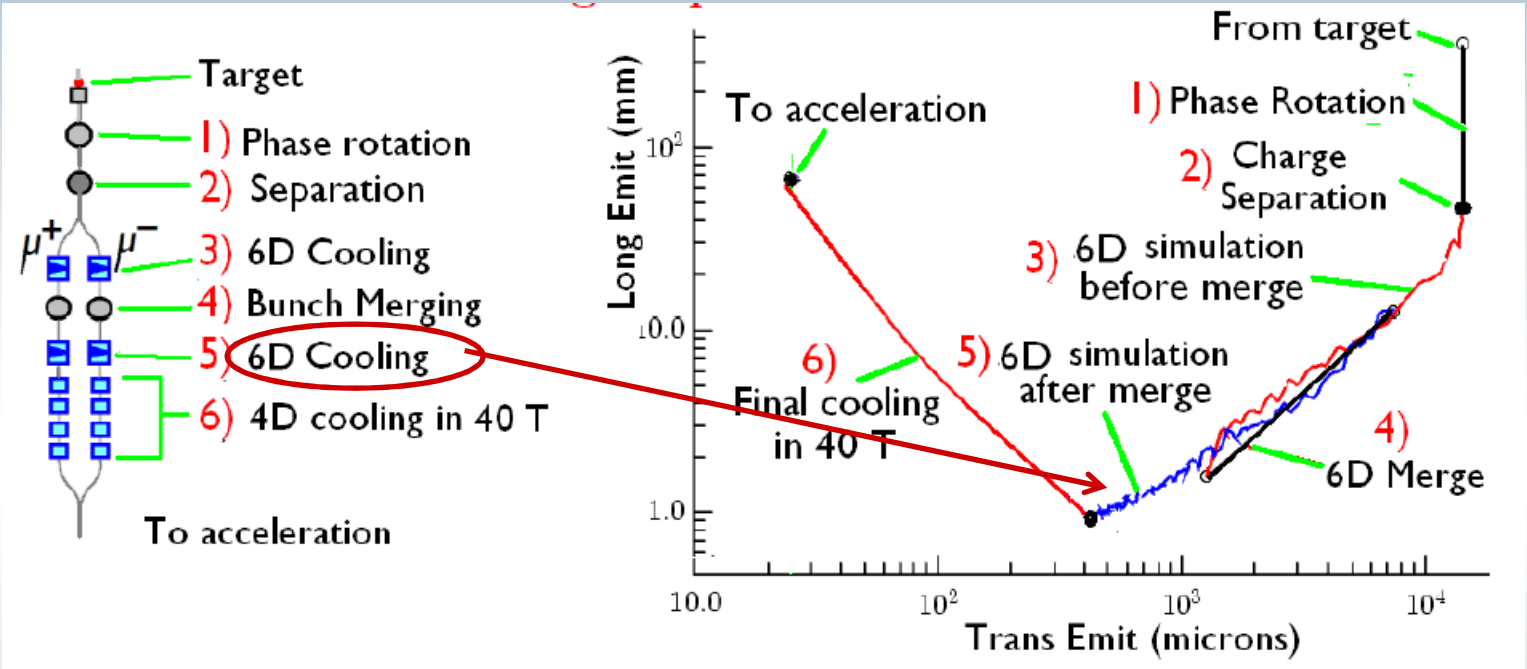
# Space-charge effects on ionization cooling lattices for muons

