Future Huntings for Very High Momentum PID Hadrons with Guy in ALICE

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Wigner RCP of the Hungarian Academy of Sciences

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Symposium in Honor of Prof. Guy Paic, UNAM Mecixo D.F., Mexico 30th October 2017

Collaboration with a pessimistic optimist...

Collaboration with a pessimistic optimist...

Be positive, but think on all issues as ‘worst case’ scenario!

Collaboration with a pessimistic optimist...

- 1990 Prehistoric time (slides taken from Jürgen)
- 1992 Hungary @ CERN (J. Zimányi, G. Vesztergombi)
- 1996 Hungary @ ALICE (G. Vesztergombi)

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H. Satz	SATZ@ CERNVM	CERN-TH
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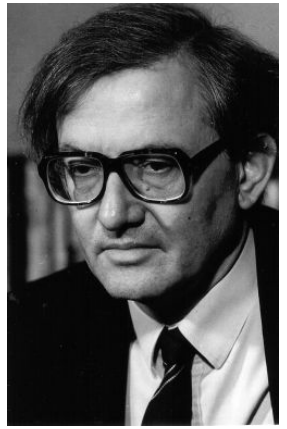
[illegible]	CASTOR	LPC Clermont-Ferrand



Collaboration with a pessimistic optimist...

- 2005 I joined to ALICE HMPID
  - Join the ‘high table’ in Utrecht ALICE week
- 2006 one month ‘PostDoc’ at UNAM (HELEN)
  - Basics of the analysis, computing, AliROOT, HMPID
  - Jet studies, jet quenching, etc: S. Pochybová, Gy. Bencédi, A. Agócs, L. Molnár
- 2009-2013 VHMPID (proto) collaboration
  - An UG proposal for the HMPID ALICE detector
  - Mexican-Hungarian bilateral grant for 2 years
- 2015- Next generation (Analysis in HMPID & TPC with TPC UG)
  - Gy. Bencédi with Antonio, Hector & Guy (ePLANET)
  - ALICE Analysis: 13 TeV pp data
  - Croatian-Hungarian ‘Monarchy’ collaboration: Mirko Planicic (Zagreb) → TPC UG (nanoamp meter R&D)

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Altas energías y impulsos...

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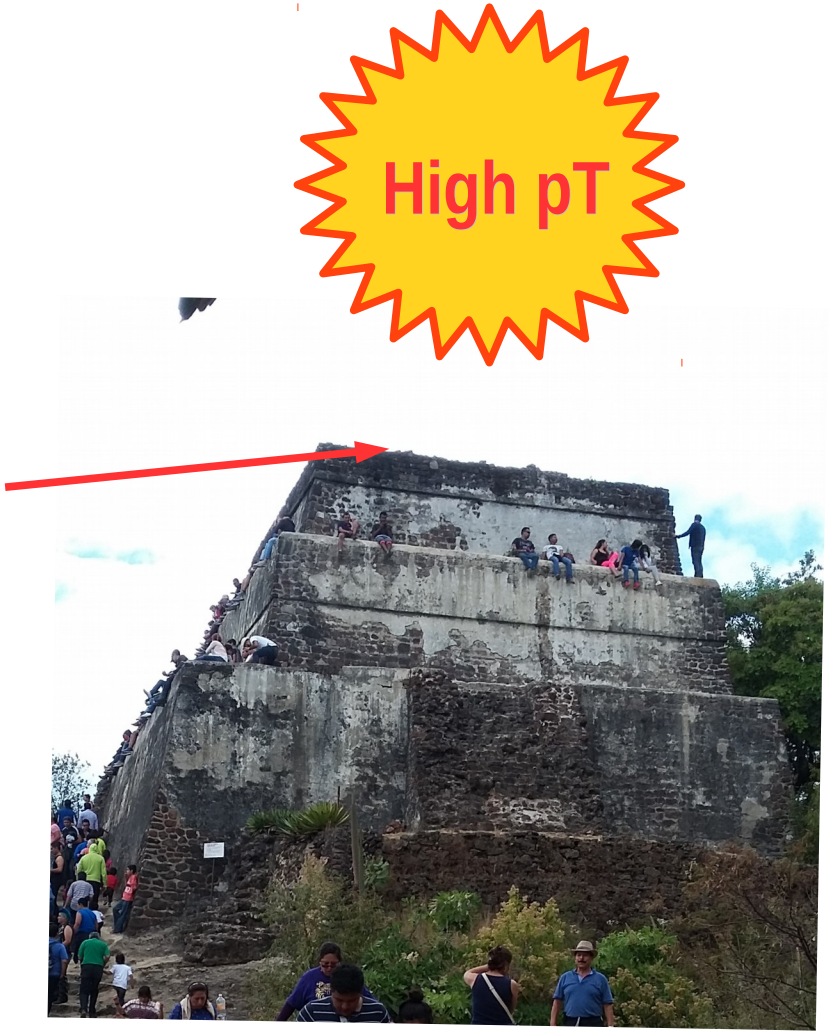

Altas energías y impulsos...

