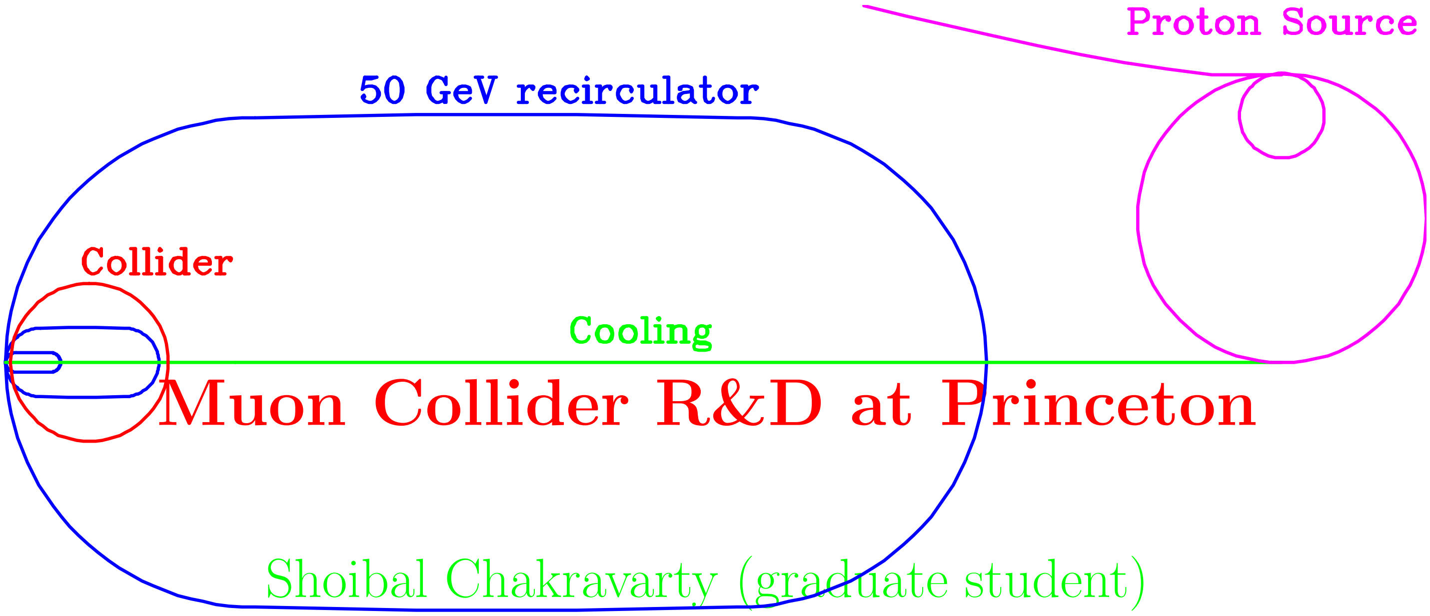


Muon Collider R&D at Princeton

Shoibal Chakravarty (graduate student)

Hulya Guler (undergraduate)

Changguo Lu

Kirk McDonald

Eric Prebys

Sven Vahsen (graduate student)

[Members of the Muon Collider Collaboration:

(Over 100 physicists from 28 institutions)]

December 4, 1998

Princeton Physics Department Advisory Council Meeting

Princeton Muon Collider page:

`http://puhep1.princeton.edu/mumu/`

What is a Muon Collider?

