Space-Charge Studies on 6D Ionization Cooling Lattices

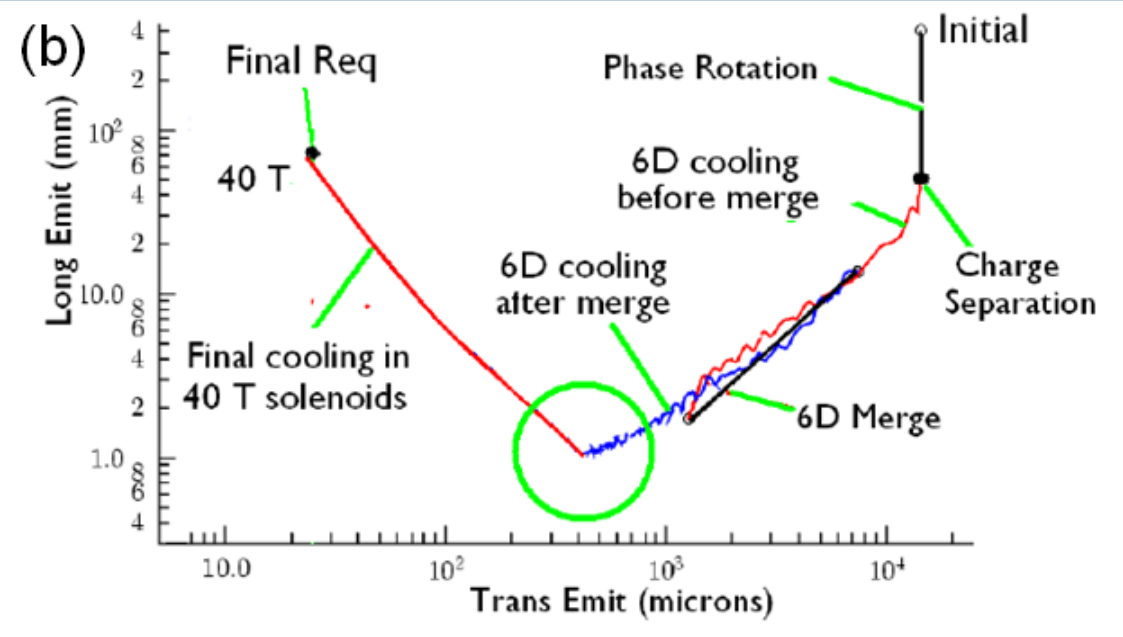
Diktys Stratakis

Brookhaven National Laboratory

AAG Group Meeting

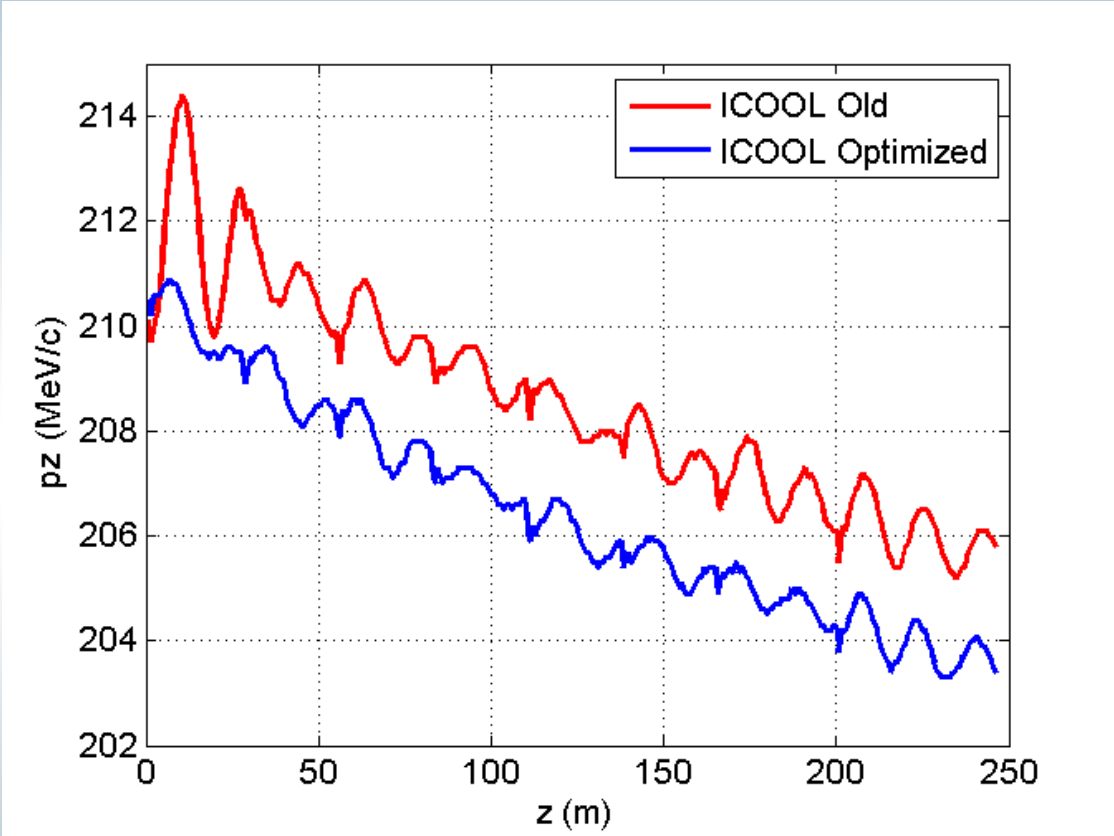
May 02, 2013

