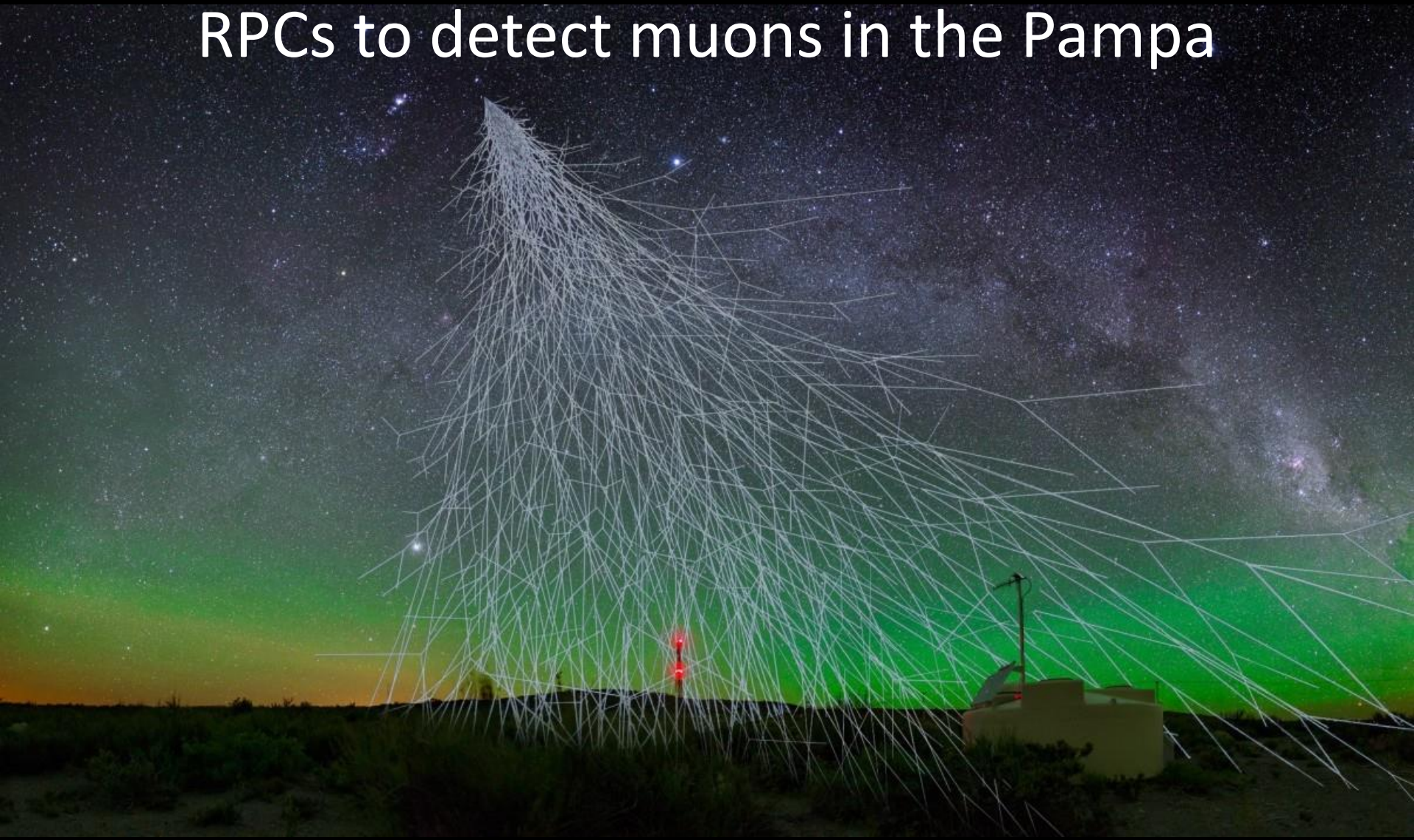
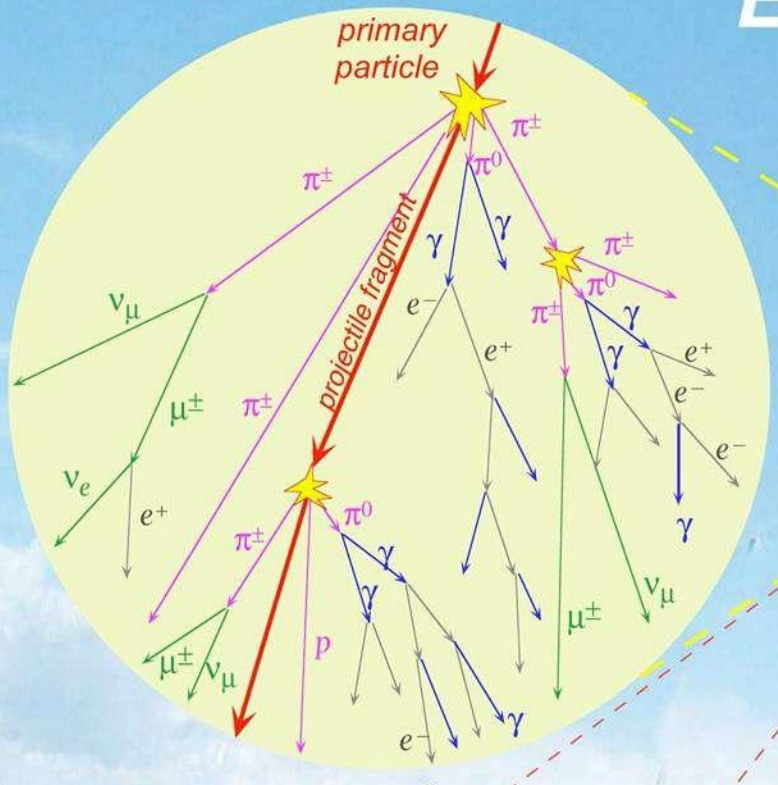
The MARTA project in AugerPrime: RPCs to detect muons in the Pampa



