MTA ”Lendület” Innovative Particle Detector Development Group

Varga, Dezső (WIGNER RCP HEP)

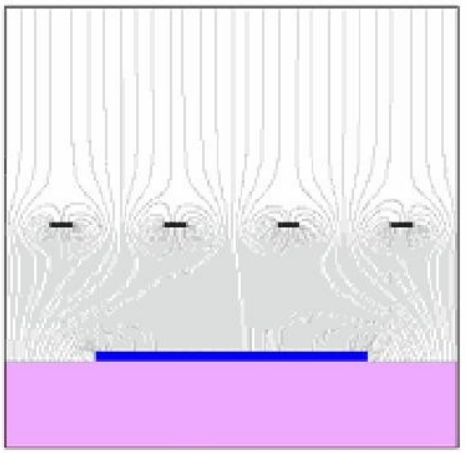
- R&D: Gaseous detectors: Improving **classical** and **microstructure** designs, developing new technologies

Examples of specific projects:

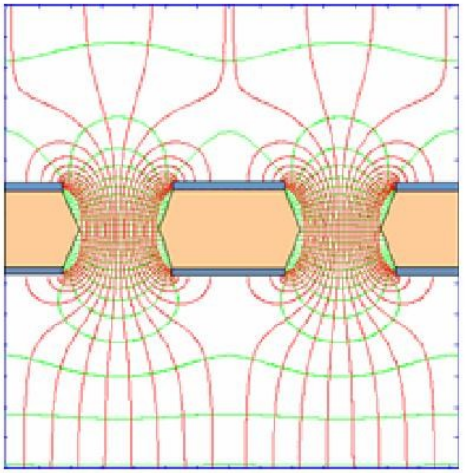
- Cherenkov detection with Thick GEMs
- Large size small material budget MWPCs
- Cosmic muon geological tomography
- NA61 low momentum particle (centrality) detector
- DAQ activities: applications in HEP experiments

Why gaseous detectors: low material budget, cost efficiency, long term experiences... **can it compete with silicon**?

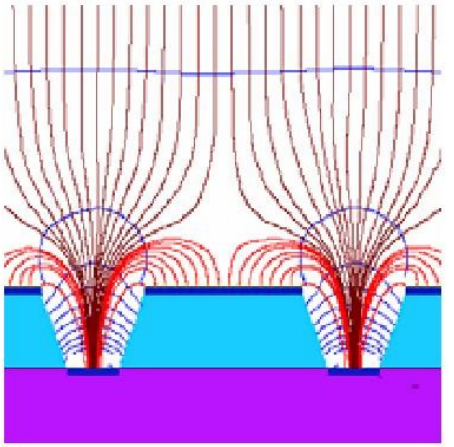
Innovative approaches on the micrometer scale



parallel plate



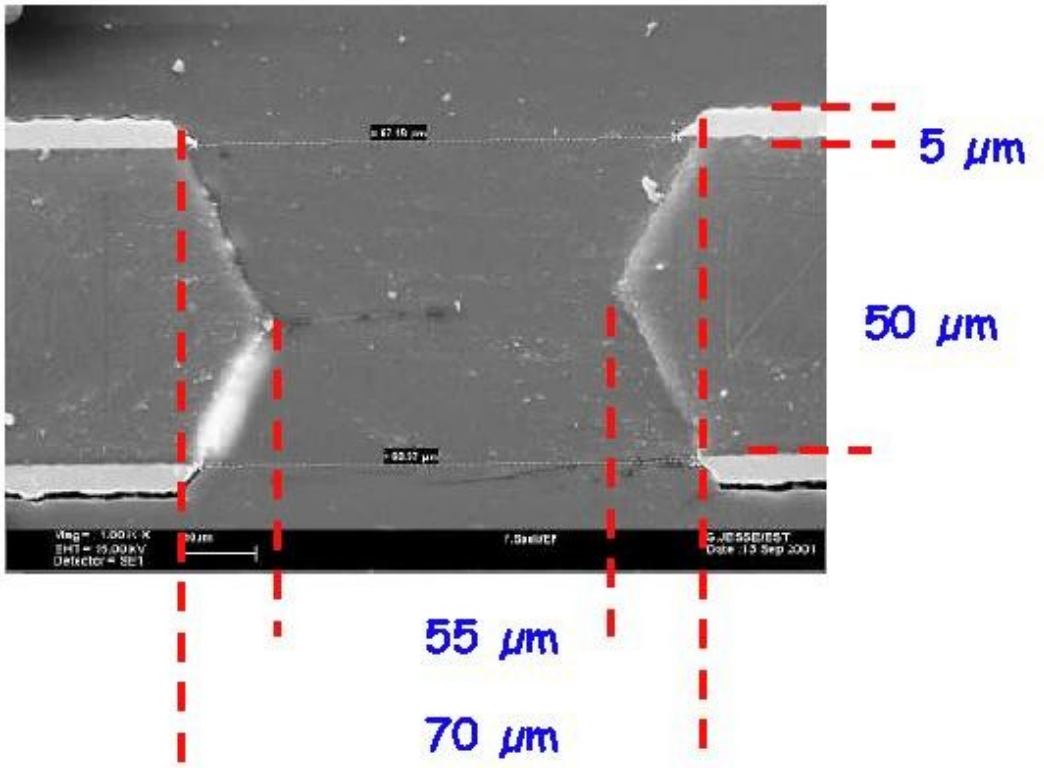
hole

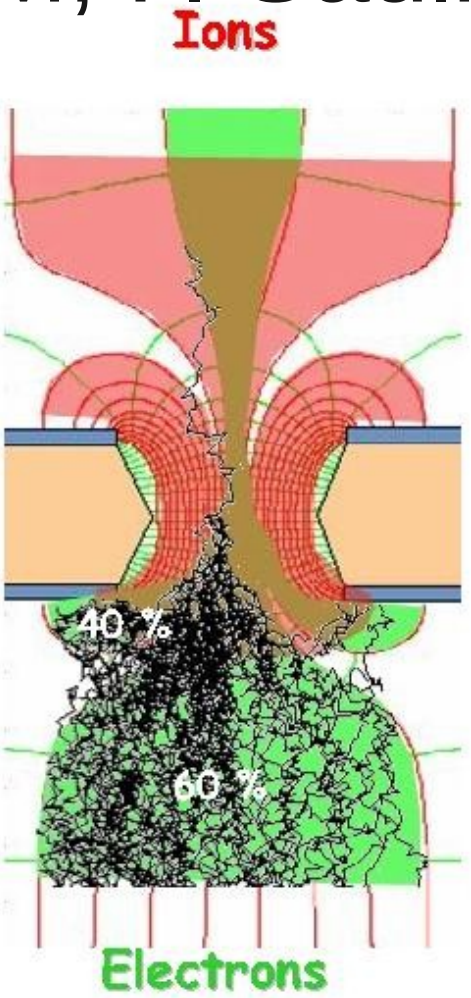


groove

- Micro-Pattern detectors (MPGD): improved position resolution, timing, rate capability, etc...

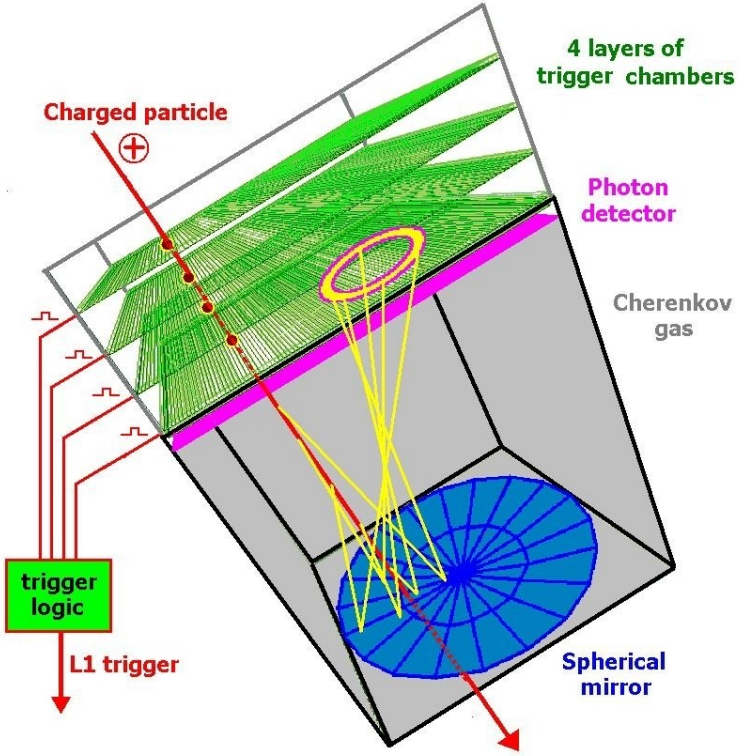
Gas Electron Multiplier (GEM, F. Sauli)

