Summary: Detector design, prototypes and tests

Eleazar Cuautle

ICN-UNAM

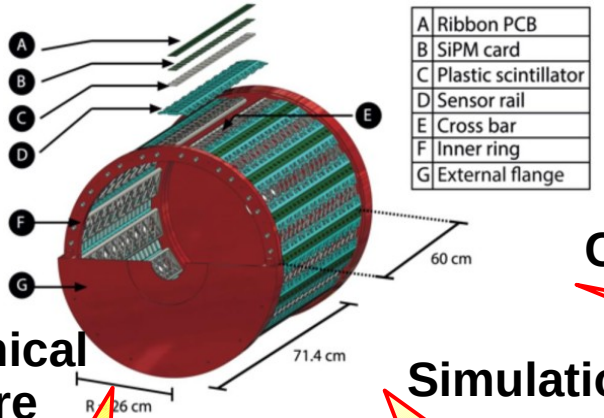
MexNICA Collaboration Winter Meeting 2020

Summary : Design, prototypes and test detector

Electronic

Advances in the miniBeBe Front-End design

Lucio Robledo



Mechanical structure

Mechanical support design for miniBeBe

Ramón Kado

Simulation

- miniBeBe simulation
- Intrinsic time resolution
- BeBe time resolution

Heber Zepeda
Javier Hernández
Edmundo Marquez

Computer

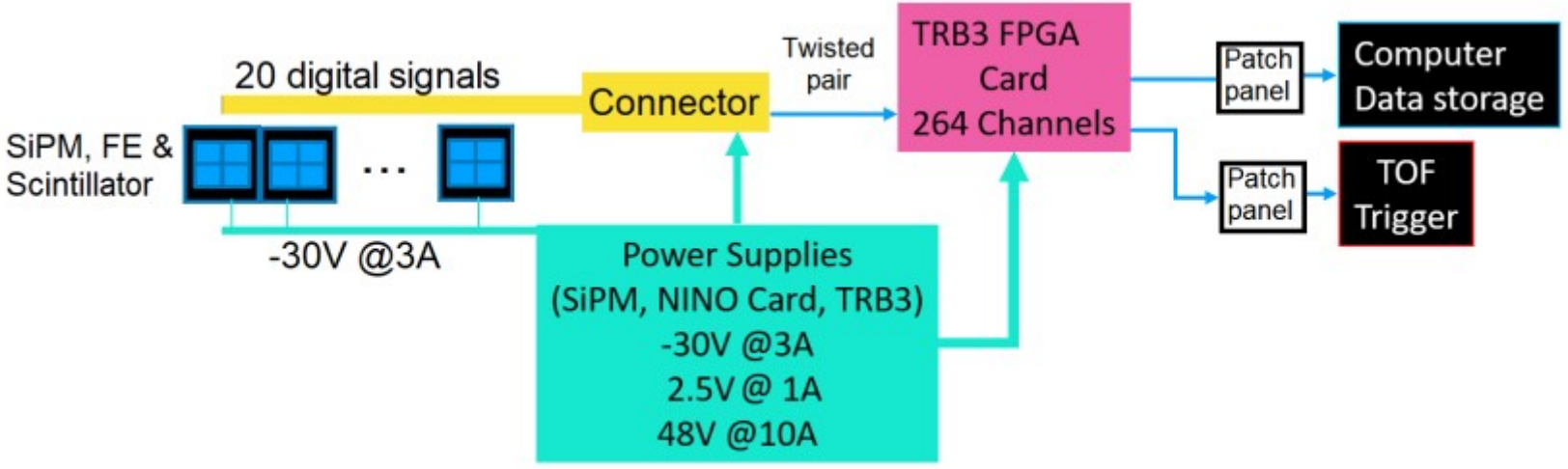
MexNICA HPC infraestructure

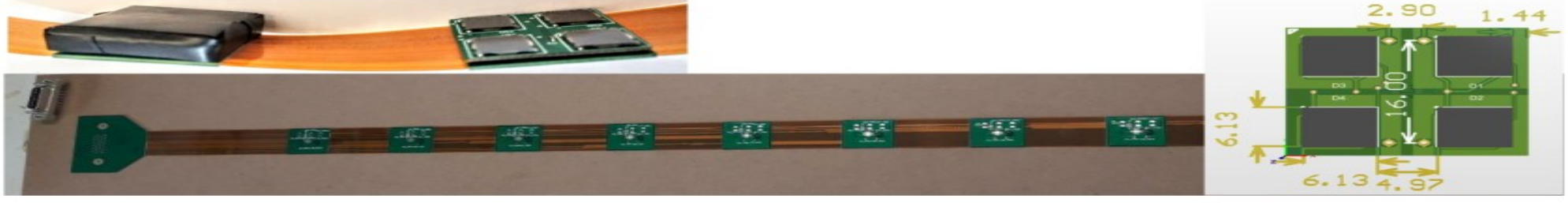
Luciano Díaz

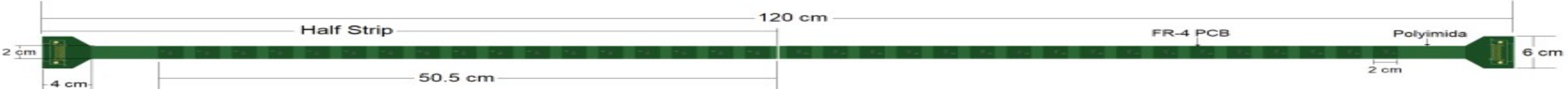
Advances in the MiniBeBe Front-End

Lucio Rebolledo-Herrera.

General scheme of MiniBeBe







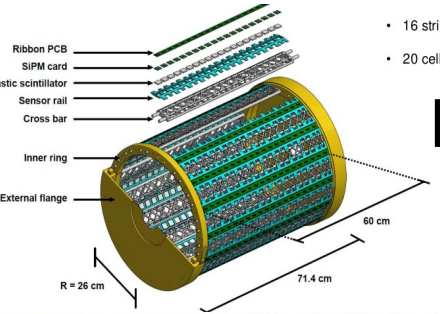
The most important

- Prototype development with fast electronic to reach time resolution required by the experiment, has been done.
- First complete strip prototype will be fabricated at the beginning of 2021

Issues to be solved

- Made prototype which should be tested in Puebla and then go to the radiation test. TRB3 test to provide signal to FPGA follow the chain of the signal. Program the trigger signal and the communication to the Central Processor Trigger .

- The new dimensions of miniBeBe, will it modify the developed prototype?
- How fast the electronic will be done when decide to increase the size/geometry of the detector?

