Front End Chicane Parameters

J. Scott Berg
Brookhaven National Laboratory
MAP Front End Meeting
1 April 2014
Introduction

- Goal: optimize chicane parameters for high energy cutoff
- Not dealing with absorber for low energy protons
- Chicane field is 2 T
  - Could be done for other fields
- 25 cm radius aperture downstream of chicane
  - No aperture in chicane
- Scanned in chicane length and angle
Performance Parameters

- Look at fraction of muons at end of chicane that are captured in cooling
  - Depends on absorber thickness
  - Also depends on NBPR design
  - Also did for pions

- Call “transmission” muons within 80–260 MeV kinetic energy, pions 80–320 MeV

- Initially looked at proton power downstream
- Decided better criterion was energy beyond which all protons were lost
  - Came up with designs that removed more proton energy, but left many high energy protons.
Performance Parameters

Fraction of Accepted Muons vs. Kinetic Energy (MeV)

1 April 2014 J. S. Berg | Chicane | MAP Front End
Performance Parameters

![Graph showingMuon Accelerator Program](image)

- Proton Power per MW per 20 MeV (W)
- Kinetic Energy (MeV)
- 3.5 m 100 mrad

1 April 2014 J. S. Berg | Chicane | MAP Front End
Results

• Can find solutions with best transmission for a given proton energy cutoff
• For higher proton energy cutoffs, two sets of optimal solutions
  ○ One for shorter chicanes, but look less robust
  ○ One for longer chicanes
  ○ Need to analyze these a bit more
  ○ Optimal clearer for lower proton energy cutoffs
• Some cutoffs appear lower than I say
  ○ Cutoff can be determined by a single proton
  ○ Working on criterion of integrated power
Results

Chicane angle (mrad) vs. Chicane Half Length (m) vs. Proton Kinetic Energy Cutoff (MeV)

- Chicane angle values range from 0 to 400 mrad.
- Chicane Half Length values range from 0 to 10 meters.
- Proton Kinetic Energy Cutoff values range from 0 to 1000 MeV.

The graph shows the distribution of data points across the variables, with color coding indicating different energy cutoffs.

1 April 2014 J. S. Berg | Chicane | MAP Front End
Results

![Graph showing Muon Transmission in Band (%)](image)

- X-axis: Chicane Half Length (m)
- Y-axis: Chicane angle (mrad)
- Legend: Muon Transmission in Band (%)
Results

1 April 2014  J. S. Berg | Chicane | MAP Front End

Proton Power per MW per 20 MeV (W)
Kinetic Energy (MeV)

4.0 m 160 mrad

3.5 m 140 mrad

6.0 m 220 mrad

5.5 m 180 mrad
Results
Conclusions

- Can find best solutions (in terms of muon transmission) for various proton energy cutoffs
- Best cutoff will depend on downstream details
  - Lower cutoff energy requires less absorber
  - But some loss in muon transmission
    - More than indicated here: higher energy muons also transmitted
- Will need to optimize full system
- Need to understand best parameter regime
- Could look at other fields
- Could pass distributions at end of chicane to G4beamline
Plan Going Forward

- Produce distributions at chicane end as a function of cutoff
- Run through drift in G4beamline with absorber at two positions
  - At end of chicane
  - At distance where all pions are decayed
  - Optimize absorber thickness for both cases
- Pass to ICOOL to optimize NBPR
  - Still a function of cutoff
  - Additionally two positions for absorber
- Pick a good solution, then global optimize in G4beamline