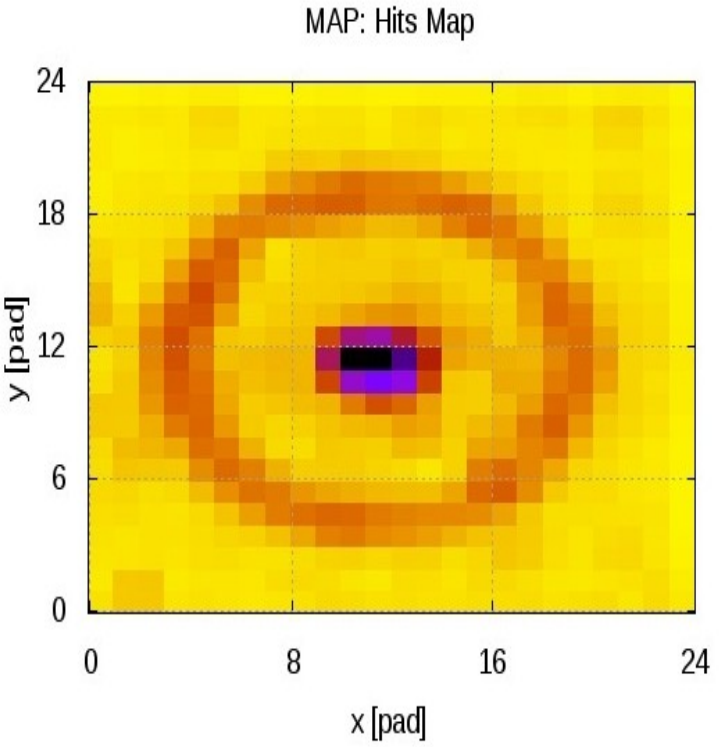


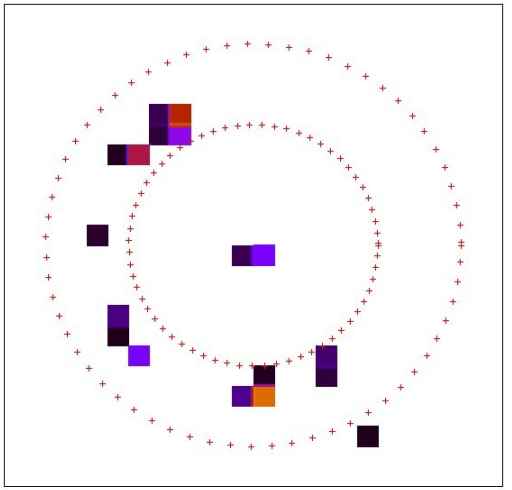


- Focusing field lines: foil acts as amplifier!
- **Thick GEM**: about 10 times larger size

