Front End Chicane
Chicane Geometry and Absorber

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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

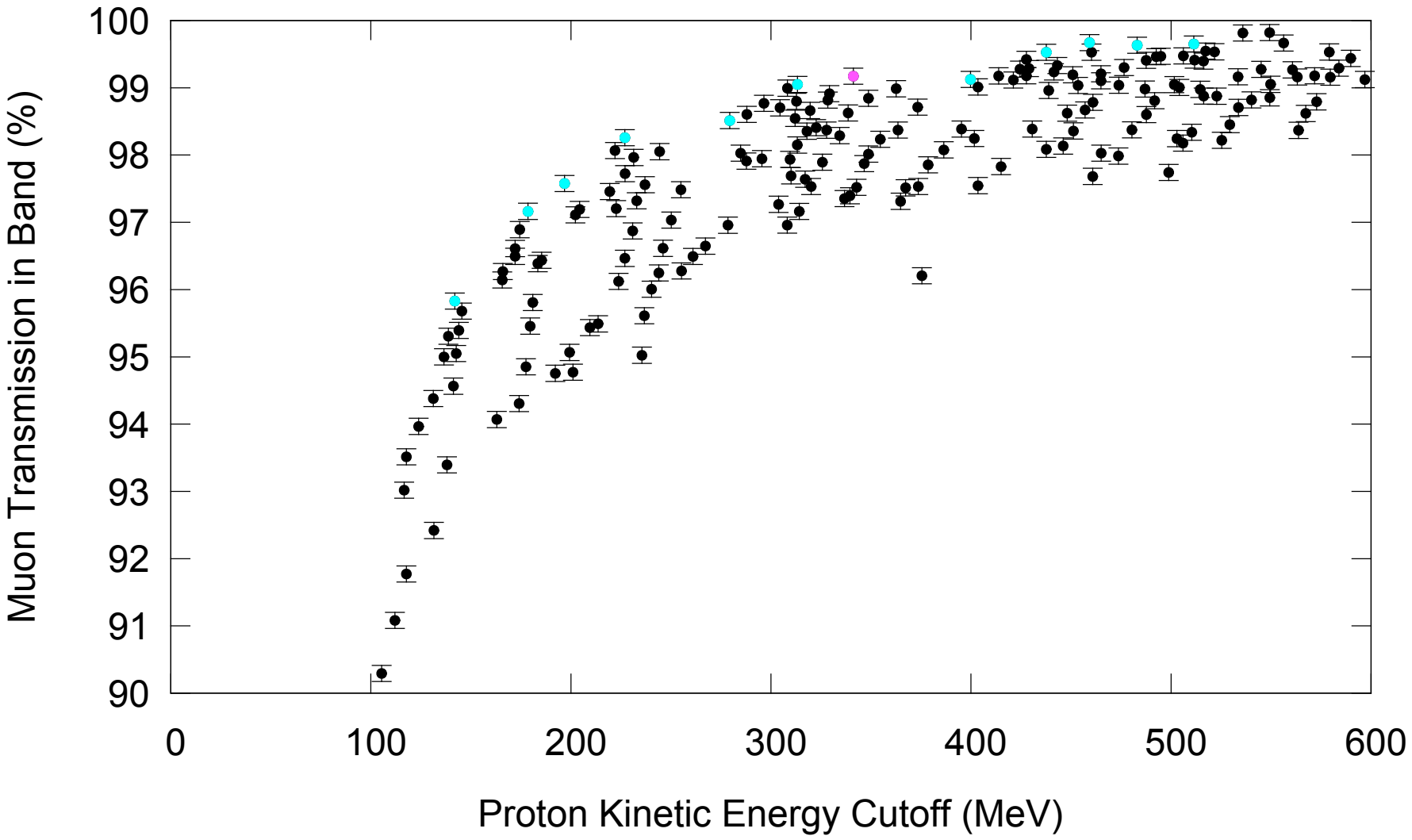
Previous Status (1 April)

- 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)
- Found some problems
  - Apparent proton spectrum cutoff lower then maximum energy
    - Small number of high energy stragglers
  - Parameters for best transmission for a given cutoff not a smooth function of the cutoff for some cutoff ranges
    - Mixture of short- and long-chicane solutions
    - Short chicane solutions didn't look robust

