Status of Production Target simulations for Mu2e II

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DPA and power density as functions of beam energy and HRS material
Muon yield as a function of beam energy
Figure of merit (muon yield per radiation damage)
• Damage at 3 GeV beam energy is worst but overall variation is 50%.
• Tungsten is almost a factor of 3 better than bronze.
• Minimum is at 0.5 - 1 GeV.
• At 100 kW the peak DPA is a factor of 4 higher than the requirement.
\( \pi^- \) and \( \mu^- \) yields at constant beam intensity

- Constant beam intensity (not power) = \( 6 \cdot 10^{12} \text{ p/s} \).
- Yields per damage unit drop with beam energy.
- Highest rise in \( \mu^- \) yields is between 0.5 and 2 GeV.
inner bore shape may affect muon yield

decrease from 25 to 20 cm was estimated to reduce $\mu$-yield by $\approx 8\%$.

DPA drops in the tungsten absorber at 1 GeV protons ($W$ target) by a factor of $\approx 4$ each $\approx 9$ cm of thickness
HRS thickness can be increased

Mu2e-DocDB-3165, K. Lynch and J. Popp

- Muon yields with liner radius

- inner bore 20 cm
- no yield drop down to \( \approx 17 \) cm
- Beam energy 1 GeV, carbon target.
- Radiation quantities drop with the same rate as w/W target.
- Required a 90 cm HRS radius.
G4beamline acceptance functions were used with MARS15 for both $\mu^-$ and $\pi^-$. 

$\pi^-/\mu^-$ ratios are different for MARS15 and G4beamline (GEANT4).

At some point yields need to be compared (uncertainty).
Conclusions

- Optimal $\mu^-$ stopping rate is at 2 - 3 GeV proton beam.
- Optimal $\mu^-$ stopping rate per DPA is at 1 GeV.
- Highest radiation damage is at 3 GeV (at constant beam power).
- Radiation damage varies between 1 and 8 GeV by $\sim$50%.
- For tungsten absorber at 100 kW:
  - peak DPA is $1.6 \cdot 10^{-4}$ (limit $4 \cdot 10^{-5}$ yr$^{-1}$),
  - peak power density is $4.2 \cdot 10^{-2}$ (limit $3 \cdot 10^{-2}$ mW/g).
- Decreasing the HRS inner bore can mitigate much of the difference.
- Tungsten target requires less shielding than carbon.
- More optimization work is needed taking the muon yield into account.
- On-line RRR monitoring during Mu2e I run will help setting limits.