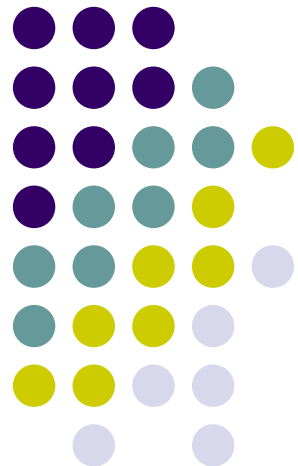
Hall C Compton Polarimeter Update

Dave Gaskell

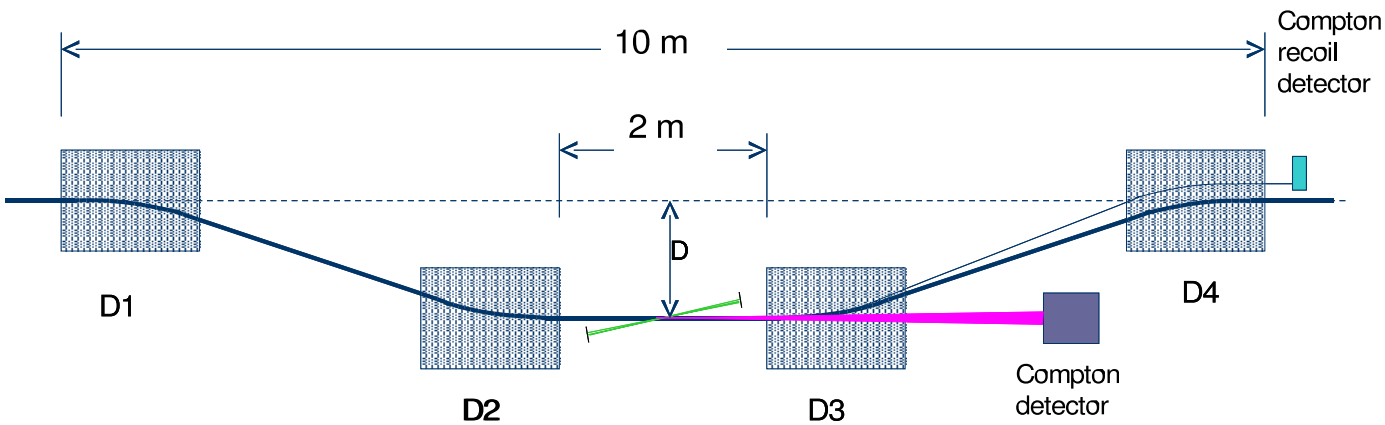
Hall C Meeting

January 26, 2007



Compton Polarimeter Overview

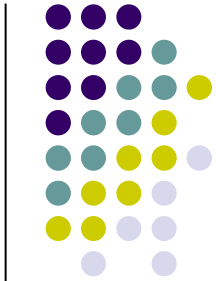
- Compton polarimeter required to make continuous beam polarization measurements at same time as data-taking
- Provides cross-check of Hall C Møller, although (initially) the precision will likely be worse
- Requires the insertion of a 10-11 m dipole chicane in the Hall C beam line