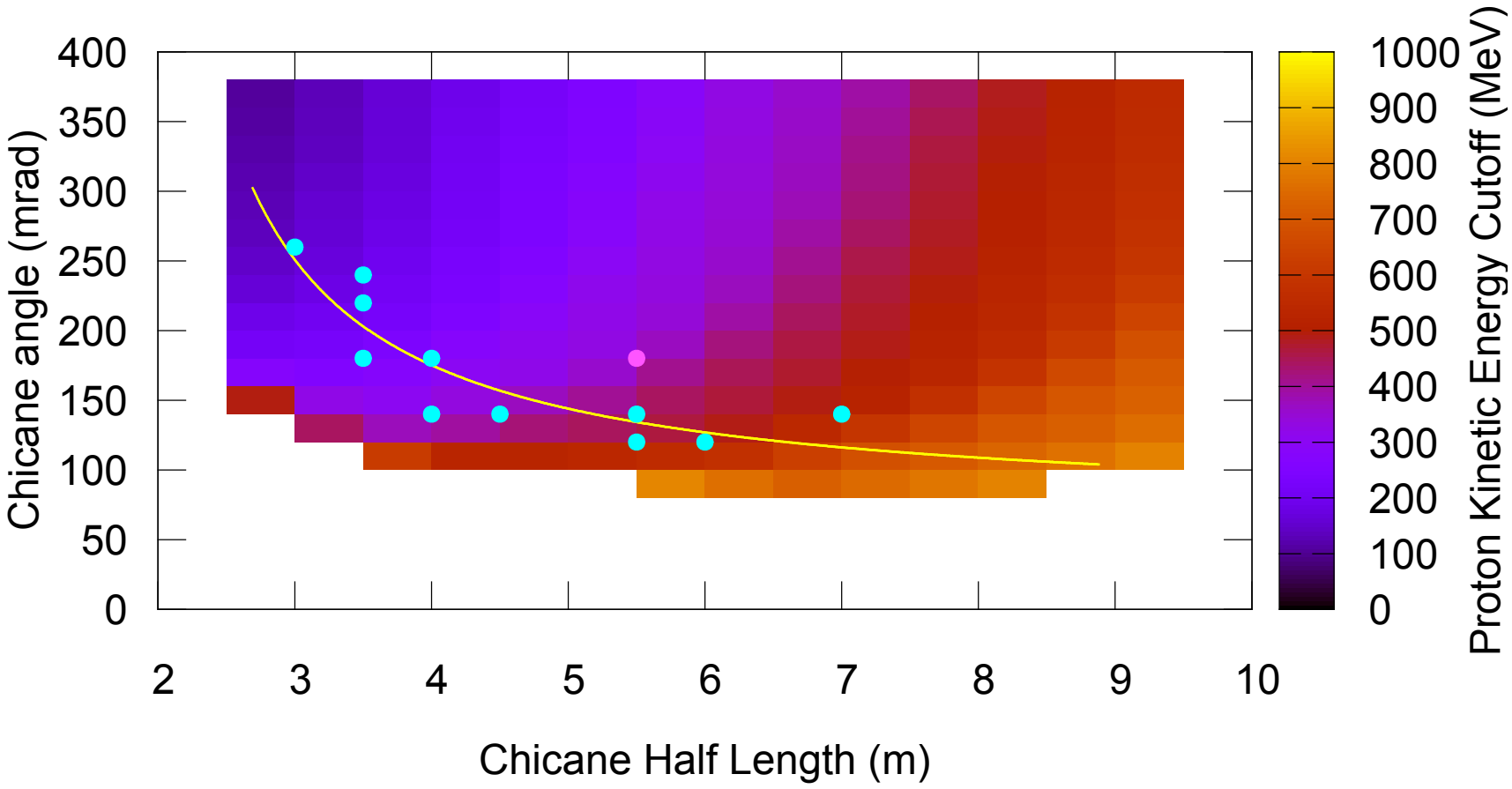
New Cutoff Definition

- New definition of proton energy cutoff: no more than 2 W of protons above the cutoff per proton MW on target
- Choose set of solutions with best transmission for a given proton energy cutoff
- Fit solutions to a functional form
  - Dropped one outlier

