Preparation of Intense Bunches at MI 8 GeV

September 08, 2010

Kiyomi Seiya
(Fermilab)

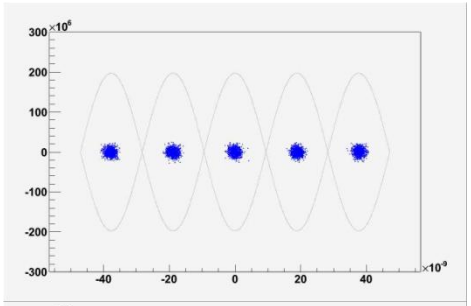
Goal

Make an intense bunch (intensity ~2.5E11/bunch) @ 8GeV for space charge measurements.

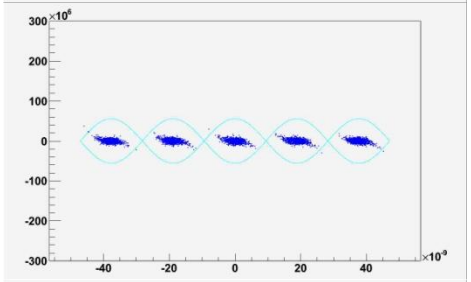
Outline

- 150GeV coalescing operation for TeV
- Simulation results for 8 GeV coalescing
- RF requirements
- Beam studies
- Conclusion

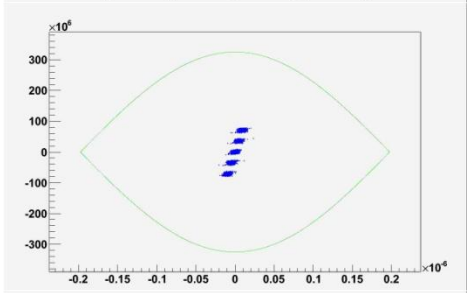
Coalescing operation @ 150 GeV



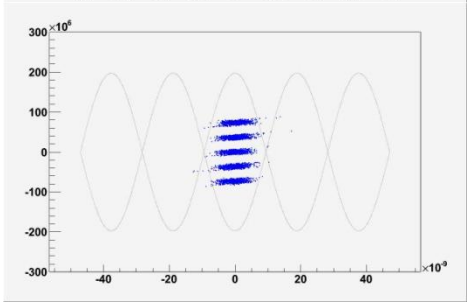
Vrf(53MHz)=500kV, Vrf(2.5MHz)=0kV
Beam accelerated to 150 GeV with 53MHz rf.



Vrf(53MHz)=40kV, Vrf(2.5MHz)=0kV
53MHz rf voltage was dropped.
Beam rotated by 1/4 of synchrotron period in the bucket and reduced energy spread.



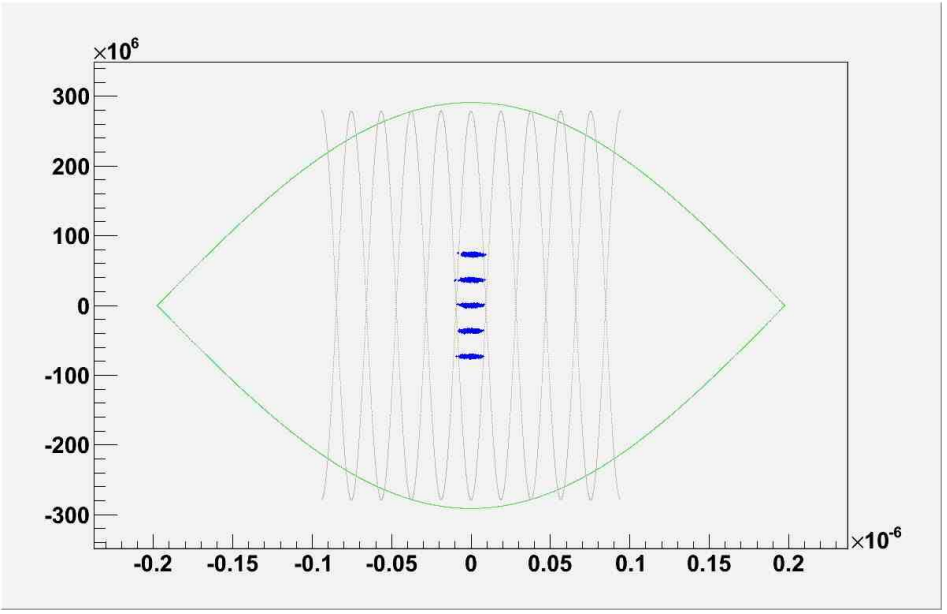
Vrf(53MHz)=0kV, Vrf(2.5MHz)=52kV
Beam was captured with and rotated in the 2.5MHz bucket.