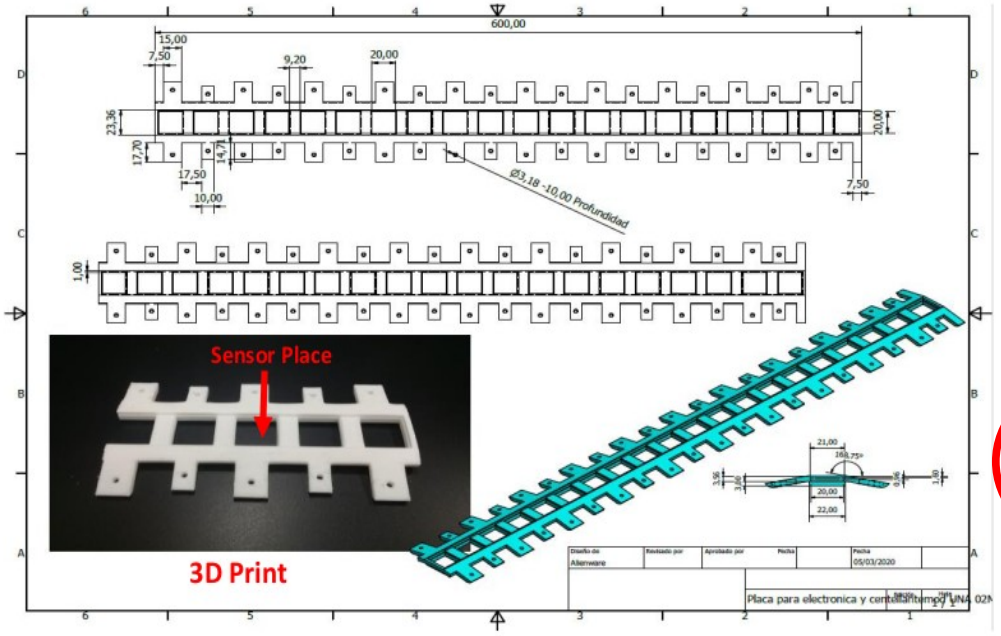


- 16 strips
- 20 cells/strip

Mechanical structure support of detecto(Prototype)

Ramon Kado

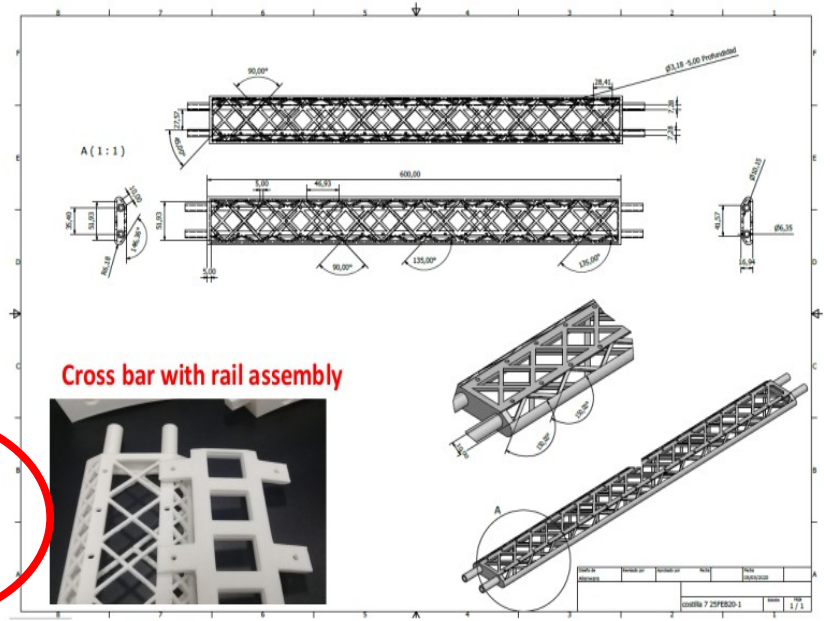
Sensors Rail (CAD)



Cross bar

Characteristics:

1. Transverse stiffness for the assembly of rails, rings and flanges.
2. Lightweight structure.
3. In finite element analysis does not show deformation along the 60cm.



New dimension of miniBeBe imply new analysis on deformation and,,,

The relevant

- The first mechanical structure prototype design is done. It need to be printed

- It is not the final prototype, it required information on the electronic (dissipation heat, ...) and also from geometry of the detector design.

Issues to be done

Any change on dimension of the detector should require a new analysis on material strengths.

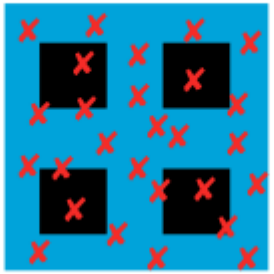
MiniBe-Be detector simulation

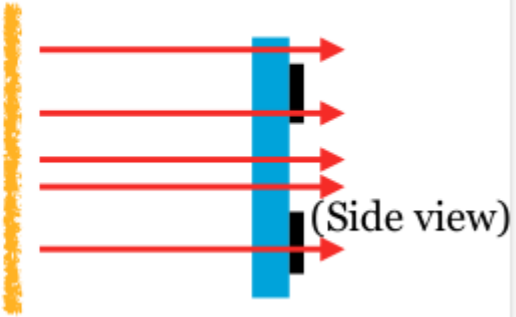
MiniBe-Be cell intrinsic time resolution

