

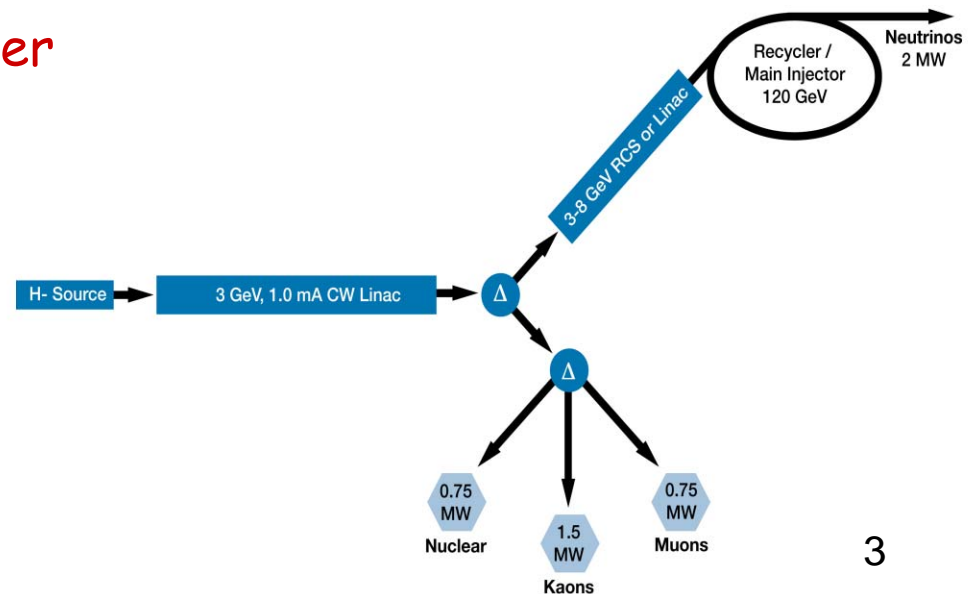
# **Bunch trains for Neutrino factory/ Collider**

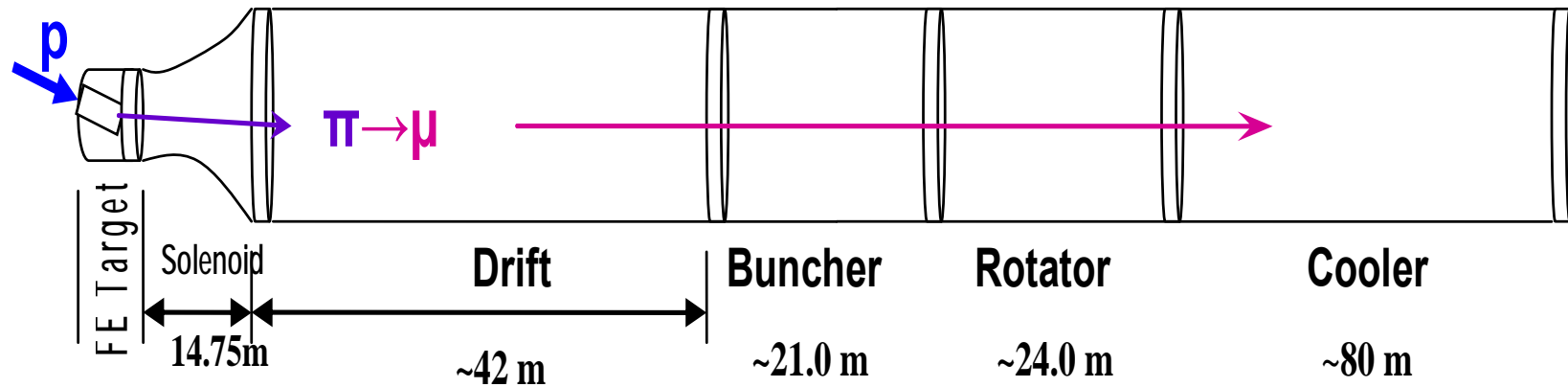
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November 2013

- Front End
- “Muon Collider” versions
- 325 MHz
- Add Chicane/Absorber
  - rematch

