Radiation Studies for Mu2e and Mu2e-II - brief status report

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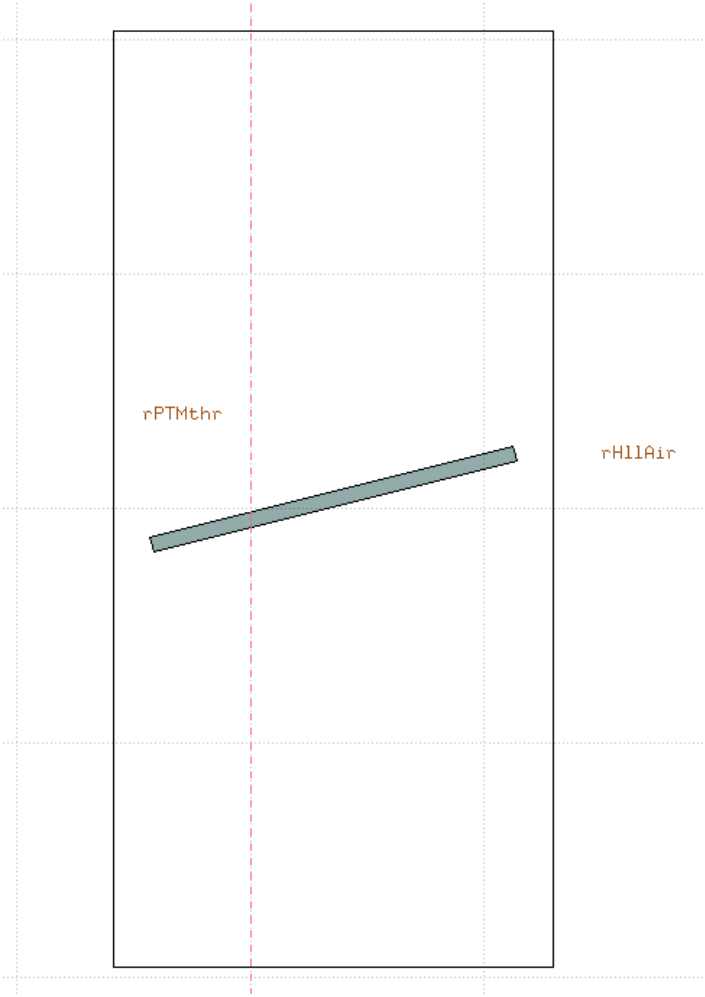
Target simulations for MU2E

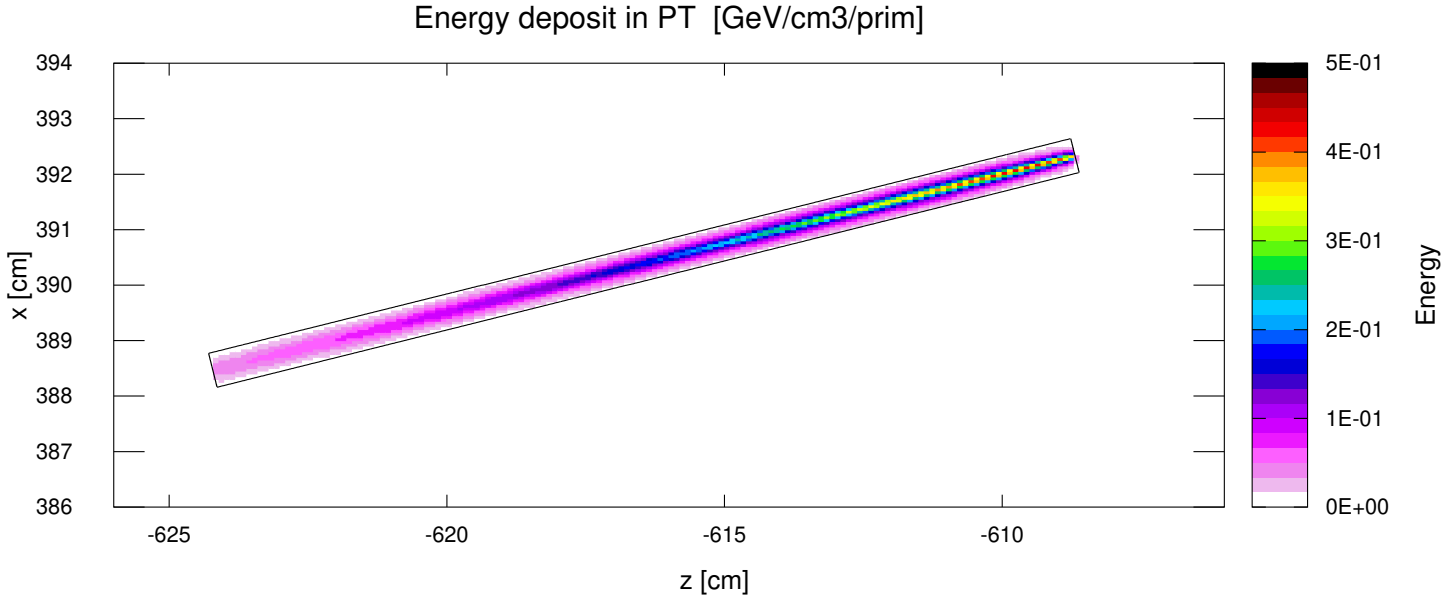
Simple tungsten cylinder to compare simulation results