Diktys Stratakis
Physics Department
Brookhaven National Laboratory

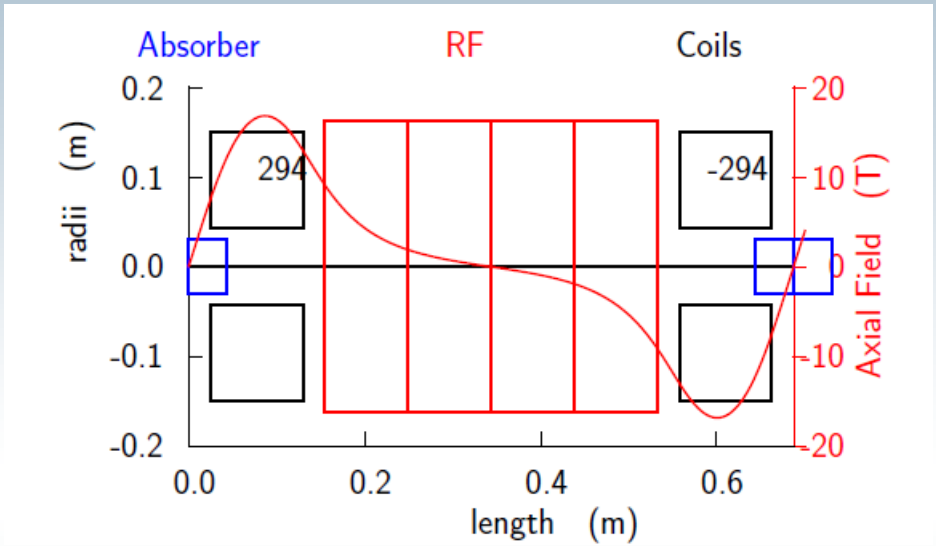
AAG Group Meeting
November 14, 2012

# Muon Collider Beam Cooling




- New born muon beam needs to be cooled transversely and longitudinally
- Most stages have been simulated so far
- Simulations did not consider Space-Charge (SC) effects