Heber Zepeda

- From MPDRoot: π^+ of 0.5 GeV.
- Random interaction

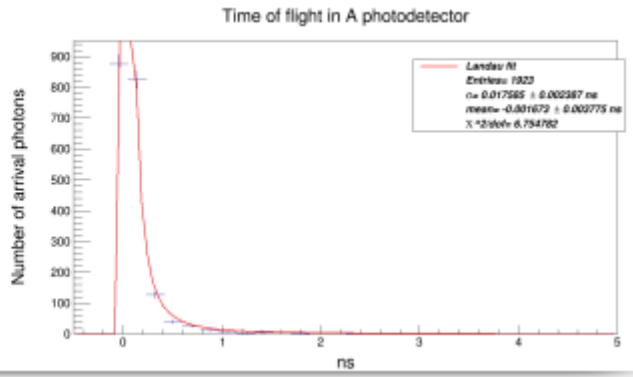
(Front view)





(Side view)

- **Each event: The minimum mean arrival time Landau distribution of each scorer was taken.**



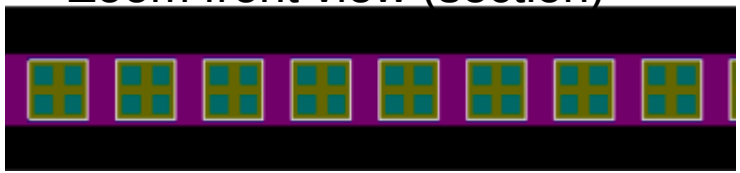
A. Alvarado et al. 2020 Nucl. Instrum. Meth. A **953** 163150.

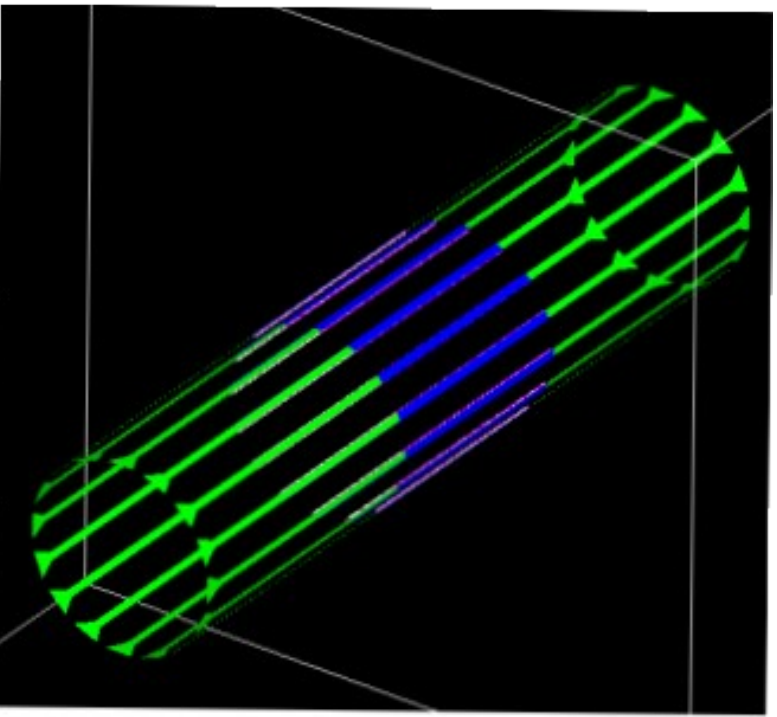
How the intrinsic time resolutio changes when the π are not perpendicular to the cell?