Compton Subsystems

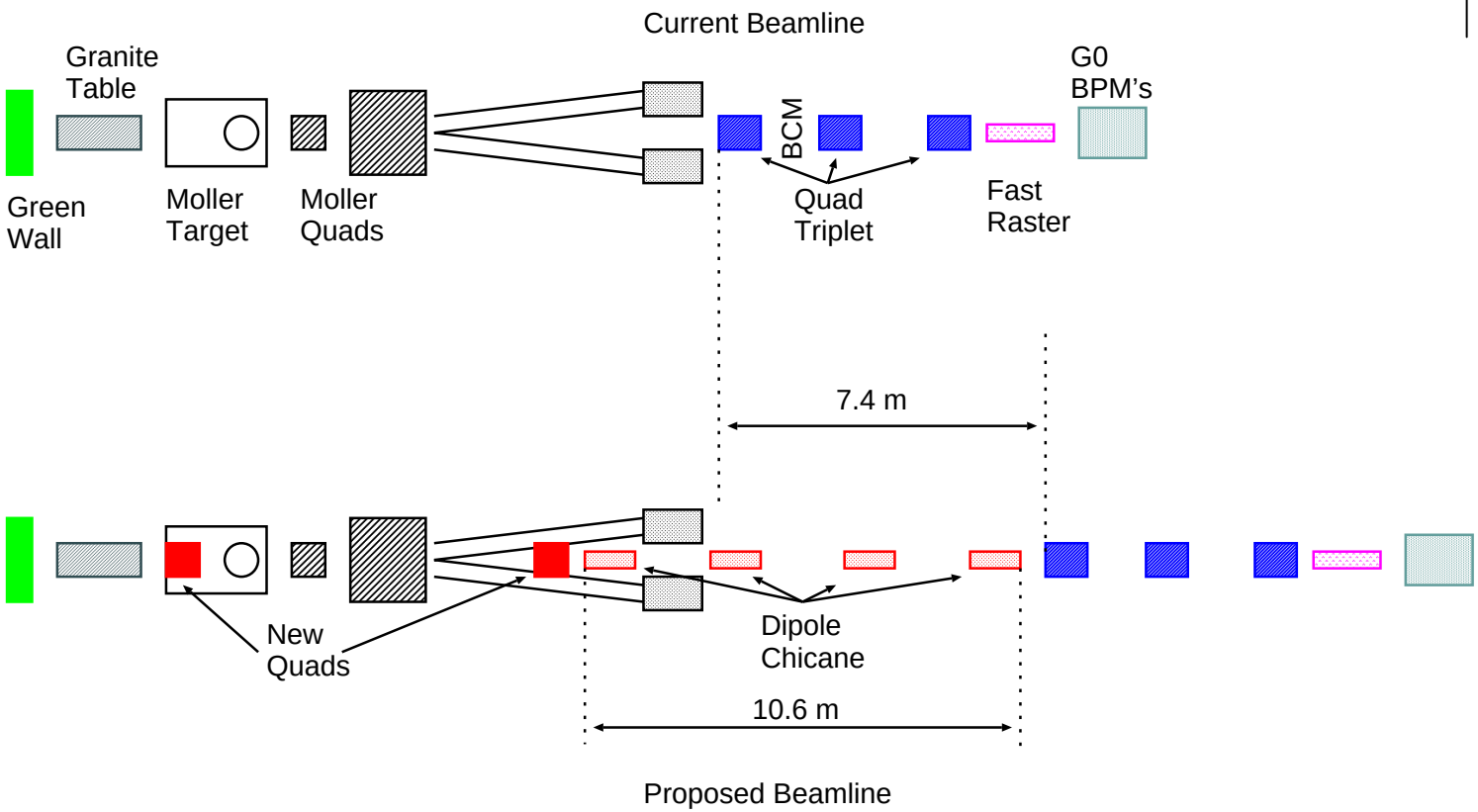
- Laser + optics
  - Present concept uses high power (90 W) pulsed green laser
  - Requires energy-weighted counting, but has the advantage of reducing background
- Photon detector
  - Prototype lead tungstate detector built by Yerevan
  - Photon beam tests being pursued
- Electron detector
  - “Diamond strip” detector proposed by Miss. State and Winnipeg
  - Funding sought from NSF and NSERC as combined project
- Chicane -> see the rest of this talk

Compton Chicane and Beamline Layout Constraints



- Compton requires insertion of 10-11 m dipole chicane
- Hall C Beamline must be overhauled
- Constraints/Requirements
  - Fast raster must be at least 14.5 m from the Hall C pivot
  - No quadrupoles between raster and target
  - Polarized target chicane still useable
  - Compton must work for Q_{Weak} (1.165 GeV) AND at 11 GeV
  - Compton must accommodate coincidence electron+photon detection