Cooling Baseline for a MC



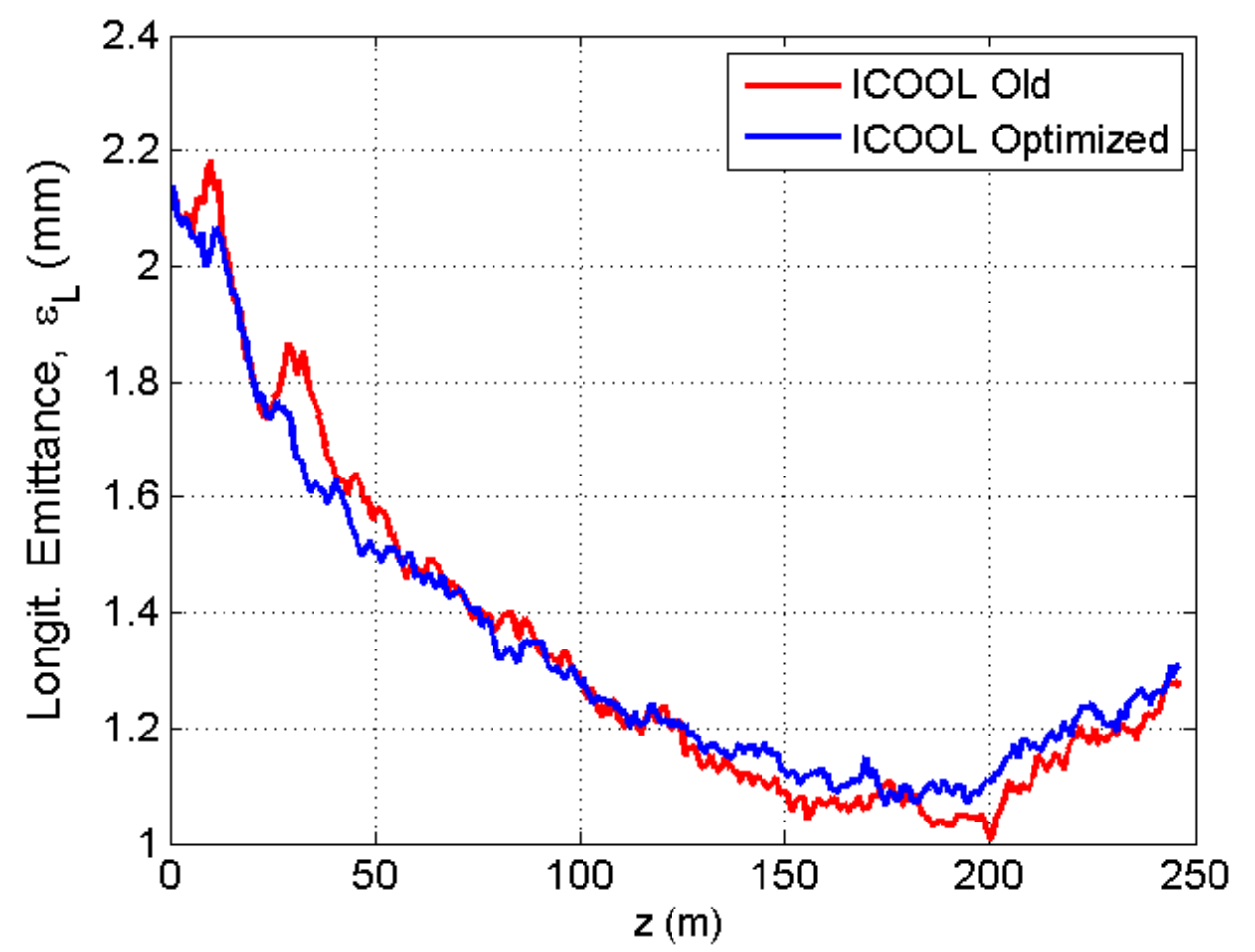
- Last stages of the Post merge cooling lattice:
  - Beam rms bunch length is short (~2cm)
  - ~4x10^12 muons per bunch -> 4.6 kA current
  - Space-charge effects may exist

