# Front End Chicane Parameters

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

# Introduction

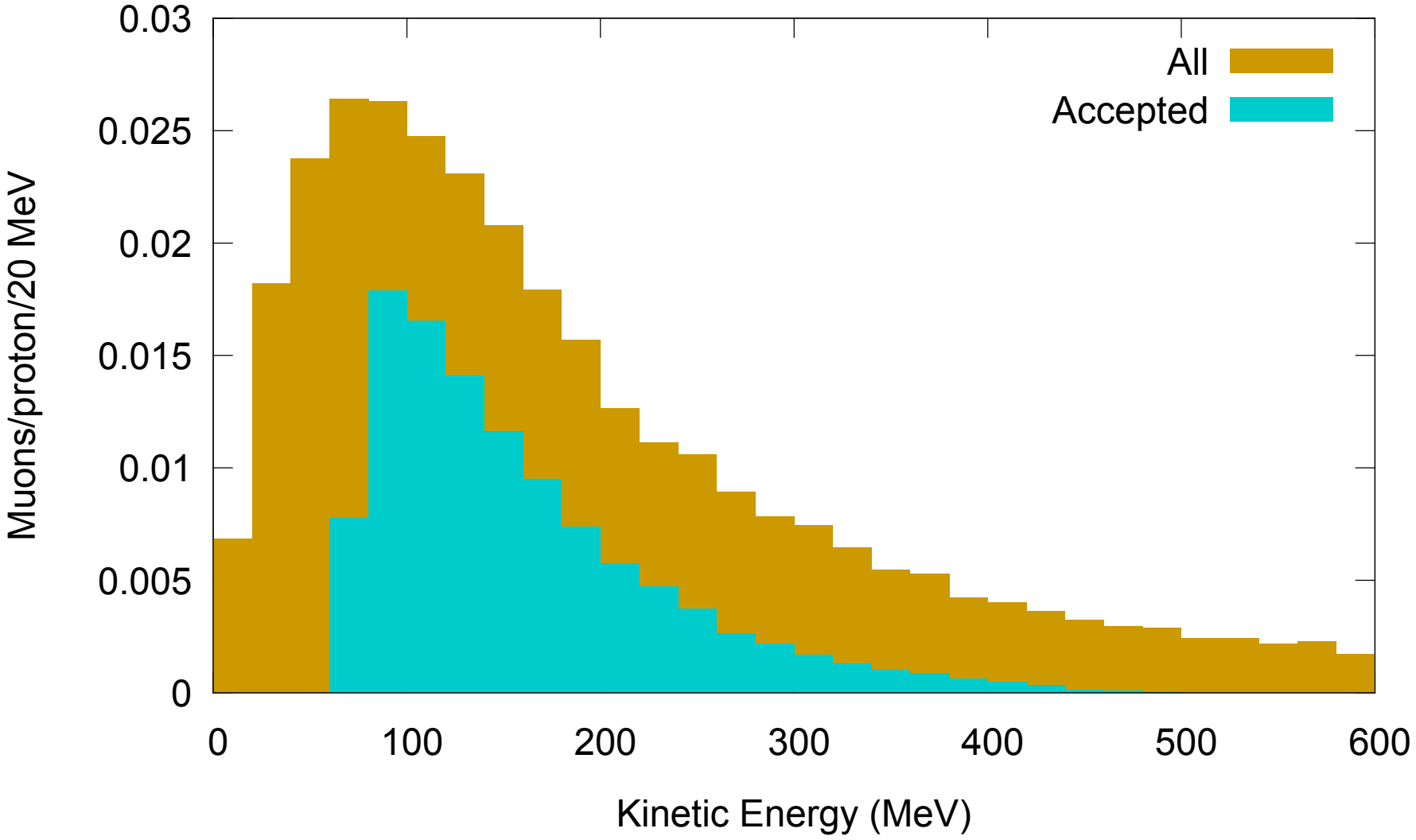
- Goal: optimize chicane parameters for high energy cutoff
- Not dealing with absorber for low energy protons
- Chicane field is 2 T
  - Could be done for other fields
- 25 cm radius aperture downstream of chicane
  - No aperture in chicane
- Scanned in chicane length and angle

