XI Collaboration Meeting of the MPD Experiment at the NICA Facility

Implementation of MiniBeBe detector in the MPD setup

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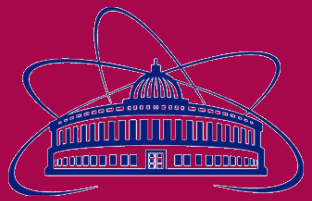
April 19th, 2023



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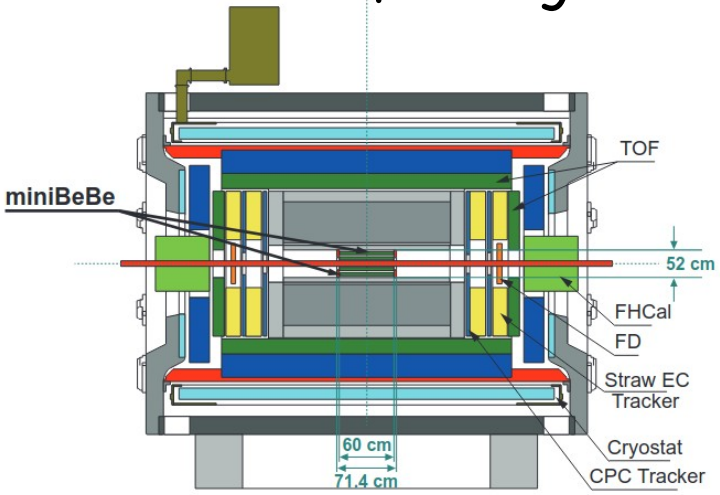
Introduction

- Its main goal is to contribute with an additional wake-up trigger signal for the TOF, particularly for low multiplicity events.



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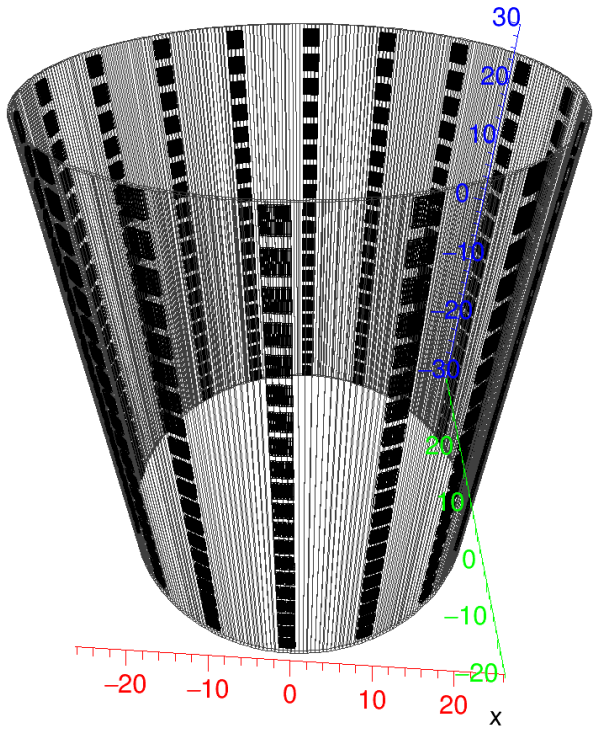
Geometry

Characteristics

- Length = 60 cm
- Radius = 25 cm
- 320 Scintillators - 2X2 cm
- 16 strips with 20 scintillators each



List of classes used for transport

- MbbDetector.h (.cxx)
- MbbPoint.h (.cxx)
- MbbGeo.h (.cxx)
- MbbGeoPar.h (.cxx)

- It runs in v22.12.22
- Name of classes not in new format MpdDetector.h(.cxx)
- ProcessHits
  - only considers eloss - along all the steps of particle in sensitive volume
  - Light output for scintillators is not implemented

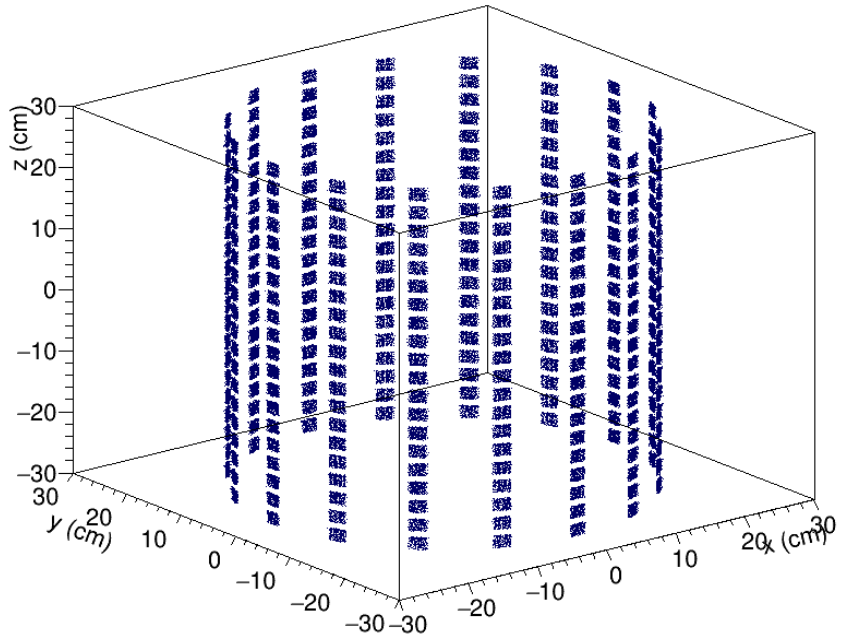
http://er.jinr.ru/howto.html

Sample used for test

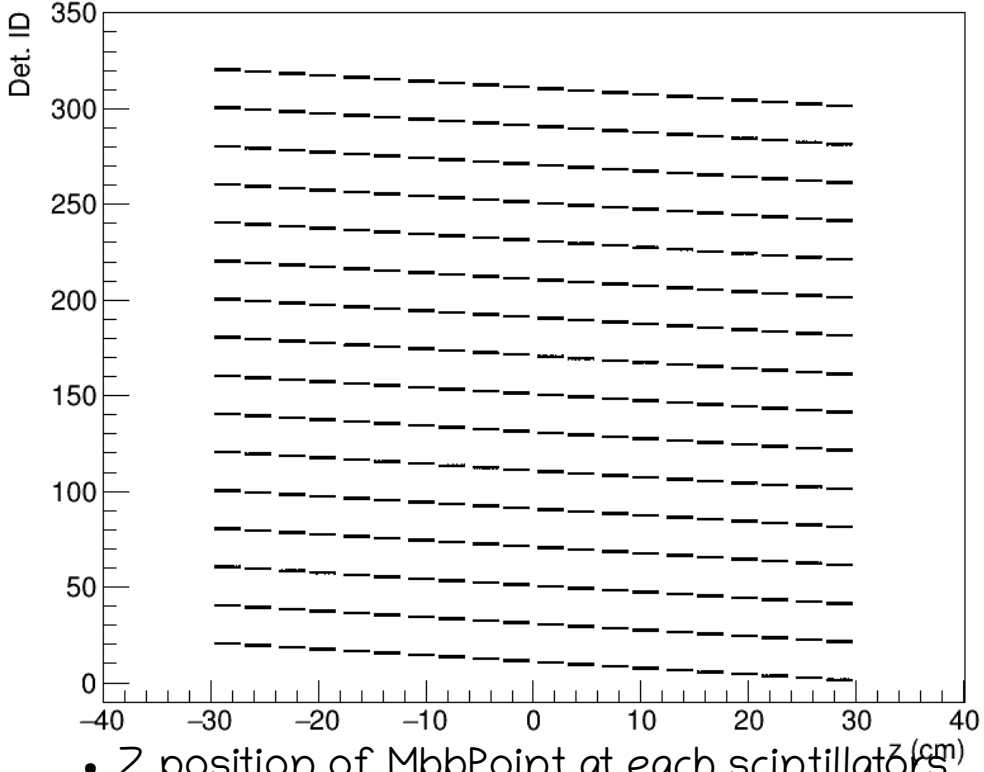
- MC - DCM-QGSM-SMM
- BiBi @ 4GeV
- ~100k Events
- Not a full transport
  - MCTrack
  - MbbPoint
  - FHCal
  - FFDPoint
  - MCEventHeader
  - GeoTracks

