Luminosity detector and the beam pipe

V. Riabov

Initial configuration at NICA startup

- Summer of 2025:
  - ✓ MPD is in service position (being assembled)
  - ✓ stainless steel beam pipe (diameter = 80 mm, width = 1 mm)
  - ✓ luminosity detector to detect collisions with high efficiecny

- Beam conditions:
  - ✓ Xe^{124}
  - ✓ intensity (???)
  - ✓ energy (???) – 0.5, 2.5 and 4 GeV/n

- Question:
  - ✓ best position for the beam luminosity detector?
  - ✓ efficiency?

Geometry

- Simplified geometry for quick Geant-4 estimations:
  - ✓ stainless steel beam pipe (diameter = 80 mm, width = 1 mm)
  - ✓ luminosity detector – 4 scintillator blocks of 10 x 10 cm^2 at different locations along zed
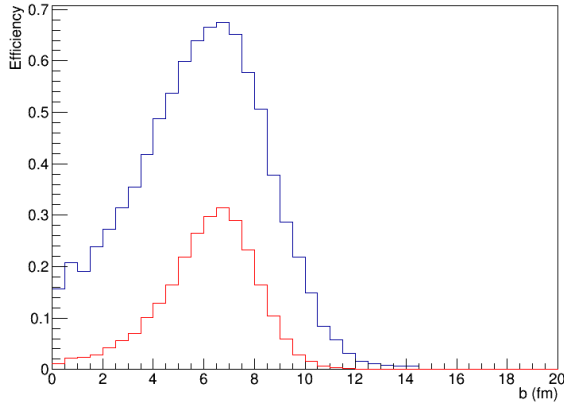 - ✓ collision vertex is at -85 cm, Xe^{124} + W; DCM-QGSM-SMM event generator
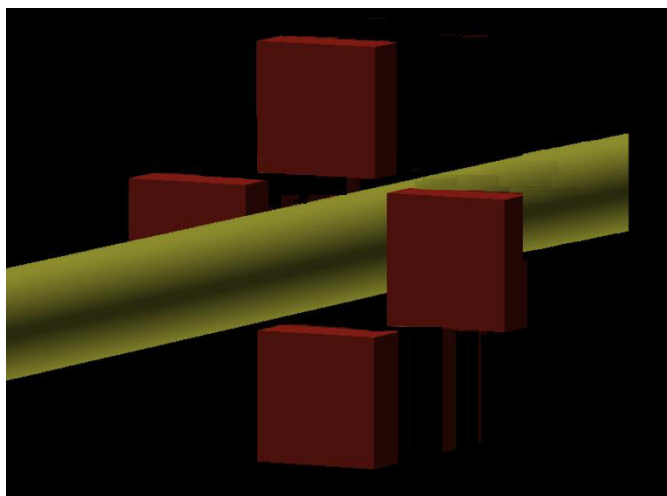
- Hits:
  - ✓ one particle with energy deposition of > 5 MeV (energy of ~ charged mip)

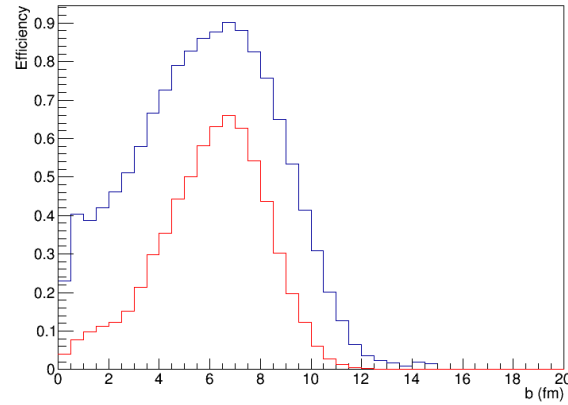- Trigger conditions:
  - ✓ at least one hit
  - ✓ at least two hits

