Matching into EMMA

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EMMA Design Review
26 February 2007

Basic Machine Parameters

- Single (?) electron bunch
- Accelerate from 10 to 20 MeV
- Inject beam anywhere in that range
  - Commissioning
  - Initial fixed-energy runs
  - Exploring individual resonances
- Charge
  - Smaller is better: space charge, beam loading
  - Need enough charge for diagnostics
- Beam size
  - Beam much smaller than acceptance: paint to probe acceptance
  - Larger beam is helpful for space charge

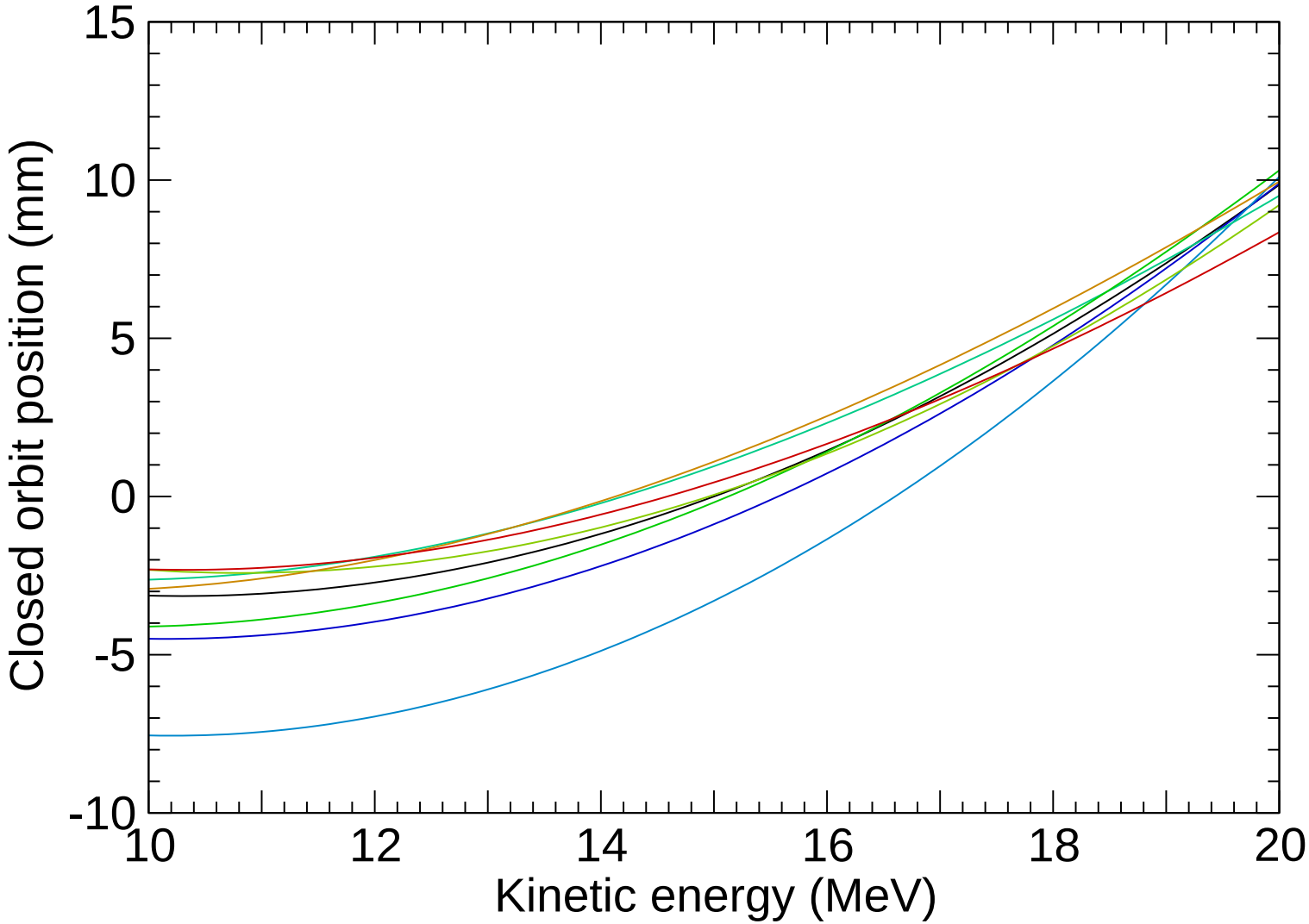
Painting Phase Space

- We have a probe that is much smaller than the acceptance
- Commissioning
  - Run at fixed energy
  - Watch for closed orbit oscillations
- Definition of normalized acceptance (3 mm)
  - If a is beam half size in whatever direction that gets transmitted
  - Normalized acceptance is $a^2 p/(\beta_\perp mc)$
  - p is momentum, $\beta_\perp$ is Courant-Snyder beta, m is mass, c is speed of light
  - We paint everywhere that falls within the ellipse which has half-width less than a