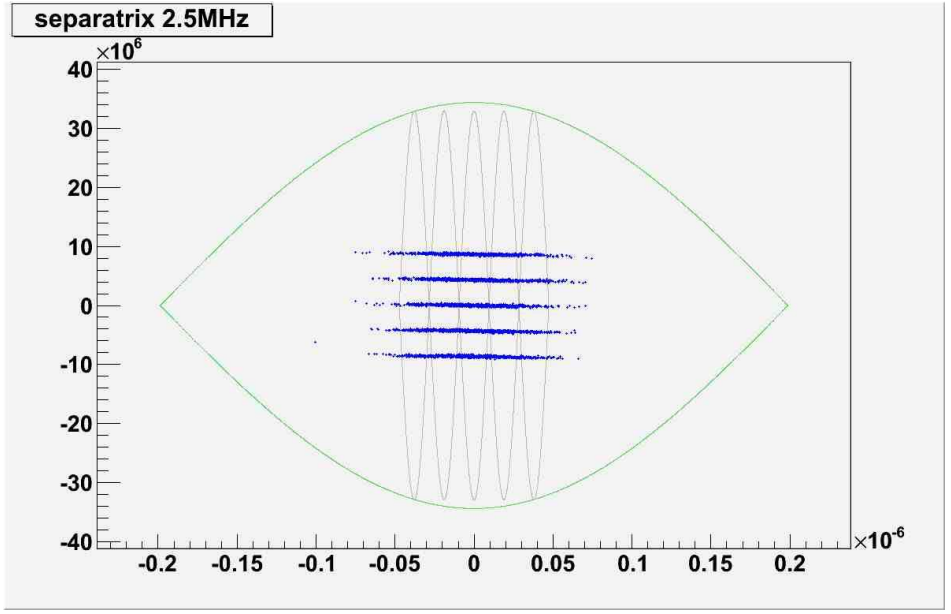
Vrf(53MHz)=500kV, Vrf(2.5MHz)=0kV
Beam was captured with 53MHz rf bucket.

