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THE TECHNOLOGY TRANSFER NETWORK FOR PARTICLE PHYSICS: STATUS ON MPGD PILOT OFFER

RD51 Collaboration Meeting, CERN, 14 April 2011

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TTN in a nutshell

Purpose

- Establish a genuine partnership / collaboration amongst institutes active in Particle Physics in MS with a view to enhancing Technology Transfer activities
- Develop the image of the PP community as a source of knowledge that benefits society

Programme of work:

- 3-year project to develop tools and methods in order to support a permanent operation

Financing

- During the execution of the project, the TT Network members will cover their own costs

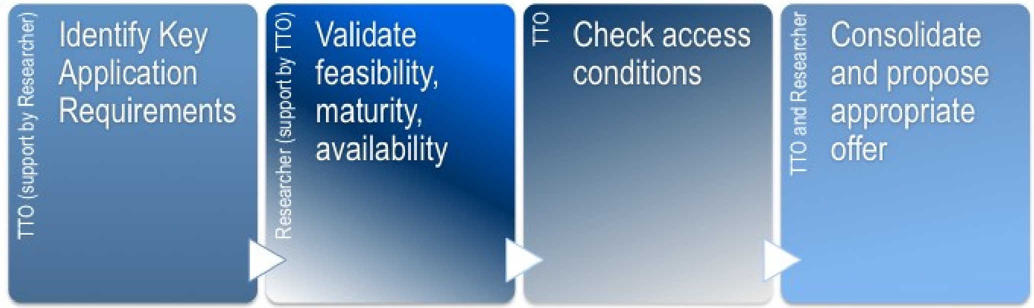
Institution*	Country
CEA/IRFU	France
CERN	
CHALMERS	Sweden
Copenhagen University	Denmark
CNRS/IN2P3	France
DESY	Germany
EPFL	Switzerland
GSI	Germany
INFN	Italy
JSI Jožef Stefan Institute	Slovenia
PSI Paul Scherrer Institute	Switzerland
National Technical University of Athens	Greece
LIP	Portugal
STFC, Scientific & Technology Facilities Council	UK
University of Sofia	Bulgaria
CPAN	Spain

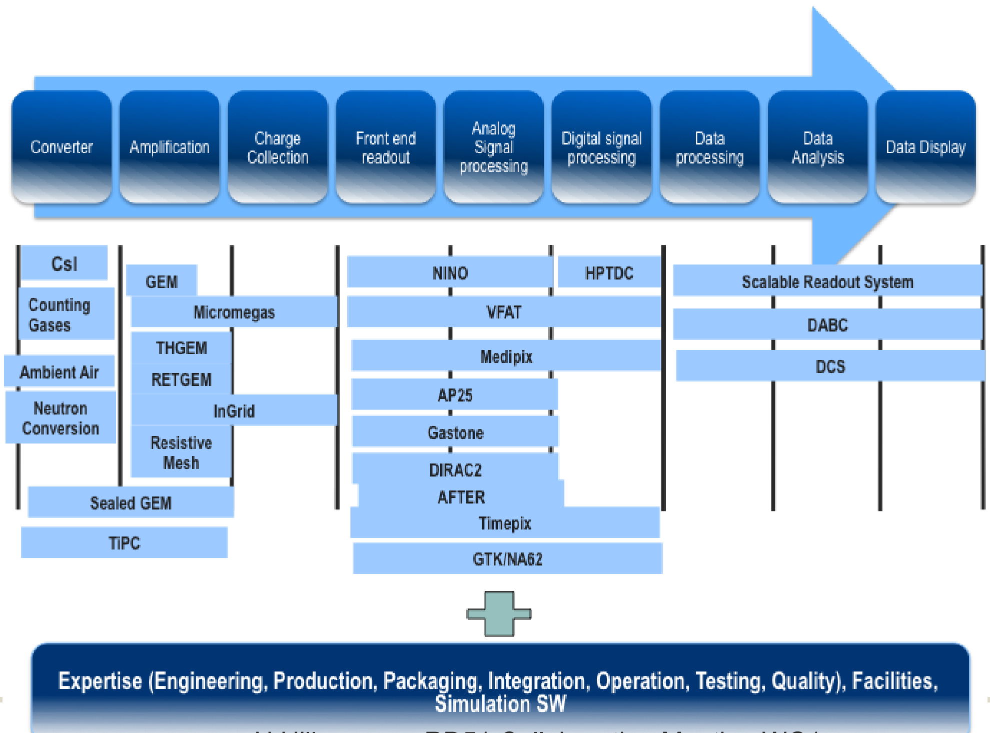
*TT Network members on September 2010, ILL officially applied for full membership, KFKI, Hungary observer status