Beam Matching (1)

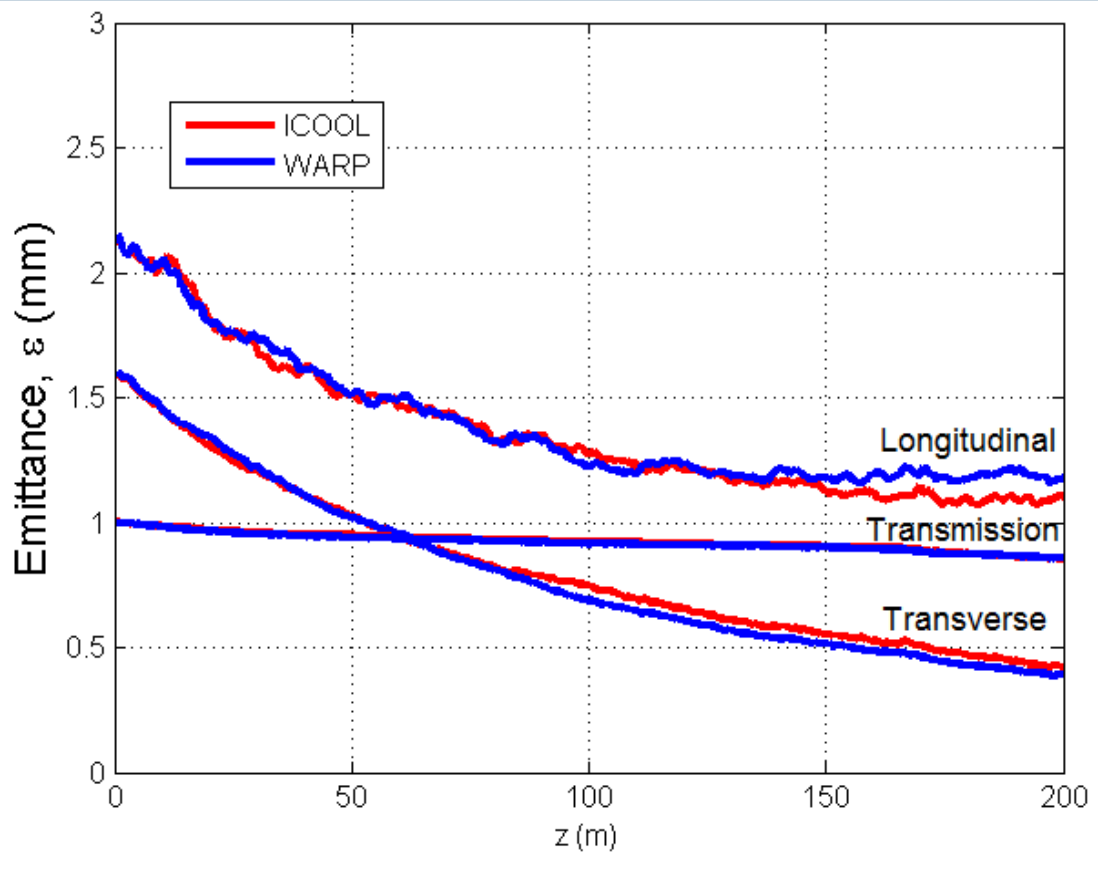


- Last 8 stages of the post-merging Guggenheim
- Minimized momentum oscillation

Beam Matching (2)