Phase space @ 8& 150 GeV after coalescing

150 GeV



8 GeV



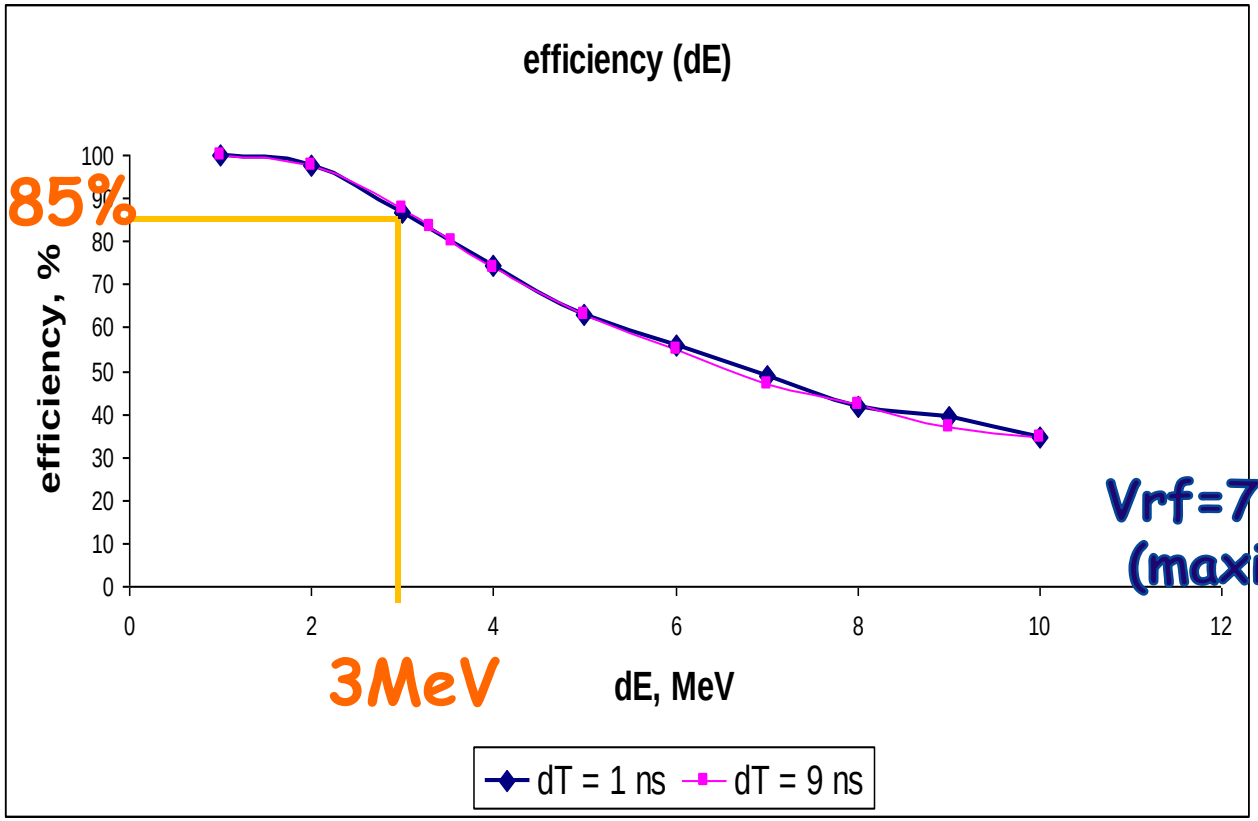
Bucket height: dE~300MeV
Synchrotron frequency: f~110Hz