- 0.35 cm radius, 16 cm length
- muon and hadron thresholds at 1 keV, neutrons at 1E-5 eV
- Proton beam with 8 GeV energy
- Simulation comparisons for FLUKA, MARS15, MCNP6 and Offline/G4Beamline
- Use FLUKA development version which includes kaon capture reactions



FLUKA target simulations for MU2E: Energy deposition

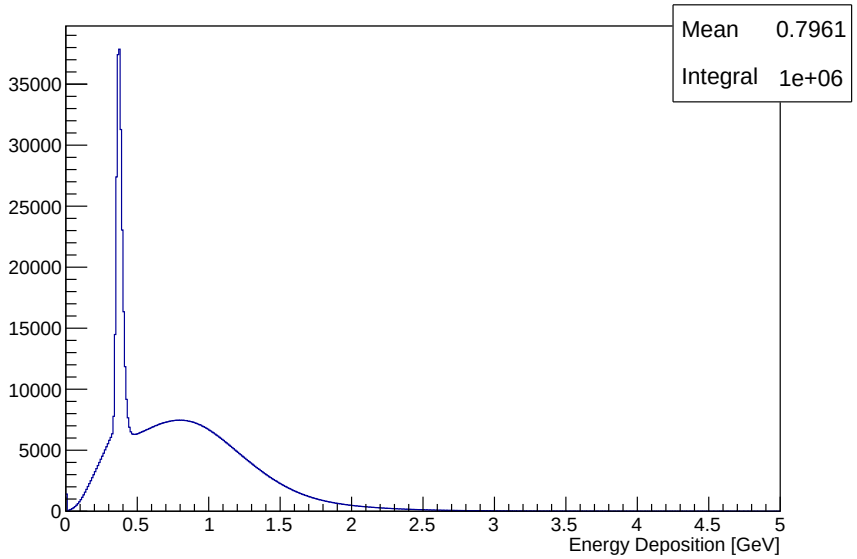
SPROT source (8 GeV protons, Gaussian smearing 1mm, 170 Mio. POT) on Tungsten target (ϱ =19.3g/cm^3)



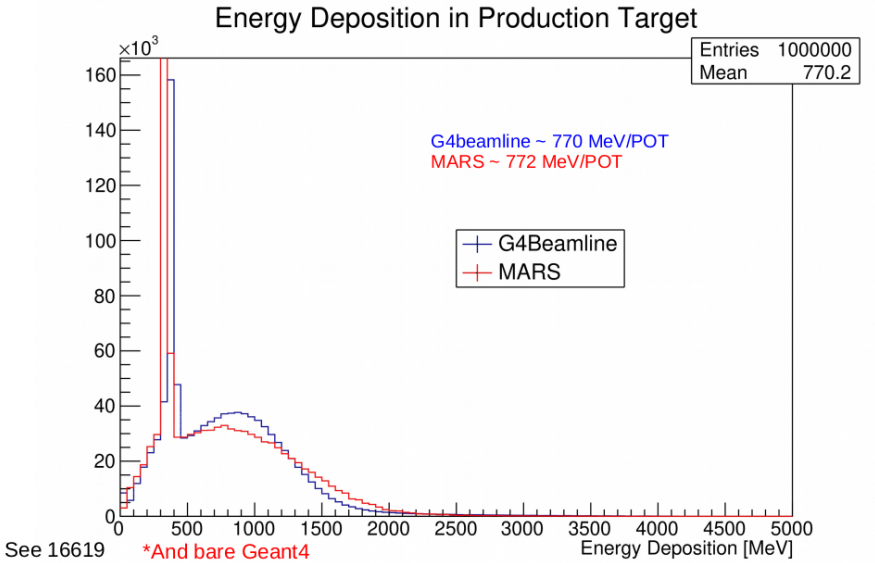
FLUKA finds an average energy deposition of **0.794 GeV/proton** $\pm$ **0.005%**, which corresponds to **695.5 Watt@7.3kW beam power**. (A newer version of FLUKA finds 0.836 GeV/proton, still under investigation)

