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

RD51 Collaboration Meeting, Bari, 8 October 2010

Hartmut Hillemanns

Council approved the creation of the TT Network in March 2008

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

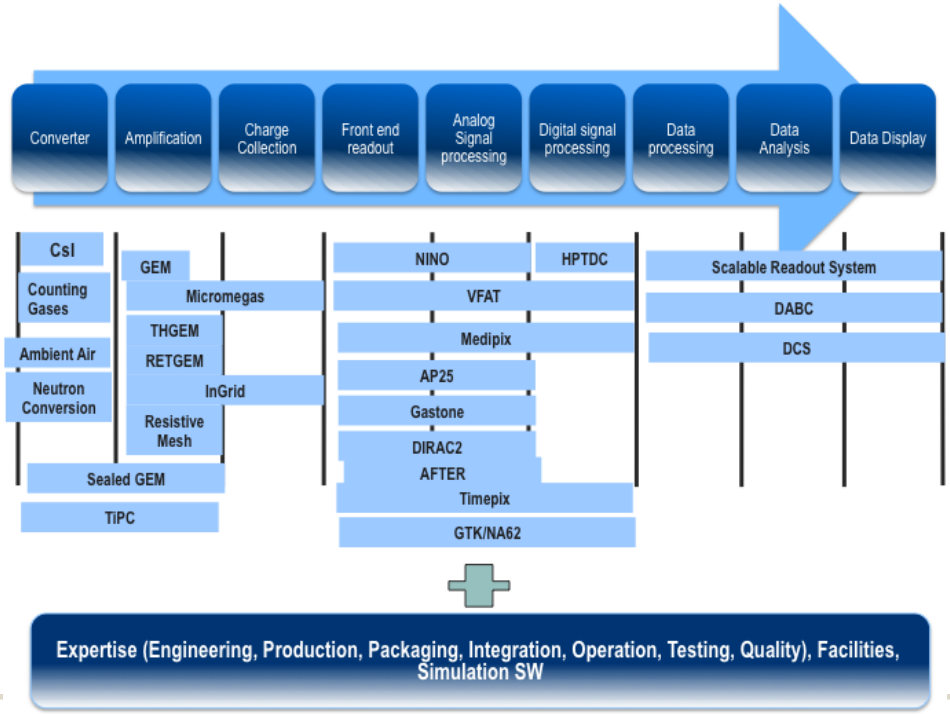
*TT Network members on September 2010, CPAN/SPAIN officially applied for full membership, KFKI, Hungary observer status

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

Operation activities: 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: Ex.1, n/γ imaging

Case identification: combined neutron / gamma imaging for fast air cargo mass inspection in homeland security providing information on object shape AND material