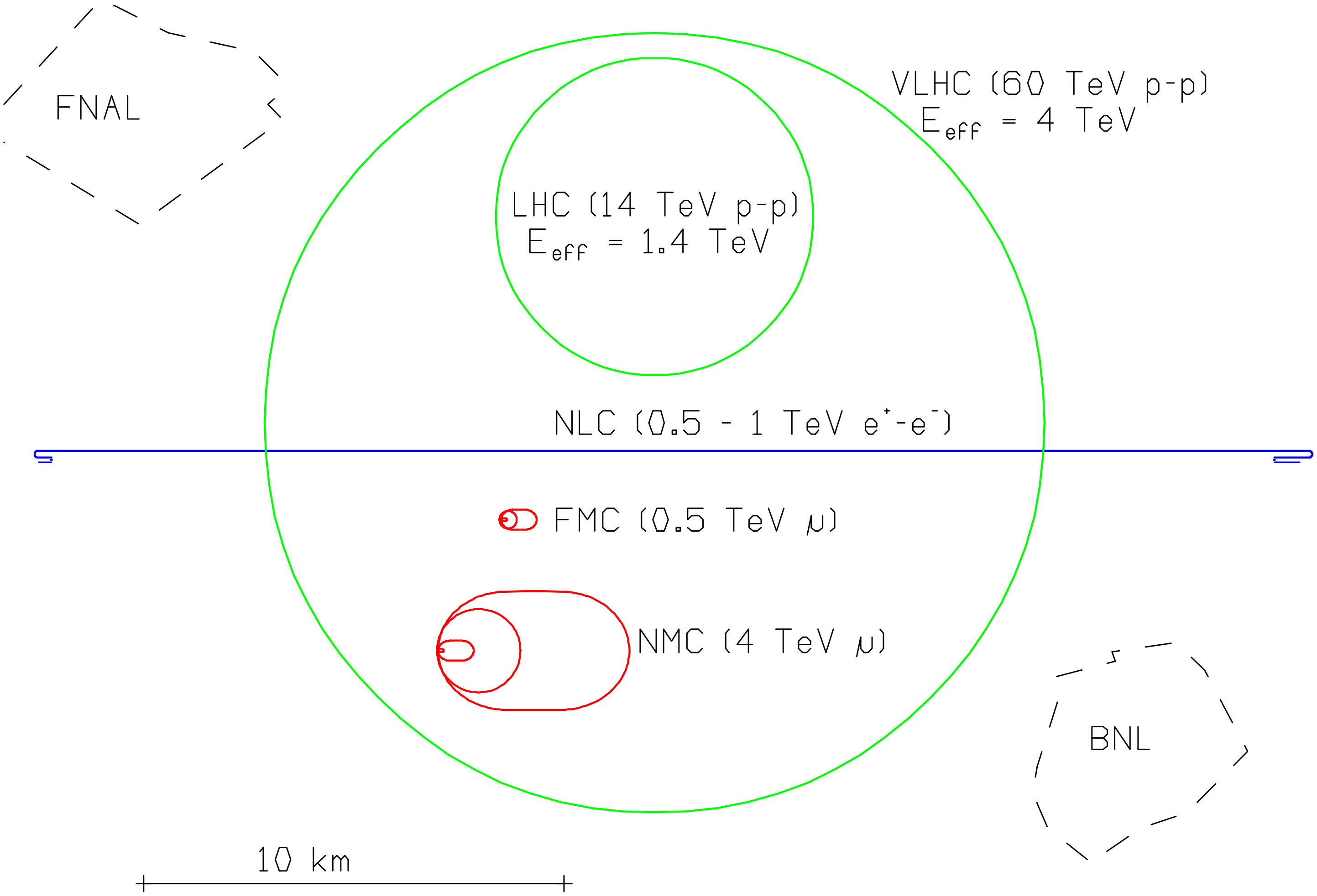
An accelerator complex in which

- Muons (both μ^+ and μ^-) are collected from pion decay following a pN interaction.
- Muon phase volume is reduced by 10^6 by ionization cooling.
- The cooled muons are accelerated and then stored in a ring.
- $\mu^+\mu^-$ collisions are observed over the useful muon life of $\approx$ 1000 turns at any energy.
- Intense neutrino beams and spallation neutron beams are available as byproducts.

