Brief report on the MARTA detector concept for LATTES

Ruben Conceição

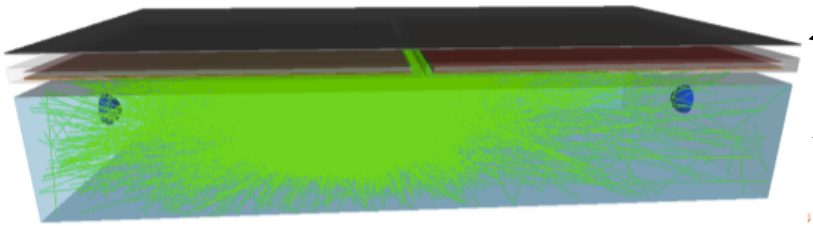
Jakub Vicha, Bernardo Tomé*

**Work done mainly by this author*

LIP

Motivation

BASELINE design



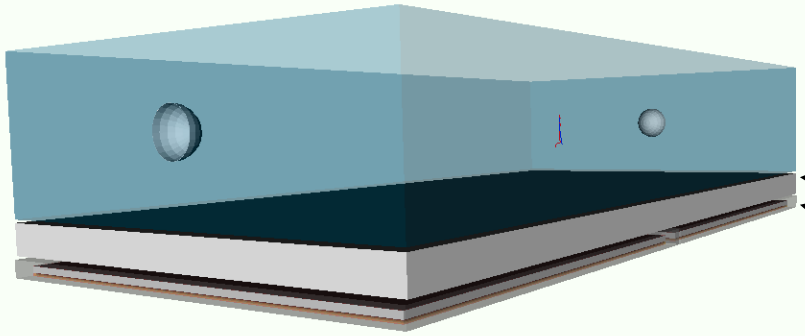
Pb plate 0.5 cm ~ 1 X_0

RPCs - shielded by ~ 1 X_0

WCD (50 cm of water) - shielded by ~ 1 X_0

Shielding generally:
- **absorbs low-energy electrons**
- **converts high-energy photons**

MARTA design



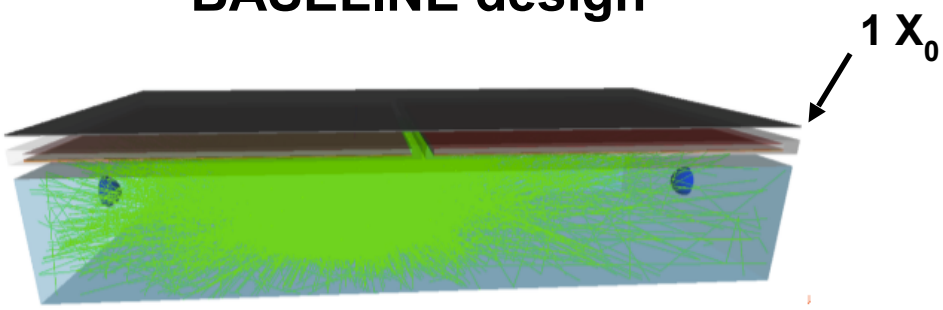
WCD - unshielded (40 cm of water ~ 1 X_0)