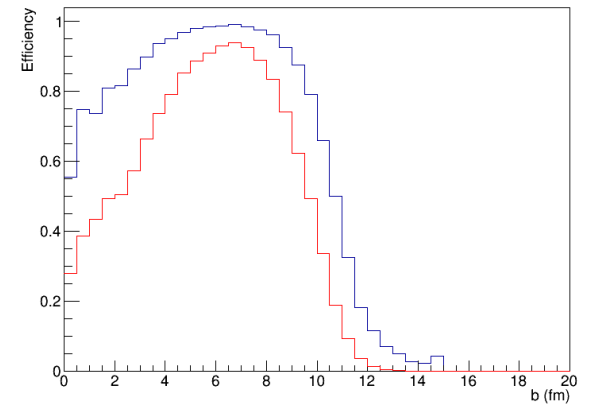# Beam energy T = 0.5 GeV/n

- **At least one hit; At least two hits**

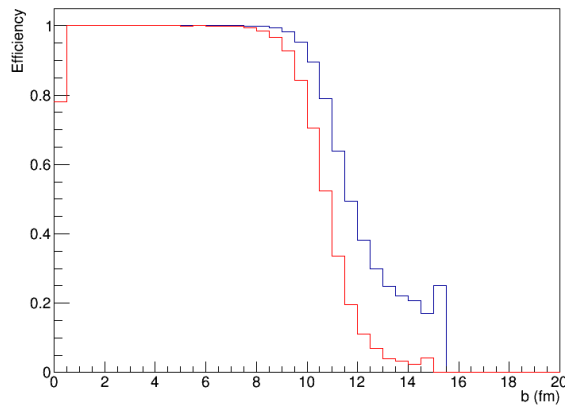260 cm: 49.4101% 17.379%
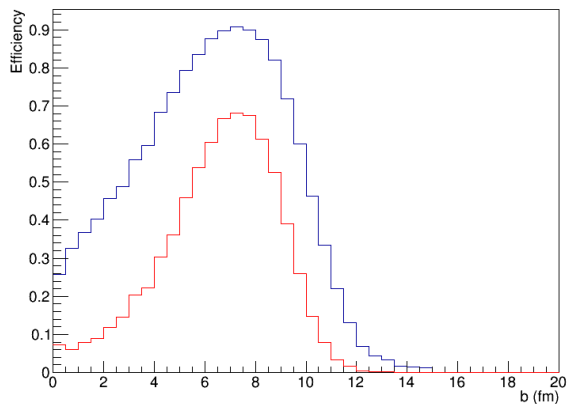160 cm: 72.9293% 41.8173%
 60 cm: 94.0022% 41.8173%
-40 cm: 99.6846% 98.6558%
-85 cm: 97.6874% 91.8781%

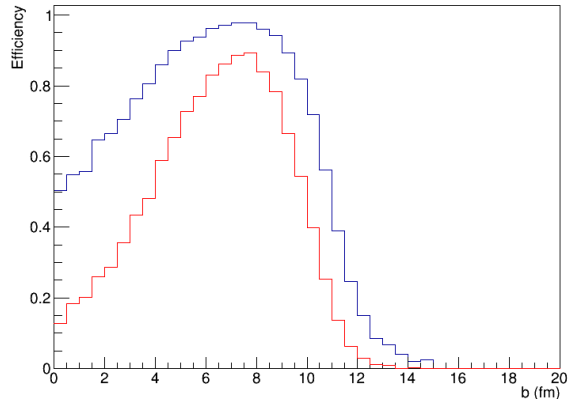# Beam energy T = 1.0 GeV/n
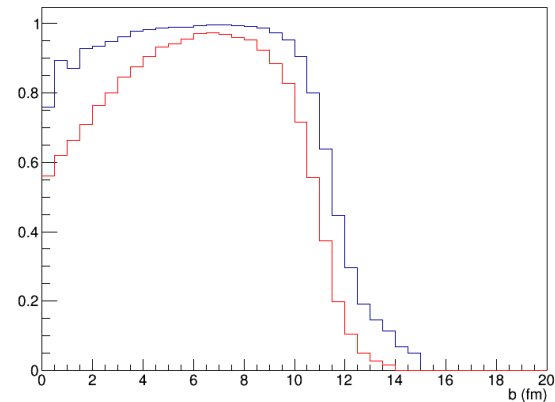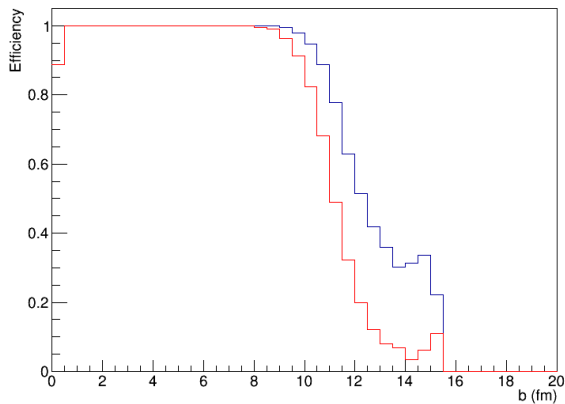
- **At least one hit; At least two hits**

260 cm: 76.7452% 47.1636%
160 cm: 89.821% 70.5578%
 60 cm: 98.0373% 70.5578%
m40 cm: 99.8844% 99.4572%
m85 cm: 99.3471% 97.1304%