Transmission vs. Cutoff



Cutoff vs. Length and Angle



Fit Parameters vs. Cutoff

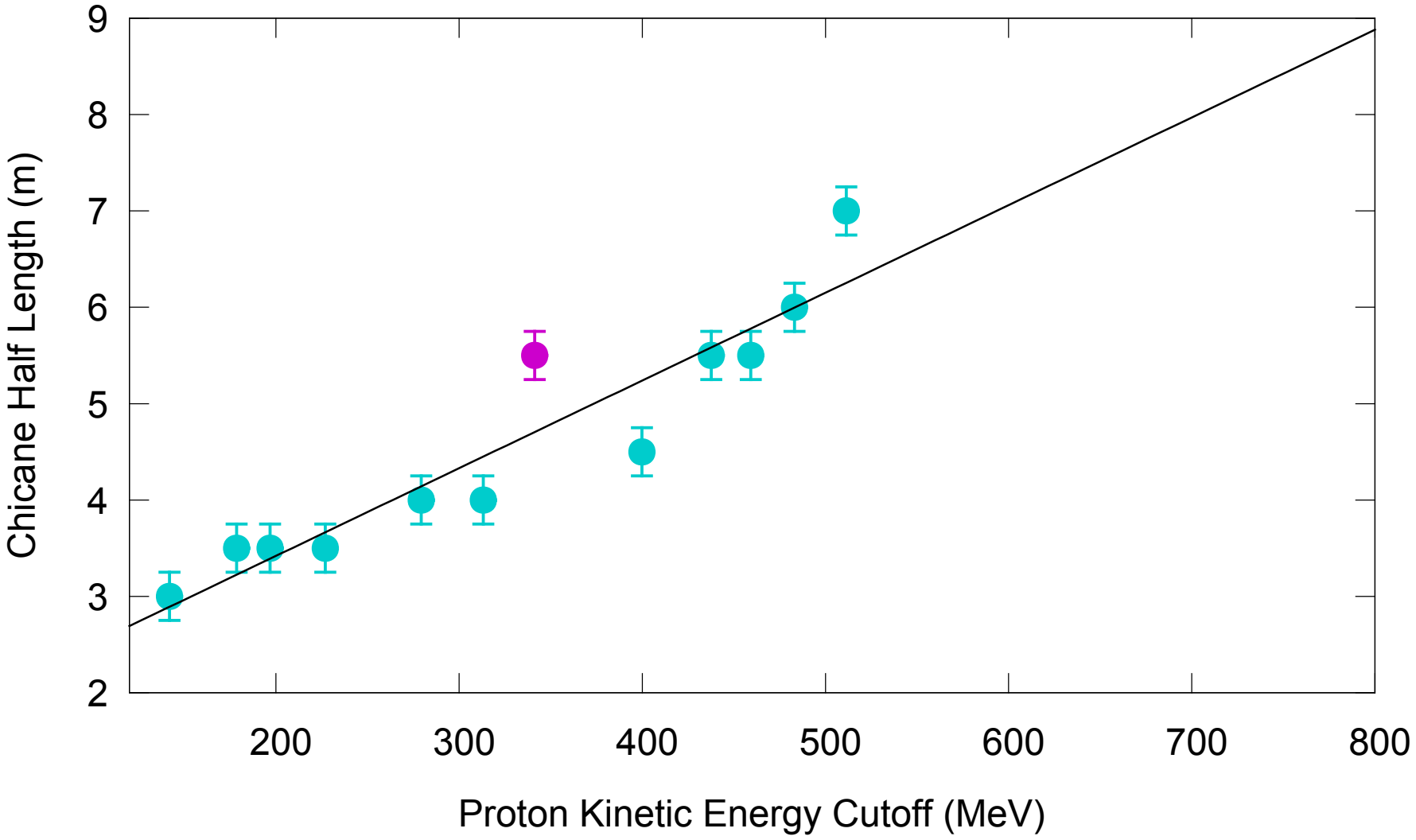
- Fit angle and legnth vs. proton energy cutoff for optimal solutions
  - Ignore single outlier

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

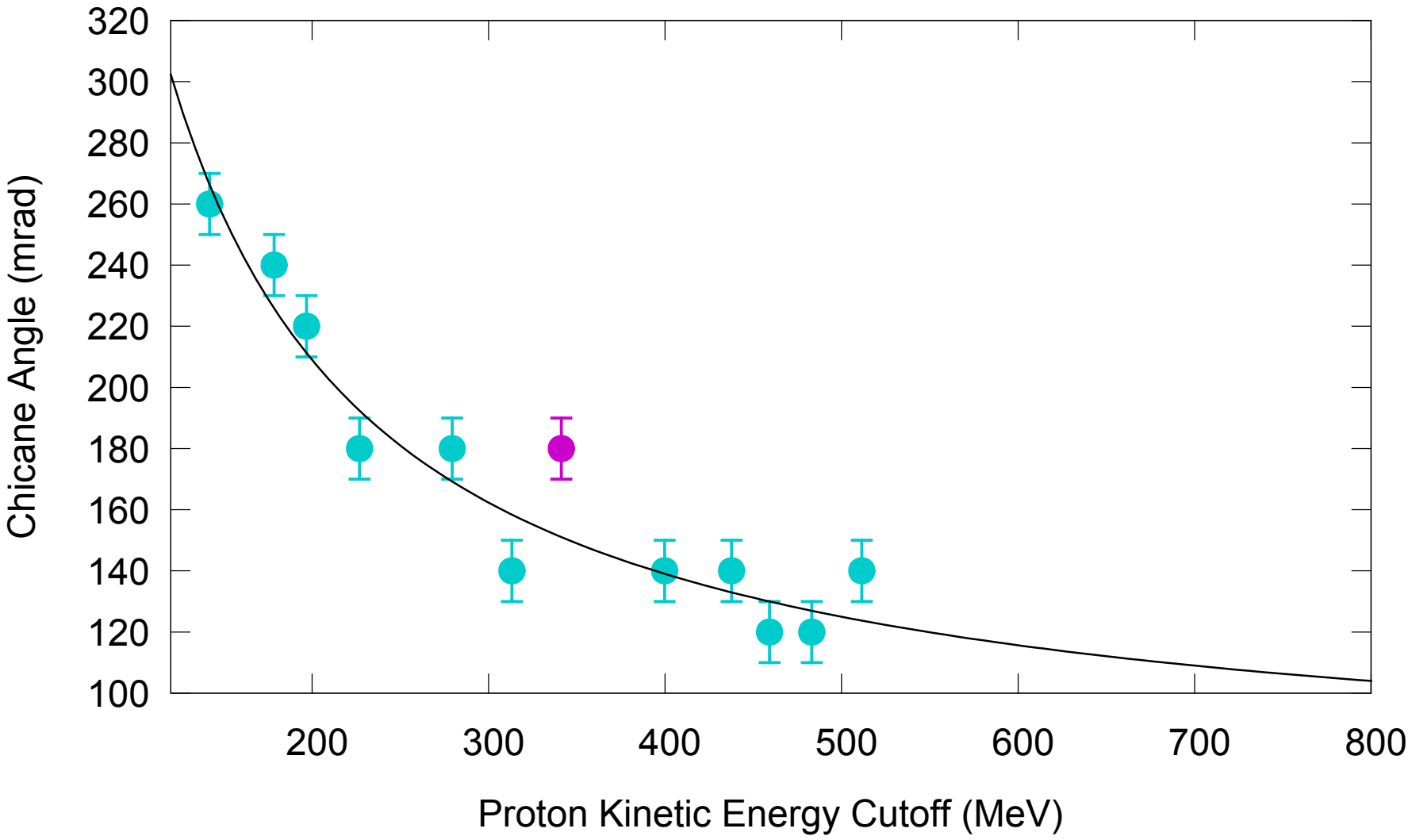
L_0 (m)	1.6	L_1 (m/GeV)	9.1
θ_0 (mrad)	69	θ_1 (mrad GeV)	28

