Jornadas 2016

19 a 21 de Fevereiro de 2016

Universidade do Minho - Braga

Coimbra RPC-Group Activities

A. Blanco, P. Fonte, L. Lopes, L. Margato

What we do?

- Medical Instrumentation
  - Animal PET (Coimbra)
  - Human PET (Coimbra)

- High Energy Physics
  - HADES-RPC (GSI-Darmstadt)
  - HIGH RATE (AIDA2020-CERN)

- Collaborations with Industry
  - muTT(Vigo)

- Astrophysics
  - AUGER (Malargue)
  - CBPF (Rio de Janeiro)
  - FAPESP (São Paulo)
  - Santiago de Compostela

- Neutron Physics
  - Thermal Neutron detectors (ILL-France)

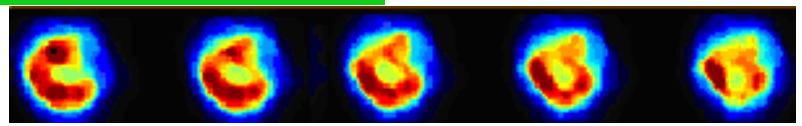
- Many other things
  - ….

Medical Instrumentation - APET

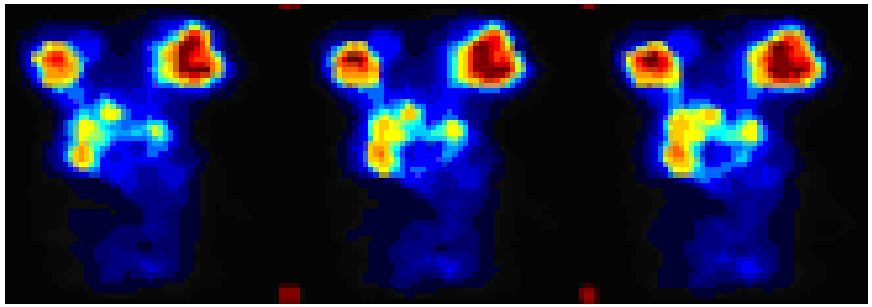
World's first RPC-PET tomograph
Now installed at ICNAS, Univ. of Coimbra

A spin-off of our Nuclear Instrumentation research

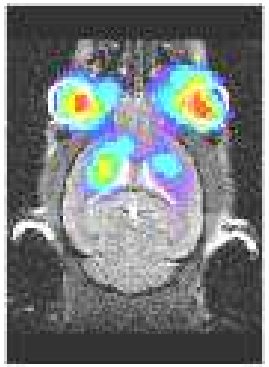
See P. Fonte talk tomorrow



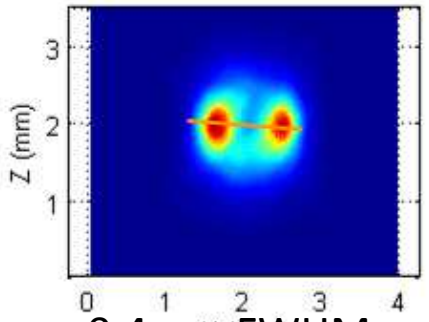
Live heart transaxial sections with ^{18}FDG



