Solenoid vs. horn focus for Neutrinos

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Assumptions in Solenoid Design

Ideal taper is claimed to be:

\[
B_{\text{ideal}} = \frac{B_0}{1 + kz}
\]

But match to initial flat 20 T is abrupt

\[
B = \sqrt{\frac{1}{1/B_{\text{ideal}}^2 + 1/B_0^2}}
\]

Initial Try:

- taper over 100 m
- taper B down by 100
  - reduce \(<p_t>\) by 10 from 300 to 30 MeV/c
- extend initial flat field to get final focus at 6 GeV
- look at each end of 80 cm target
Solenoid Fields

![Graph of solenoid field strength as a function of distance](image)
Horn picture

![Horn picture graph showing data points on a 2D Cartesian plane with labels and coordinates.](image-url)
Horn vs. Solenoid Focusing

horn0: 250 250 kA

Merit for all energies: 9.6936
Merit for up to 8 GeV 6.078663
horn 4 3: horns

\[ \begin{align*}
\text{p (GeV/c)} & \quad 0 \quad 5 \quad 10 \quad 15 \\
\text{theta ratio} & \quad -0.10 \quad -0.05 \quad 0.00 \quad 0.05 \quad 0.10
\end{align*} \]

\[ \begin{align*}
14.24392 \\
9.250586
\end{align*} \]
Neutrino flux calculation assumptions

- MARS 14 pion production from H. Kirk
- C target 80 cm long, 1 cm rad
- initial 20 T has 7.5 cm radius,
- no radial cut thereafter !!!
- 380 m decay tunnel
- 2 m radius decy tunnel
Horn vs Solenoid Neutrinos (PRELIMINARY)

black horns (175 400 kA)
red solenoid (100 m)

Relative events

\( \frac{p}{(\text{GeV/c})} \)

0.0  2.5  5.0  7.5  10.0
Conclusion

- Solenoid may be superior at low momenta
- Solenoid is worse at high momenta (good?)
- Solenoid could be improved if larger bore affordable
- Horn system could be improved at low momenta if re optimized
- More work needed