- No physical meaning to these fits
- Quadratic fit for length gives undesirable behavior
- Fit stays nicely away from non-robust region

Length vs. Cutoff



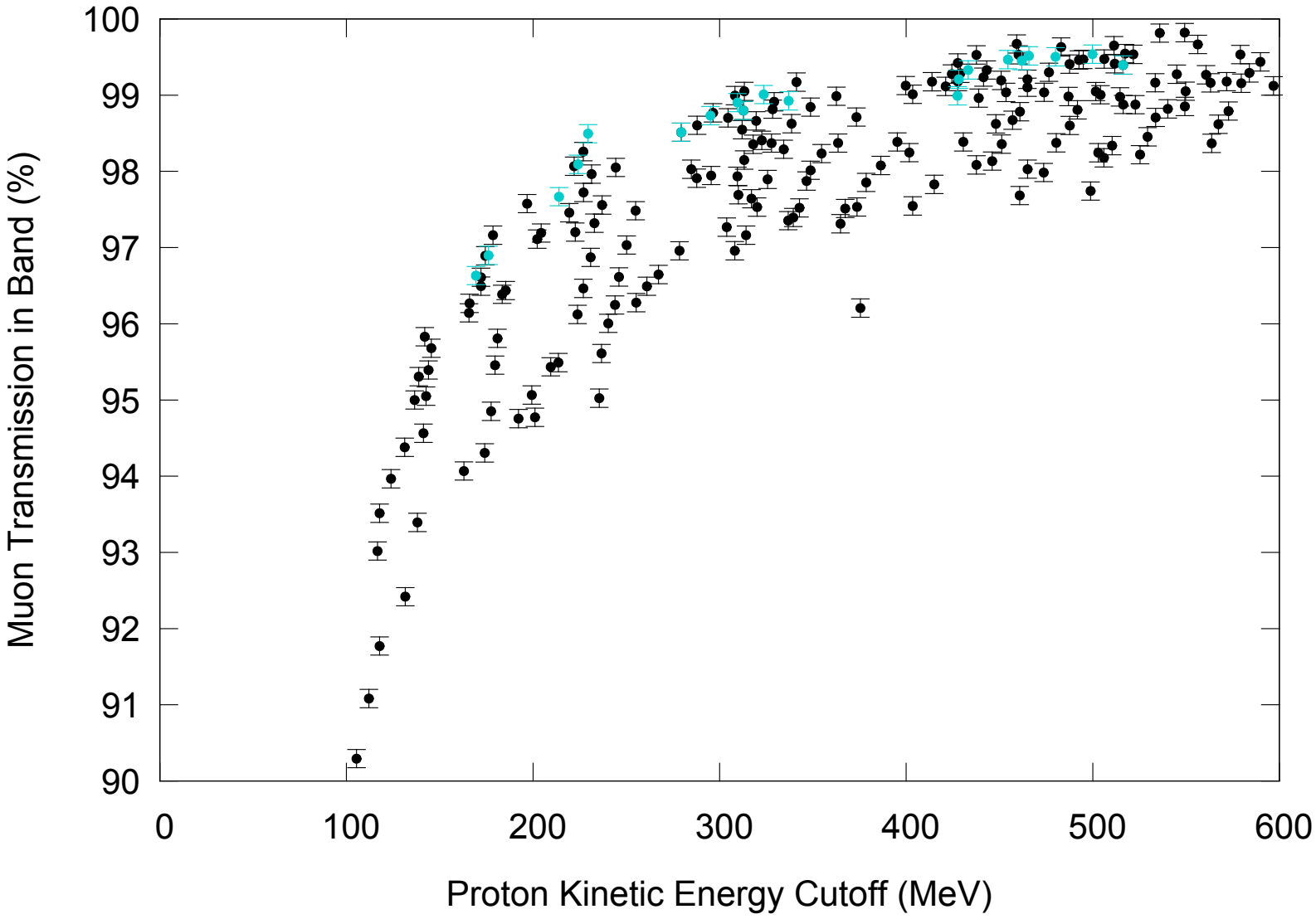
Angle vs. Cutoff



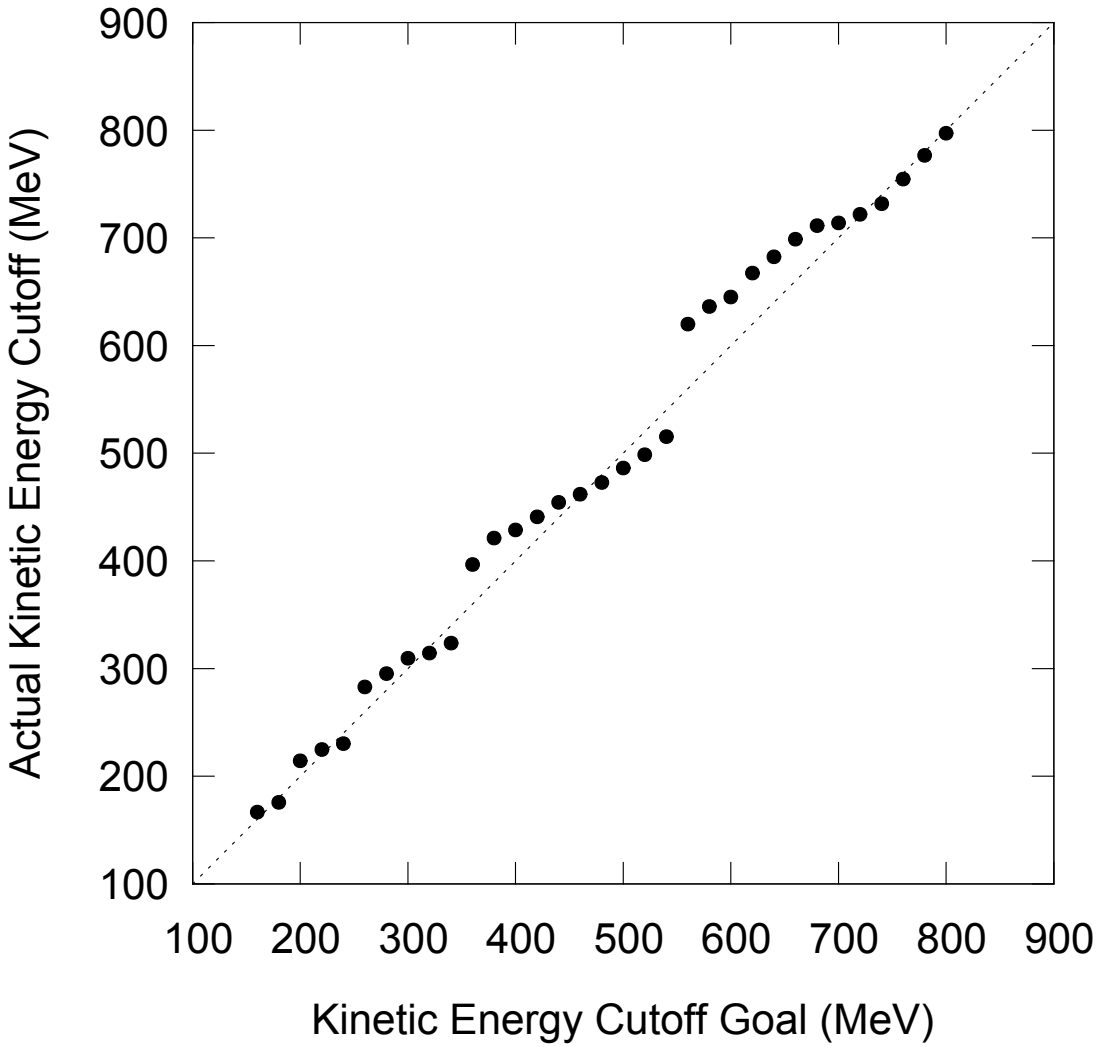
Optimal Chicane Designs

- Use formula to produce designs for various proton energy cutoffs
- Achieve good transmissions
- Actual cutoff sometimes differs from predictions
  - Missing bands of actual cutoff
  - Likely related to Larmor rotation
  - Could change curvature continuously
  - Add chicane apertures that follow muon beam