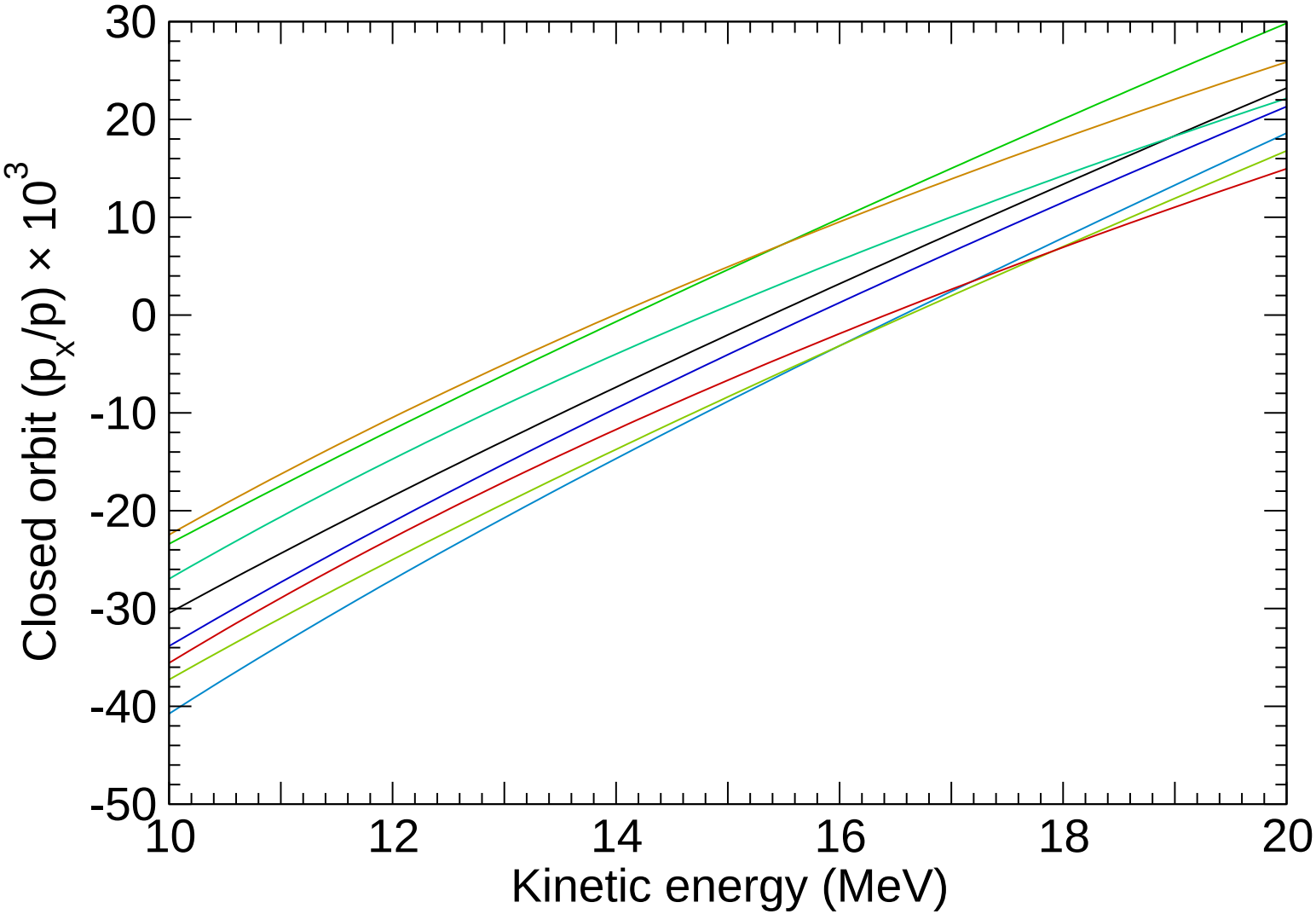
Lattice Parameters for EMMA

- Information at the center of the long drift
- I've tried to put things in the "usual" form
- Everything as a function of energy
- Everything for each of the 8 configurations I've specified
- Ideally the probe should be matched
  - Otherwise the probe itself blows up!
  - A mismatch may not be too painful
    - Same argument says a small space charge blowup is harmless, assuming the space charge has negligible effect on lattice functions
- Ideally, able to inject over full acceptance
  - Requires both position and angular control
  - How to create vertical amplitude (position and angular)?