- Data asociated to request 21
- Simulation considers **NO** smearing of primary vertex
- Analysis should be done for small systems:
  - pp, dd, CC, ...

Results



- MbbPoint Position - at the first step in sensitive volume



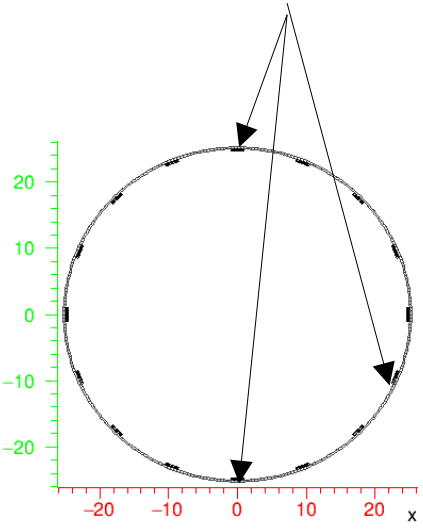
- Z position of MbbPoint at each scintillators

Probability - 1 hit per event

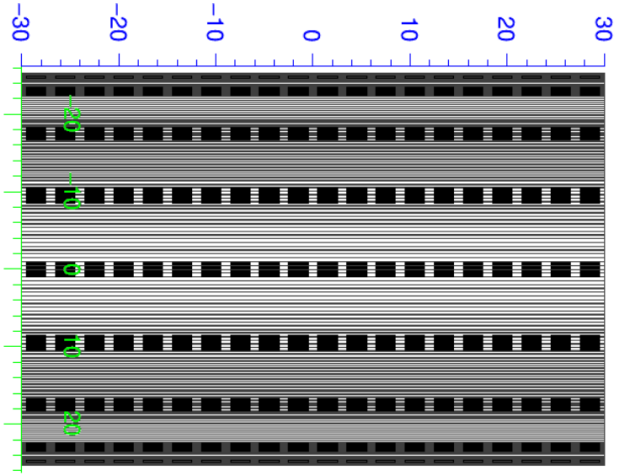
Details of selection

- We consider the probability that exist at least 1 MbbPoint at each ring, that means can be detected by any of 16 scintillators at each ring (each z position)