# Performance Parameters



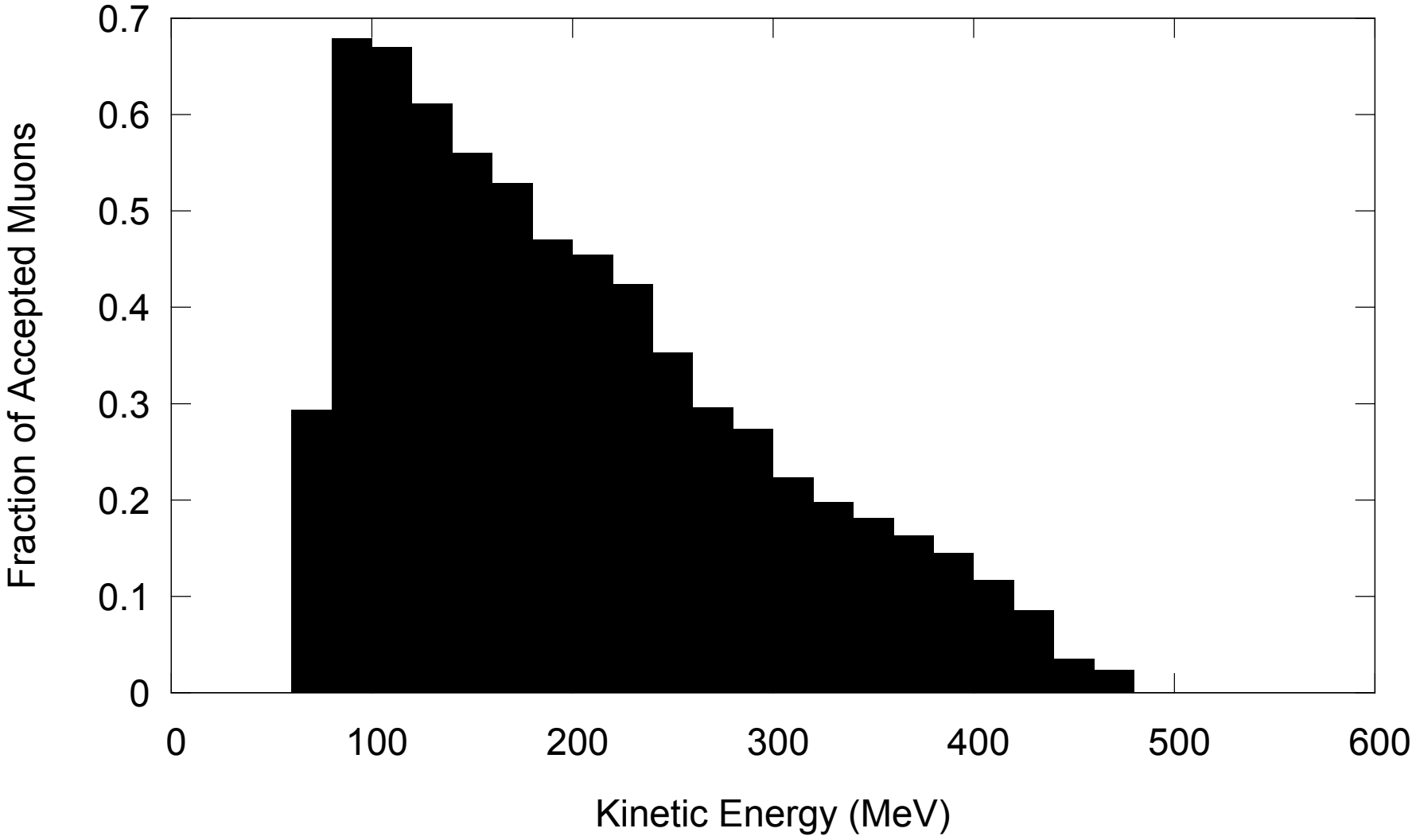
- Look at fraction of muons at end of chicane that are captured in cooling
  - Depends on absorber thickness
  - Also depends on NBPR design
  - Also did for pions
- Call "transmission" muons within 80–260 MeV kinetic energy, pions 80–320 MeV
- Initially looked at proton power downstream
- Decided better 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