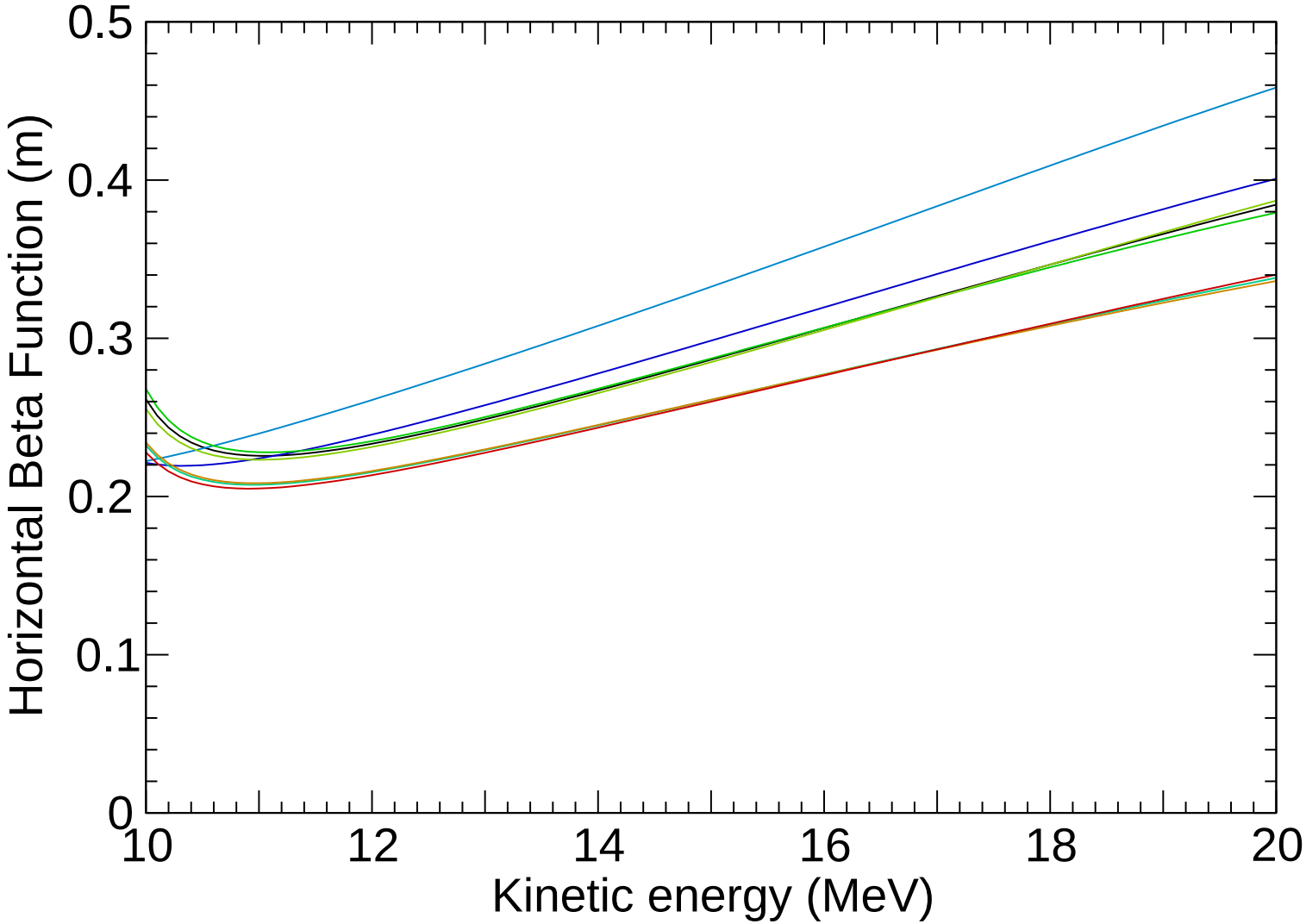
Closed Orbit Position



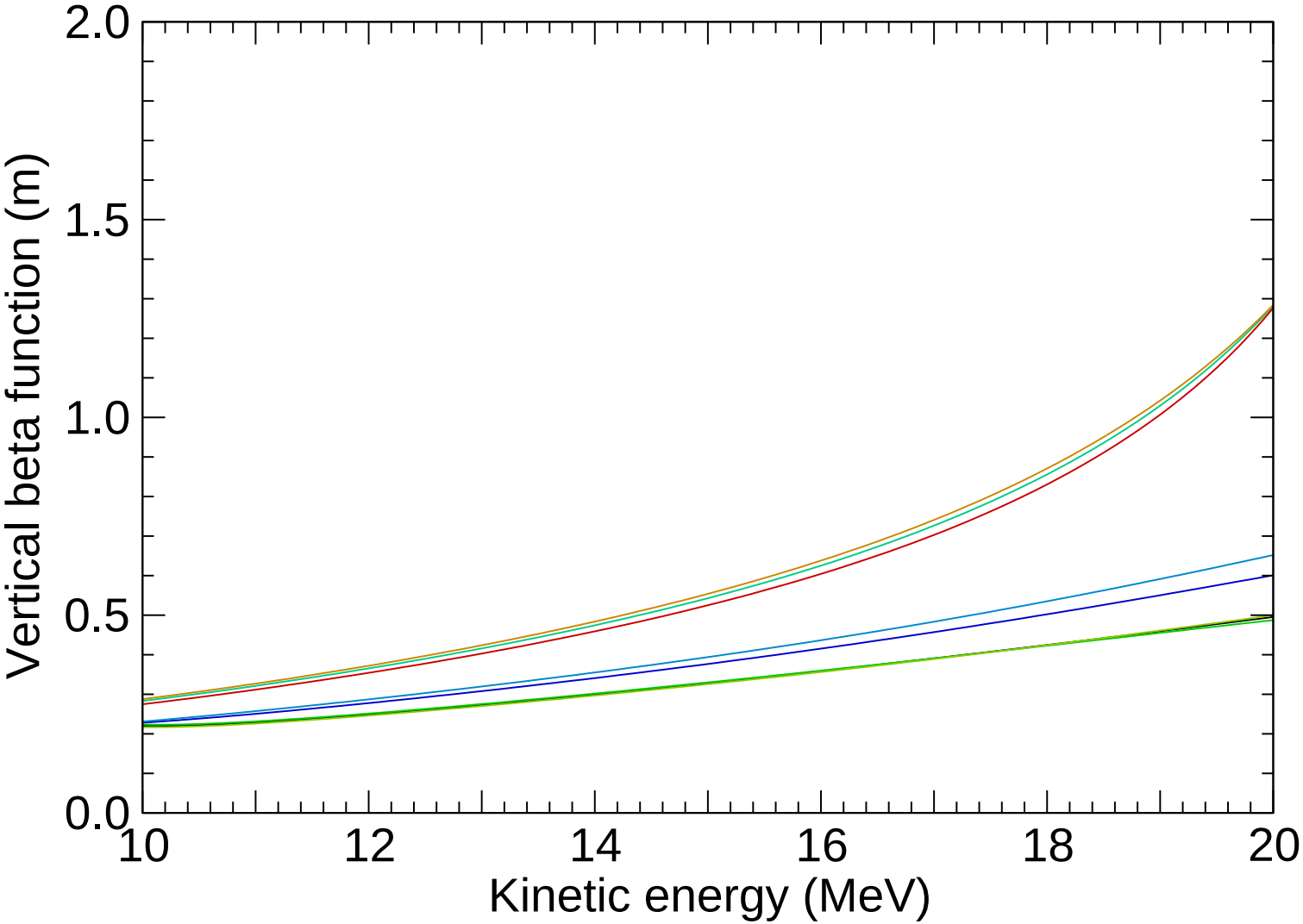