- Each ring - consisting in 16 scintillators

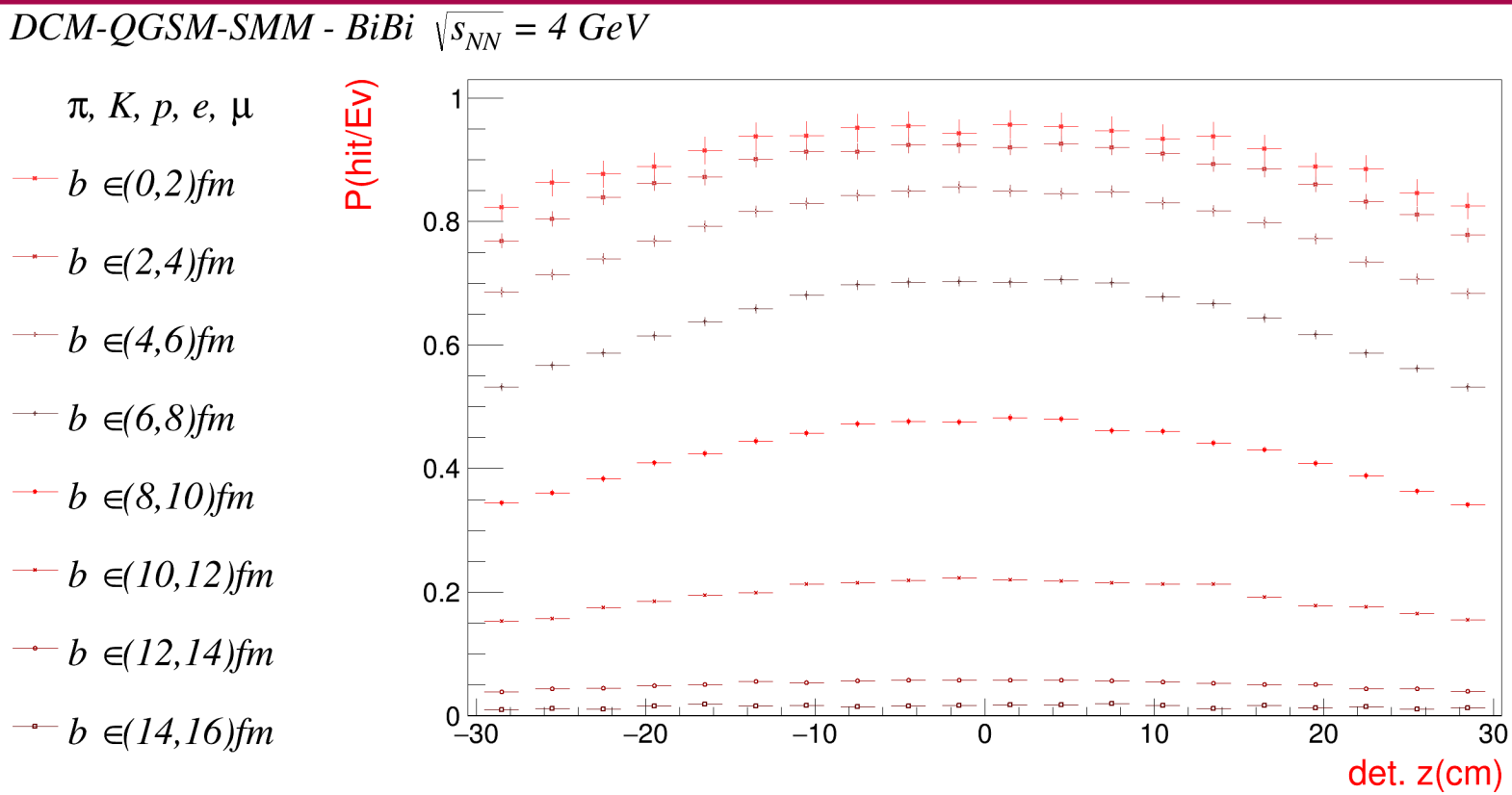


- 20 rings at different z position



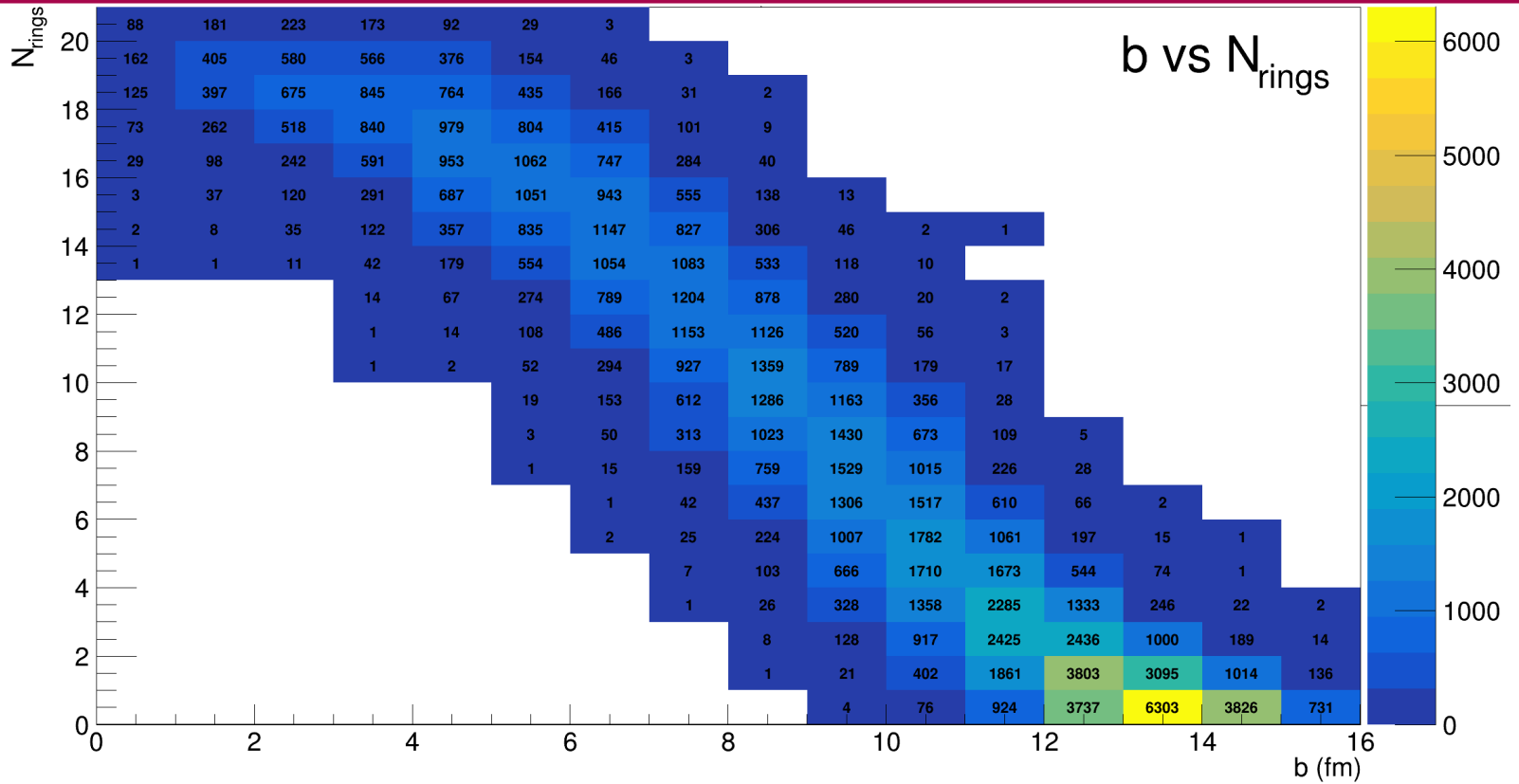
Rings: 1,2 … → … 19,20

Probability - 1 one hit per event



- At least one charged MbbPoint at each ring without any other consideration.
- The probability in average at each scintillator should the value divided by 16

Number of rings fired per event



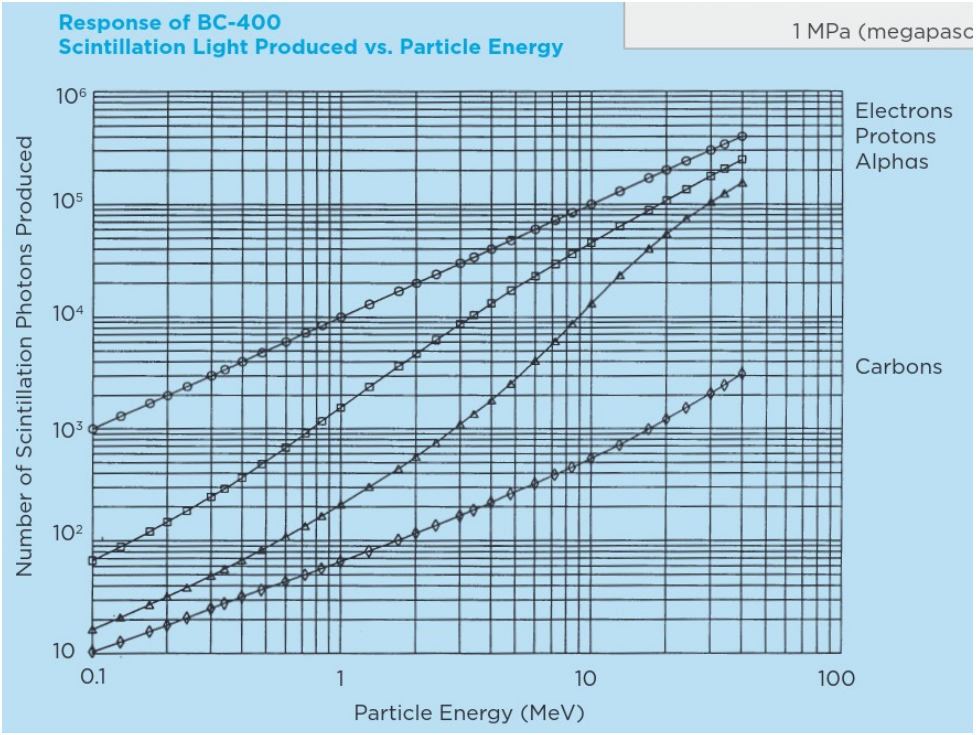
- Vertical axis shows the number of rings with at least 1 MbbPoint at each event
- There are ~ 15% of events without MbbPoints. That corresponds to b>9 fm