Simulation of almost all material on detector

A Strip of MiniBe-Be:

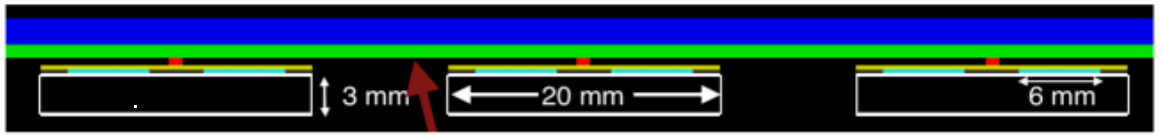
Zoom front view (section)



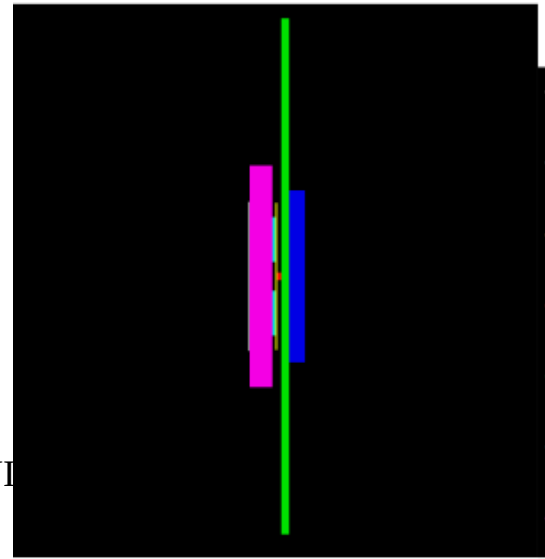


MiniBe-Be simulation.

Top view (without the Sensor rail)



Side view (with support)



*Scintillator (BC404)
*Glass (SiPM)
*Bakelite (SFED)
*PVC (conector)
*Bakelite (strip)
*Carbon Fiber (Top Cover)
*Carbon Fiber (Sensor rail)

Done

- Time resolution of a cell and simulation of the material around the miniBeBe
- Still will it be implemented more details of the detector: cables, fiber, connector, …

Next task and questions:

- Implementation on the MPDRoot frameworks.
- Which is the best way to proceed, Simulate miniBeBe on Geant and implement it on MPDRoot or work directly on MPDRoot?
- Which is the effects on the resolution time when the simulations are done with not perpendicular direction to the scintillator?

Study of the Time Resolution through Geant4 for the configuration of plastic scintillators coupled to SiPM as a function of its dimensions

Javier Hernández

METODOLOGY

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Radiation Gun

Muons Beam

Scintillator

Photosensor (2 SiPM)

Radiation Gun

Muons Beam

Scintillator

WHAT IS AN EVENT??

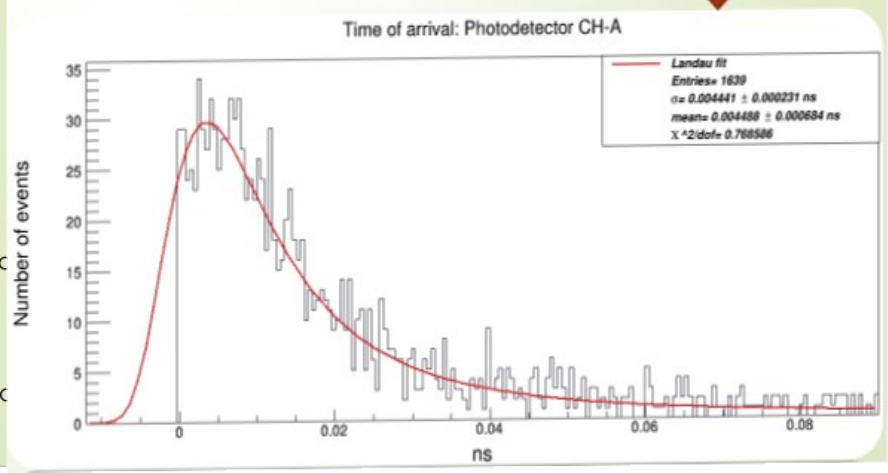
Photosensor (1 SiPM)