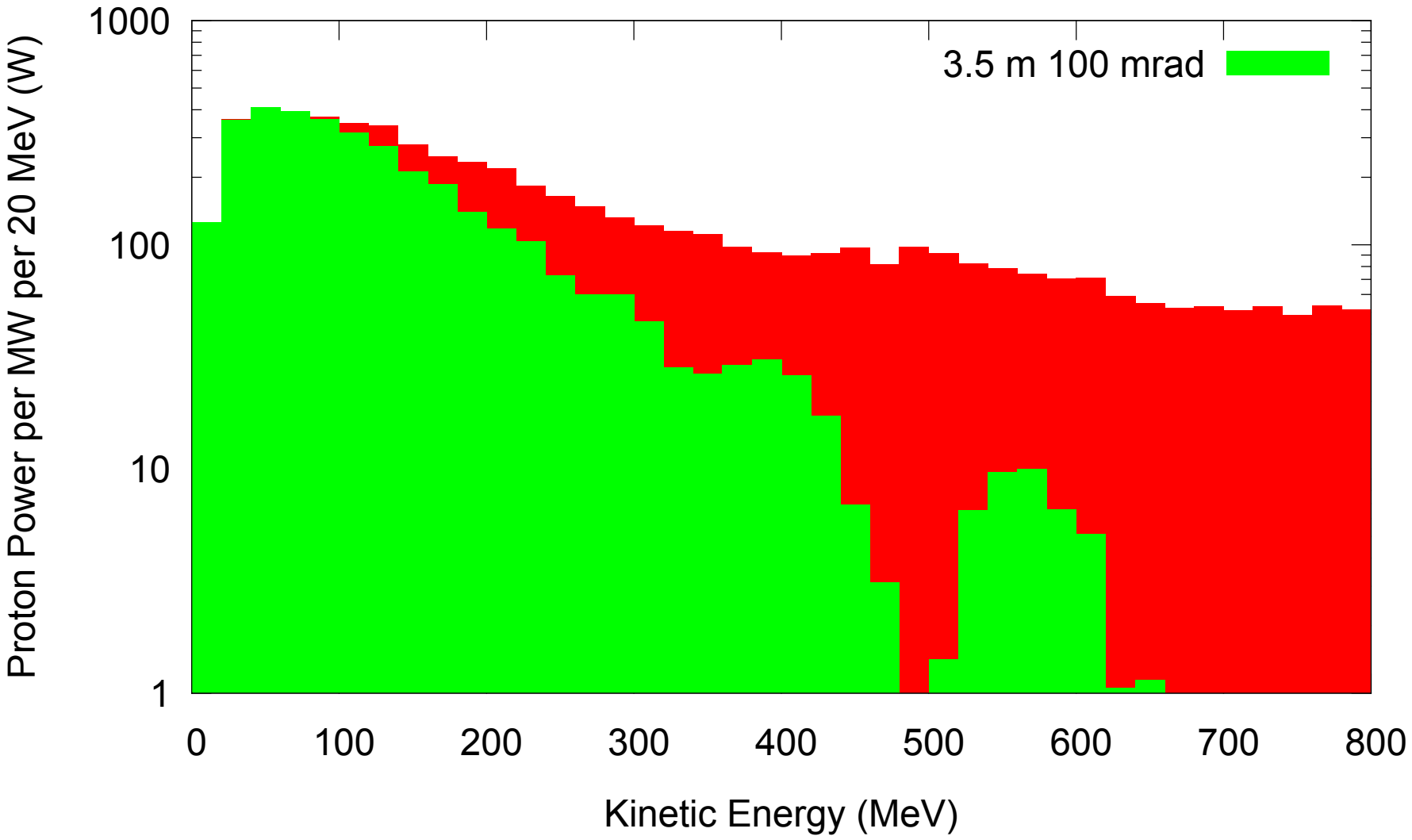


# Performance Parameters





# Performance Parameters

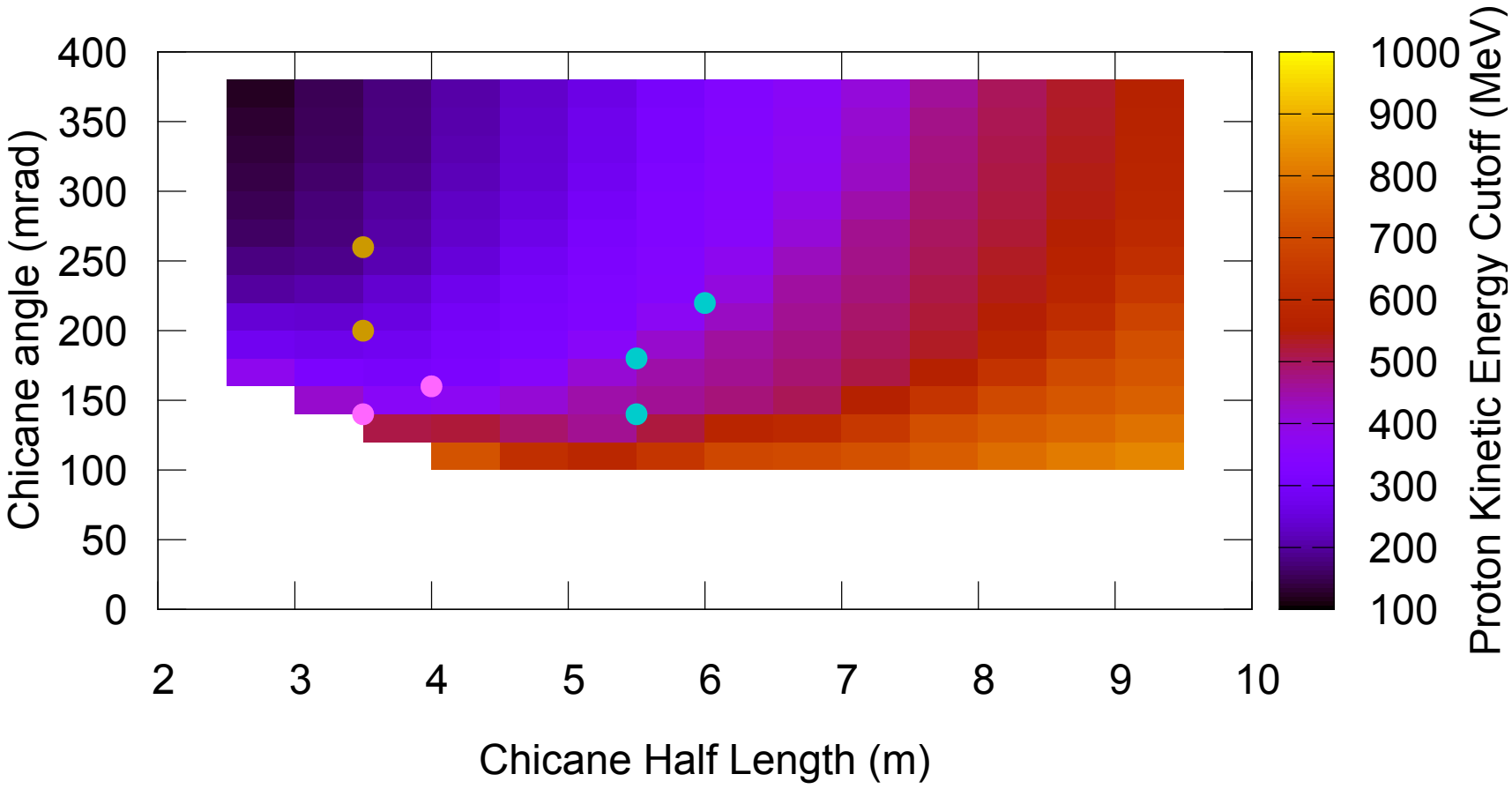


# Results

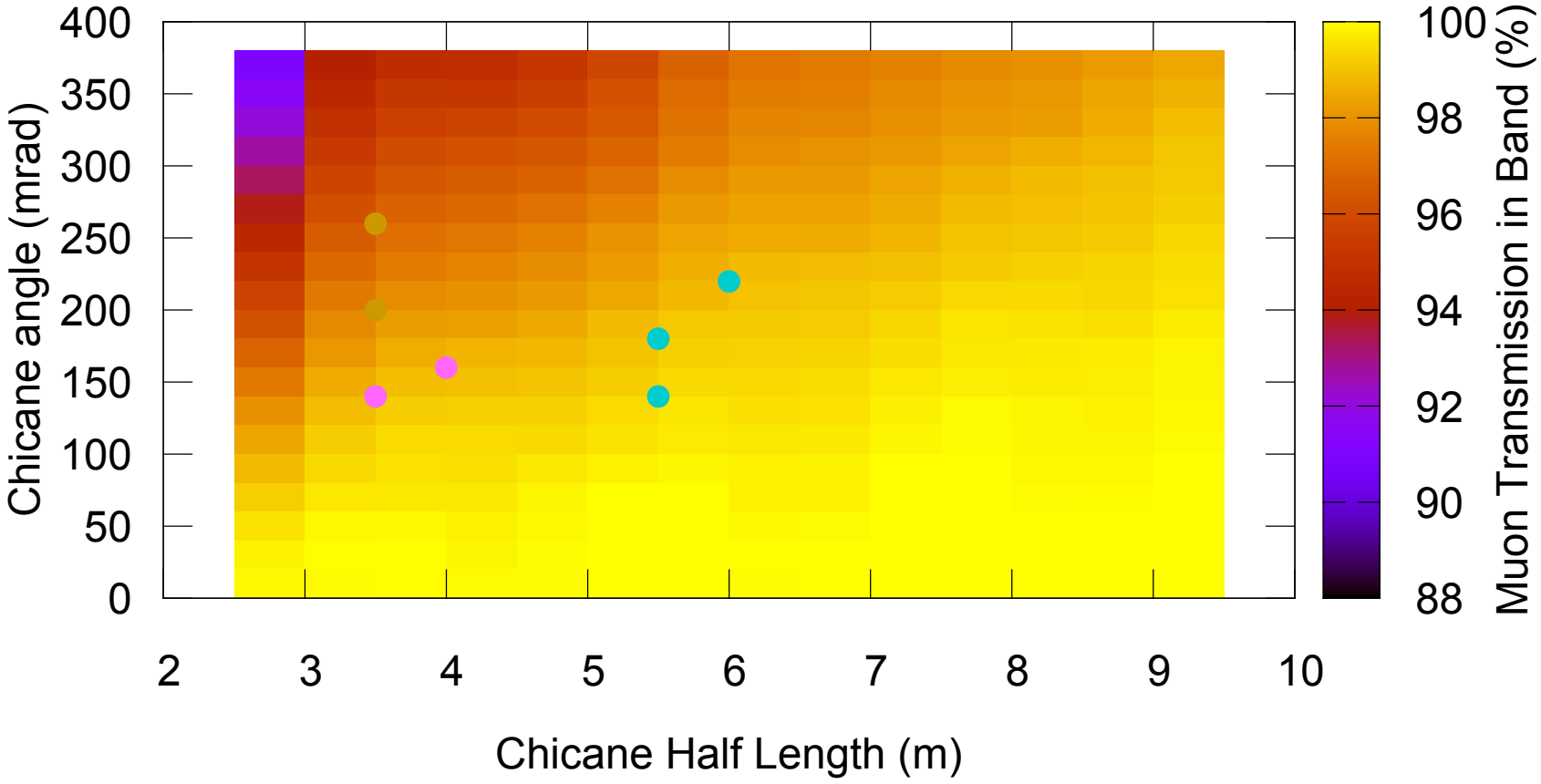


- Can find solutions with best transmission for a given proton energy cutoff
