Chicane Optimization

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Introduction

- Goal: optimize chicane by itself
  - Chicane angle and length
  - Downstream absorber thickness
- Chicane field is 2 T
  - Could be done for other fields
- 25 cm radius aperture downstream of chicane
  - No aperture in chicane
  - 6.58 kW of protons per MW on target at chicane start within 25 cm radius

Chicane Geometry Scan

- Looked at chicane without absorber
- Scan in chicane length, angle
- Defined performance in terms of
  - Muon transmission from 80 to 260 MeV KE
    - Pions also, 80 to 320 MeV
  - Maximum energy of transmitted protons (cutoff)
    - No more than 2 W of protons above this energy per proton MW on target

Choosing Optimal Solutions

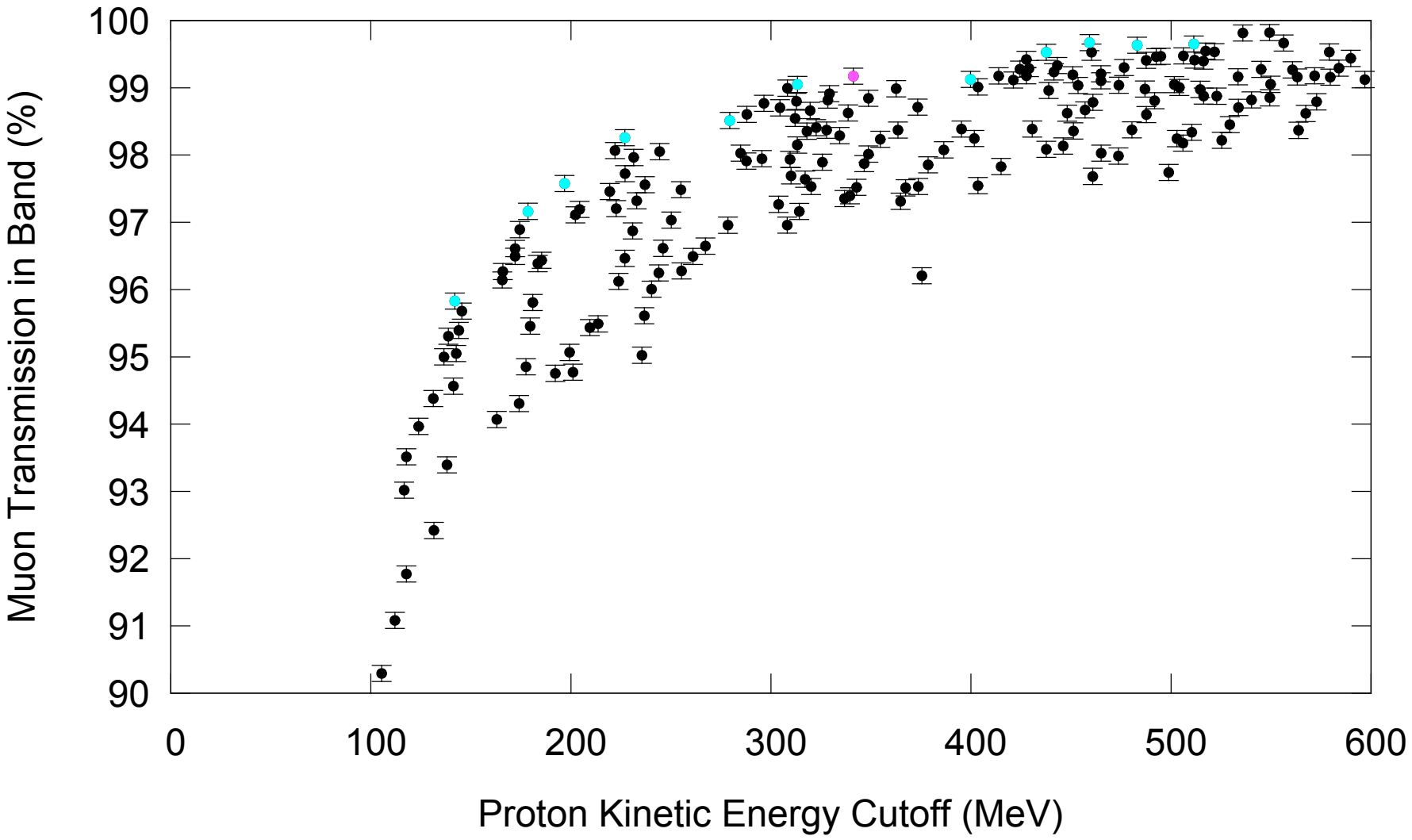
- Choose set of solutions with best transmission for a given proton energy cutoff
- Fit angle and length for these solutions to functions of proton kinetic energy cutoff

