Energy-Phase Rotation with a proton absorber

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Outline

- Front End for the Neutrino Factory-IDS
  - Beam loss and control
- Add Chicane + Proton absorber
  - Chicane removes high-energy particles
  - Proton Absorber removes low energy
- Need to rematch bunching and phase rotation
  - compensate for energy loss in absorber
Chicane, Absorber geometry

**Chicane:**

- **bend out**
  - $L=5\text{m}$, $\theta=12.5^\circ$
- **bend back**
  - $L=5\text{m}$, $\theta=-12.5^\circ$
  - centroid displacement of $1.1\text{m}$
- **composed of displaced, tilted $B=1.5\text{T}$ coils**
  - $\sim0.25\text{m}$ segments

**Absorber:**

- **10cm Be**
  - $\sim30\text{MeV}$ energy loss
Chicane effect:
- $P > \sim 500\text{MeV/c}$ are lost
- $P < \sim 500\text{MeV}$ pass through
  - displaced by $\sim 1.1\text{m}$
- Nominal Path length increased by only 8cm
  - orbits perturbed

Absorber effect:
- removes low energy particles
  - designed to remove protons
- distorts energy distribution
  - energy phase-rotation distorted; must be rematched
Front End: IDS Baseline

- **IDS setup**
  - particle 1-233 MeV/c
  - particle 2-154 MeV/c
  - Drift
  - Bunch N=10
  - Rotate N=10.05
  - Cool -201.25MHz

- **with absorber**
  - particle 1-270 MeV/c
  - particle 2-185 MeV/c
  - absorber at 29m
  - 10cm Be
  - particle 1-237 MeV/c
  - particle 2-144 MeV/c
  - Bunch N=10
  - Rotate N=10.04
  - Cool -201.25MHz
  - $p_{\text{ref}}=230$ MeV/c
Front End with Absorber

- with absorber
  - particle 1-270 MeV/c
  - particle 2-185 MeV/c
    - absorber at 29m
      - 10cm Be
      - particle 1-237 MeV/c
      - particle 2-144 MeV/c
    - Bunch N=10
    - Rotate N=10.04
    - Cool -201.25MHz
      - $p_{ref}=230$ MeV/c
Longitudinal beam through system

0.1m Be absorber

1m
29m
29.1m
38m
46m
98m
152m
252m
ICOOL Simulation results

- Similar to without absorber
  - ~10m shorter drift
  - ~10% fewer μ's within acceptance
  - drop of ~20% intensity at absorber
  - but longitudinal emittance also reduced
    - surviving μ's are stretched in longitudinal phase space
Summary; to do

- Procedure for rematching bunching/rotation with “proton” absorber is demonstrated
  - track reference particles with energy loss through system
- results similar to without absorber
  - ~10% fewer μ’s accepted
  - Losses reduced by some factor

- Chicane + Absorber Geometry needs to be defined and simulated
  - ~10—20% less μ/p (?)
  - Losses reduced/controlled by ?

- Is this version preferred?