



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

R.C. Fernow
BNL

- 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

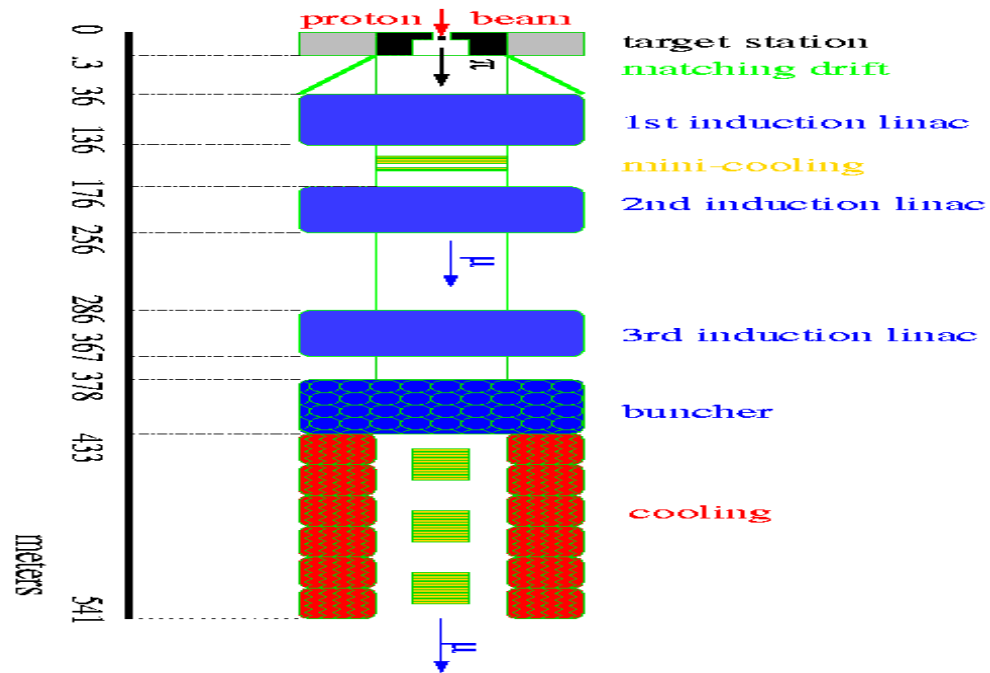


NEUTRINO FACTORY,
SITE PLAN

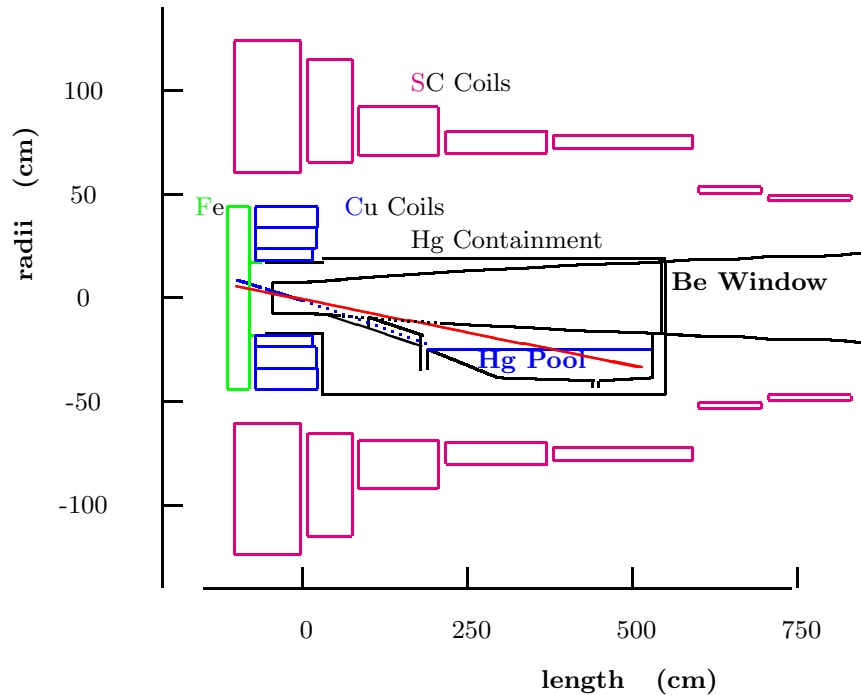
BROOKHAVEN
NATIONAL LABORATORY

Brookhaven Science Associates
U.S. Department of Energy

Schematic of the Front End

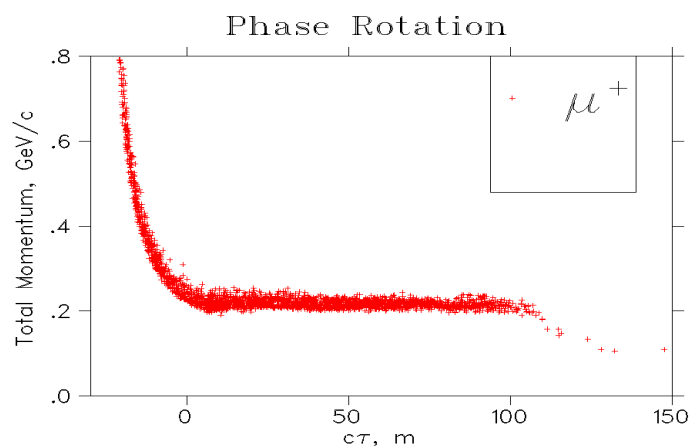


Target area



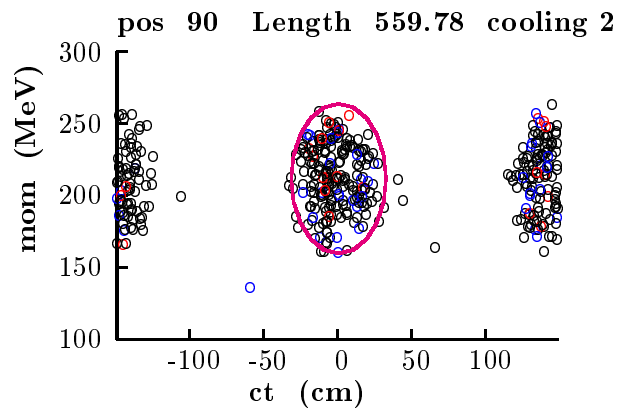
- Hg jet target
- cross at angle
- 20 - 1.25 T solenoid