Energy deposition in PT

Energy deposition pulse-height spectrum in FLUKA (to be compared with docdb-26811):



We did a fresh comparison of G4Beamline and MARS in 2018*

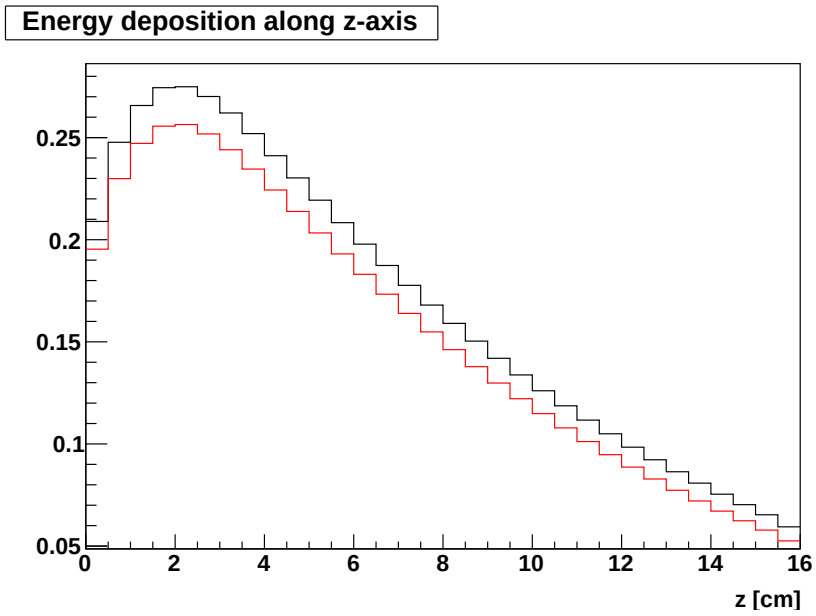


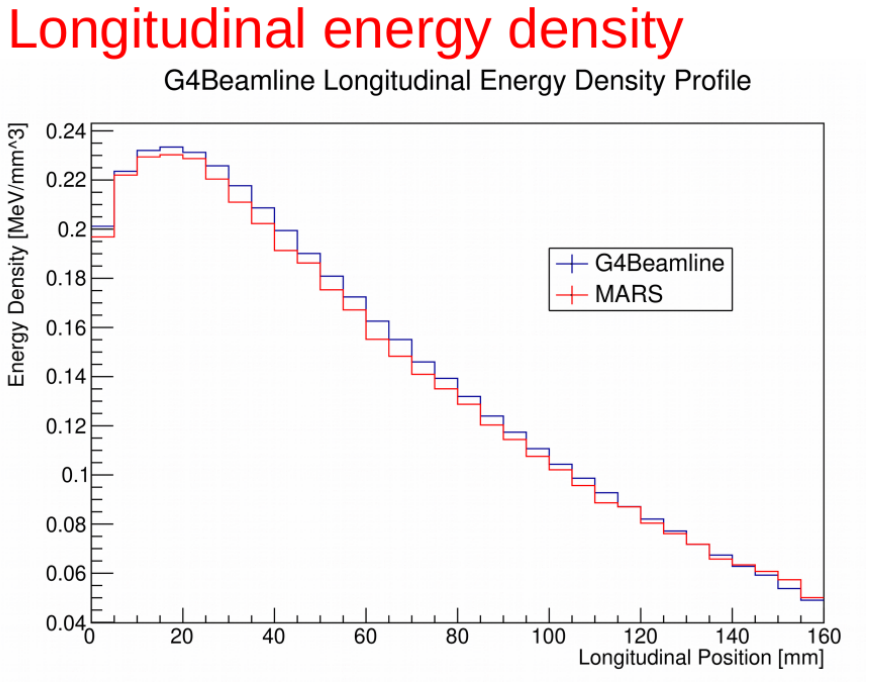
See 16619 *And bare Geant4