- Linac, Accumulator, Compressor run at 15 Hz - 4 bunches
  - bunches at 60 Hz
    - 4 bunches
  - 1 bunch at time into neutrino factory
    - 1  $\mu^+$  and 1  $\mu^-$  batch per cycle
    - 60 Hz neutrino factory
  - Without trombone
    - 60 Hz single p bunch for collider
  - With trombone
    - 4  $\rightarrow$  1 15 Hz bunches for collider





## ➤ Drift

- 20T → 2T

## ➤ Buncher

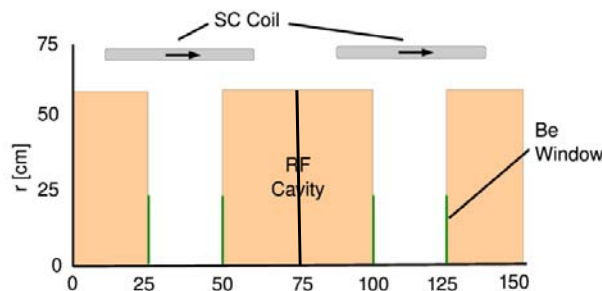
- $P_0 = 250 \text{ MeV}/c$
- $P_N = 154 \text{ MeV}/c$ ;  $N = 10$
- $V_{rf} : 0 \rightarrow 15 \text{ MV}/m$ 
  - (2/3 occupied)
- $f_{RF} : 490 \rightarrow 365 \text{ MHz}$

## ➤ Rotator

- $V_{rf} : 20 \text{ MV}/m$ 
  - (2/3 occupied)
- $f_{RF} : 364 \rightarrow 326 \text{ MHz}$
- $N = 12.045$
- $P_0, P_N \rightarrow 245 \text{ MeV}/c$