dE~35MeV
f~900Hz

Operation efficiency > 85%

- **Need higher rf voltage and smaller energy spread.**

8GeV coalecing efficiency



85%

3MeV

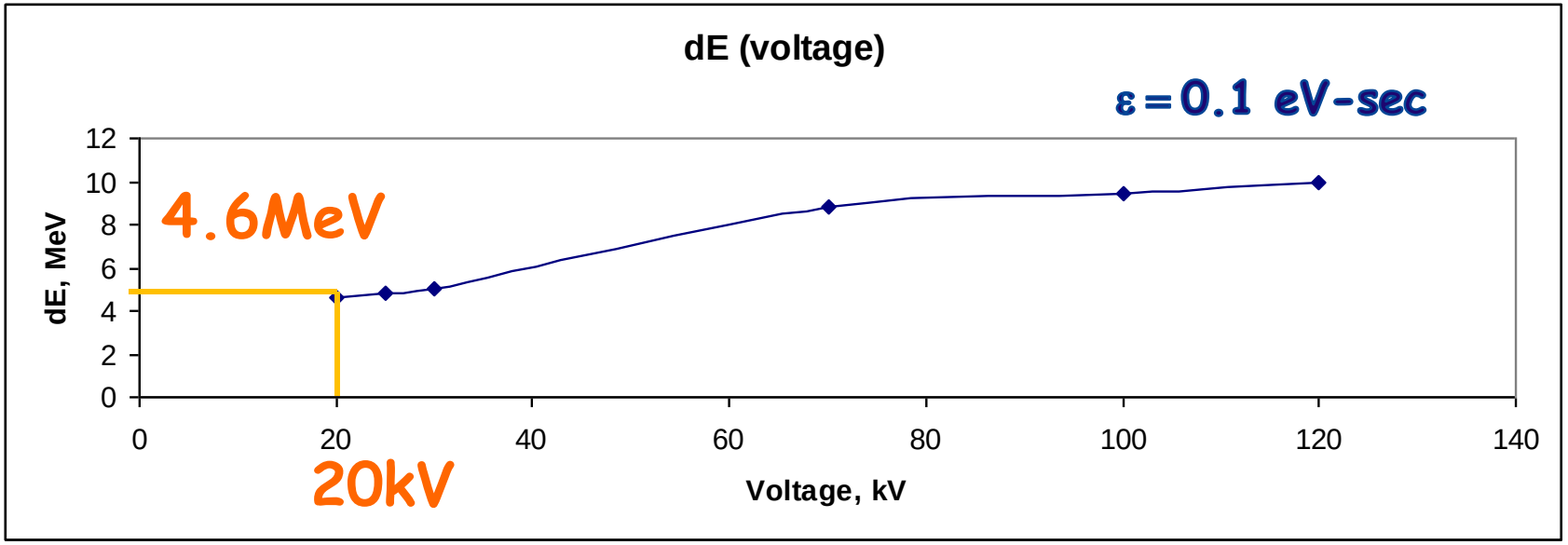
dT= +/-1 nsec

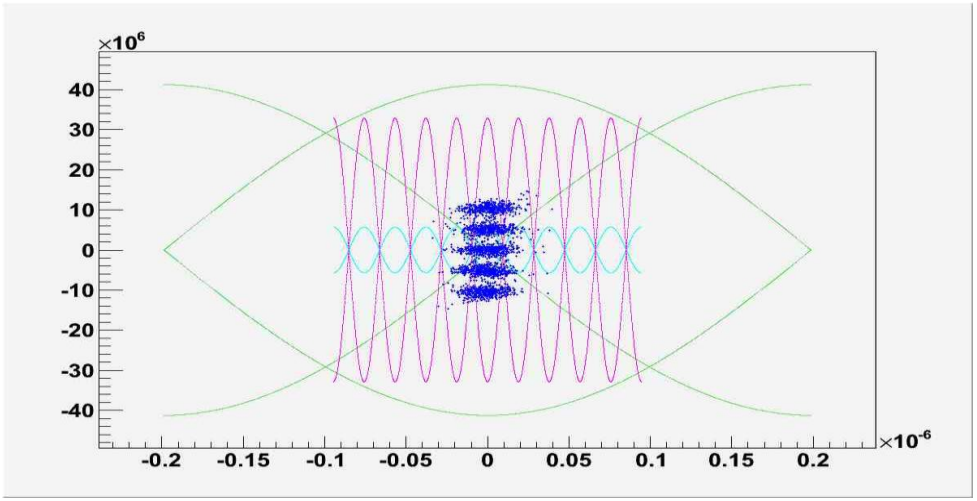
dT= +/-9 nsec

Vrf=75kV
(maximum available voltage)

