RPC R&D 2022. Lines of work and Highlights

RPC-PET
- **RPC-PET for small animals** continue to **operate routinely**, demonstrating that is indeed useful.
- **HiRezBrainPET** is fully assembled and **partially evaluated exhibiting spatial resolution < 1 mm FWHM (which must be homogeneous over the whole field of view) and central point sensitivity of 0.09 %. NIMA 1051 (2023) 168236**
- Active **search for funding**: LaCaixa Health Research Projects (refused) and FEDER (within a consortium of 10 partners, LIP is the lead institution).

Timing RPCs (tRPCs) and PS-tRPCs
- The construction and successful operation (in a six weeks production test beam) of the **RPC-TOF-FD** for the **HADES** group. The **first RPC system operated at higher working temperature to increase the counting rate capacity** (600 Hz/cm^2 at 31.5 ºC and a x4 demonstrated). **NIMA 1050 (2023) 168182, NIMA 1045 (2023) 16765**
- Successful operation of a TOF for **R³B** experiment (SHiP timing detector prototype). ~2m², Eff > 98 %, σ_t < 100 ps **arXiv:2212.05490**
- Construction and test of a **0.1 m² RPC TOF-Tracker prototype** with a **position and timing precision of 70 um and 60 ps**.

Autonomous RPCs
- Successful outdoor operation of **MUTOM** demonstrating once again the **ability of RPC systems to work remotely outside the laboratory** environment.
- First evaluation of **STRATOS** as a **scatter muon tomograph and low gas consumption system NIMA 1050 (2023) 168183, NIMA 1046 (2023) 167744**
- Assemble a 1 m² double gap **sealed RPC chamber** fully instrumented and in the process of characterization, exhibiting an **Eff > 98% and stable operation after more than four months of sealing arXiv:2212.05131v1**

RPC R&D. Future (main lines) of work and SWOT

- **RPC-BrainPET:** full evaluation according to the NEMA standards (including timing precision), imaging of human subjects. Continue to seek funding to continue work. Currently waiting for FEDER answer.
- Continue with the evaluation of **Sealed RPCs** and the installation of the **sealed RPC telescope at SND@LHC** for muon flux characterization.
- Consolidate the tasks proposed for **RPCInnova,** focused on ultra low gas consumption (sealed) and position sensitive timing RPCs.

Strengths
- The team has proven repeatedly to be **competent, inventive, productive and reliable**. We have access to LIP's technical infrastructures, which include some very good and experienced technicians and a well equipped Mechanical Workshop.

Weaknesses
- The rather **small size of the team** and its **dispersion among many projects**, incorporation of students or other senior member will help.

Opportunities
- We believe to have very **competitive detectors** for the application "markets": animal and human **RPC-PET, muon tomography, cosmic ray physics and HEP (HADES, R3B, SHiP).**
- The human full body RPC-PET application requires a longer and more demanding development, along with funding of the order of millions, but it is potentially hugely interesting.
- The obtained funding in "Fundo CERN" call will boost the fundamental R&D.
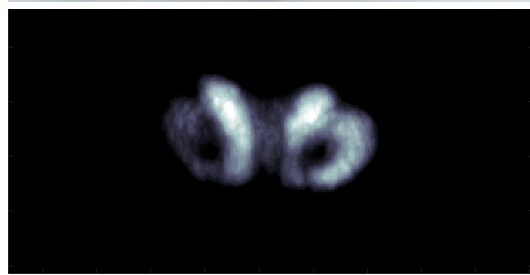- **Sealed RPCs** have the potential to be a breakthrough.

