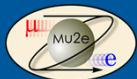


FLUKA simulations for MU2E and MU2E-II targets

S. E. Müller

Helmholtz-Zentrum Dresden-Rossendorf

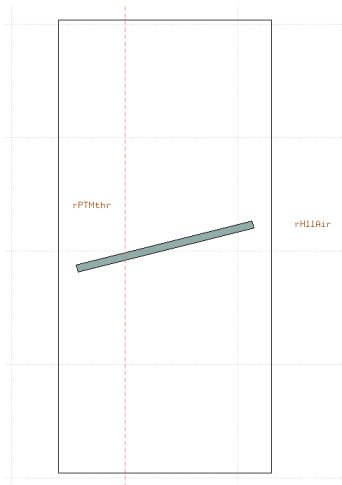
MU2E-II workshop, October 28, 2020



FLUKA target simulations for MU2E

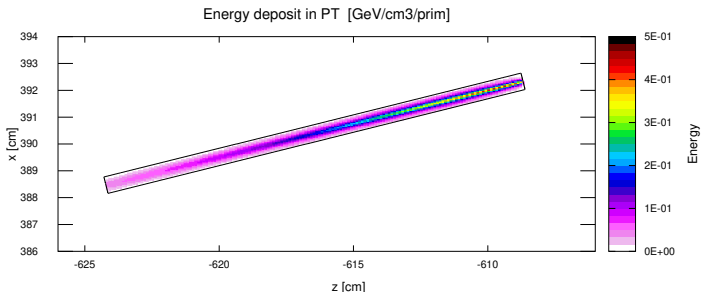
Simple tungsten cylinder to compare simulation results

- 0.35 cm radius, 16 cm length
- Use FLUKA development version which includes kaon capture reactions
- muon and hadron thresholds at 1 keV, neutrons at $1E-5$ eV
- 37.5 million events
- SPROT source term: Proton beam hitting production target
 - 8 GeV kin. energy
 - Gaussian smearing of position with 1mm sigma



FLUKA target simulations for MU2E: Energy deposition

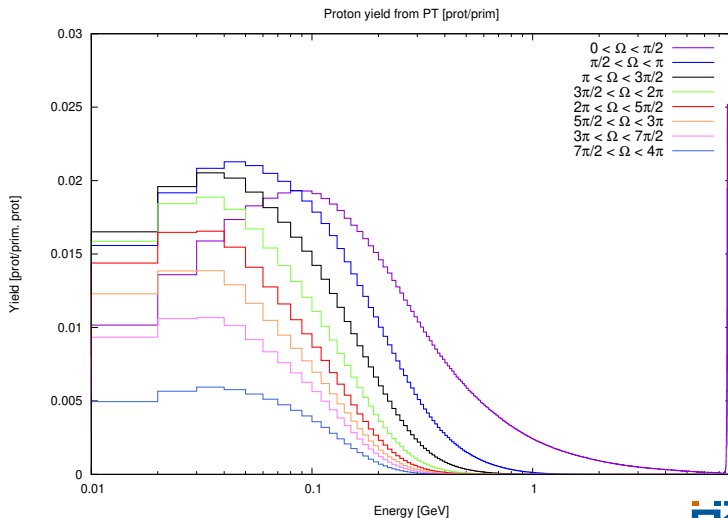
SPROT source (8 GeV protons, Gaussian smearing 1mm, 37.5 Mio. POT) on Tungsten target ($\rho = 19.3\text{g/cm}^3$)



FLUKA finds an average energy deposition of **0.796 GeV/proton** \pm **0.01%**, which corresponds to **697.3 Watt@7.3kW** beam power.

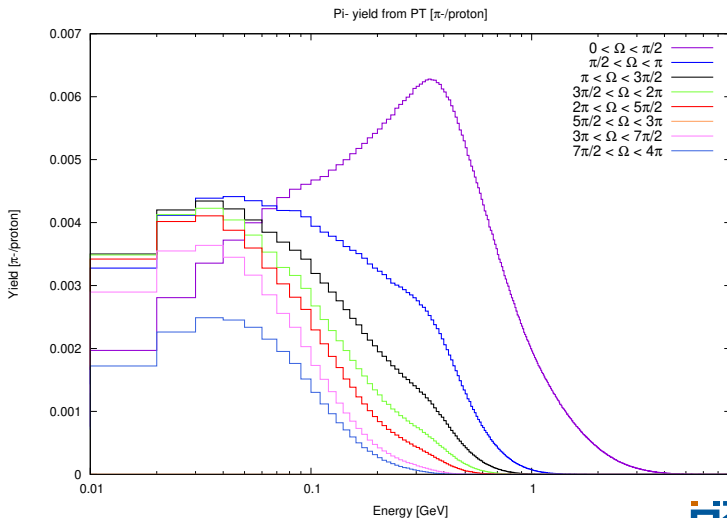
Proton yield emitted from production target