Closed Orbit Horizontal Momentum



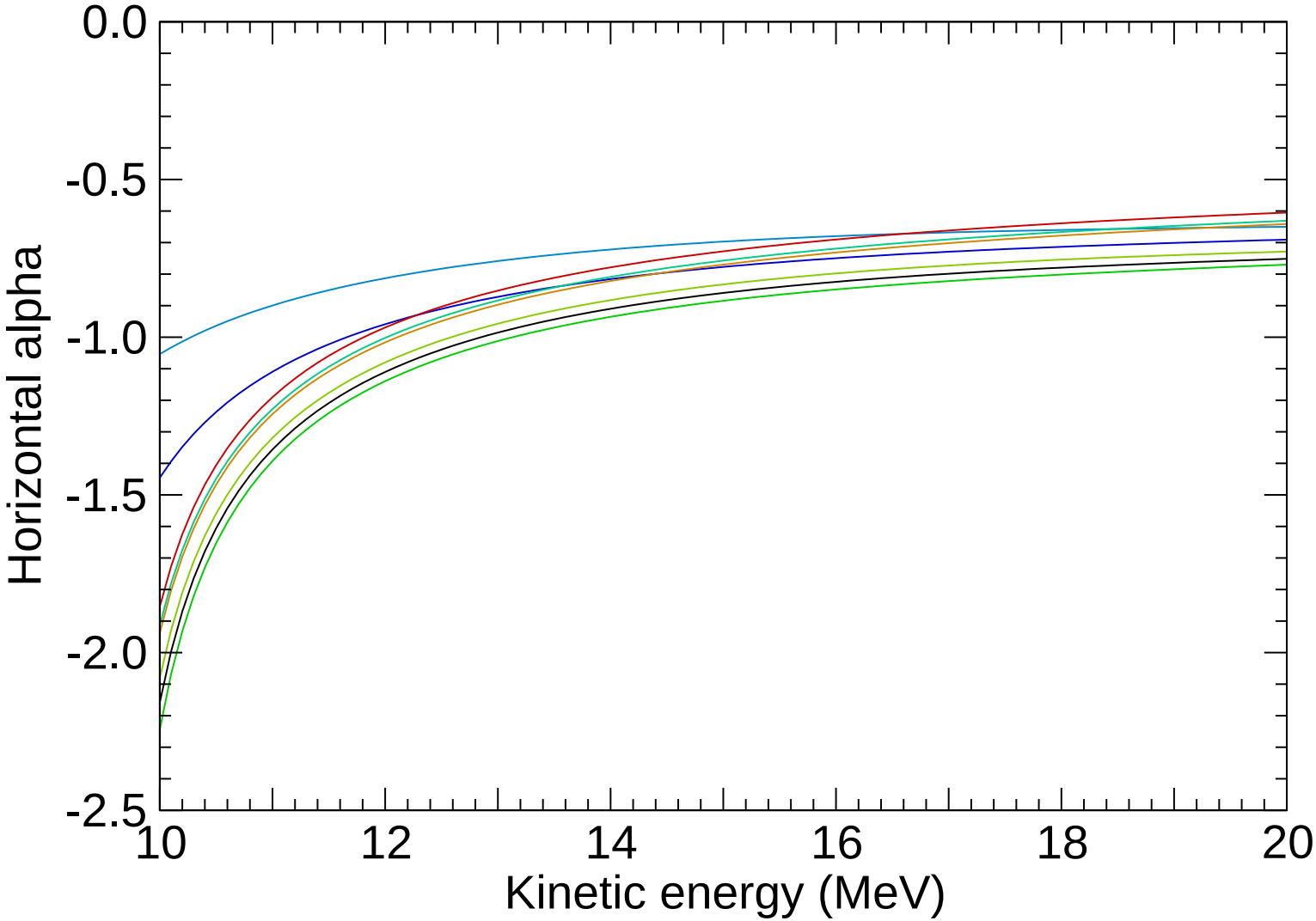
Horizontal Beta Function



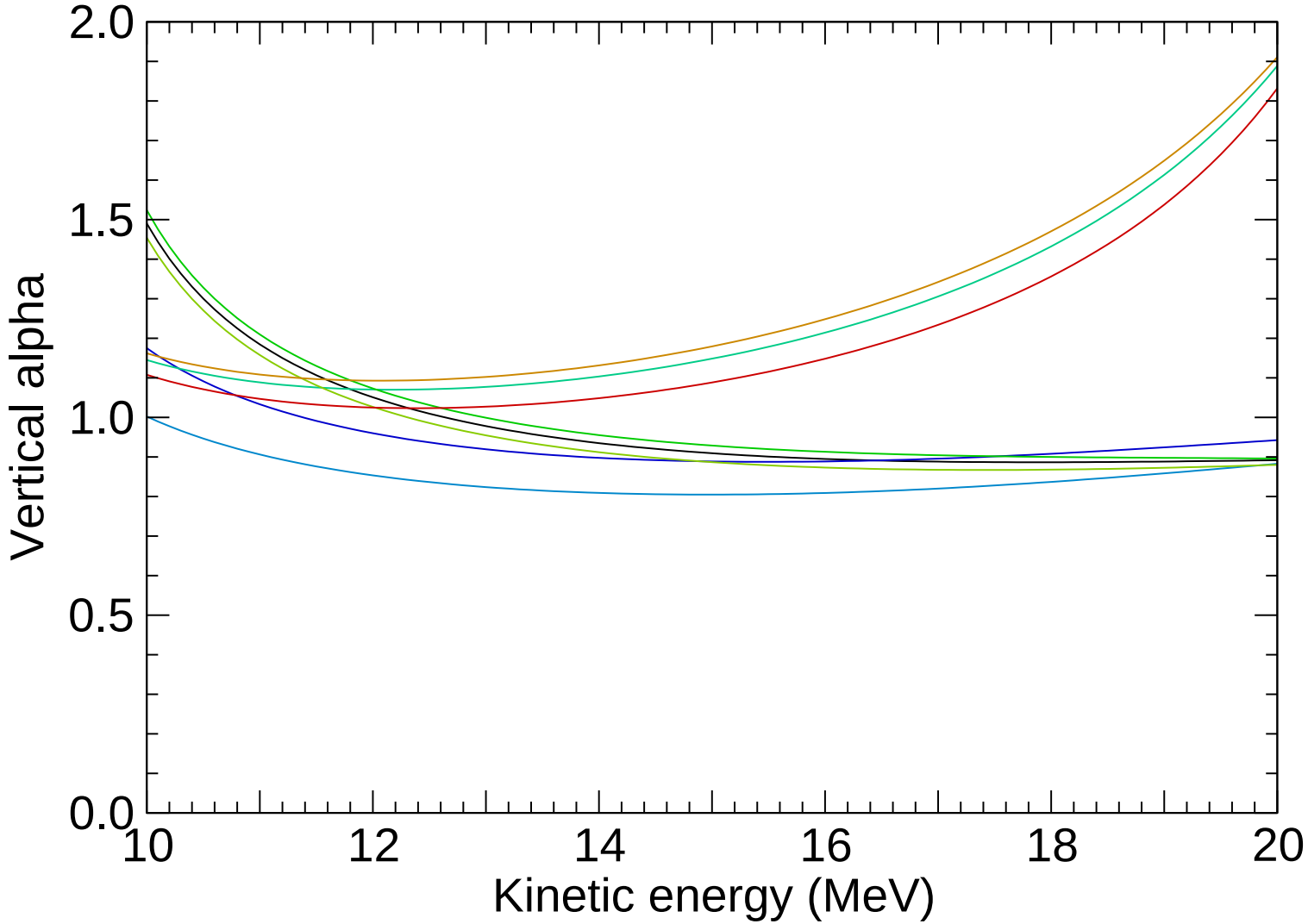