Harderian glands and left striatum
with ^{11}C-raclopride



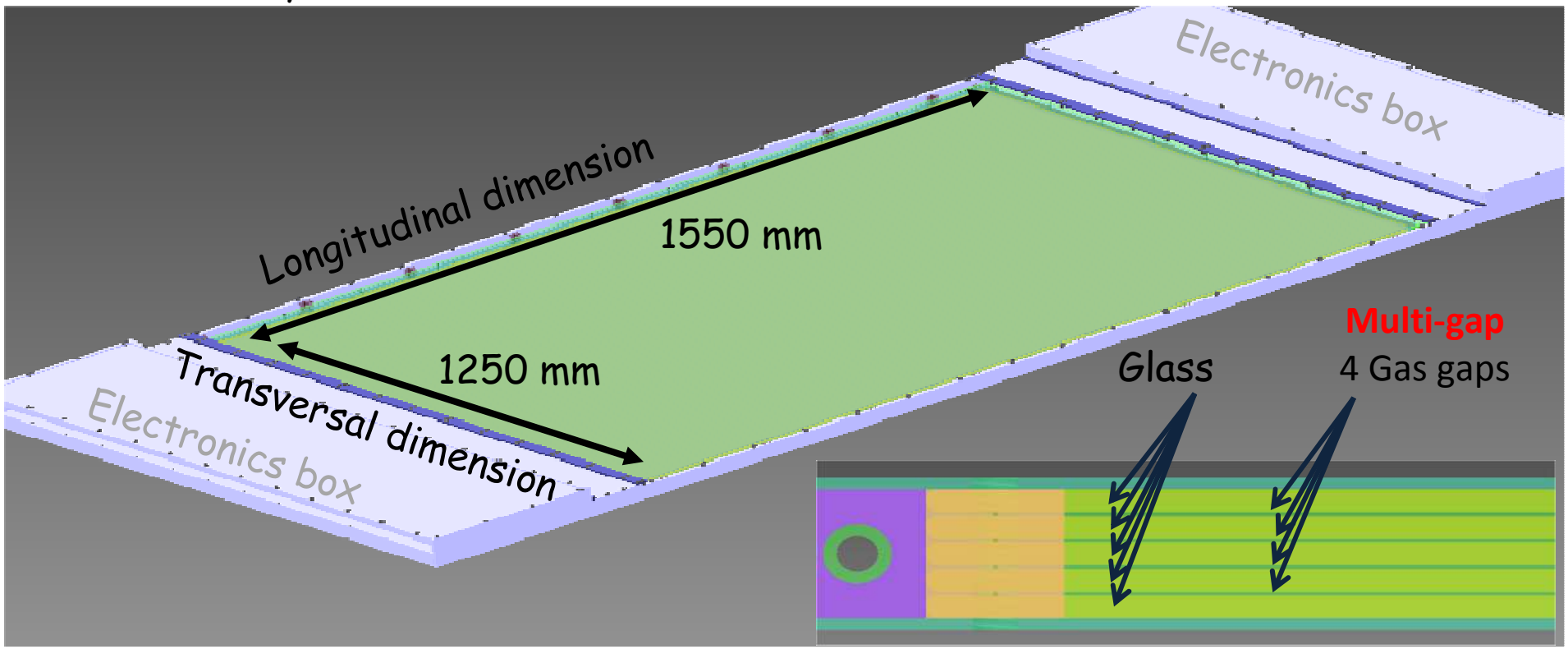
Co-registration
with MRI



0.4mm FWHM
position resolution

Medical Instrumentation HPET/MASTER

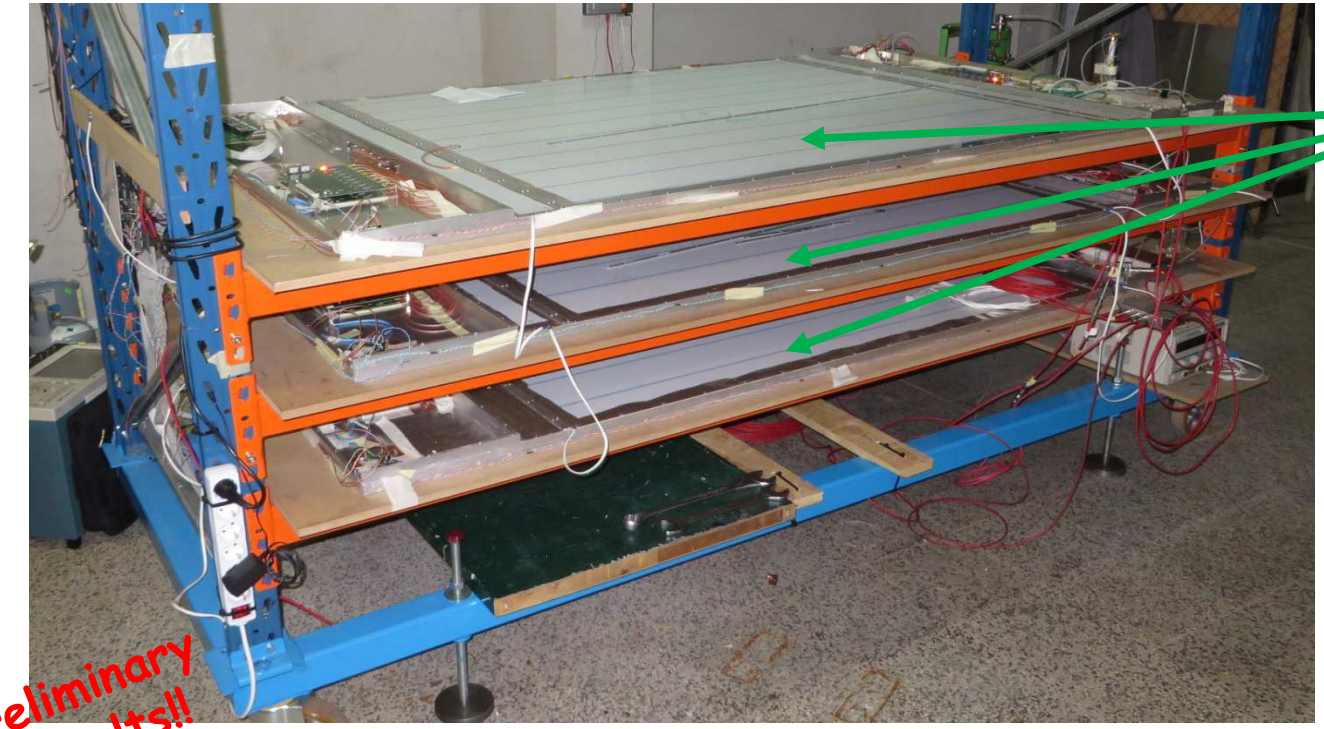
TOF-Tracker. **Simultaneous measurement of accurate time and bi-dimensional space coordinates** in a single gaseous detector, in large area.
Already demonstrated in small 60x60 mm^2size [JINST 2012 7 P11012]



Similar to an Auger RPC sensitive Module. Size (~1550 x 1250 mm^2) and technology, **but with 5x2 mm glasses and 4x0.3 mm gas gaps** instead of 3x2 mm glasses and 2x1 mm gas gaps => **Timing RPC**

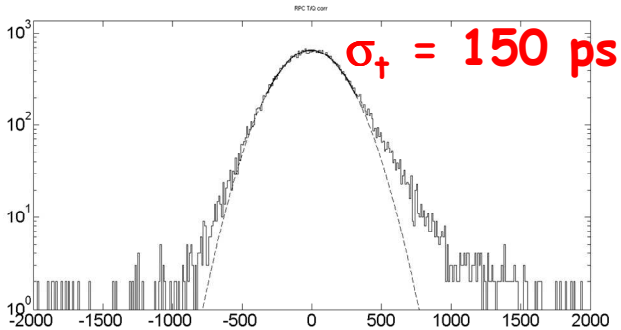
Medical Instrumentation HPET/MASTER

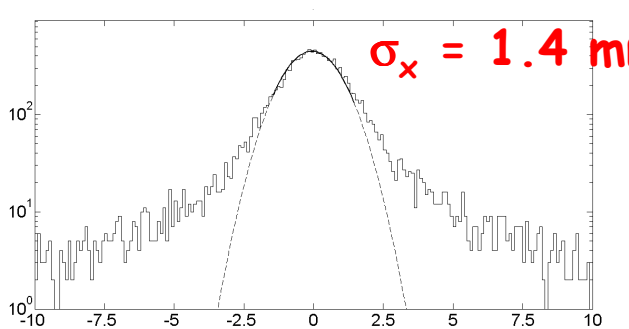
Very encouraging preliminary results!!



3 layer telescope. **Current status @ Coimbra Lab-Detector.**

Preliminary results!!