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

- 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

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

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

Each material has a specific R

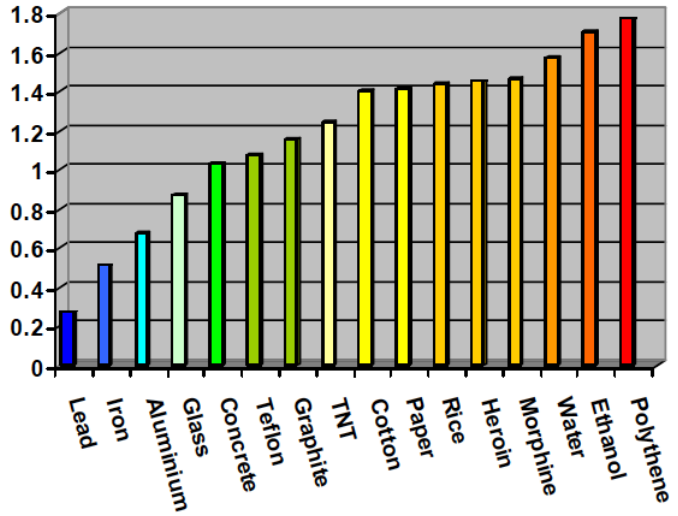
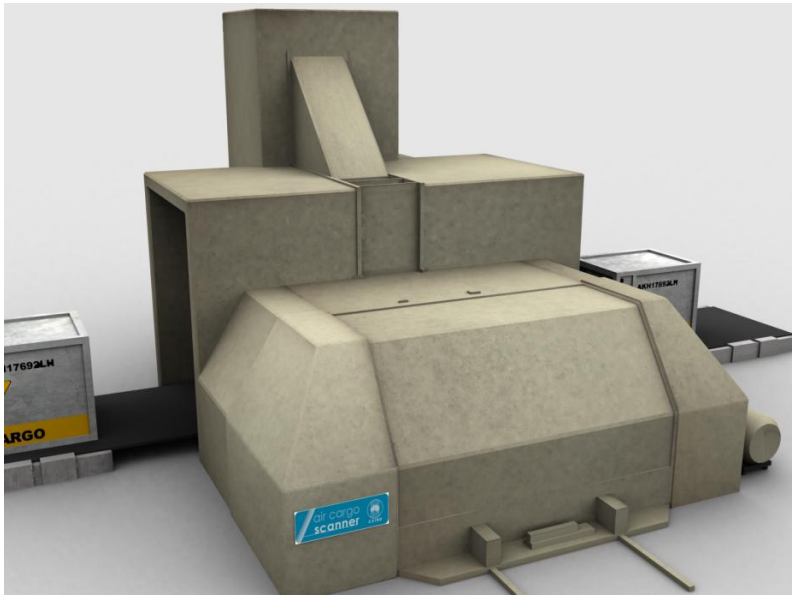


Figure 1. Calculated R values for a range of materials, using 14 MeV neutrons and ^{60}Co gamma rays.

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

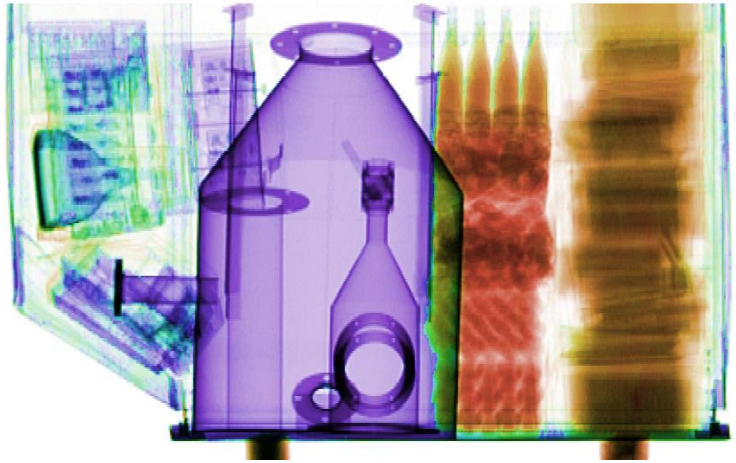
How to build a technology offer in practice: Ex.1, n/γ imaging

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



Conventional Technologies:

- Plastic scintillators (n)
- CsI (γ)

