

Technology Transfer

ICFA Seminar

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Giovanni Anelli, CERN



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- Becky Parker (Simon Langton School, UK)
- Several colleagues at CERN

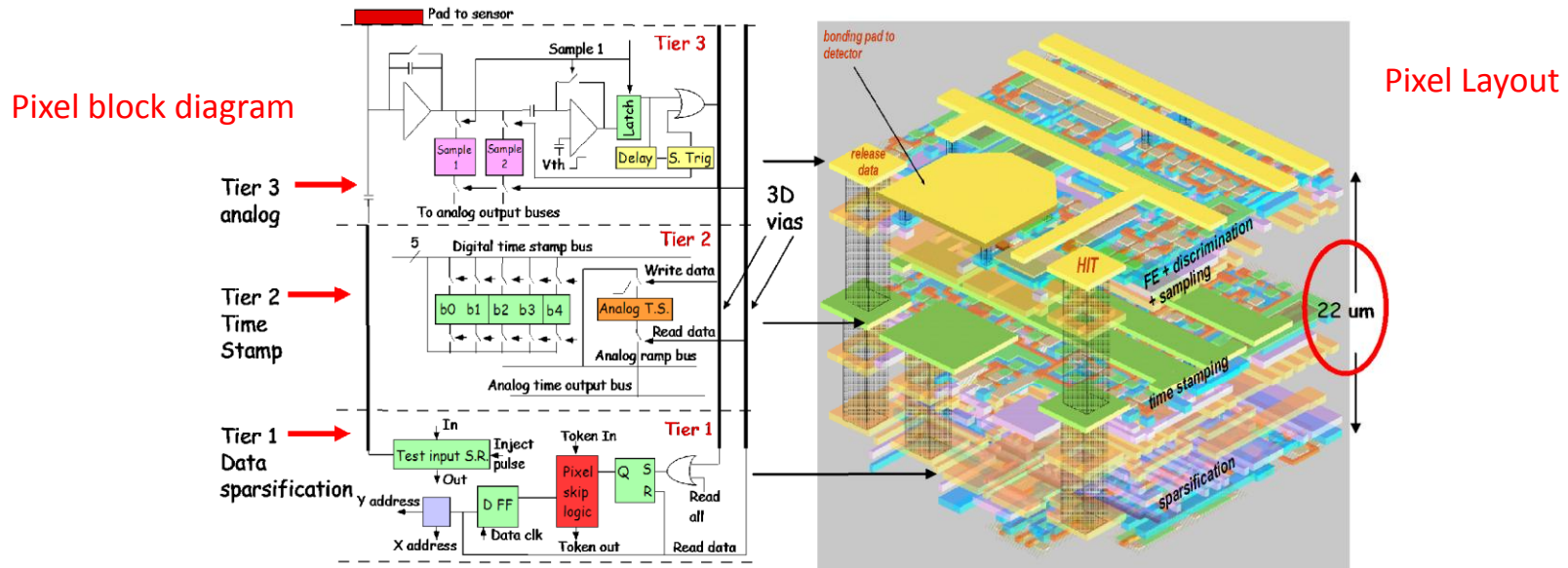
3D Circuit R&D - Fermilab

Working with a vendor as “early adopter” to develop and finally commercialize a technology

Work Started for ILC in 2006
Can provide more processing in smaller pixels ...

- MIT LL 3D Process
- First submission 2006 (Fermilab)
 - ILC pixel ROIC
 - Multiple processing problems
 - Took more than 1 year to fab

- Second submission 2008 (Fermilab)
 - Same basic design
 - Relaxed design rules to improve yield Yield much better, acceptable performance
 - Almost 2 years to fab



Circuit Design Efforts Shifted to Commercial Vendors

- **Chartered Semiconductor (now GlobalFoundries)**
 - Established foundry (in Singapore)
 - Smaller feature process - 0.13 um
 - High yield process
 - CMOS instead of SOI
 - Cost lower than other 0.13 um processes
 - Signed agreement with Tezzaron for 3D development
- **Tezzaron Semiconductor**
 - Leader in 3D technology development (received prestigious 2009 Semi North American award for 3D contributions)
 - Has commercial customers using 3D
 - 3D Process
 - Willing to work with HEP customers (domestic and foreign)