LIP TÉCNICO LISBOA

pedro.assis@lip.pt

Extended Air Showers



primary particle

Pierre Auger Observatory:
10^{19} eV < E < 10^{21++} eV

Fluorescence light - isotropic

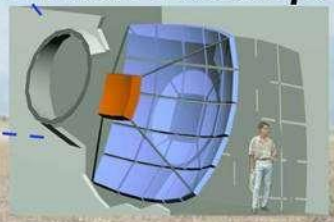
Trajektorie

Cherenkov light

$v \approx c$

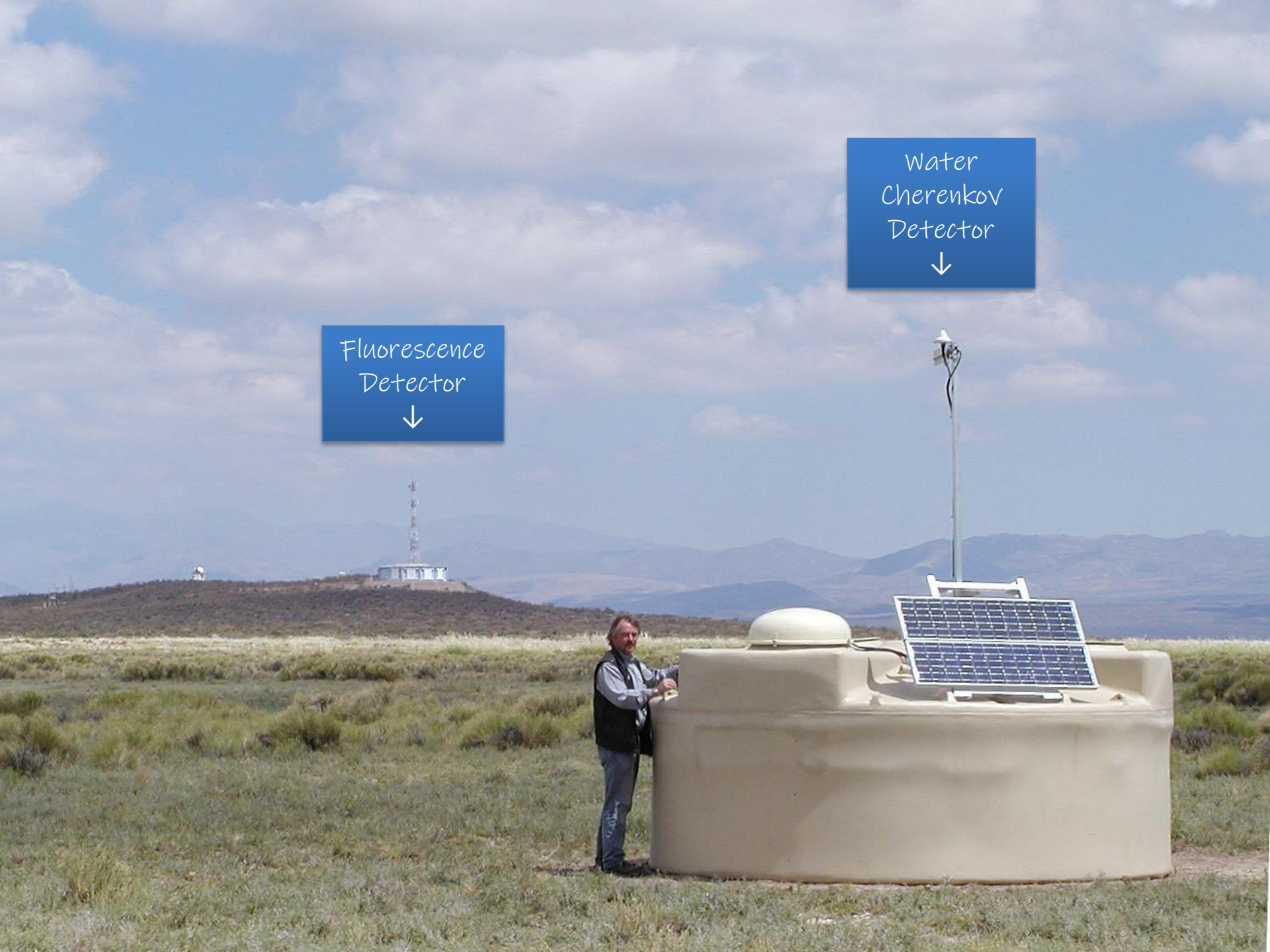
1 m thickness

Electronic Schmidt telescope



Water-Cherenkov detectors

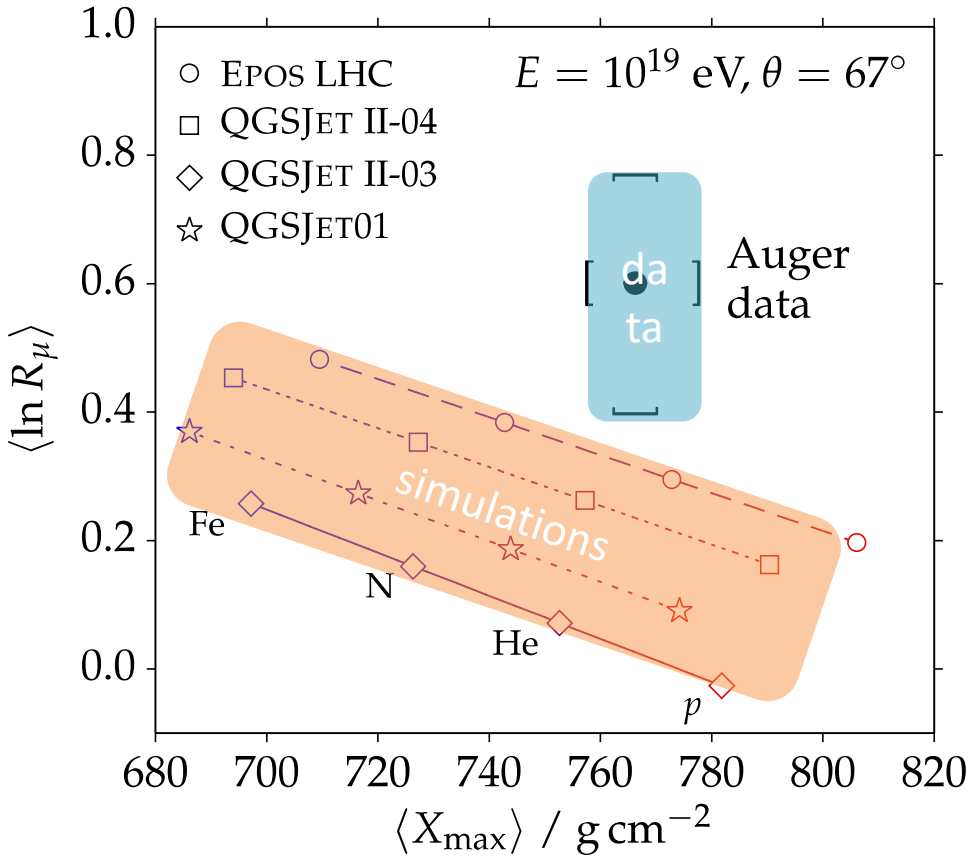
1,5 km


Water
Cherenkov
Detector
↓
Fluorescence
Detector
↓

Making precision measurements to shed light on what's the muon content

The muons "problem"

"number" of muons
Measured by tanks



Depth of shower – Measured by FD

GAP2013-020

MARTA
Muon Auger RPC for the Tank Array
Design Report

V1.0

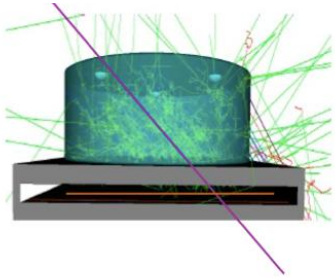
GAP2013-XXX

MARTA
Muon Auger RPC for the Tank Array
1st Progress Report

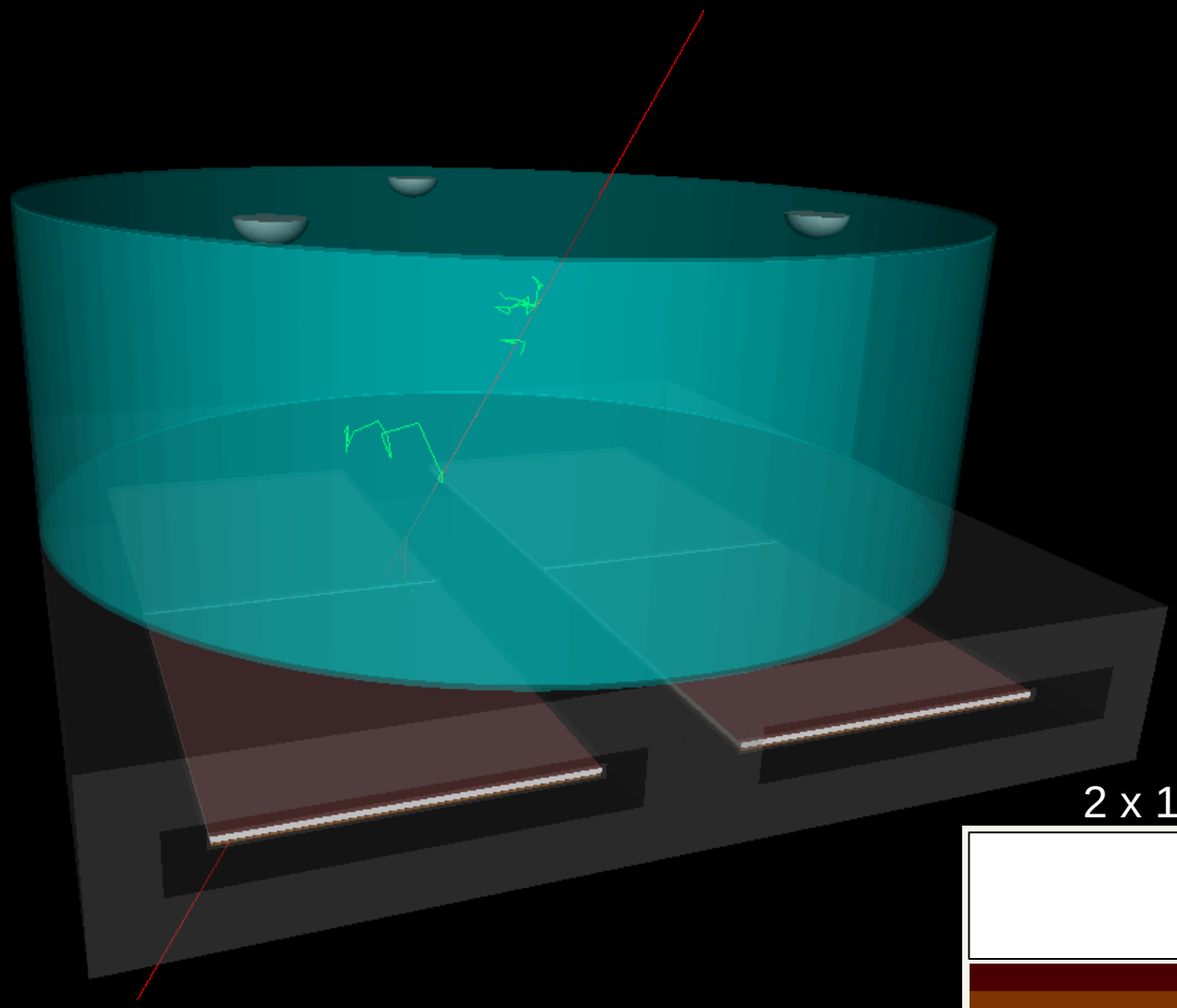
CBPF - Centro Brasileiro de Pesquisas Físicas, Brazil
FZU - Institute of Physics, Czech Academy of Sciences, Czech Republic
IFSC/USP - Instituto de Física de S. Carlos, Universidade de S. Paulo, Brazil
LIP - Laboratório de Instrumentação e Partículas, Portugal
UNICAMP - Universidade Estadual de Campinas, Brazil
UFRJ - Universidade Federal do Rio de Janeiro, Brazil
Universitá di Roma II, "Tor Vergata", Italy
Universitá di Napoli, "Federico II" and INFN, Napoli
USC - Universidade de Santiago de Compostela, Spain