~~Concrete precast 10 cm ~ 1 X_0~~

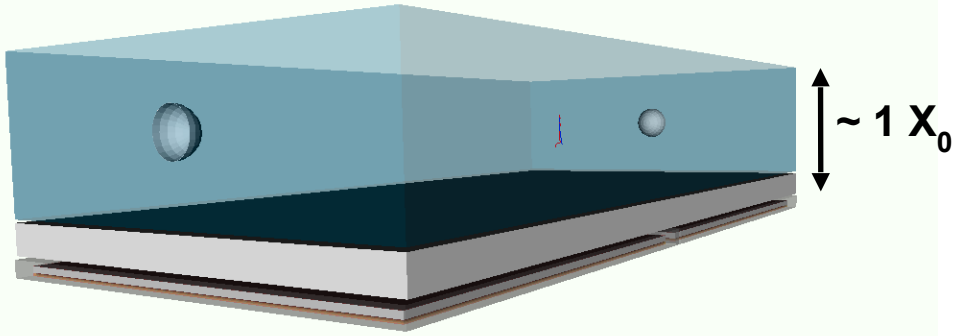
RPCs - shielded by ~ 1 X_0

Motivation

BASELINE design



MARTA design



- **In principle, both designs are ~ equivalent**

-> need to be tested with simulations

- **No need for Pb plate**

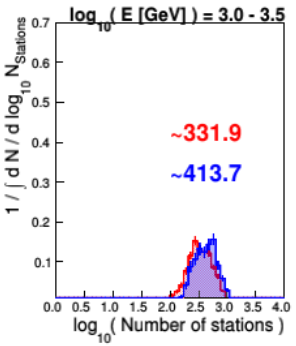
(~200 kg) in the MARTA design

-> less demanding on cost and deployment, smaller temperature variations in RPCs

Summary of results at station level

- Many tests at the station level and at different shower energies (**BASELINE** / **MARTA**)
  a. WCD total number of stations
  b. WCD number stations vs core distance
  c. WCD LDF
  d. RPC number stations vs distance
  e. RPC LDF
  f. …
- We currently believe that we understand all these features
- Document describing all finding to be produced soon

a.



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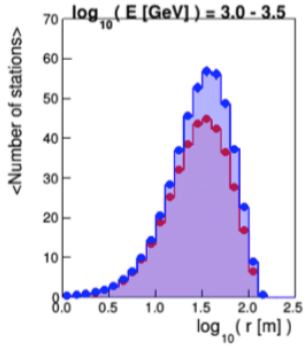
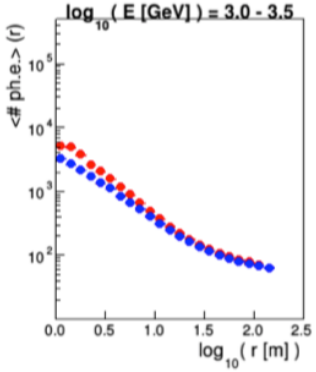


c.



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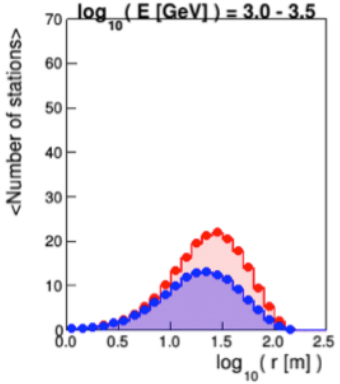

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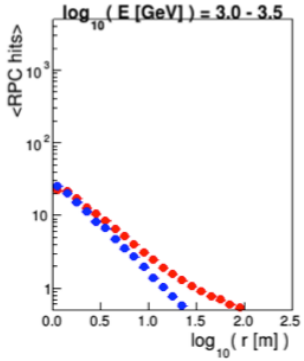

f.

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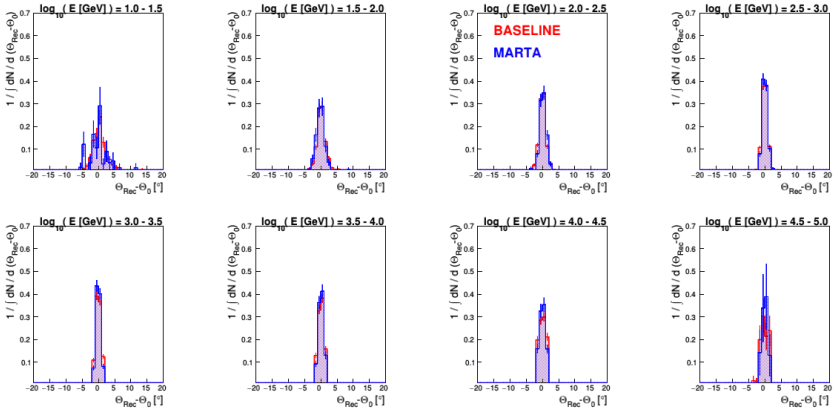
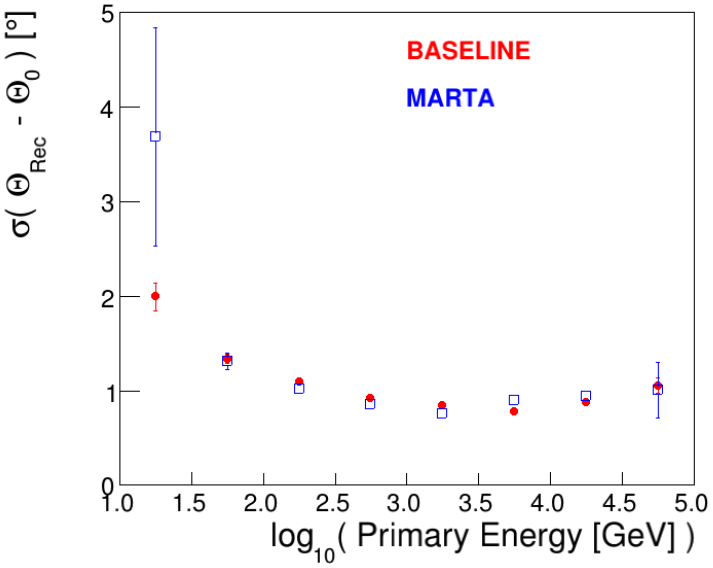
Going directly to impact on shower reconstruction