Energy threshold to fire a scintillator

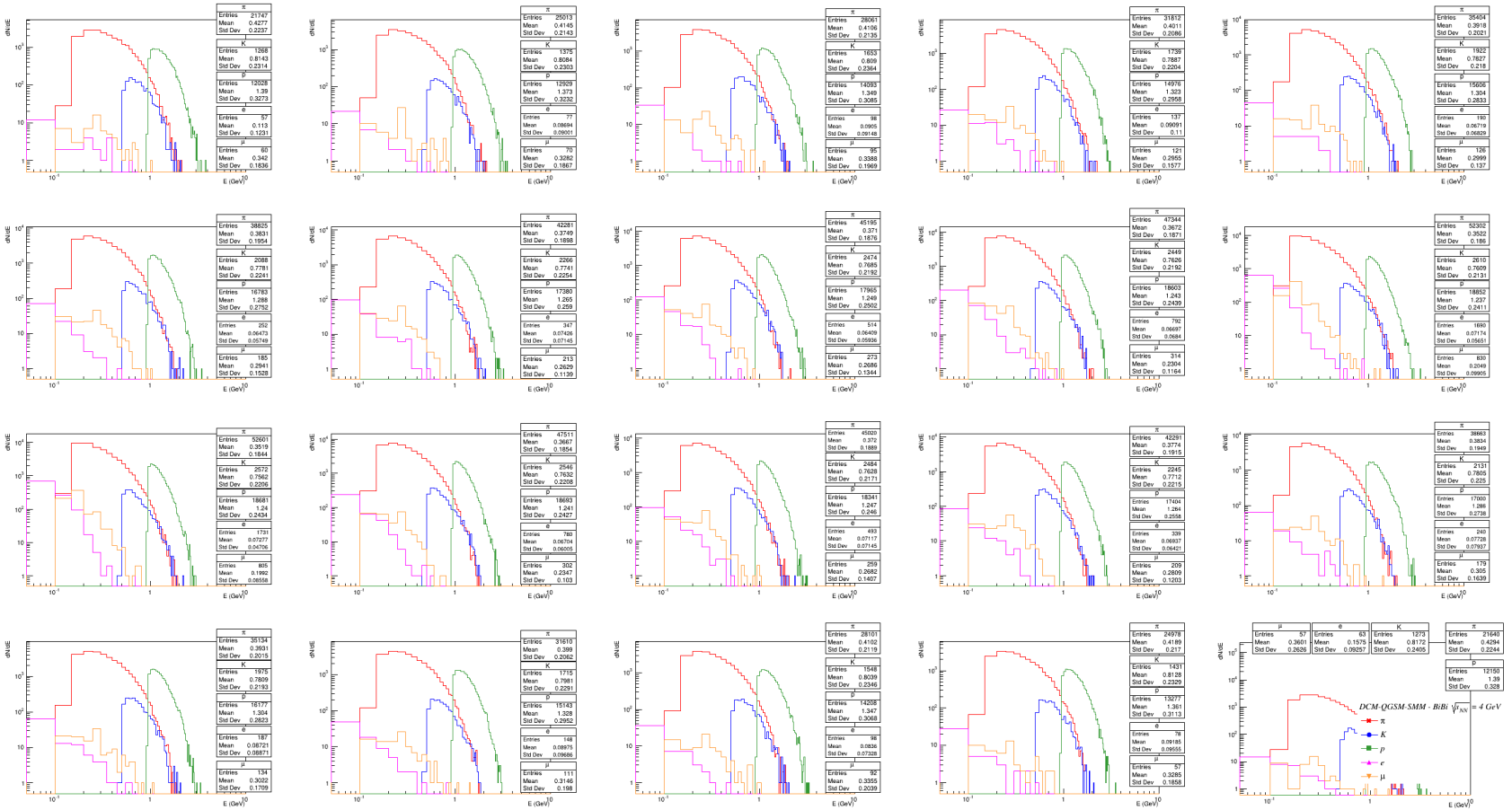
- We need to introduce the scintillation efficiency

$$R = \frac{Energy\ of\ emitted\ photons}{Energy\ absorbed}$$

- Because change of BC404 → EJ232(BC422)
  - λ of Max. Emission changes 408nm → 370nm
- Energy cut for fire the ring will change



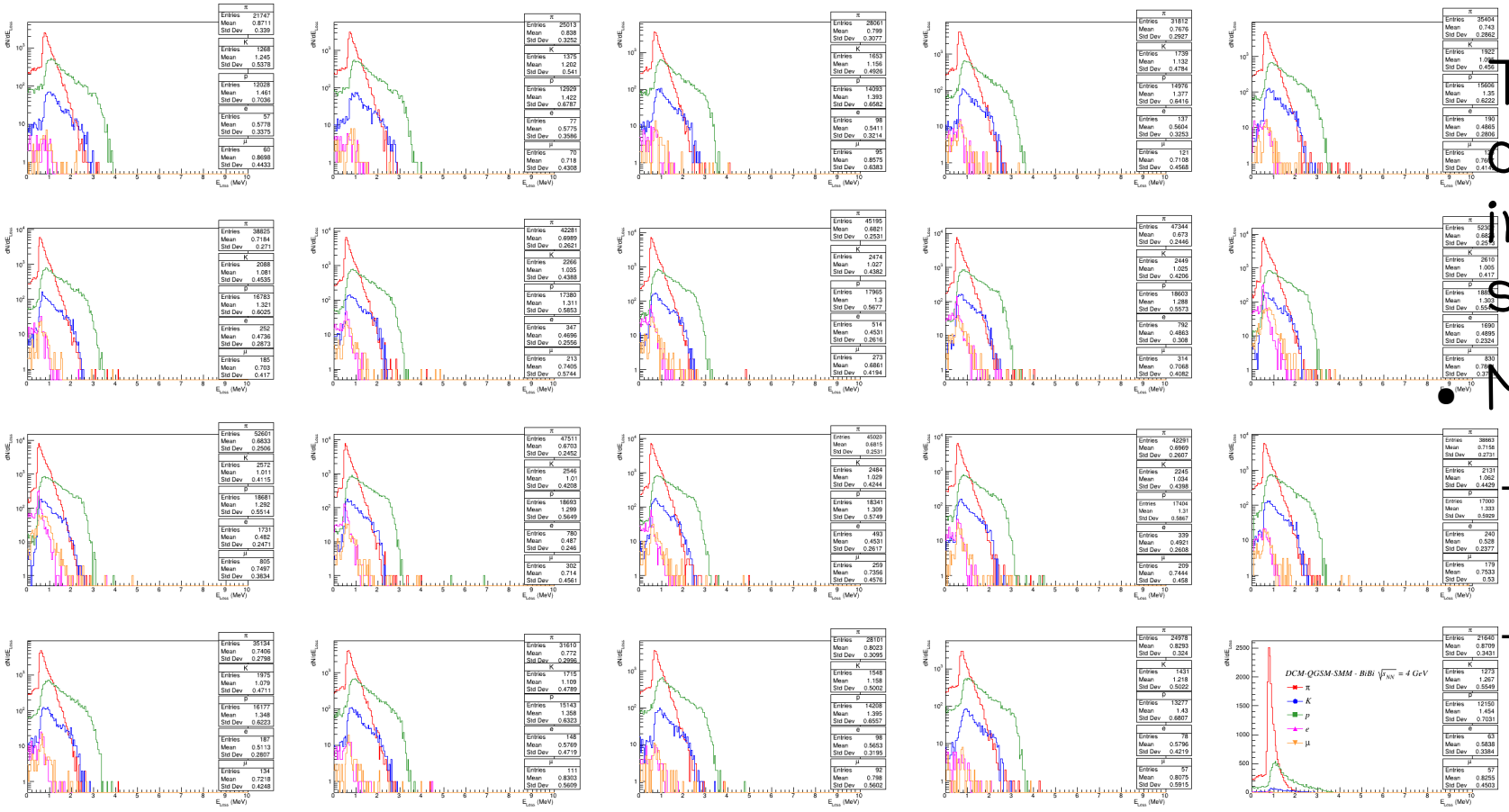
MC association with each MBBPoint mcTr→GetEnergy();