High pT

The Very High Momemtum PID Detector

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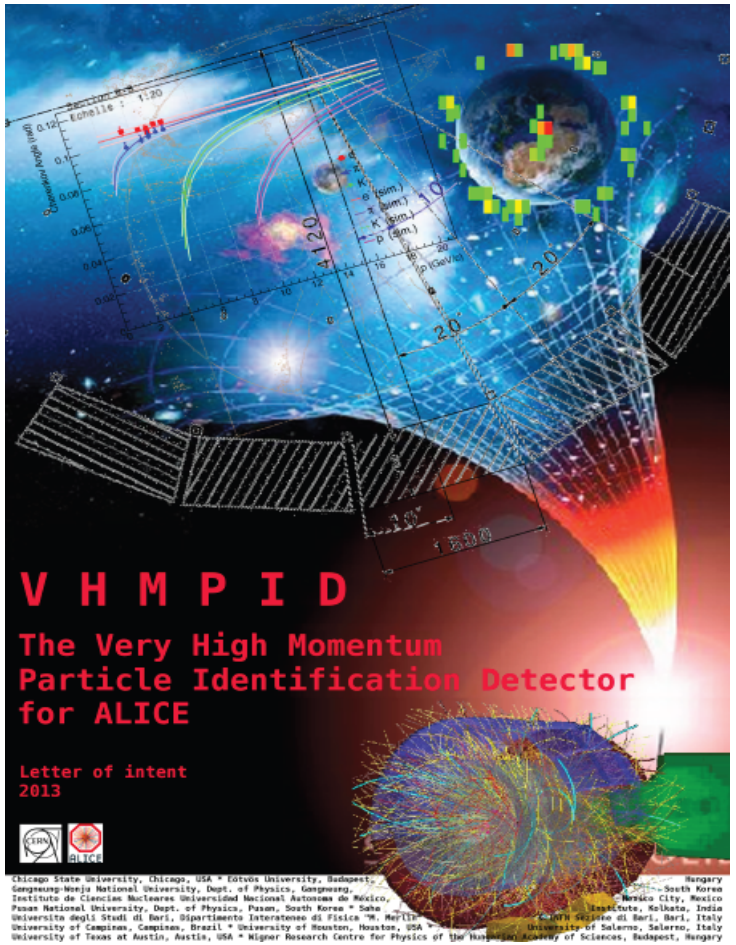

Participating Institutions:

Austin (USA), Bari (Italy), Budapest (Hungary), Campinas (Brazil), Chicago (USA), Gangneung (South Korea), Houston (USA), Kolkata (India), Mexico City (Mexico), Pusan (South Korea), Salerno (Italy)

12 institutions (~60 scientists)

major R&D contributions from CERN and Yale (USA) and contributions from LLNL (USA)

The Very High Momemtum PID Detector

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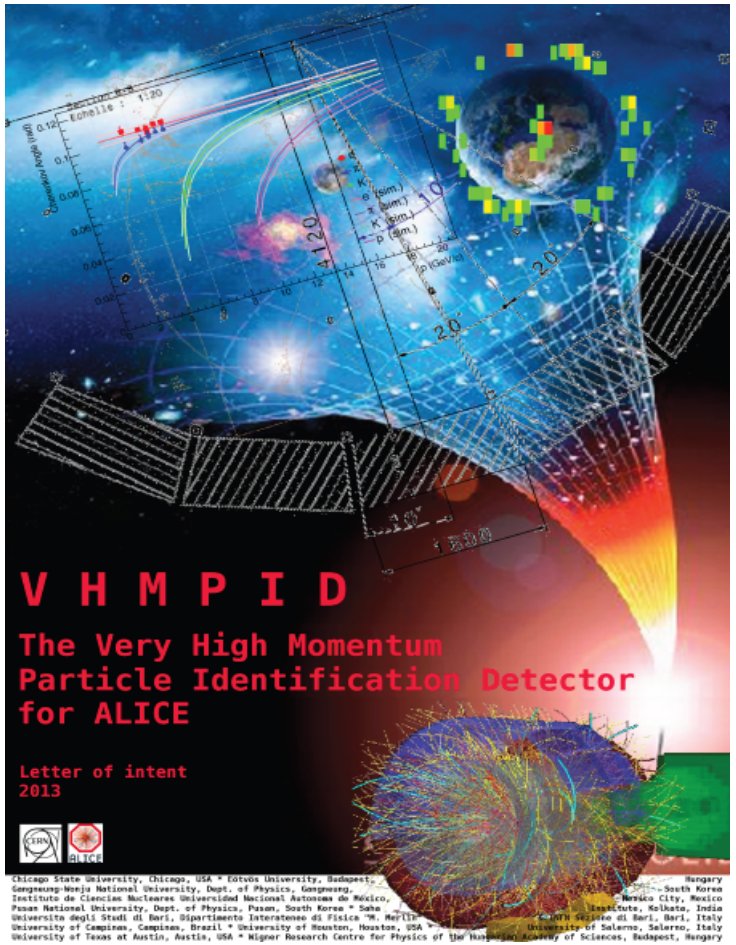

Participating Institutions

Chicago State University, Chicago, IL, USA
E. García, A. Harton

Eötvös University, Budapest, Hungary
L. Oláh, D. Varga

Gangneung-Wonju National University, Dept. of Physics, Gangneung, South Korea
D.W. Kim, J.S. Kim

Instituto de Ciencias Nucleares Universidad Nacional Autónoma de México, Mexico City, Mexico
R.T. Jimenez, D. Mayani, G. Paić, M.E. Patino, V. Peskov