Vertical Beta Function



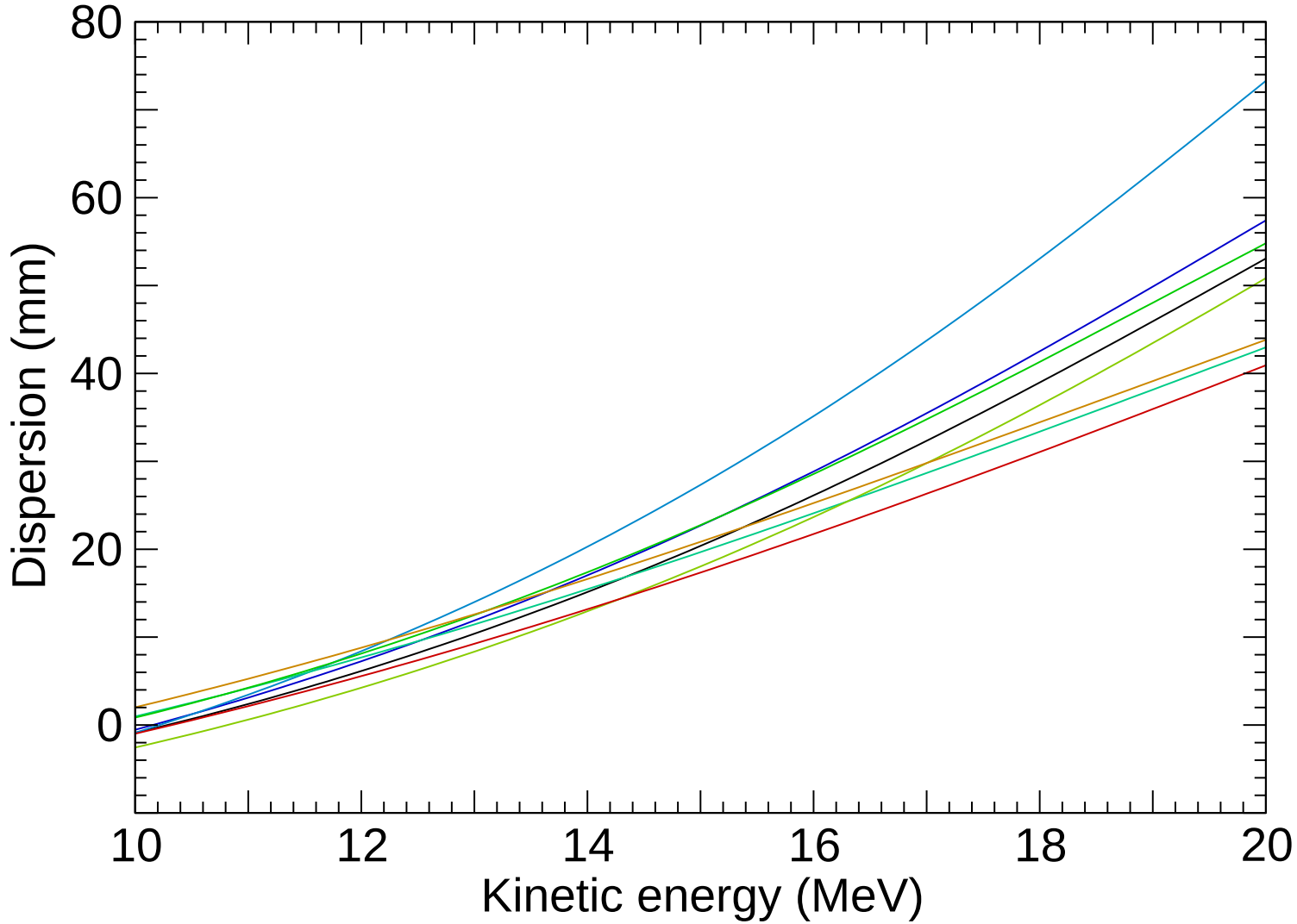
Horizontal Alpha Function