Beam energy T = 2.5 GeV/n

- **At least one hit; At least two hits**
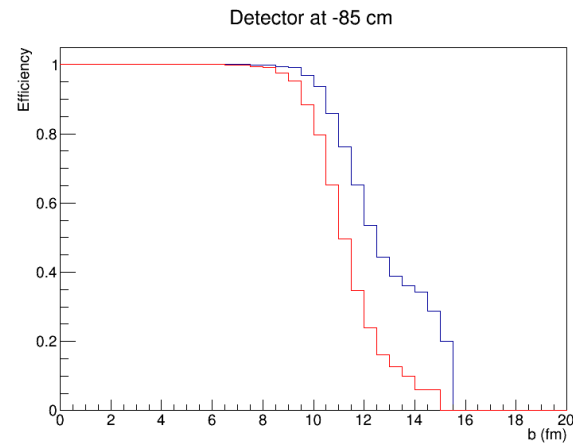
260 cm: 92.9344% 76.92%
160 cm: 99.5234% 97.7537%
 60 cm: 99.5234% 97.7537%
-40 cm: 99.9302% 99.8237%
-85 cm: 99.8317% 99.1449%

Beam energy T = 4.0 GeV/n

- **At least one hit; At least two hits**

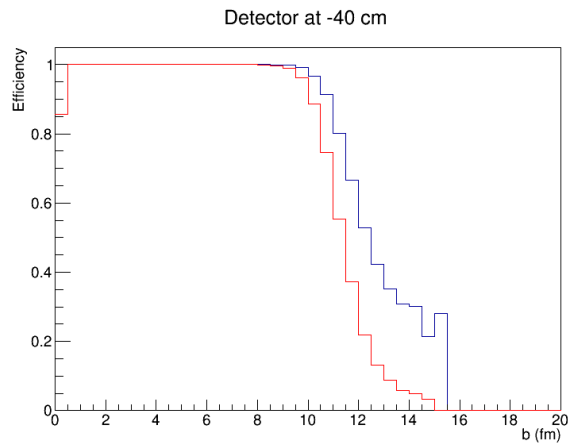

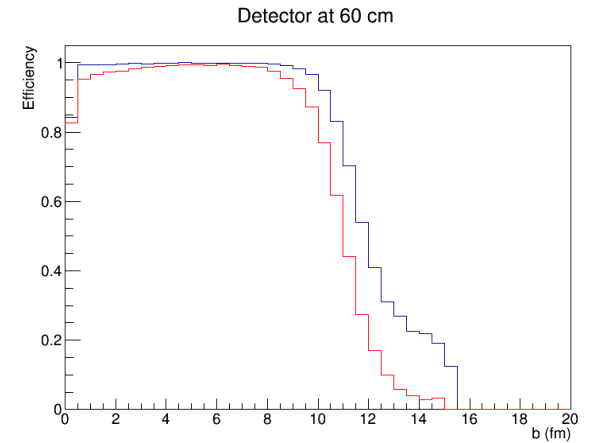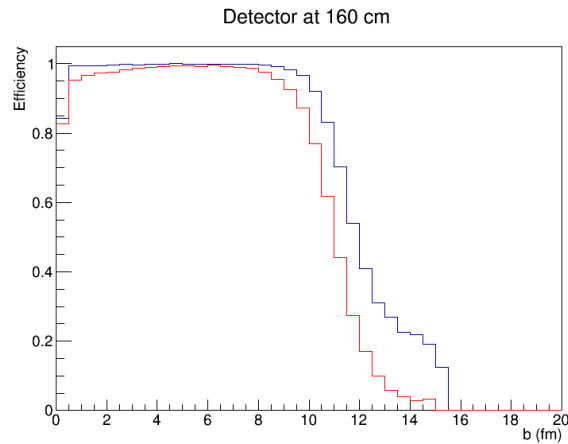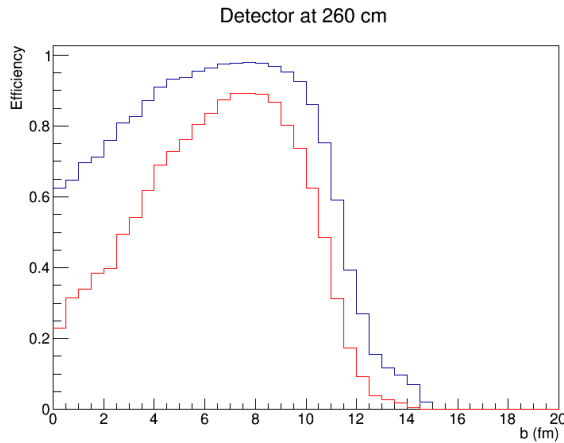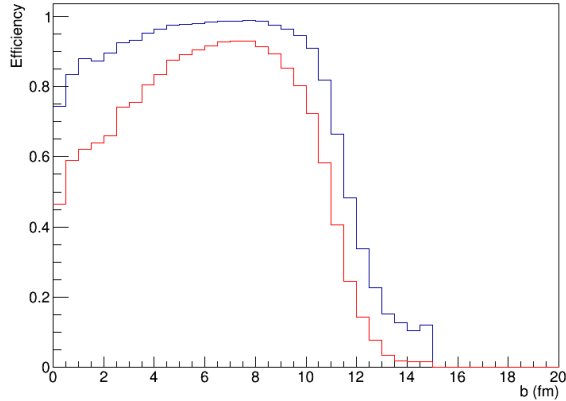