E < 1GeV for muons

E < 2GeV for pions

Eloss for each MBBPoint mbbpoint→GetELoss();



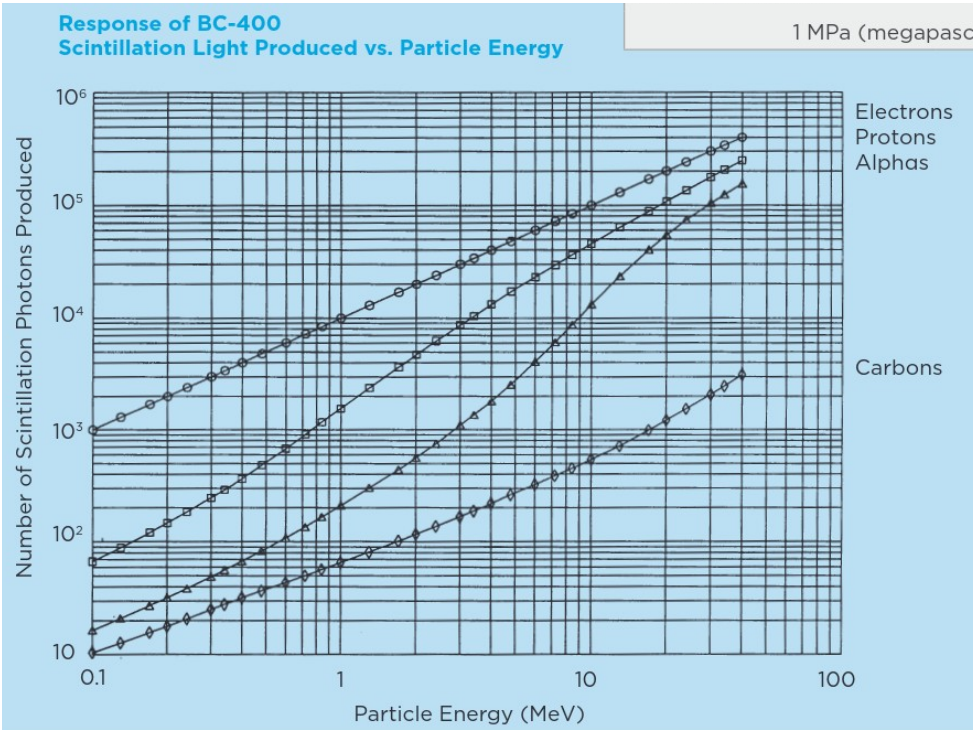
- Total energy deposition in each scintillator
- MPV for:
  - μ ~ 0.65MeV
  - π ~0.62 MeV

Energy threshold to fire a scintillator

- We need to introduce the scintillation efficiency

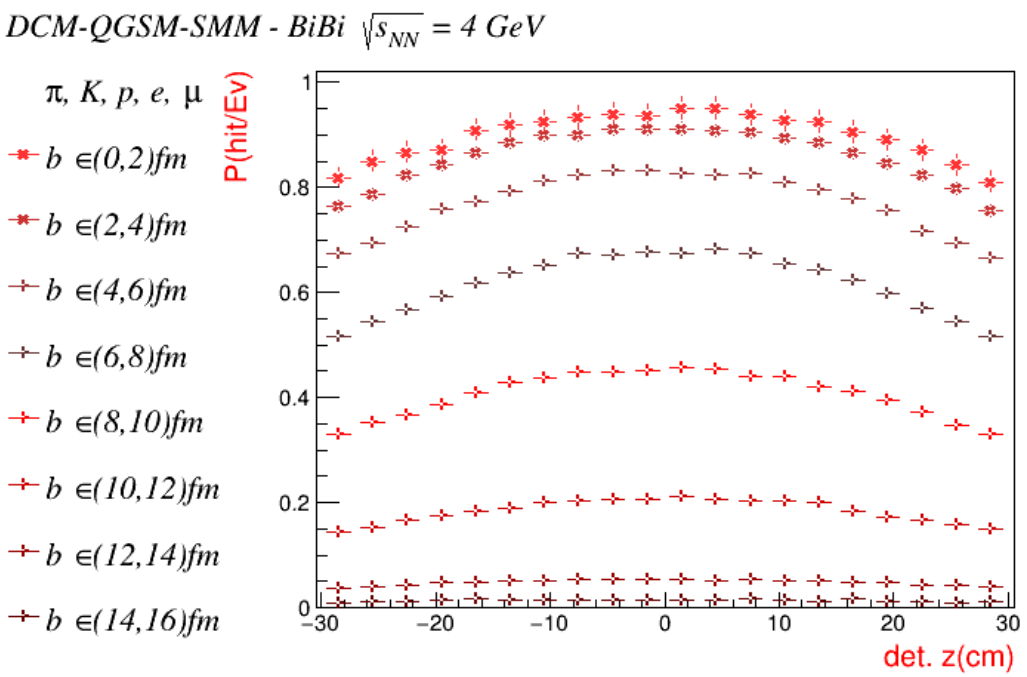
$$R = \frac{Energy\ of\ emitted\ photons}{Energy\ absorbed}$$