- For higher proton energy cutoffs, two sets of optimal solutions
  - One for shorter chicanes, but look less robust
  - One for longer chicanes
  - Need to analyze these a bit more
  - Optimal clearer for lower proton energy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

# Results

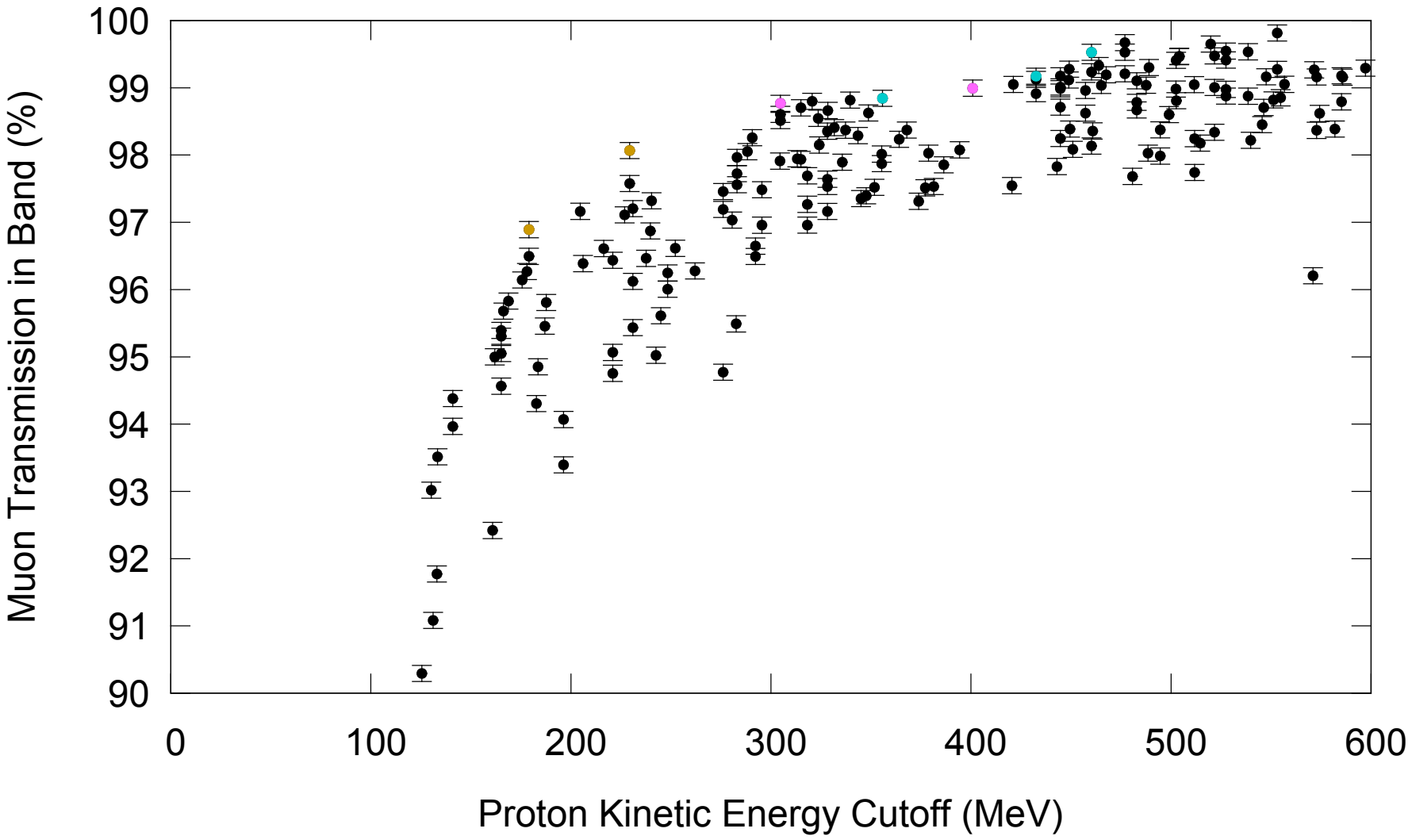

Chicane angle (mrad)
400
350
300
250
200
150
100
50
0
2
3
4
5
6
7
8
9
10
Chicane Half Length (m)
1000
900
800
700
600
500
400
300
200
100
Proton Kinetic Energy Cutoff (MeV)

