Meson Production Calculations

1st Princeton/Oxford
High-Power Targets Workshop

Oxford

May 1-2, 2008
Count all the pions and muons that cross the transverse plane at z=50m.

For this analysis we select all pions and muons with KE< 0.35 GeV.
Optimizing Soft-pion Production

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

Yield at 9 m

- $\pi^-$
- $\pi^+$
- $\mu^-$
- $\mu^+$

Target radius (mm)

Tilt angle (mrad)

- $+50$ mrad
- $-50$ mrad
- $+100$ mrad
- $-100$ mrad
- $+150$ mrad
- $-150$ mrad

Harold G. Kirk
Consider mesons within acceptance of $\varepsilon_\perp = 30\pi\text{ mm}$ and $\varepsilon_\mathrm{L} = 150\pi\text{ mm}$ after cooling.

Use meson count with KE $< 350\text{ MeV}$ as a figure of merit.
Meson KE < 350 MeV at 50m

Mesons/Proton

Mesons/Proton normalized to beam power
The Target Interaction Length

Hg/Beam angle=33mrad
⇒ 30.3cm Hg/Beam overlap

Hg/Beam angle=60mrad
⇒ 16.6cm Hg/Beam overlap
Meson Production Efficiency

10GeV Proton Beam

KE < 0.35GeV at 50m

Mesons/Protons Ratio

Beam/Jet Interaction length, cm

50mrad
Overlap = 1.45λ₁

Harold G. Kirk
Key Merit Result

24 GeV Proton Beam

Disruption Length, m

Proton Intensity, TP

Disruption Length 17 cm
The 24 GeV 30TP shot

Beam pulse energy = 115kJ
B-field = 15T
Jet Velocity = 20 m/s
Disruption Length = 17 cm

We will replace 1.45 interaction lengths (20cm)

Then the jet transport time is 20cm/20m/s = 10ms

- Rep rate of 100Hz
- Proton beam power at that rate is 115kJ *100Hz = 11.5MW
## Demonstrated Beam Power at 24 GeV

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<th>Beam Power</th>
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### Demonstrated Beam Power at 14 GeV

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