Muon Transmission vs. Cutoff



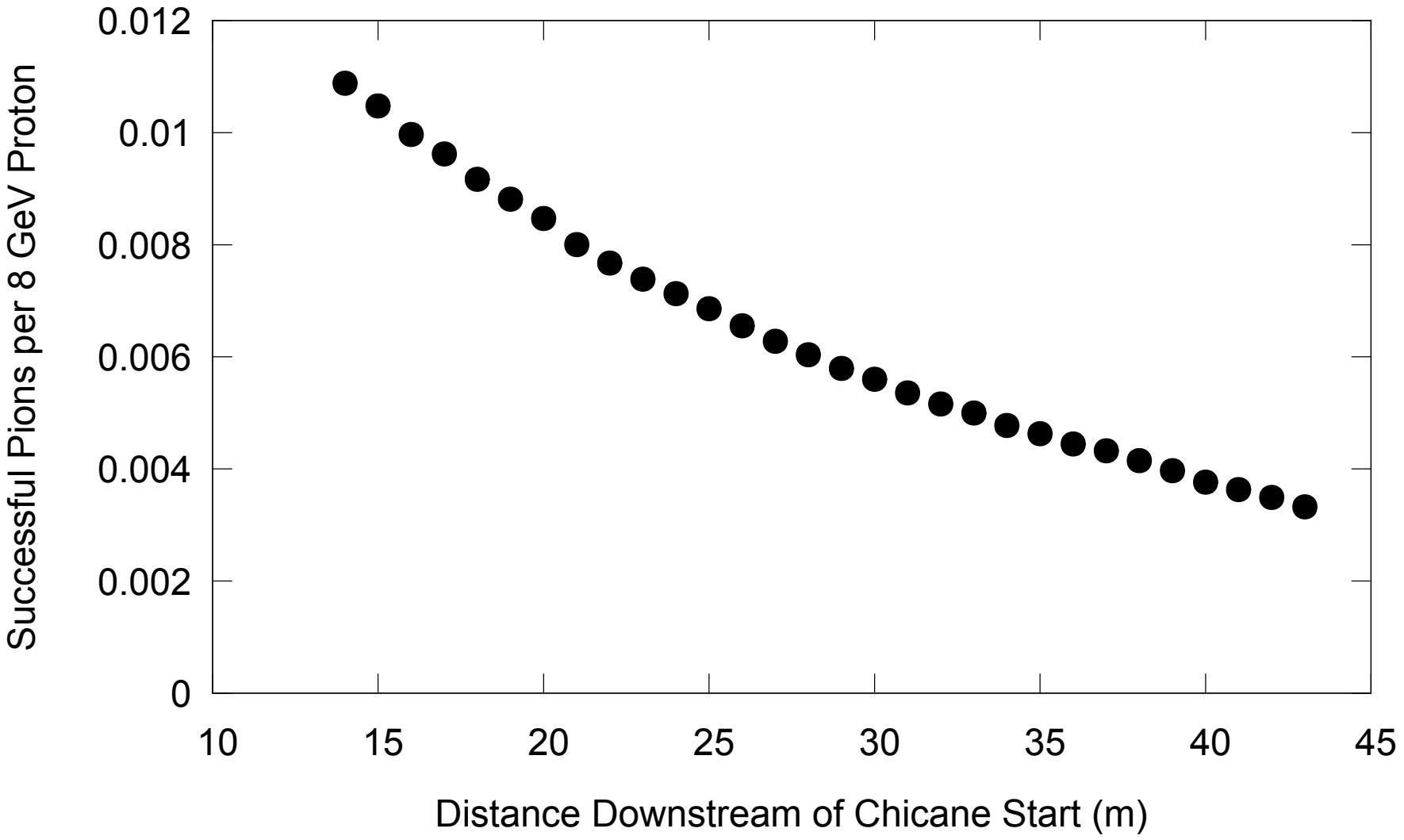
Predicted vs. Acutal Cutoff



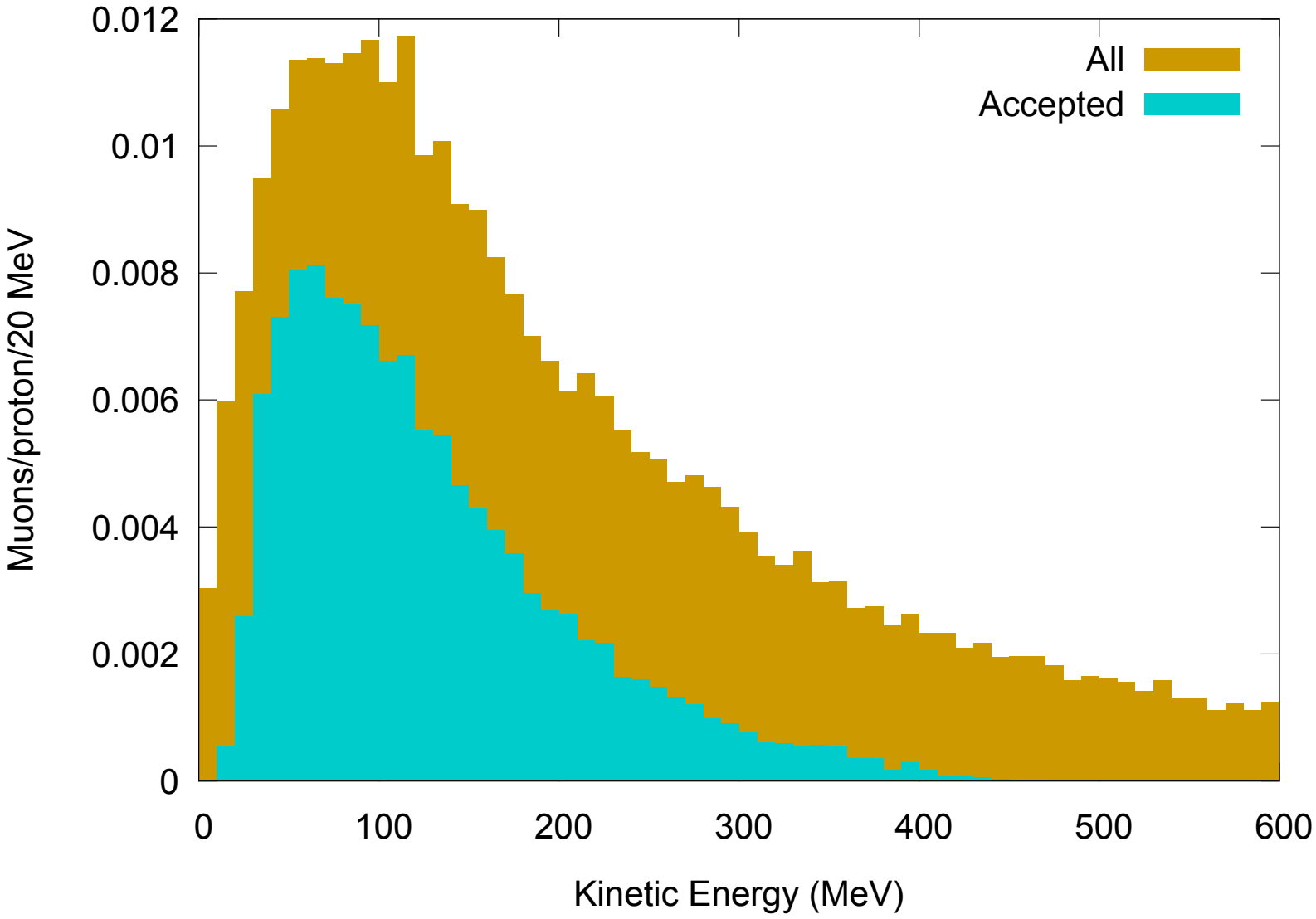
Add the Absorber

- 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
  - Good actual cutoff relative to predicted