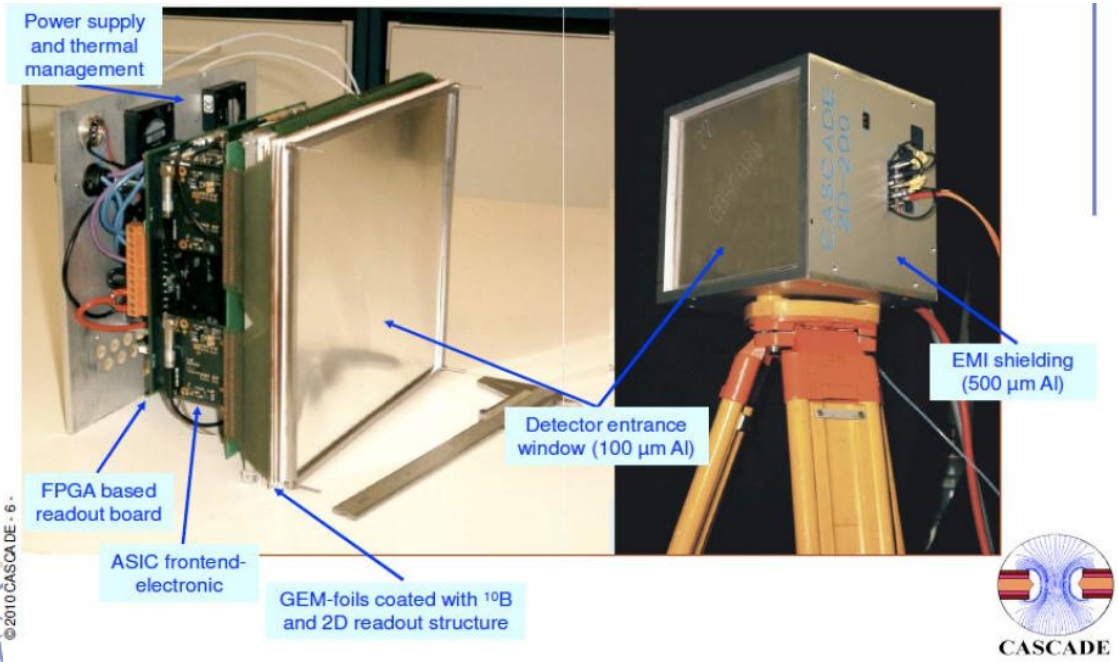


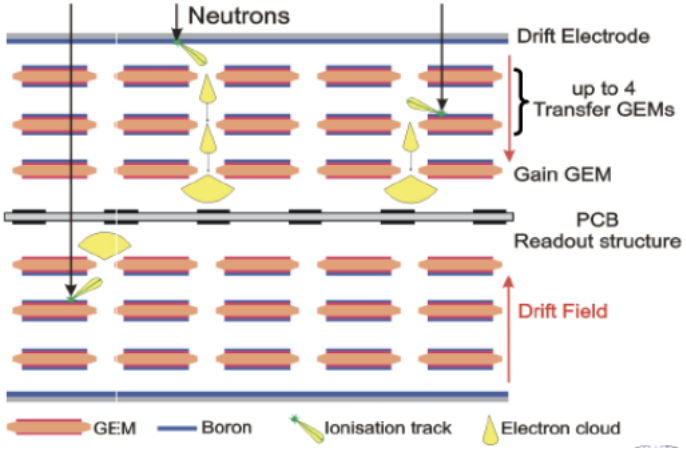
How to build a technology offer in practice: Ex.1, n/γ imaging

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

Combined neutron / gamma imaging with GEM detector stack:

- CASCADE detector system with photo-sensitive layer
  - GEM-based neutron detector module commercially available
  - Integration of photo-sensitive GEM feasible





M. Klein, CASCADE, Vienna 2010

CASCADE

How to build a technology offer in practice: Ex.1, n/γ imaging

Check compliance with user requirements

Identify possible synergies with ongoing RD51 activities

- Are there similar developments ongoing within RD51's own research program ?

Validate with RD51 experts the availability of necessary technologies and support

- Performance
- Readiness
- Production
- Etc.

Develop "unique selling points"

- Why customs and others should use it ?

