Front End design of the Neutrino Factory (for the Muon EDM Experiment?)

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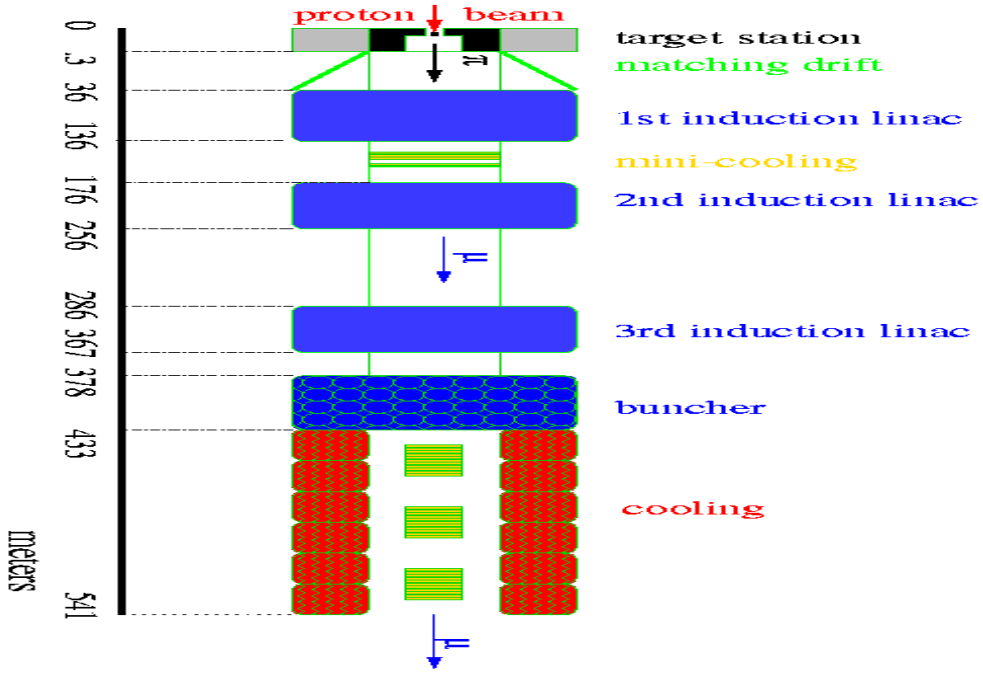
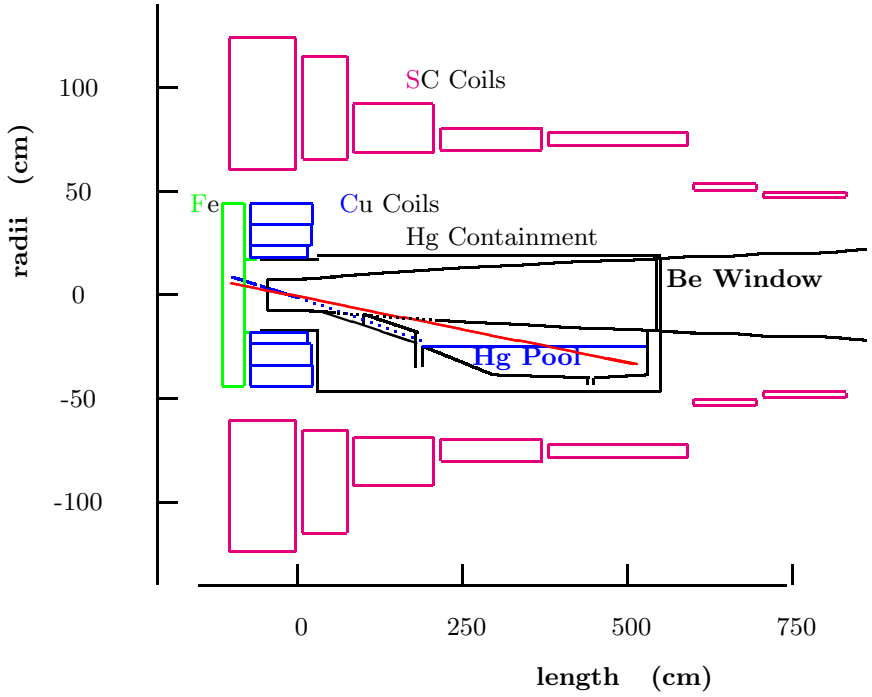
- The Muon Collaboration (MC) was formed about 6 years ago to study the possibility of building a muon collider
- MC is currently focusing on the possibility of building a high intensity neutrino source based on a muon storage ring (neutrino factory)
- have completed four major neutrino factory studies:
  - (1) ν physics using neutrino factory
  - (2) ν physics using enhanced proton driver
  - (3) minimal R&D machine design (Fermilab site)
  - (4) enhanced performance machine design (BNL site)
- benefits everyone if additional physics is possible using parts of the machine