HEP 3D Multiproject Run

- HEP consortium for 3D circuit design formed in late 2008
 - 17 member groups from 6 countries (Italy, France, Germany, Poland, Canada, USA)
 - First Meeting Dec 2008
 - Began working on 3D MPW run to Chartered/Tezzaron - First MPW run for outside customers
- HEP MPW run - more than 25 two tier designs (circuits and test devices)
 - CMS strips, ATLAS pixels
 - ILC pixels
 - B factory pixels
 - X-ray imaging
 - Test circuits
- Many issues resolved by Fermilab/Tezzaron - first wafers delivered this September

Commercialization

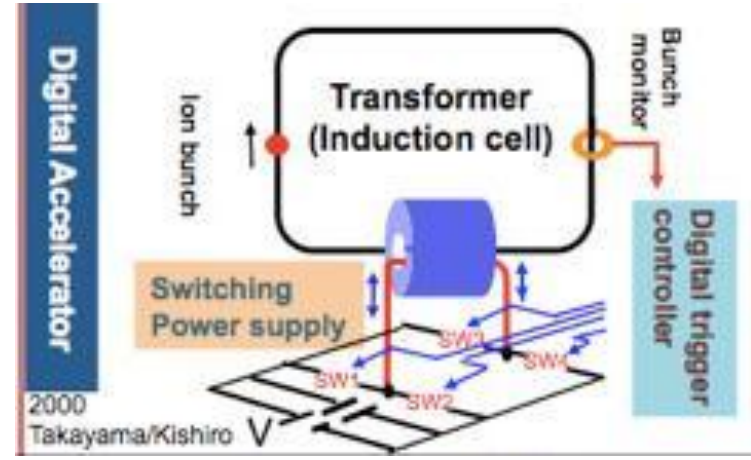
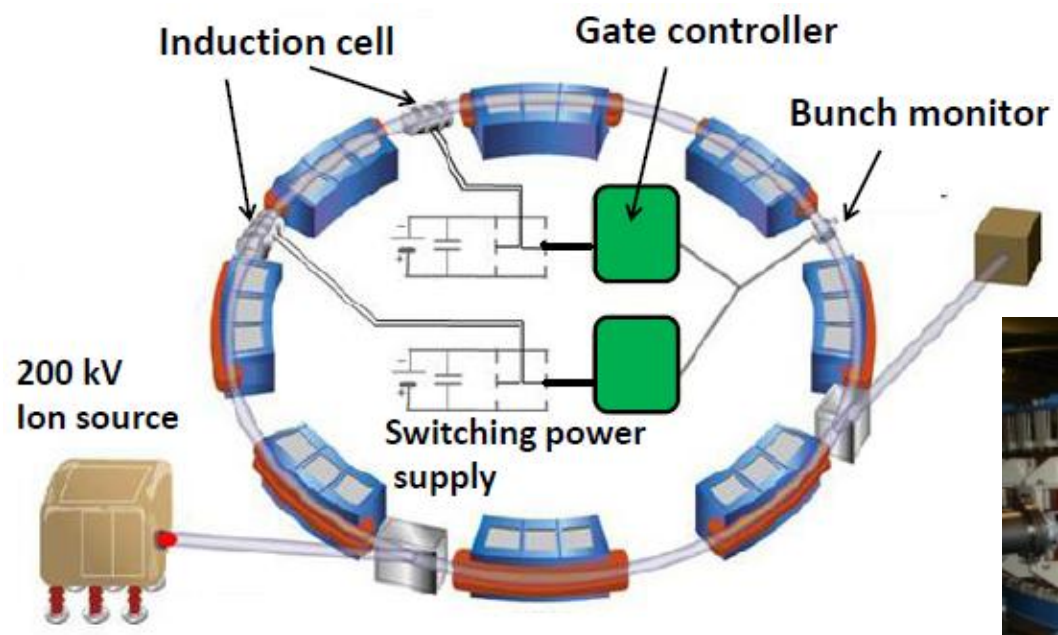
- MOSIS/CMP/CMC (silicon brokers in US, France, and Canada)
 - Agreement with Tezzaron for commercialization
 - June 2010 - Announced plan to offer 3D services using Tezzaron
 - Working with Fermilab to make HEP 3D efforts available to the commercial world
 - Design platform is now available at CMP - first submissions received
 - Tezzaron will handle the final processing of the 3D frame (e.g. adding bond pad interface fill, etc.) and submit design to Chartered.