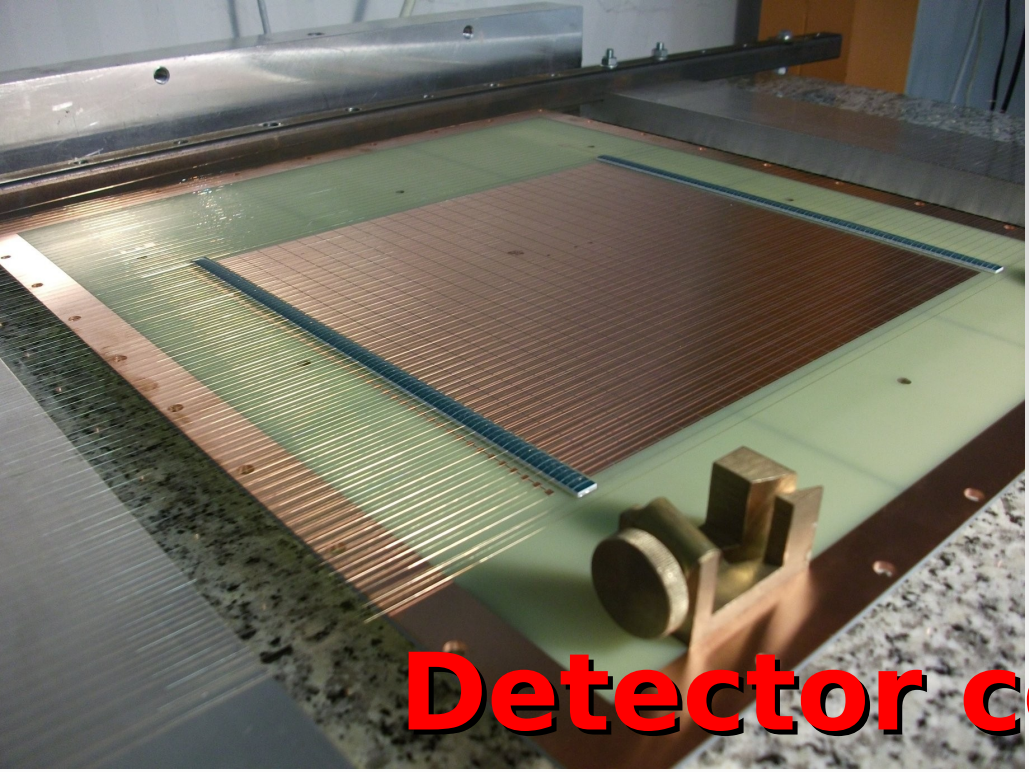
Cherenkov detector prototype

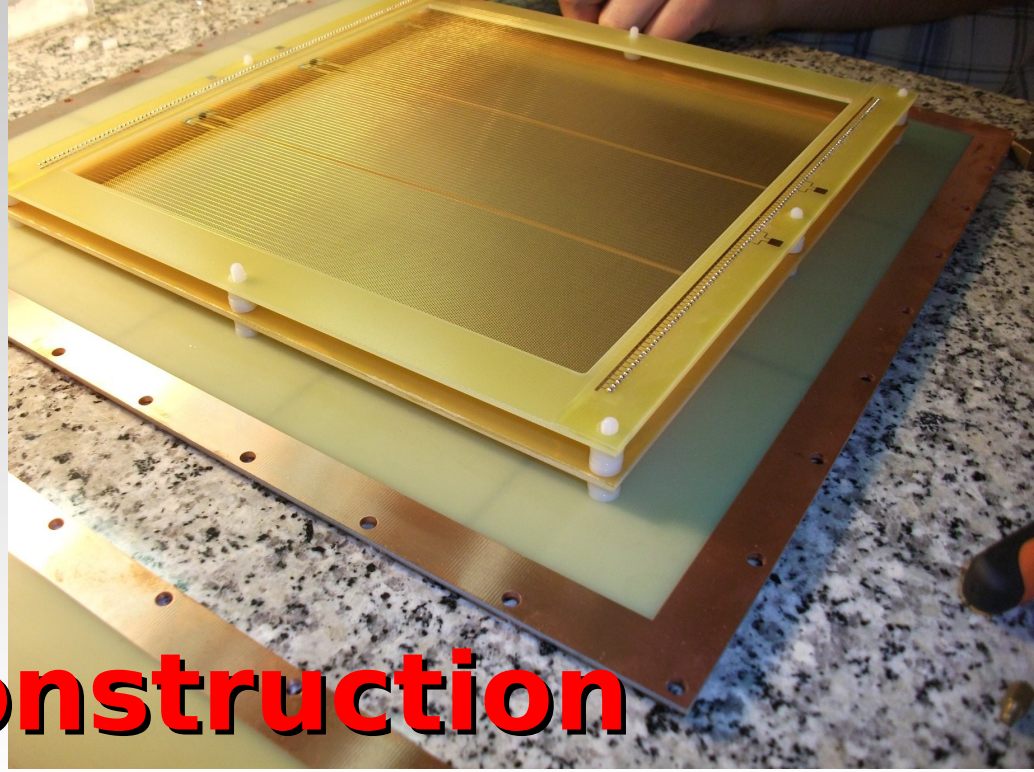




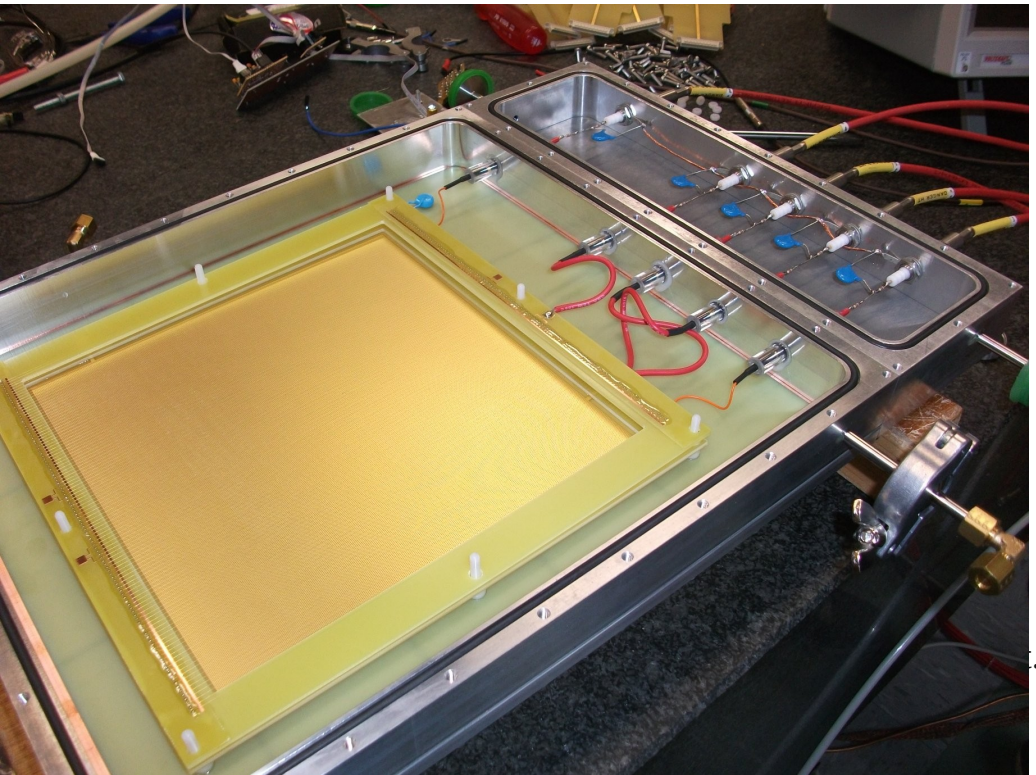


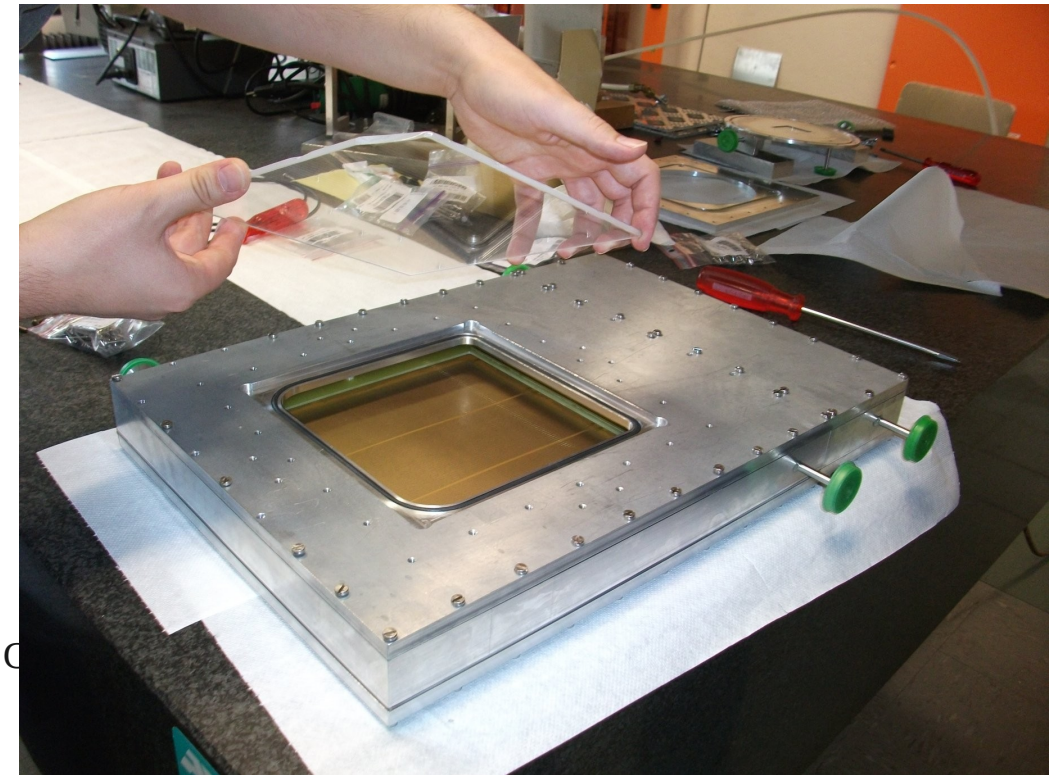
- Particle identification by Cherenkov ring imaging – few photons!
- Thick or thin GEMs are considerably cheaper than PM tubes, that is, larger area coverage for the same investment



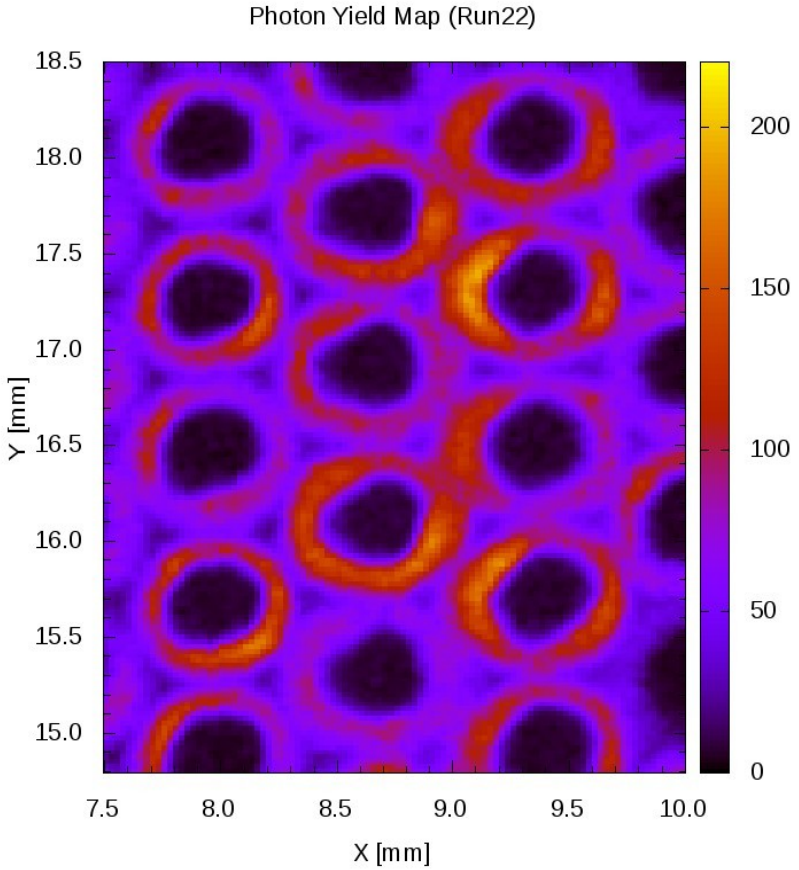


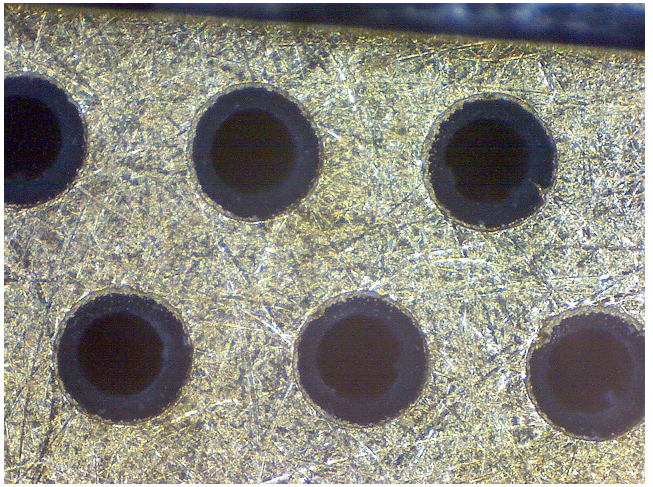
Detector construction

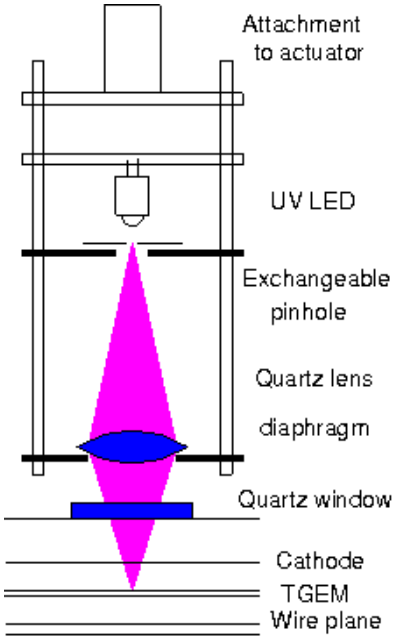




High resolution single UV photon scanning (diagnostics)







- Hole structure: sensitive rims and insensitive symmetry lines

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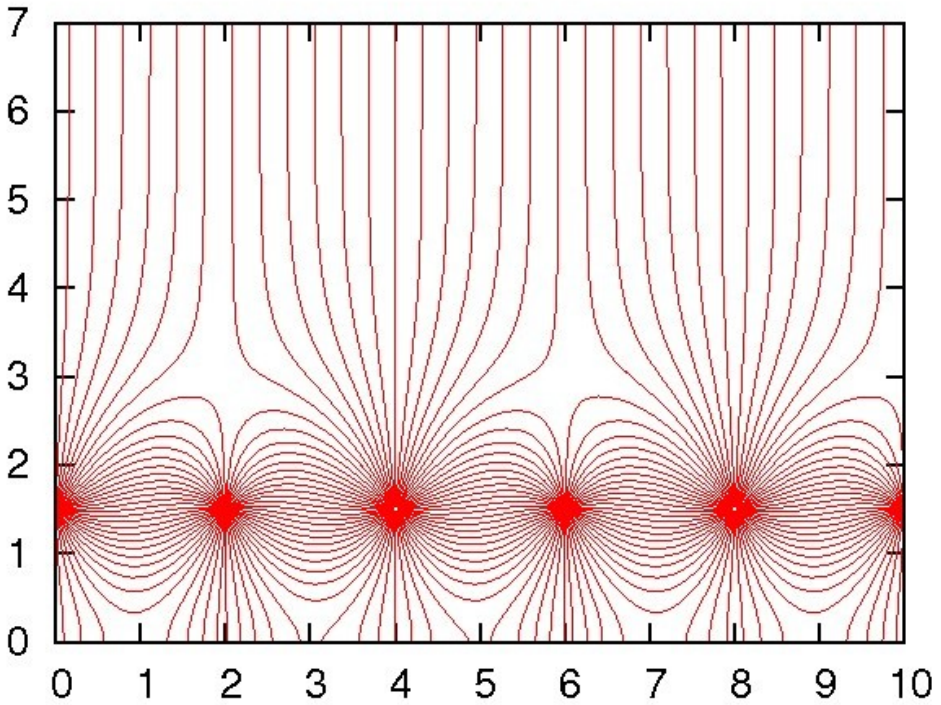
Close Cathode Chamber