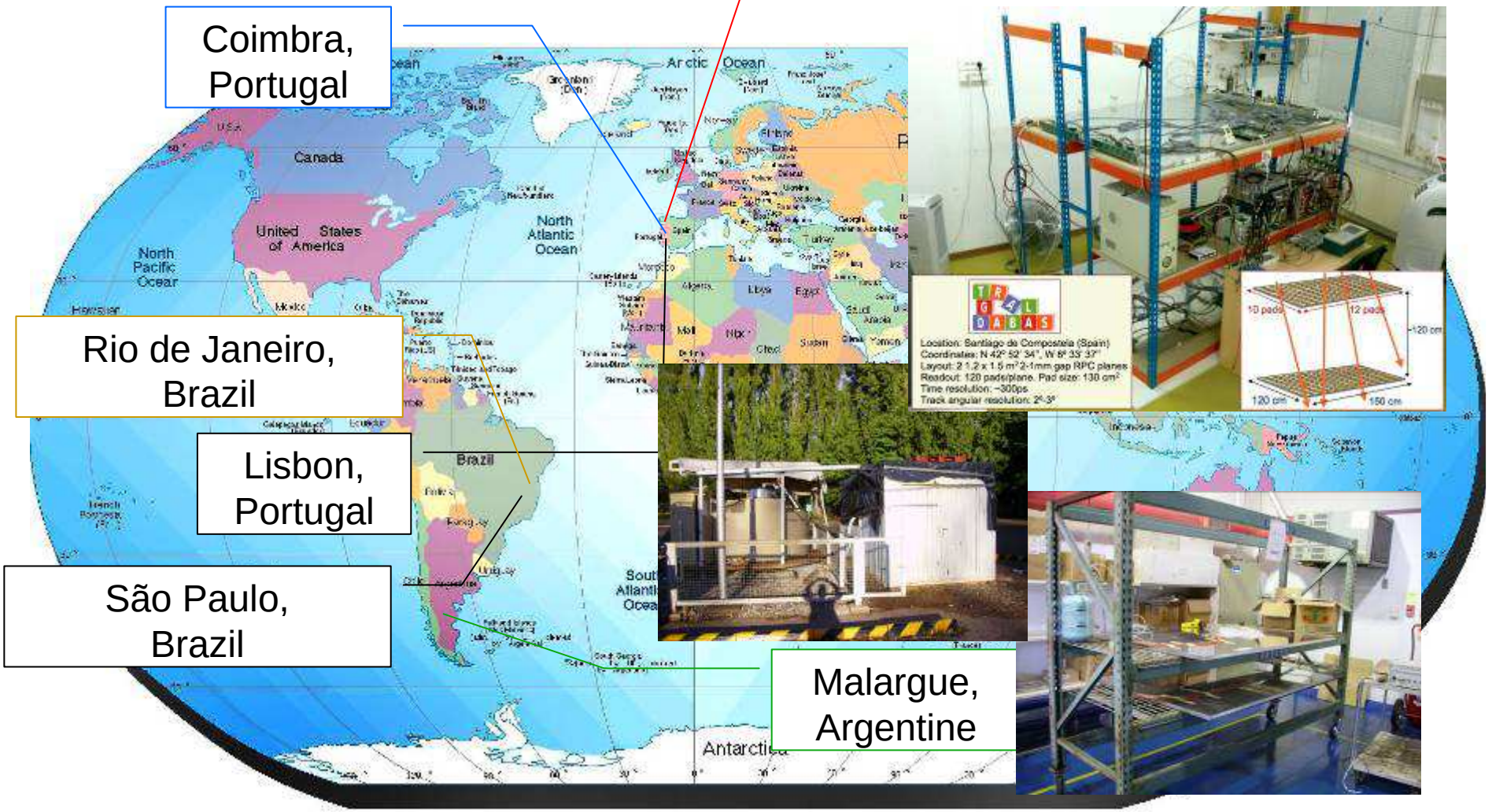




Astrophysics

- More than **30 large area (1.5x1.2 m^2) RPCs** done in the past years
  - 20 with readout system and tested
    - 6 in **Malargue** (Auger), 4 operating outdoor since January 2014
    - 4 at **Rio de Janeiro**, 2 operating indoor since March 2015
    - 4 in **Santiago de Compostela** operating since August 2013
    - Remain ones in Coimbra
      - Under test and/or as basis for performance studies
      - Also to provide necessary information to improvements and support systems for monitoring and/or remote control
  - The other 10
    - 2 at Rio de Janeiro, for final assembly by local staff
    - Remain ones at Coimbra, for test and shipment to Rio de Janeiro
- Data analysis of all detectors (except SC), both indoor and outdoor. Allowing a permanent checkup and fast response in situations related with detector performance. Continuous support and frequent missions to sites where RPCs are installed.

Astrophysics



Astrophysics - AUGER

One chamber @ the top
off the tank and other
beneath the tank

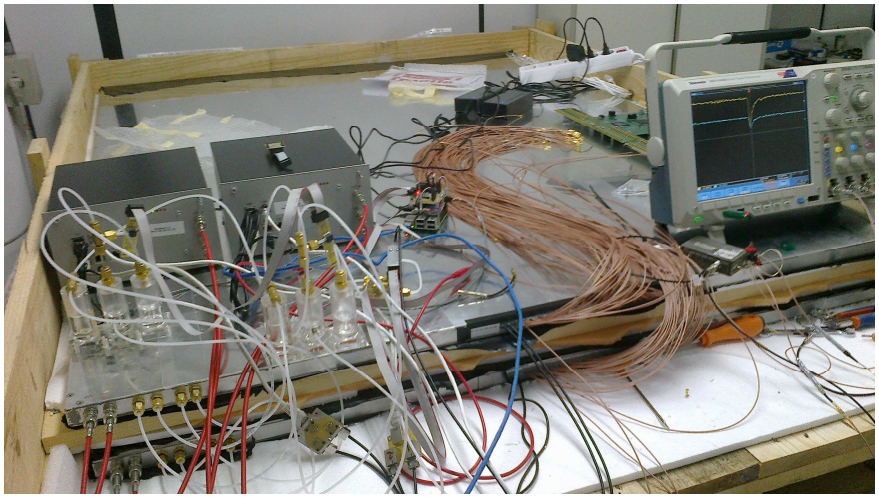
Remember morning talks from:
Francisco Diogo
Ricardo Luz
Ruben Conceição

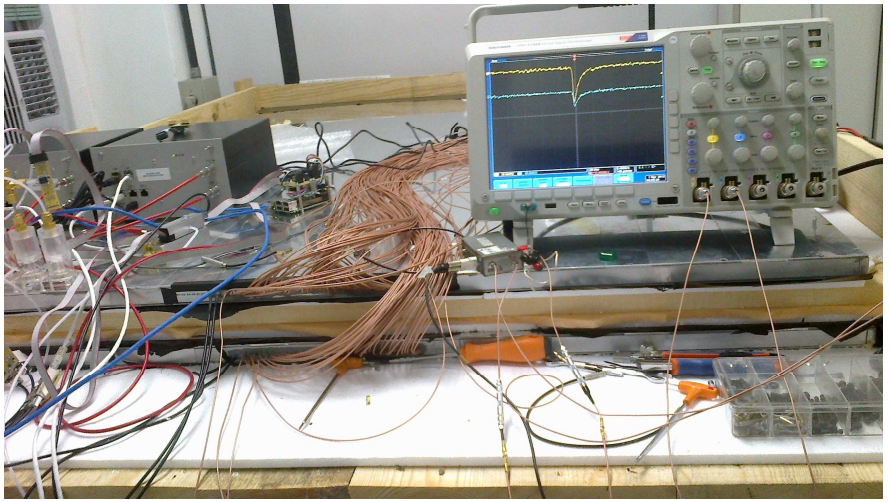
Astrophysics - AUGER

Easy integration in local community!