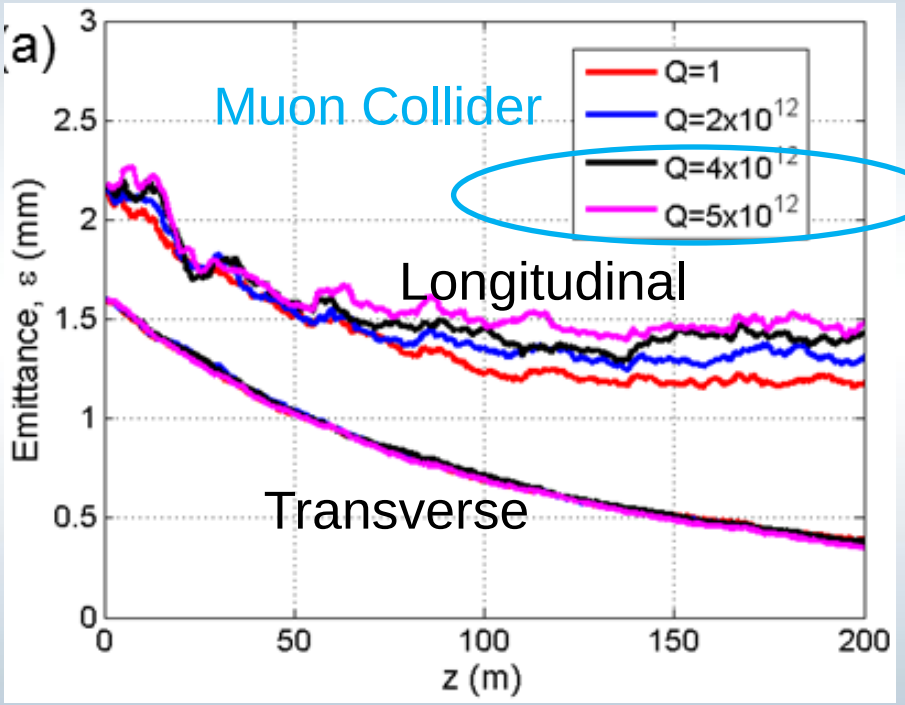


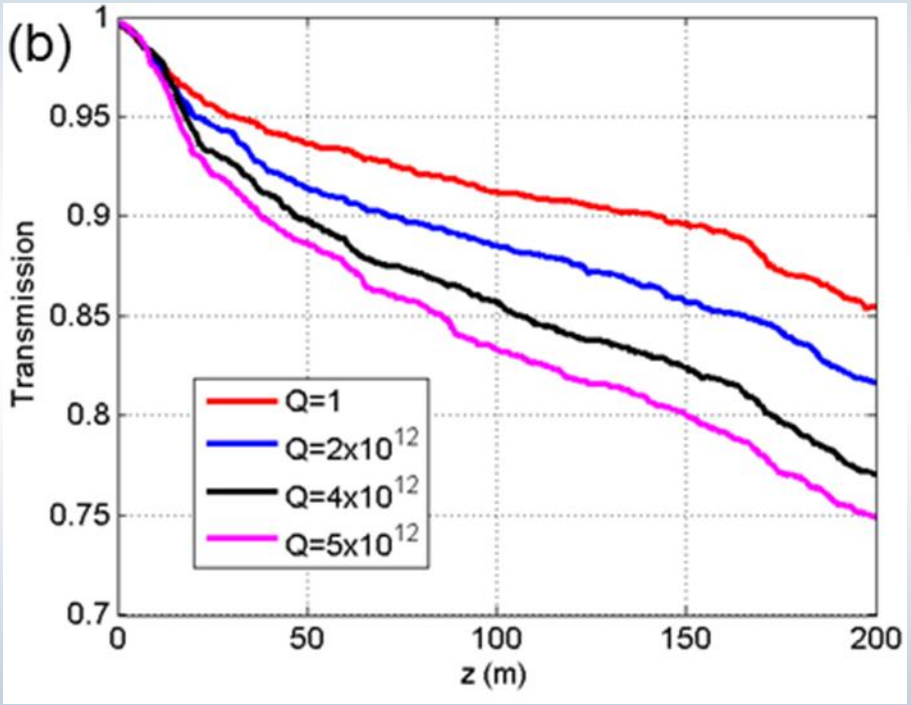
Comparison with WARP Code (Q=1)