- Electric field concentrated within the wire structure



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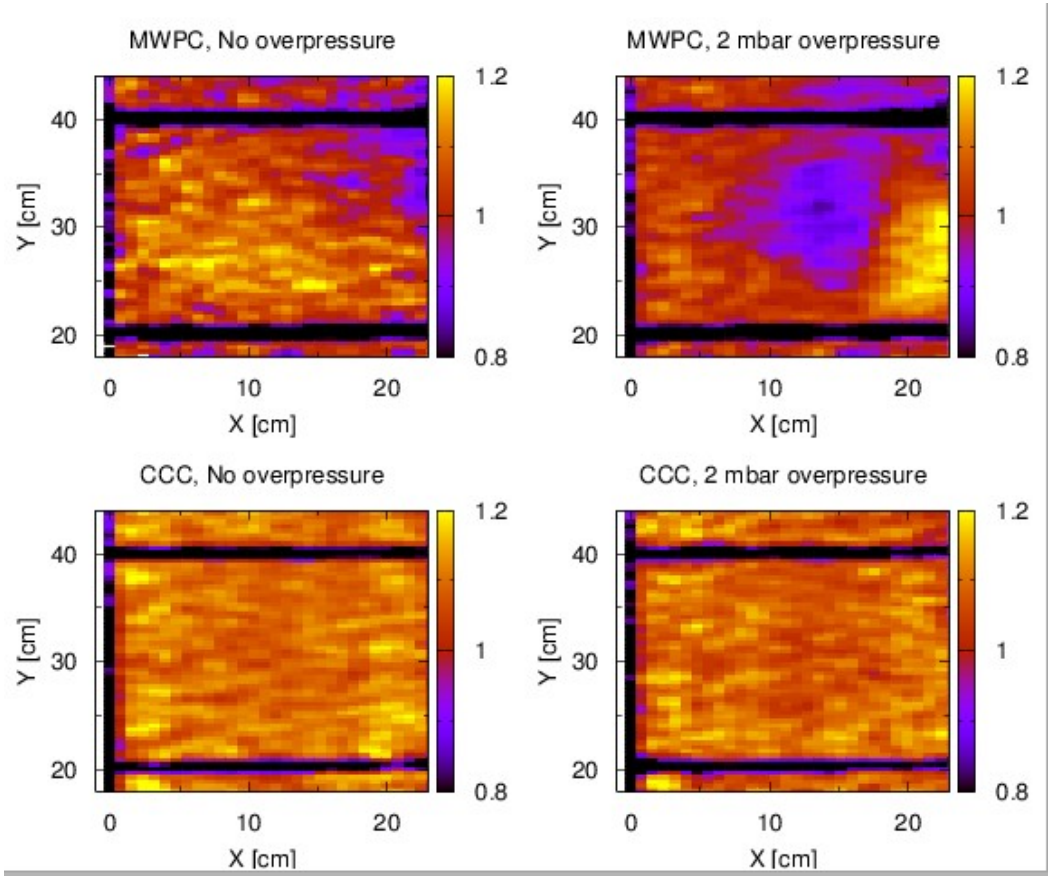

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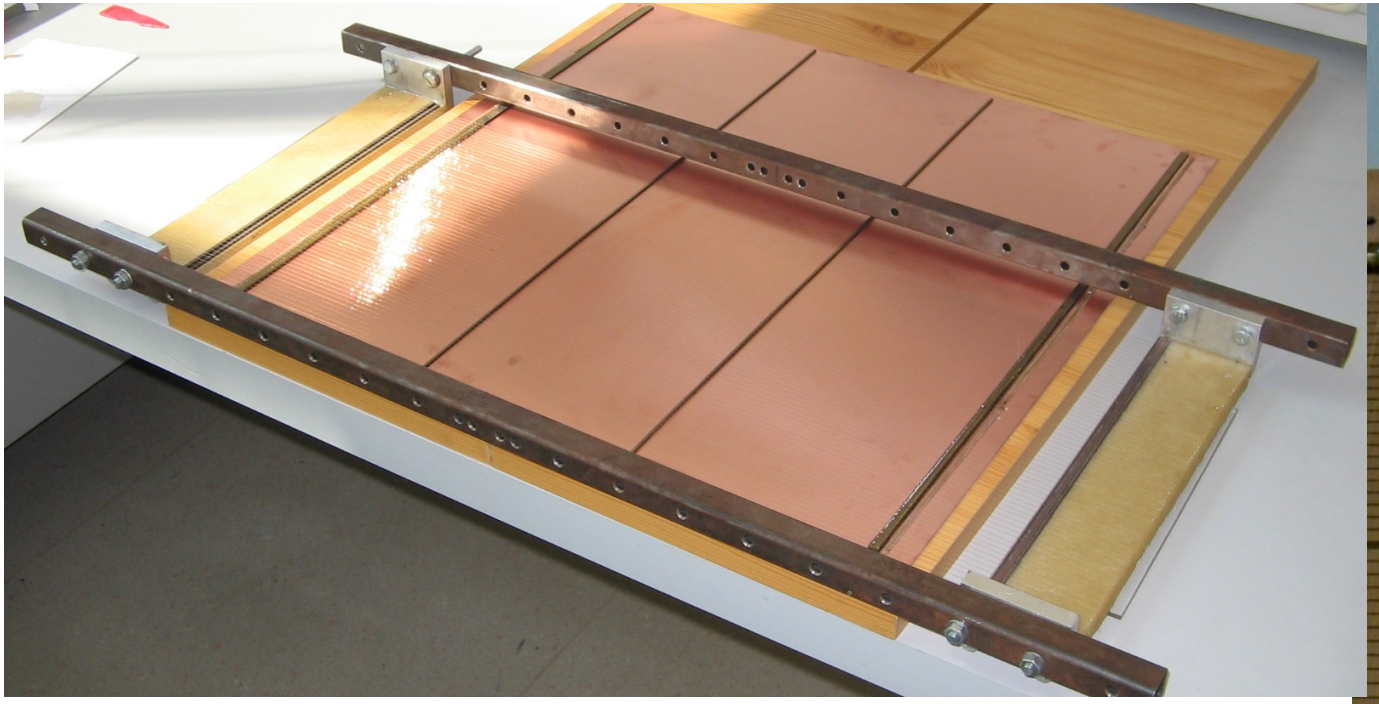
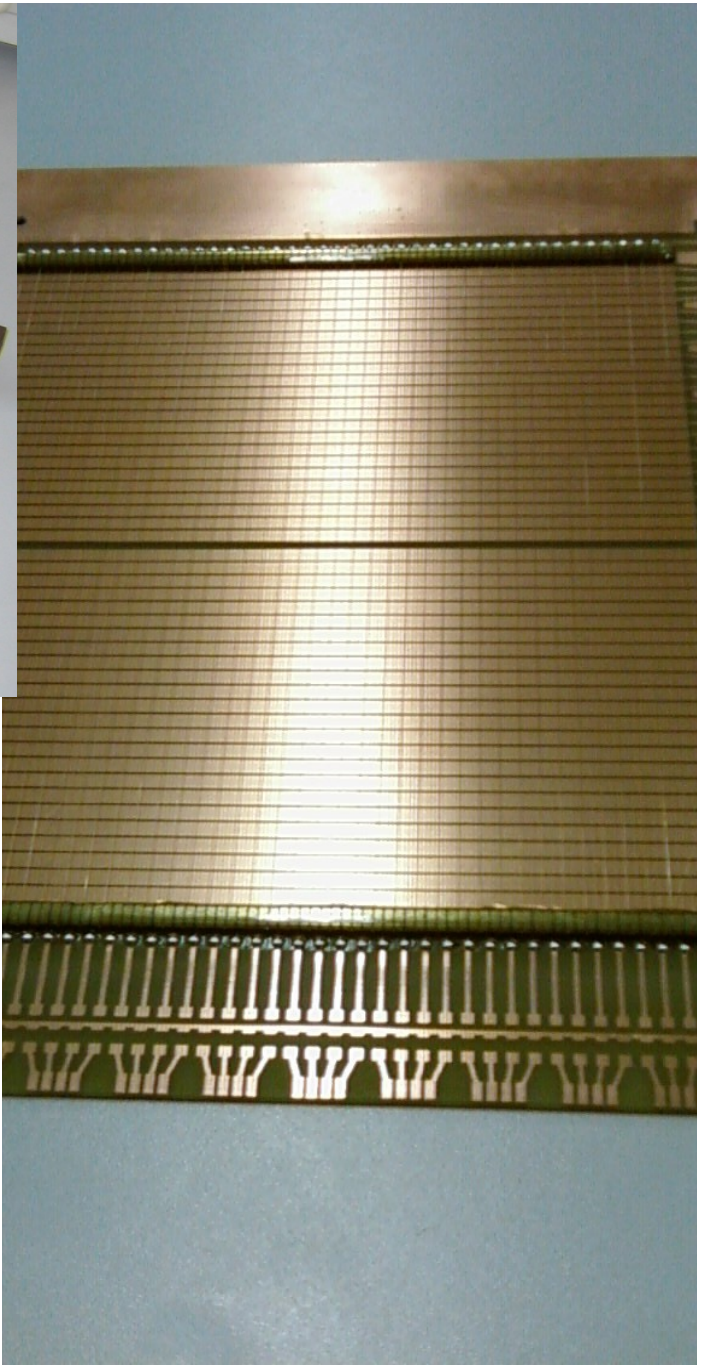
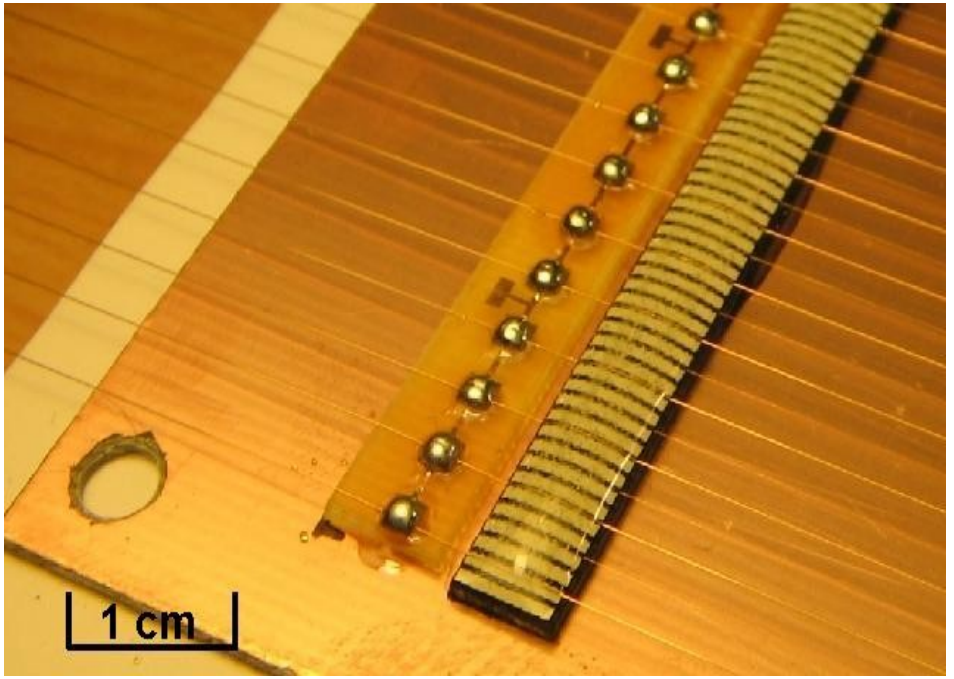