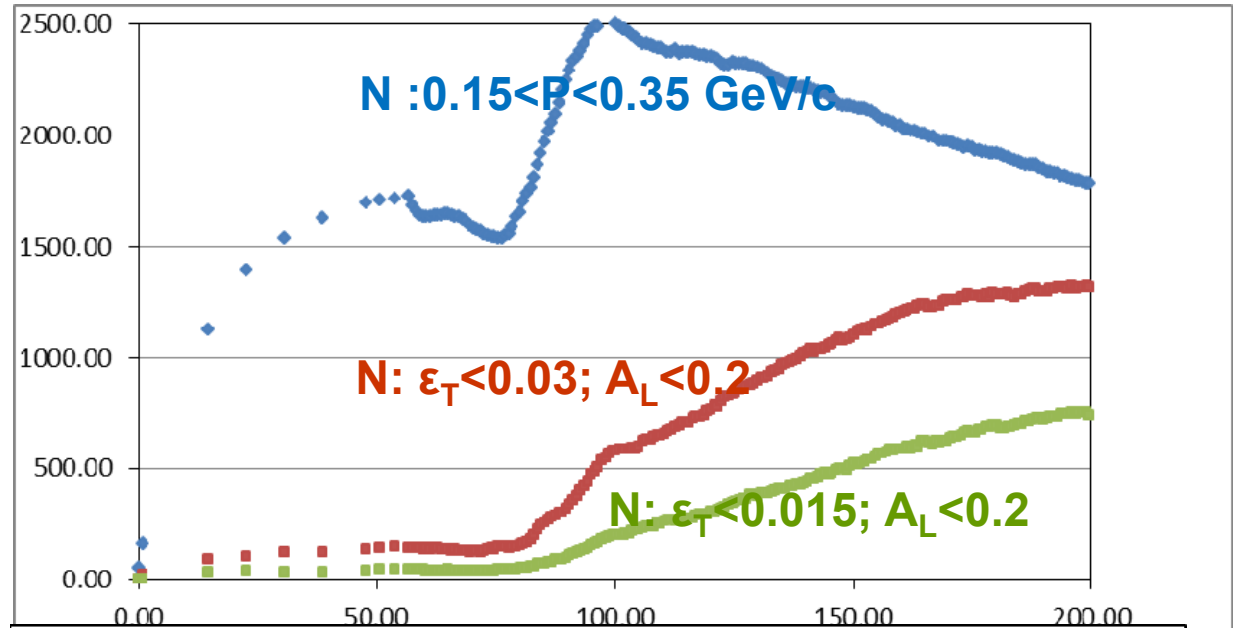
## ➤ Cooler

- 245 MeV/c
- 325 MHz
- 25 MV/m
- 2 1.5 cm LiH absorbers / 0.75m



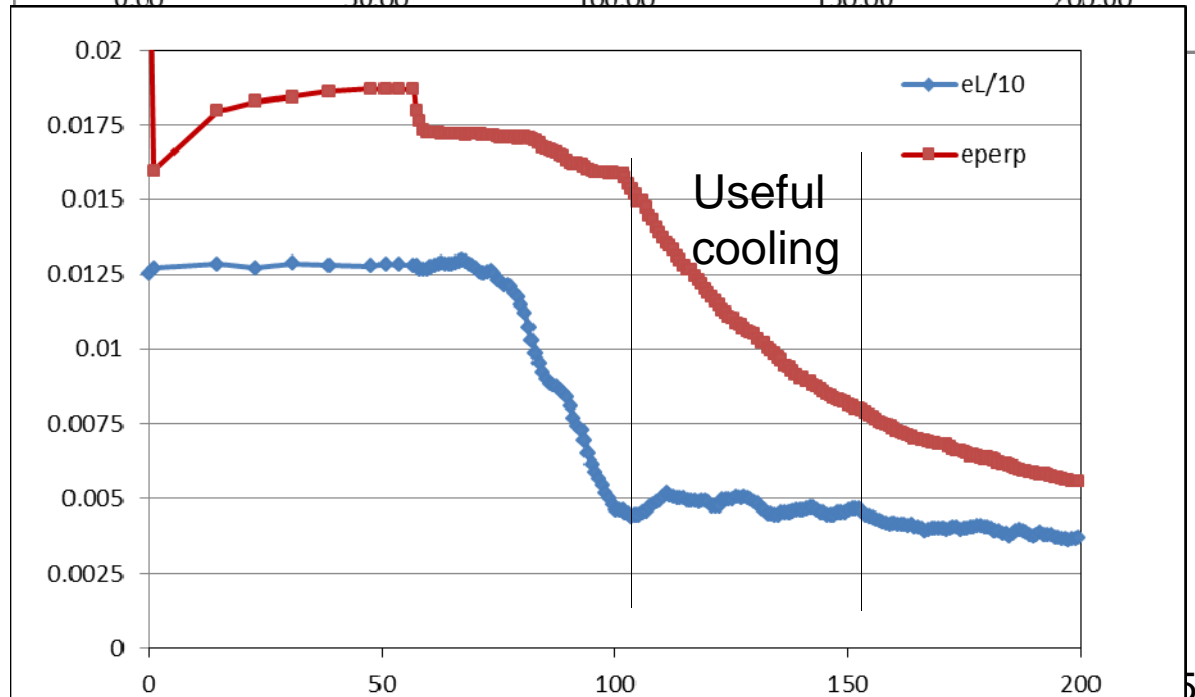
## ➤ Simulation obtains

- $\sim 0.125 \mu/p$  within acceptances
- with  $\sim 60m$  Cooler
- shorter than baseline NF