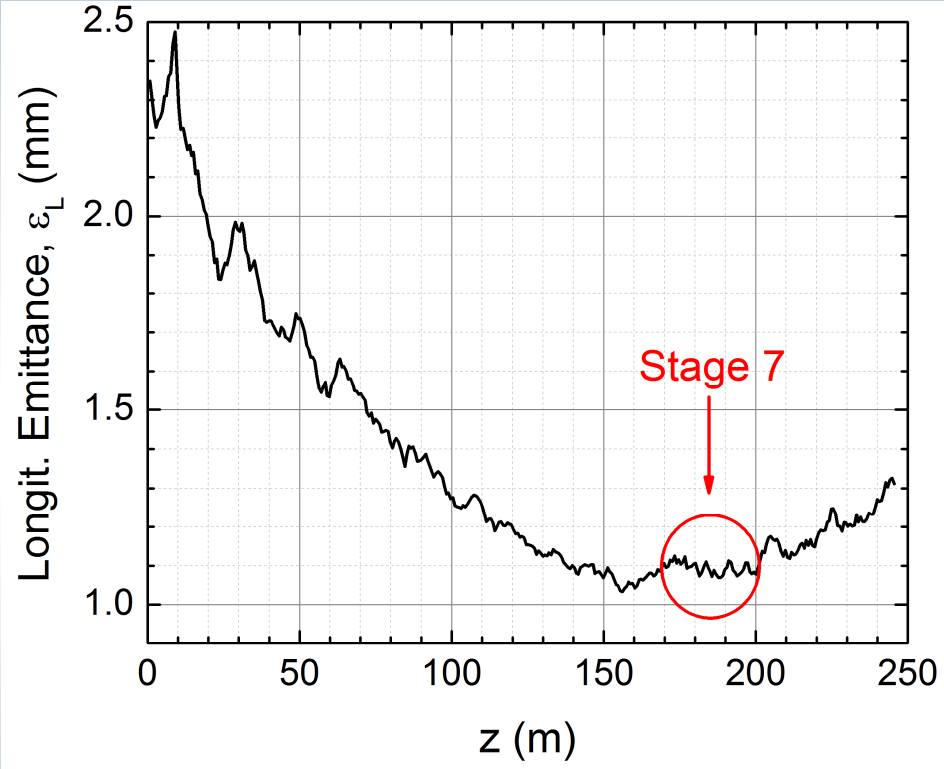
# Post-Merging 6D cooling channel

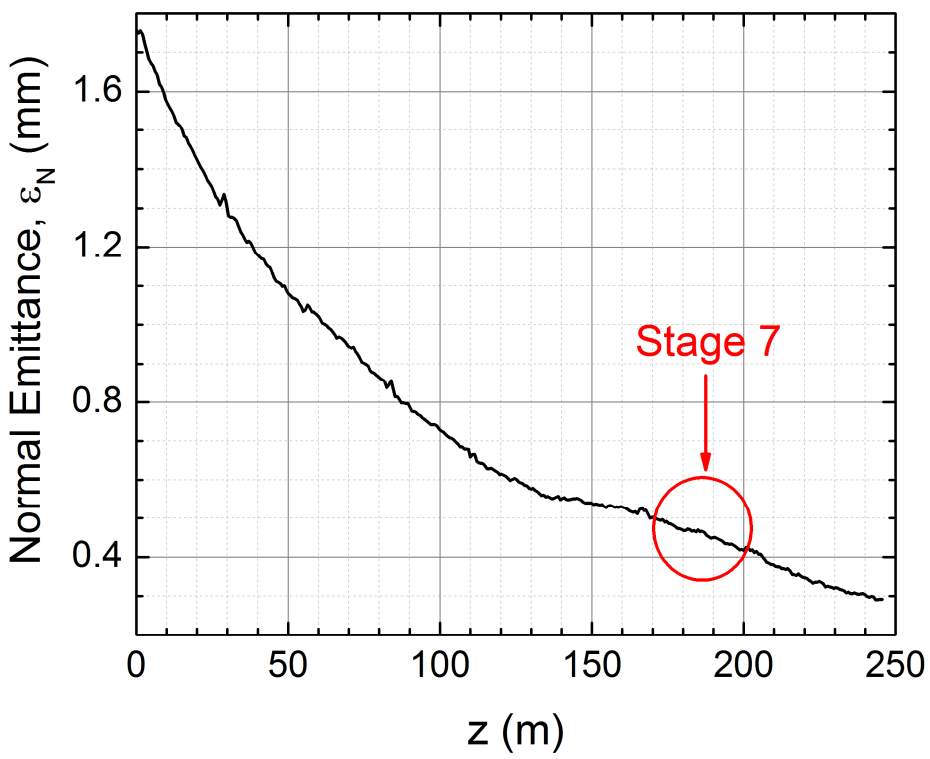



.

- It is a 8-Stage flip-field lattice with 805 MHz cavities
- Mainly LH absorbers except last stages that contain LiH
- Longitudinal cooling done with an emittance exchange matrix (2D simulation)