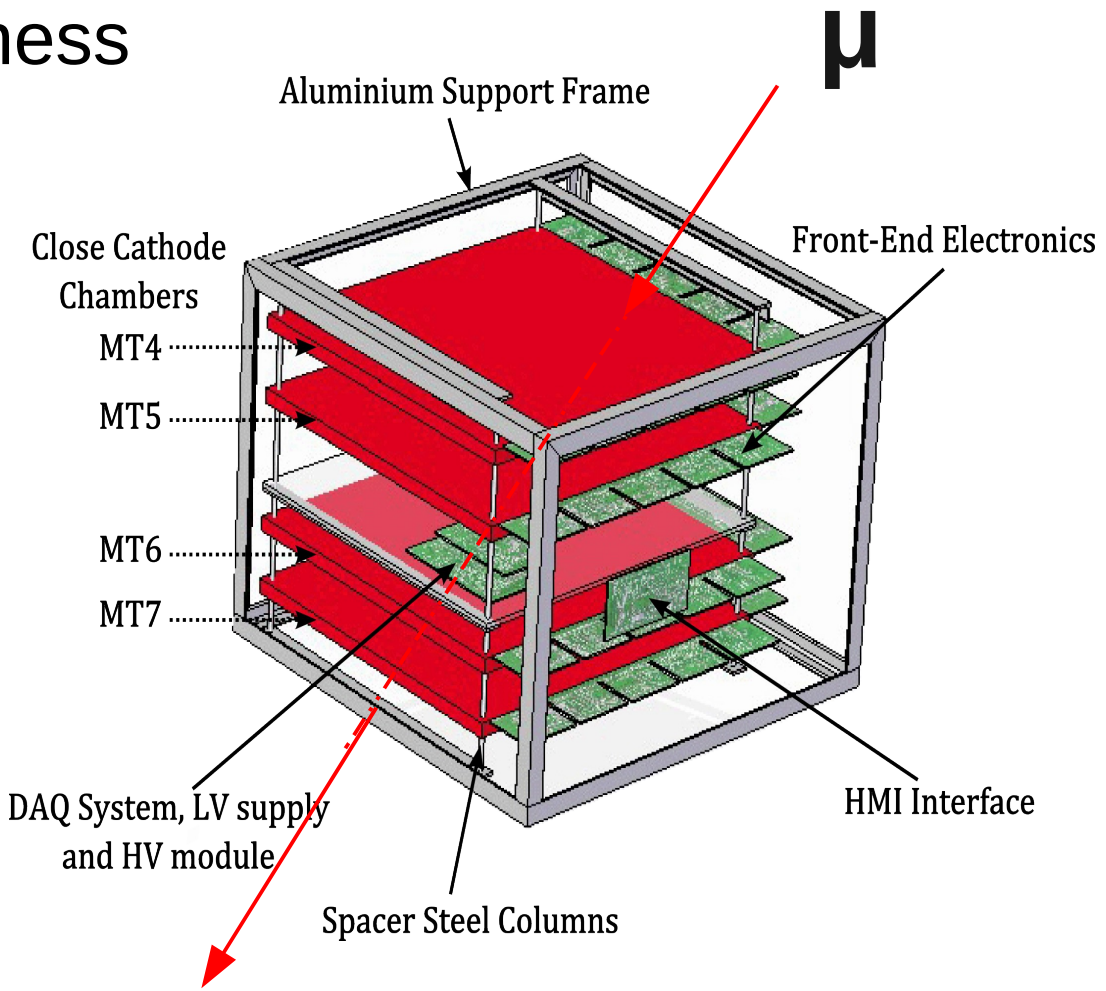



1 cm


… in the end, it is the size that matters...

Application of high energy physics detector technology: geophysical measurements

- Reconstructing soil thickness from flux measurement
- Optimized CCC tracking:
  - Mobile
  - Low power (< 5W)
  - Easy control (for non-experts)