Pusan National University, Dept. of Physics, Pusan, South Korea
J. Song, J. Yi, I.-K. Yoo

Saha Institute, Kolkata, India
S. Chattopadhyay, T. Sinha, D. Das, K. Das, L. Das-Bose, D. Das

Universita degli Studi di Bari, Dipartimento Interateneo di Fisica "M. Merlin" & INFN Sezione di Bari, Bari, Italy
F. Barile, G. De Cataldo, D. Di Bari, E. Nappi, C. Pastore, D. Perrino, I. Sgura, G. Volpe

UNICAMP, University of Campinas, Campinas, Brazil
T. V. Acconcia, A. K. Dash, J. Takahashi

University of Houston, Houston, USA
R. Bellwied, D. D. Chinellato, L. Pinsky, A. Timmins, M. Weber

University of Salerno, Salerno, Italy
S. D'Ambrosio, F. Cindolo, S. De Pasquale, G. Iannone, G. Patimo

University of Texas at Austin, Austin, USA
A. Knospe, C. Markert, L. Xaplanteris

Wigner RCP of the HAS, Budapest, Hungary[1]
A.G. Agócs, G.G. Barnaföldi, Gy. Bencédi Gy. Bencze, D. Berényi, L. Boldizsár, E. Futó, G. Hamar, L. Kovács, P. Lévai, L. Molnár, S. Pochybová

The Very High Momemtum PID Detector

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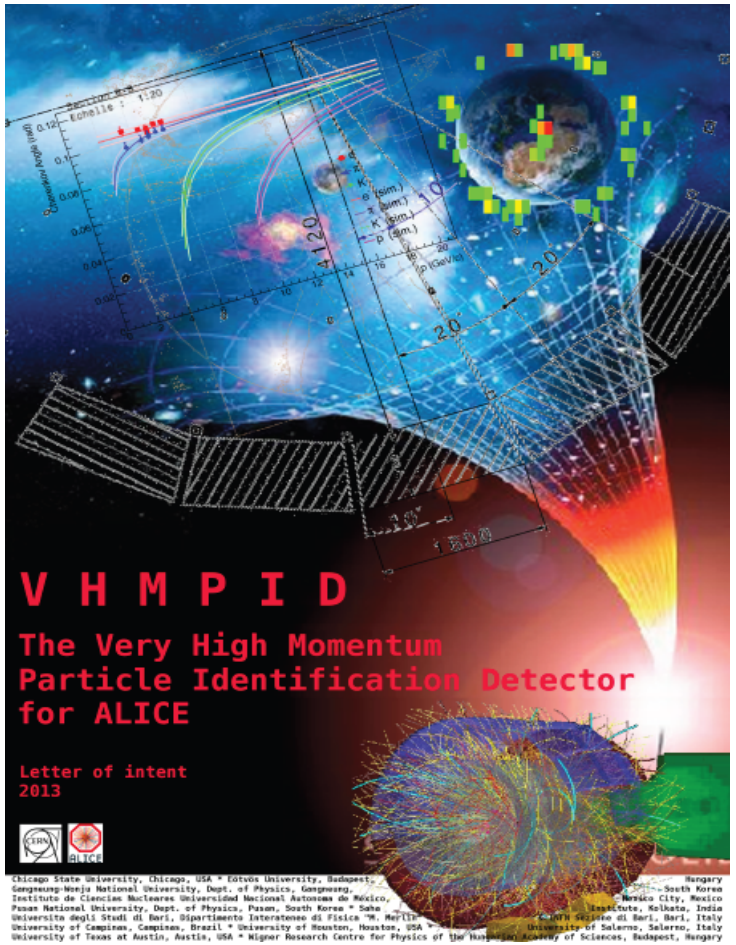


Project component	Participating institutions
Project Management	Chicago, Bari
Detector Design	Houston, LLNL
Detector Machining	Austin, Houston, LLNL
Photon Detector	Kolkata, Mexico City
FEE	Budapest, Kolkata, Salerno
Tracking layer	Budapest, Kolkata
Gas system	Pusan, Bari
Cooling system	Bari, Pusan
Mirrors	Chicago, Houston
DCS, HV, LV	Bari, Campinas, Gangneung
Integration	CERN, Houston
Detector software & simulations/analysis	Bari, Chicago, Mexico City, Houston, Campinas, Budapest

The proposed physics goals

Unique proton-proton physics

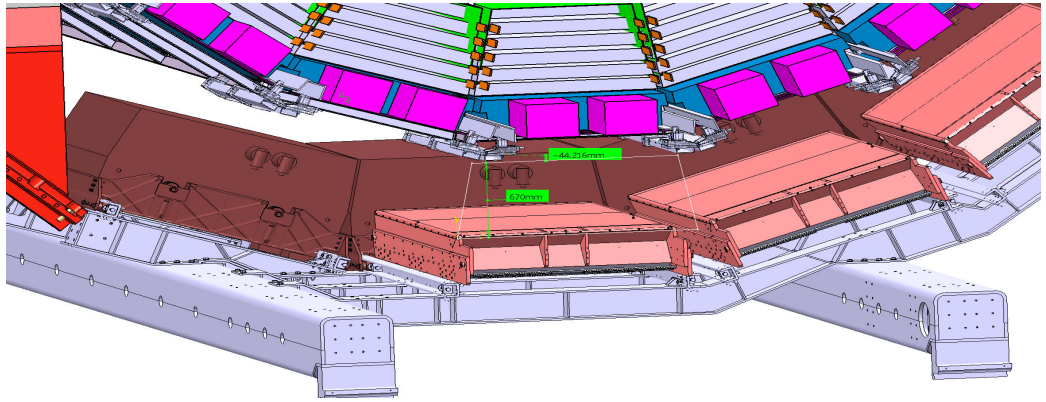
- Determination of **baryon fragmentation functions** via proton in jets
- Determination of **charmonium production process** via PID characteristics in sub-leading heavy quark jet.
- Determination of **quark vs gluon fragmentation** by measuring hadro-chemistry in tagged jets.

