Summary of my research work and proposition of the research project

Jan BLAHA

Concurs CNRS, 8 March 2010, Marseille

Curriculum vitae

Education

- Czech Technical University in Prague (CTU) – Faculty of Nuclear Sciences and Physical Engineering (FNSPE)
  - Master studies in Nuclear Engineering 1996 – 2002
  - Master Thesis: “Utilization of plastic light-guide and scintillating fibres for dose rates determination in high-energy bremstrahlung”
  - Doctoral studies in Nuclear Physics (passed with honours) 2003 – 2006
- Université Claude Bernard Lyon 1 and Czech Technical University in Prague
  - PhD studies in Particle Physics (la mention très honorable) 2005 – 2008

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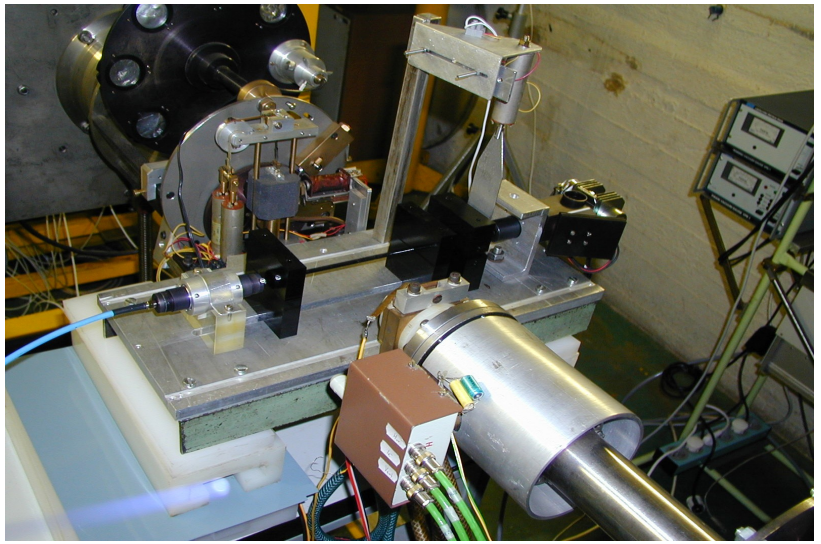
Experience

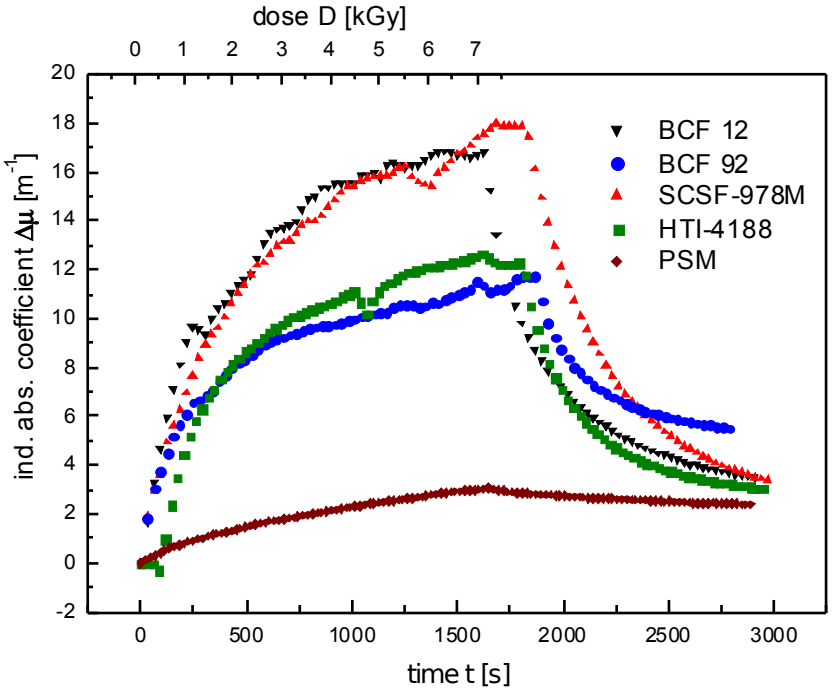
- Study of radiation induced changes in scintillating materials
- Calibration of the electromagnetic calorimeter for CMS experimet
- Development of the digital hadronic calorimeter for a future linear collider (posdoctoral work)

Radiation induced changes in scintillators

Objective: Study of radiation-induced changes in different scintillating and detector materials and its applications in dosimetry, nuclear medicine and high energy particle physics experiments.

