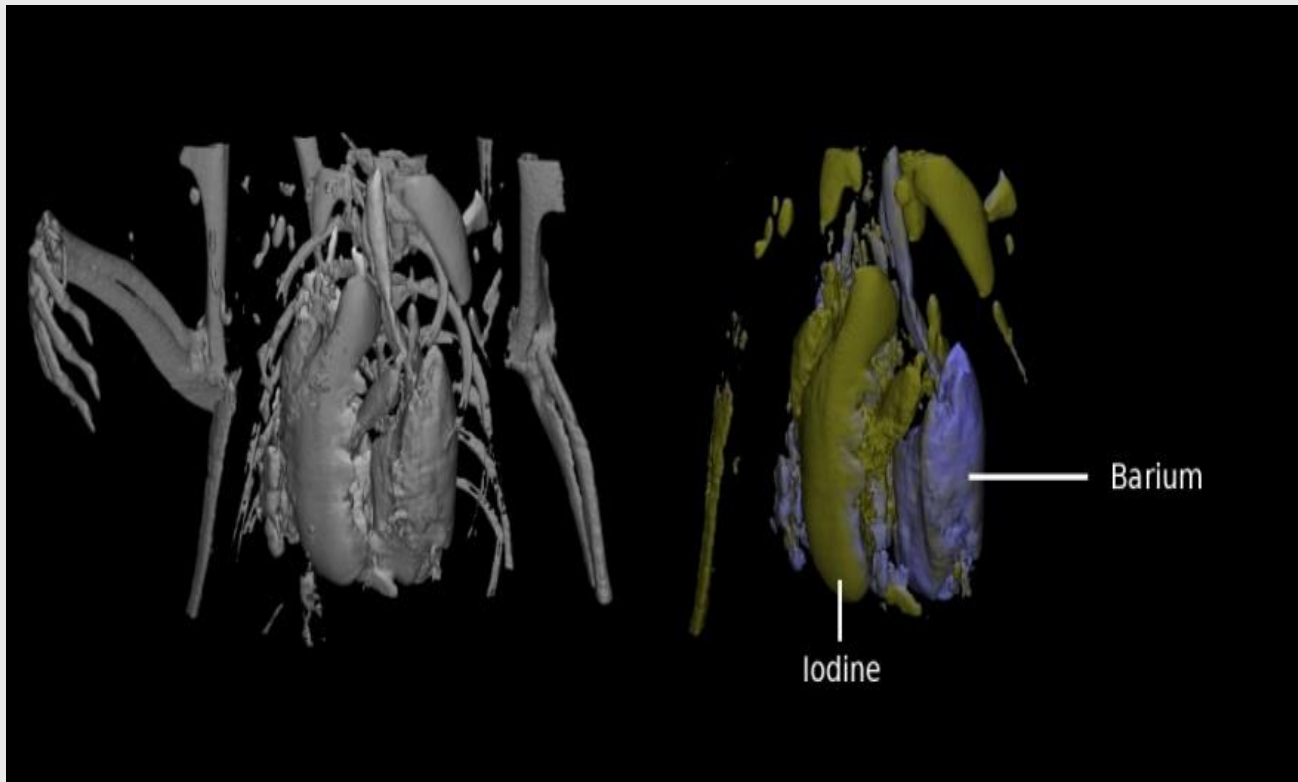


- A family of single photon counting integrated circuits used in Hybrid Silicon Pixel Detectors
- The Medipix collaborations (close to 20 institutes) contributed to the development and dissemination of the technology
- A good example of how (fundamental) science fosters innovation which can be transferred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

# Medical imaging

## ■ MARS project

Colour CT X-ray scanner based on the Medipix technology



(courtesy of MARS Bioimaging Ltd)

# Material analysis

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





# 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



# Diaphragm fixation technique

Inventor: A. Ijspeert, TTO: M. Castoldi

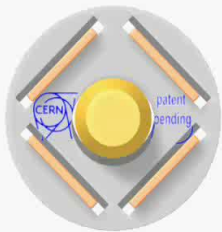
## Key benefits:

- Fixing multiple objects
- Instantaneously
- High precision
- Instantaneous disassembly
- Objects of any shape
- Low cost