with the collaboration of
Peter Mazur and Alan Watson

27 May 2013

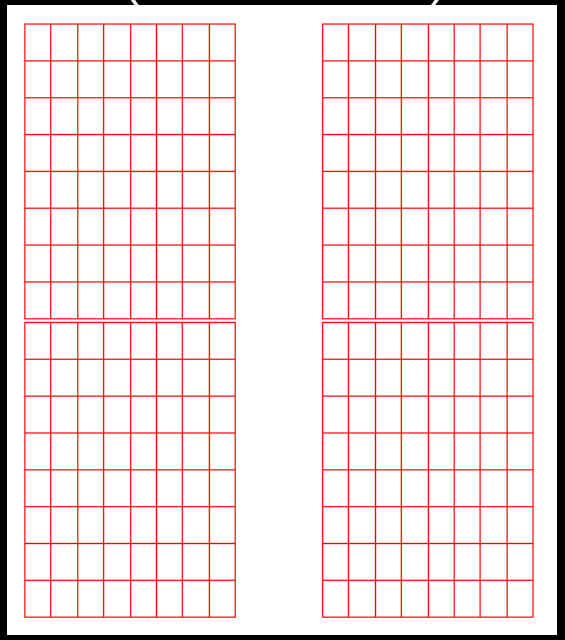


Baseline configuration



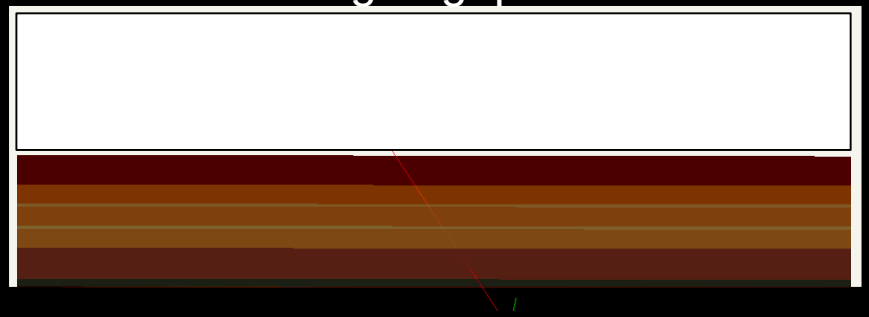
Concrete precast : 20 cm thick (~50 g/cm^2)

4 x (1.5 m x 1.2 m) RPC



8x8 pads each RPC

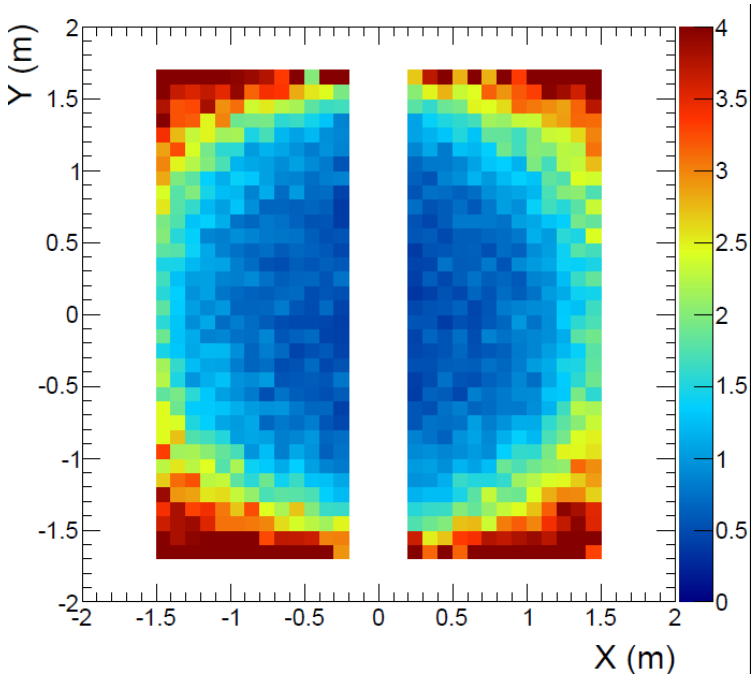
2 x 1 mm gas gap RPC inside Al ca

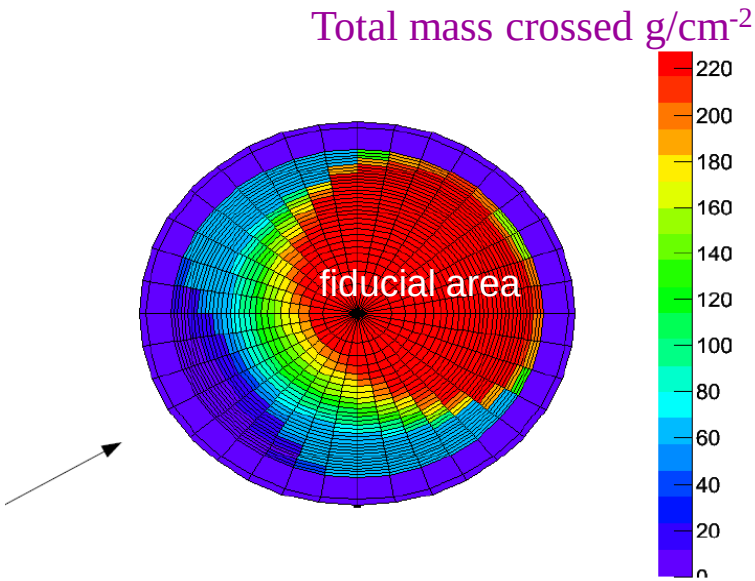


Punch-through

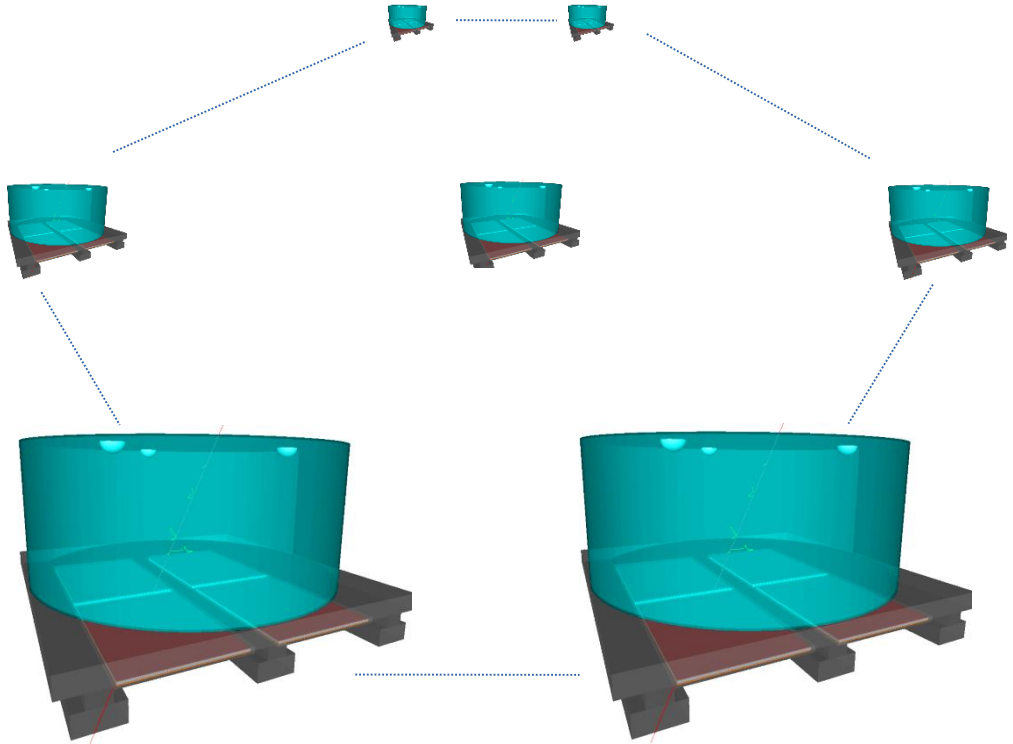
- “only muons reach the RPCs”

- Some parts of the RPC are more “exposed”
  - Segmented readout allows to create e.m. contamination maps
  - Dynamically define a fiducial area (shower to shower, dependent on station-shower distance)
  - Only pads with e.m. contamination below predefined threshold are used
  - Allows for muon measurement with small bias from e.m. component



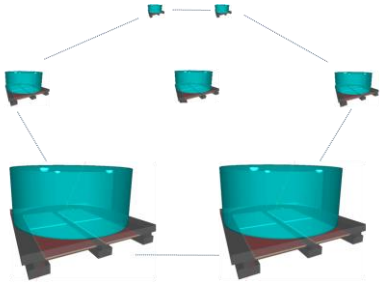


MARTA EA



The MARTA Engineering Array

FCT – FAPESP project
(Portugal – Brasil)