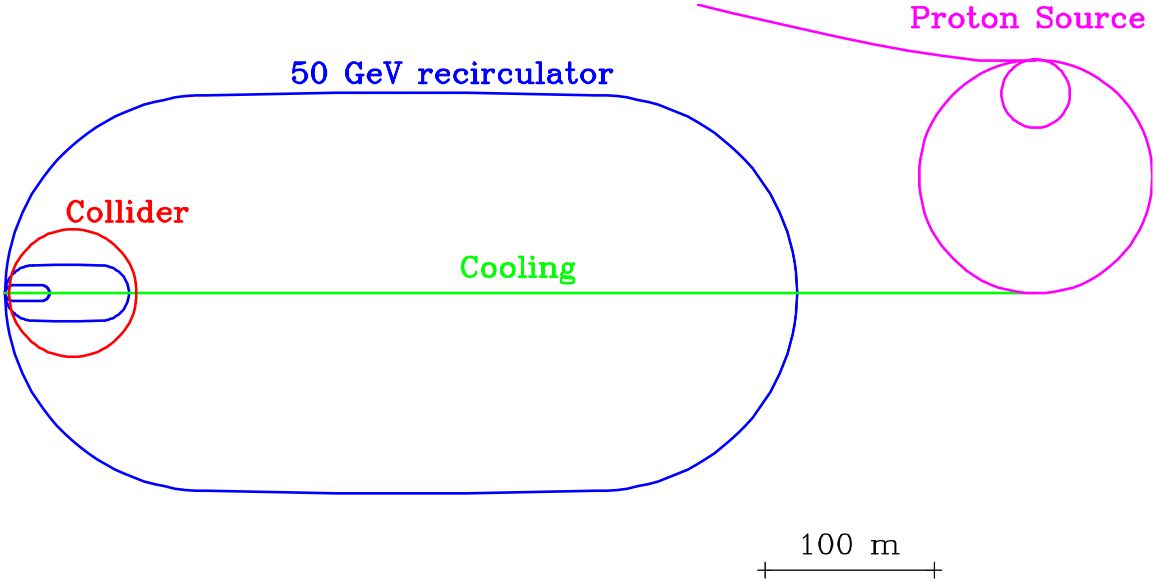
Muons decay: $\mu \rightarrow e\nu \qquad \Rightarrow$

- Must cool muons quickly (stochastic cooling won't do).
- Detector backgrounds at LHC level.
- Potential personnel hazard from ν interactions.

Footprints

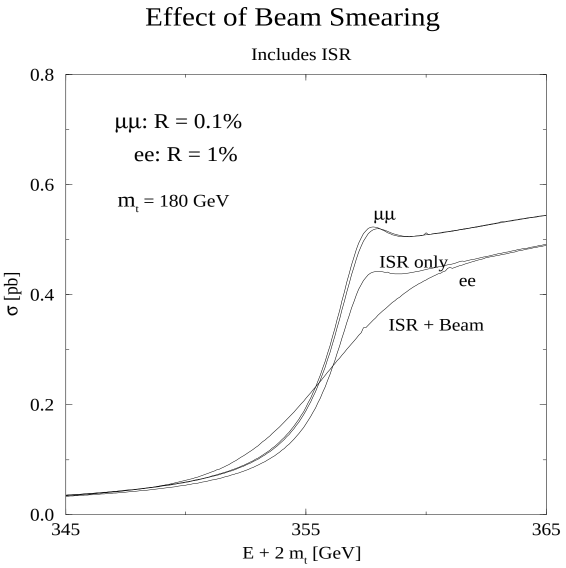


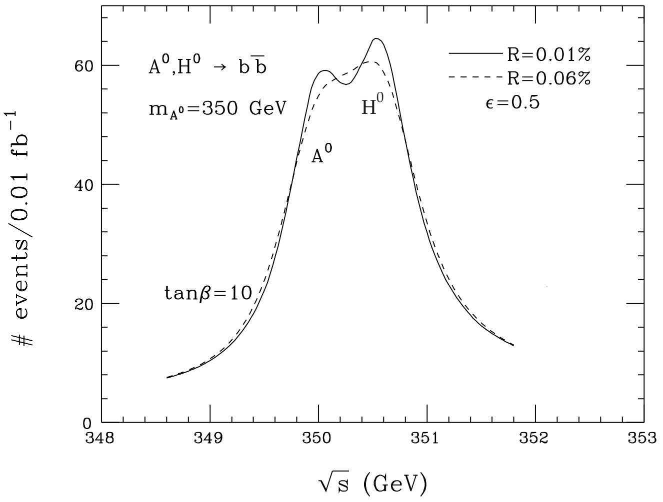
A First Muon Collider to study light-Higgs production:



The Case for a Muon Collider

- More affordable than an e^+e^- collider at the TeV (LHC) scale.
- More affordable than either a hadron or an e^+e^- collider for (effective) energies beyond the LHC.
- Precision initial state superior even to e^+e^-.





- Initial machine could produce light Higgs via s-channel:

  Higgs coupling to μ is $(m_\mu/m_e)^2 \approx 40,000\times$ that to e.

  Beam energy resolution at a muon collider $< 10^{-5}$,

  $\Rightarrow$ Measure Higgs width.

  Add rings to 3 TeV later.

- Neutrino beams from μ decay about 10^4 hotter than present.

Princeton Efforts

- Tests of a gallium jet as the primary target for the 4-MW proton beam.