$$L = L_0 + L_1 K \qquad \theta = \theta_0 + \theta_1 / K$$

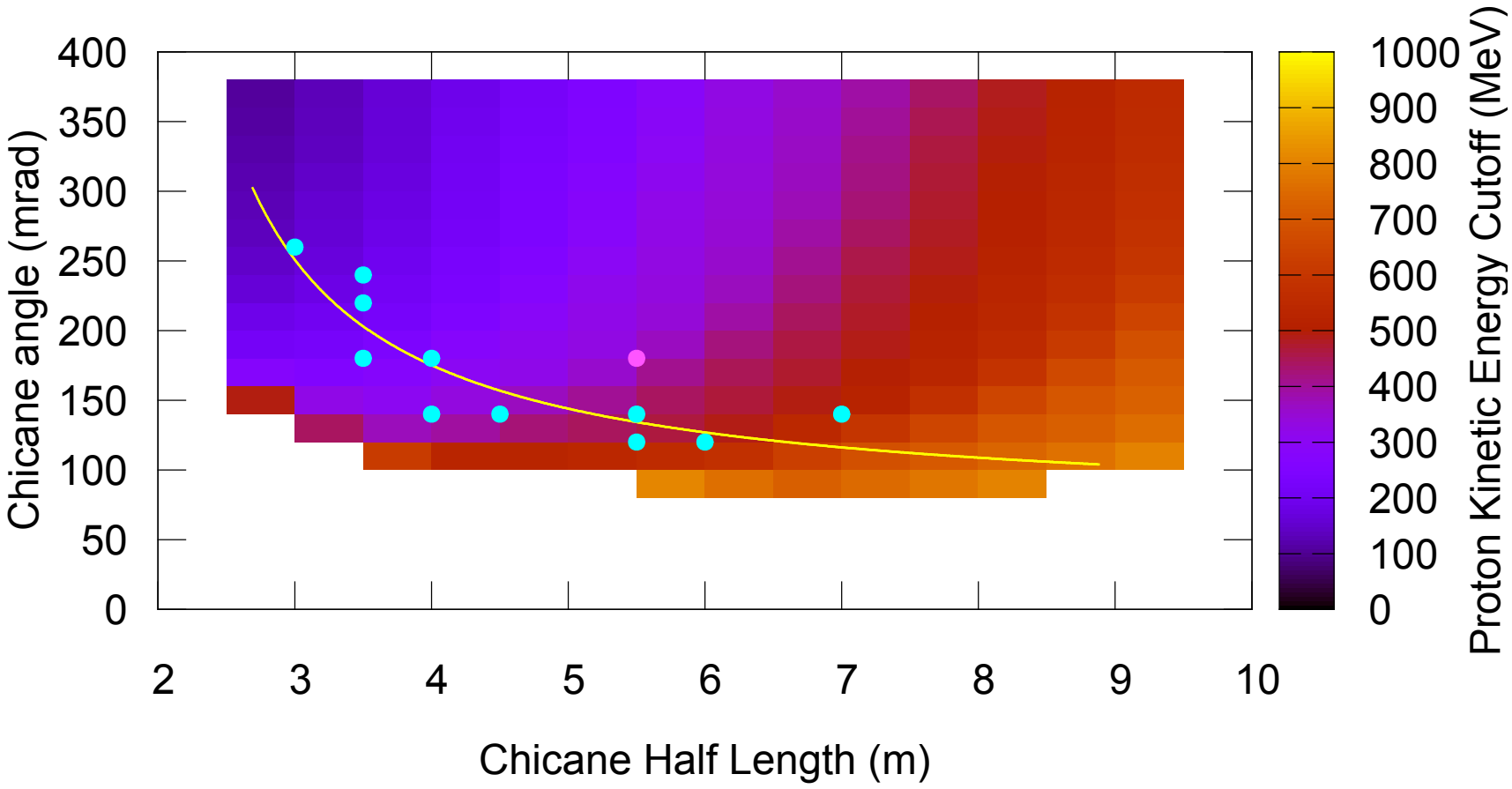
L_0 (m)	1.6	L_1 (m/GeV)	9.1
θ_0 (mrad)	69	θ_1 (mrad GeV)	28