- Cu insert
- Superconducting outsert
- 18 m long
- E951 - target R&D
- centered at BNL

Longitudinal phase space after phase rotation



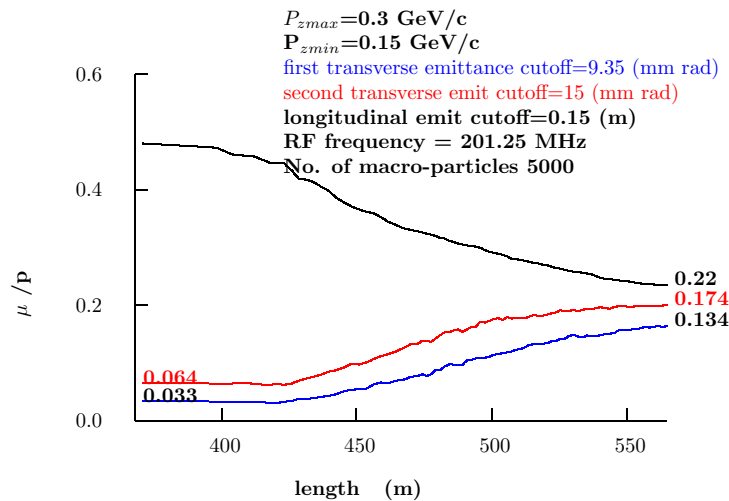
- Purpose: reduce large ΔE
- beam drift --> E-t correlation
- use induction linacs
- V pulse accelerates slow μ
- and decelerates fast μ
- 360 m long

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		
$N_{\mu/\text{bunch}}$	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 5×10^{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