RPCs inside

Astrophysics - Rio de Janeiro/São Paulo





•2 complete detectors in coincidence, “first” Copacabana cosmics record in February 2015

•Master telescope in final phase of test, to be deliver within the first semester of 2016

Collaboration with São Paulo (FAPESP) is in the end off technology transfer phase

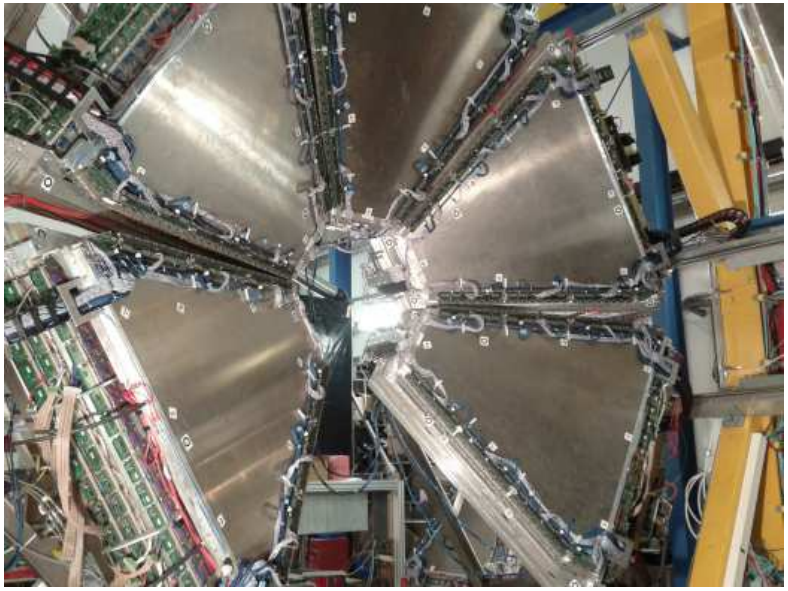
- •First 20 chambers should be deliver until the end of 2016
- •First installation at Auger site (Engineering Array) fourth trimester of 2017

Astrophysics - Santiago de Compostela

•We deliver 4 RPCs with high granularity, different pad size, each chamber with 120 channels. We take responsibility of installation and maintenance.

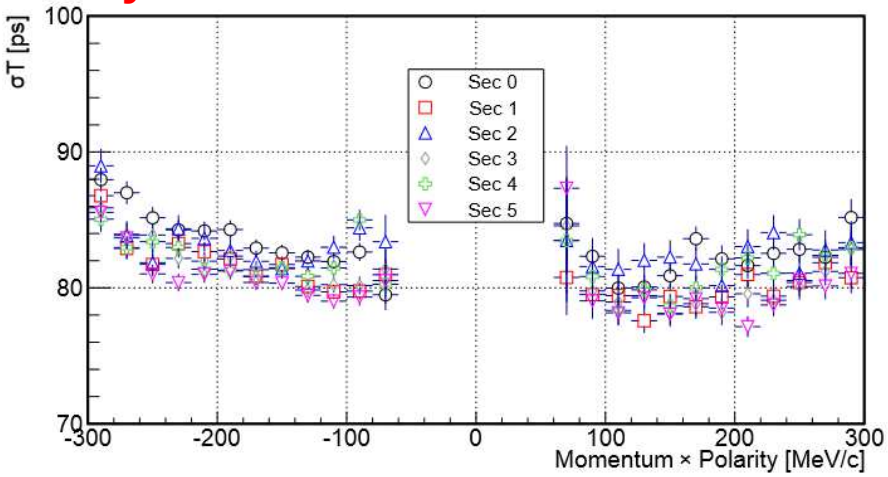
High Energy Physics – HADES

Lip is responsible for the optimization and maintenance of the HADES-RPC



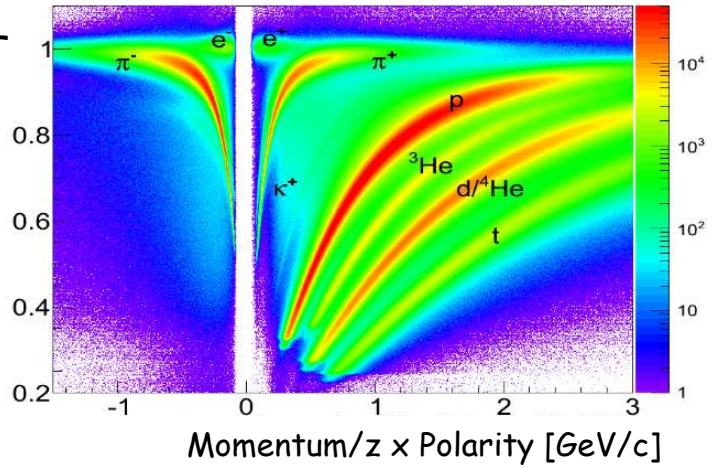
Operation performance Au+Au 1.23 AGeV

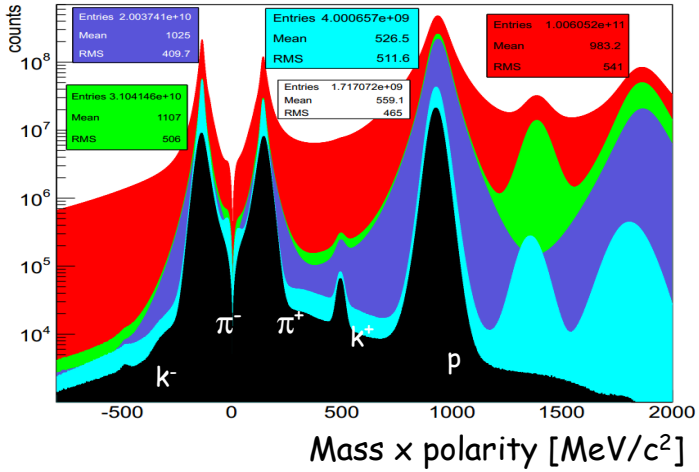
System time resolution. e^- e^+



Very good particle identification in a wide momentum range

Reconstructed mass distribution with very low background contamination.