Threats
- **Non stable funding environment.** We complained in the past about little funding, now we are complaining about a lot ... but it seems that we are stabilizing. The FCT is now committed to open regular calls, which is very helpful. **Is this true?**
- In the long term, the excessive **maturation of the team members** will become a determinant factor, students could contribute to mitigate this. Work has already started ….
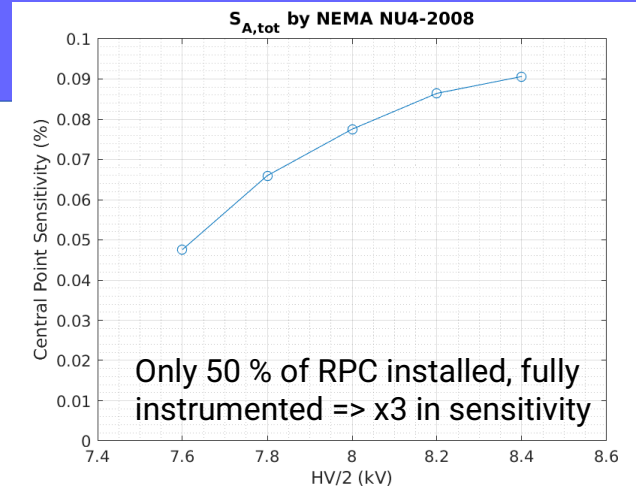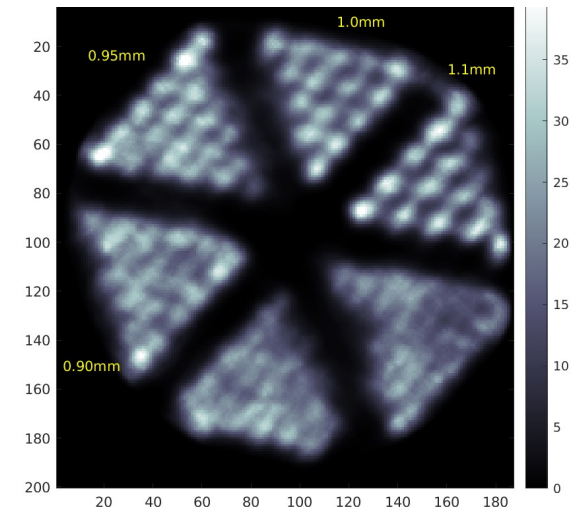
RPC R&D
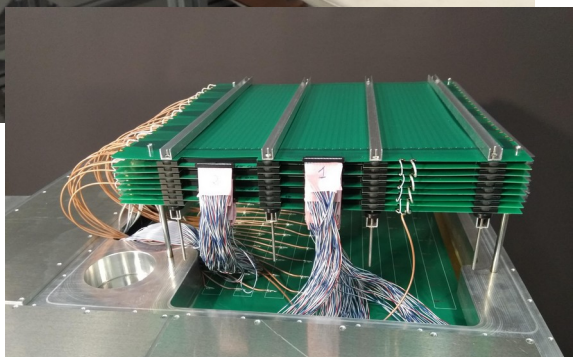
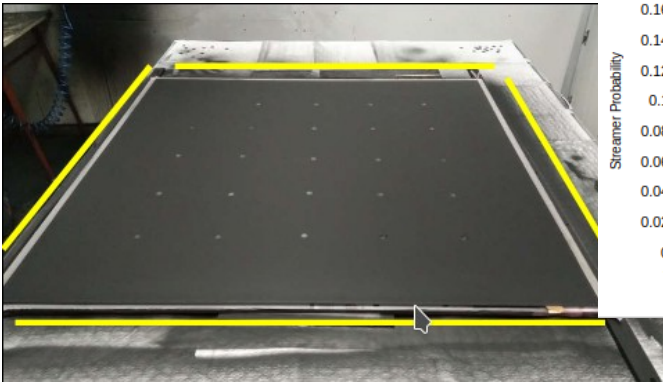

Striatal Phantom -
Radiology Support Devices Inc

Only 50 % of RPC installed, fully instrumented => x3 in sensitivity
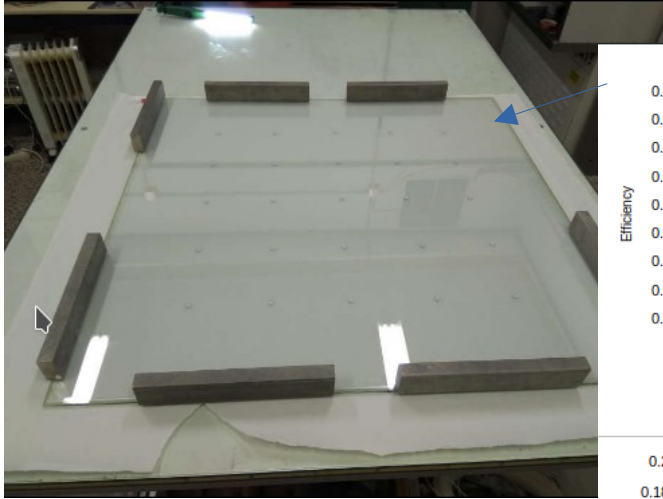
$S_{A,tot}$ by NEMA NU4-2008