- Benchmark WARP for the no space-charge case

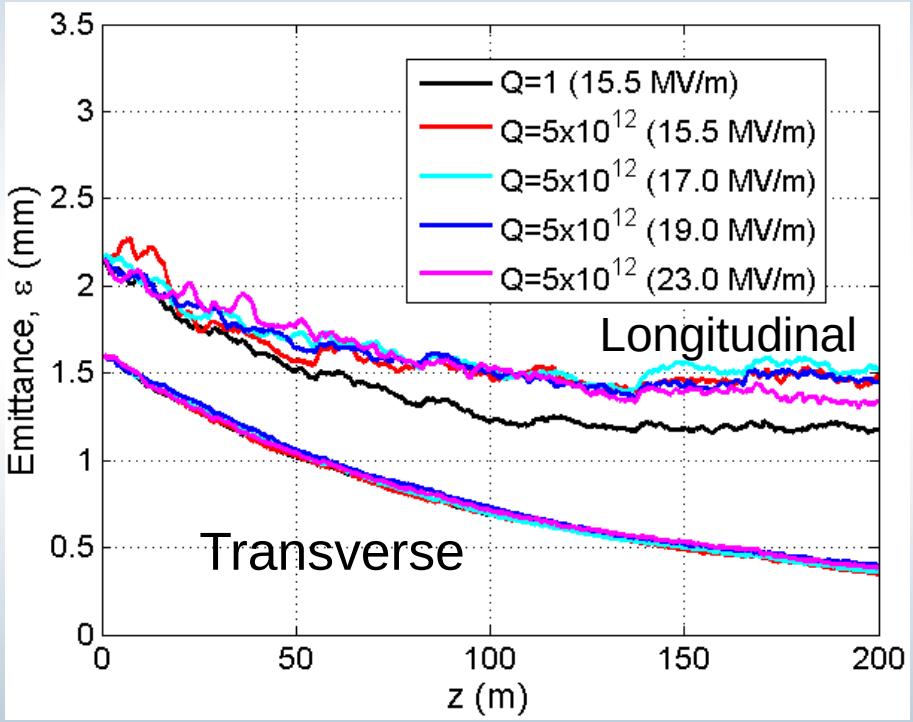
WARP with Space-Charge (1)

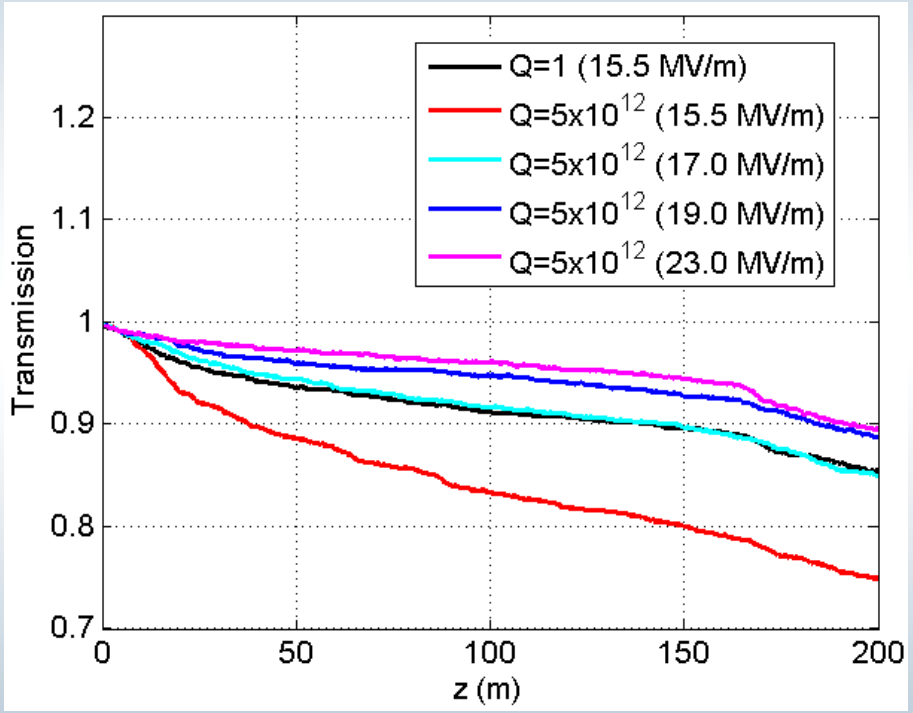




- SC causes particle loss and opposes longitudinal cooling
- SC do not affect the transverse cooling

Space-Charge Mitigation





- Raising rf voltage mitigates SC effects
- Still cooling below 1.5 mm is very hard

Conclusion

- Matching by tuning rf phases and reference momentum
- Full space-charge simulation with WARP
- Space-charge opposes cooling below 2 mm and causes substantial particle loss
- Effect can be mitigated for rf voltages higher than 17 MV/m
- Still cooling longitudinally below 1.4-1.5 mm is very difficult.