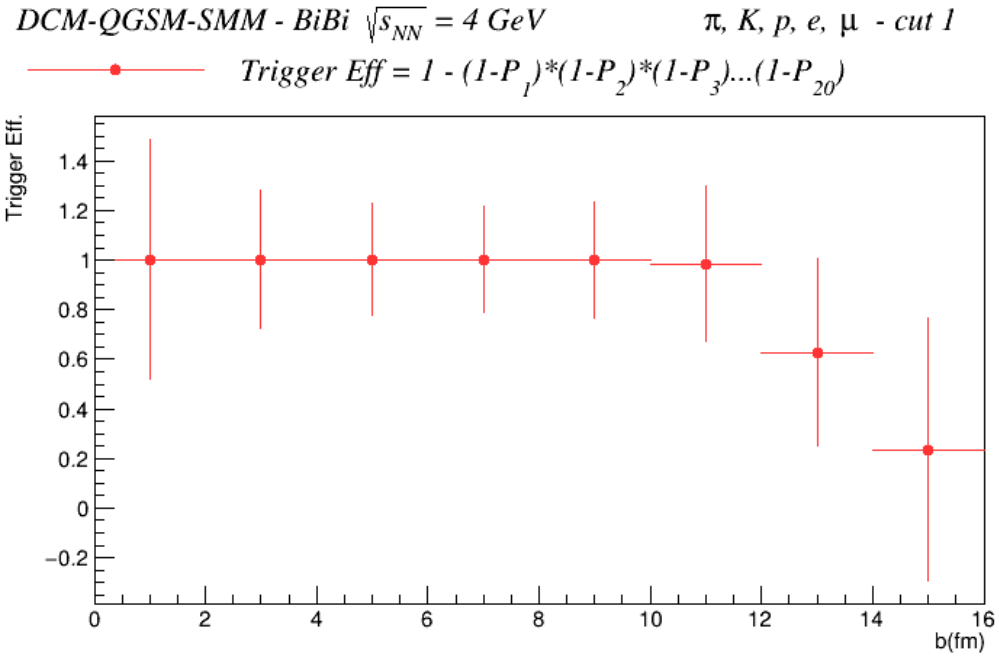
- Because change of BC404 → EJ232(BC422)
  - λ of Max. Emission changes 408nm → 370nm
- Energy cut for fire the ring will change. The number of photons decrease for the same R