A difficult and time and resource consuming process – but important to progress in detector technology



KEK All Ion accelerator/Digital accelerator for material and biological sciences

An induction synchrotron developed and demonstrated first in 2006 .



Cryocooler for Liquid Xenon Detectors

Example of TT
from KEK to Industry



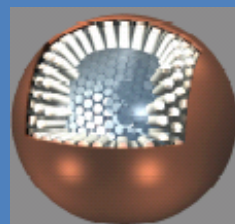
200W@165K

World wide Liquid xenon exp., for γ -ray, Dark matter...

● MEG exp.
(PSI, Zurich)



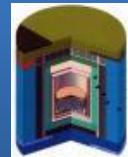
● XMASS exp.
(Kamioka,
Japan)



● XENON exp.
(Gran Sasso, Italy)



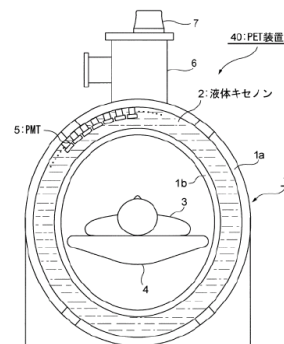
● PANDA-X exp.
Jin Pin, China)



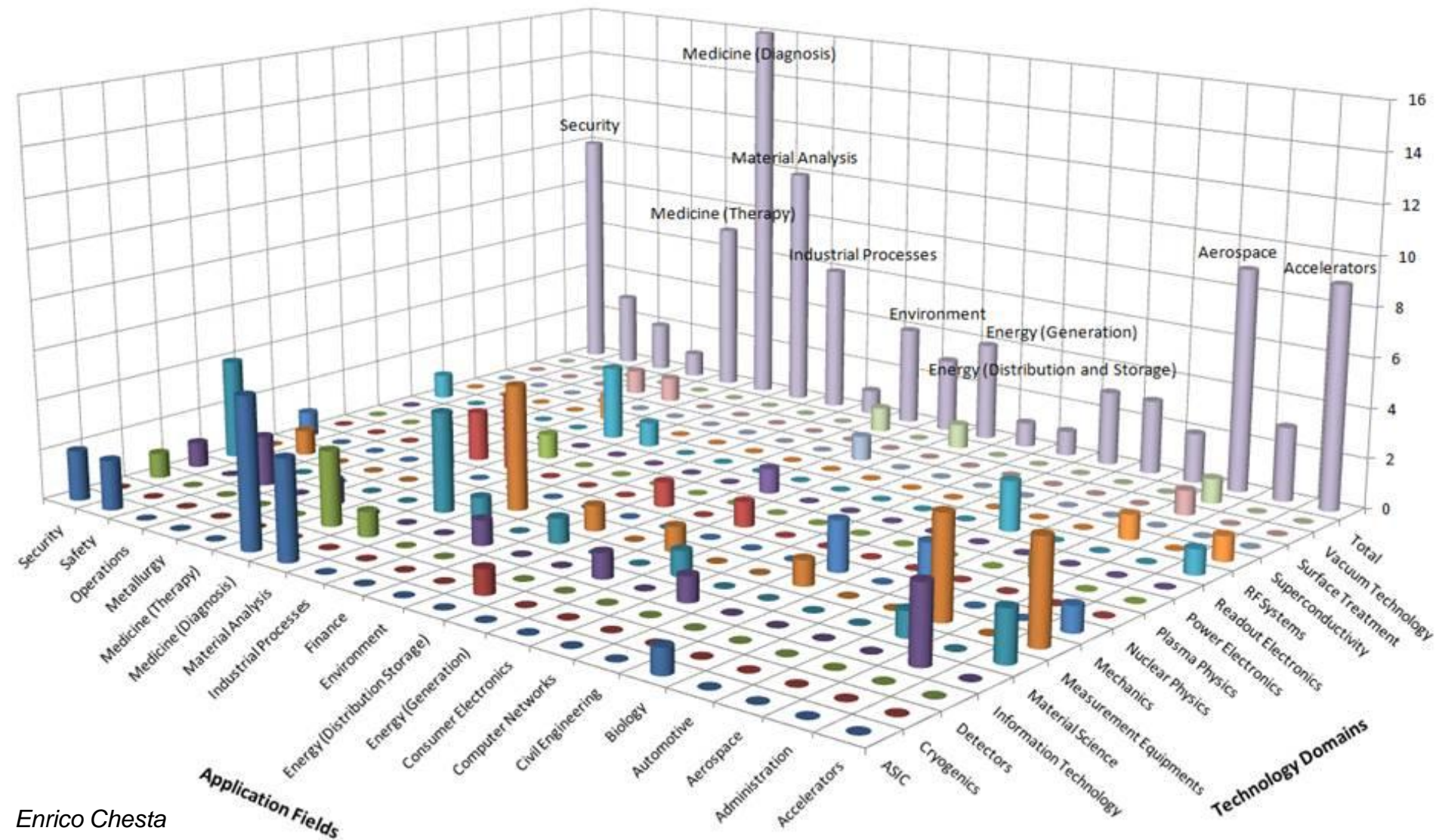
- Precise temperature control
- Stable long-term operation
- High cooling power