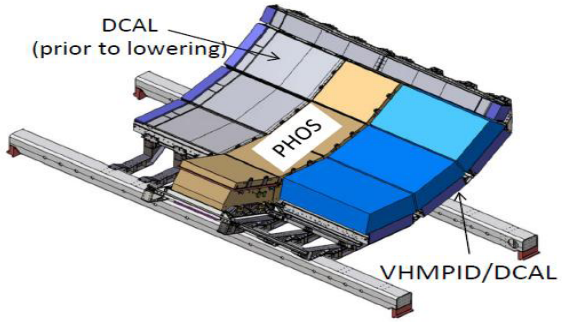
Unique heavy ion physics

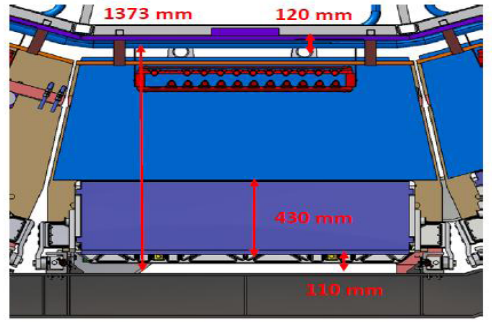
- Determination of cause of **baryon puzzle** at intermediate to high pT through measurement of hadro-chemistry in tagged jets
- Determination of **gluon splitting process** (energy loss in medium) through measurement of **hadro-chemistry in jets**.
- Determination of medium **modification and gluon/quark fragmentation**
- Determination of **baryon/anti-baryon imbalance** through pT dependent proton/anti-proton measurement in medium
- Determination of **hadronic resonance modification** in medium at high pT

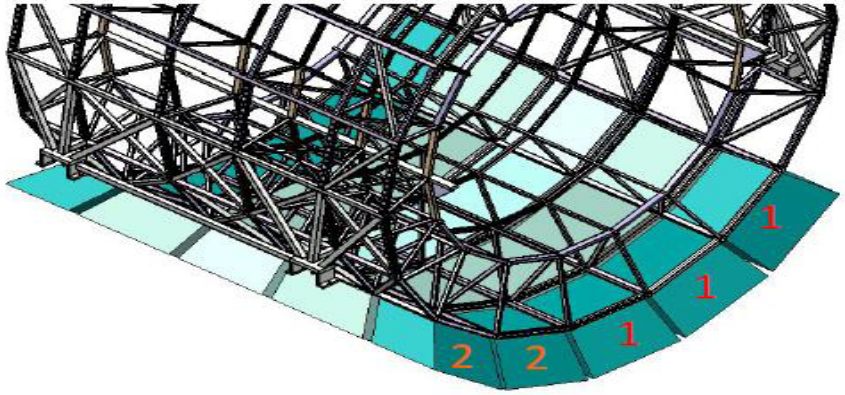
How to place?

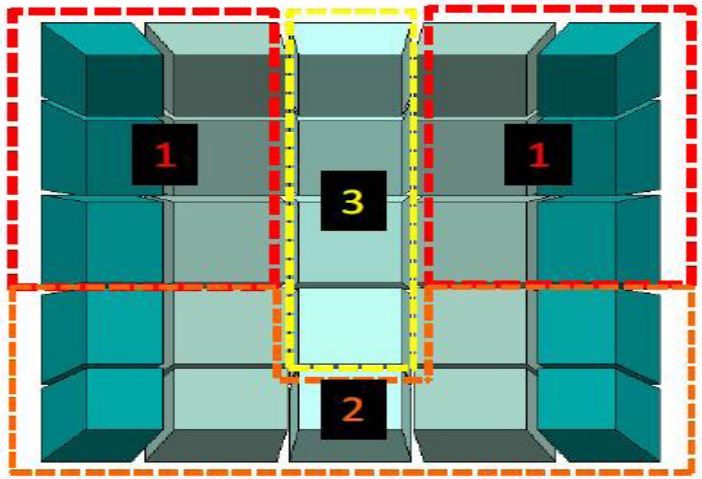
- Detector can be built in three stages (DCal, VHMPID, PHOS areas)
  - covers ~30% of TPC acceptance
  - integration with DCal and PHOS feasible
- Eight test beam times during 2011-12:
  - Proof that pressurized radiator vessel works
  - Proof that readout in the visible is possible
  - Proof that GEM readout option is possible