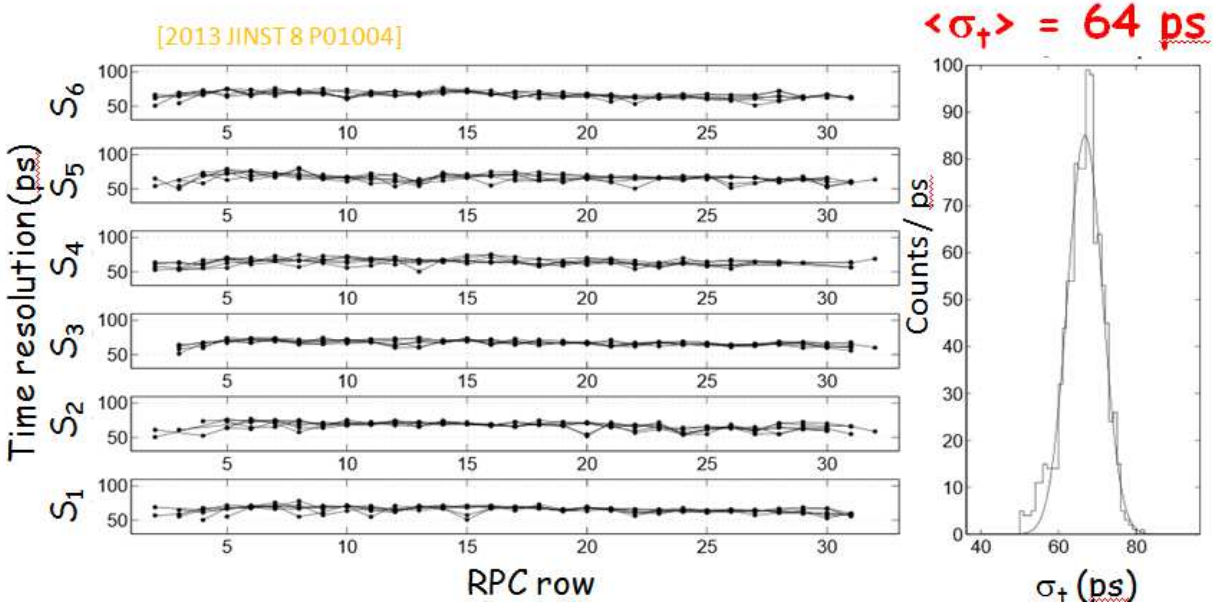


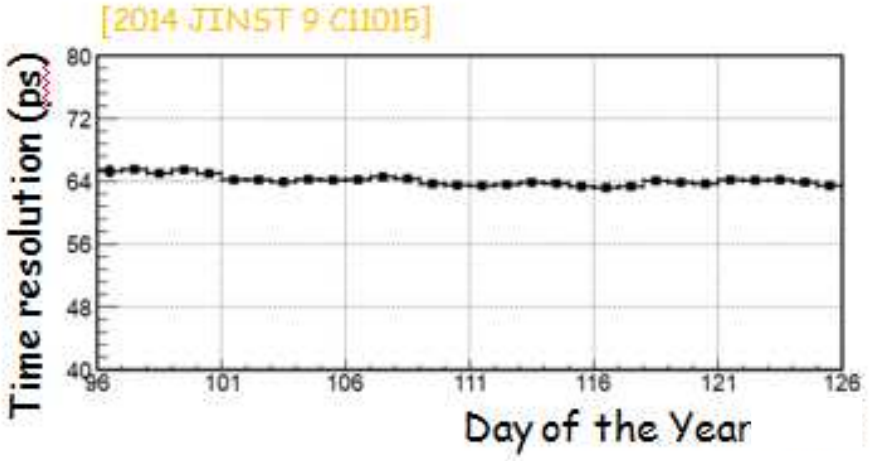
[2014 JINST 9 C11015]

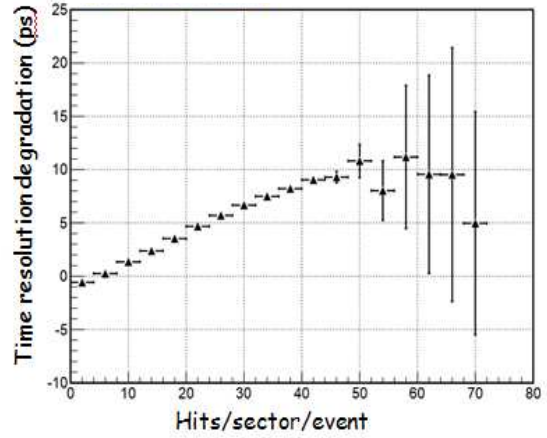
HADES RPC TOF wall. Operation performance Au+Au 1.23 AGeV.

Intrinsic time resolution

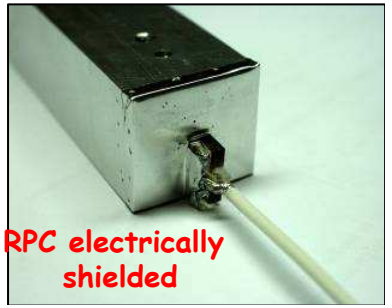
$\langle\sigma_t\rangle$ = 64 ps for all particles and area, stable in the whole beam time