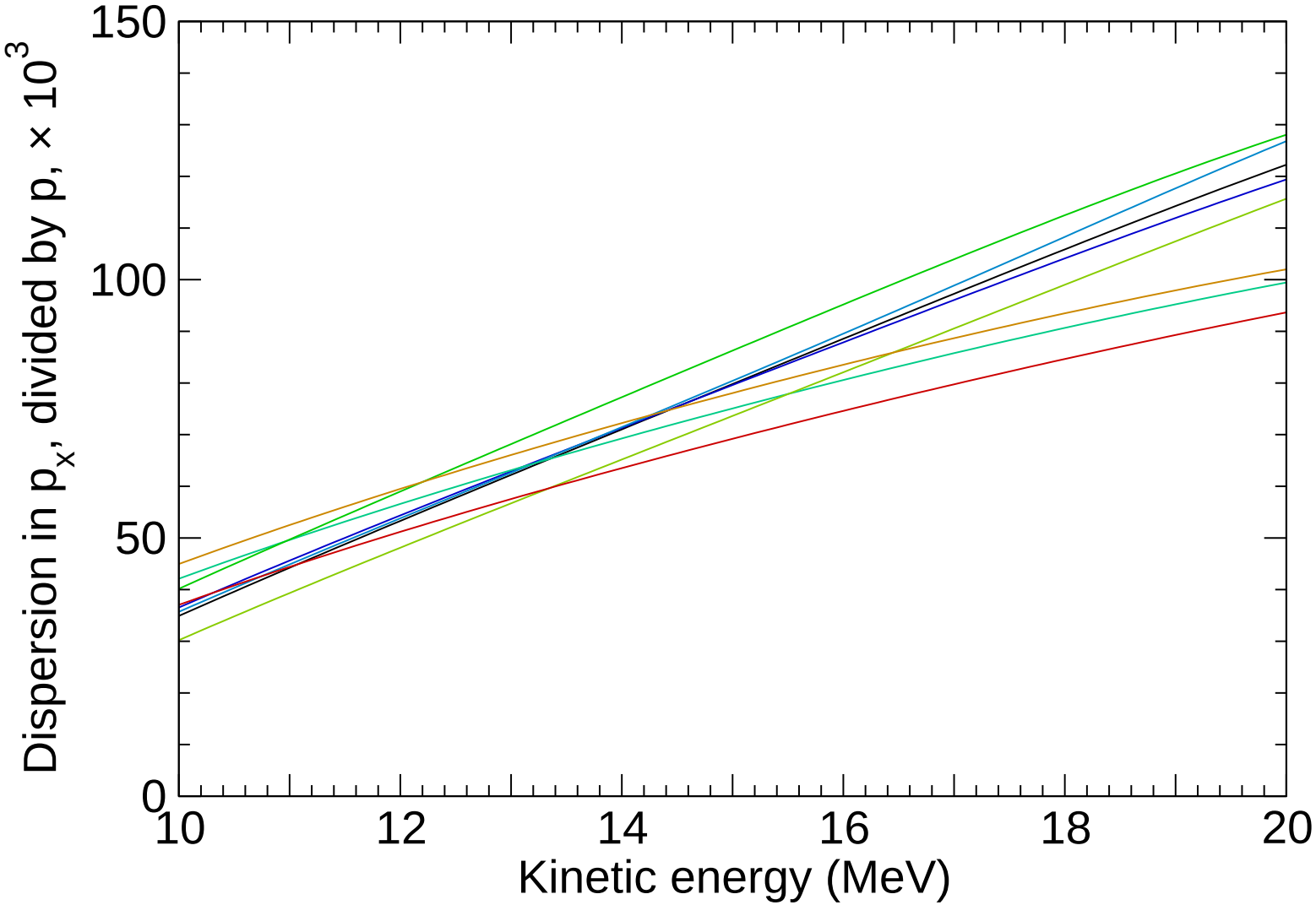
Vertical Alpha Function



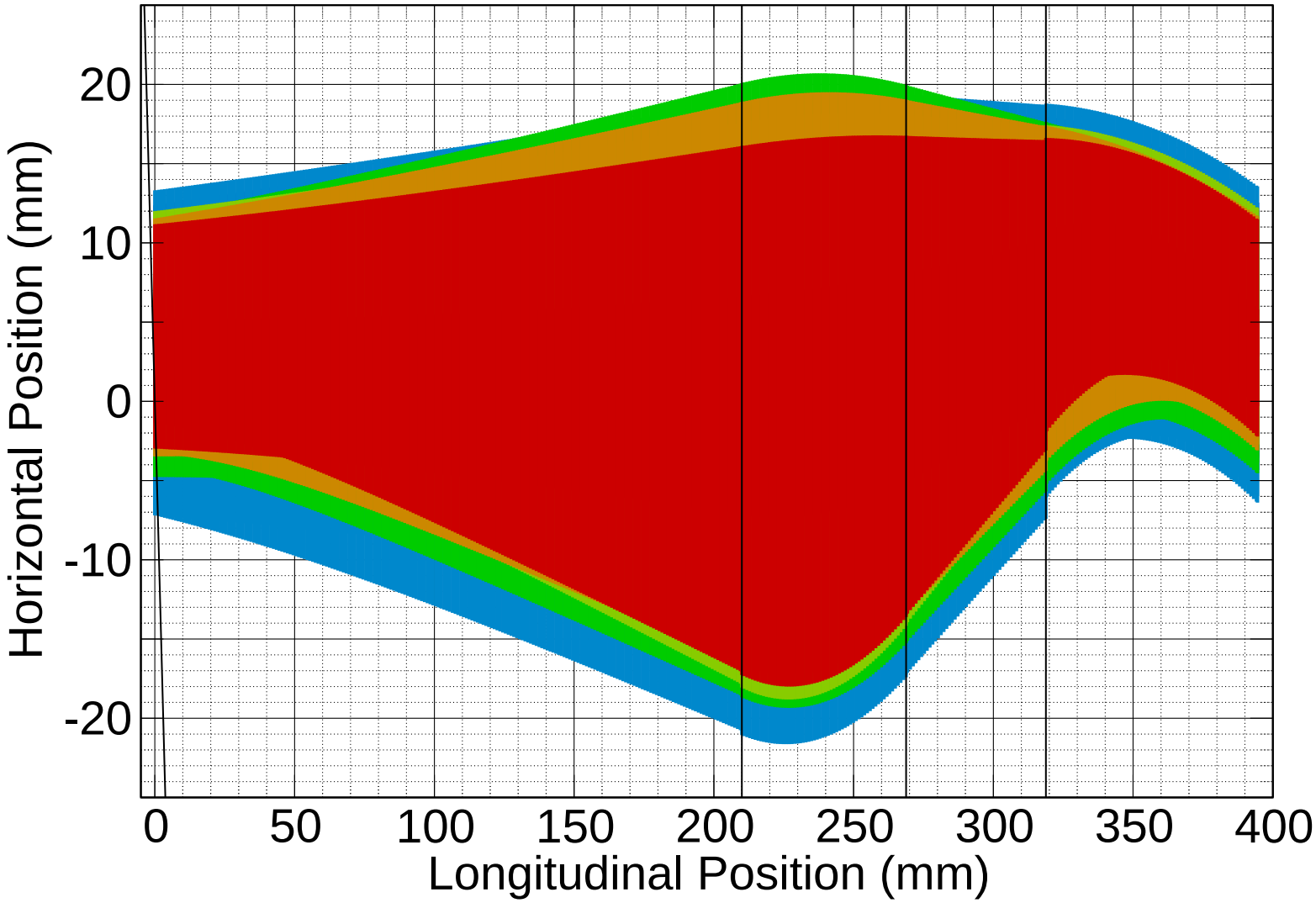
Dispersion