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

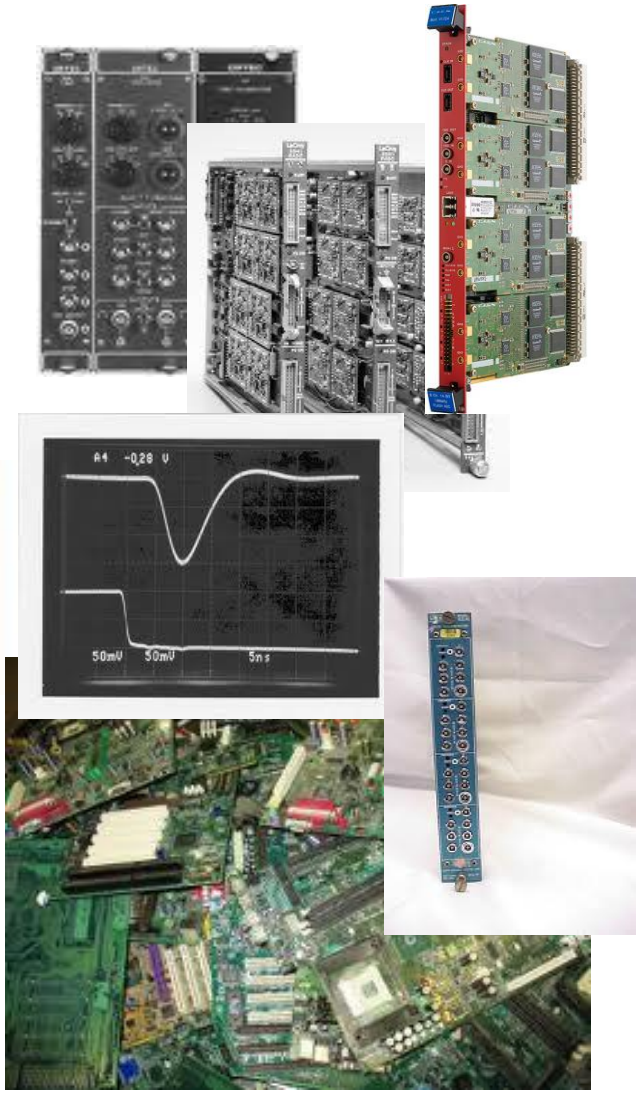
How to build a technology offer in practice: Ex.2, SRS

Case identification: a flexible, modular readout system for multi channel detector systems based on widely used industry standards for a wide range of applications

Market needs and user requirements for detector readout systems:

- Modular setup of user specific detector systems
- Support of widely used readout ASICs
- Maximum use of industry standards
- Programmable architectures and trigger schemes
- Easy to use, reliable, cost efficient

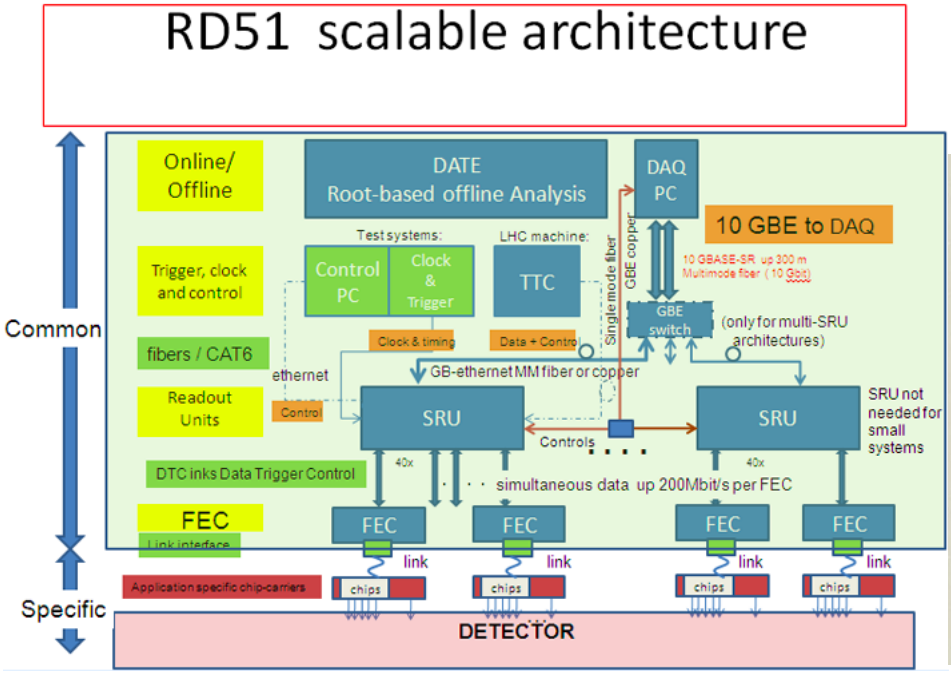
Problem: No One-Size-Fits-All solution available on the market matching all needs of multi channel detector readout systems