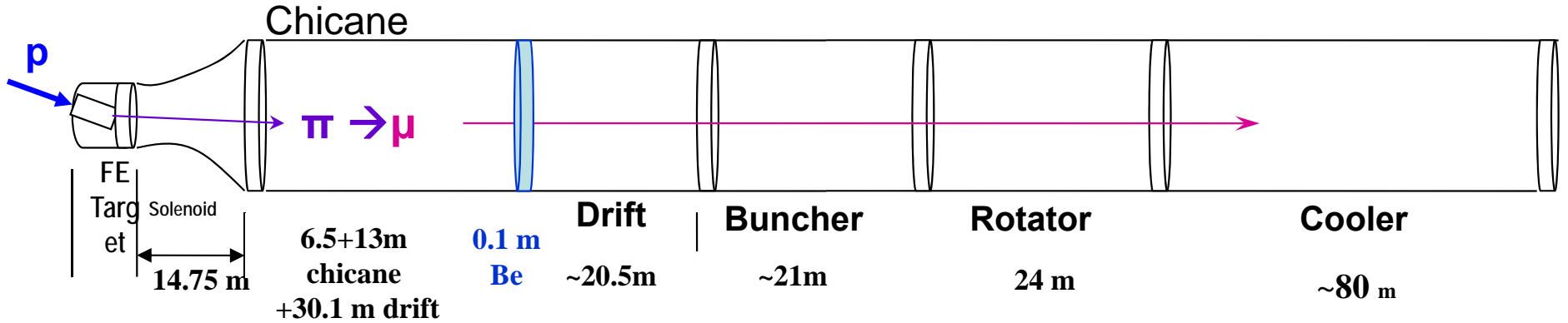
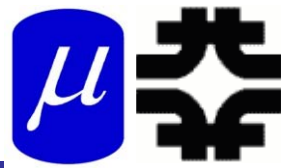


## ➤ But

- uses higher gradient
- shorter than baseline NF
- 325 MHz - less power
- more bunches in bunch train



# 325 Collider w/Updated Chicane/Absorber



## ➤ 13m chicane

\*6.5m  $\rightarrow$  +21.67°, -21.67°

- particle 1-283 MeV/c
- particle 2-194 MeV/c

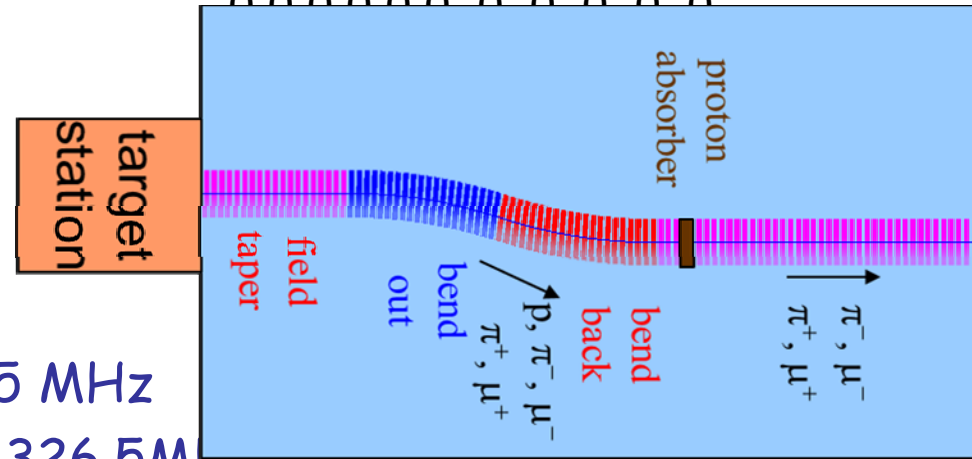
- Add 30m drift before absorber

## ➤ absorber at ~65m

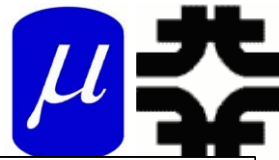
- 10cm Be
- particle 1-250 MeV/c
- particle 2-154 MeV/c

- Bunch (N=12) 0  $\rightarrow$  15 MV/m : 496  $\rightarrow$  365 MHz
- Rotate (N=12.045) - 20MV/m : 365  $\rightarrow$  326.5MHz
- Cool -325MHz -25 MV/m
  - $p_{ref}=245$  MeV/c