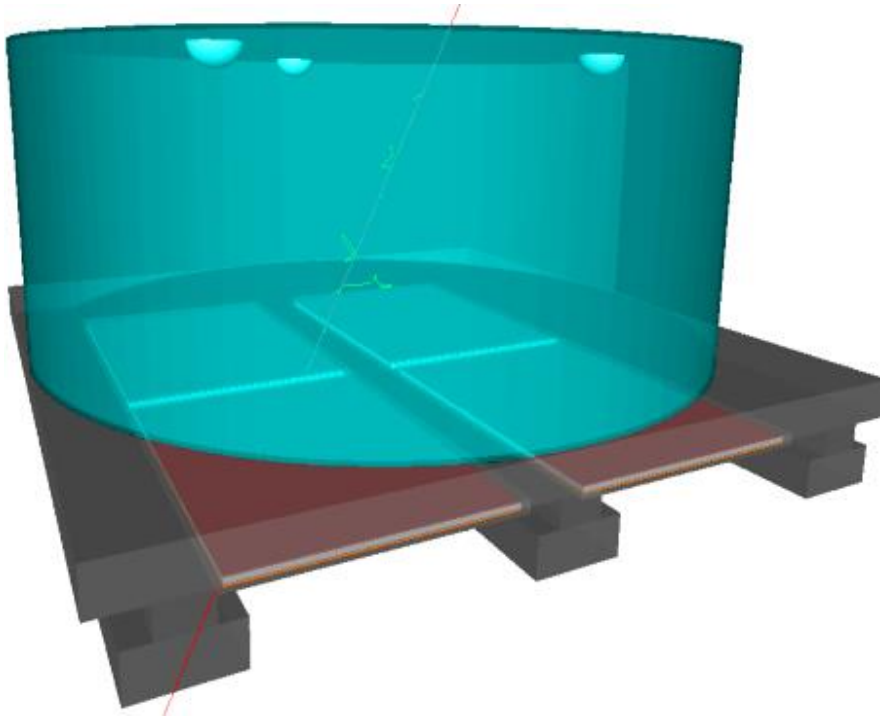


Results from a specific call FAPESP-FCT

- RPC R&D
- RPC technology @ Brasil
- Build RPC detectors
- Install EA (hexagon) in Auger

Synergies with AugerPrime

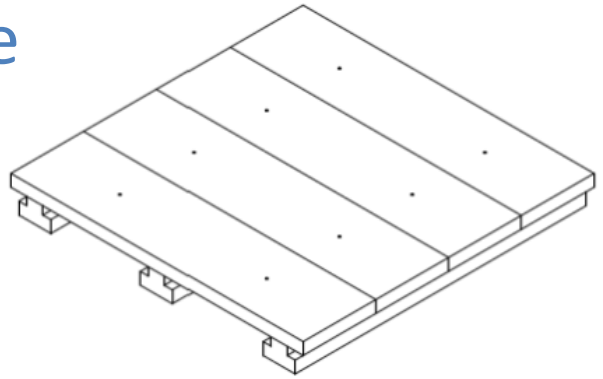
- RPC hodoscopes for testing SSD
- Cross-calibration
- Physics at E=10^17 eV

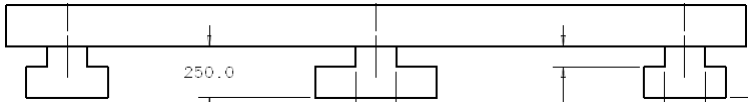


Install a unitary cell (hexagon)
In the infill area, in AMIGA tanks

The support structure

Precast structure built at the observatory
Transported to the field
Installed in a couple of hours
(Emptying/Filling the tank
is more time consuming)