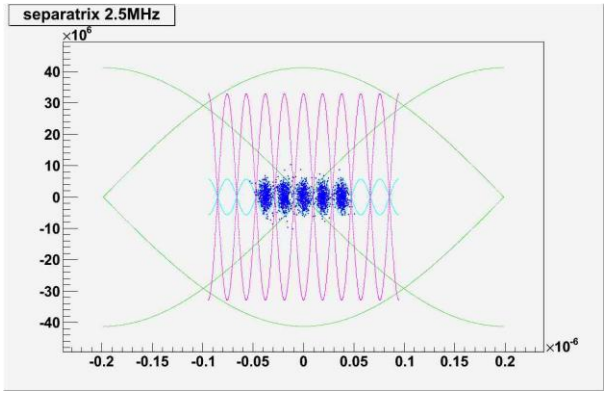
- Required energy spread dE < 3MeV

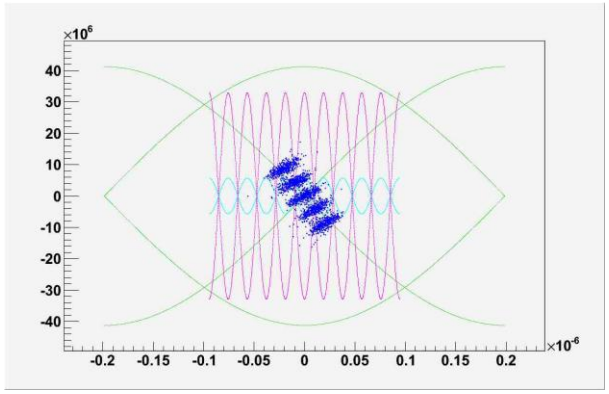
Adiabatic voltage reduction