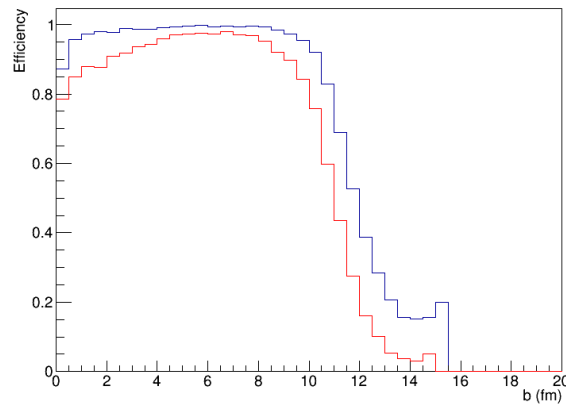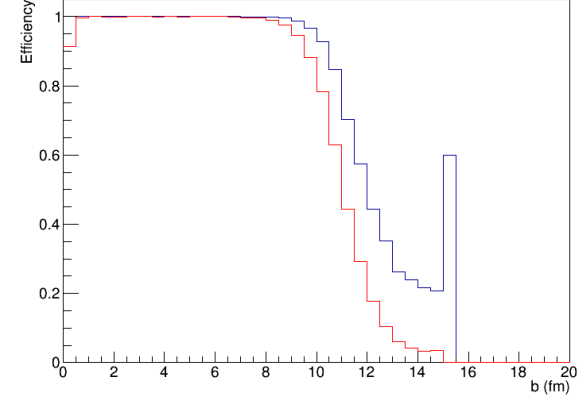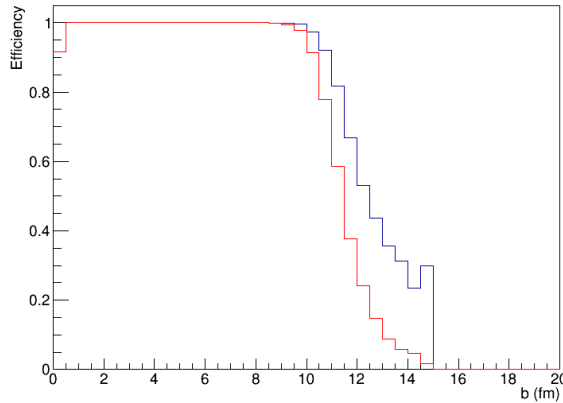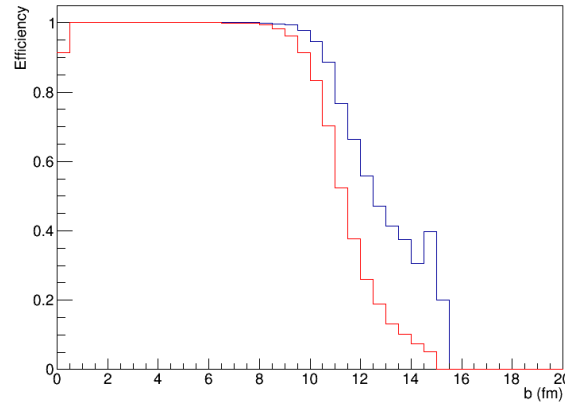Detector at 260 cm

Detector at 160 cm

Detector at 60 cm

Detector at -40 cm

Detector at -85 cm

260 cm: 96.6586% 86.5349%
160 cm: 98.8714% 94.7088%
 60 cm: 99.7783% 94.7088%
-40 cm: 99.9604% 99.9076%
-85 cm: 99.8697% 99.3465%

Summary

- Efficiency is higher for higher beam energies

- Closer location to the target-wire is preferable, effect is energy dependent