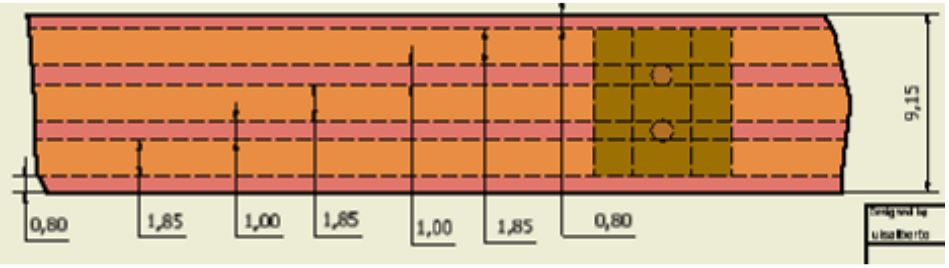


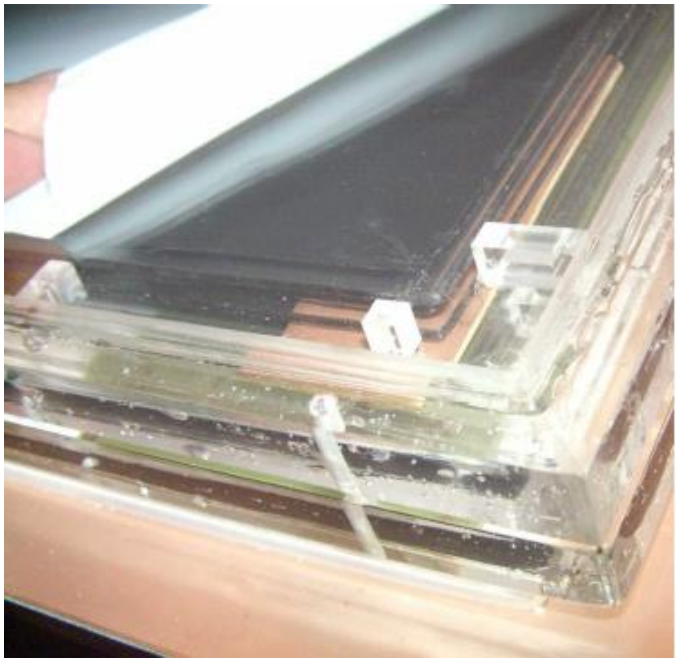


The modules

4 modules of RPC to be installed in each station
Triggered by the WCD

The active medium

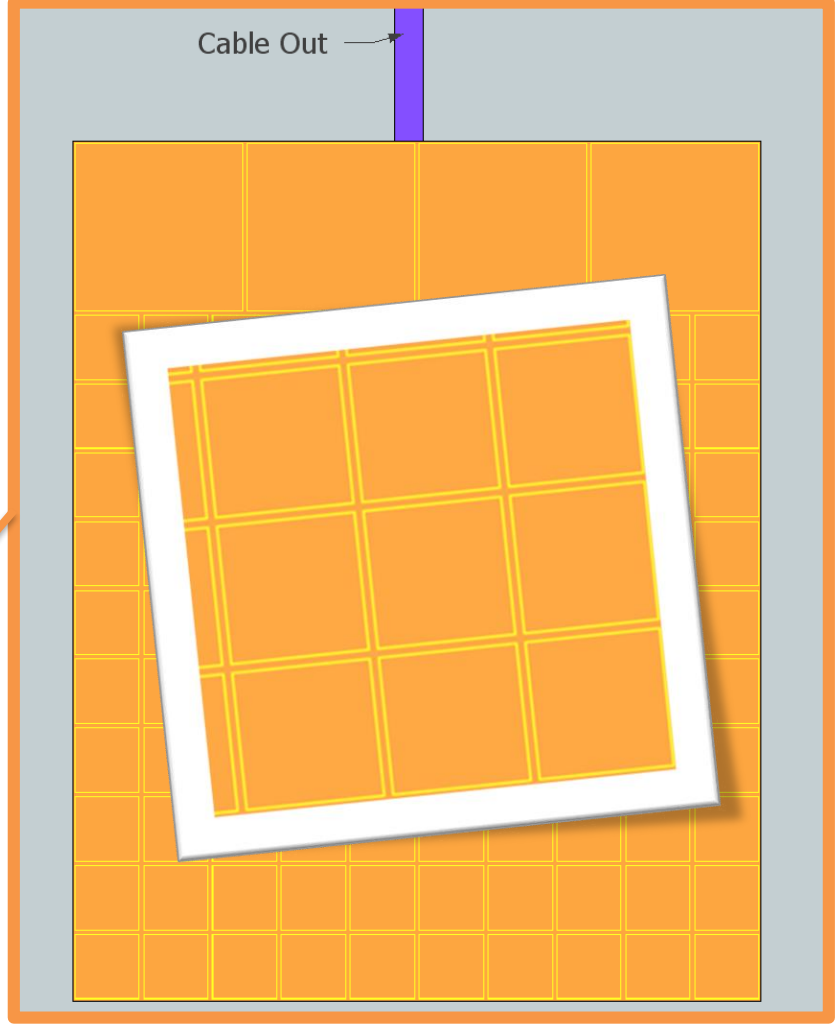


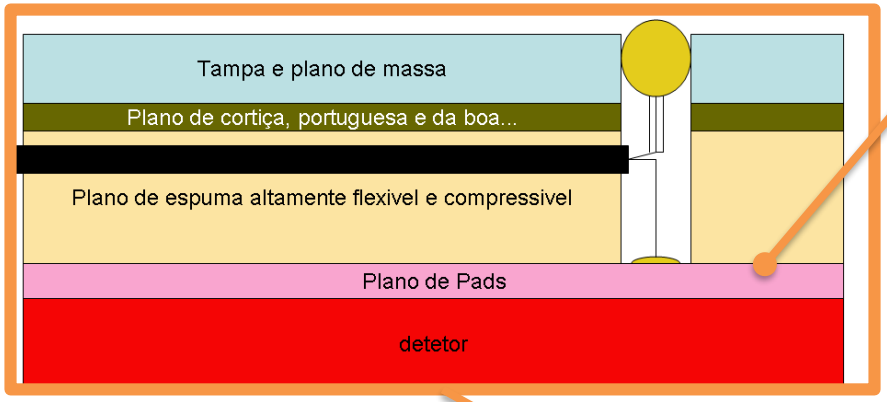


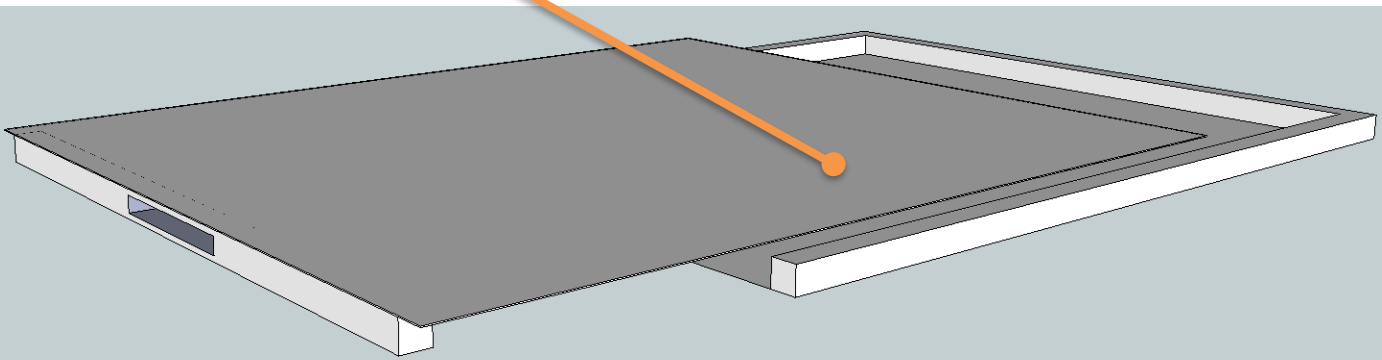
Pads & Housing

(first design)

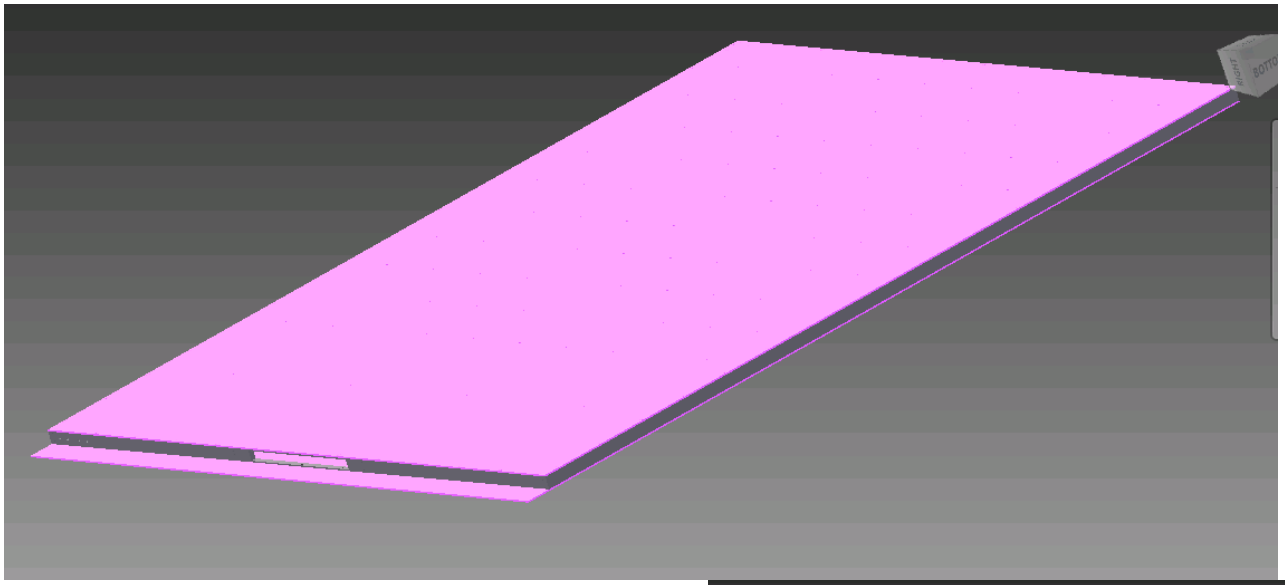
Pads are defined in PCB boards. Routed with 2mm leaving ground between them