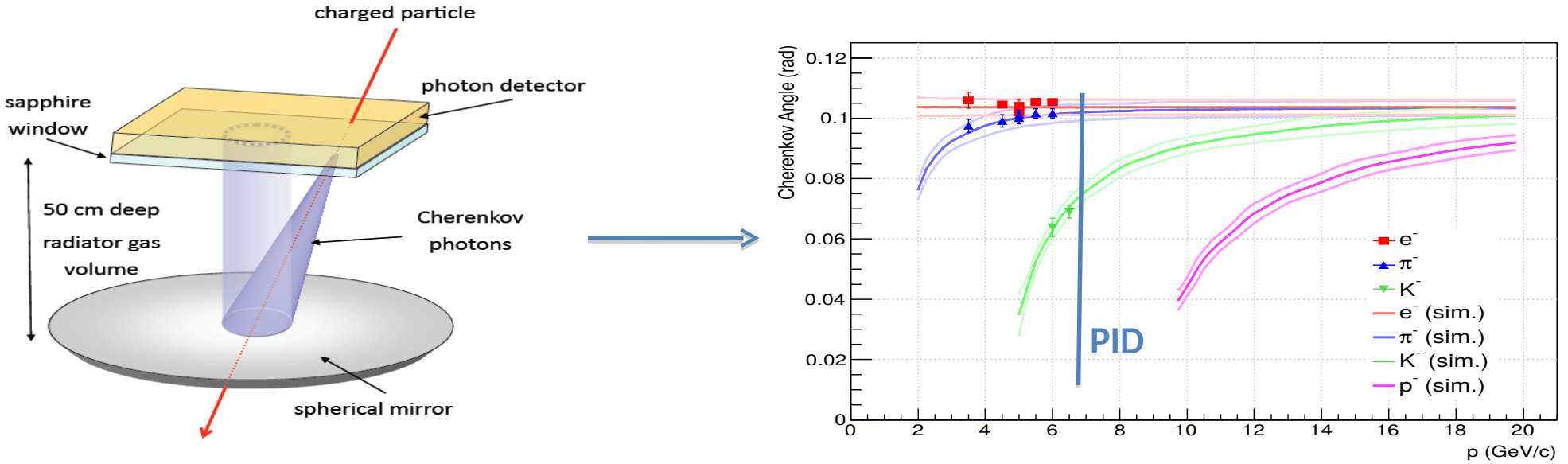






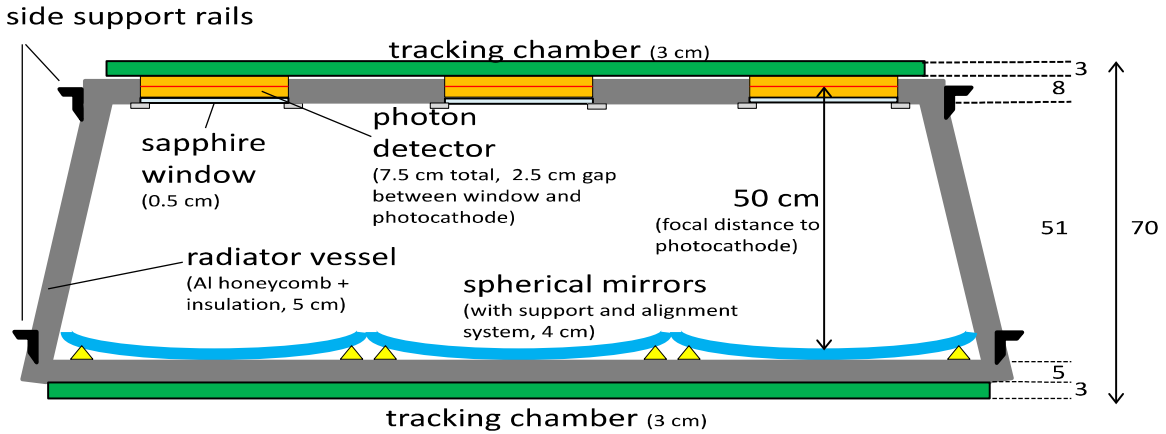
The VHMPID deliveries

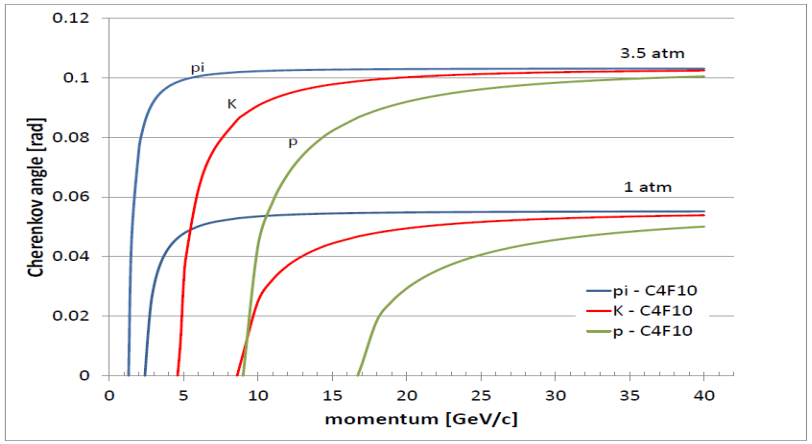
- Unique capability of ALICE to a new regime (**p_T = 5-25 GeV/c**) to perform new measurements possible with a VHMPID in combination with calorimetry (Jets up to R~0.7).
- PID in this momentum regime requires a **pressurized gaseous RICH** detector.
- Thin layout (~70 cm) enables **integration in front of DCal modules**.
- Detector resolution (~1.5 mrad) allows for **3σ p/K separation up to 25 GeV/c, π/K separation from 5 GeV/c** on.