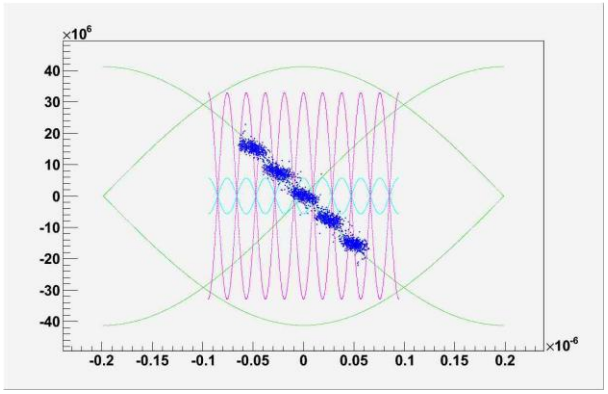


Bunch stretching on the unstable fixed point



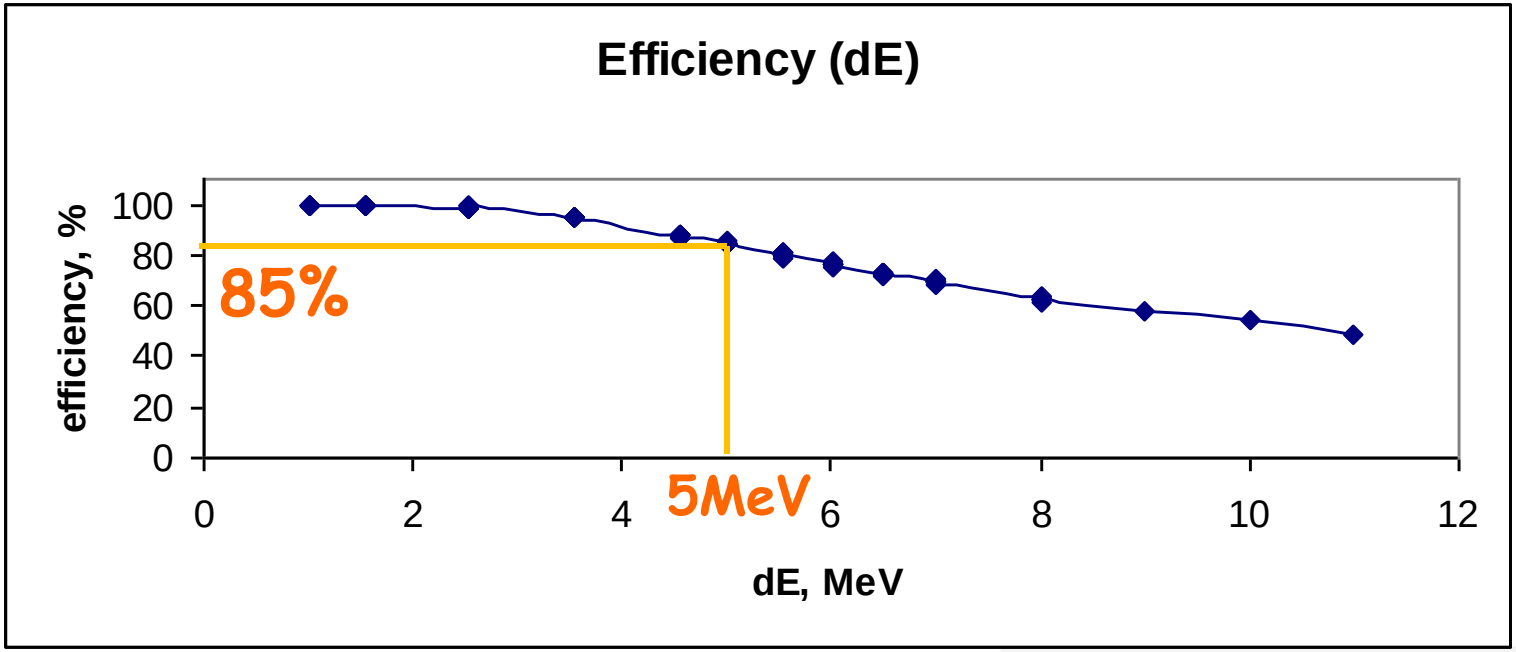


Rf phase was jumped by 180 degree