Normalized to 1E6 events (but binning is different).

Energy deposition in PT

Longitudinal energy deposition along PT (to be compared with docdb-26811):

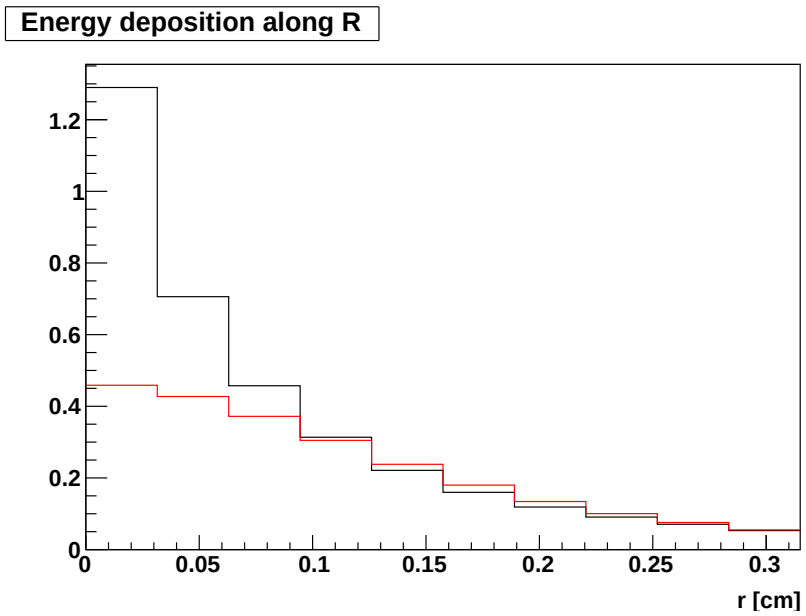




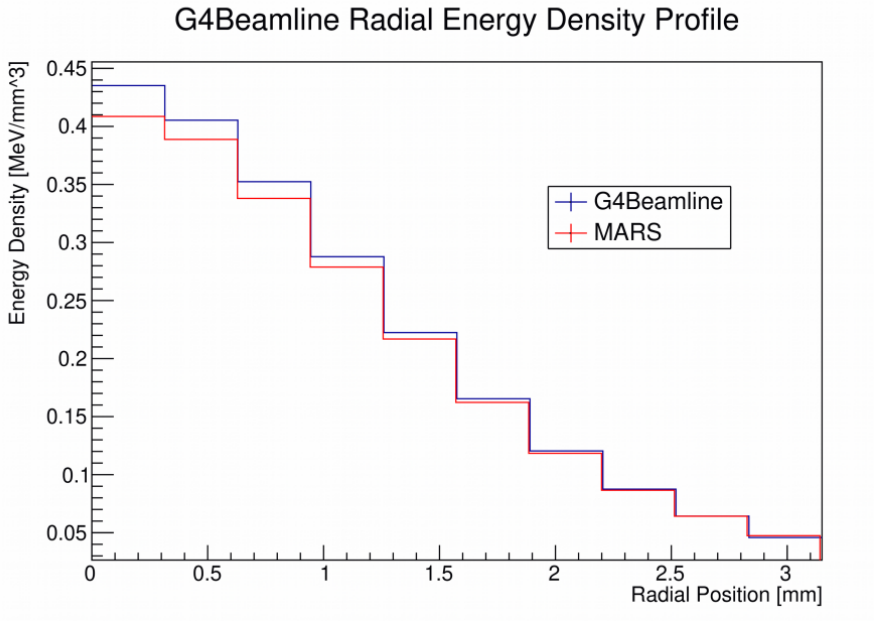
Difference in FLUKA results due to updated coalescence model (I think).