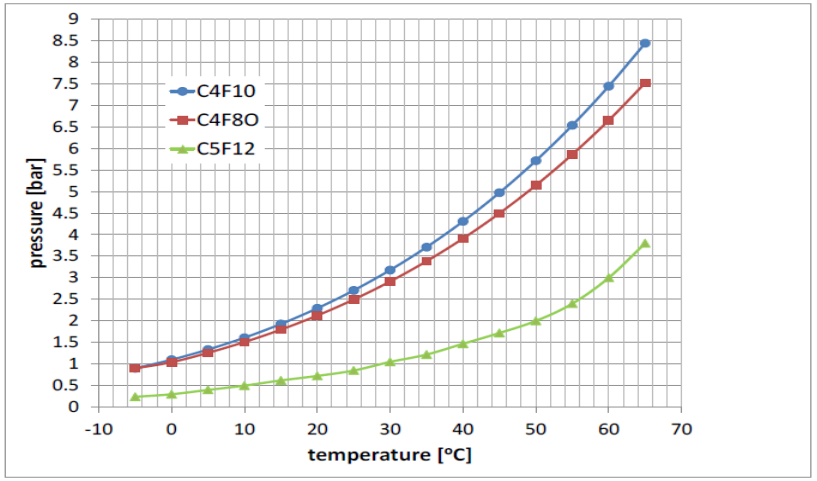


A special detector techniques

Pressurized radiator gas vessel using focusing geometry



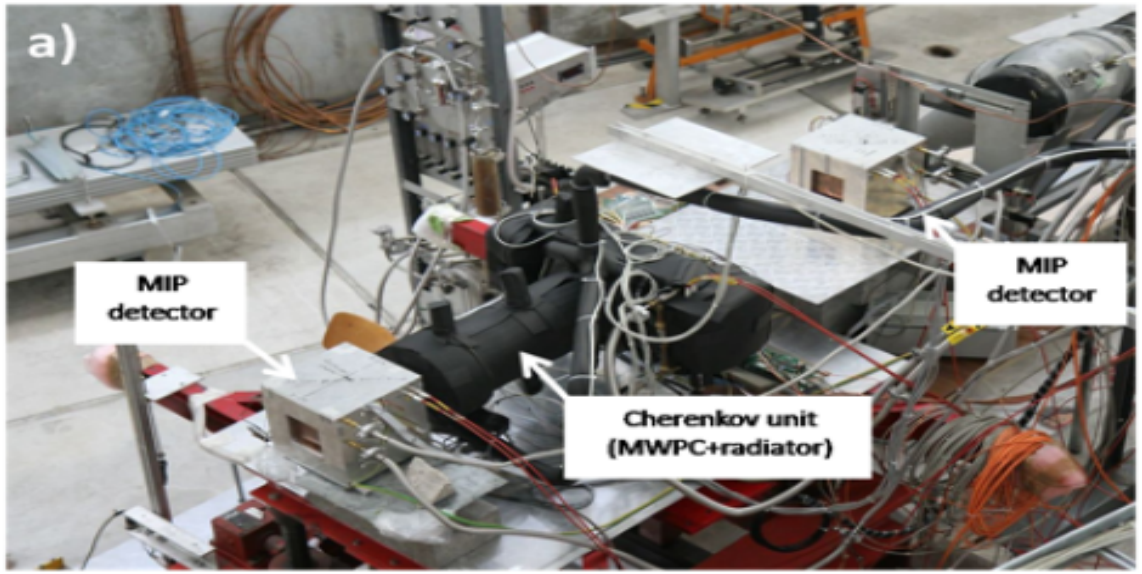


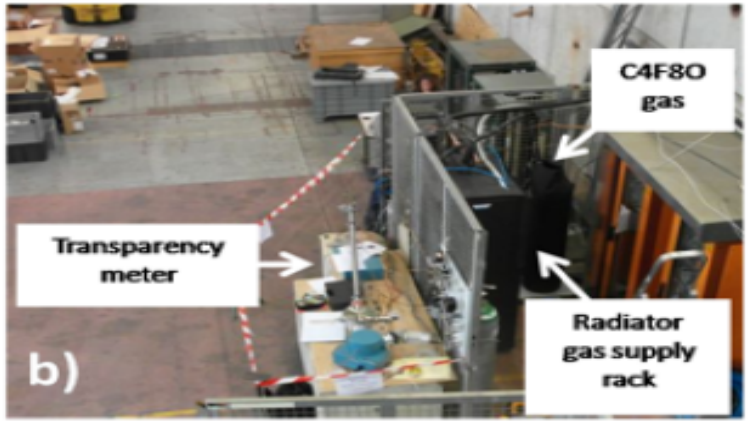


Details:

Focusing	RICH
Radiator:	3.5 bar C_4F_8O
Photon detector:	MWPC
Window:	Sapphire
Mirrors:	3x3

The beam test performed at CERN





Full VHMPID setup:

- MIP detectors
- Pressurized radiator
- Photon detector (MWPC)
- Online radiator gas transparency meter
- Automatized radiator gas control

Test program:

- Photon detection performance
- Cherenkov angle resolution
- Particle separation