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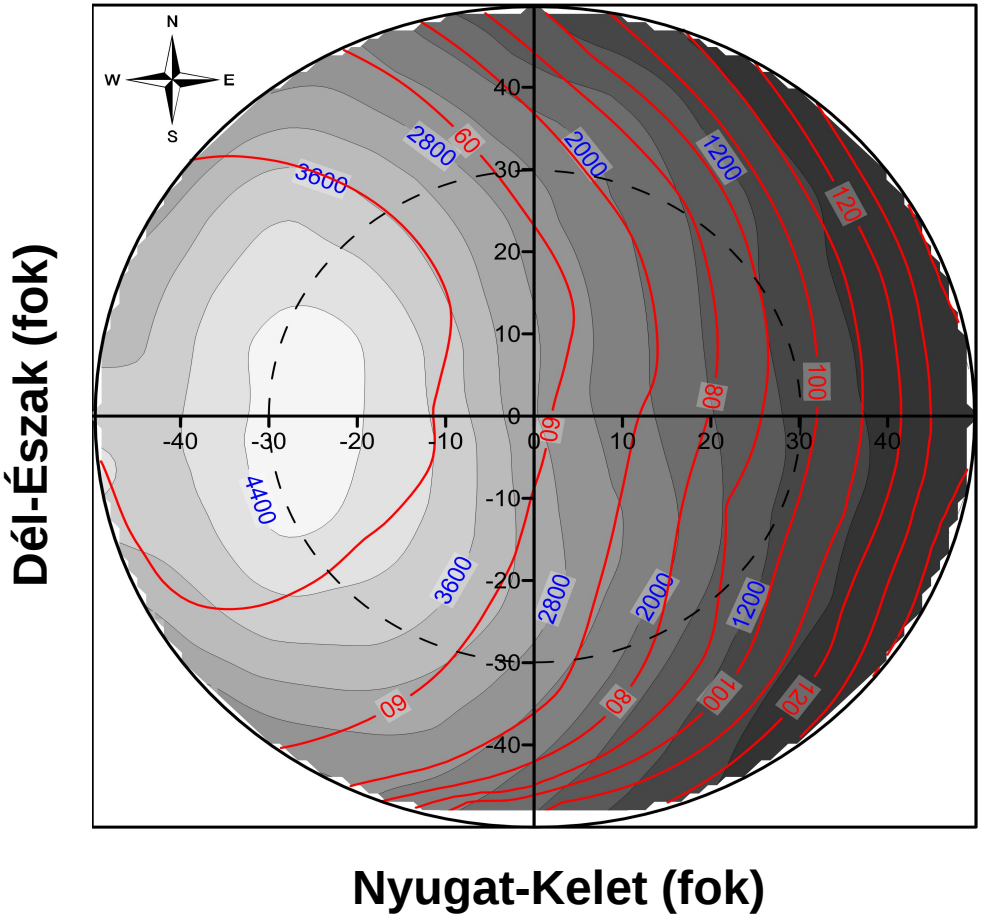
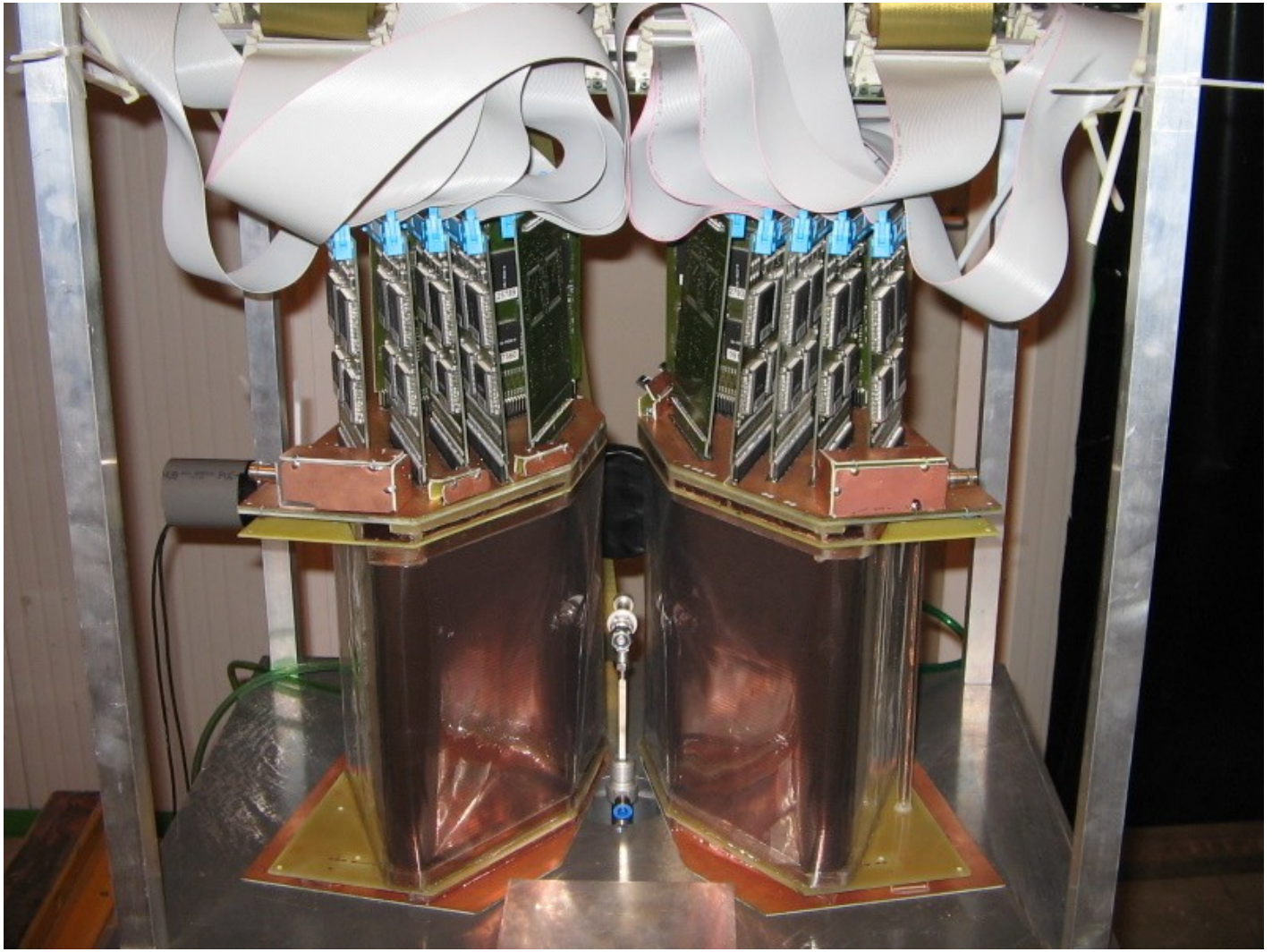
Searching unexplored cave tunnels with cosmic muons

(Pilis Mountains, Ajándék cave)



CERN NA61: small size TPC surrounding the target area

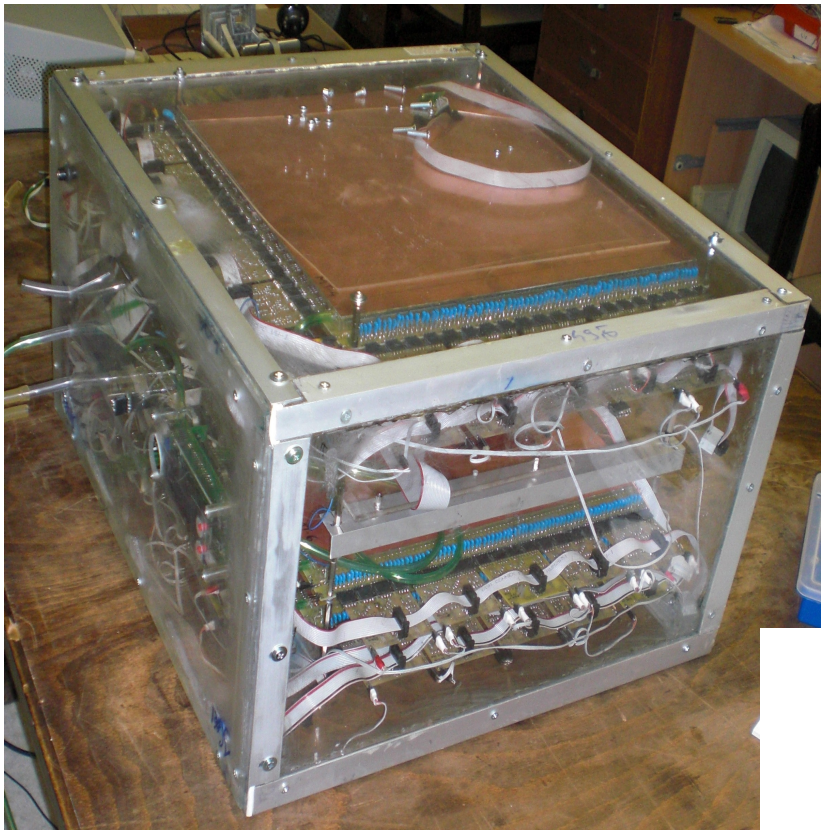


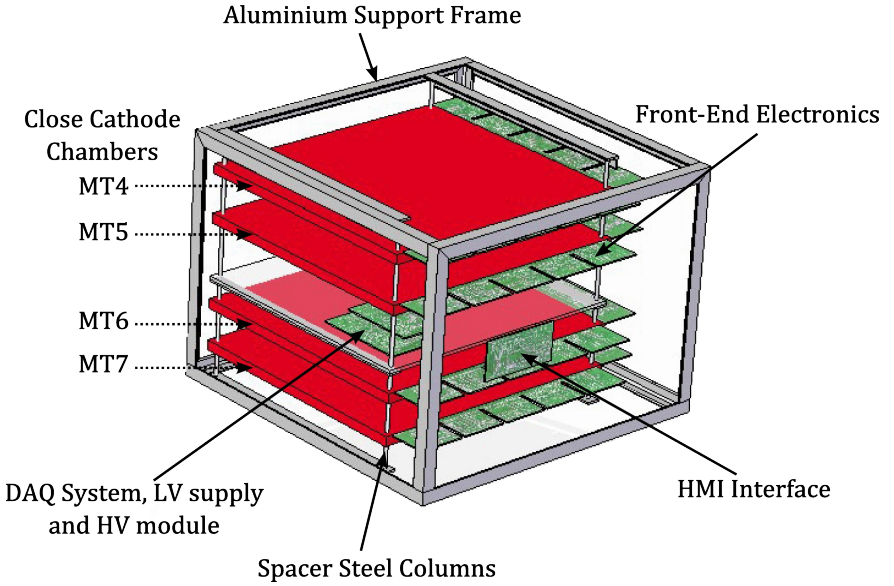
Outlook and future plans

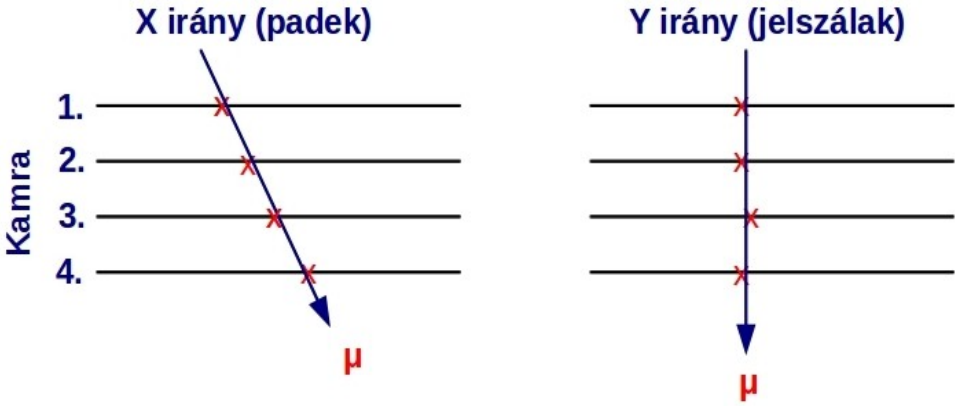
- Clean environment (under construction)
- High quality gas system (under commissioning)
- Lab refurbishing, electronics and technical environment upgrade

- ALICE TPC upgrade: joining the R&D and construction activities (GEM technology)