- 2005 MEXT Minister's Awards
- 2006 University alumni Awards
- 2007 Daily Technology Newspaper article

Medical application...
LXe PET(KEK, Nantes)



Portfolio of CERN Technologies



Enrico Chesta

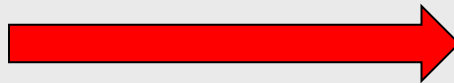
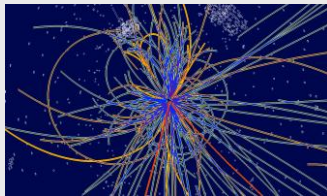


Medical applications

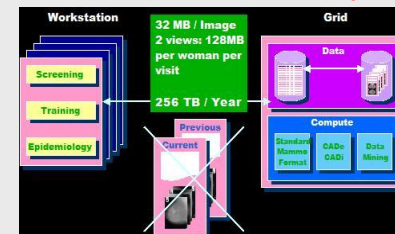
Particle accelerators for **hadron therapy**



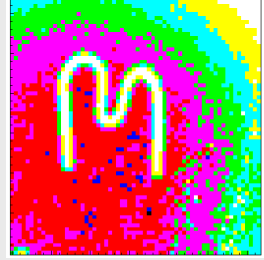
Particle detector for **medical imaging**



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



Medipix

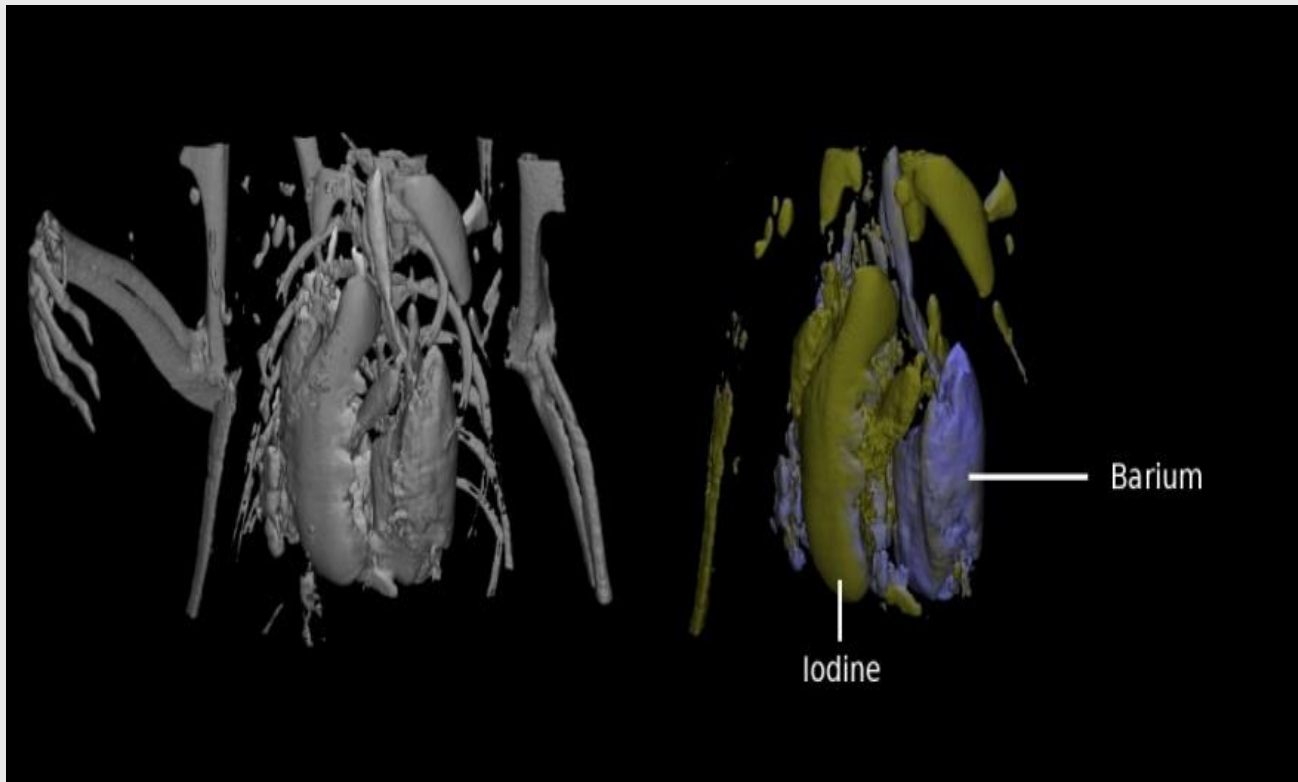


- A family of single photon counting integrated circuits used in Hybrid Silicon Pixel Detectors
- The Medipix collaborations (close to 20 institutes) contributed to the development and dissemination of the technology
- A good example of how (fundamental) science fosters innovation which can be transferred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



Other ways of dissemination

- The “old style” Technology Transfer process:

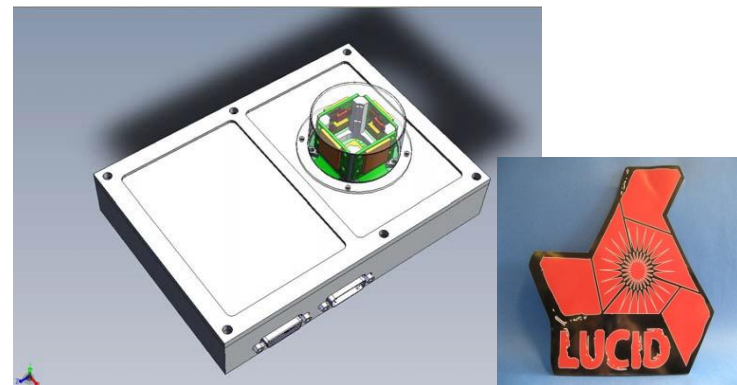
invention disclosure → IP protection → license to a company

rarely works, especially for the world of particle physics. Collaborative R&D (with industry and other research institutes) is often key for a successful transfer.