The beam test performed at CERN

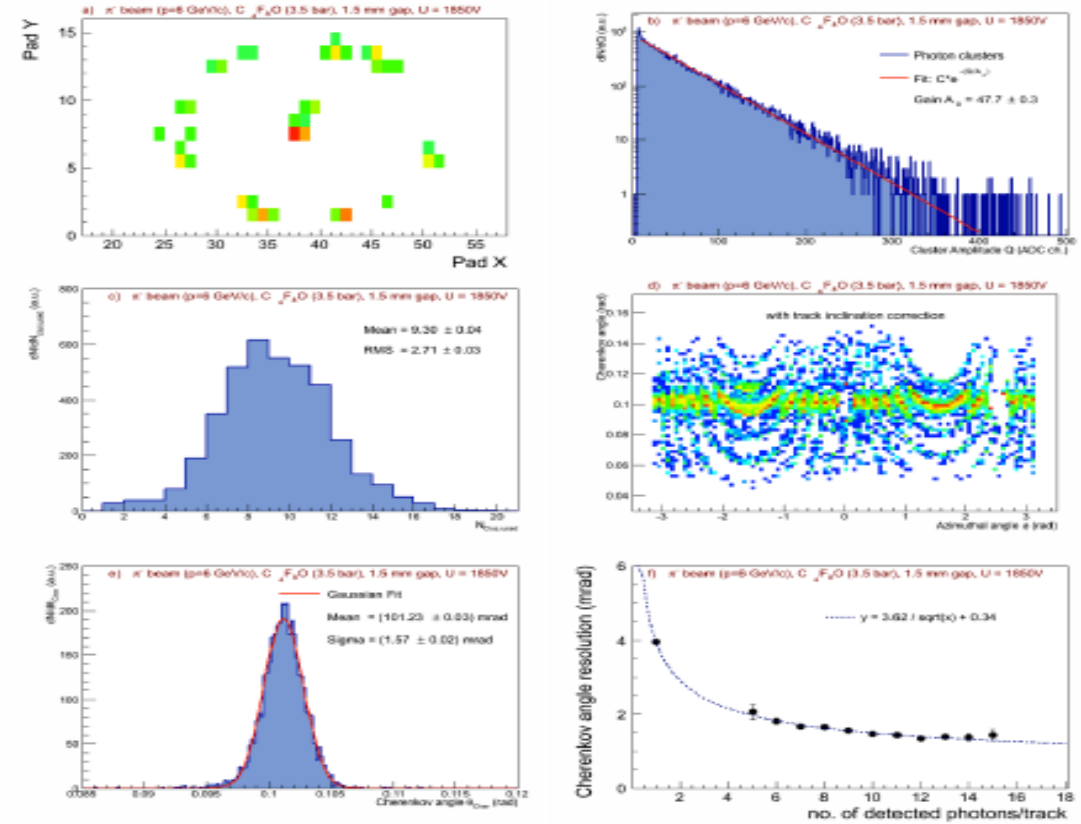


Figure 23: *Main testbeam results for 6 GeV/c pions and C_4F_8O at 3.5 bar: (a) single event, (b) single photon cluster pulse height at 1850 V and a distance between anode and padplane of 1.5 mm, (c) distribution of number of detected photons in the Cherenkov ring fiducial, (d) Cherenkov angle vs azimuthal angle (corrected for the detector–beam alignment), Cherenkov angle distributions per ring (e) and per number of detected photons (f).*

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VHMPID project is on the table

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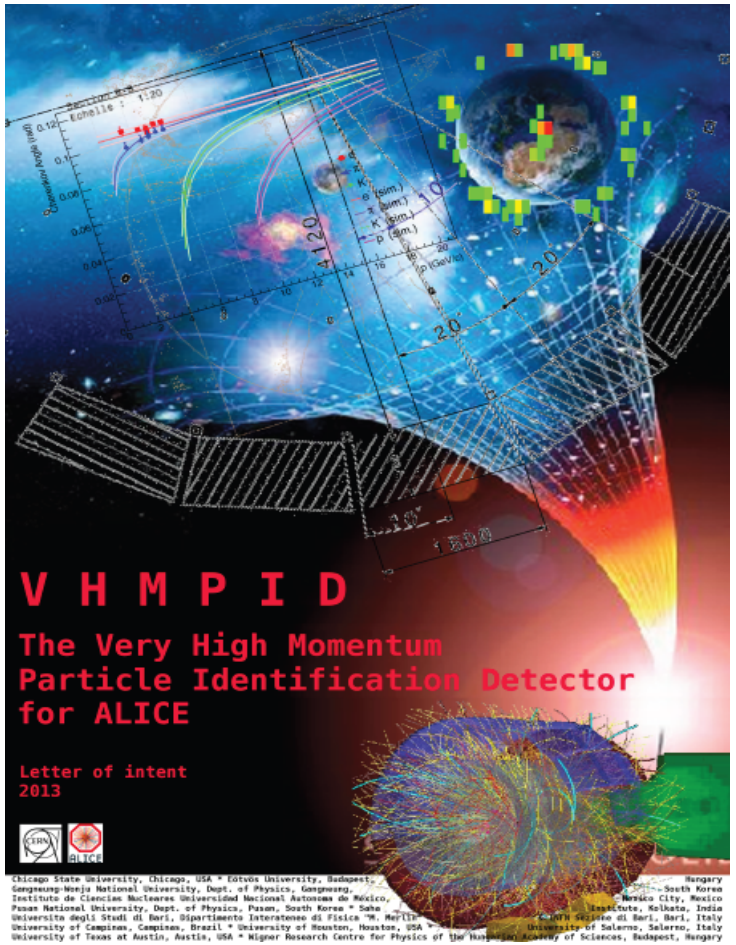