Pilot Technology Offer for MPGD (RD-51)

TT Network Nodes in RD51: CEA, CERN, CNRS-IN2P3, DESY, INFN, NTUA, (KFKI: Observer)

- RD-51 technology inventory consisting of information on the main technologies, expertise, production methods, test facilities and patents





- Classification of entries according to a conceptual gaseous detector
- User requirements elicitations for application devices in key domains
- Elaboration in collaboration with researcher of application device offers meeting user requirements and according to the conceptual gaseous detector layers

How to build a technology offer in practice: n/γ imaging

Case identification: combined neutron / gamma imaging for fast air cargo mass inspection in homeland security

$$R = \frac{\mu_n}{\mu_g} = \frac{\ln(I_n / I_n^0)}{\ln(I_g / I_g^0)}$$

Market needs and key user requirements for effective mass screening of air cargo containers:

Each material has a specific R

- High resolution images over large areas (few m^2)
- Accurate scanning without unpacking
- Less than 2 min scan time per container
- Radiation safety compliance
- Low cost, reliable, easy to maintain

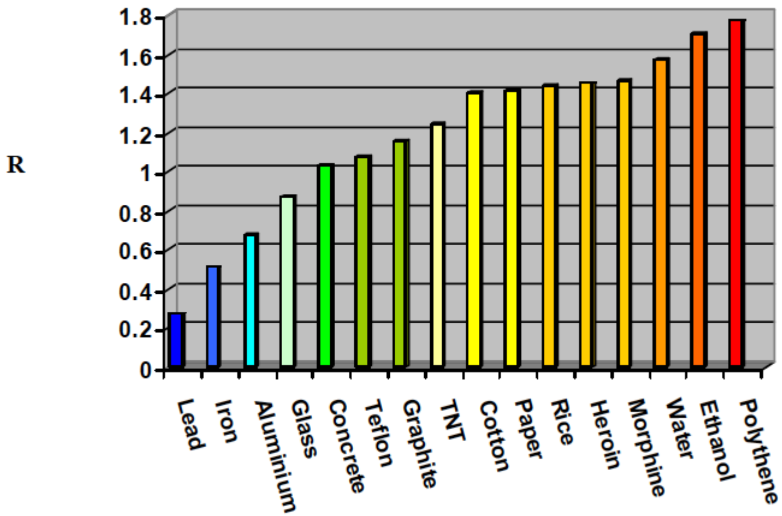


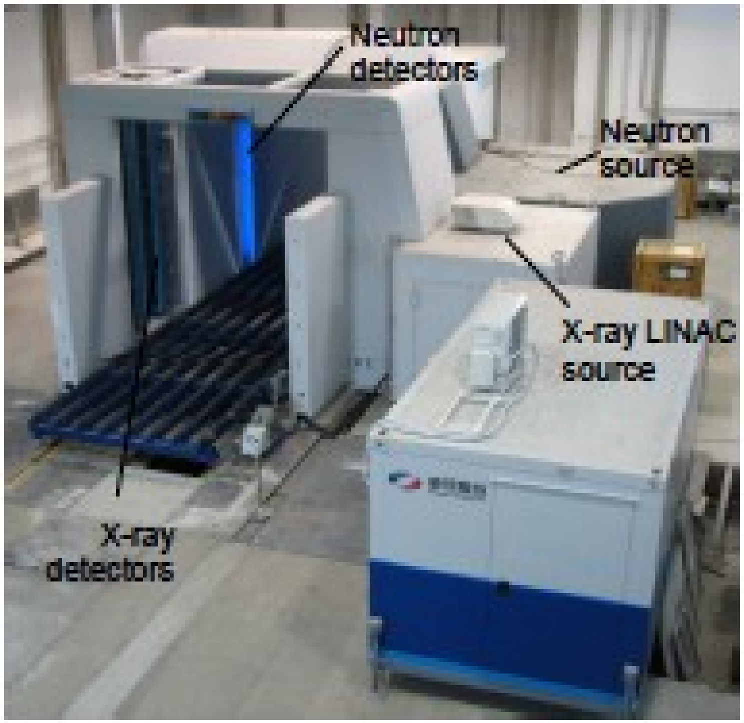
Figure 1. Calculated R values for a range of materials, using 14 MeV neutrons and ^{60}Co gamma rays.

