Proton Driver Parameters

Proton driver power: 4 MW
Proton driver repetition rate: 50 Hz
Proton energy: around 10 GeV
3 proton bunches in train
  • $1.7 \times 10^{13}$ protons per bunch at 10 GeV
Bunch length 1–3 ns
Train length at least 200 μs
The Neutrino Factory Target Concept
Count all the pions and muons that cross the transverse plane at $z=50m$.

For this analysis we select all pions and muons with $40 < KE < 180$ MeV.
50GeV Beam-Mesons at 50m

40MeV < KE < 180MeV
Mesons at 50m

Mesons/Proton

Mesons/Proton normalized to beam power

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Hg Jet Target Geometry

Previous results: Radius 5mm, $\theta_{\text{beam}} = 67\text{mrad}$

$\Theta_{\text{crossing}} = 33\text{mrad}$
Step 1: Vary the Target Radius

10GeV Beam at 67mrad beam angle and 33mrad beam/jet crossing angle

Mesons

Target Radius, cm

Positives + Negatives

Polynomial Fit (3rd order)

R_{\text{max}} = 0.48 \text{cm}
Step 2: Vary the Beam Angle

10GeV Beam-Mesons at 0.48cm target radius and 33mrad beam/jet crossing angle

$\theta_{\text{beam}} = 89\text{mrad}$
Step 3: Vary the Beam/Jet Crossing Angle

10 GeV Beam at 0.48 cm target radius and 89 mrad bem angle

θ_{crossing} = 25 mrad
Optimized Target Parameters

Target Radius

Proton Beam Angle

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Beam/Jet Crossing Angle

![Graph showing the relationship between Beam/Jet Crossing Angle and Kinetic Energy. The x-axis represents Kinetic Energy in GeV, ranging from 0 to 100, and the y-axis represents Beam/Jet Crossing Angle in mrad, ranging from 14 to 24. The data points are scattered across the graph, suggesting a possible correlation between the two variables.]
Meson Production Normalized to Beam Power
Consider mesons within acceptance of $\varepsilon_\perp = 30\pi \text{ mm}$ and $\varepsilon_L = 150\pi \text{ mm}$ after cooling.
Compare 50m to Post-Cooling

Proton Kinetic Energy, GeV

Mesons/Productions*GeV

KE cut
Icool
Summary

- Peak meson production efficiency for a Neutrino Factory Hg Target system occurs in the region of 6 to 10 GeV
- At 20 GeV we have a 10% loss in efficiency
- At 40 GeV we have a 20% loss in efficiency
- At 80 GeV we have a 40% loss in efficiency
Backup Slides
Optimizing Soft-pion Production

16 GeV on Hg
$R_T = 2.5\sigma_{x,y}$

Yield at 9 m

Target radius (mm)

Tilt angle (mrad)

Yield at 9 m

16 GeV on Hg
$R_T = 2.5\sigma_{x,y} = 5$ mm

$p^- + \mu^-$

$p^+ + \mu^+$

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Post-cooling 30π Acceptance

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Pion-Muons/Protons*GeV

Protons Kinetic Energy

Positives
Negatives

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