Energy deposition in PT

Radial energy deposition along PT (to be compared with docdb-26811):



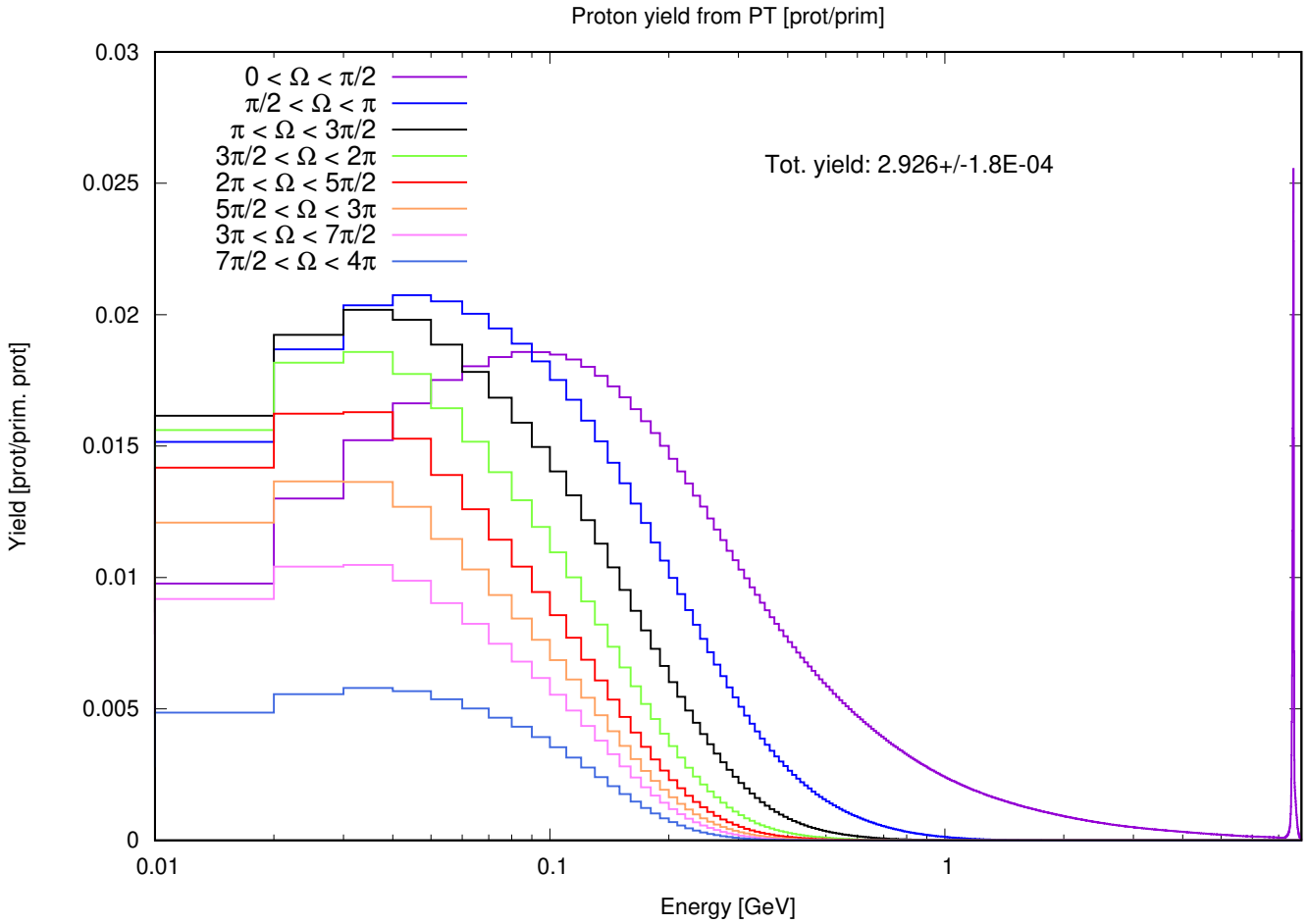
Radial energy density



Difference in FLUKA results due to updated coalescence model (I think).

