

Preparation of Intense Bunches at MI 8 GeV

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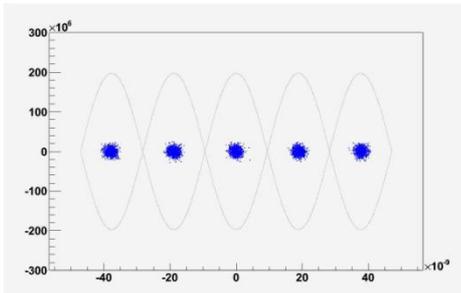
Goal

Make an intense bunch (intensity $\sim 2.5E11/\text{bunch}$) @ 8GeV for space charge measurements.

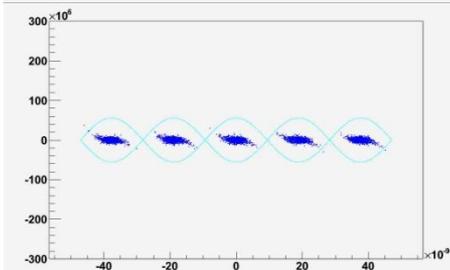
Outline

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

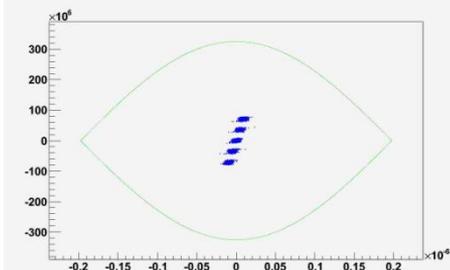
Coalescing operation @ 150 GeV



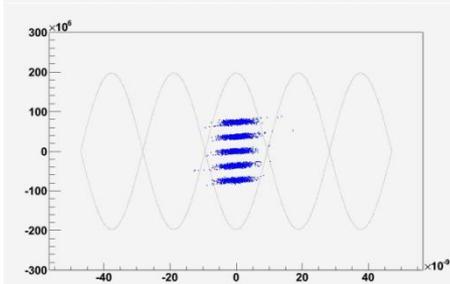
Vrf(53MHz)=500kV, Vrf(2.5MHz)=0kV
Beam accelerated to 150 GeV with 53MHz rf.



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.



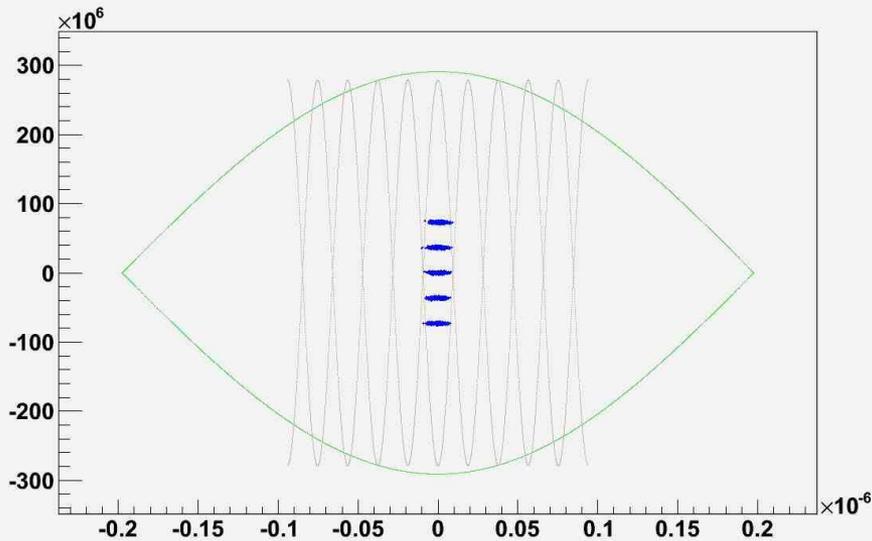
Vrf(53MHz)=0kV, Vrf(2.5MHz)=52kV
Beam was captured with and rotated in the 2.5MHz bucket.