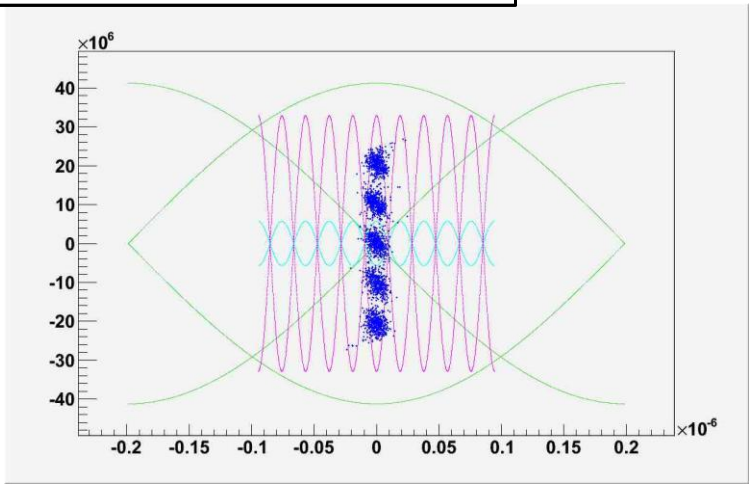


Phase was jumped to 0 deg. again

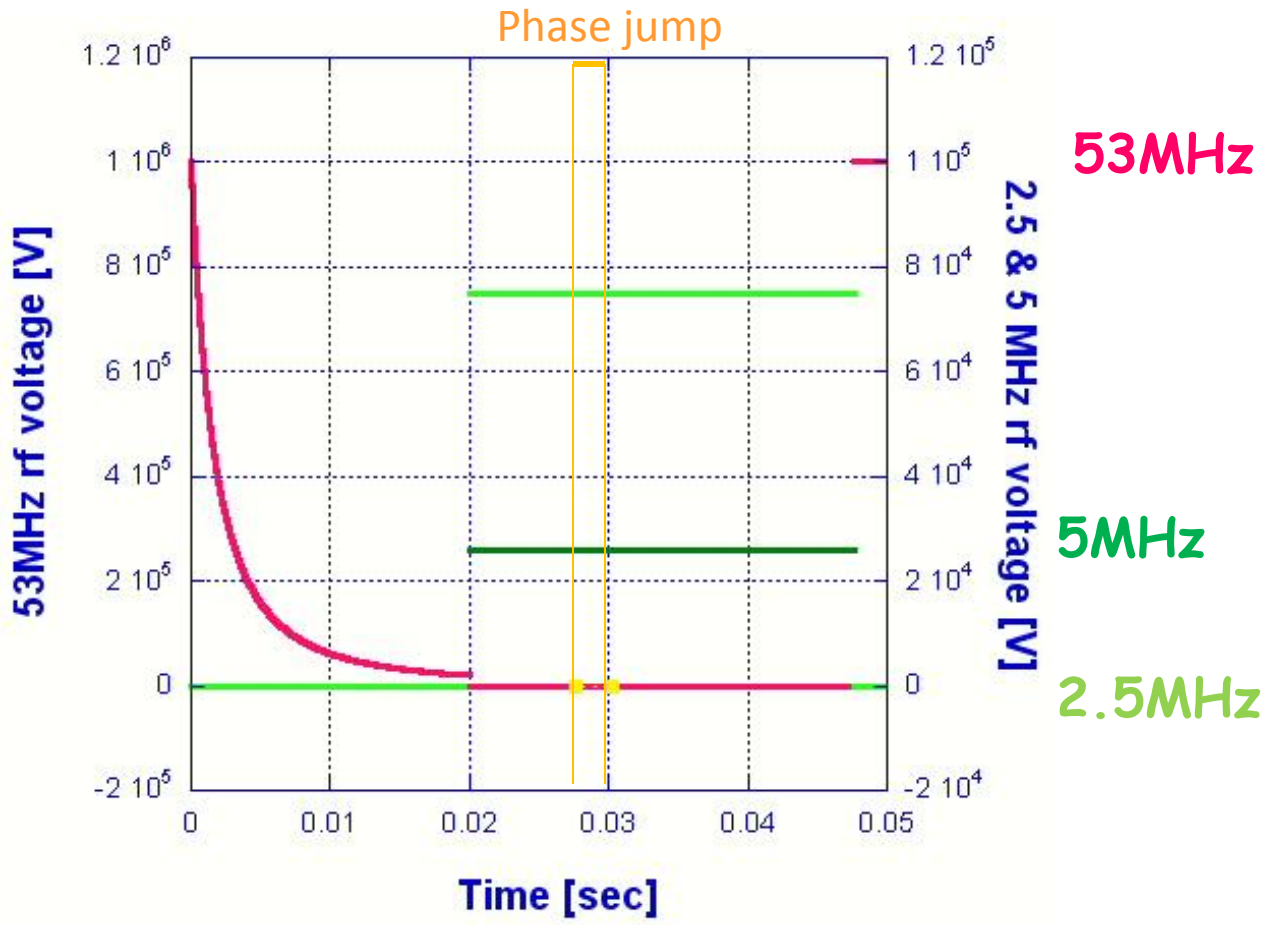
8GeV coalecing efficiency with stretching