Average activity concentration of 6kBq/ml and 50 kBq/ml in the striatum

1.0mm
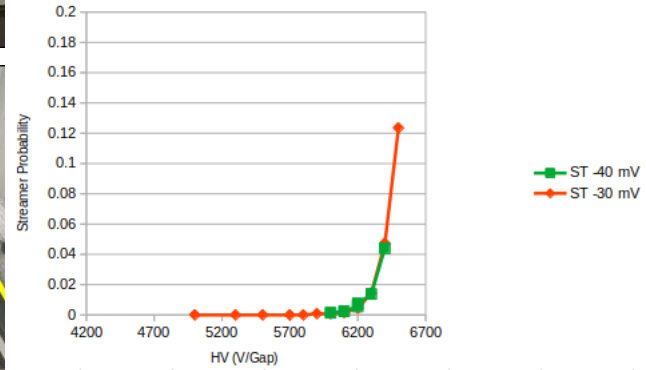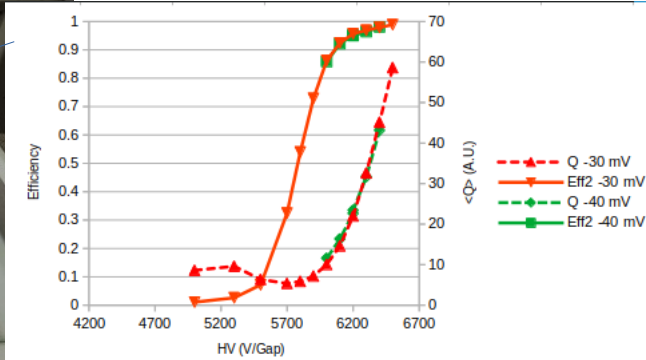0.95mm
1.1mm
0.90mm

< 1 mm limited by photon non-co-linearity with cosmic < 100 um.

RPC R&D

Real device 1x1 m²
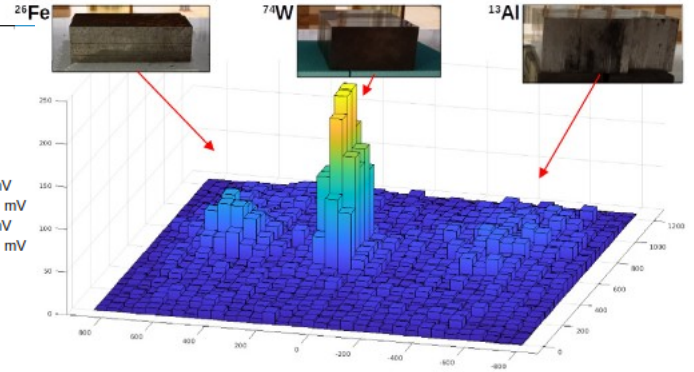
8. 2D projection of PoCA points restricted to events with angular deflection above
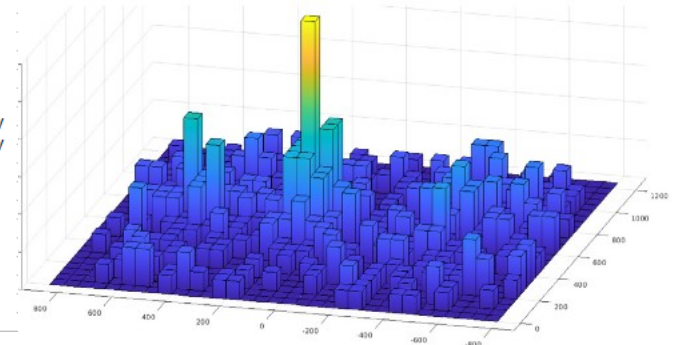
Fig. 9. 2D projection of PoCA points restricted to events with angular deflection above 10° and obtained with only 10 min of acquisition.