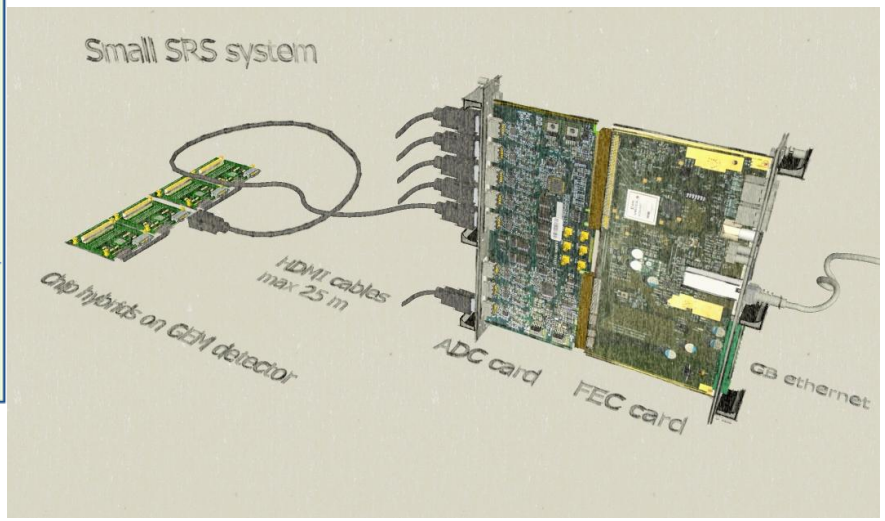


How to build a technology offer in practice: Ex.2, SRS

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

Scalable Readout System (SRS) as readout system for multi channel detector systems for many different applications





How to build a technology offer in practice: Ex.2, SRS

User requirement	
Modular setup	y/n ?
Wide ASIC support	y/n ?
Industry standards	y/n ?
programmable	y/n ?
…	…

Check compliance with user requirements

Identify possible synergies with ongoing RD51 activities

- H.Müller et.al., Prototyping and system testing
- Use of SRS in various experiments ➔ lot of user experience

Validate with RD51 experts the availability of necessary technologies and support

- Performance
- Maturity
- Pre-industrialisation and production: SRS needs partners from industry

Develop "unique selling proposition"

- Flexibility, modularity, scalability, operation

How to build a technology offer in practice: Ex.2, SRS

Build final offer:

- Scope
- Access conditions
- support

European Organization for Nuclear Research

Scalable Readout System for Multi Channel Detector Systems

Abstract

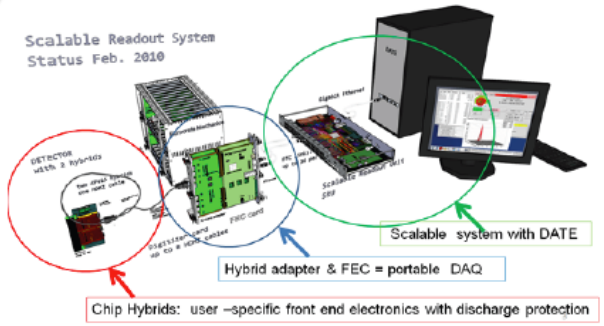
Based on developments for Micro Pattern Gas detectors for the detection of particles in many different application domains, the Scalable Readout System (SRS) for multi channel detectors to accommodate an interface to a wide range of commonly use readout ASICS, a scalability from low to large number of readout channels, a flexible data acquisition package enabling the implementation of various readout architectures and trigger schemes based on widely used industrial standards.