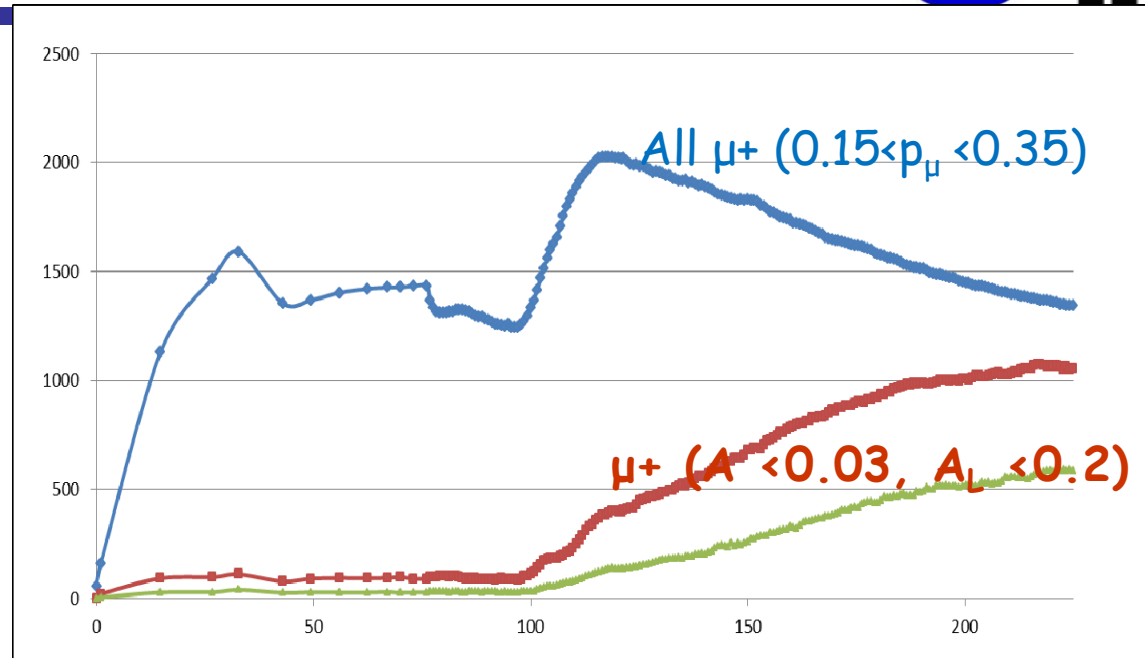
SREGION	! bentsol	
6.0	1	1e-2
1	0.	1.0
BSOL		
1	2.0	0.0 1 0.283 0.0 0.058181
0	0	0 0 0 0 0 0 0 0



# ICOOOL results



- 325 “muon collider” with chicane absorber
  - with added drifts between chicane and absorber
    - ~30m
  - $\sim 0.12 \mu/p \rightarrow \sim 0.1 \mu/p$
  - smaller emittance beams
    - scraped to better fit