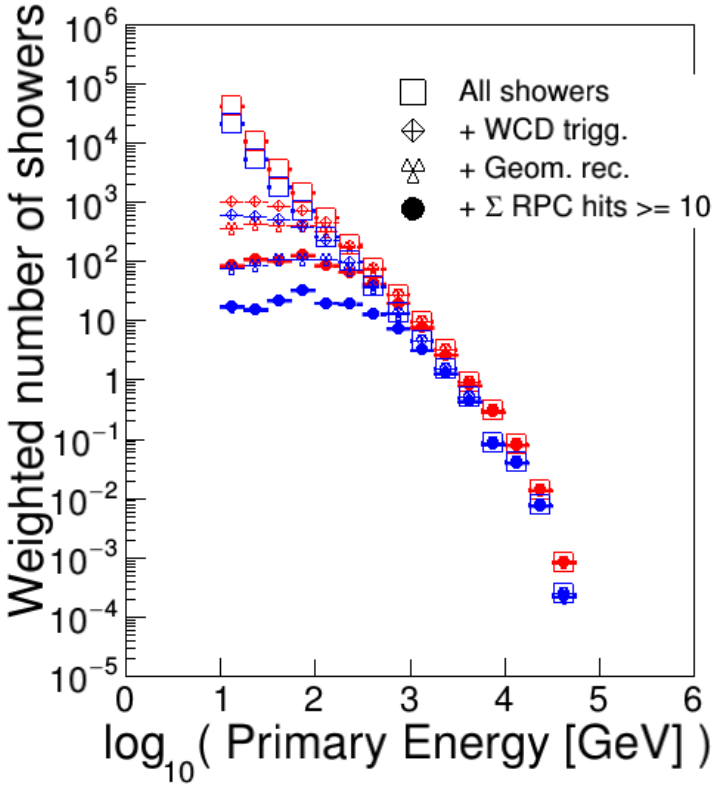
Shower geometry reconstruction

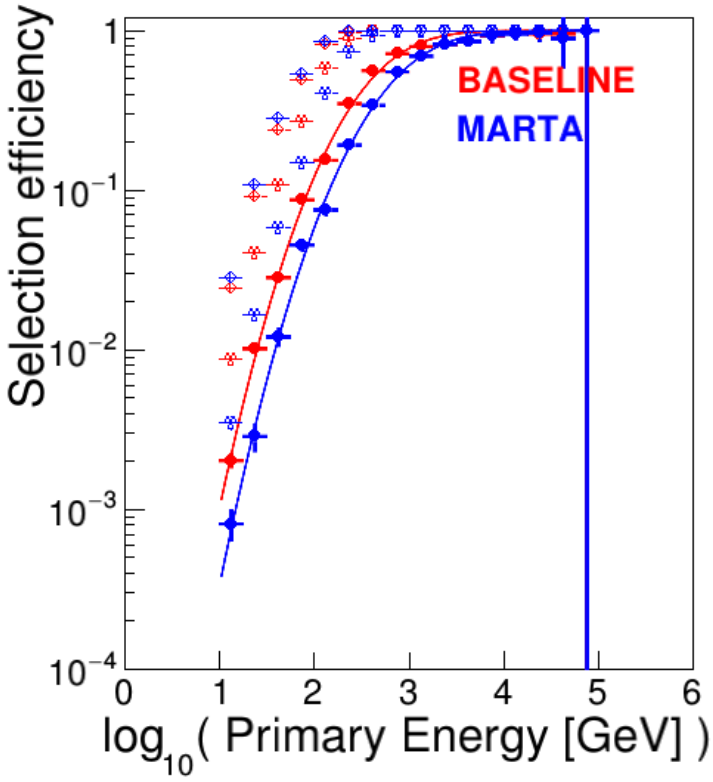
- Caveats:
  - Using simulated energy instead of reconstructed energy
  - Use LATTESrec to rec showers
- Shower geometry reconstruction is not affected