Proton yield emitted from production target

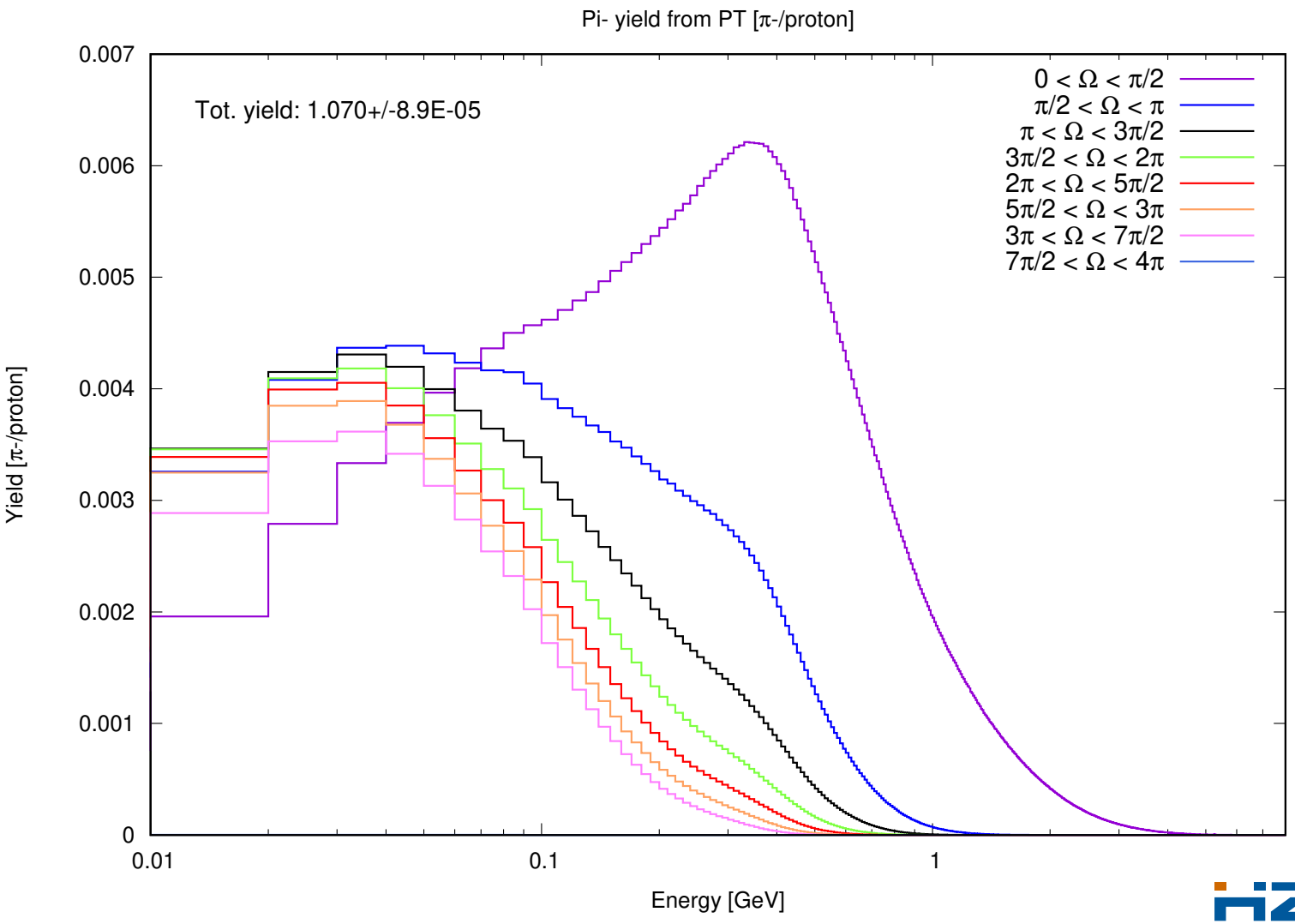
Yield of protons from production target in 8 bins of solid angle respect to initial proton beam direction:



For the anti-proton yield I find $(1.195 \times 10^{-5} \pm 2.6 \times 10^{-07})$.