Pions vs. Position



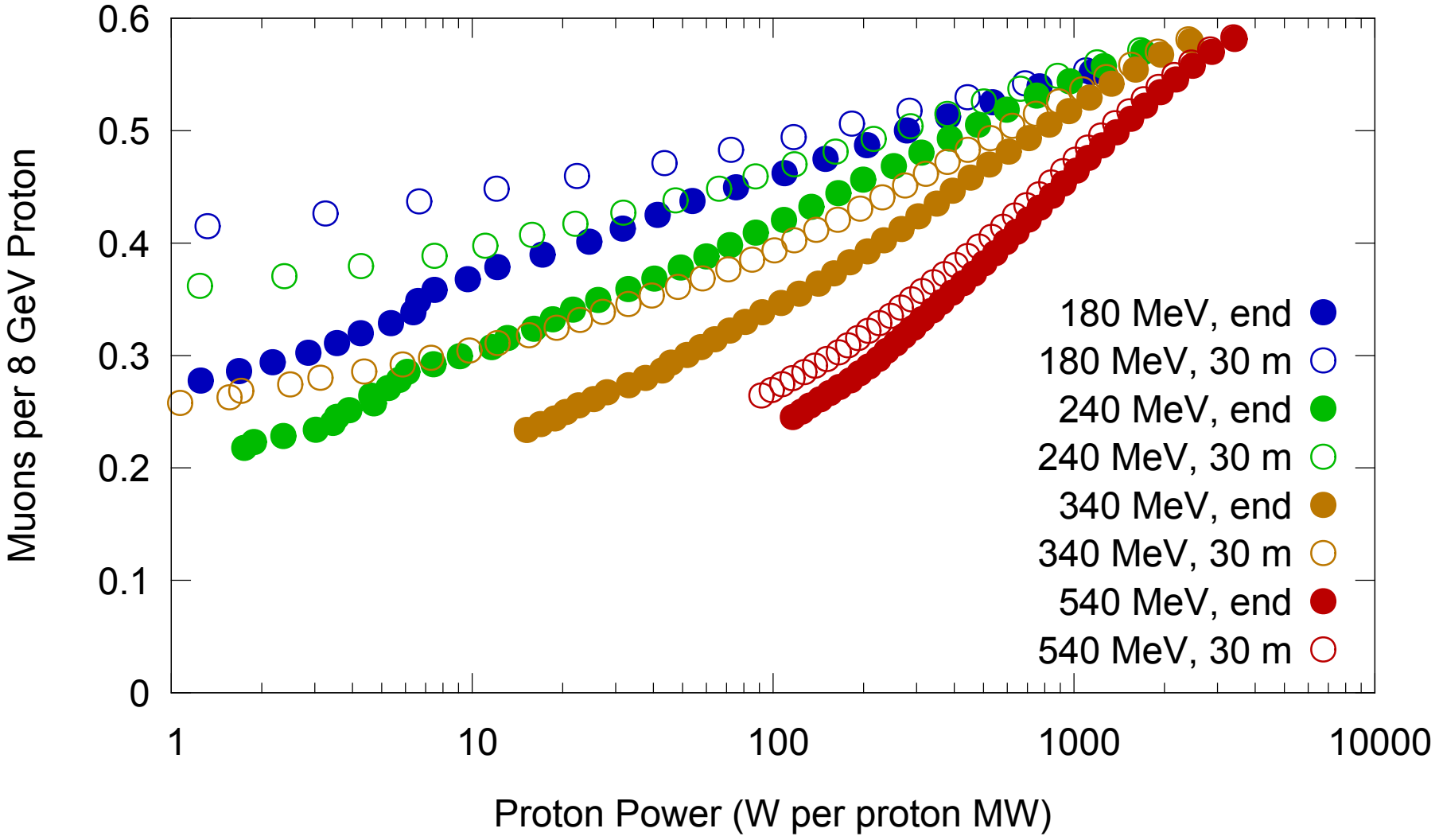
Muon Spectrum Post Absorber



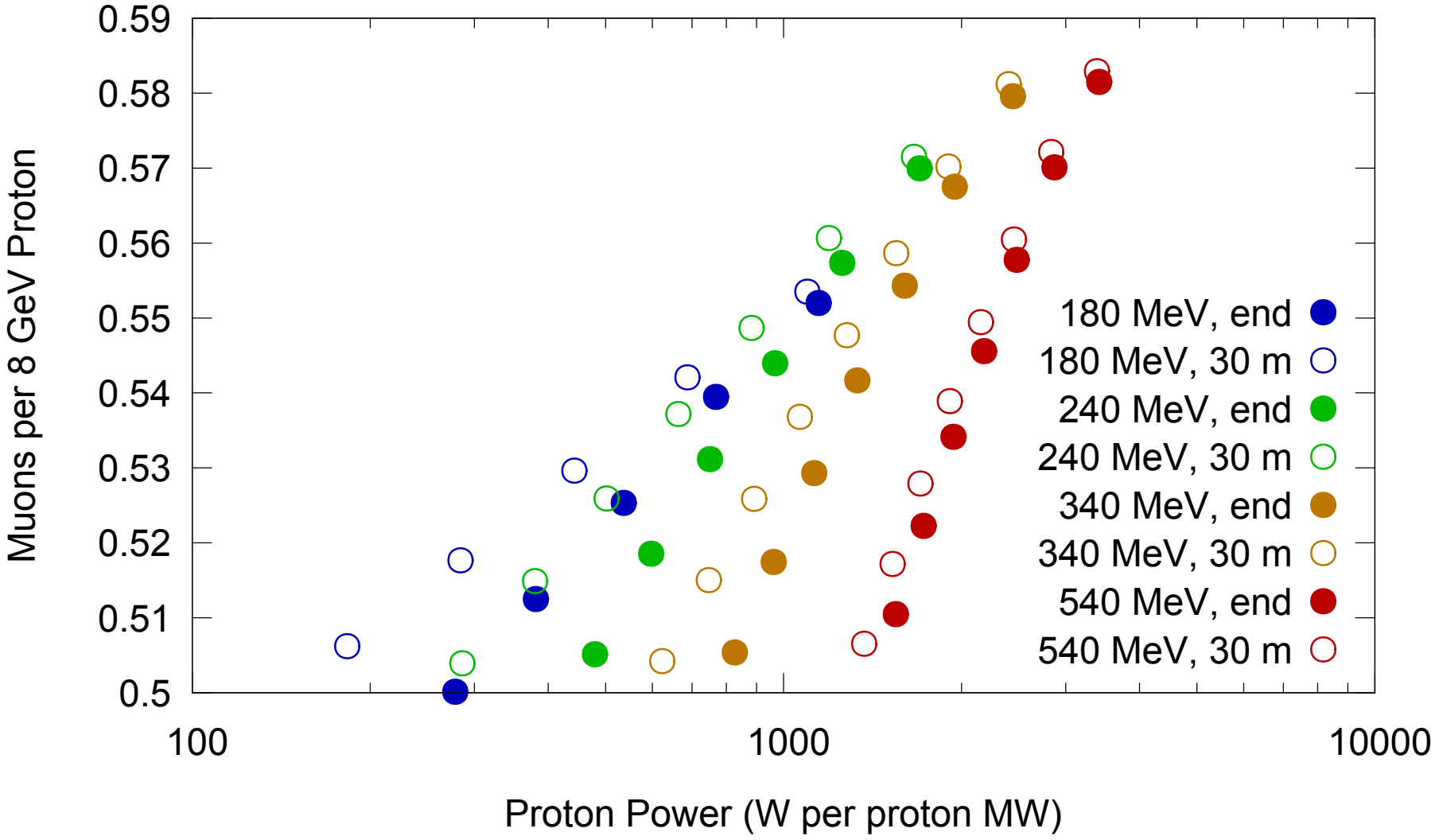
Analysis

- Look at muons vs. proton power
- Favor aggressive chicane
  - Unless you allow a lot of power downstream
- Poor transmission to get to decent 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 proton power
- High energy muons overweighted
  - Effective muon loss even higher
  - Aggressive chicane 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
- Aggressive chicane is generally preferred

Next Steps

- Add chicane apertures that track muon beam size
- Energy weighting of muon transmission
- Scan parameters with aggressive chicane in more detail
- Pass to ICOOL to optimize NBPR
- Discuss acceptable energy deposition
  - Find distribution of energy deposition downstream
- Pick best solution, global optimize in G4beamline
- Repeat for different chicane fields