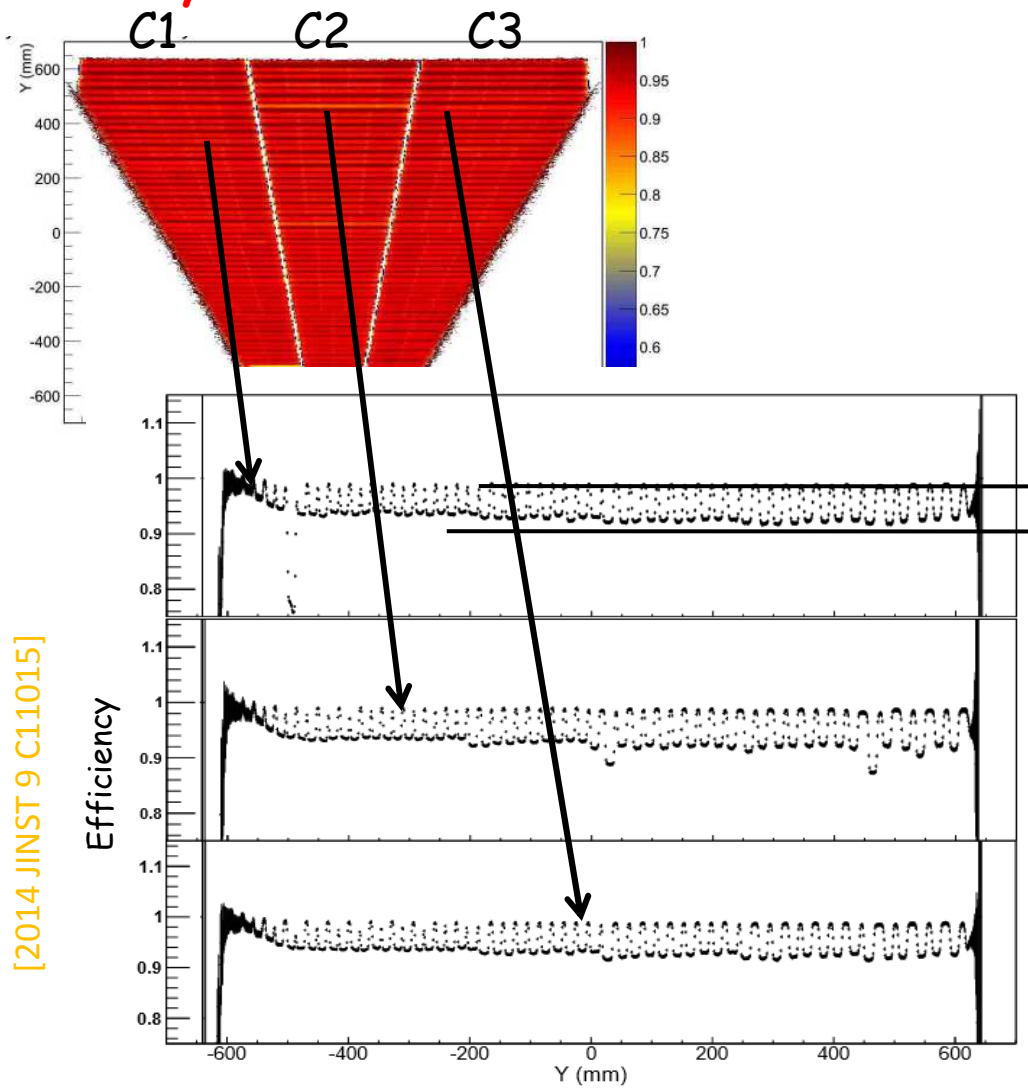
Excellent multi-hit time resolution



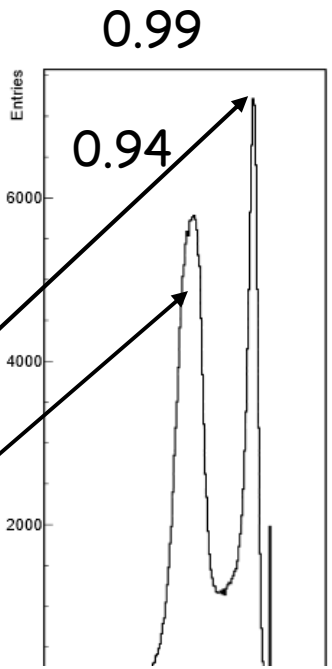
HADES RPC TOF wall. Operation performance Au+Au 1.23 AGeV.

See L. Silva talk

Efficiency



[2014 JINST 9 C11015]



$\varepsilon_{min} = \varepsilon_{int} * \varepsilon_{ext}$

$\varepsilon_{max} = (1-(1-\varepsilon_{int})^2) * \varepsilon_{ext}$

$\varepsilon_{int} = 2 - \varepsilon_{max} / \varepsilon_{min} = 2 - 0.99/0.94$

ε single cell = 0.95

Taking into account that the almost half of area is covered by two cell => **$\langle\varepsilon\rangle$ = 0.97**

High Energy Physics – High Rate AIDA2020

AIDA 2020 Advanced European Infrastructures for Detectors at Accelerators

What is AIDA-2020?

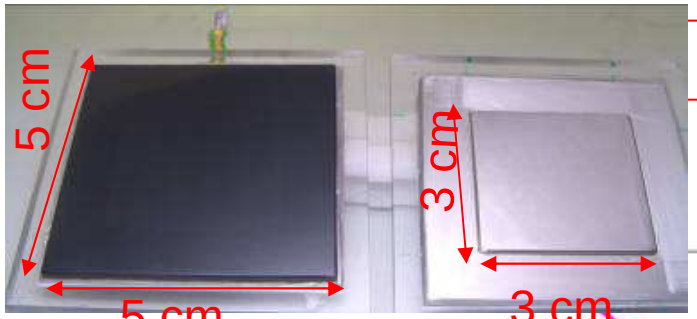
The AIDA-2020 project brings together the leading European research infrastructures in the field of detector development and testing and a number of institutes, universities and technological centers, thus assembling the necessary expertise for the ambitious programme of work.

Lip is the Beneficiary of:
WP 13.2.1 Establishing new resistive materials for high rate RPCs
And collaborates in other WPs

We define and improve a test procedure for all candidate materials. Some of them develloped by partner groups or adquired directly from the market.

Large part of the work is already done….

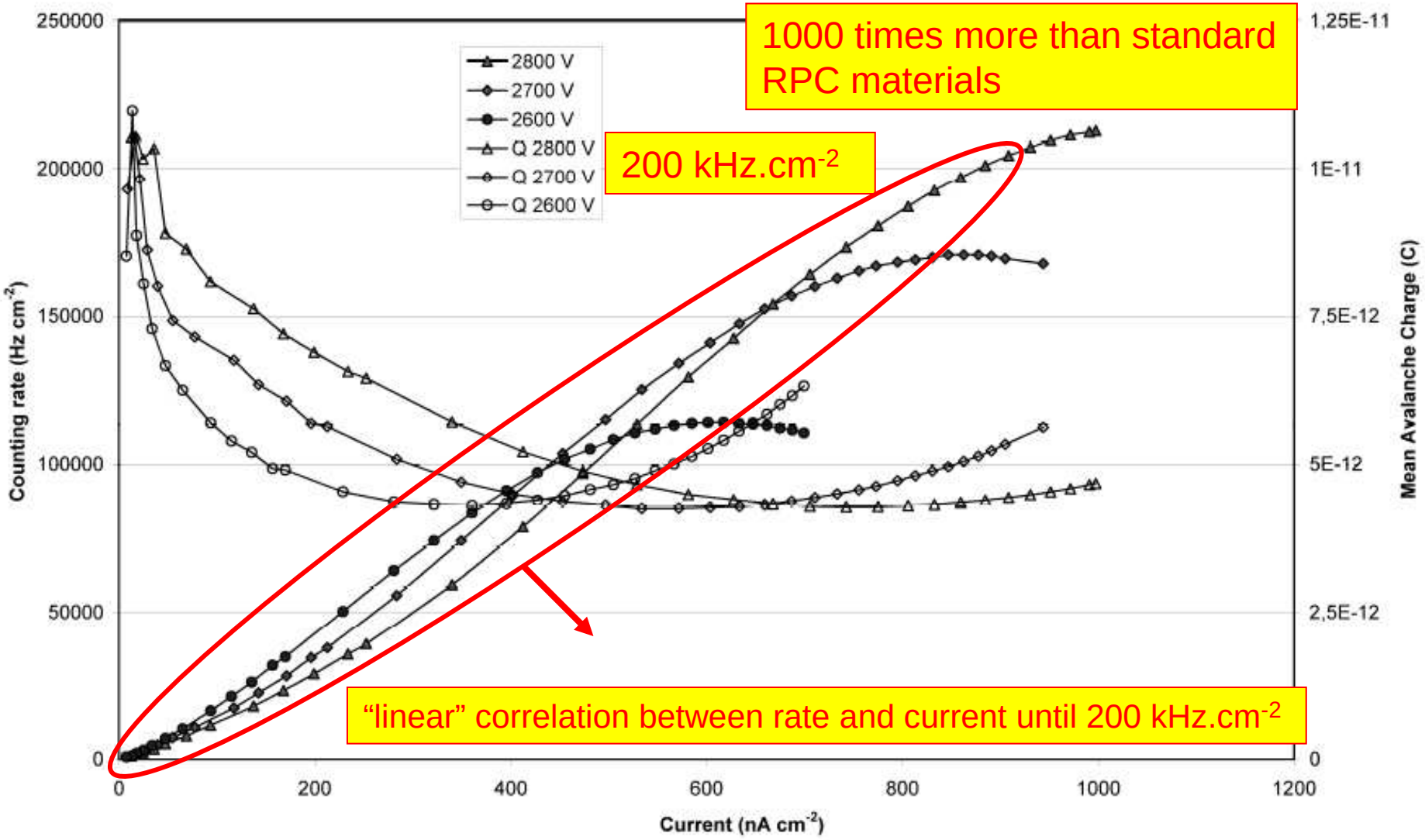
High Energy Physics – High Rate AIDA2020