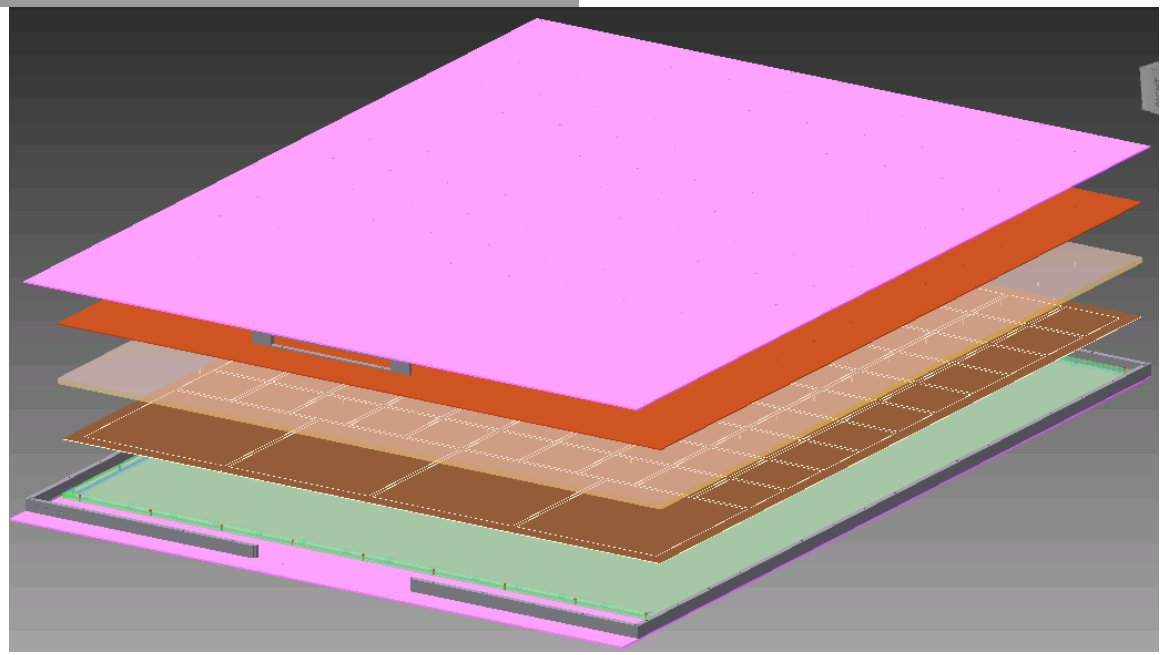




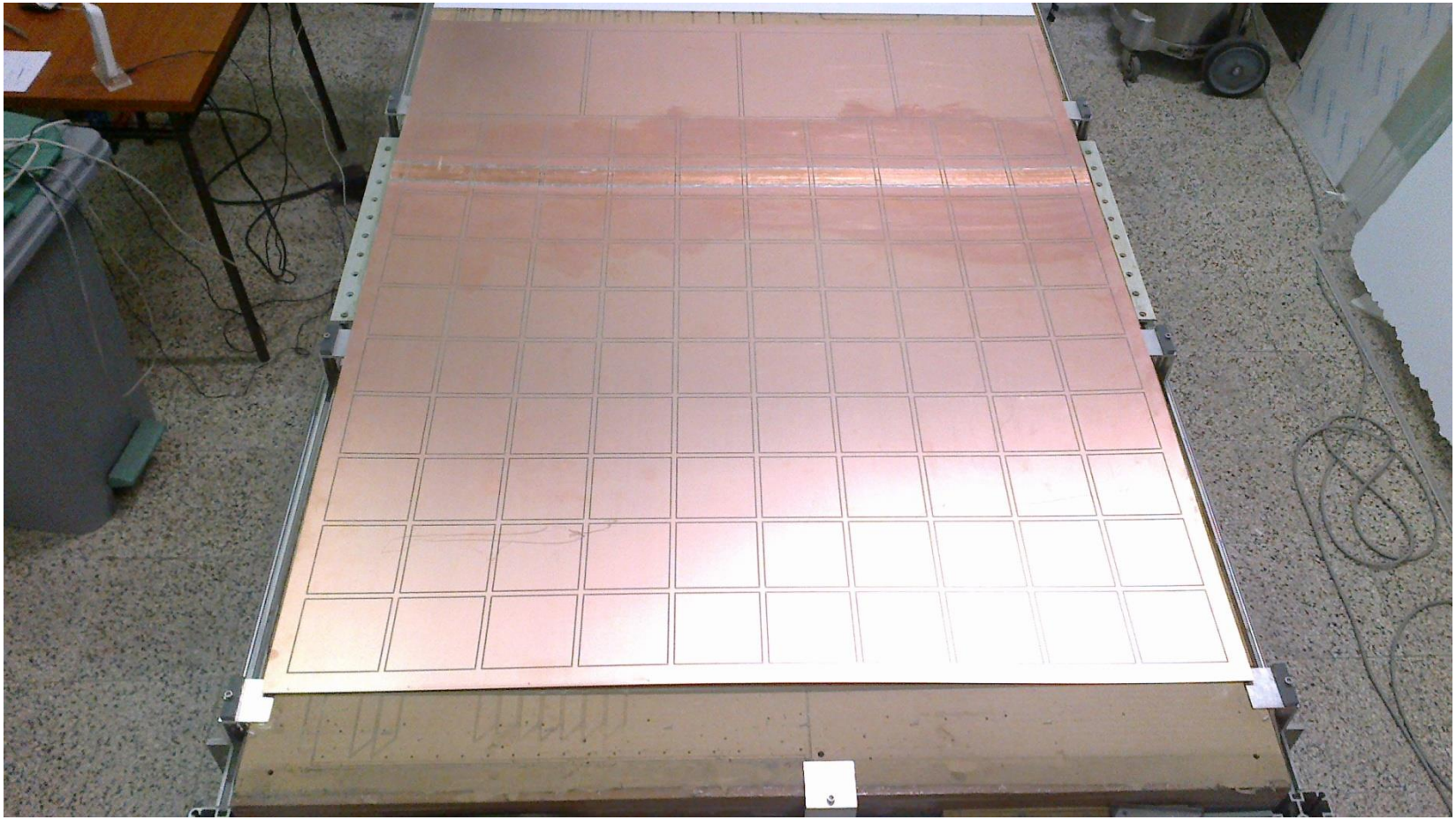


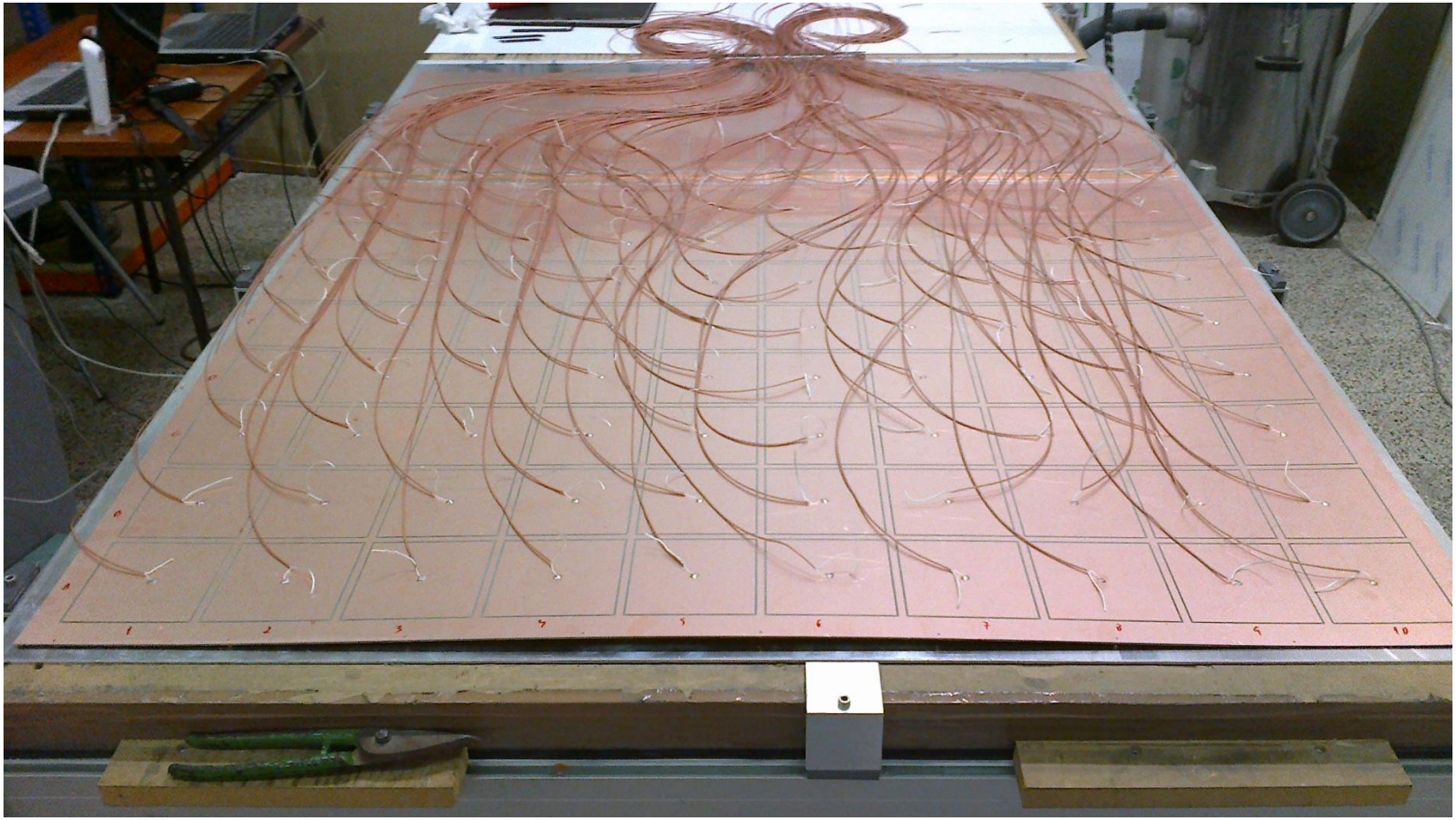
RPC Module





Read-out: Segmentation





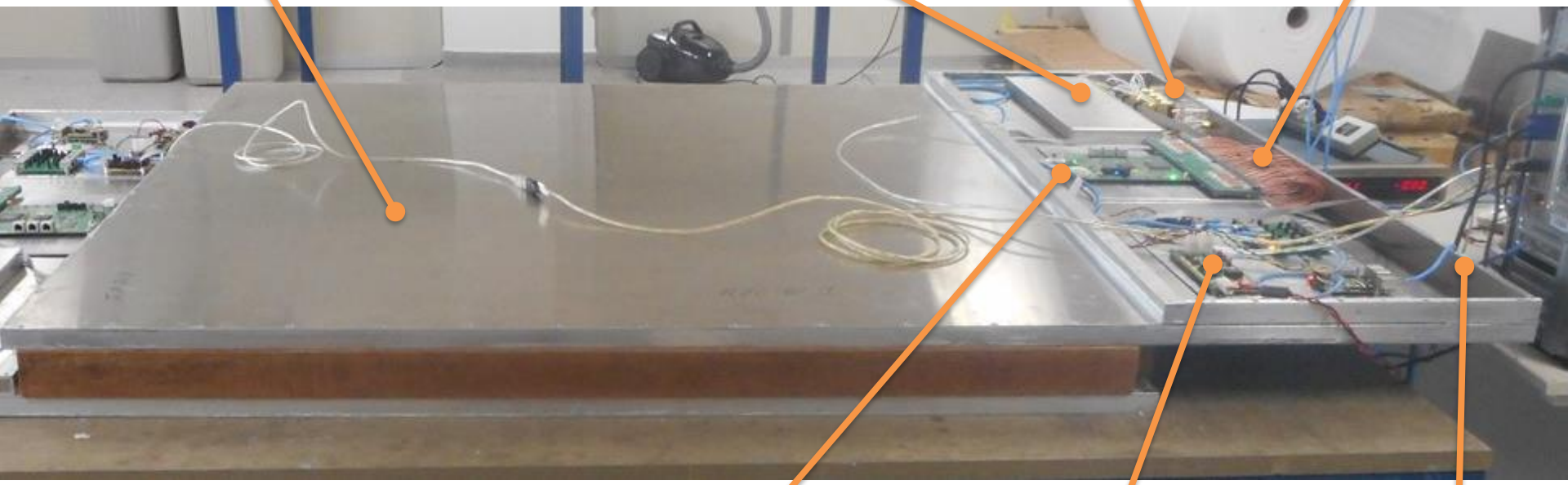
The MARTA module

Each module contains:

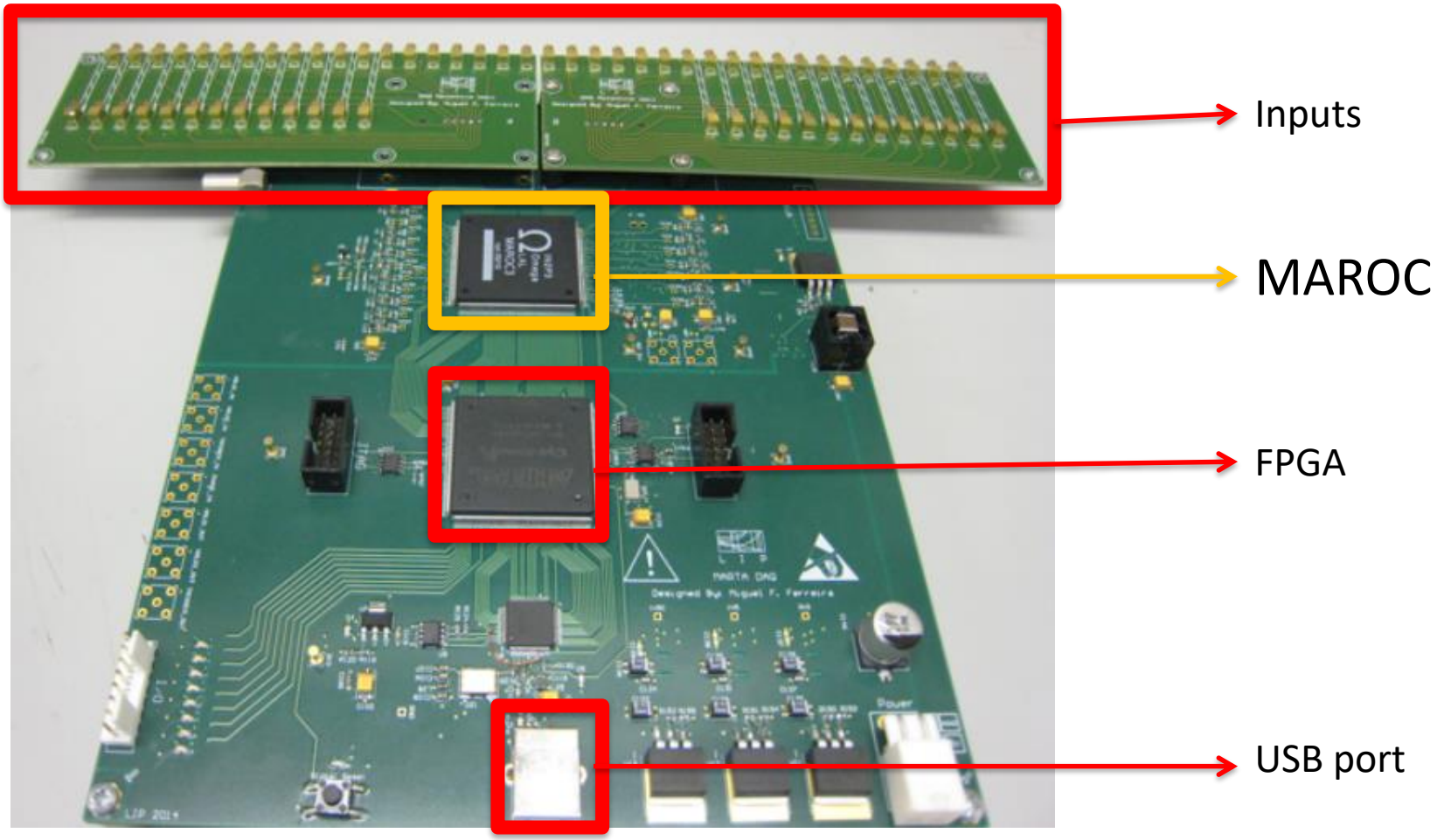
- Sensitive volume
- Pickup system
- sensors
- Enclosure
- Annex:
  - DAQ
  - HV
  - PSU
  - Control Board
  - Bubbler