- No physical meaning to these fits

Transmission vs. Cutoff



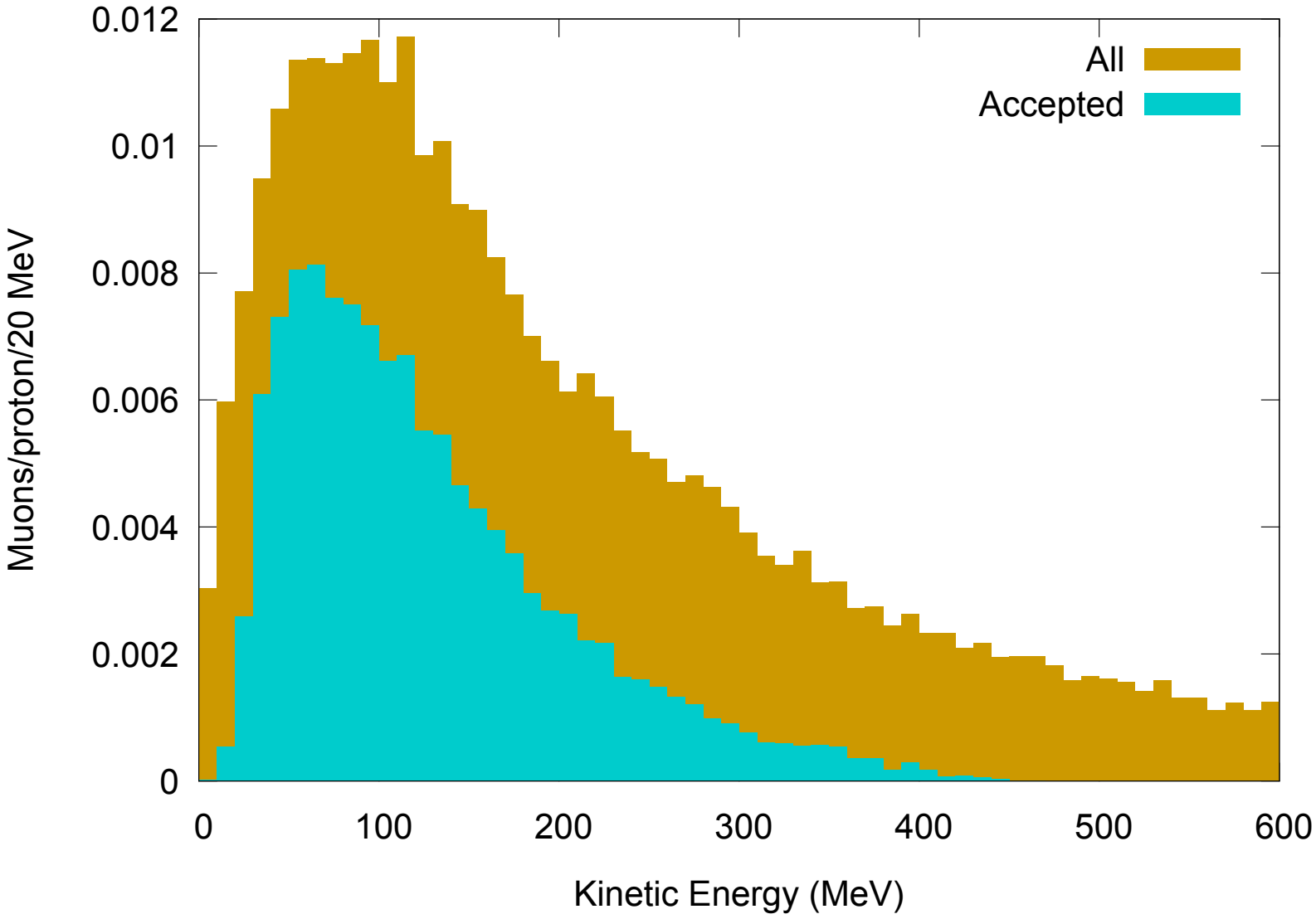
Cutoff vs. Length and Angle



Add the Absorber

- Track in G4beamline, downstream from chicane
- Measured criteria 31 m downstream from chicane start
  - Muons from 20 MeV to 390 MeV
  - Proton power
- Varied absorber thickness
- Two absorber positions
  - End of chicane
  - 30 m from chicane start
- Picked four chicane cutoffs