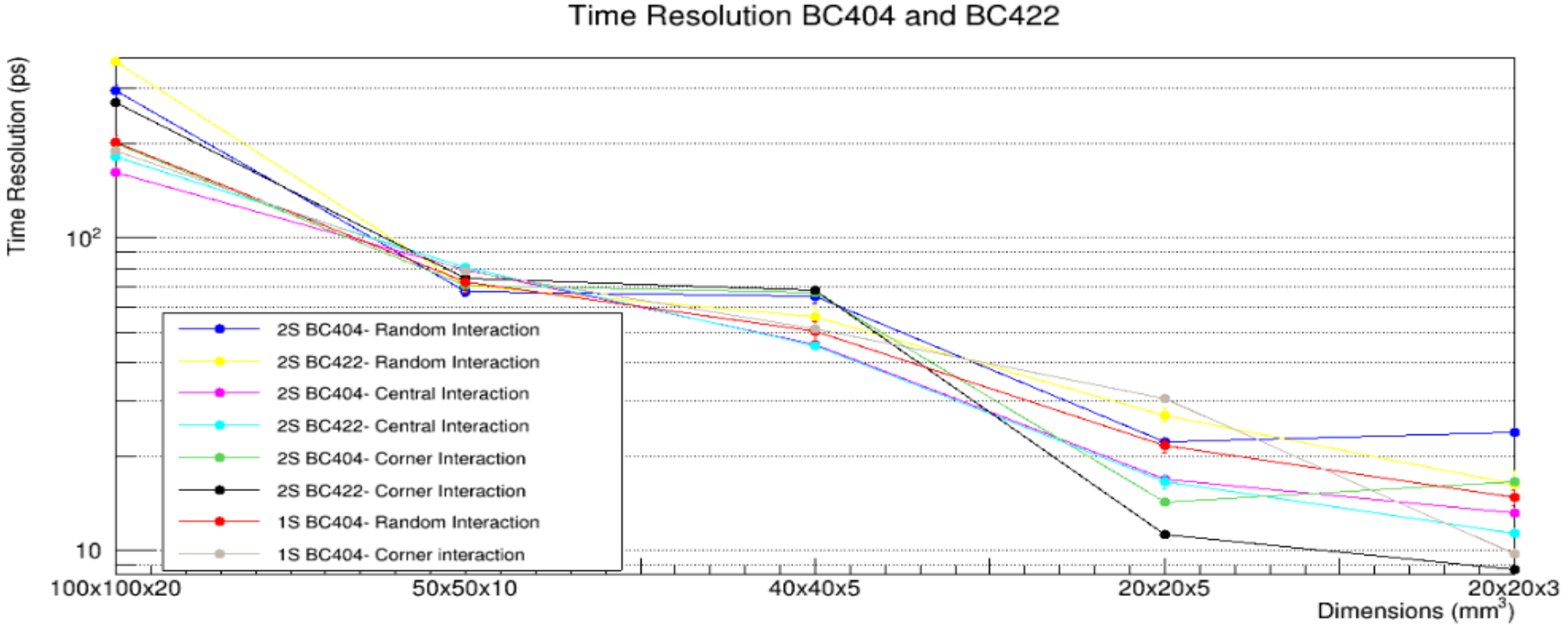
30 Simulations with 2 SiPM & 1SiPM
15 Sim. with BC404 & 15 sim. BC422
5 Sim. per 3 beam configuration.
Random, center and corner beam.

Electronics is not simulated easily in Geant4→ a sensitive area called **"Score"** will be simulated instead of SiPM:
Score= SiO_2 (just for counting the photons) 3x3x0.5

OPTICAL PHOTONS BY EVENT

The standard deviation (σ) of this last distribution, is the Time Resolution





Summary

BC404 has a better performance than BC422 at bigger scale > 50x50x10 mm 3
BC422 has a better performance than BC404 at smaller scale < 40x40x5 mm 3