(Old) Beam Line Modification Scheme

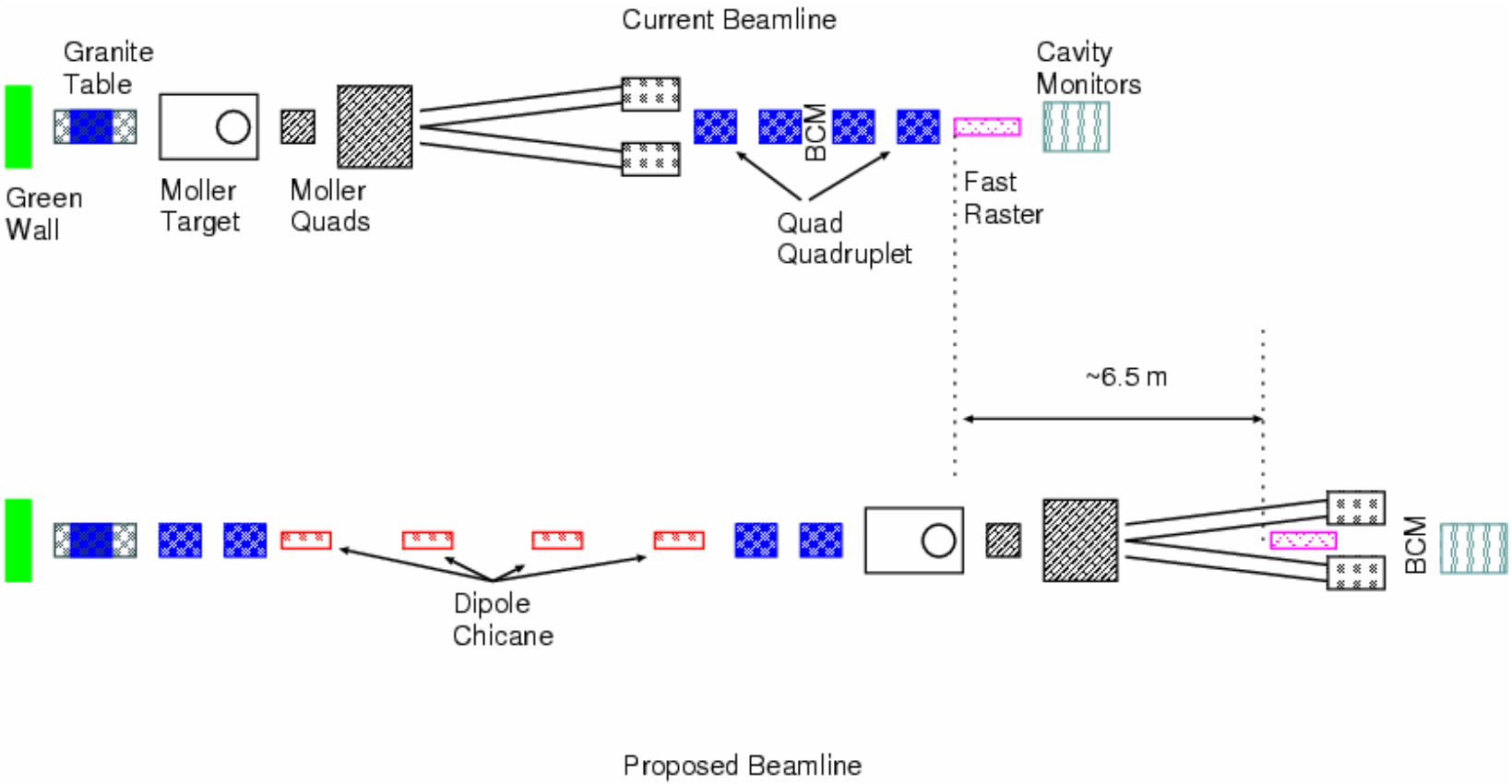


- Initial concept (2002-2006) saved space by placing 1 new quad and 1 dipole between Møller legs
- Everything downstream of the Møller moved closer to the pivot by ~ 7.5 m