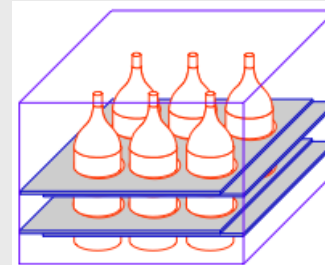
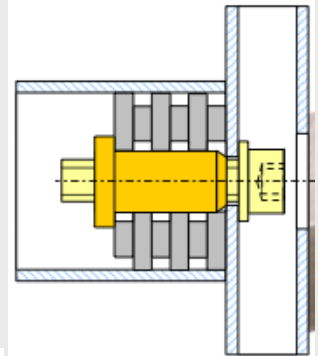
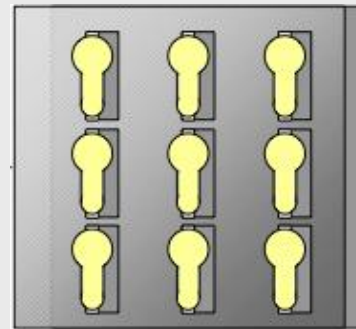
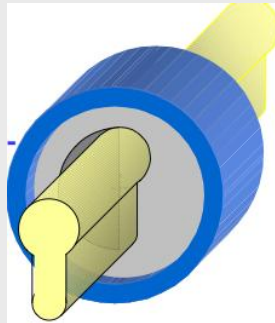
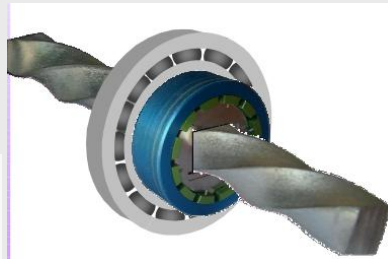
## Possible applications:

- Electric motors
- Twisted bars
- Door-lock cylinders
- Vices for CNC machining
- Packing box
- Assembly of AL profiles

CERN's Diaphragm Fixation technique

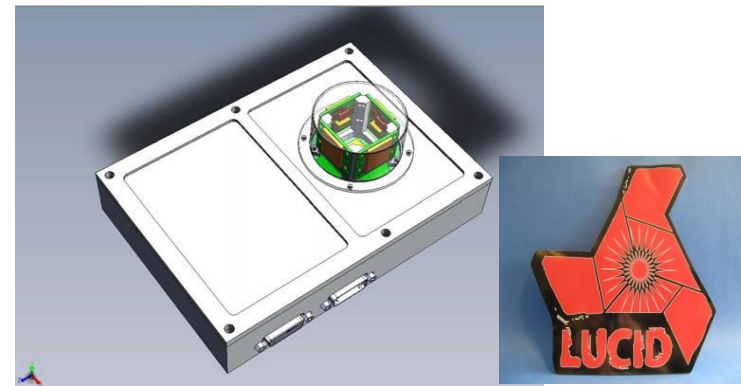


copyright IJSPEERT Innovative Techn.

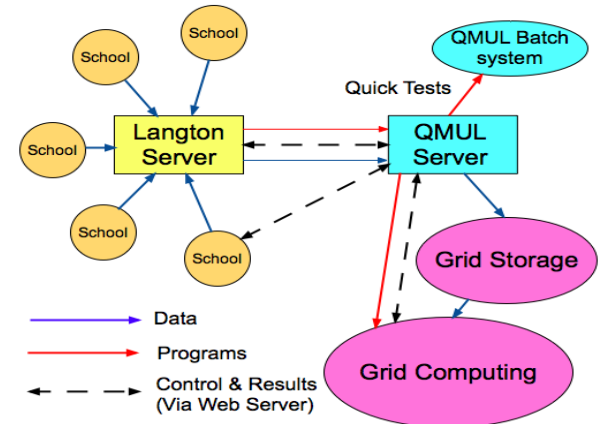




CERN@school allows students to use a Timepix chip in the lab to visualise radiation



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's Open Hardware License

CERN Courier June 2011

Electronics

## Hardware joins the open movement



The Open Hardware Repository enables electronics designers to collaborate in the design process. Now, CERN has released an Open Hardware Licence to allow this knowledge to be shared.

“Designing in an open environment is definitely more fun than doing it in isolation, and we firmly believe that having fun results in better hardware.” It is hard to deny that enthusiasm is inspiring and that it can be one of the factors in the success of any enterprise. The statement comes from the Manifesto of the Open Hardware Repository (OHR), which is defined by its creators as a place on the web where electronics designers can collaborate on open-hardware



*A circuit board designed within the context of the Open Hardware Repository. The reverse side bears the licence statement: “Licensed under CERN OHL [www.ohwr.org/cernohl](http://www.ohwr.org/cernohl).”*

# Bringing communities together



*Uniting physics, biology and medicine for better healthcare*



**A conference that brings together the International Conference on Translational Research in Radio-Oncology and Physics for Health in Europe**

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# Knowledge Transfer through Procurement

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Results from a survey of companies involved in technology-intensive procurement contracts with CERN (1997-2001).

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

# Summary of Knowledge Transfer Modes

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- Licensing of intellectual property and consulting
- Joint R&D with external partners (Industry !)
- CERN training programs and personnel mobility
- Procurement activities
- Networking and catalyzing knowledge exchange



# Conclusions

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- ❑ CERN regards knowledge and technology transfer as an integral part of its mission.
- ❑ CERN technologies have applications in several domains with high relevance to society. In particular, CERN has been providing a significant contribution to innovation in medical sciences over the last 10-15 years.
- ❑ By making an impact on key application domains we aim to illustrate the role of fundamental research as a driver of innovation which delivers tangible benefits to mankind.
- ❑ CERN's technical departments have unique knowledge and skills. We are keen to collaborating with industry and to investigate how our know-how can be used to satisfy industry needs.

**We have a lot to offer to industry – please get in touch!**