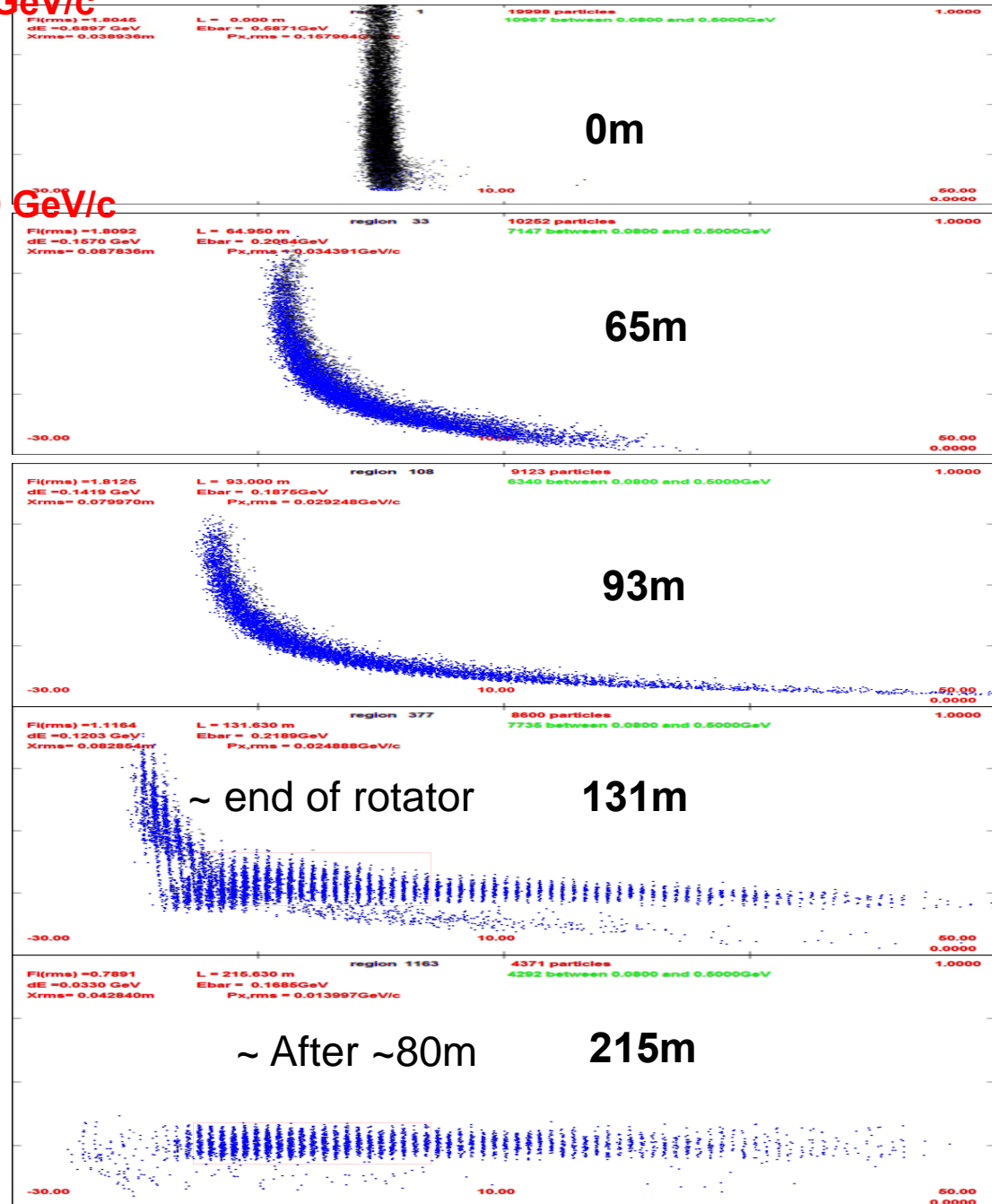


# 325 (w chicane/absorber)

- ~60 m long bunch train
  - ~60 325 MHz buckets
- For collider choose "best 21 bunches"
  - (~19m)
- Includes ~2/3 of captured  $\mu$ 's
  - many are lost
- 21 bunches are recombined to 1 in collider scenario
  - It is more difficult to recombine 21 than 12
- Would like to extend acceptance or generate shorter train