# Results


Chicane angle (mrad)
400
350
300
250
200
150
100
50
0
2
3
4
5
6
7
8
9
10
Chicane Half Length (m)
100
98
96
94
92
90
88
Muon Transmission in Band (%)

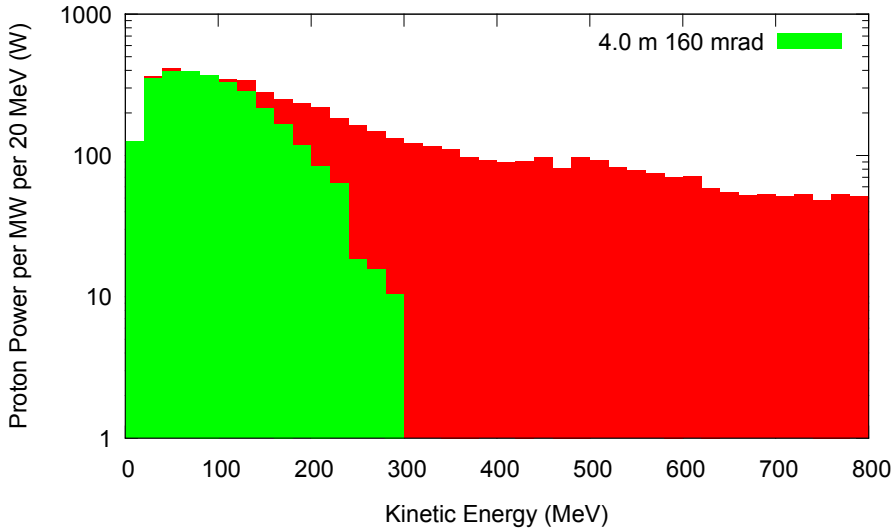
# Results

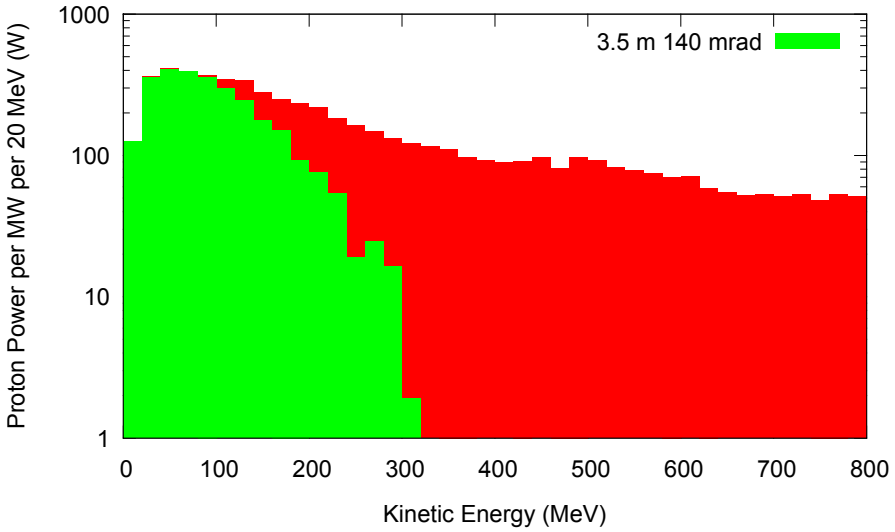


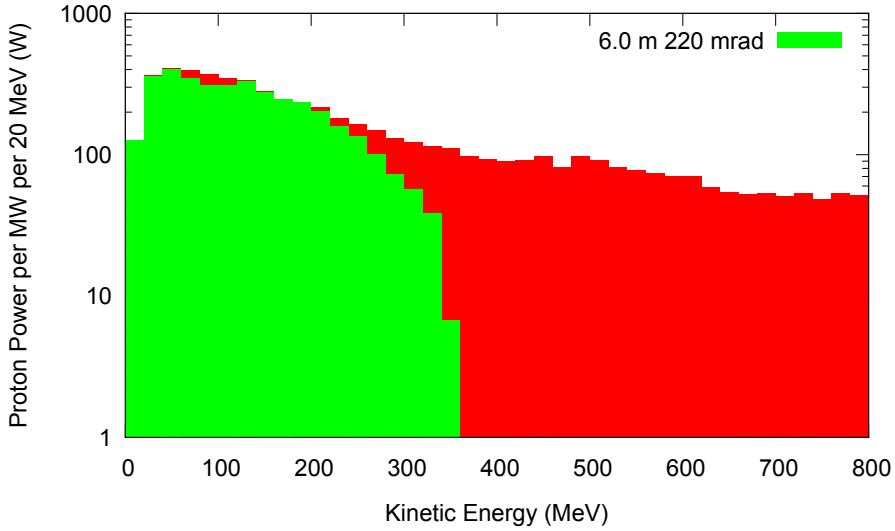

Muon Transmission in Band (%)
100
99
98
97
96
95
94
93
92
91
90
0
100
200
300
400
500
600
Proton Kinetic Energy Cutoff (MeV)