Method:





Set-up:

- Microtron (e-, gamma)
- Optical bench
- Samples: Crystals (PbWO4, YAP:Ce, CsI, BGO) and fibers

Results:

- New kinetic models
- Improved radiation hardness
- New possible applications

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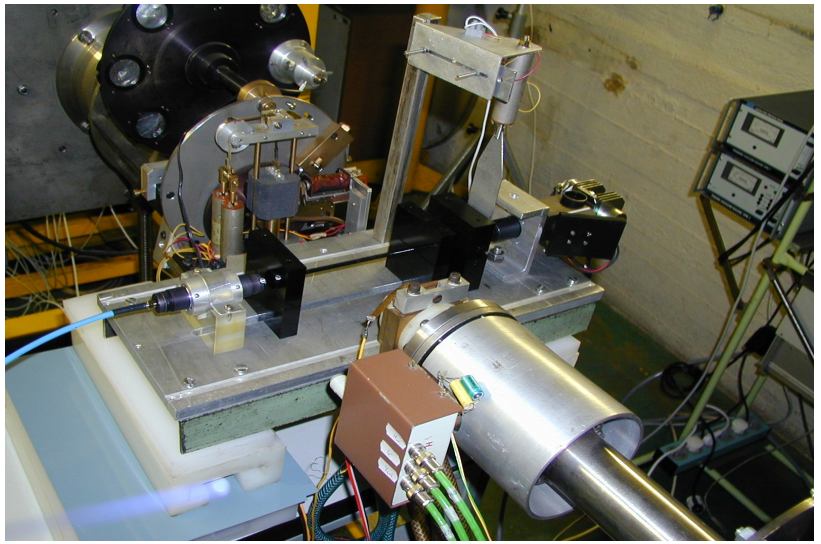

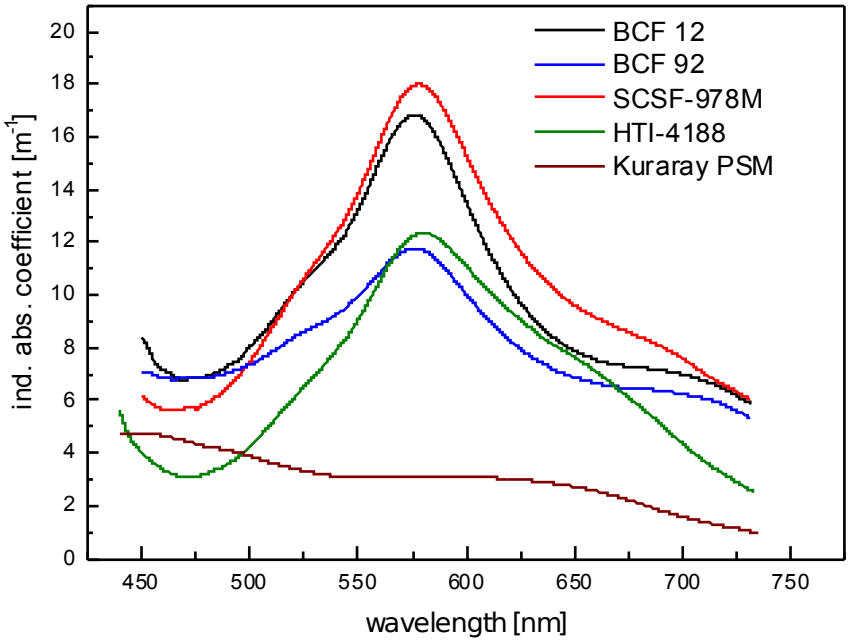

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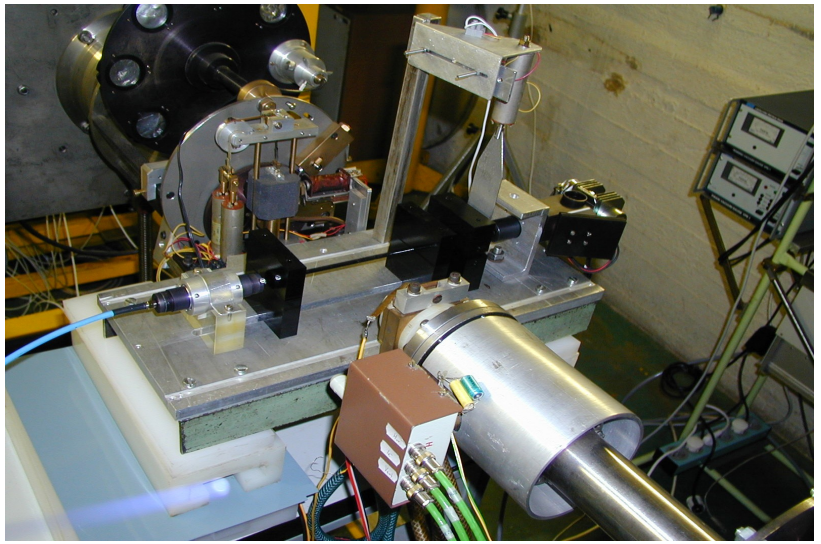