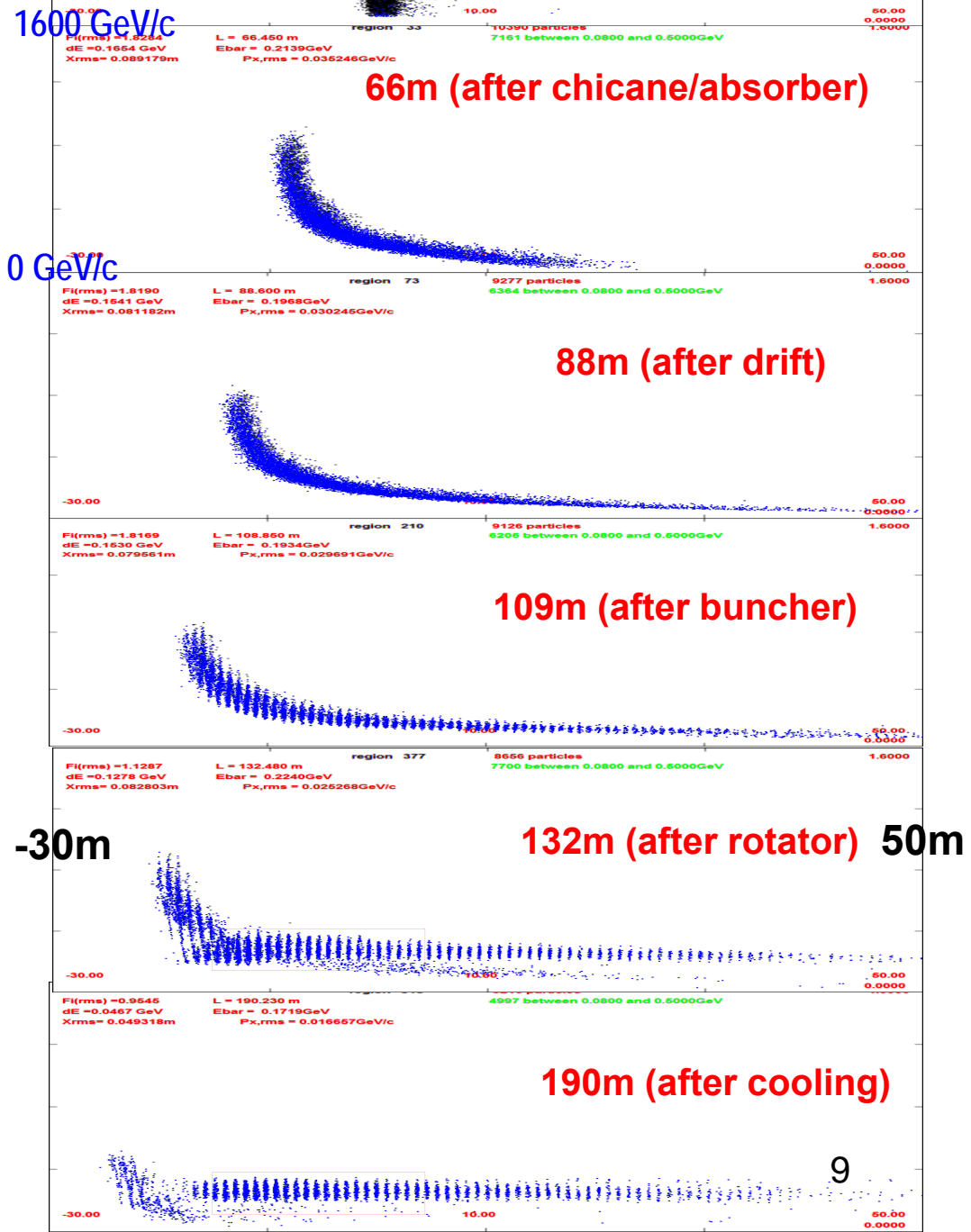
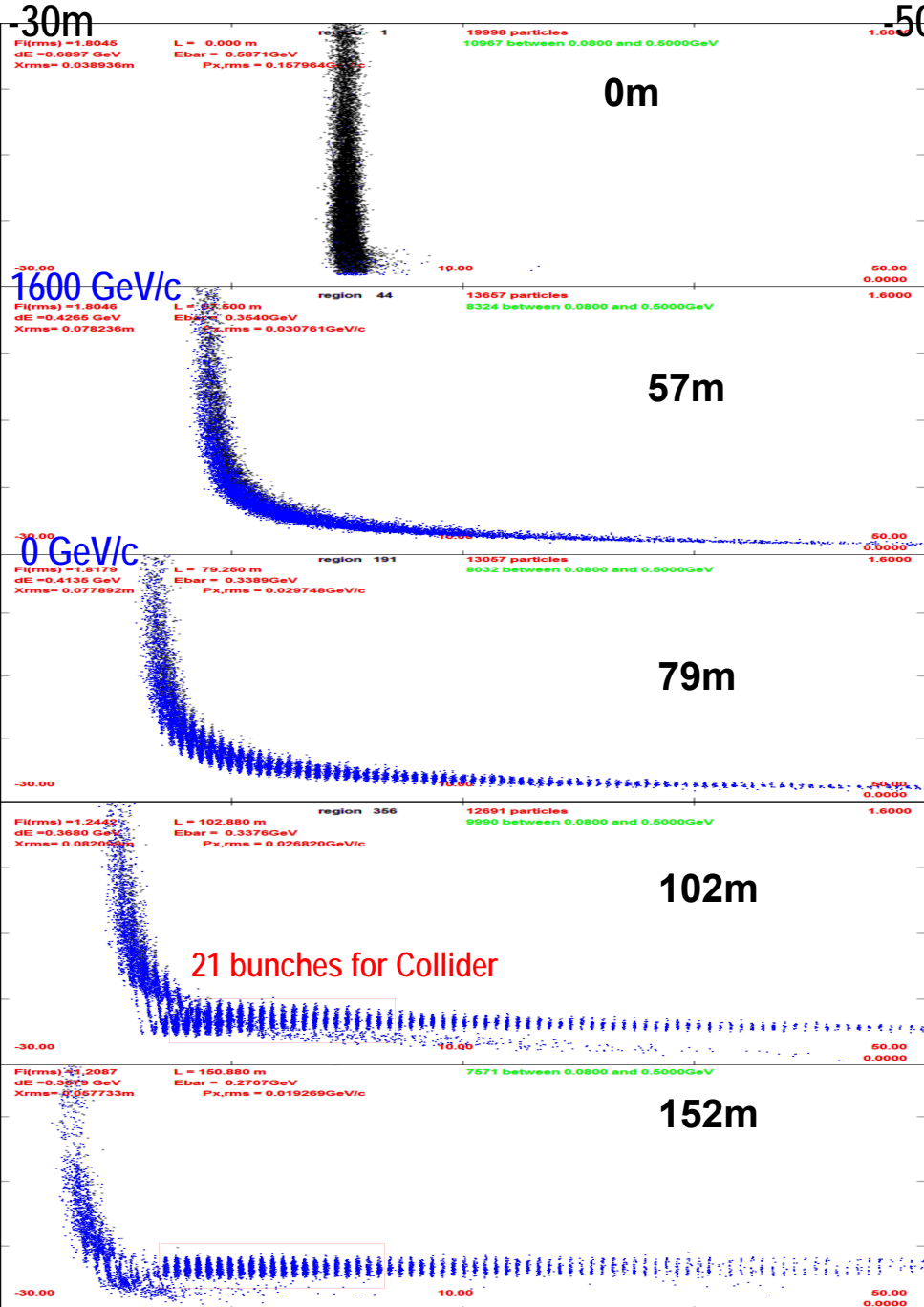
1.0 GeV/c