Shower selection efficiency

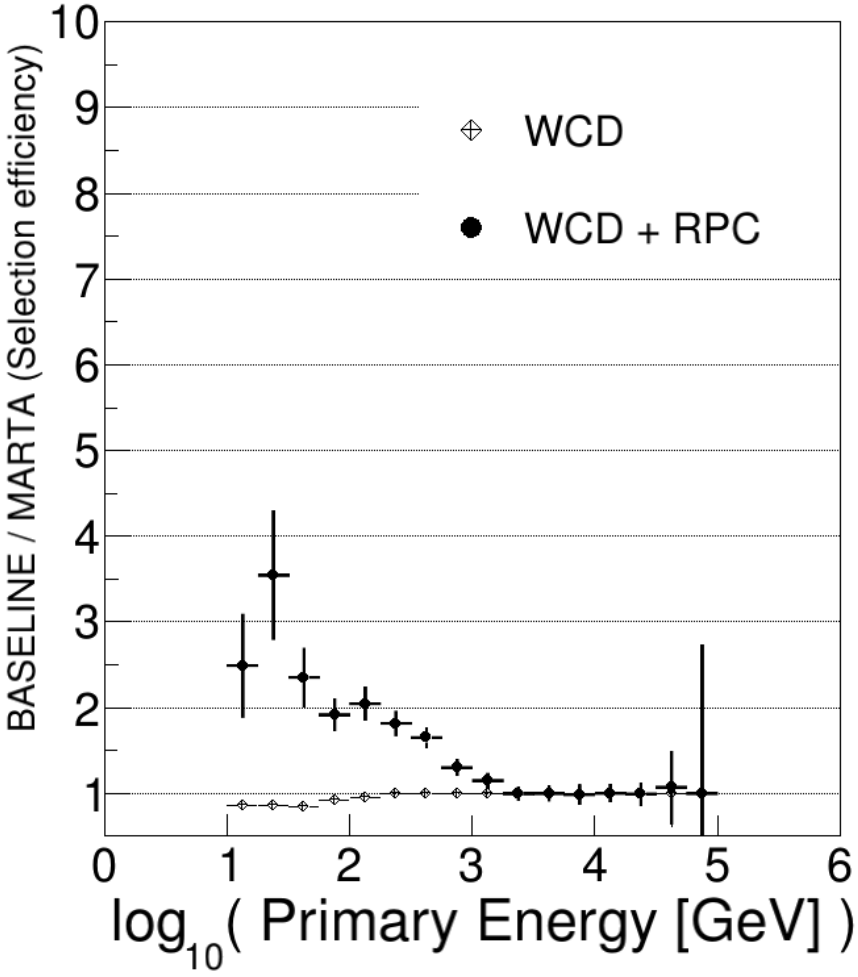




- When only WCD trigger considered, there are small differences in the selection efficiency
- Differences increase when additional conditions on geometry reconstruction (using RPC) are applied (consequence of steeper RPC <LDF> in case of MARTA)

Shower selection efficiency ratio

- Similar performance above 1 TeV (simulated energy)
- MARTA is slightly better at the WCD level
- LATTES baseline better at the RPC level
- As a consequence, LATTES baseline is a better detector when targeting lower energies



Summary

- Study of MARTA-like detector concept for LATTES
  - Features/differences understood
- Test with more inclined showers to be done
- Draft of a paper with these results to be produced as soon as possible