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



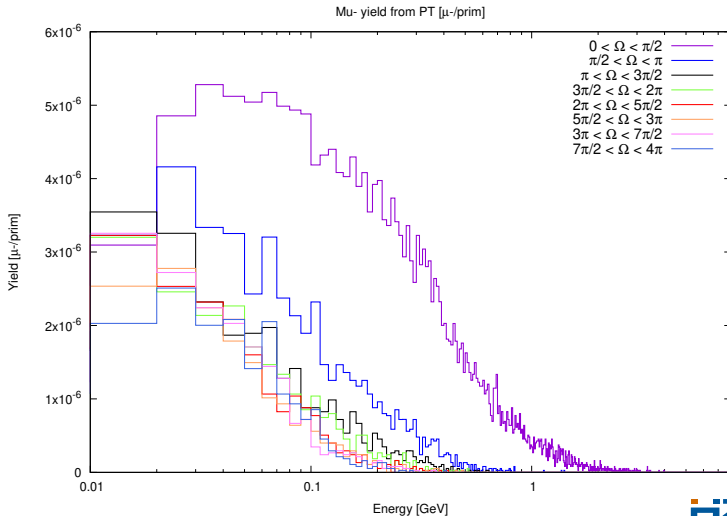
Pi- yield emitted from production target

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



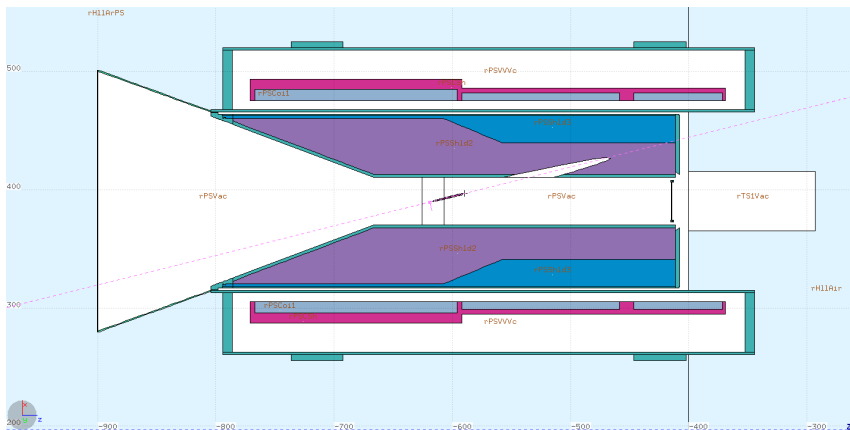
Mu- yield emitted from production target

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



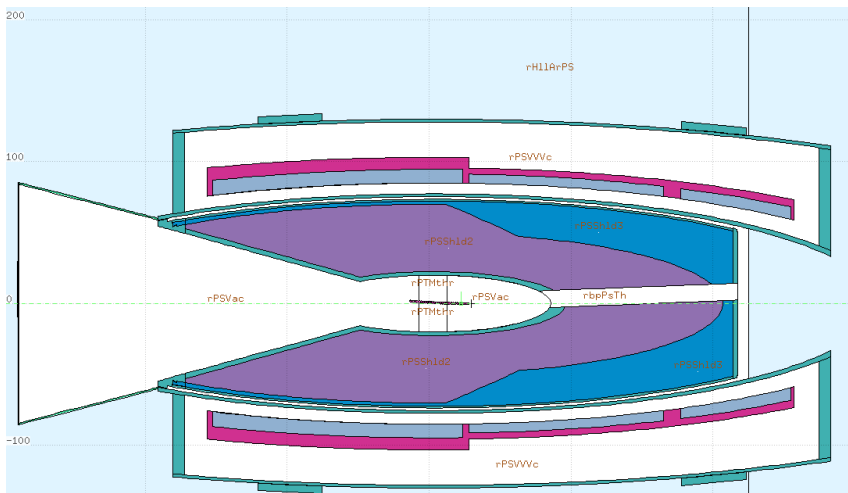
FLUKA conveyor target geometry

Geometry of 28 carbon balls for MU2E-II conveyor target has been implemented. HRS and PS structures from MU2E geometry.



FLUKA conveyor target geometry

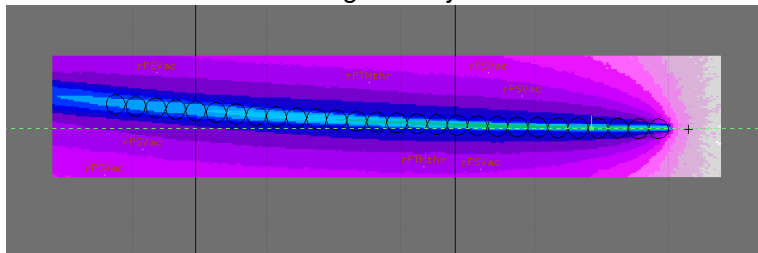
Geometry of 28 carbon balls for MU2E-II conveyor target has been implemented. HRS and PS structures from MU2E geometry.