Cut in the KE of particle - 35 MeV

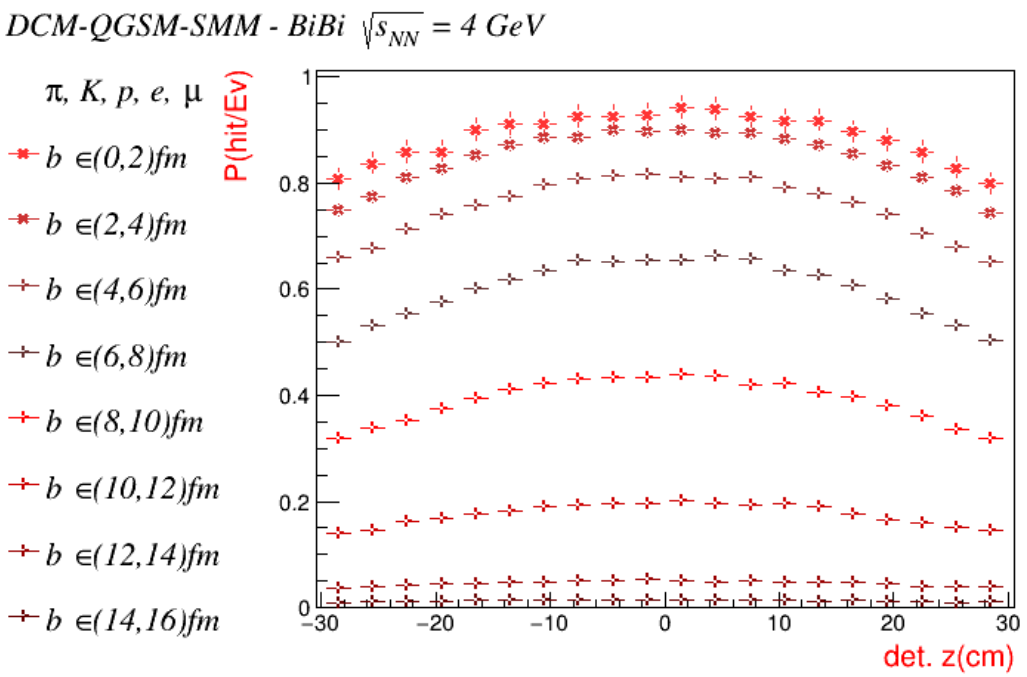
Ring

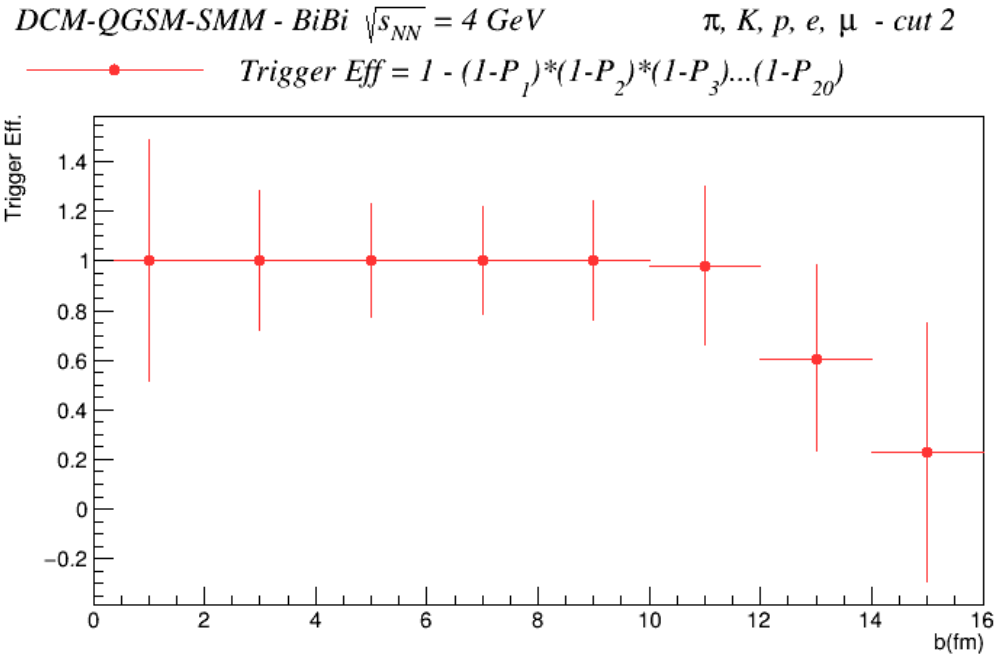




Cut in the KE of particle - 50 MeV

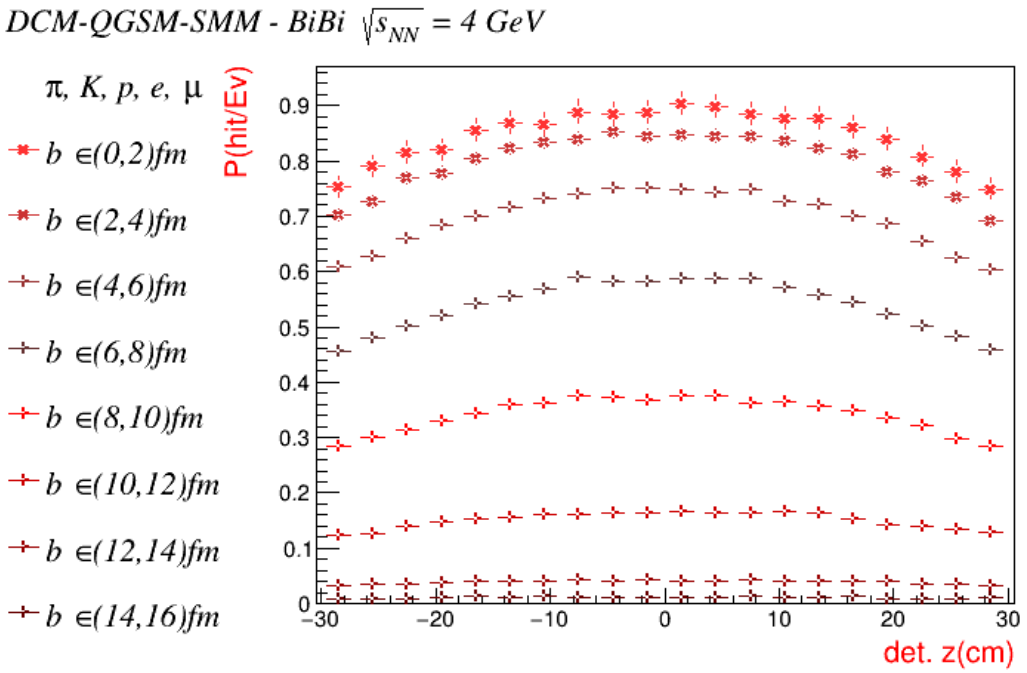
Ring

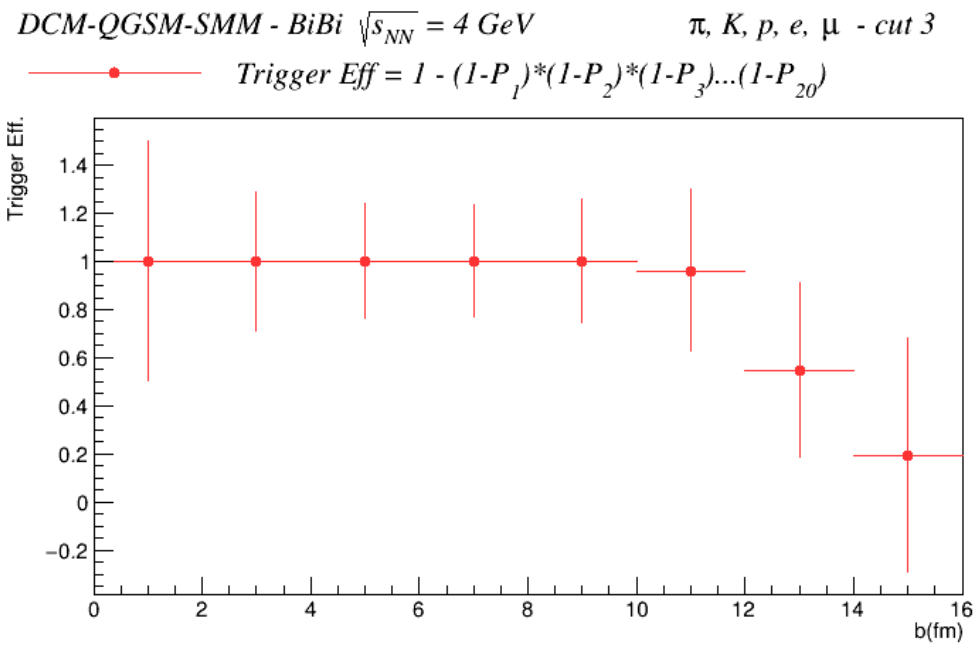




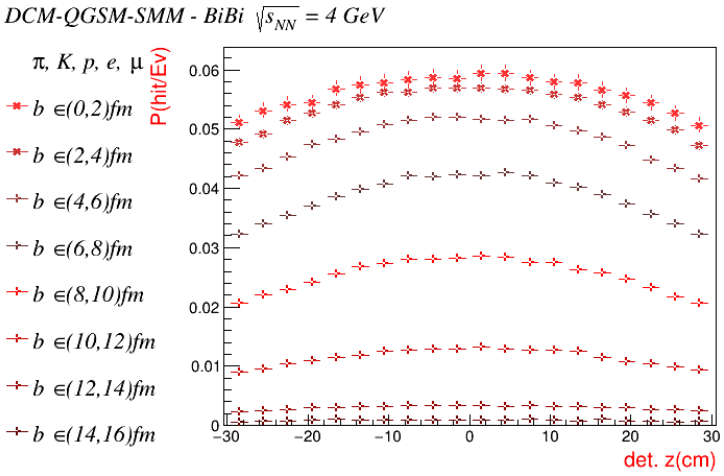
Cut in the KE of particle - 100 MeV

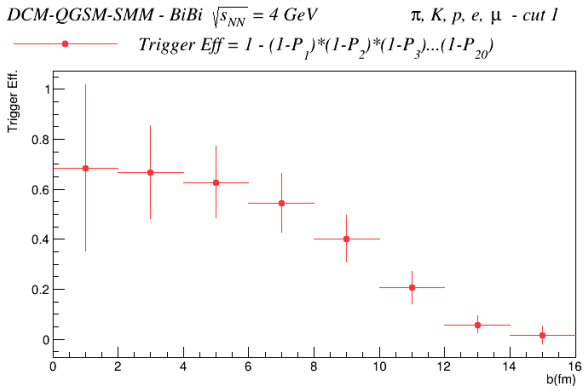
Ring

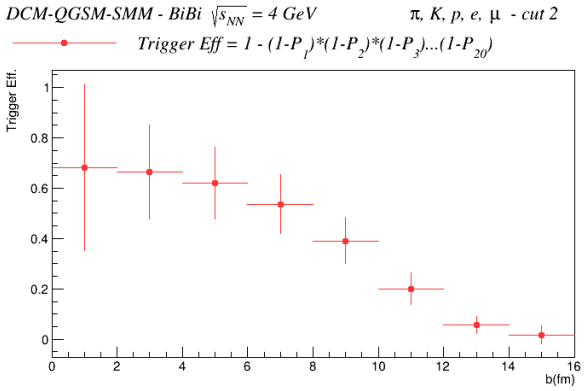


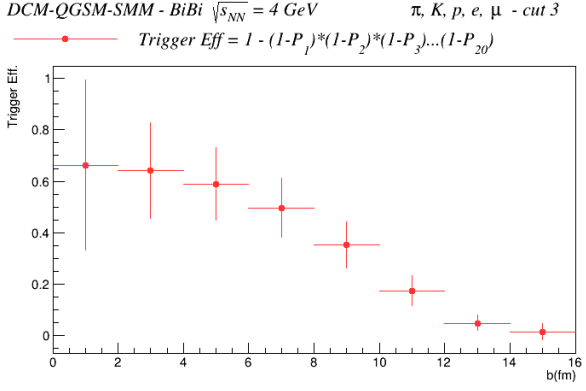


Trigger Efficiency - only 1 bar





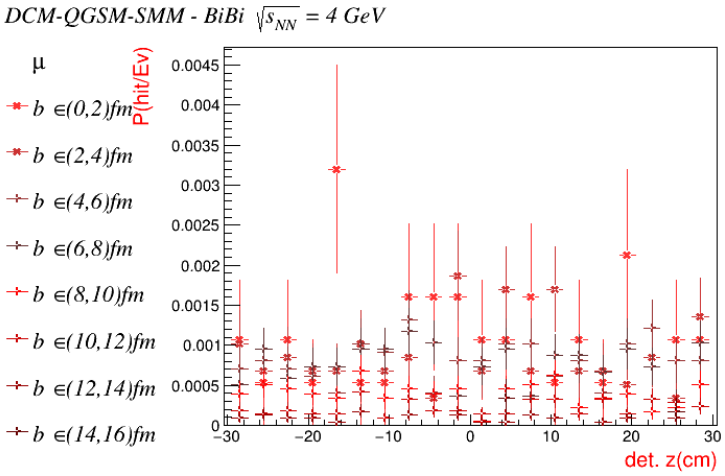


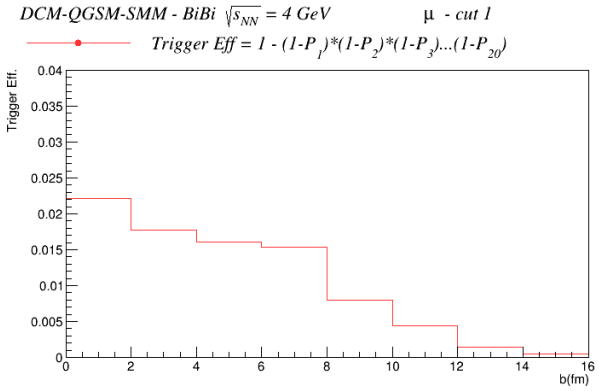


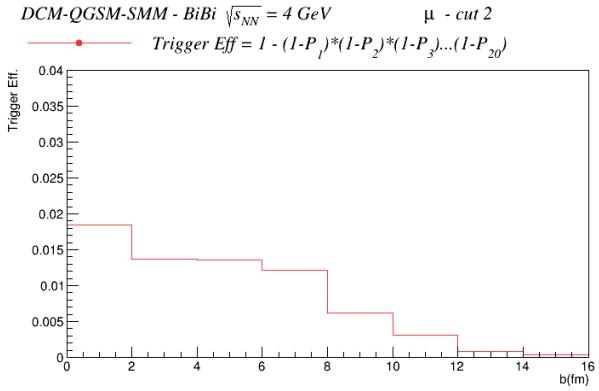
Trigger efficiency similar for three different cuts

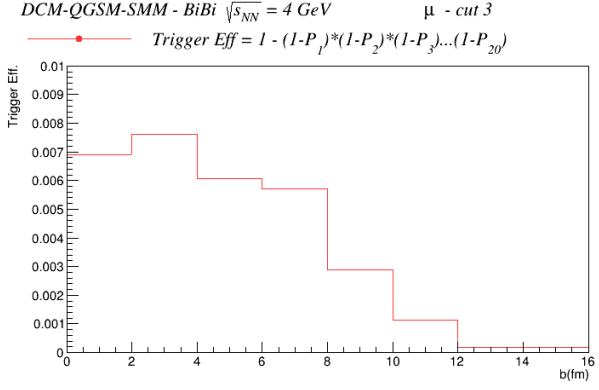
If consider the ring trigger efficiency ~ 1 for b <12 fm

Trigger Efficiency - muons in the ring









Not enough statistics for muons → trigger efficiency changes specially for cut 3