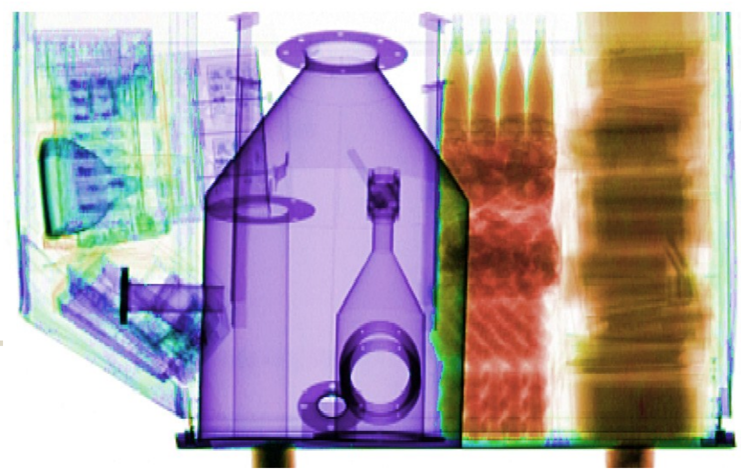
Method: Absorption measurement of 14 MeV neutrons and ^{60}Co γ's (1.17 and 1.33 MeV)

J.E.Eberhardt, Y.L. (2006), Fast Neutron and Gamma-Ray Interrrogation of Air Cargo Containers, Proceedings, of Science (FNDA2006)

How to build a technology offer in practice: n/γ imaging

Prototype scanner (CSIRO) tested with Australian customs (2006):





Conventional Technologies:

- Plastic scintillators (n)
- CsI (γ)

Can Particle Physics propose an alternative solution based on MPGD technologies from RD51 to meet user requirements ?

User requirement	
Large area	y/n ?
Short scan time	y/n ?
Shape AND material info	y/n ?
Device costs	y/n ?
…	…

Identify detailed user requirements

Identify possible synergies with ongoing RD51 activities

- Are there similar developments ongoing within RD51's own research program ? (➔ large area detectors for HEP !)

Validate with RD51 experts the availability of necessary technologies and support

- Performance & efficiency
- Readiness
- Production
- Etc.

Develop "unique selling points"