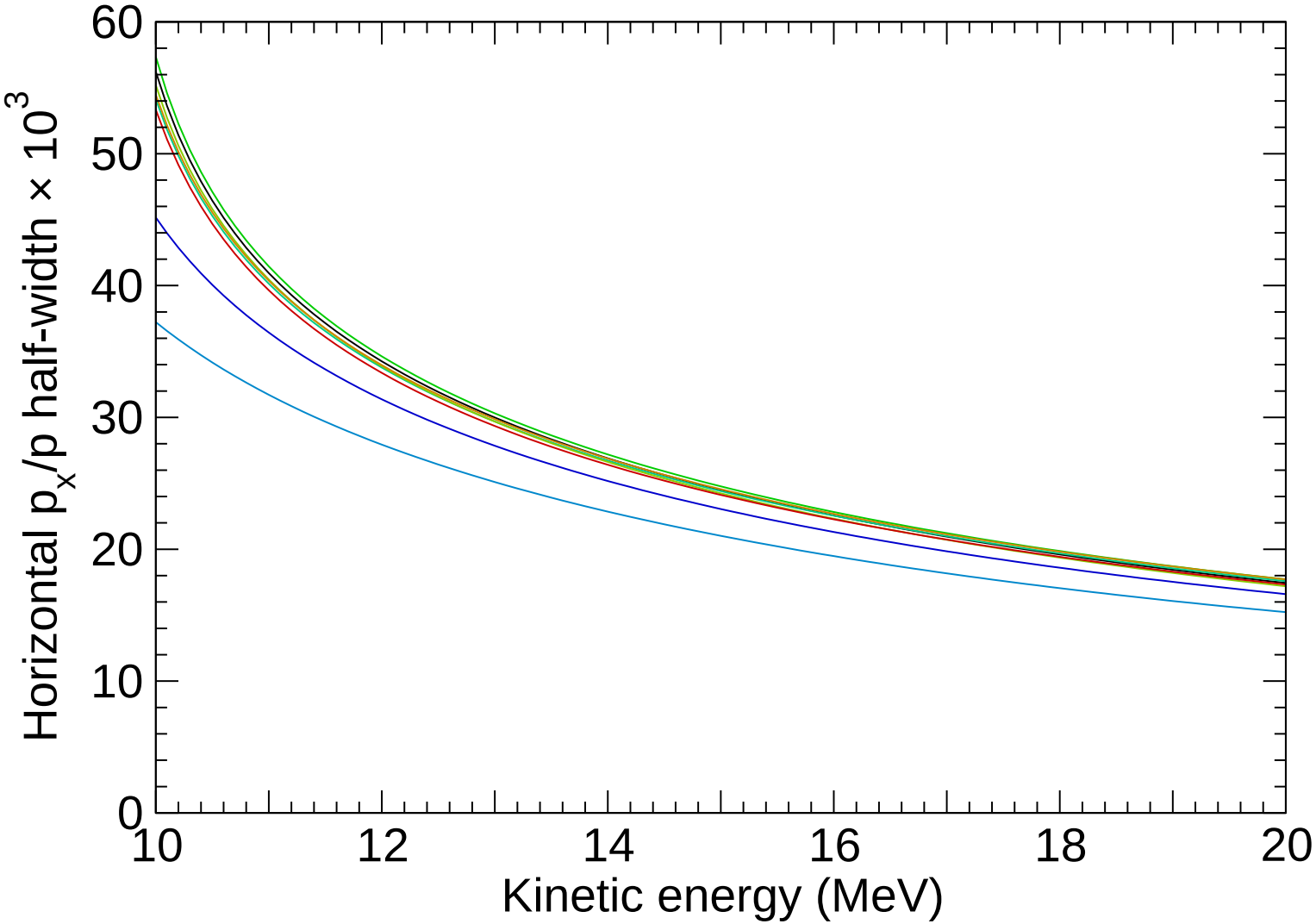
Momentum Dispersion



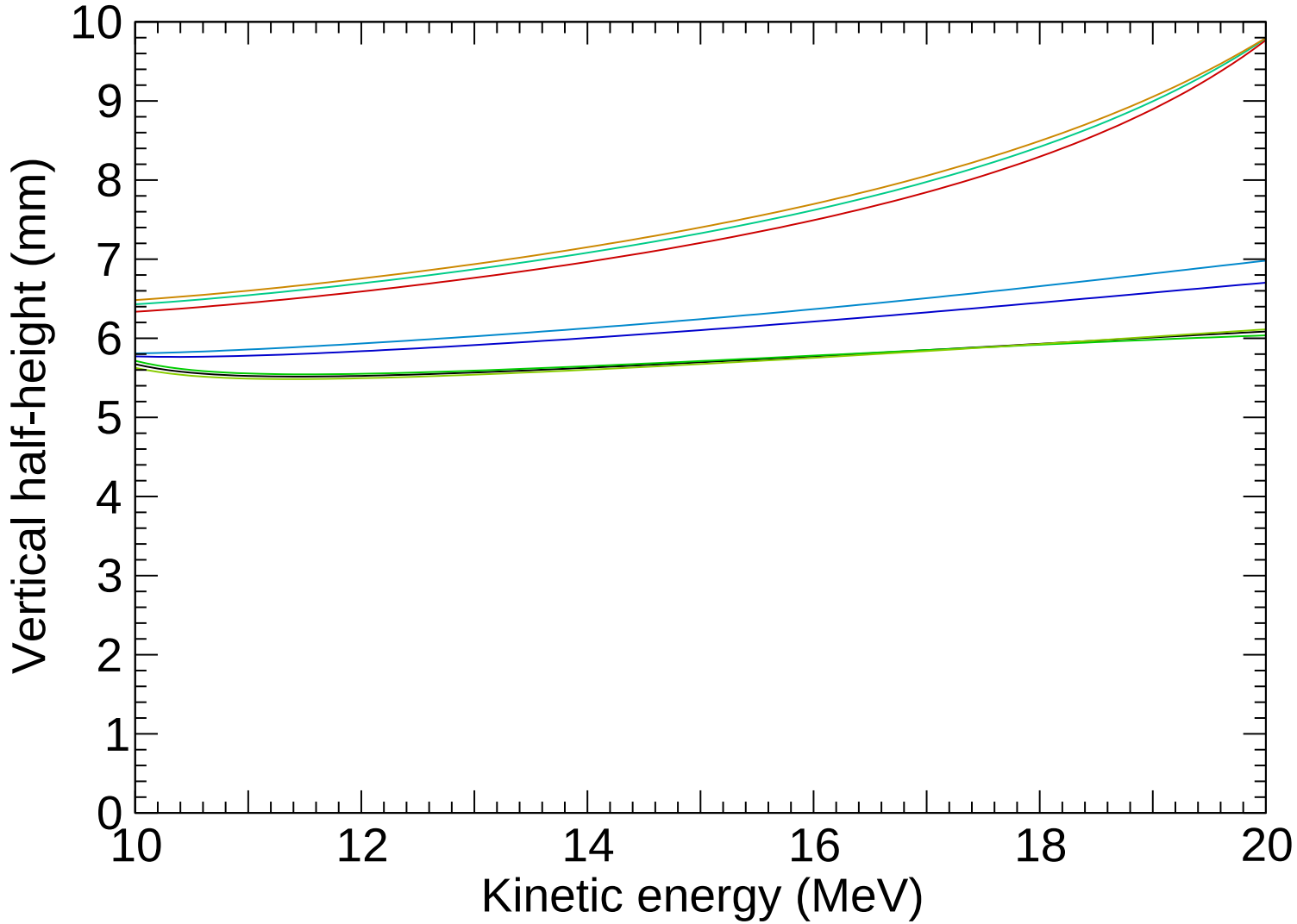