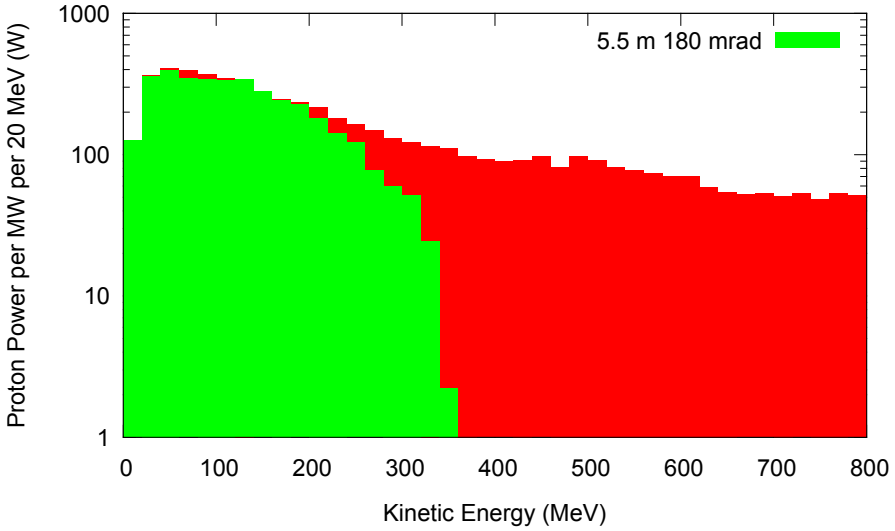
# Results




4.0 m 160 mrad
Proton Power per MW per 20 MeV (W)
Kinetic Energy (MeV)
1000
100
10
1
0
100
200
300
400
500
600
700
800

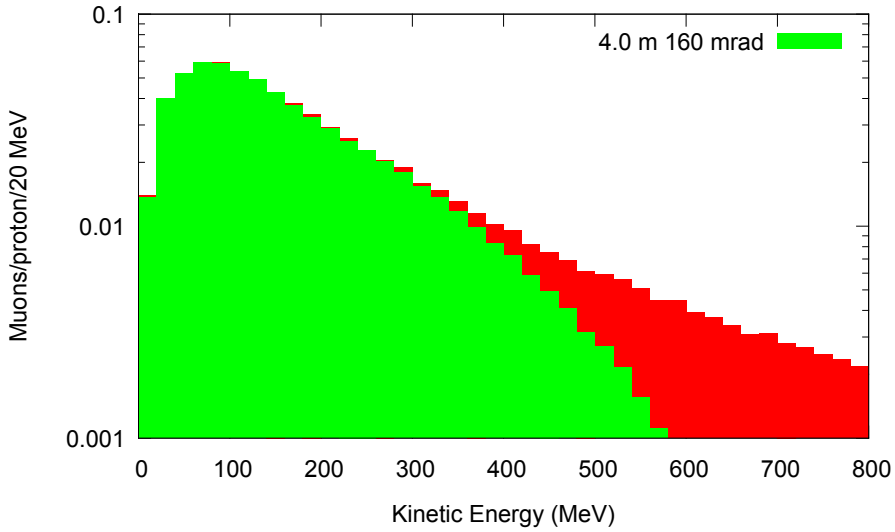

3.5 m 140 mrad
Proton Power per MW per 20 MeV (W)
Kinetic Energy (MeV)
1000
100
10
1
0
100
200
300
400
500
600
700
800