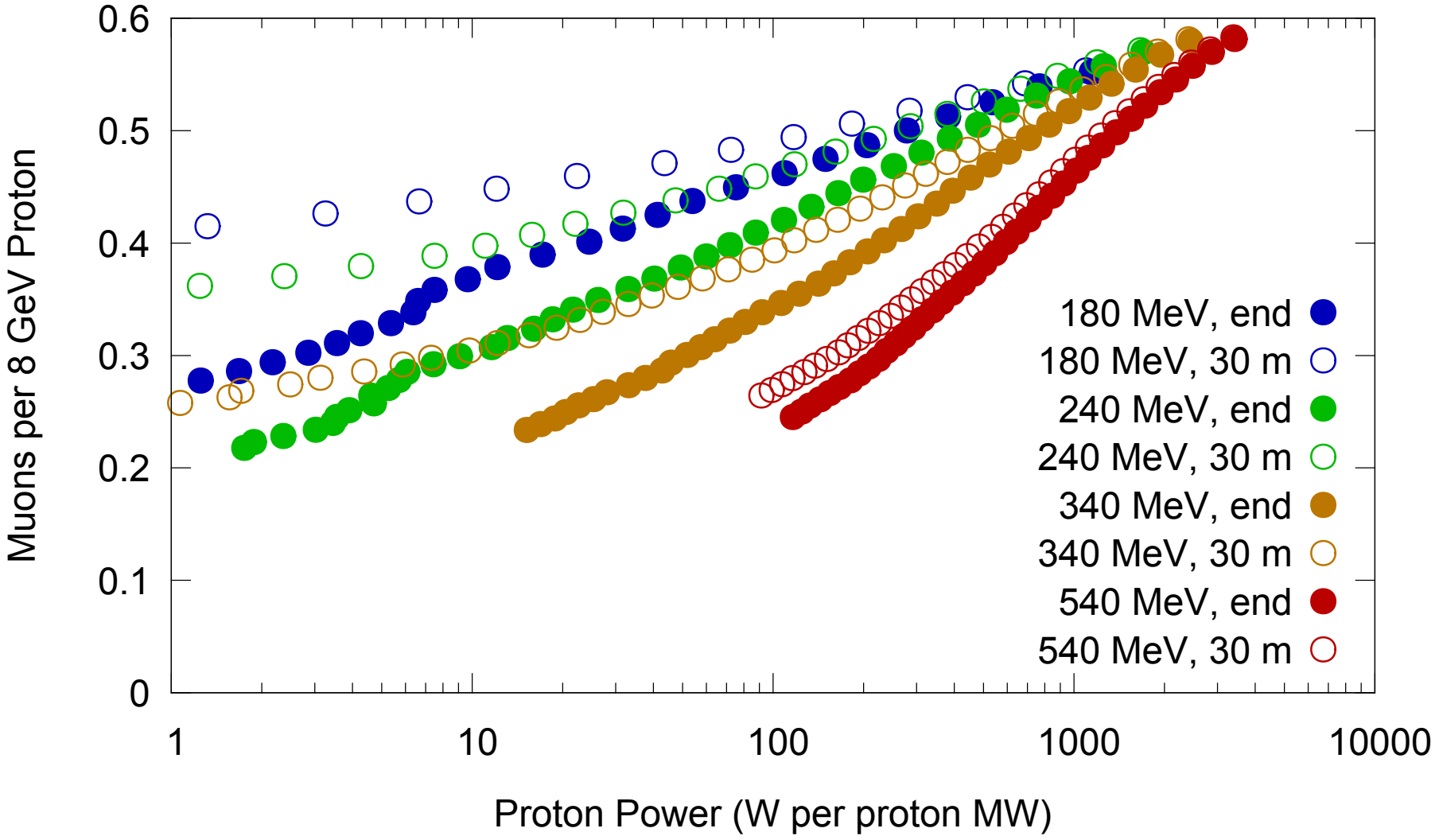
Muon Spectrum Post Absorber



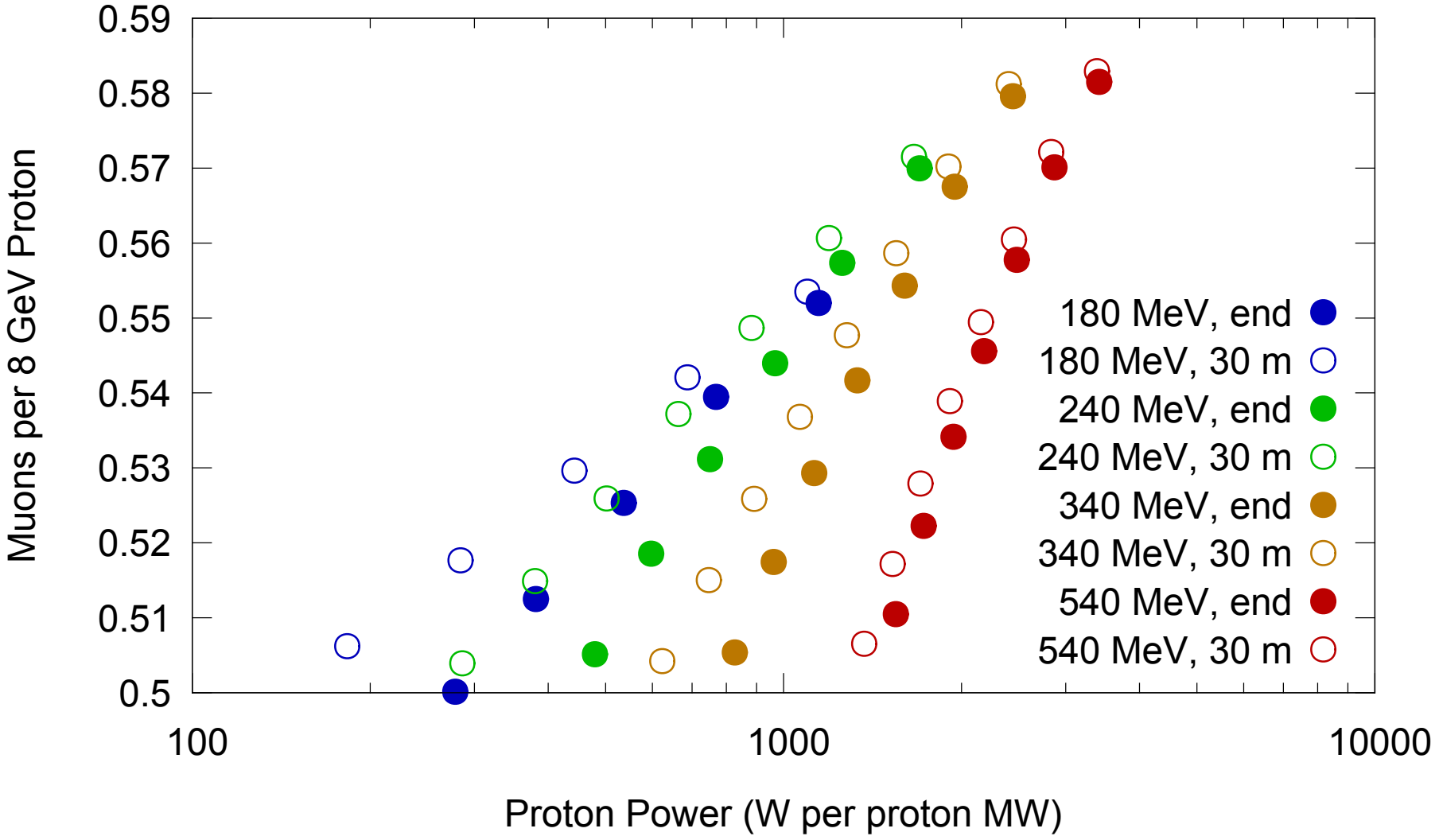
Analysis

- Look at muons vs. proton power
- Favor low proton energy cutoff
  - Unless you allow a lot of power downstream
- Poor transmission to get to low proton powers
  - Need to pick tolerable proton power
- Moving absorber downstream helps
  - Effect exaggerated by overweighting high energy?
  - But may not win when NBPR considered
  - Would gain even more by moving further
  - Less benefit for more downstream proton power
- High energy muons overweighted
  - Effective muon loss even higher
  - Low proton energy cutoff even more strongly favored

Muons vs. Proton Power



Muons vs. Proton Power



Summary

- Have a solution for chicane parameters for a given proton kinetic energy cutoff
  - Some behavior not well analyzed and understood
- Significant tradeoff between muon transmission and downstream proton power
- Low proton energy cutoff in chicane is generally preferred

Next Steps

- Chicane parameter scan
  - Add chicane apertures that track muon beam size
  - Add energy weighting of muon transmission
  - Scan chicane with low proton energy cutoff in more detail
- Design NBPR matching some chicane solutions

Next Steps

- Choose proton energy allowed downstream of absorber
  - Find regions of energy loss with ICOOL/G4beamline
  - Detailed MARS simulations for selected regions
    - Determine precise location of loss (coils, cavities, etc.)
- Pick solution with best transmission for permitted proton energy downstream
- Repeat for different chicane fields