Technology stage

Various prototypes are available off the shelf or can be produced on short term. CERN and RD51 provide support and solutions (data acquisition, chip boards, readout software) for integration of the SRS with user specific detectors and support

- Scalable from few channel systems up to a few millions of readout channels.
- User programmable trigger and clock interface
- Possibility to integrate application specific adapter cards
- Availability of low cost test systems for systems with few readout channels

physical overview SRS of RD51



Specifications

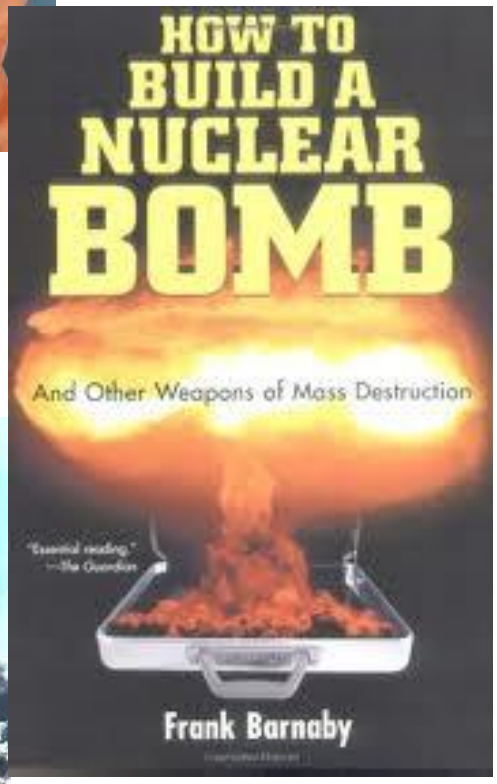
- 10 Gigabyte Ethernet standard readout links.
- Programmable Front End Cards

Technology Offer, Ex.3: Large area GEM's for homeland security

Case identification: large detector modules for the identification of nuclear material in homeland security

General needs for effective mass screening of large containers and trucks:

- Accurate scanning without unpacking
- Less than 2 min scan time per container for mass screening
- Applicable in harbors and custom stations
- Low cost, reliable, easy to operate and maintain



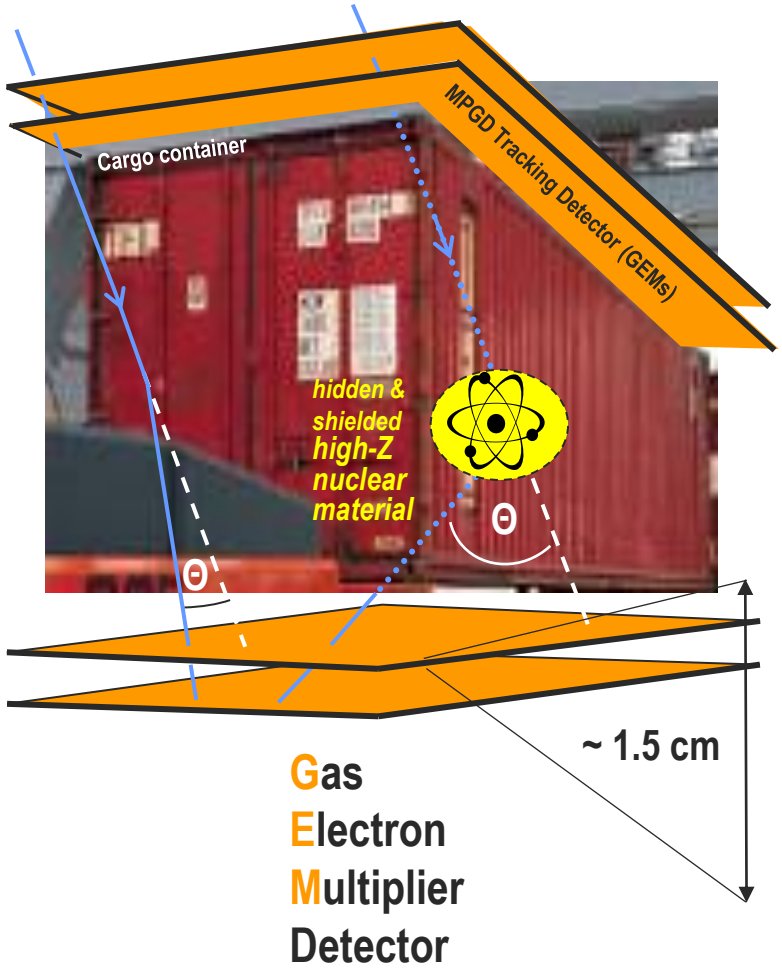
Technology Offer, Ex.3: Large area GEM's for homeland security