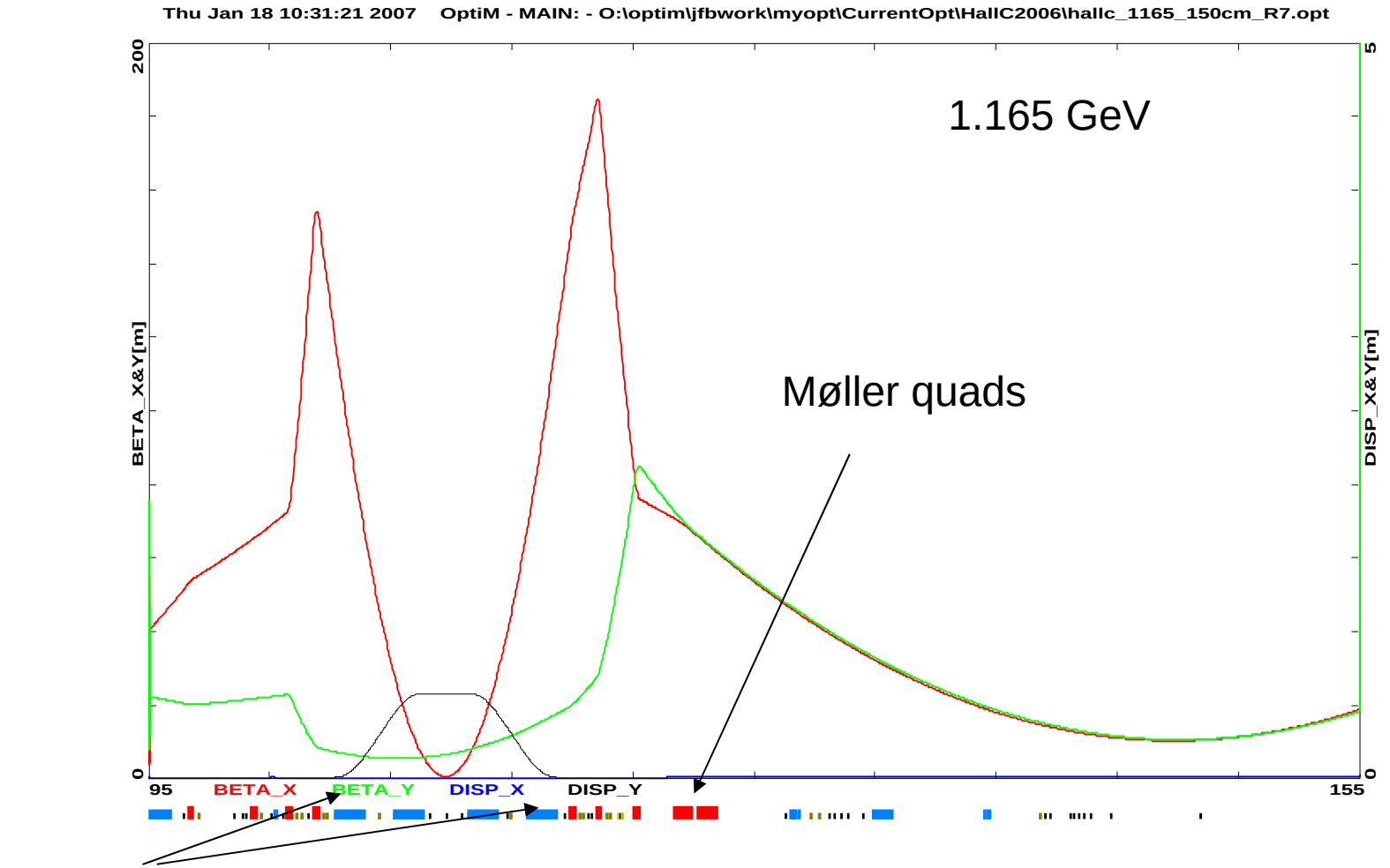
Compton 2006

- Memorandum of Understanding (MOU) with MIT-Bates approved by both institutions in July 2006
  - MIT-Bates will do the detailed design of the Compton polarimeter dipoles and arrange for fabrication
- Subsequent meeting with JLab Engineering suggests that we re-evaluate the beam line concept
- Jay Benesch came to a few quick conclusions
  - Not enough space for needed extra quads if Møller precedes Compton
  - Møller after Compton OK if we make some compromises
- Jay will present his new concept at the Q_{Weak} collaboration meeting next week