Acknowledgements

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REPÚBLICA PORTUGUESA

LIP

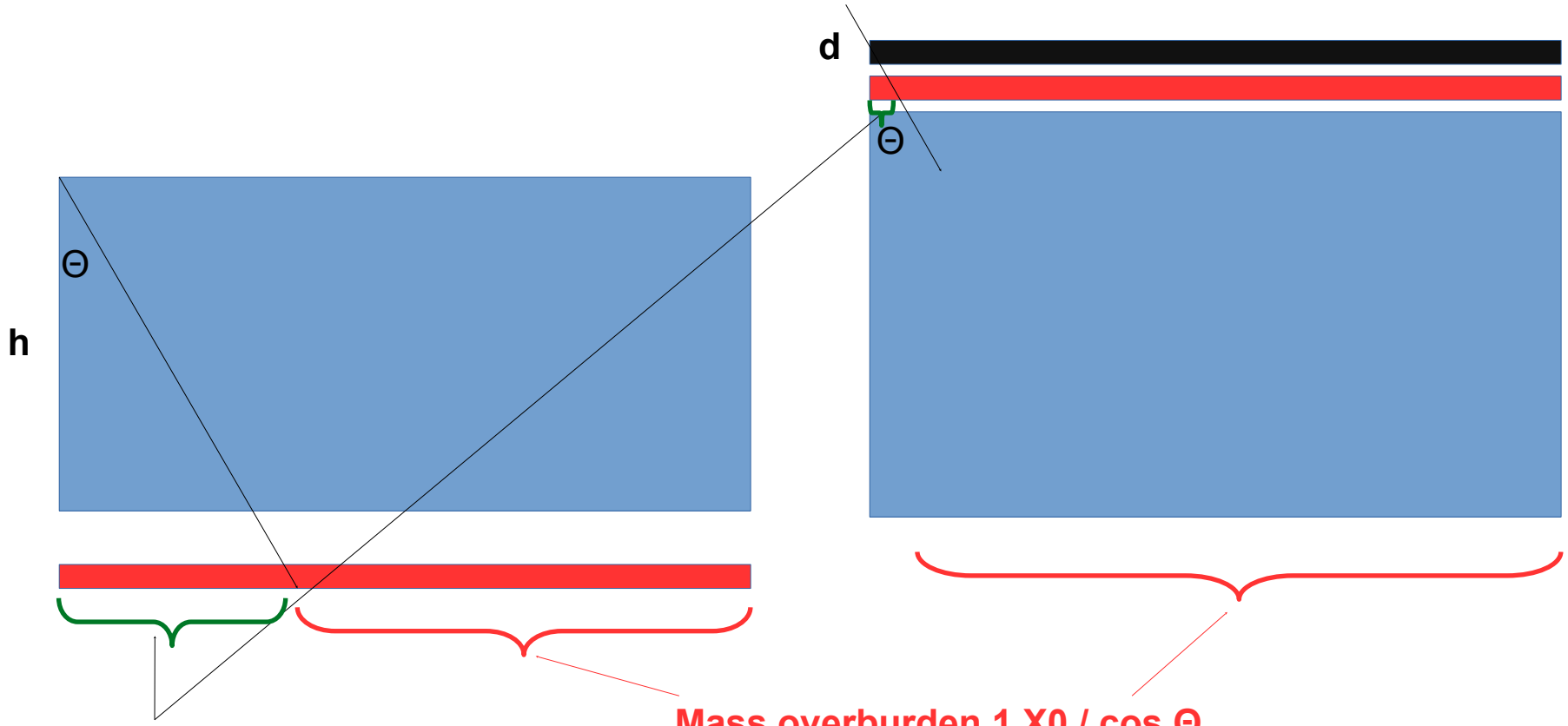
TÉCNICO LISBOA

Backup slides

Summary

- **Above 1 TeV**
  - at the WCD level, Marta and Baseline equivalent
  - at the RPC level, about 20% less RPC hits in case of MARTA, but not affecting the angular resolution
  - selection efficiency ~ the same
- **Going below 1 TeV**
  - at the WCD level, Marta triggers events with more stations farther from the core -> more total ph.e. collected - effect on energy resolution yet unknown
  - at the RPC level, Baseline collects more hits, but again does not seem to affect angular resolution
  - selection efficiency is by 2-3 times better in case of Baseline due to more hits collected (trigger 10 hits)

Geometry effect



Mass overburden 1 X0 / cos Θ

"Antifiducial area" with smaller mass overburden than the rest - are we loosing the subshower content (photon conversions)?

Ratio "Antifiducial area" / Total area for Θ=30°:

- Marta: (h · tan Θ) x 1.5m / 1.5m x 1.5m = ~15%
- Baseline: (d · tan Θ) x 1.5m / 1.5m x 1.5m = ~0%

What are the production points of particles? Are Θ=30° possible farther from the core?