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

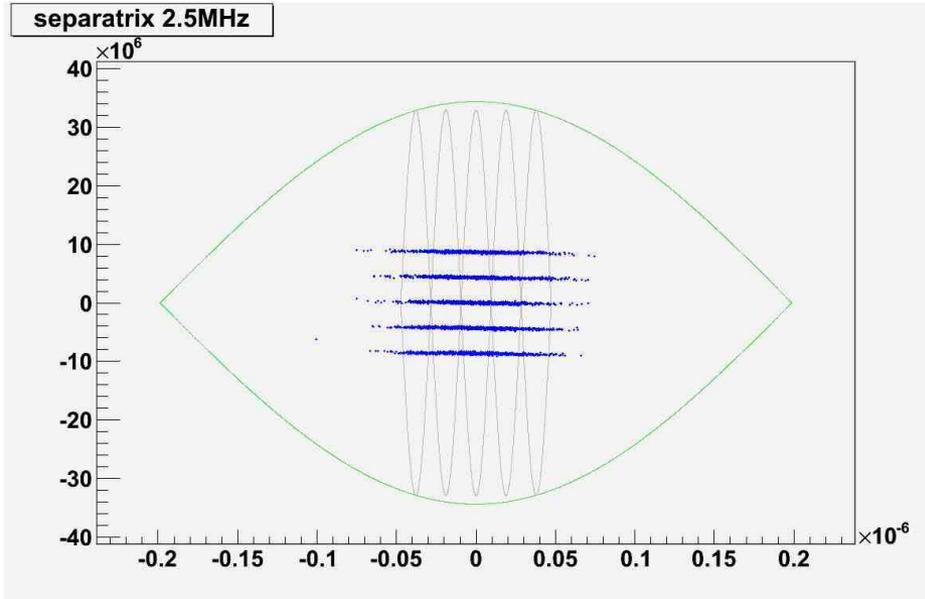
Phase space @ 8 & 150 GeV after coalescing

150 GeV



Bucket height: $dE \sim 300 \text{ MeV}$
Synchrotron frequency: $f \sim 110 \text{ Hz}$