Integration at São Carlos, Brazil

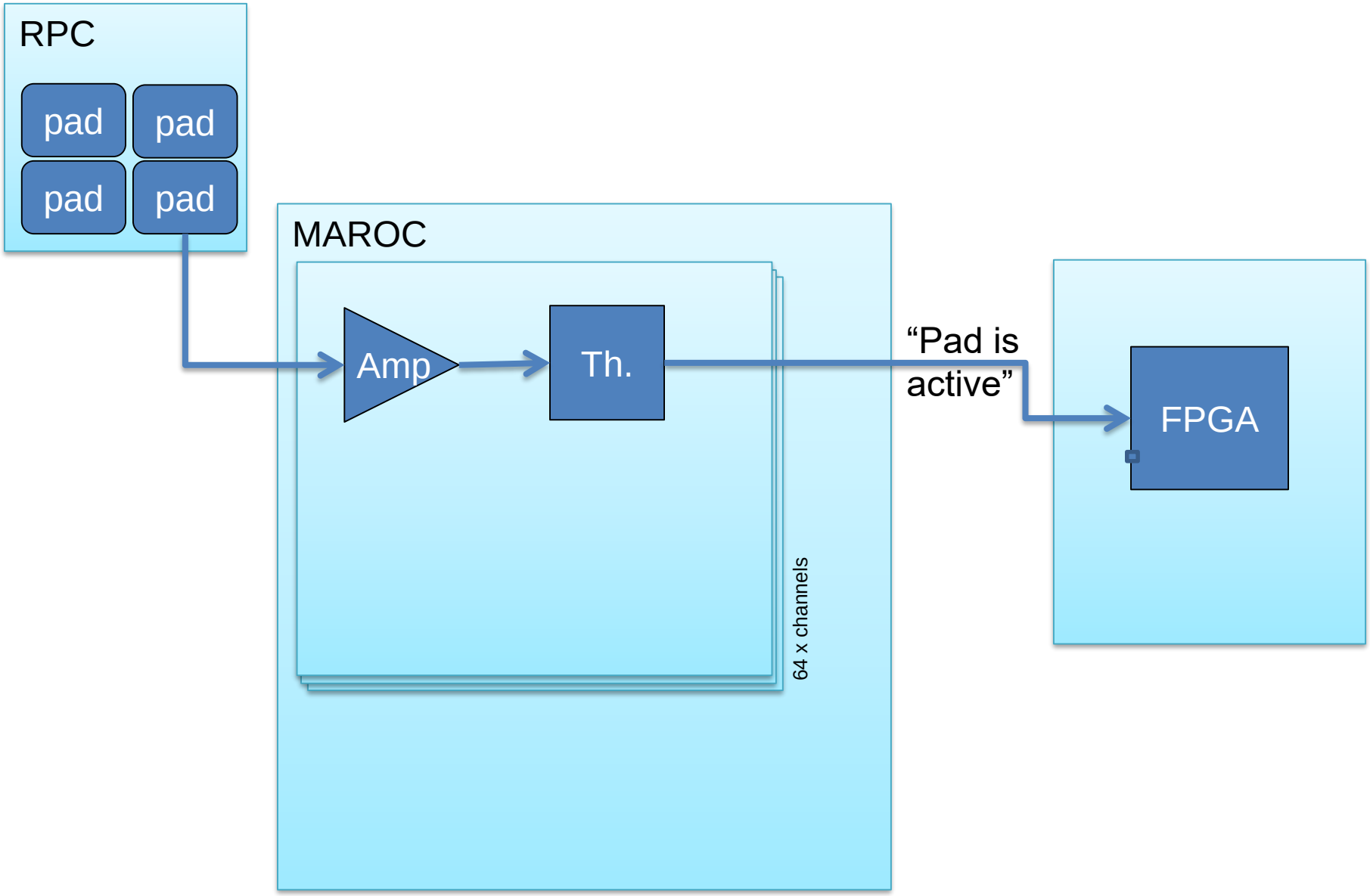
The MARTA module



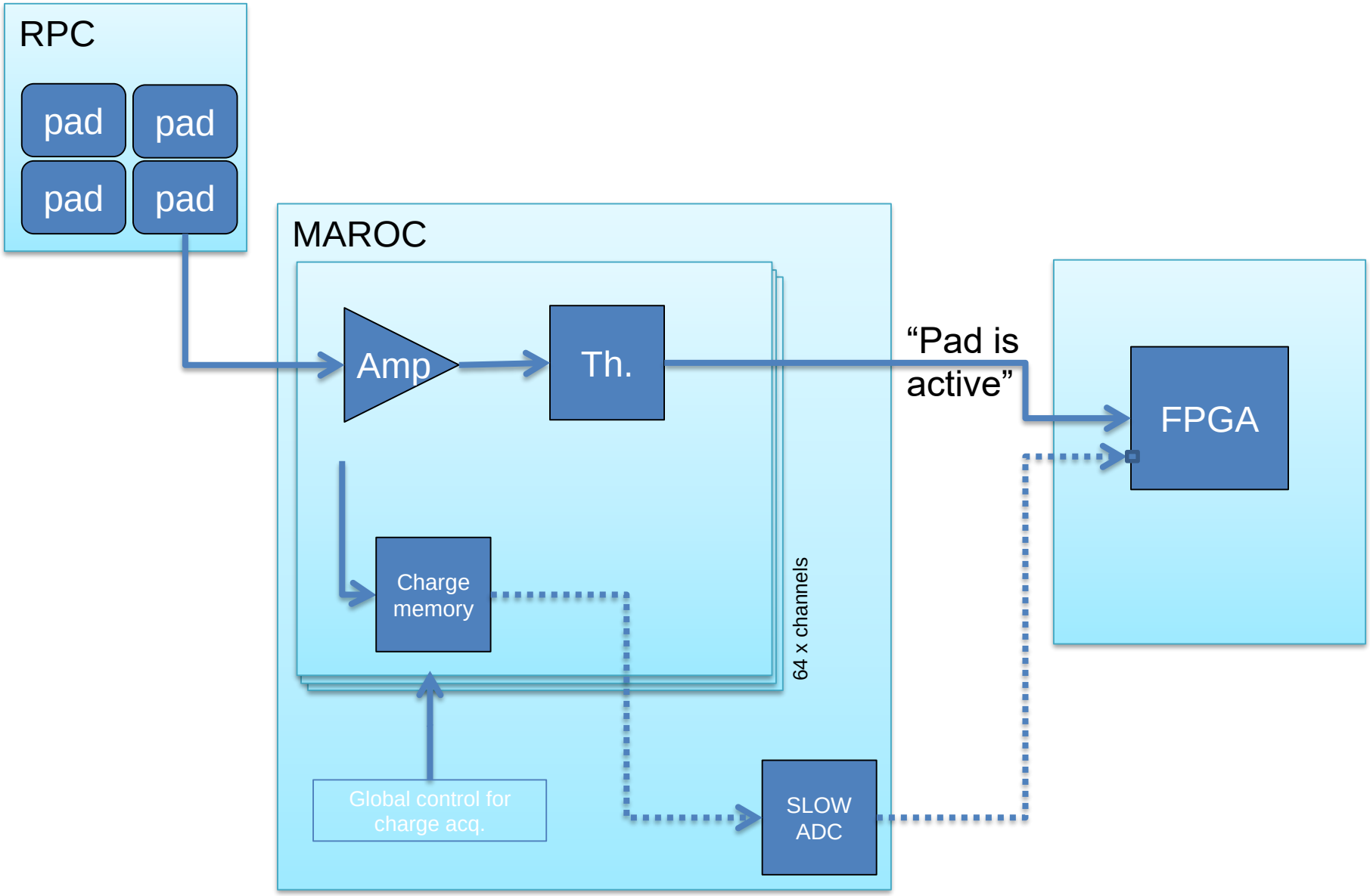
MARTA Readout System



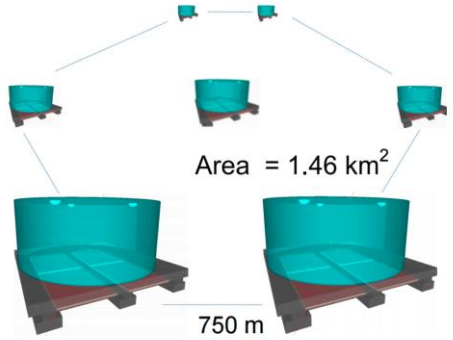
RPC channel


RPC
pad
pad
pad
pad
MAROC
Amp
Th.
64 x channels
“Pad is active”
FPGA

RPC channel


RPC
pad
pad
pad
pad
MAROC
Amp
Th.
"Pad is active"
FPGA
Charge memory
64 x channels
Global control for charge acq.
SLOW ADC

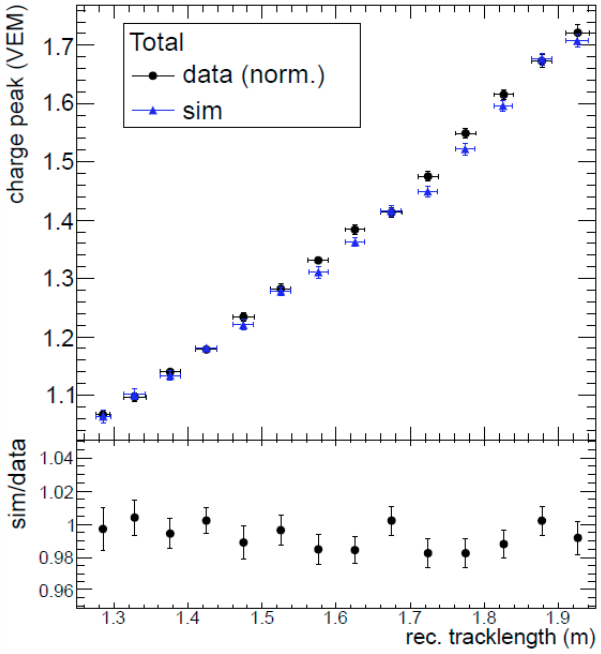
First field station



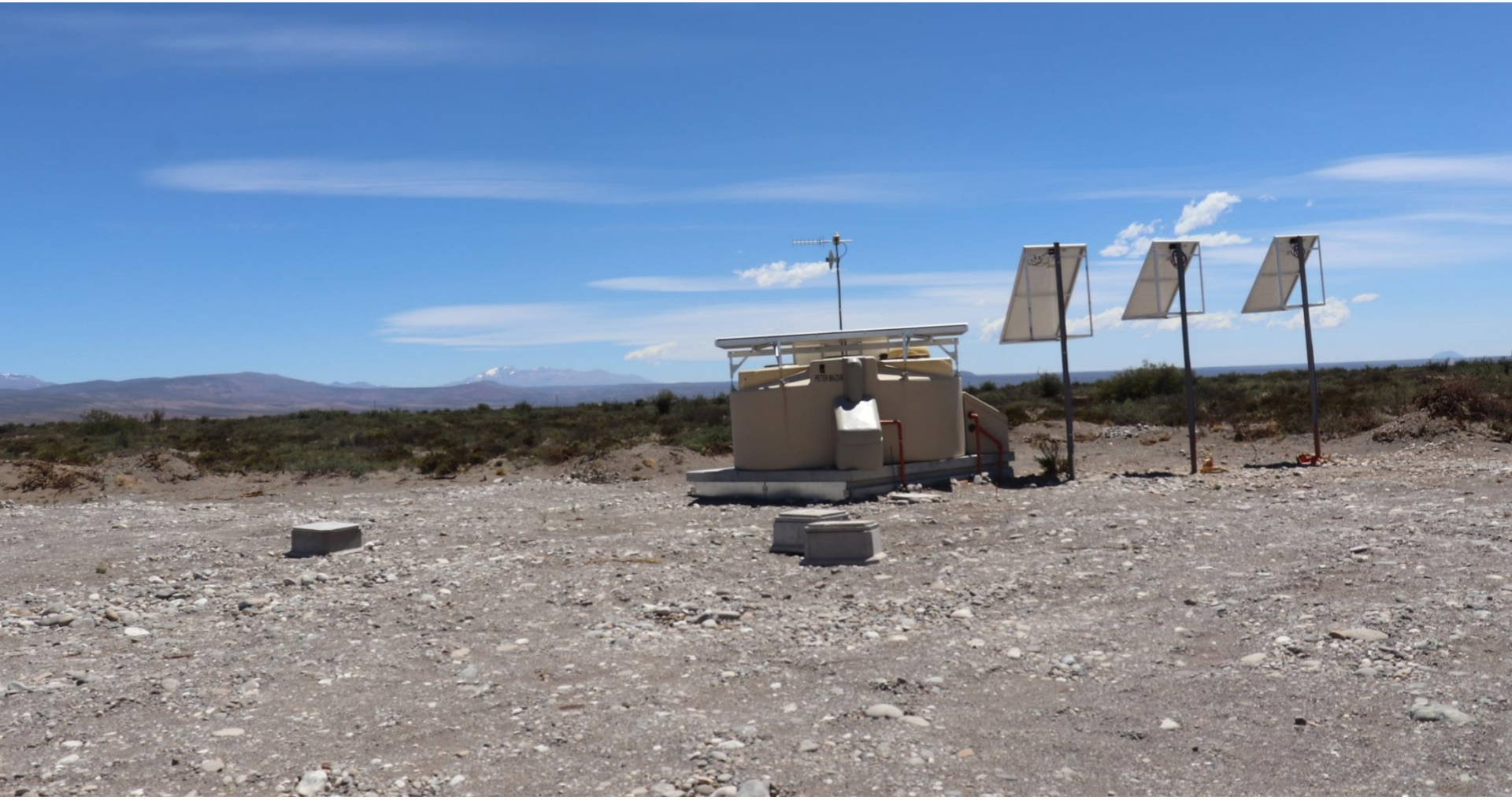
Spin-offs

Hodoscopes to test other detectors

Gianni Navarra setup



Telescopes
for
muon-graphy



www.lip.pt
pages.lip.pt/auger/

Thank you

Acknowledgements

FCT
Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA

REPÚBLICA PORTUGUESA

LIP

TÉCNICO LISBOA