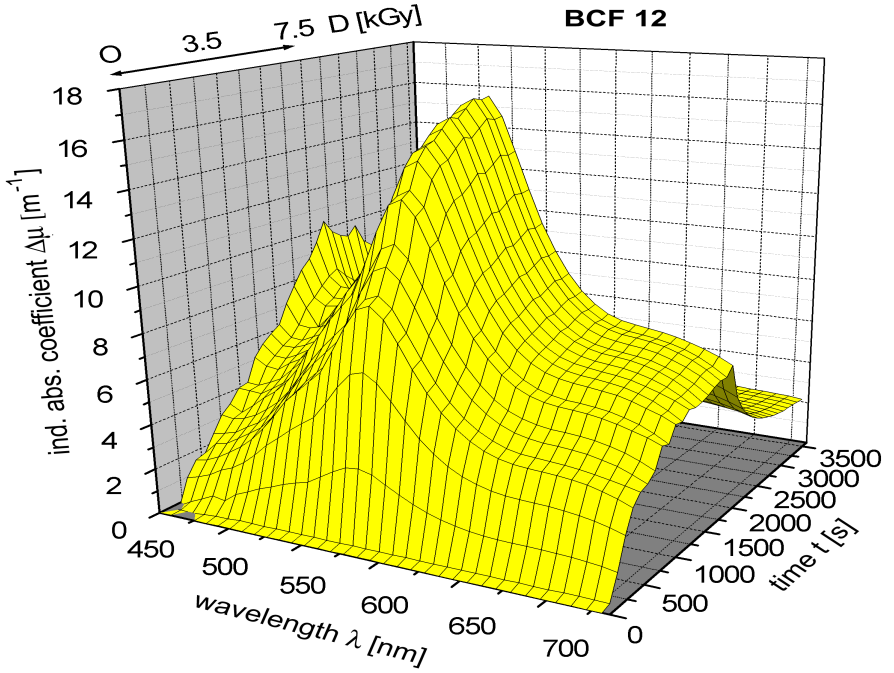

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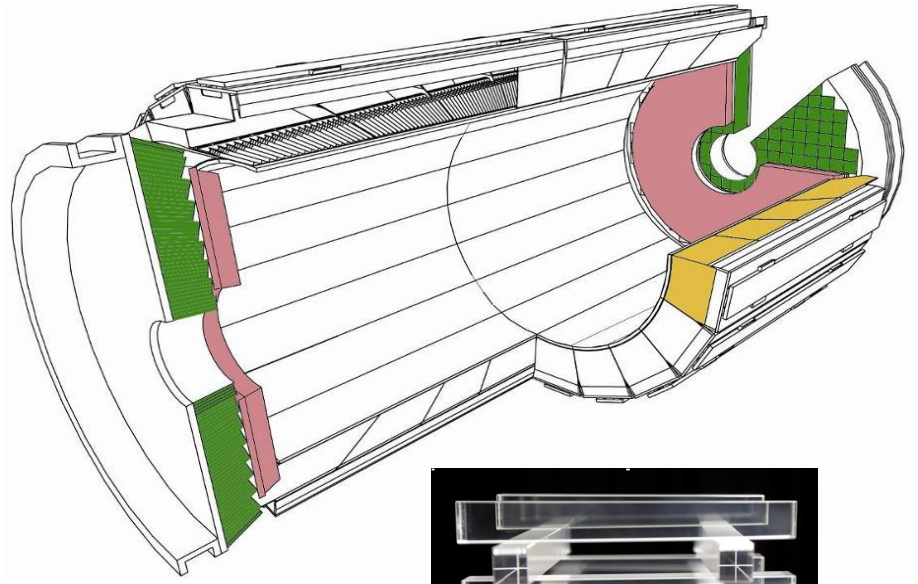
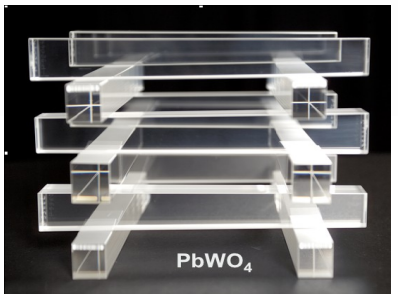
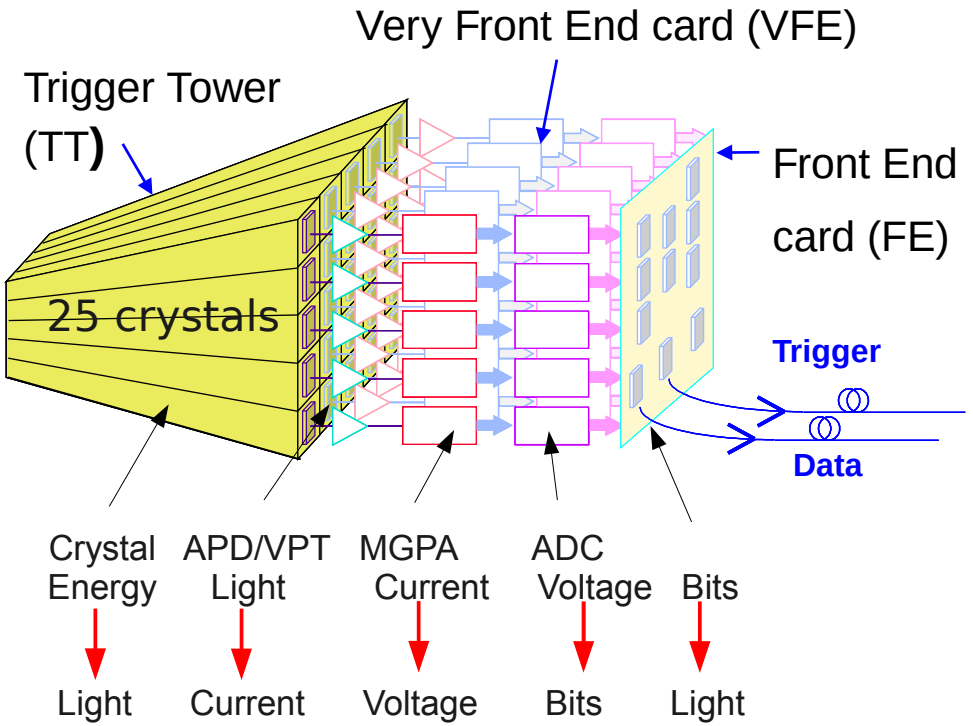
The CMS electromagnetic calorimeter