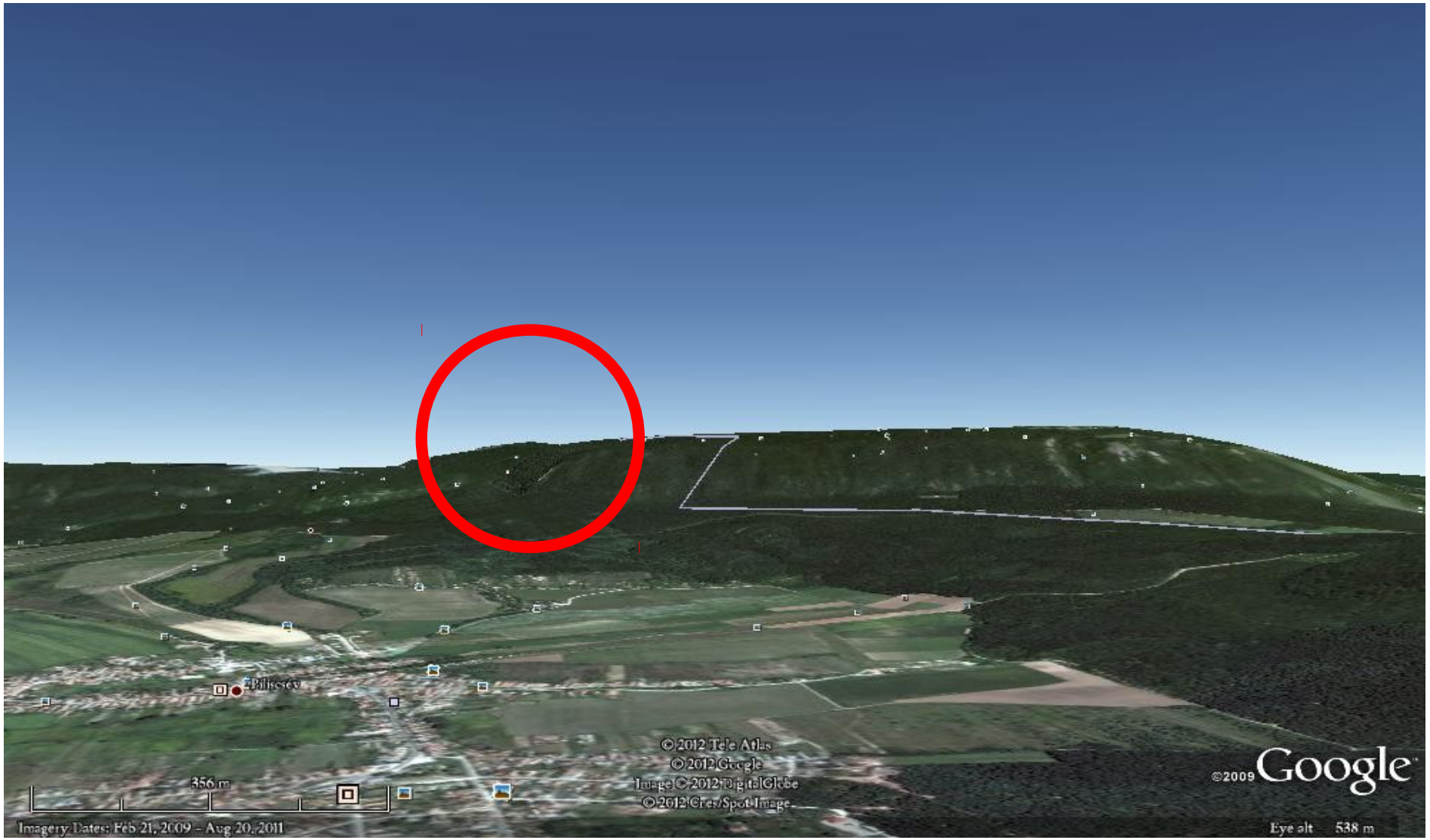
Tomographic imaging with muons: particle tracking