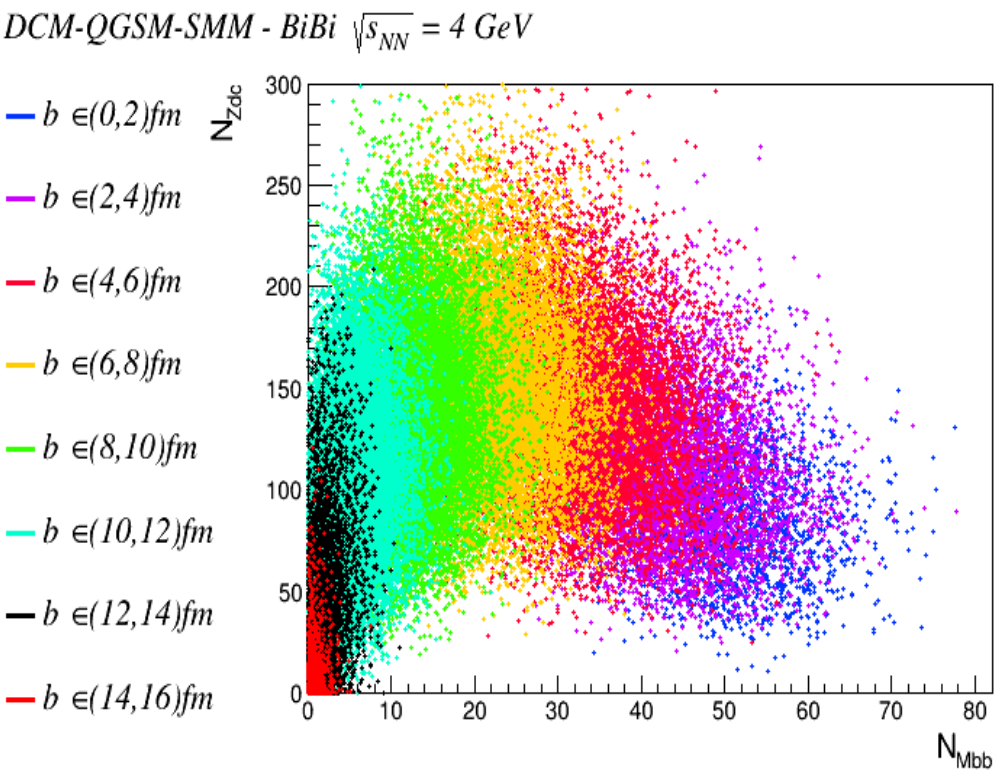
Summary

- Use of basic geometry and Mpdroot classes without include light output for Mbb detector was used to test BiBi at $\sqrt{s_{NN}}$ = 4 GeV.
- Trigger efficiency for charged particles was calculated with different cuts in particle Energy to estimate scintillator response.
- For charged particles in each ring Eff ~ 1 for b < 12 fm
- For charged particles in each bar decreases from Eff ~ 0.6 to almost 0 in the most peripheral collisions
- For only muons Eff <~0.02 for any cut

For to do

- Improve the MbbPoint selection according the scintillator and SiPM response
- Test as function of energy and for another systems pp, dd, CC, …
- Further studies → compare multiplicity with another detectors

Number of FHCalPoints vs MbbPoints



- Number of FHCal and Mbb points per event
- Each color corresponds to different impact parameter interval

Thank you