Objective: Construction and calibration of the electromagnetic calorimeter fulfilling CMS physics requirements.







Energy resolution

Contribution	Barrel ($\eta = 0$)	End-cap ($\eta = 2$)
Stochastic term	2.7%/ $\sqrt{E}$	5.7%/ $\sqrt{E}$
Constant term	0.55%	0.55%
Noise term	155 MeV (210 MeV)	770 MeV (915 MeV)

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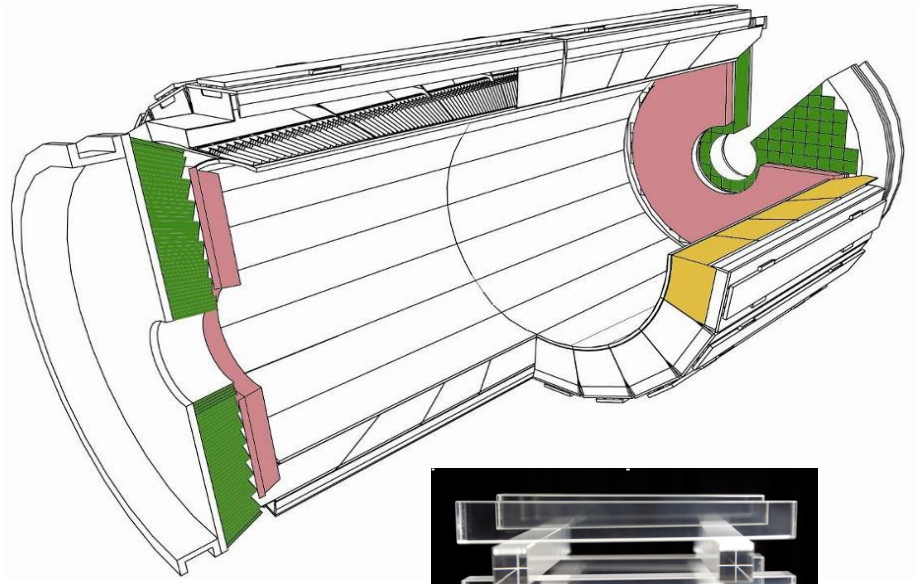