Layout of Neutrino Factory on the BNL site

Schematic of the Front End

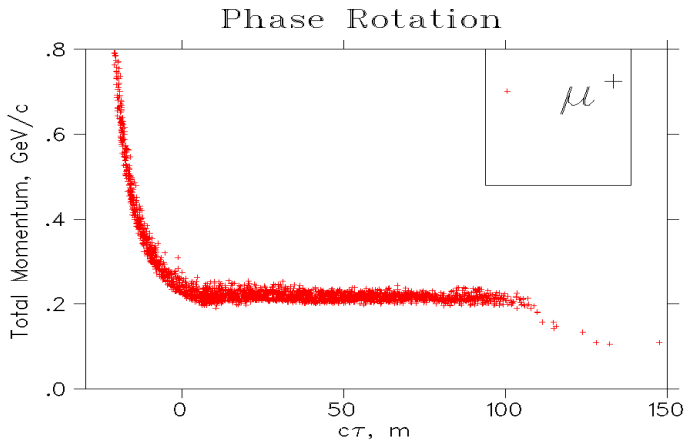


Target area



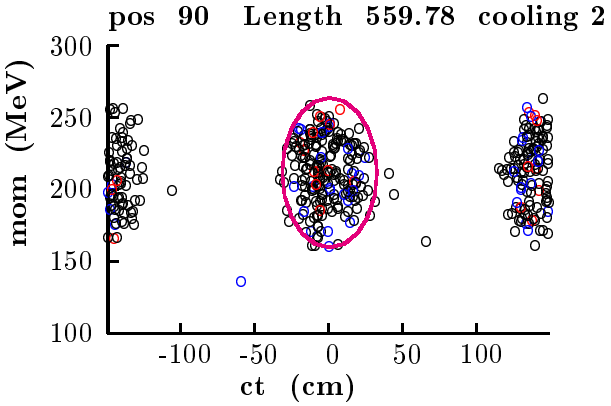
- Hg jet target
- cross at angle
- 20 - 1.25 T solenoid
- Cu insert
- Superconducting outsert
- 18 m long
- E951 - target R&D
- centered at BNL

Longitudinal phase space after phase rotation



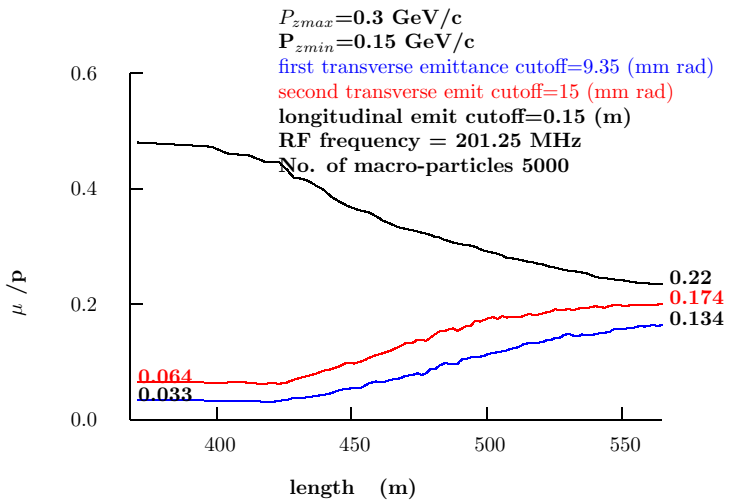
- Purpose: reduce large ΔE
- beam drift --> E-t correlation
- use induction linacs
- V pulse accelerates slow μ
- and decelerates fast μ
- 360 m long

Buncher



- Prepares beam to match longitudinally into cooling
- 3 sections of rf cavities and drifts
- uses 200 MHz rf
- 55 m long

Results of transverse cooling



- Uses ionization cooling
- tapered design (6 types)
- Increases μ density into linac acceptance by x3
- 108 m long
- 0.22 μ / p at end
- MUCOOL - cooling R&D centered at Fermilab

Beam parameters leaving the Front End (1 MW)

$\langle p \rangle$	203	MeV/c	
σ_p	21	MeV/c	
ε_{TN}	2.5	mm	
σ_x	24	mm	
$\sigma_{x'}$	102	mr	
T_{rf}	5	ns	
λ_{rf}	1.5	m	
σ_t	0.51	ns	
N_{bunch}	67		
$N\mu$/bunch	3×10^{11}		(6×10^{11} @ 4 MW)
f_{rep}	2.5	Hz	(5 Hz @ 4 MW)
Pol	0.16		

Conclusions

- A high-intensity cooled μ beam would be available in the early stages of the neutrino factory project
- in the first phase of the project 5 x 10^{13} μ should be available each second
- we need to carefully consider how well this beam matches the requirements of the EDM (and other) experiments