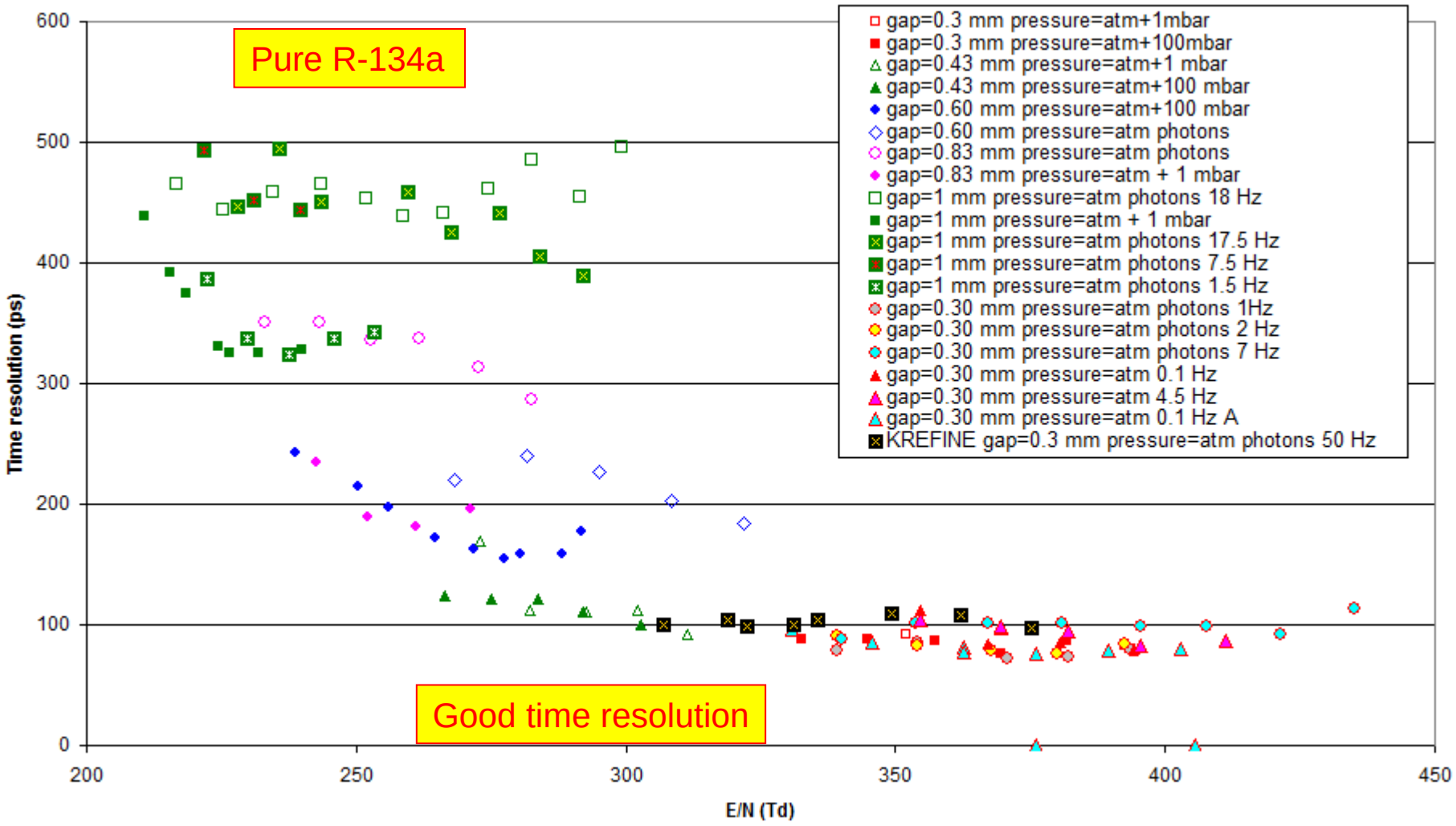
Open symbols ⇔ RH lines are only for eye guidance

Not pure electronic like conductor, but less than a factor 2 variation in volume resistivity over more than 40ºC

X-ray beam parallel to the 300 μm gap

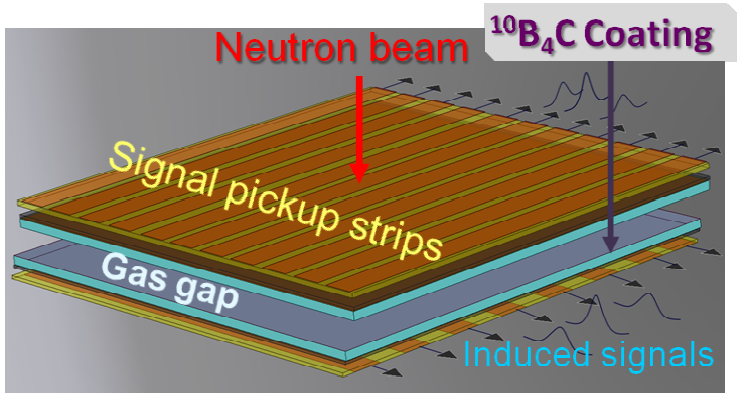


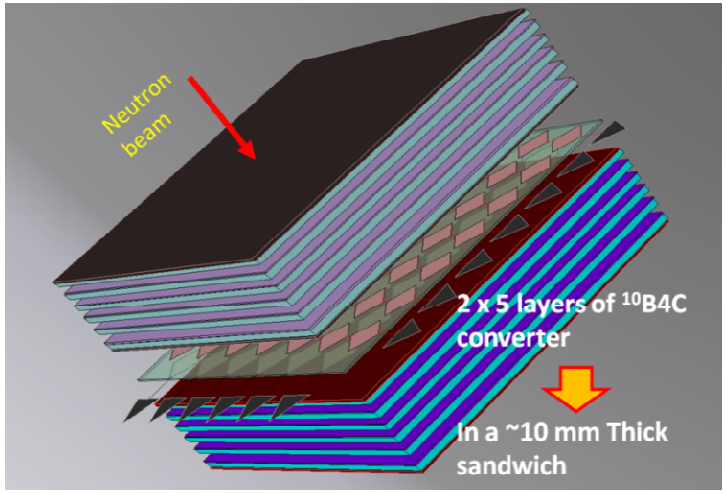
All other measures/data with soda lime glass



Motivation to Investigate RPCs for Position Sensitive Neutron Detectors (PSNDs)