0.0 GeV/c





# Compare without/with chicane



- NERSC does not work (for me)
- Batch Jobs submitted "run" using no time, no output, no useful diagnostics
  - has run properly a couple of times

- Hidden UNIX system feature?

```
#PBS -q regular
#PBS -A map
#PBS -l mppwidth=192
#PBS -l walltime=00:07:00
cd $PBS_O_WORKDIR
aprun -n 192 /project/projectdirs/map/Codes/ICOOOL/mpi/bin/icool-332-mpi-00
```

```
Warning: no access to tty (Bad file descriptor).
Thus no job control in this shell.
```

```
+ -----
+      Job name: fee.pbs
+      Job Id: 7049094.hopque01
+      System: hopper
+      Queued Time: Mon Jan 27 09:40:11 2014
+      Start Time: Mon Jan 27 09:42:28 2014
+      Completion Time: Mon Jan 27 09:42:32 2014
+      User: dneuffer
+      MOM Host: nid04219
+      Queue: reg_1hour
+      Req. Resources: mppnodect=8,mppnppn=24,mppwidth=192,other=QSUBPID:24420:hopper09,walltime=00:07:00
+      Used Resources: cput=00:00:00,mem=0kb,vmem=0kb,walltime=00:00:07
+      Acct String: map
+      PBS_O_WORKDIR: /global/u2/d/dneuffer/FE_201_shorttaper
+      Submit Args: fee.pbs
+ -----
```

- **Are studying 325 MHz version (~Collider)**
  - produces more bunches in same length bunch train than 200 MHz
  - requires more bunches to be recombined  $\sim 12 \rightarrow 21$ 
    - more difficult ... ?
    - HCC recombiner ?
  - Are including chicane/absorber
  - Would like to fit more  $\mu$  in fewer bunches

# Weekly Summary