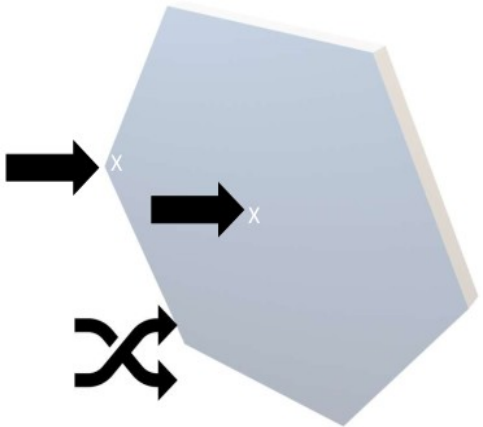
- Time resolution depends on the dimensions, optical path and the interaction zone

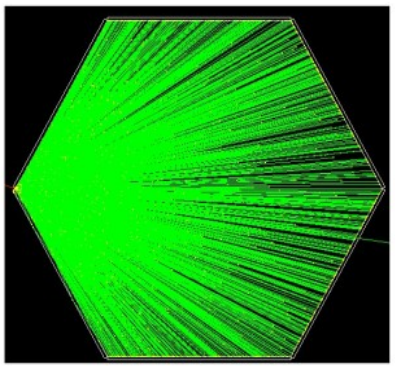
- Not smooth distribution; do it need more sizes of scintillators? What about to simulate different particles at different energies?

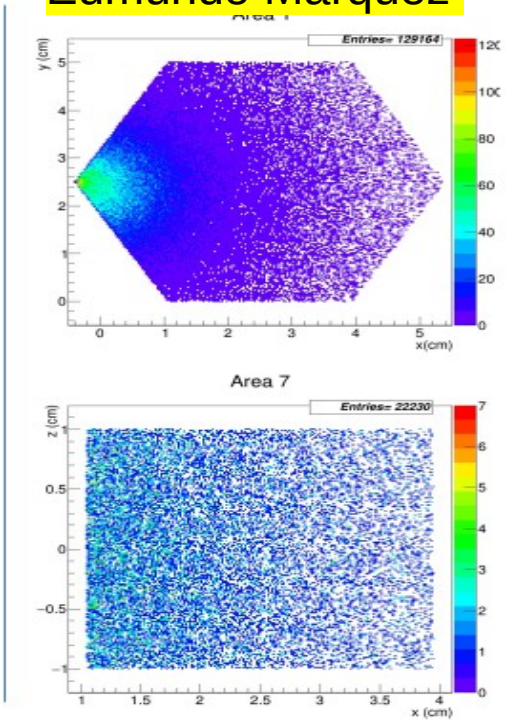
Study of the distribution of optical photons produced by different particles in a BE-BE hexagonal cell

Edmundo Márquez

Simulation







Corner beam simulations (protons)

Arrivel time of photons studies suggest that:
PMT or SiPM in any of the areas of the perimeter of the hexagon is fine.

MexNICA HPC infrastructure

Luciano Diaz

HPC resources

Also the cluster has received hardware contributions from MexNICA members

Alejandro Ayala

- **server : 1 Xeon Silver 4110 = 16 cores / 32 GB ram**

Eleazar Cuautle

- **1server: 1 Xeon Gold 6230R = 52 cores / 96 GB ram**

Coming soon from the project / UCOL (for 2021)

- **server: 2 Xeon Gold 6230R = 104 cores / 256 GB ram**

DIRAC configuration

- The cluster is able to receive jobs from JINR using DIRAC framework

About software

- MPDRoot installed on CentOs 6 -Obsolete
- In 2021 the cluster will be migrated to ubuntu 20.04
- MPDRoot container on
- Github administrator

Suport for MexNICA group; Monitoring jobs on DIRAC

Detector design prototypes and test
(Summary of the summary)

Great advances on the detector design prototypes for miniBeBe

What was reported

- Electronic
- Simulation (geometry and time resolution of plastic scintillators)
- Mechanical structure
- HCP(DIRAC) and software management (github)

We need to take care

- The first prototype has been developed for small dimension of the miniBeBe, however, there is plans to increase at least at double size.

- Each change on the dimension, imply redesign electronic, new simulation, new studies on strengths of the material for the mechanical structure, imply also new development on software for MPDRoot.