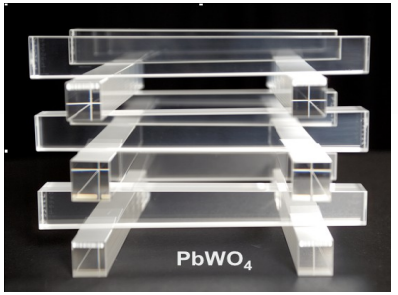

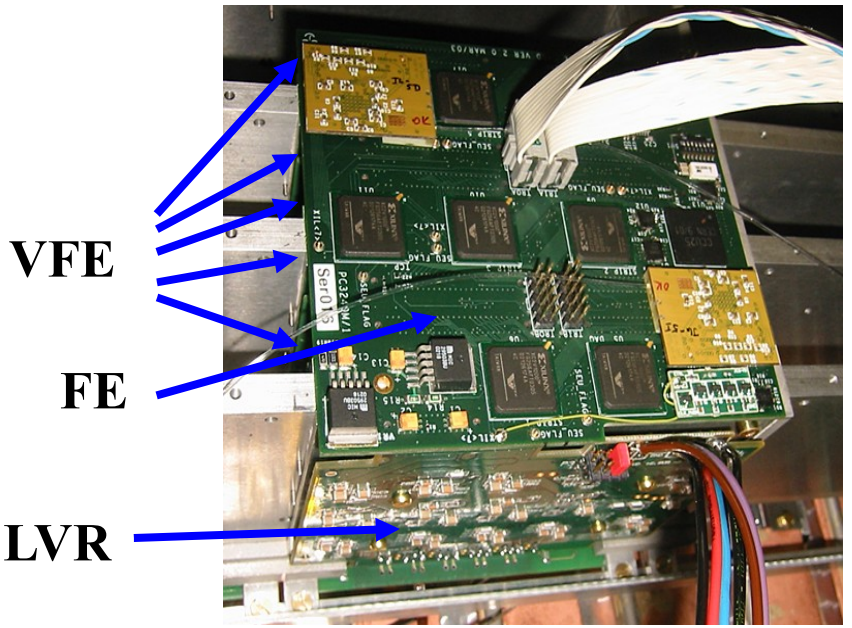

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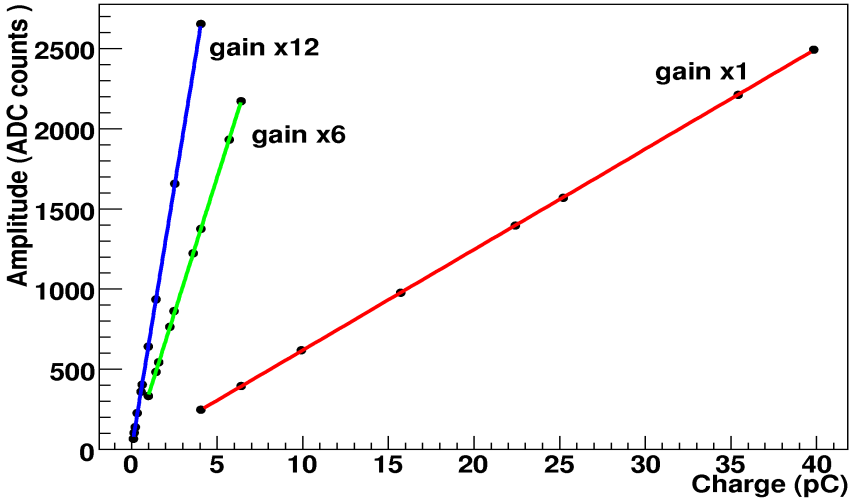
Calibration of the CMS ECAL

1. Calibration and performance test of the readout electronics

Results:

- ~16,000 VFE boards were calibrated and fully characterized
- ~2% failed the test criteria
- ~1% dispersion in the gains

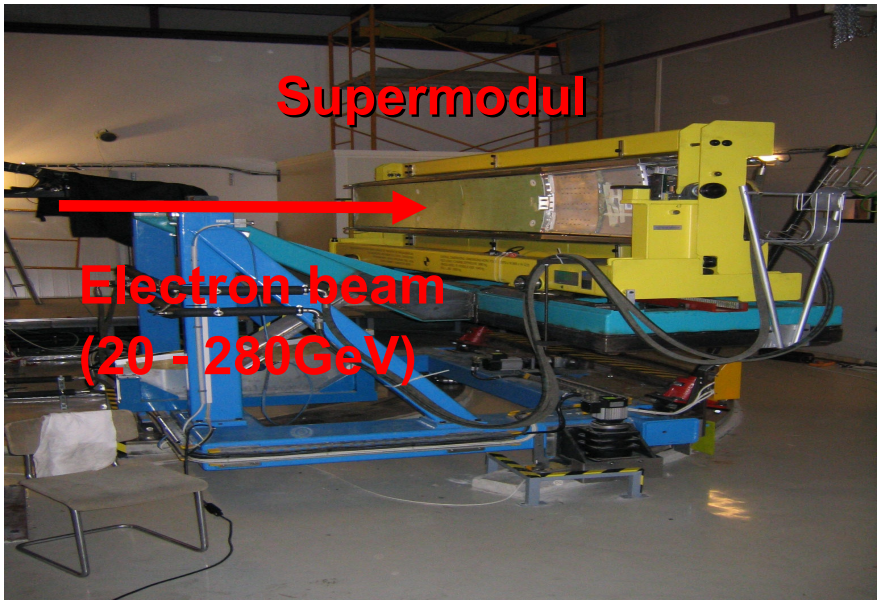


2. Calorimeter inter-calibration with particle beams

Results:

- 9 supermodules were calibrated
- Calorimeter performance validated

$$\left(\frac{\sigma_E}{E}\right)^2 = \left(\frac{3\%}{\sqrt{E}}\right)^2 + \left(\frac{0.12(GeV)}{E}\right)^2 + (0.4\%)^2$$