8 GeV

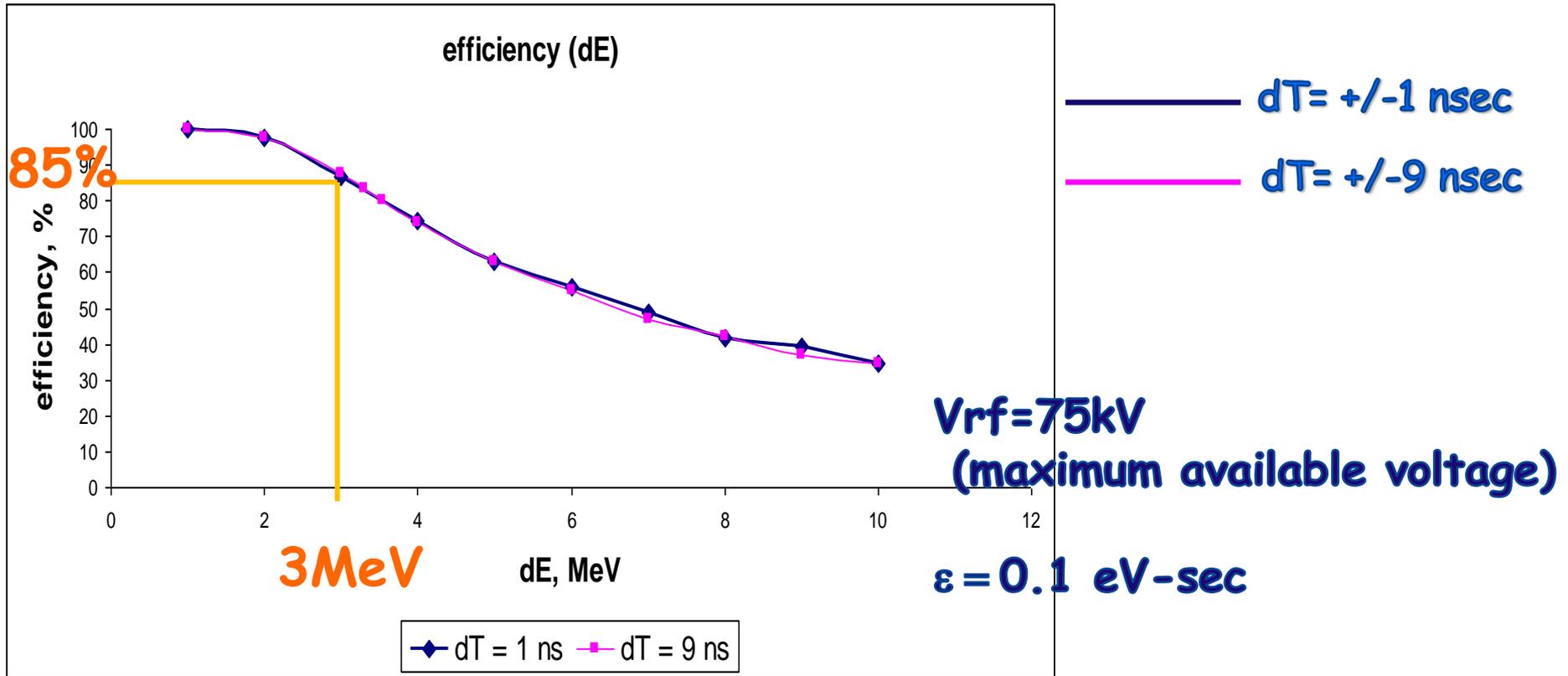


$dE \sim 35 \text{ MeV}$
 $f \sim 900 \text{ Hz}$

Operation efficiency > 85%

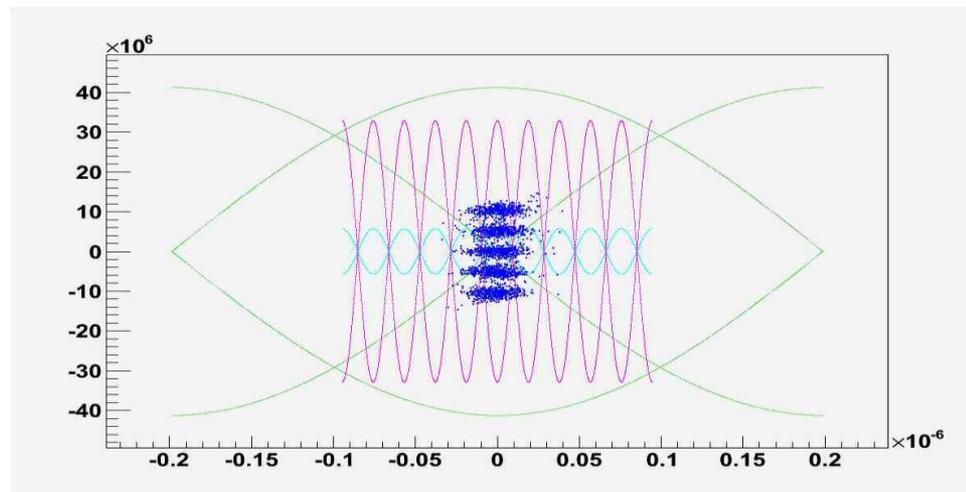
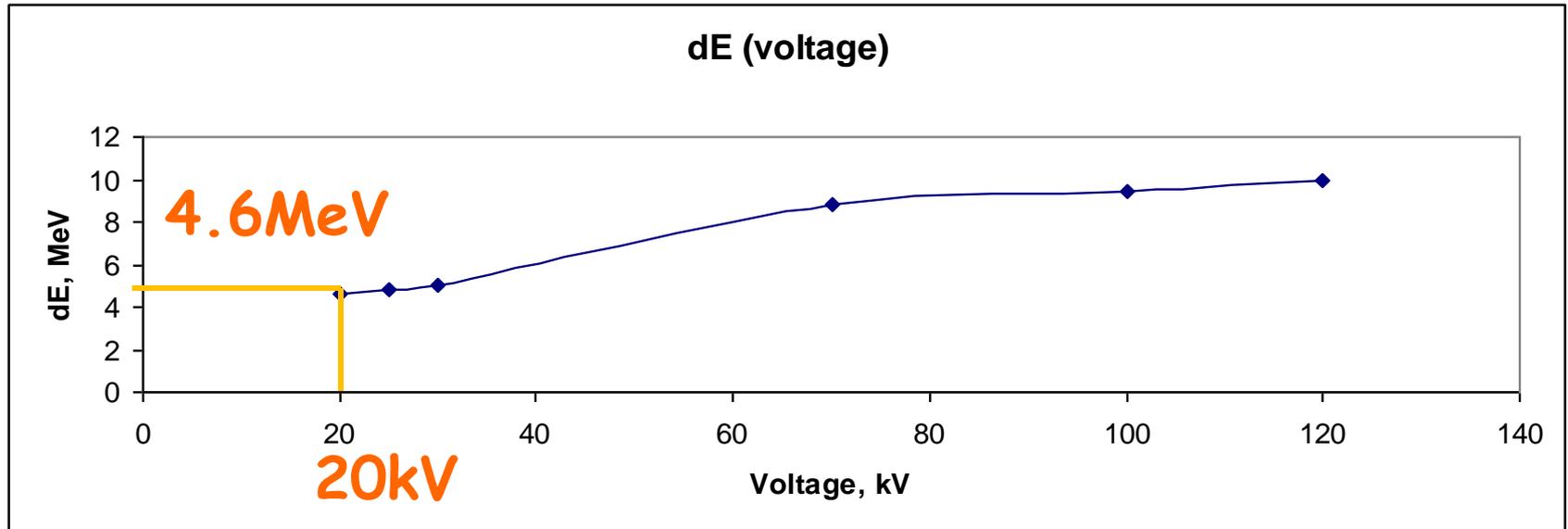
● **Need higher rf voltage and smaller energy spread.**