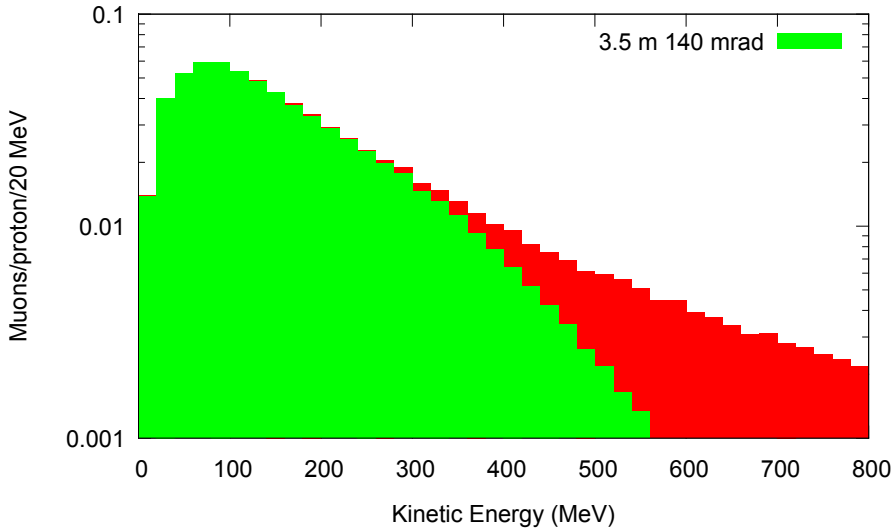

6.0 m 220 mrad
Proton Power per MW per 20 MeV (W)
Kinetic Energy (MeV)
1000
100
10
1
0
100
200
300
400
500
600
700
800

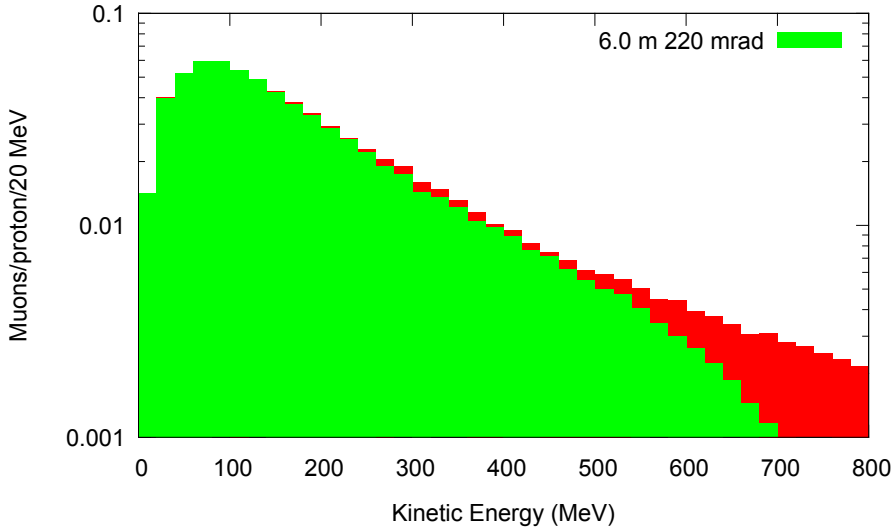

5.5 m 180 mrad
Proton Power per MW per 20 MeV (W)
Kinetic Energy (MeV)
1000
100
10
1
0
100
200
300
400
500
600
700
800

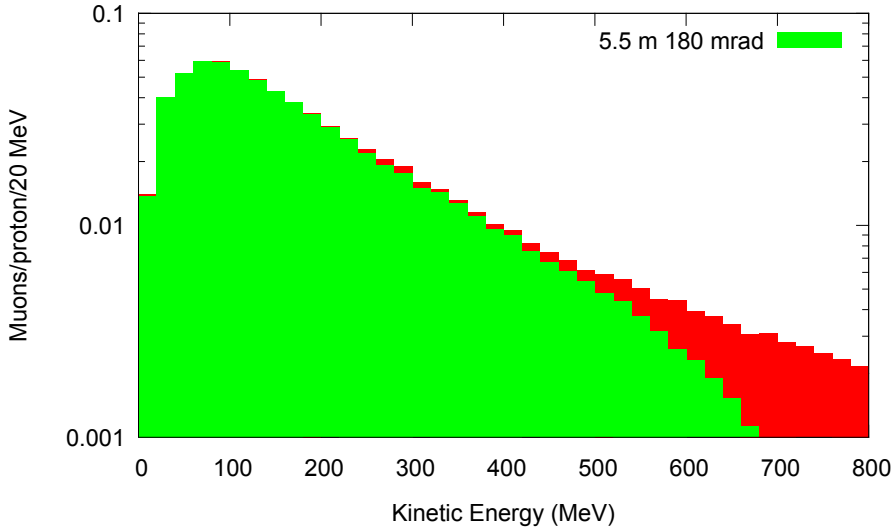
# Results




4.0 m 160 mrad
Muons/proton/20 MeV
0.1
0.01
0.001
0
100
200
300
400
500
600
700
800
Kinetic Energy (MeV)


3.5 m 140 mrad
Muons/proton/20 MeV
0.1
0.01
0.001
0
100
200
300
400
500
600
700
800
Kinetic Energy (MeV)


6.0 m 220 mrad
Muons/proton/20 MeV
0.1
0.01
0.001
0
100
200
300
400
500
600
700
800
Kinetic Energy (MeV)


5.5 m 180 mrad
Muons/proton/20 MeV
0.1
0.01
0.001
0
100
200
300
400
500
600
700
800
Kinetic Energy (MeV)

# 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