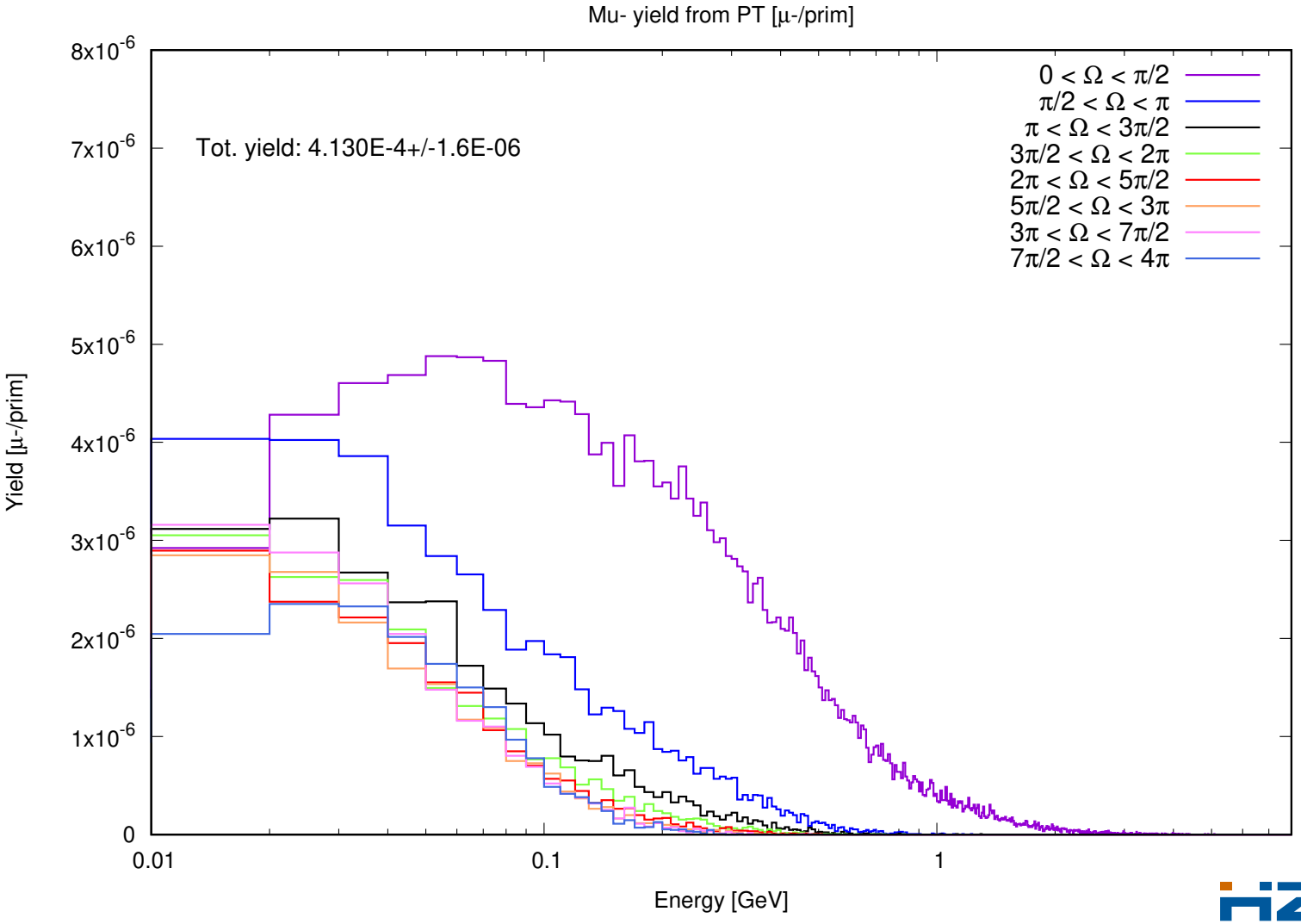
Pi- yield emitted from production target

Yield of negative pions from production target in 8 bins of solid angle respect to initial proton beam direction:



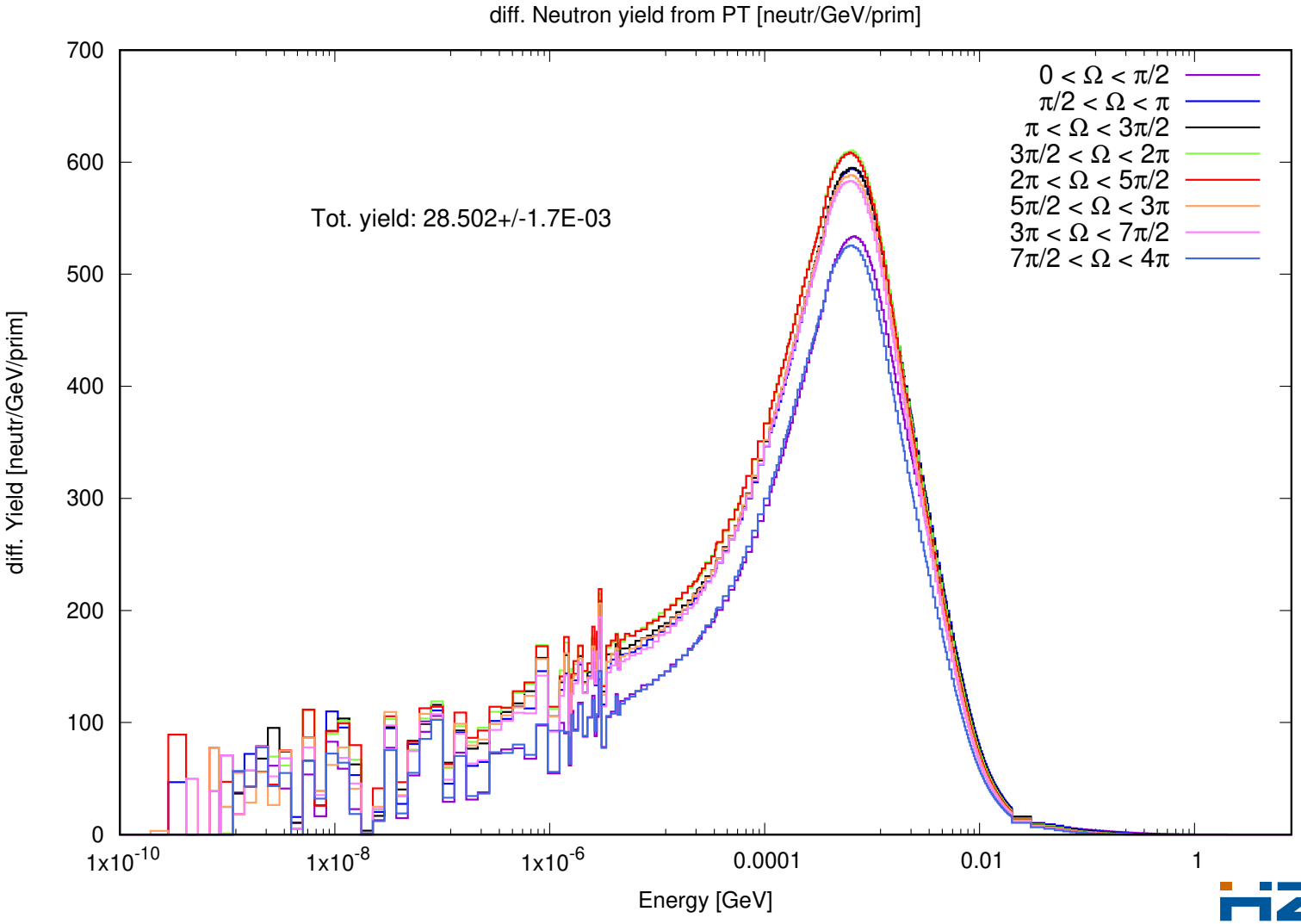
Mu- yield emitted from production target

Yield of negative muons from production target in 8 bins of solid angle respect to initial proton beam direction:



Neutron yield emitted from production target

Diff. Yield of neutrons from production target in 8 bins of solid angle respect to initial proton beam direction:



Conclusions and Outlook

- Need to compare MARS15, FLUKA, MCNP6 and Offline (or G4beamline) results
  - Energy deposition in target (still!) - distribution in z and r, energy spectrum
  - Particle yields coming out of the target and angular distributions
  - Particle yields entering the TS

- **Next steps for FLUKA:**
  - Convert magnetic field maps from ASCII to FORTRAN binary format
  - Evaluate particle yield at entrance to TS
  - Include possibility to dump list-mode data