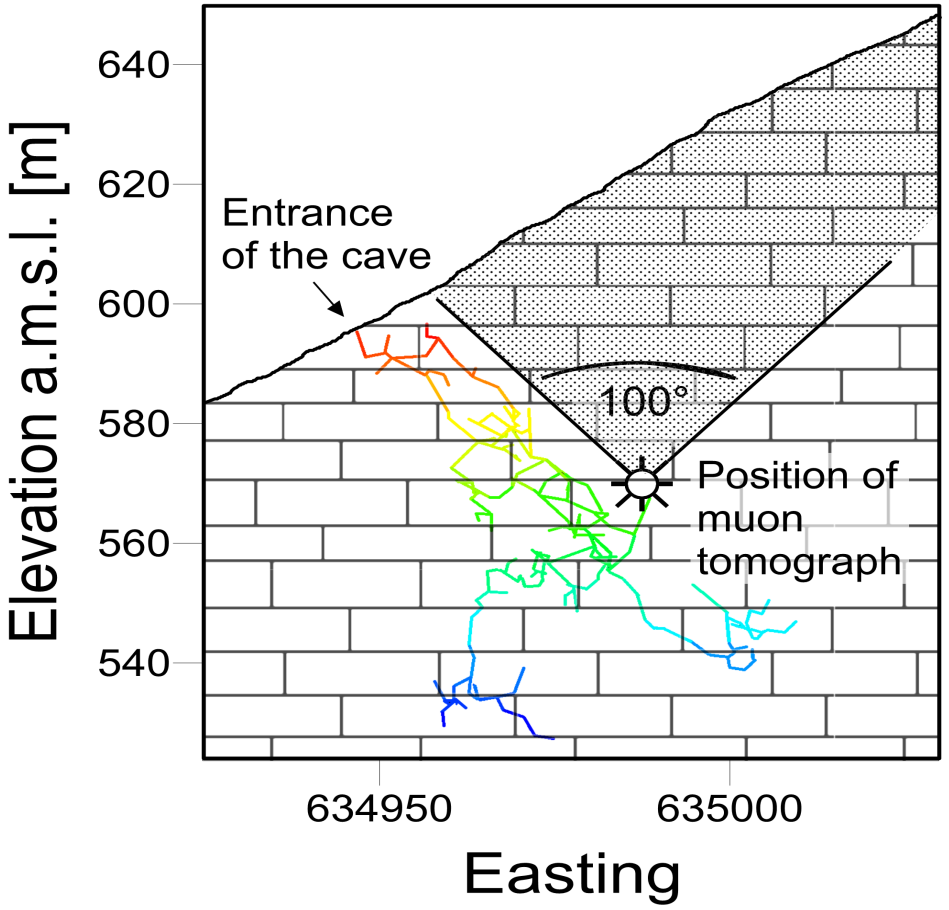
Pilis hegy, Ajándék Barlang



Ajándék Cave: part of a larger system

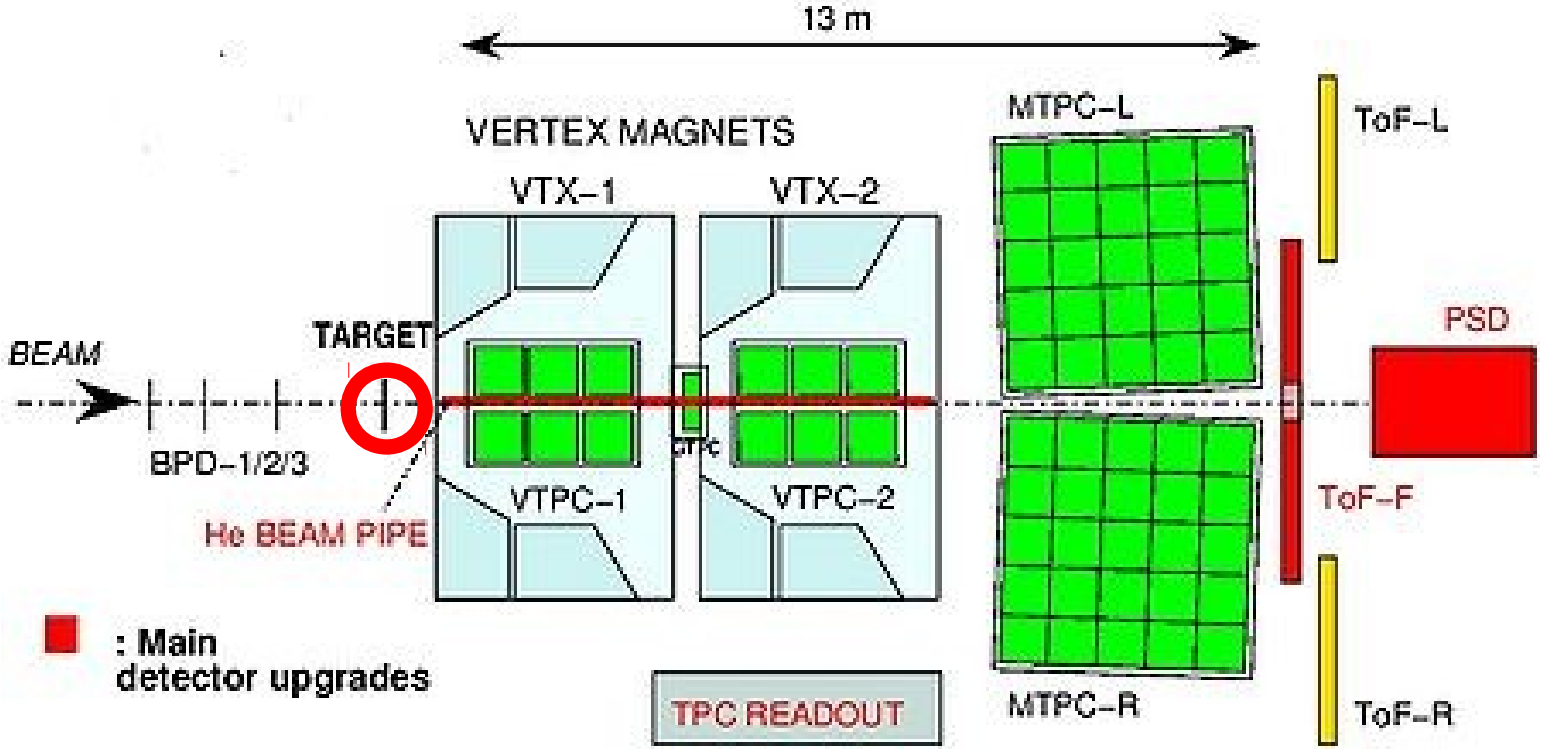
- Explored 1979-2001
- 50m depth

- Strongly inclined terrain towards West



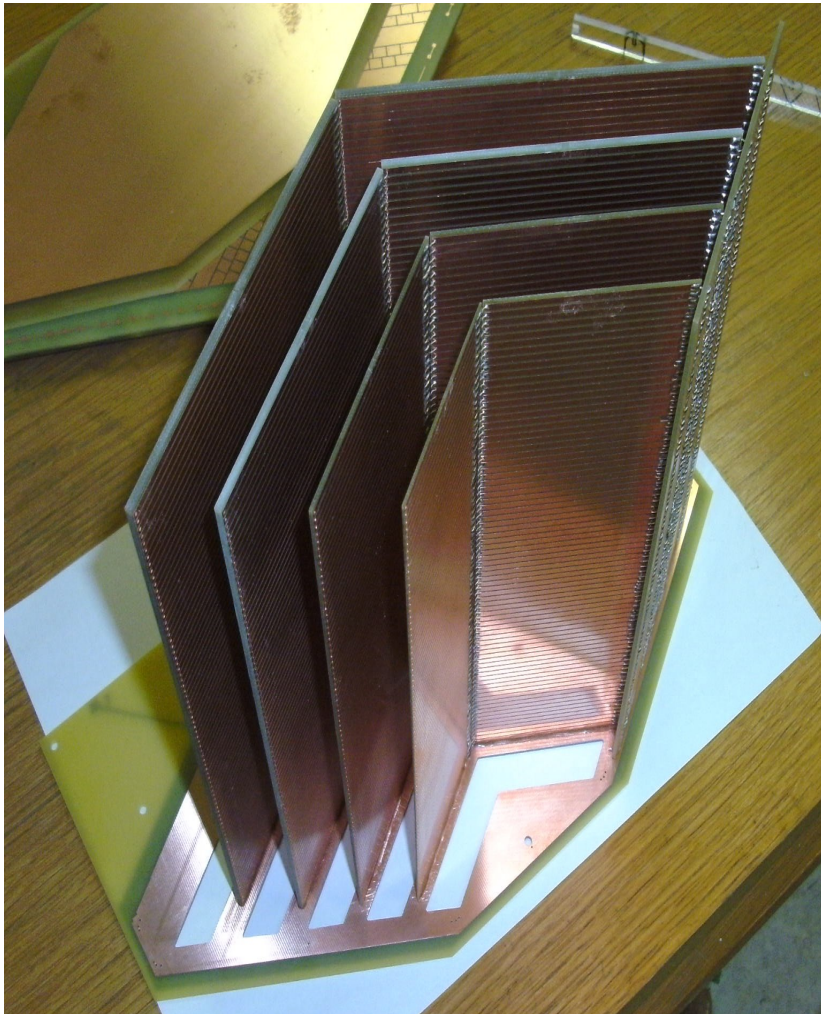

mse

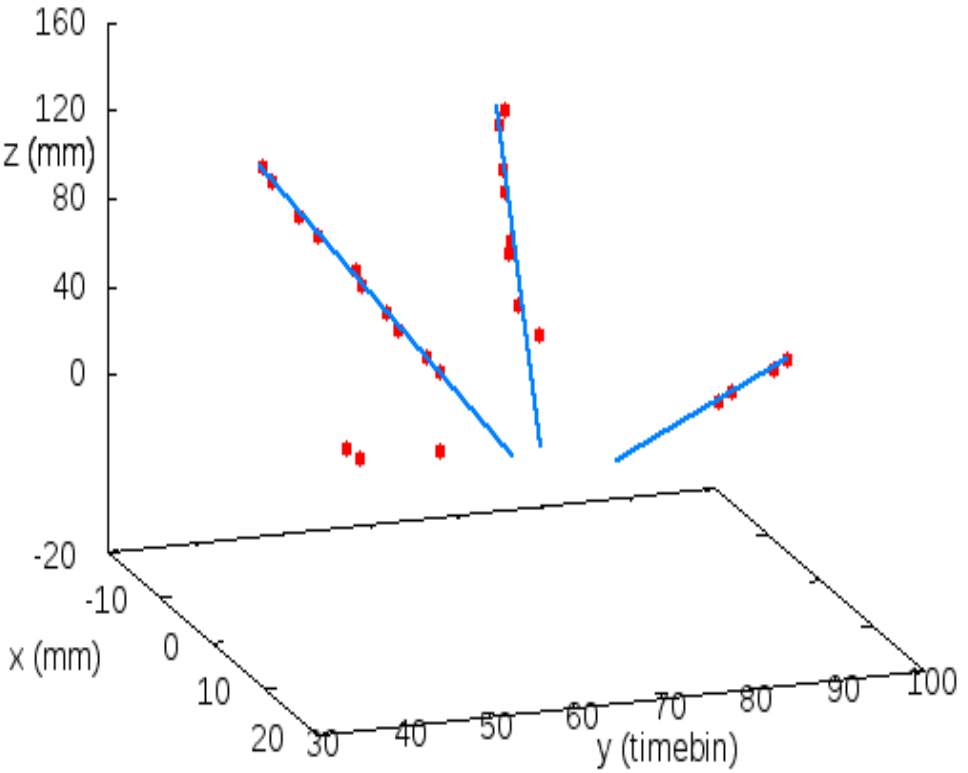
Low Momentum Particle Detector (LMPD) at CERN NA61



- **Particle Identification**: measurement of range and ionization (protons vs pions)

Operation in routine data taking in summer 2012





DAQ activities (details)

The detector building group has a long established tradition in developing high performance, reliable data transmission links for CERN experiments (ALICE, SHINE/NA61). We have a lot of experience in FPGA based hardware, firmware, and software development in the field of data communication

The ALICE Detector Data Link (DDL) development project was the major Hungarian engineering contribution (between 1996-2007) for building the LHC at CERN. Since 2007, a lot of follow-up developments and technical support have been provided for the ALICE DAQ group

Now all three major TPC detectors in the world (ALICE, SHINE (CERN), and STAR (BNL)) use the DDL system as the common interface between the detectors and the online system

The detector leading group preserved its major role in the future upgrades of the ALICE experiment, too. (Taking part in developments for Run2 : 2015-2016, and Run3: 2018-2019). We have undertaken the responsibility of the development of the new Common Read-out Units as the common interface between the upgraded detectors and the oline system

Selected publications

- REGaRD group:

DV., GH, GK: Asymmetric Multi-wire Proportional Chamber With Reduced Requirements ..., **Nucl. Inst. and Meth, A 648, 163-167, 2011**

HG, VD: Vastag GEM alapú trigger-detektor az LHC ALICE kísérletben, **NUCLEON** (Az MNT lapja), **II. évf. 2. sz. (2009) p.47**

******* HG,VD: High Resolution Surface Scanning of Thick-GEM for Single Photo-Electron Detection, **Nucl.Inst. and Meth. D-12-00226**

******* GGB, GH, HGM, LO,GS,DV: Portable Cosmic Muon Telescope for Environmental Applications, **Nucl. Inst. and Meth.D-12-00221**

- CERN collaboration:

A. Di Mauro, Z. Fodor, G. Hamar, D. Varga et al.: Very high momentum particle identification in ALICE at the LHC., **NIM A 617 (2010) 424**

L. B, A. A, G.G.B,, G. B, Z. F, E. F, G. H, L. K, P. Li, L. Mr, D. V: High-p(T) trigger detector... **Nucl.Phys.Proc.Suppl.197:296-301,2009**

A. Agocs, G. Hamar, Z. Fodor, D. Varga et al (ALICE VHMPID Coll.): VHMPID..., **Indian J.Phys.84:1635-1639**,2010

NA49 Collaboration: H. G. F, M. M, D. V, Z. F et al: Inclusive production of charged kaons in p+p collisions... **Eur.Phys.J.C68 1-73 (2010)**

A. Di Mauro, G. Bencze, Z. Fodor, G. Hamar, D. Varga et al: The VHMPID RICH upgrade project for ALICE , **NIM A 639, 274 – 277**, 2011

B D, A A.G, A R, BGG, B Gy, B L, F E, HG, KL, LP, L Cs, M L, P S, V D for VHMPID collaboration: VHMPID: a new detector for the ALICE experiment at LHC, **EPJ Web of Conferences Volume 13, 03004** (HCBM 2010)

M D, B Gy, HG, K L, V D, et al, for the VHMPID Coll.: A Very High Momentum Particle Identification, **AIP Conference Proc. 1348, 61**, 2011

- In preparation:

BGy, HG, VD: Close Cathode Chamber: Low material budget MWPC (NIM-A)

MK, AL, HG, VD: Low Momentum Particle Detector for the NA61 Experiment at CERN (NIMA)