- Required energy spread with stretching dE < 5MeV

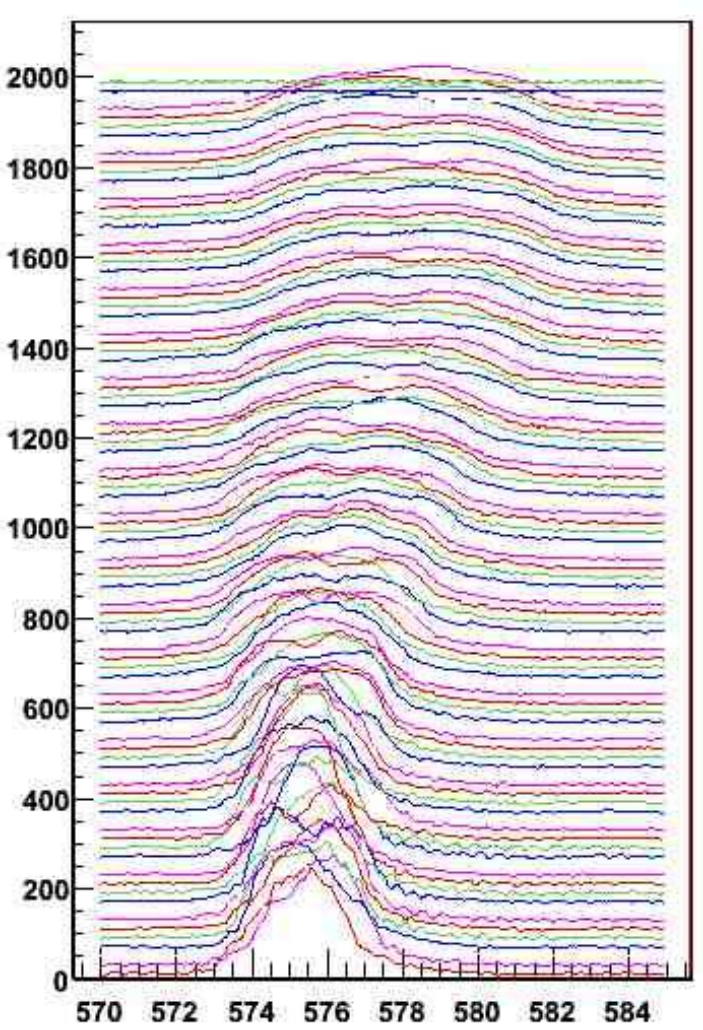


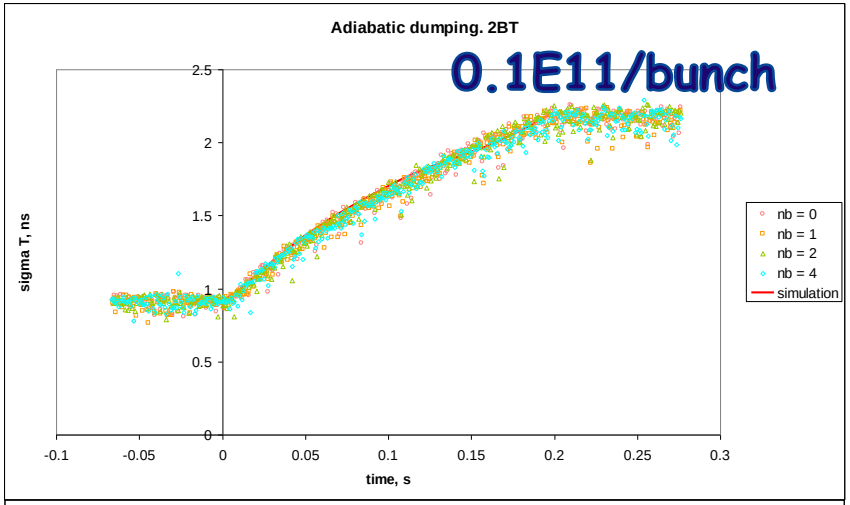
Required rf parameters

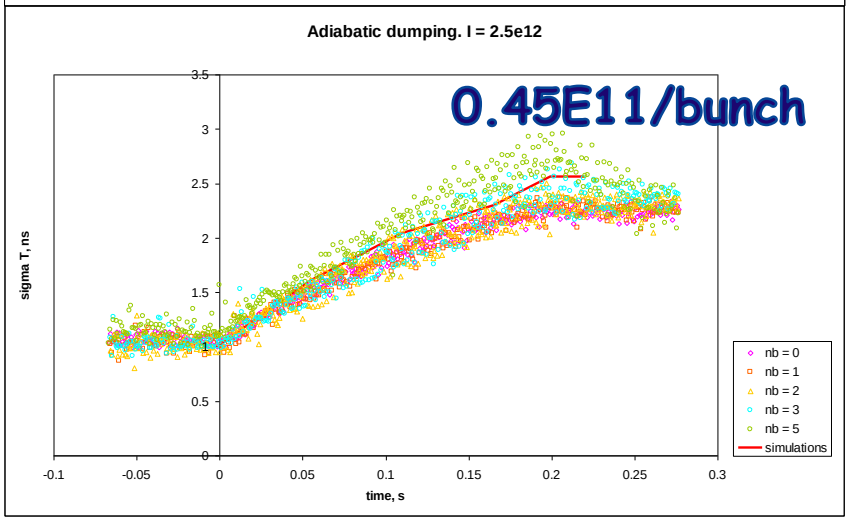


- Required time resolution < +/-60μsec
- Current LLRF system ~ 1.3msec (720Hz)

Beam studies with adiabatically lowered voltage







Summary

- Performed longitudinal simulation for 8GeV coalescing and optimized rf parameters.
- Required energy spread before coalescing was increased from 3MeV to 5MeV with stretching in the simulation.
- Timing resolution needs to be less than +/-60μsec. Current LLRF code with the resolution of 720Hz has to be modified. The work will take LLRF expert's effort by one man * one month.
- Move on to the space charge measurements with low intensity for now.