8GeV coalecing efficiency

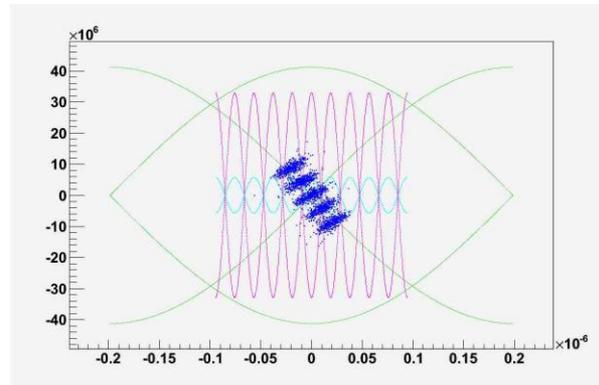
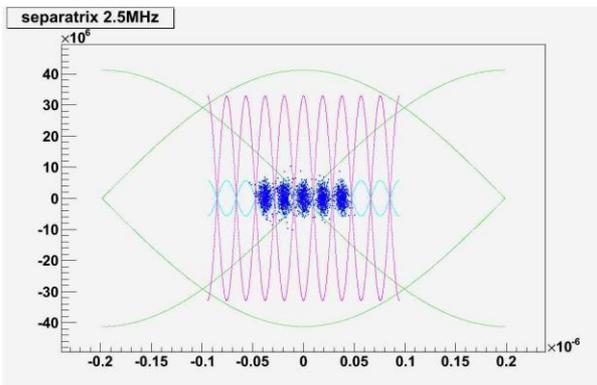