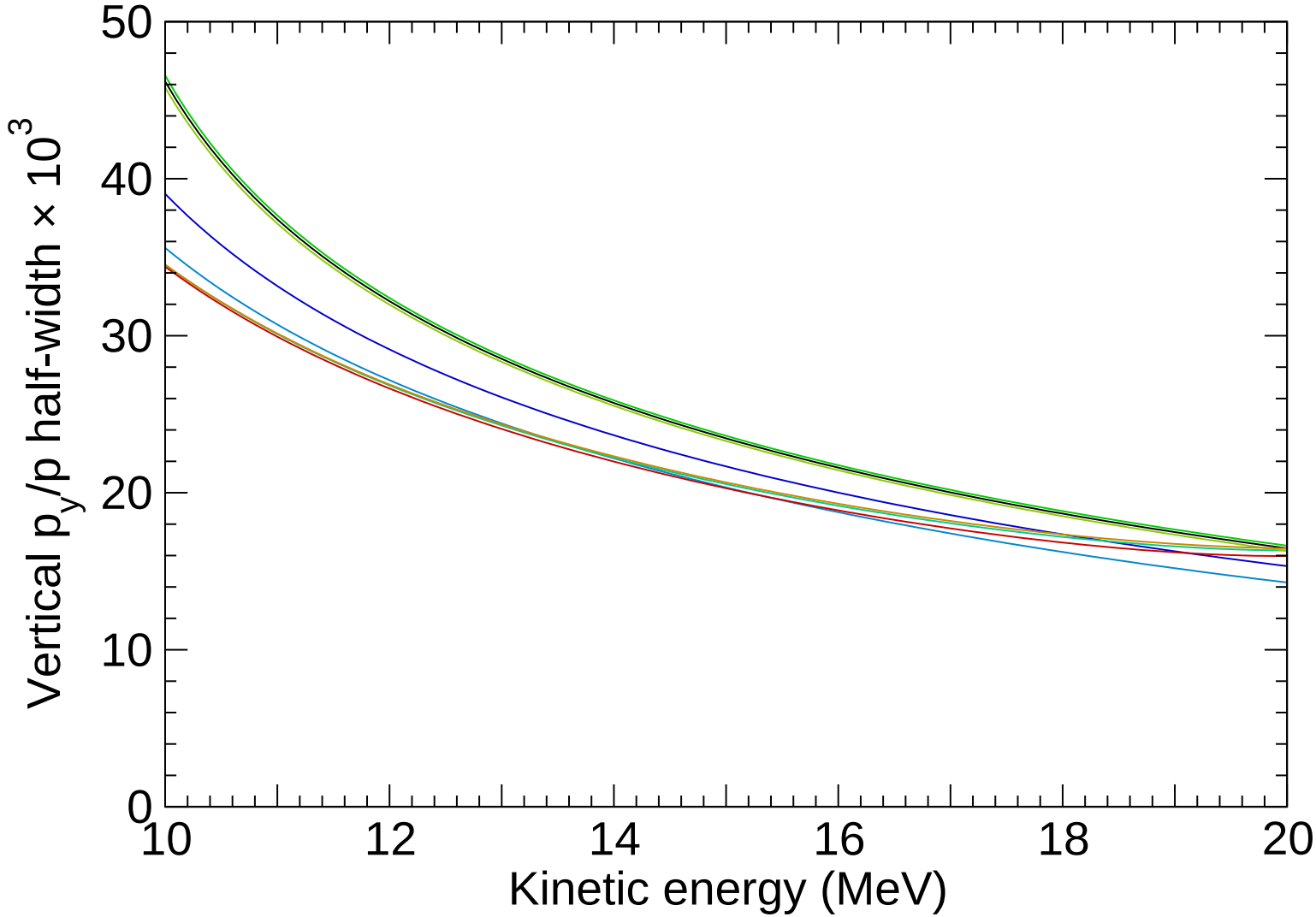
Horizontal Beam Footprint



Horizontal Angular Size



Vertical Size



Vertical Angular Size