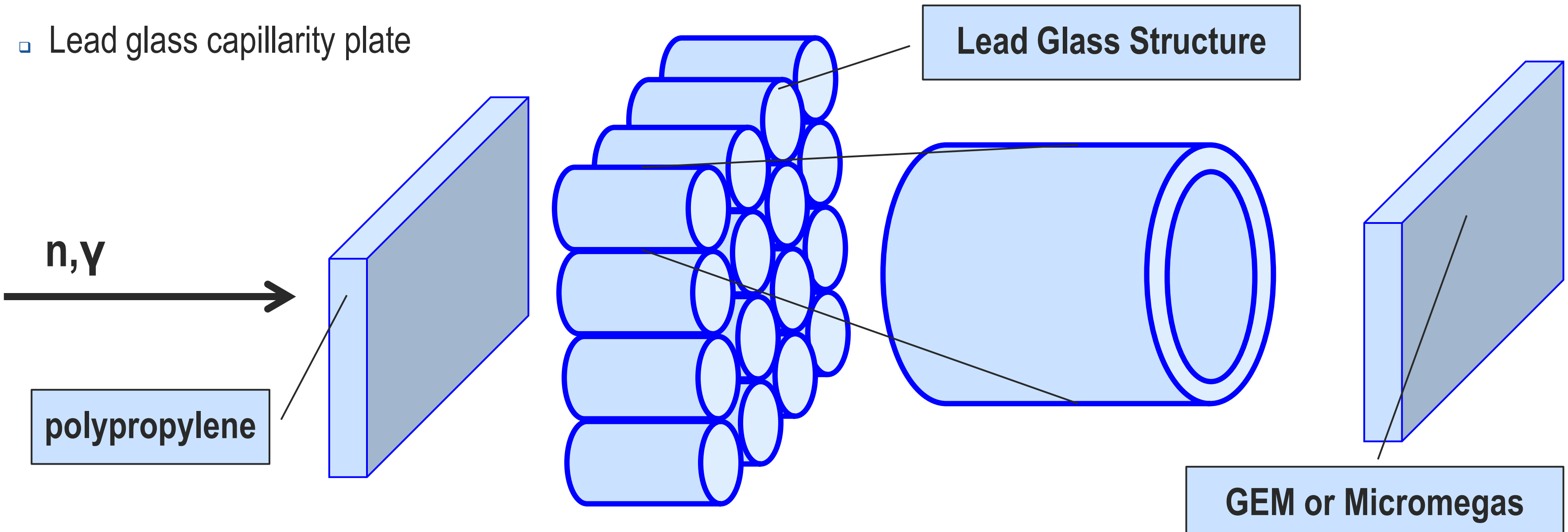
- Why customs and others should use it ?

First discussions with RD51 experts*

2-dim combined neutron / gamma imaging with GEM or MicroMegas detector stack.

Preliminary ideas on conceptual design:

- Neutron conversion to recoil protons using polypropylene entrance window.
- Photon conversion using a lead glass structure with optimised geometry and surface to volume ratio:
  - Lead glass capillarity plate



***Vladimir, Leszek, Maxim, Rob, Hans, Supratik**

Open Issues

N detection efficiency:

- Few percent seem to be possible with polypropylene, but further simulations and a demonstrator needed

X-ray detection efficiency :

- Requirement: not less than a few percent for 3 – 6 MeV photons
- Optimal structure for gamma converter (➔ see Rob's talk in WG4)
- Availability and price of gamma converter for large area systems

Simultaneous or alternating n/gamma measurement:

- Better if we don't need to discriminate between n/γ

Charge multiplication structure, Readout structure

Operation, Integration and production

Answering these questions requires:

- More detailed simulations (expression of interest by Saha)
- building a small proof-of-concept prototype to attract industry and/or other research laboratories active in homeland security
- Project proposal, plan, funding schemes, resources, lab infrastructure, etc.

Experts welcome !!

“Non-technological” tasks

Collaboration with Vienna university of economics, Institute of Entrepreneurship and Innovation:

- 5 students over 3 months to establish a “business plan” for the route-to-market of combined neutron gamma imaging for fast air cargo scanning
  - Market assessment: consolidation of key user requirements, trends, unique selling points, “hot” features
  - Identification of key players, expert forums, conferences and industry fairs
  - Existing solutions
  - Funding schemes

Visits of existing installations, interviewing of air cargo experts

- Better understanding of market needs, operational aspects under real conditions, and customers

Identification of suitable industry and governmental agency contacts

Conclusion and Future Steps

HEP cannot build a complete scanner by itself

Ideal solution: make available MPGD technology package for collaborative R&D with academia and industry

An appropriate proposal for such collaborative R&D on large area detector systems requires:

- Better understanding of market needs and opportunities:
  - Finalise study with WU Vienna
- Better understanding of detector physics of combined neutron gamma detection
  - Carry out simulation studies
- Building of a demonstrator prototype for a combined neutron gamma detection module
  - dedicated project proposal (objectives, planning, funding, staffing)

Final goal: optimise the pilot offer on MPGD technology for the homeland security sector:

- Technologies, expertise, knowhow, facilities, etc

Thank you for your attention

For more information and questions please contact:

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