● Required energy spread $dE < 3 \text{ MeV}$

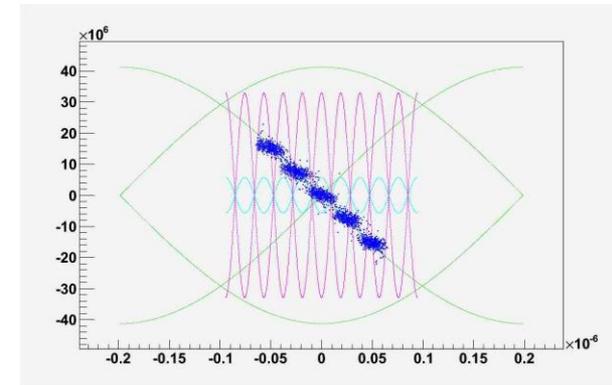
Adiabatic voltage reduction



Bunch stretching on the unstable fixed point

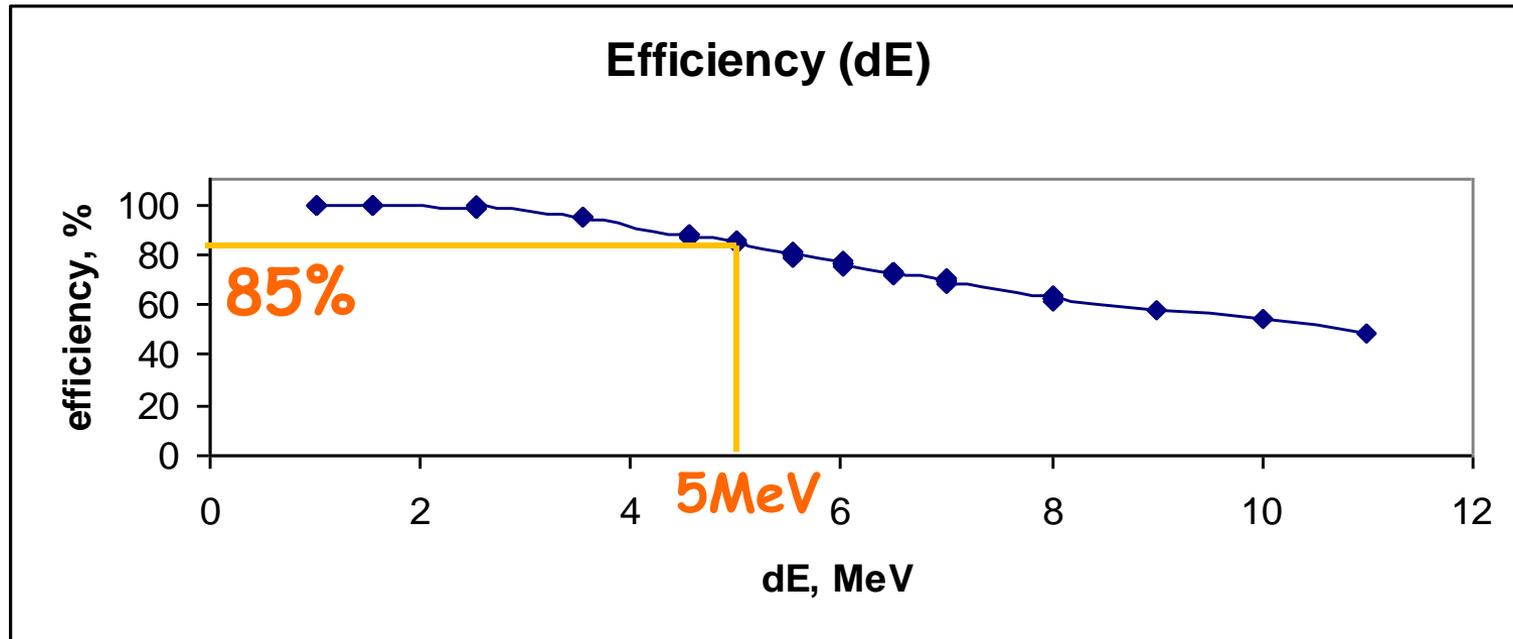