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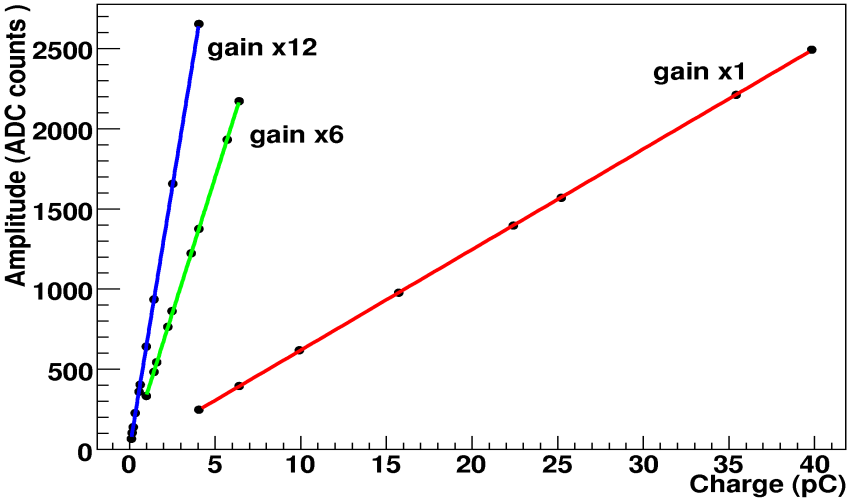

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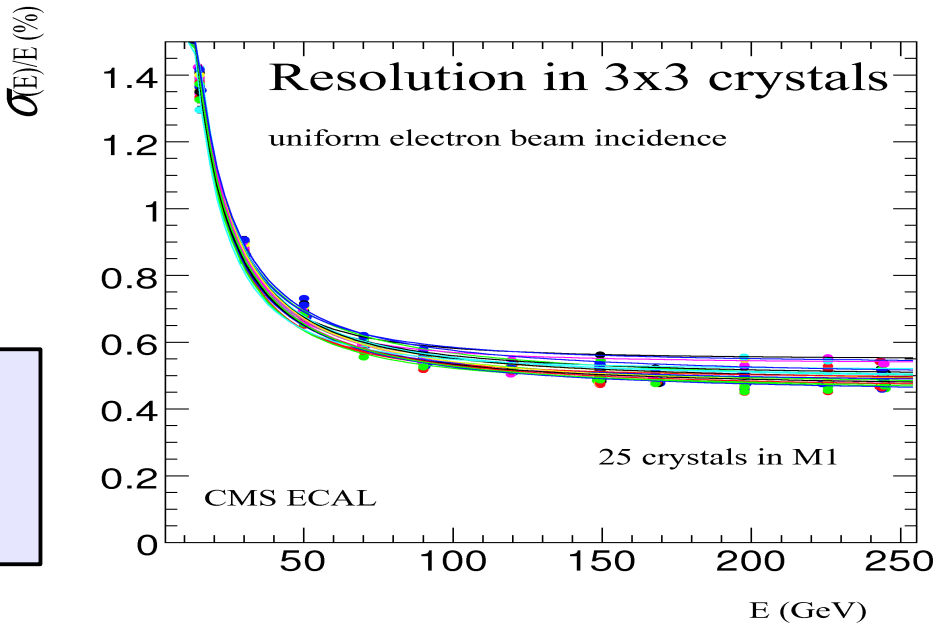
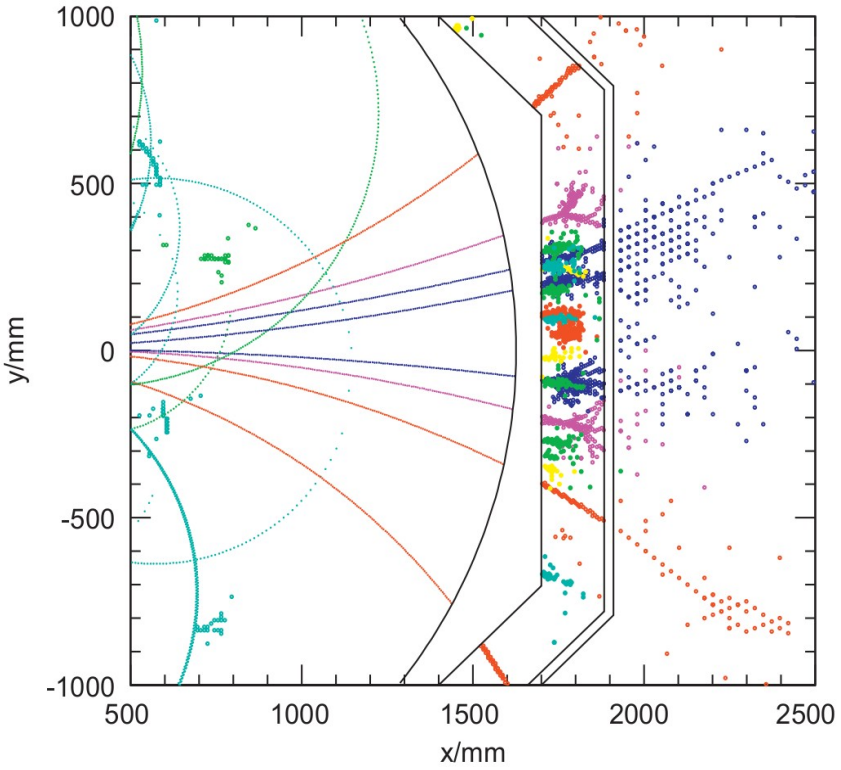


Calorimetry for a future e^-e^+ collider

Objective: Construction of a hadron calorimeter with excellent jet energy resolution 30%/sqrt(E).