Cartoon of New Layout



Optics with New Layout

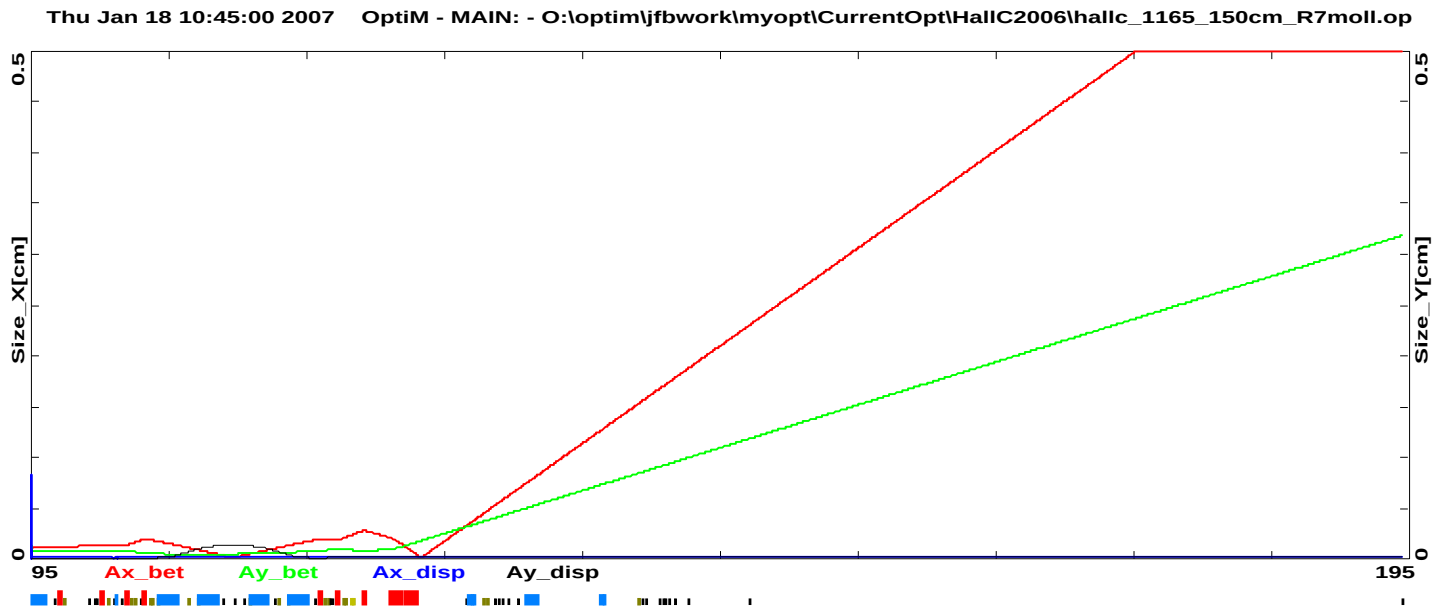


New Features

- Dipoles length may be increased to1.5 m keep fields low (~ 1T for 11 GeV running)
  - 1m dipoles would require ~1.4 T, introducing higher multipoles
- Møller quads are now part of the beamline
  - A quadruplet before the chicane is used to prepare the beam for the Compton (3C16, 3C17, 3C18, 3C19)
  - Another quadruplet is required after the Compton to prepare the beam for the target (3C20, 3C21, MQ1, MQ2)
- No “combined optics”
  - Moller quads cannot be at measurement values while beam is on target
- Allowed combinations:
  - Compton + target
  - Compton + Møller (high current questionable)
- Kicker may no longer be useable at 1 GeV