**Rf phase was jumped
by 180 degree**

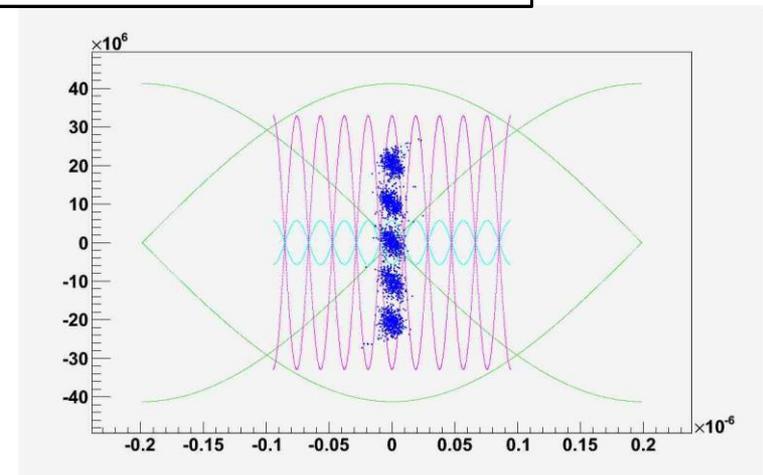


**Phase was jumped
to 0 deg. again**

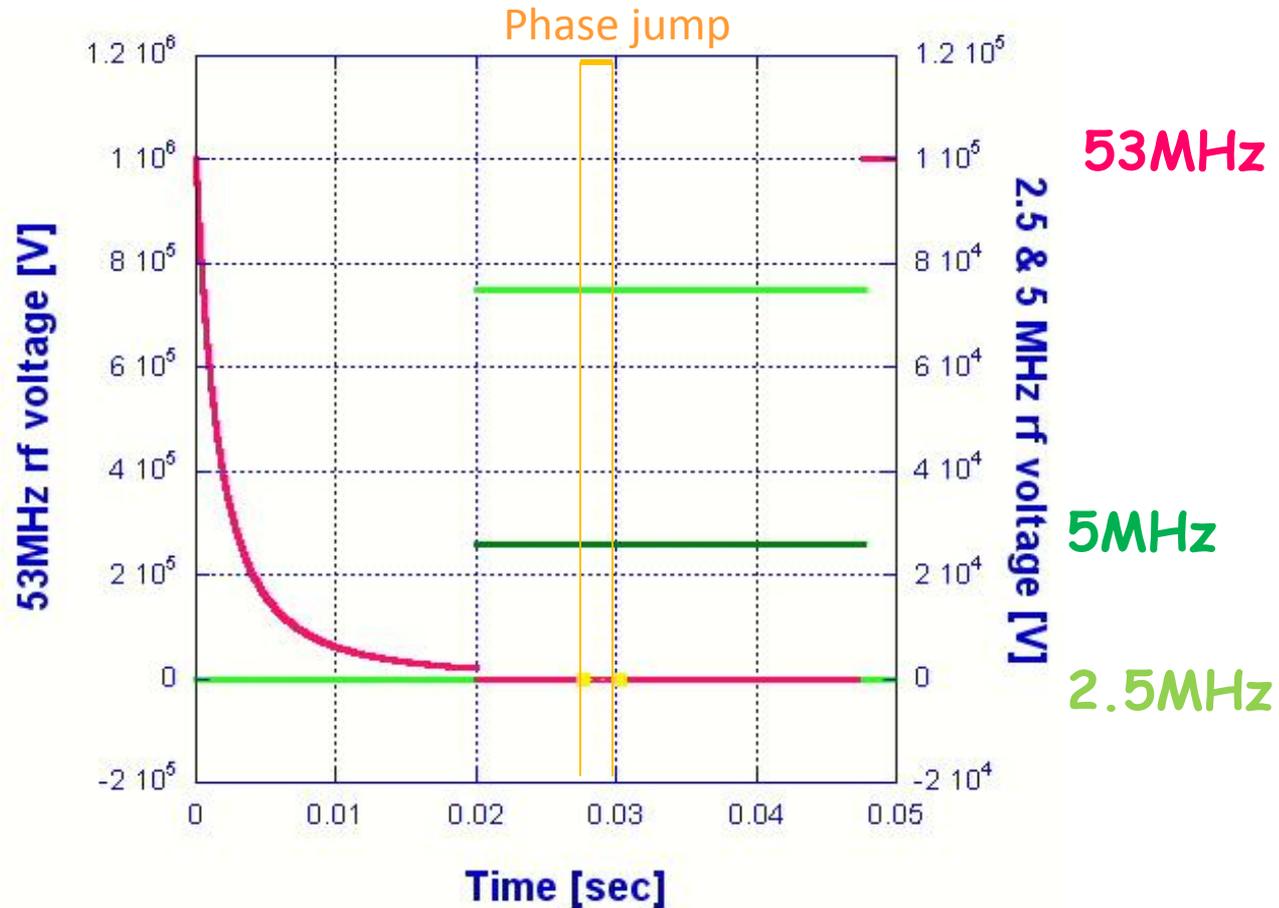
8GeV coalecing efficiency with stretching