Detectors (SiD and ILD) are based on PFA (Particle Flow Algorithm) that requires highly granular calorimeter (factor ~200 better than LHC)



Hadron calorimetry:

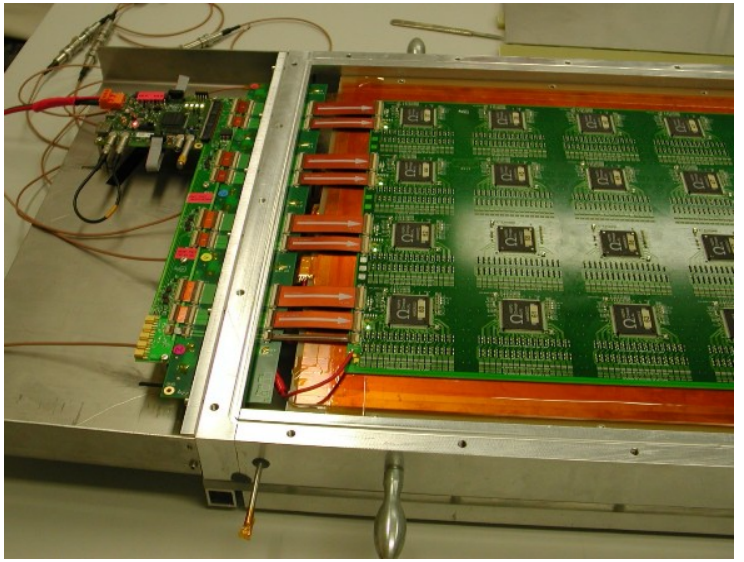
- Analog HCAL (Fe + Scintilator)
- Digital HCAL (Fe + Micromegas/RPC)

Extensive R&D program towards the $1m^3$ technological prototype made of 40 planes (400,000 readout channels!)

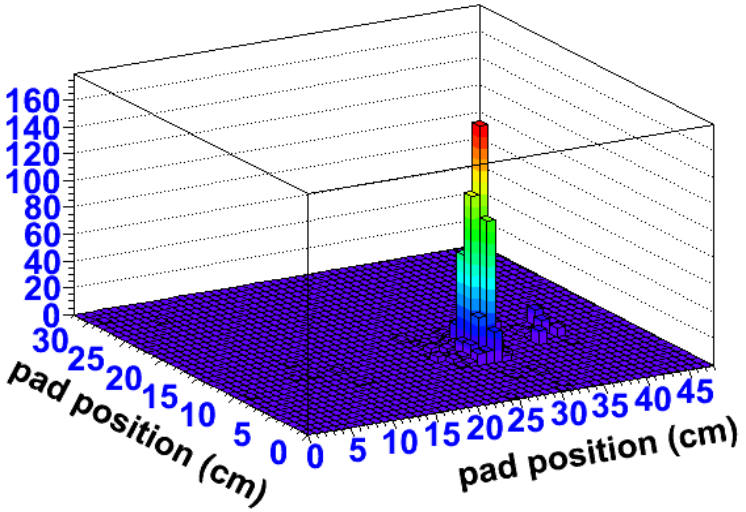
Micromegas R&D

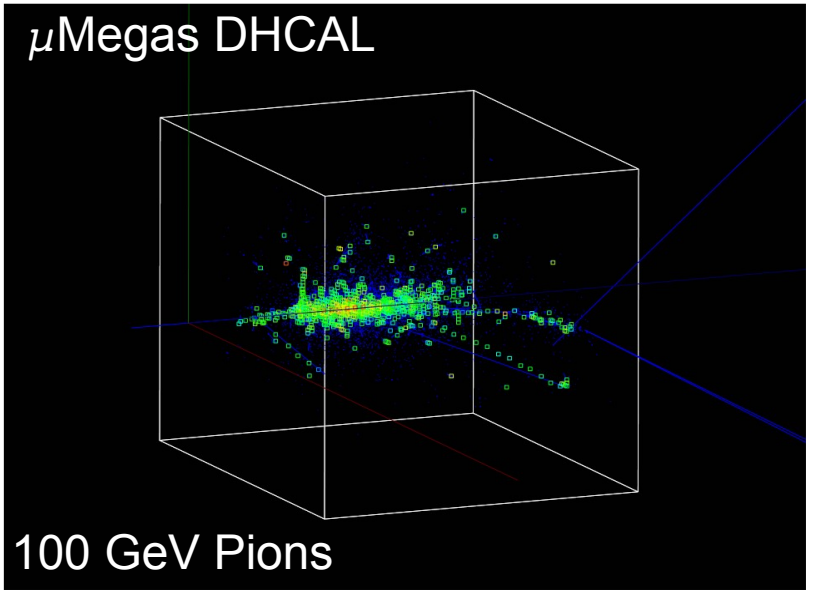
R&D includes:

- technology of Micromegas chamber manufacturing
- developing of embedded readout electronics
- test of new prototypes with different particle sources
- Simulations of physics performance



Beam profile





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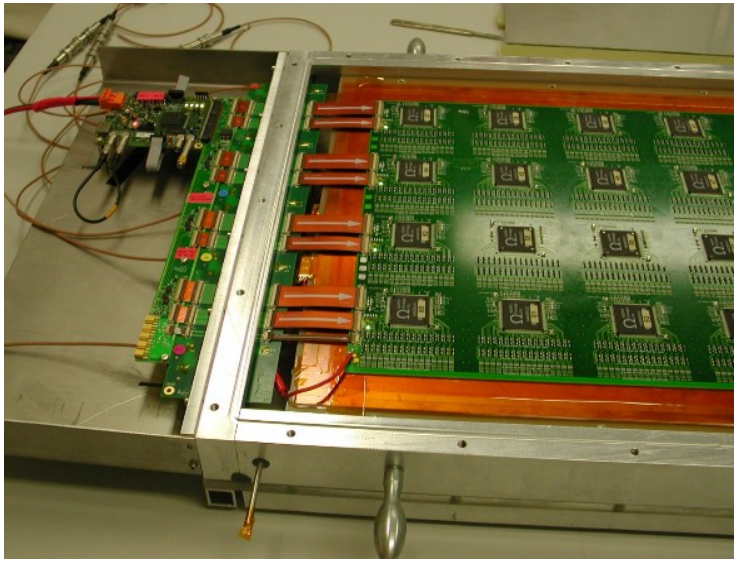

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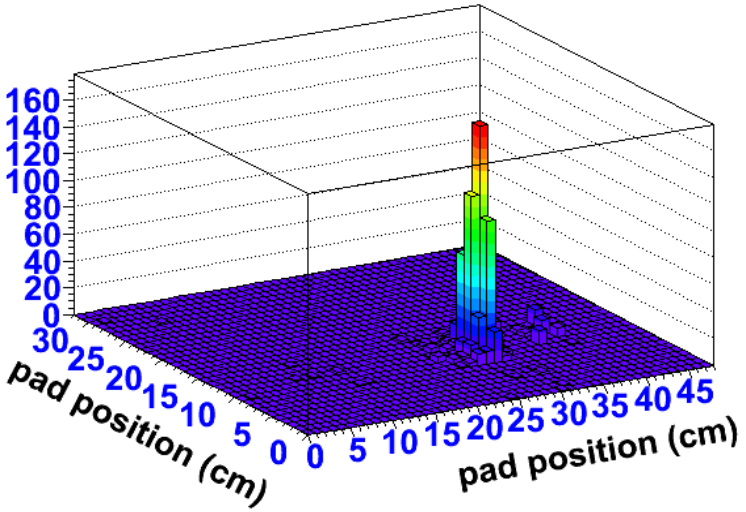

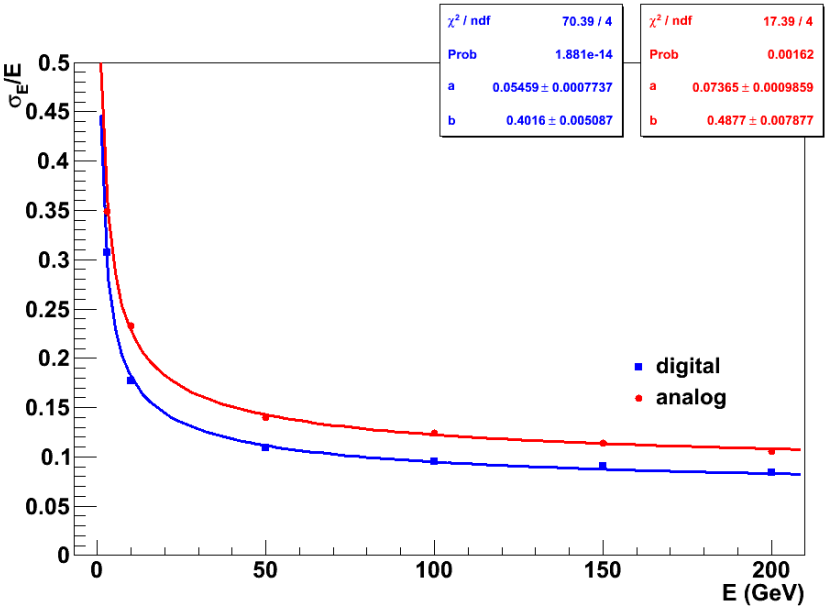

Proposed research project

Detector calibration and performance optimization

- Understanding of detectors and improvement of their performance
- Precise calibration using calibration services as well as physics events

Physics data analysis

- Treatment, analysis and interpretation of measured data
- Tuning of reconstruction and analysis software

Detectors upgrade for super LHC

- Development and preparation of new detectors that will comply with sLHC requirements