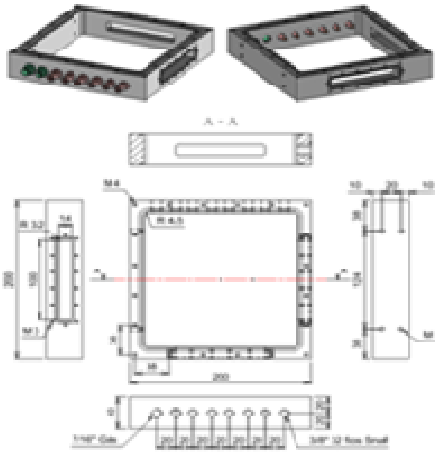
See L. Margato talk



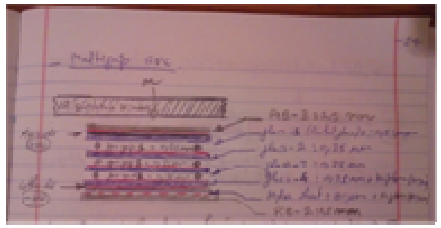


- RPCs are well suited to operate in the **multi-layer configuration** (needed to ensure high neutron detection efficiency)
- Good position resolution (~100μm) and time resolution < 1ns
- RPCs allow a modular detector design and good scalability
- RPCs is a Well-established technology which is widely used for large area detectors (> 100 m^2) in high energy physics (HEP) and astroparticle physics
- **Cheap** technology **(built with affordable materials)**

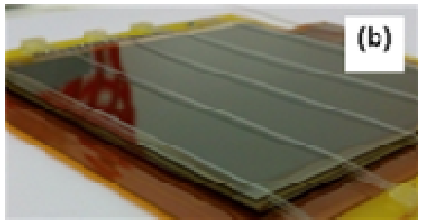
10B4C coated RPCs for Position Sensitive Neutron Detectors

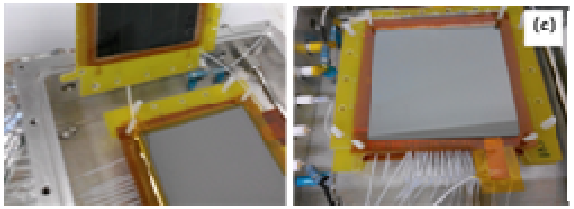


Design of the gas chamber for the B4Ccoated Multi-Gap RPC assembly

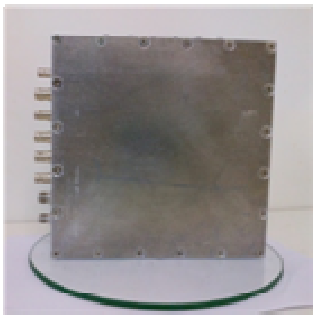


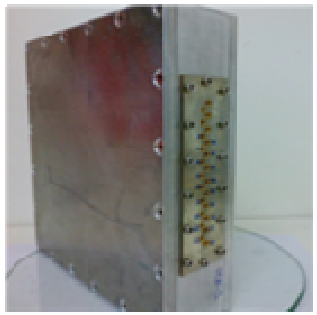
Sketch of the Multi-Gap RPC showing its structural design





Photos showing the assembling of the Multi-Gap RPC on the gas chamber





New prototype, spacer free

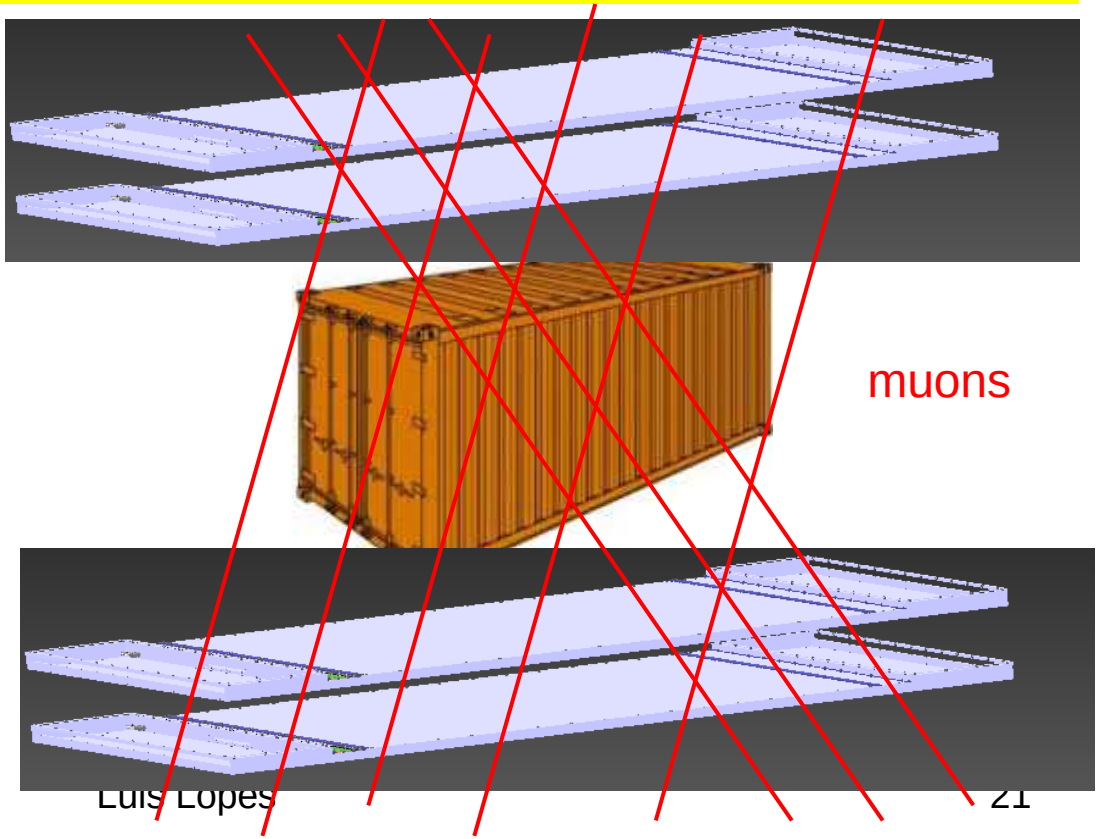
Collaborations with Industry - Vigo

Industry partner:
http://www.hidronav.com/

HIDRONAV
HIDROACÚSTICA Y NAVEGACIÓN

The aim of the project is the study of different technologies (among them RPCs) for the monitoring of large size charge containers at the harbors, seeking for high mass materials in the fight against nuclear smuggling

We will construct a muon TOF Traker (muTT), using the same technology developed for the MASTER telescope to Rio de Janeiro.
So R&D is not needed, largely reducing the risk of the project, that should be deliver to the partner until the begin of 2017.



Many Other Issues