- Required energy spread with stretching $dE < 5\text{MeV}$

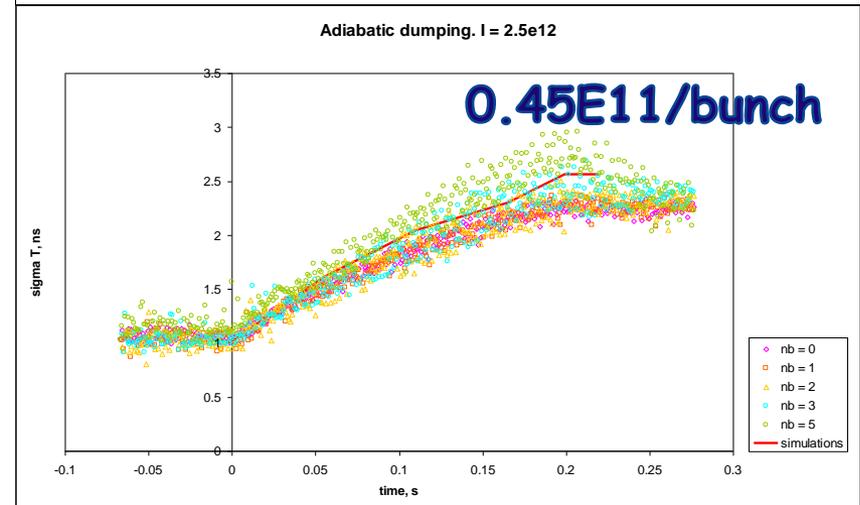
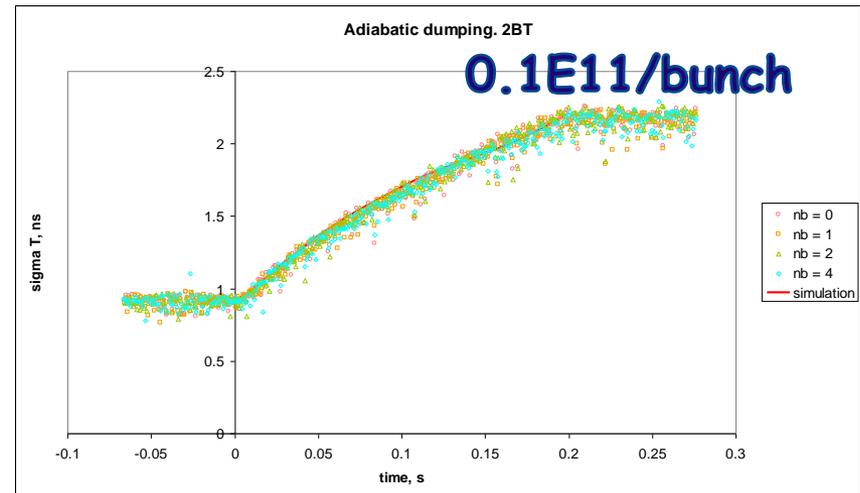
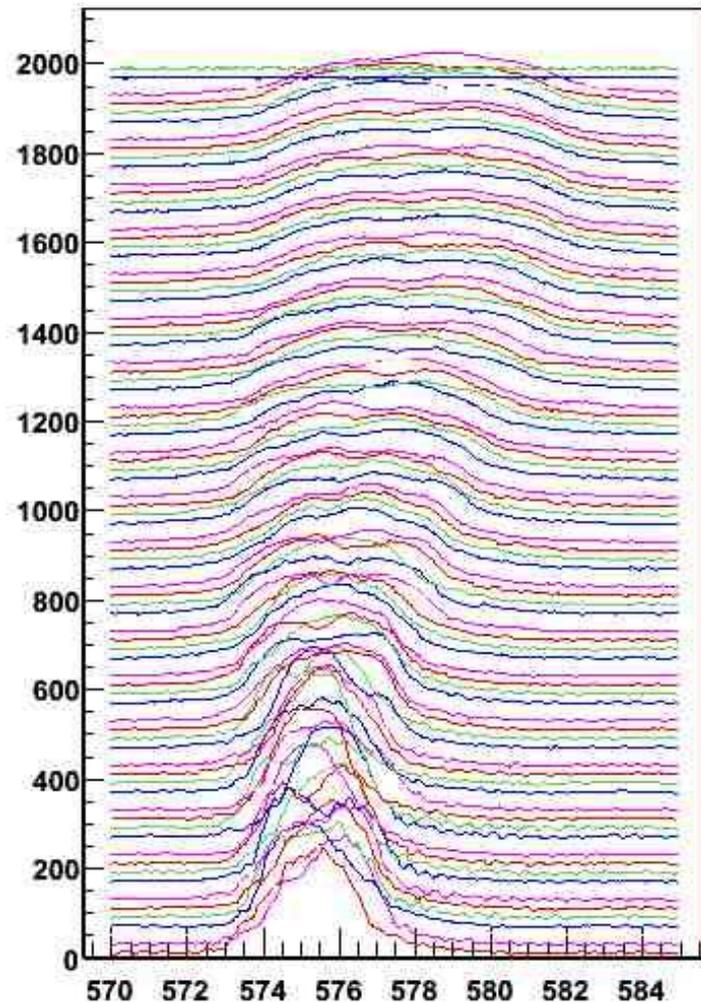


Required rf parameters



- Required time resolution $< \pm 60 \mu\text{sec}$
- Current LLRF system $\sim 1.3 \text{msec}$ (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.