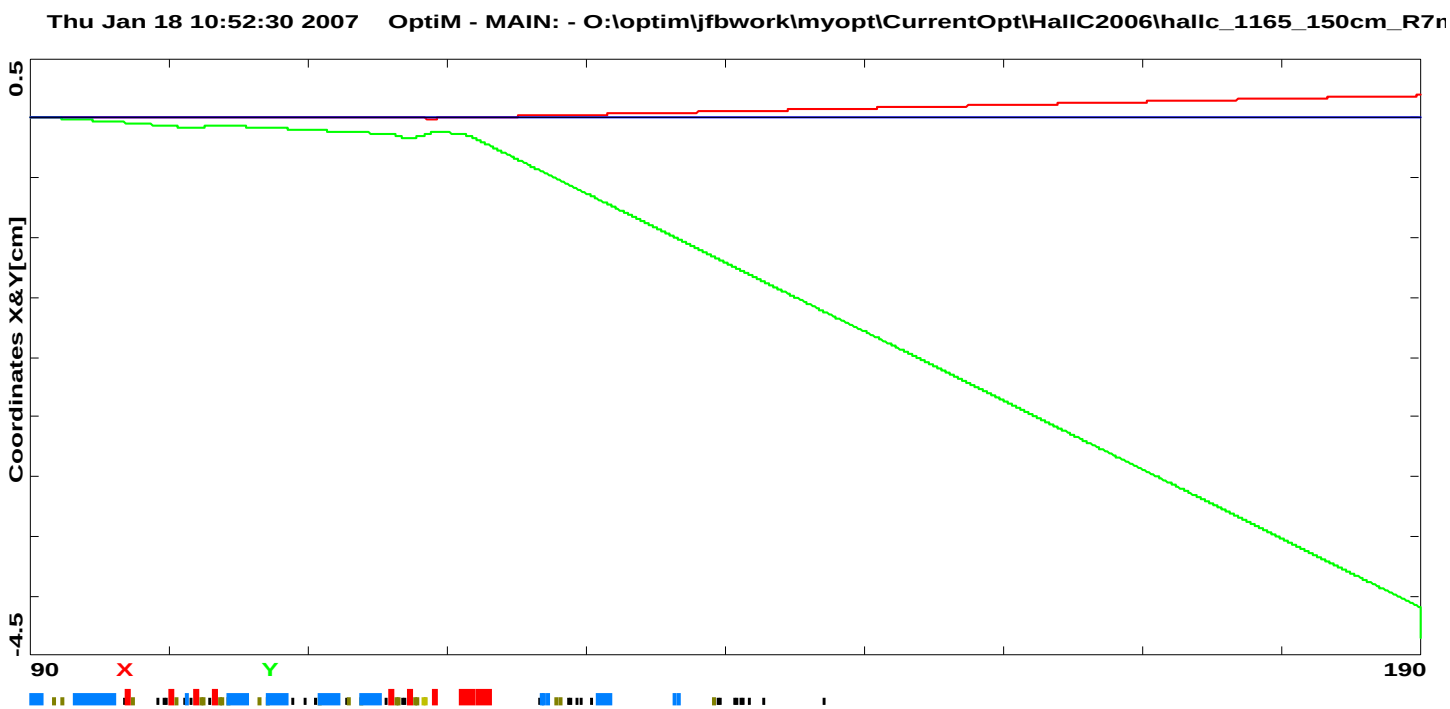
Compton + Møller

- With optics set for simultaneous Møller + Compton measurements, beam sizes get very large (sigma ~0.4 mm at raster)
- High current running may be precluded



Møller Kicker

- Kicker results in huge excursions at beam dump
- 100 μA running may be excluded



Summary

- New conceptual beamline design from Jay Benesch
- Satisfies most of our requirements (space, layout, etc.)
- We will likely need to make some compromises regarding our ability to run the Møller at high currents
- Action item: 1.5m dipoles for Compton chicane ok? Need to check with MIT-Bates as MOU assumed 1m