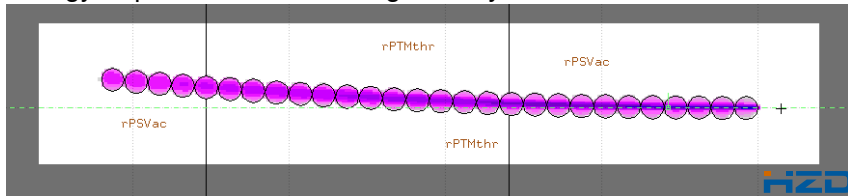
FLUKA conveyor geometry

800 MeV proton beam (1mm gaussian smearing) under 14° angle on target. Location of balls follows proton trajectories.

Proton fluence overlaid on geometry:

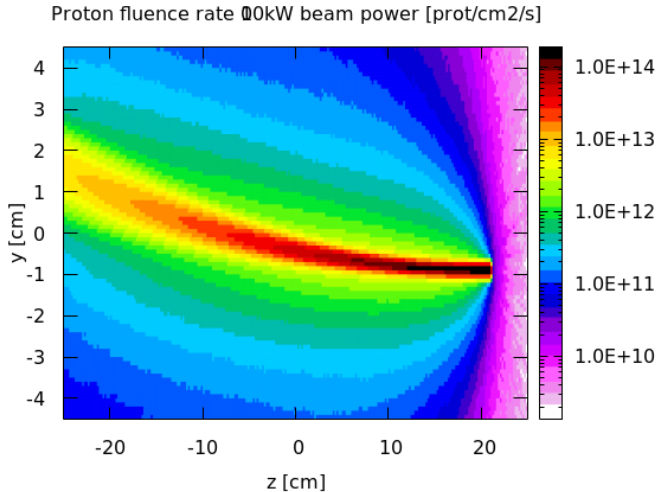


Energy deposition overlaid on geometry:



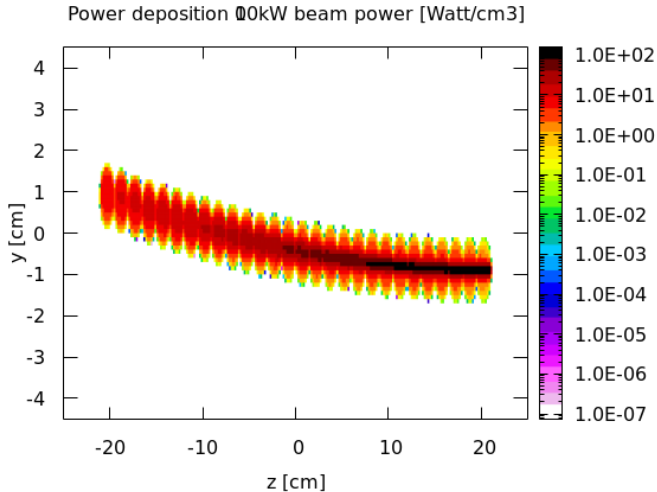
Proton fluence

Proton fluence distribution with 100kW beam power:



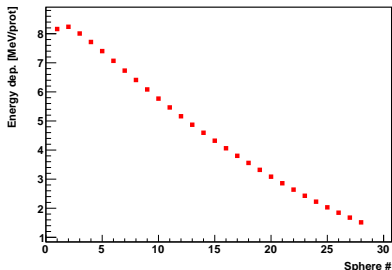
Proton fluence

Power distribution with 100kW beam power:

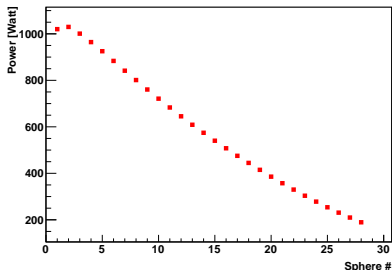


Energy deposit

Energy deposited in the 28 balls per primary proton:



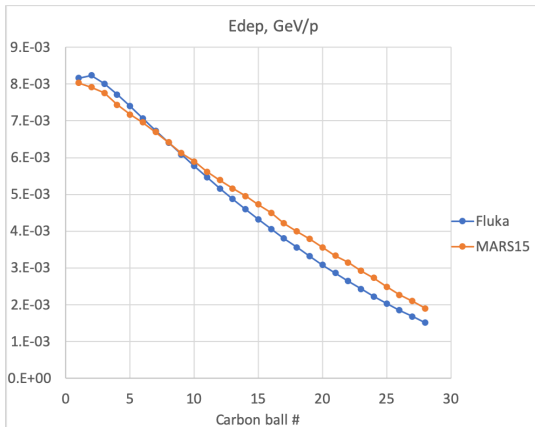
Power deposited in the 28 balls at 100 kW proton beam power:



Energy deposit

Energy deposited in the 28 balls
per primary proton:

Power deposited in the 28 balls at
100 kW proton beam power:



Conclusions and Outlook

- **FLUKA** has been used to perform simulations for the production target of MU2E and MU2E-II
- Need to compare distributions and values with MARS and Offline results
- Evaluate particle yield at entrance to TS for conveyor target
- **Next steps for FLUKA:**
 - Evaluate particle yield at entrance to TS for conveyor target
 - Include possibility to dump list-mode data