Main publications:

– ALICE VHMPID LoI
– EPJ. Plus 129 (2014) 91

Summary:

– 10 original papers
– 10 conf. proceedings
– about 80 citations
– partially ~10 PhD works
– several R&D to be recycled UGs

Status:

– As of the ALICE CB's decision, the project *carries excellent physics goals*, but decision is *postponed for the next UG*.
→ Hunting for the event-by-event PID is possible in the FUTURE

as a last speaker of the day…

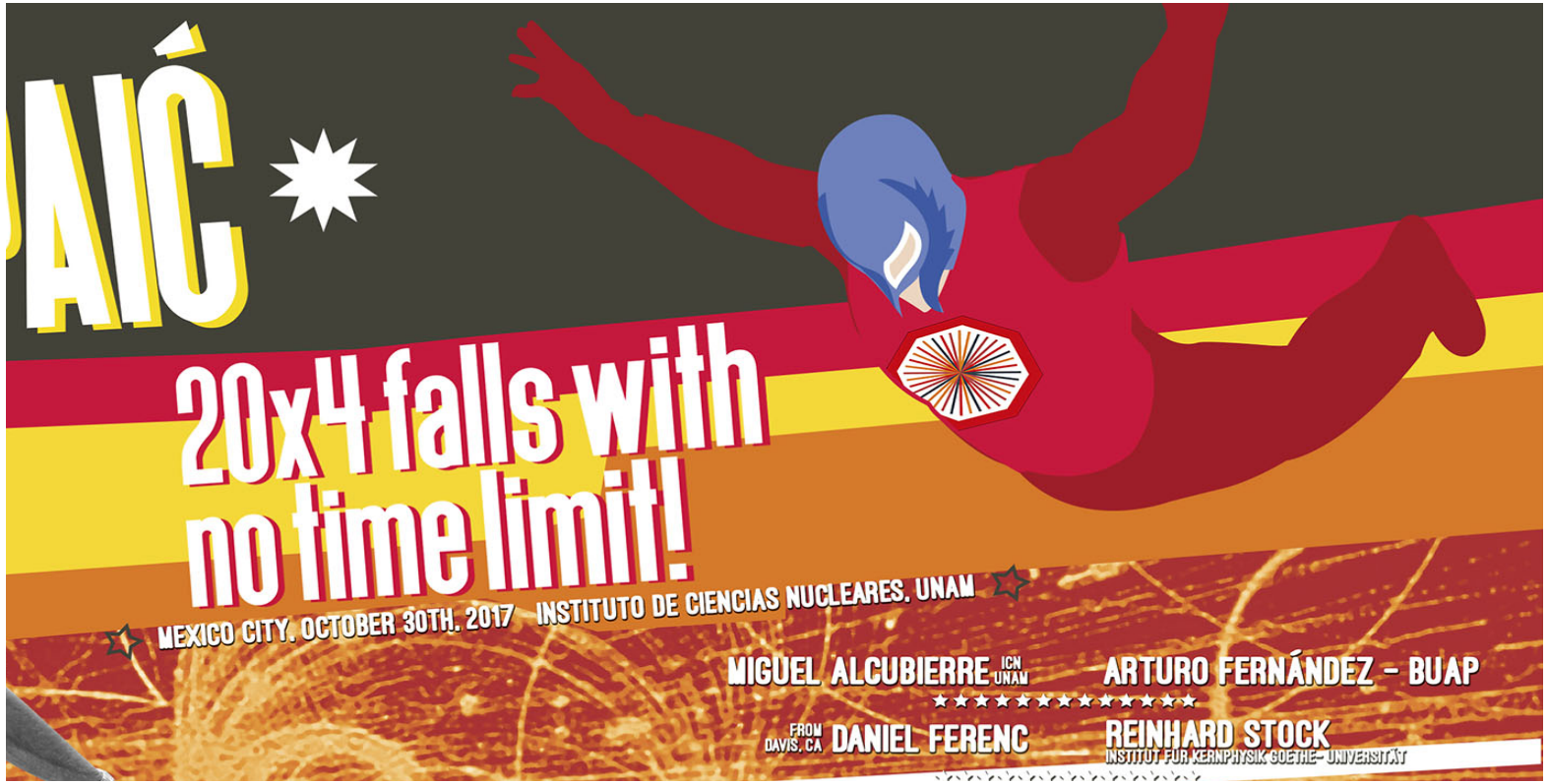
I can tell 2 secrets of Guy's 20x4 falls

I can tell 2 secrets of Guy

You can go high, but once, you have to come down at the end...

I can tell 2 secrets of Guy

You can go high, but once, you have to come down at the end...



I can tell 2 secrets of Guy

You can go high, but once, you have to come down at the end...

1) Never get too high!

I can tell 2 secrets of Guy

You can go high, but once, you have to come down at the end...

1) Never get too high!

2) You have to be always in good hands :)

Happy Birthday Guy!

We wish you high enough energy and power for the future!