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

Method: large area GEM based detector modules for the identification of increased scattering of cosmic ray muons in high Z materials (muon tomography)

Market needs and key user requirements for effective mass screening of large containers and trucks:

- High tracking efficiency and high resolution (~50µm) images over very large areas (>200 m^2 in total)
- Very high number of readout channels (O(10^6))
- Proven technology
- Maximal use of standardized components available from industry
- Easy operation and maintenance



M. Hohlmann, RD51 Freiburg 2010

Technology Offer, Ex.3: Large area GEM's for homeland security

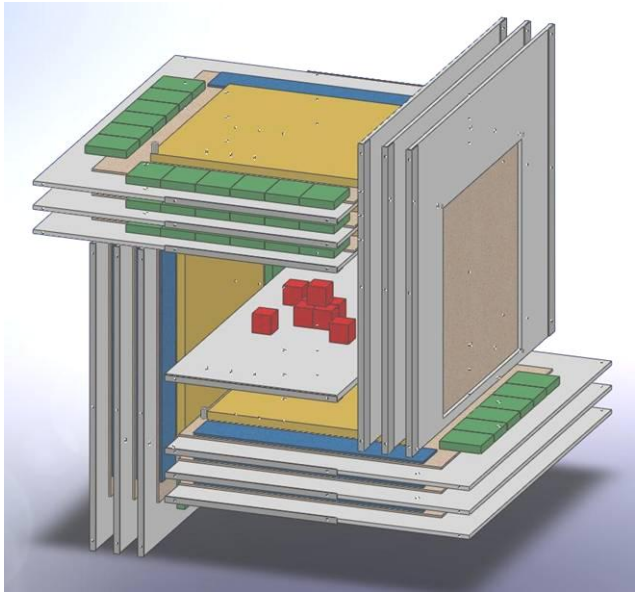
Check compliance with user requirements

➜Ongoing R&D on prototype modules (Florida Tech, others ?)

- Larger area systems
- Readout electronics, integration, long term operation

Identify possible synergies with ongoing RD51 activities

- Large area GEM production
  - production by industry (synergy with LHC experiments upgrade)
  - Quality, homogeneity
- SRS
- Long term operation
  - gas system or sealed GEM's
  - stability, ageing



M. Hohlmann, RD51 Freiburg 2010

Technology Offer, Ex.3: Large area GEM's for homeland security

Validate with RD51 experts the availability of necessary technologies and support

- Production
- Long term operation
  - gas system or sealed GEM's
  - Reliability, stability, ageing
- Integration of large systems

… and with involved TT offices:

- Clarify technology ownership
- Provide necessary licenses
  - The USE of GEM's is protected by patents
- Ensure appropriate recognition throughout future commercialization

Manufacturing and using GEM foils requires a license for 2 patents:

- GEM: hold by CERN (WO9921211)
  - In addition, production of large area GEM foils is covered by a separate CERN patent
- CAT: hold by CNRS (WO1995FR01548), CERN has the right to sublicense

CERN grants a license to a non-exclusive and royalty bearing license on the patents for the purpose of manufacturing, using and commercializing products:

- Manufacture and use GEM Foils;
- Commercialize GEM Foils with an attached sub-license allowing its acquirers to use the GEM Foils and manufacture GEM-Based Products;
- Manufacture, use, and commercialize GEM-Based Products incorporating GEM Foils manufactured by the Licensee.

Further conditions:

- Technical assistance available subject to availability of appropriate experts
- No royalties for use of GEM's in public research activities

Technology Offer, Ex.3: Large area GEM's for homeland security

Build technology offer:

Appropriate scheme: R&D partnership with industry to develop:

- "Pre-industrial" muon tomography detection modules
- Integration of a large number of such modules
- Operation under harsh conditions
- Field tests

Thank you for your attention

For more information and questions please contact:

Hartmut.Hillemanns@cern.ch