# IMPACT OF THE INITIAL PROTON BUNCH LENGTH ON THE PERFORMANCE OF THE MUON FRONT END

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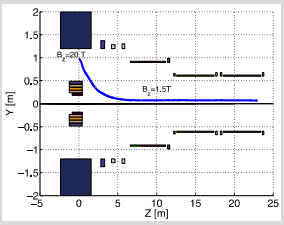
## INTRODUCTION

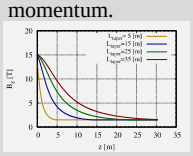
The dependence of the performance of the Front End of a Muon Collider/Neutrino Factory on the proton-driver bunch length is explored. We consider proton kinetic energies of 3 and 8 GeV. Previously, a drive-beam bunch length of 2 ns was considered for 8 GeV beam energy; however achieving such short bunch lengths for a 3-GeV drive beam is difficult due to space charge effects. The performance of the Front End based on longer proton-bunch lengths is discussed.

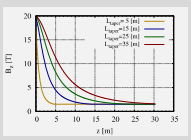
## LONGITUDNAL PHASE SPACE & CAPTURE EFFECIENCY

### CAPTURE SOLENOID PROFILE

Pions are generated with wide transverse momentum spread. As the pions move through the "tapering" solenoid field beyond the target they develop a correlation between the longitudinal velocity and the initial transverse momentum.



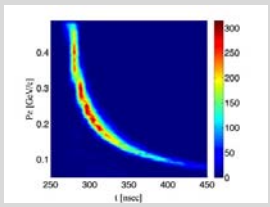


TARGET CAPTURE SOLENOID

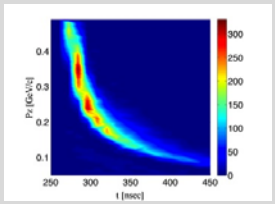
$\int Bdl$ Defines the time spread of the captured beam

### EFFECT OF CAPTURE SOLENOID TAPER ON LONGITUDNAL PHASE SPACE

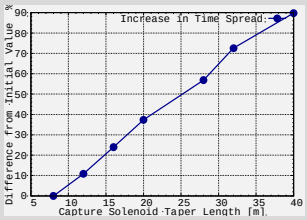
SHORT TARGET SOLENOID TAPER L= 4 m



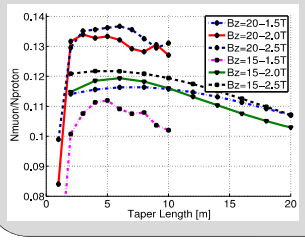

SHORT TARGET SOLENOID TAPER L= 40 m

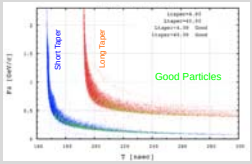



Time spread increases with the target solenoid taper length




### CAPTURE EFFECIENCY OF THE BUNCHER & ROTATOR OF THE MUON FRONT END




Muon yield after the transverse Ionization Cooling Channel within the acceptance of the following accelerator chain *vs.* the target solenoid taper length. Optimum yield is at taper length of 4-6 m.

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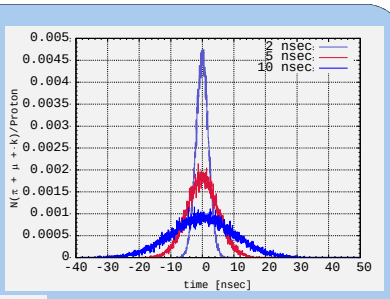
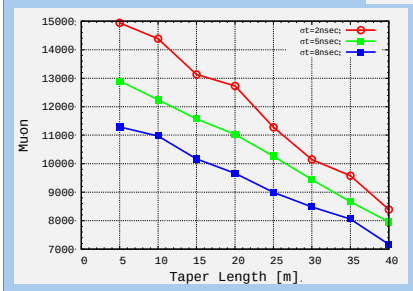
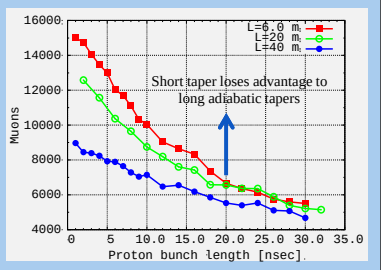
Pion beams with different bunch length varying from 2 to 10 ns off the pion-production target.

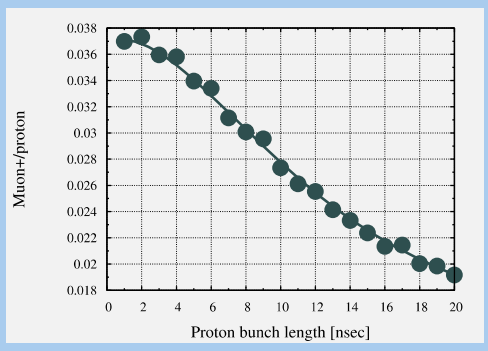



Number of positive muons within the accelerator-chain acceptance *vs.* the target solenoid taper length at three different bunch lengths of 2, 5, 8 ns.

- Number of positive muons within the accelerator chain acceptance *vs.* the initial proton bunch length for 8-GeV proton beam on a Hg-jet target.
- The tracking study was done for different target solenoid taper lengths of 6, 20, 40 m.
- The short taper loses its advantage gradually as the bunches get longer.




Number of positive muons within the accelerator-chain acceptance versus the initial proton bunch length for 3-GeV proton beam on a C target. The tracking study was done for a target solenoid peak field of 15 T, taper length of 4 m, and end field of 2.5 T. For this case the loss is ~ 5% per 1 ns increase in bunch length.