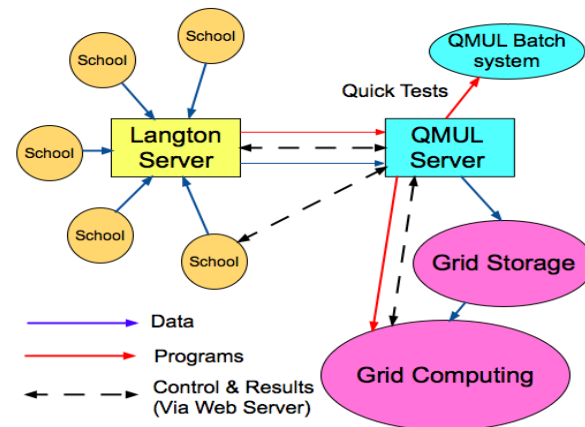
- There is much more than “pure” Technology Transfer!



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.”

Technology Transfer to Small Companies

Workshop on Technology Requirements of Super-KEKB accelerator (Vacuum, Magnet, RF cavity and Micro-wave) and Belle-II detector



Association with companies for advanced accelerator technologies

先端加速器科学技術推進協議会



Advanced Accelerator Association Promoting Science & Technology

- Advanced Accelerator Association (AAA)
Promoting Science & Technology
 - Established in 2008
 - to strive for the further advancement of scientific technologies.
 - Members: 83 companies and 38 institutional organizations (Aug 2011)
 - URL
http://aaa-sentan.org/en/about_us.html

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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Conclusions

- The knowledge and technologies developed in the world of particle physics have an important impact to society: we must make sure that we properly highlight it
- In technology transfer, what really matters is dissemination
- Collaboration and knowledge exchange with industry is key for our future developments