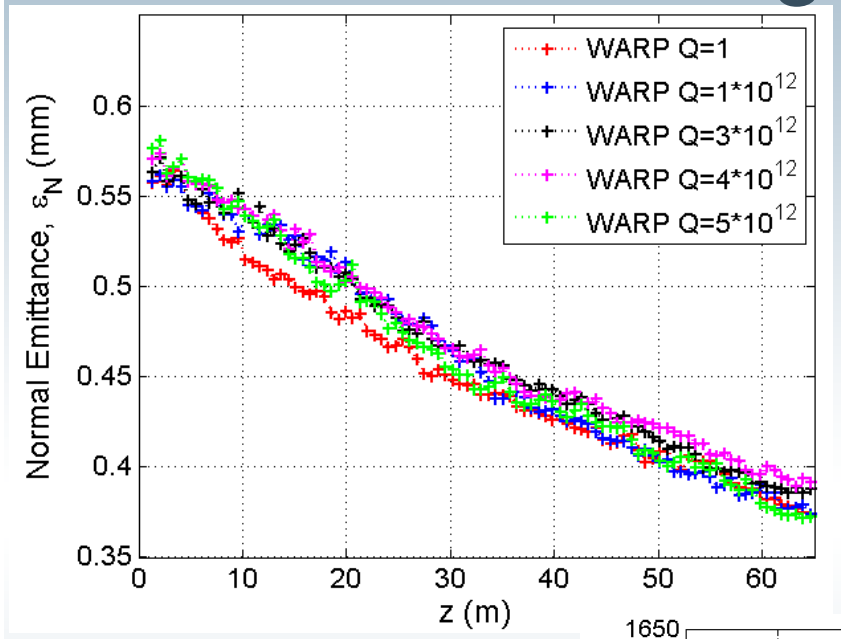
# Cooling with all 8-Stages

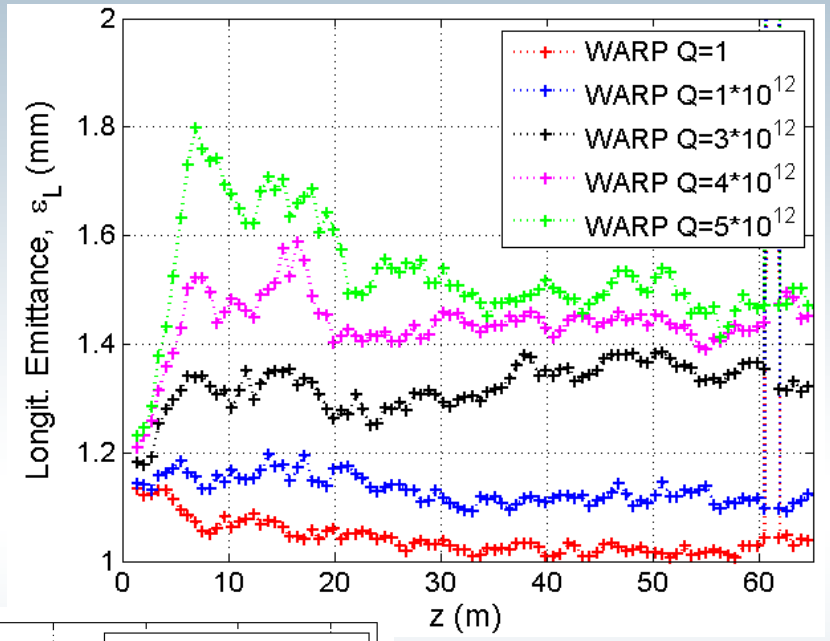


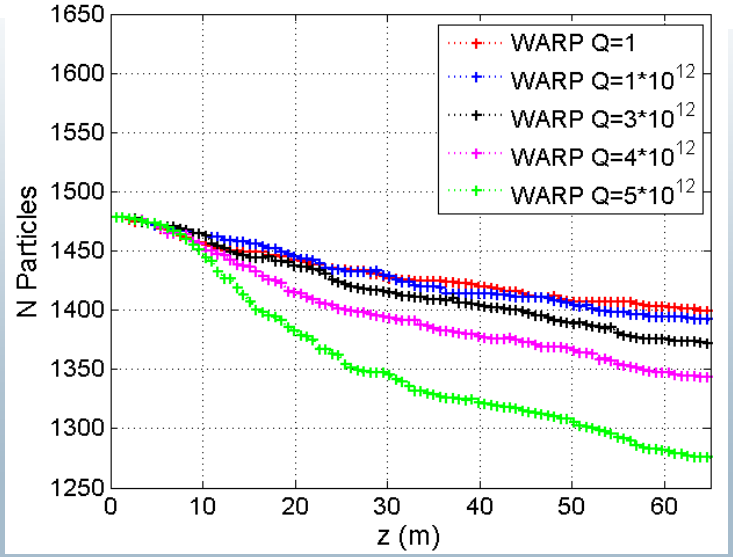




- Based on those results I decided to perform space-charge studies for Stage 7.

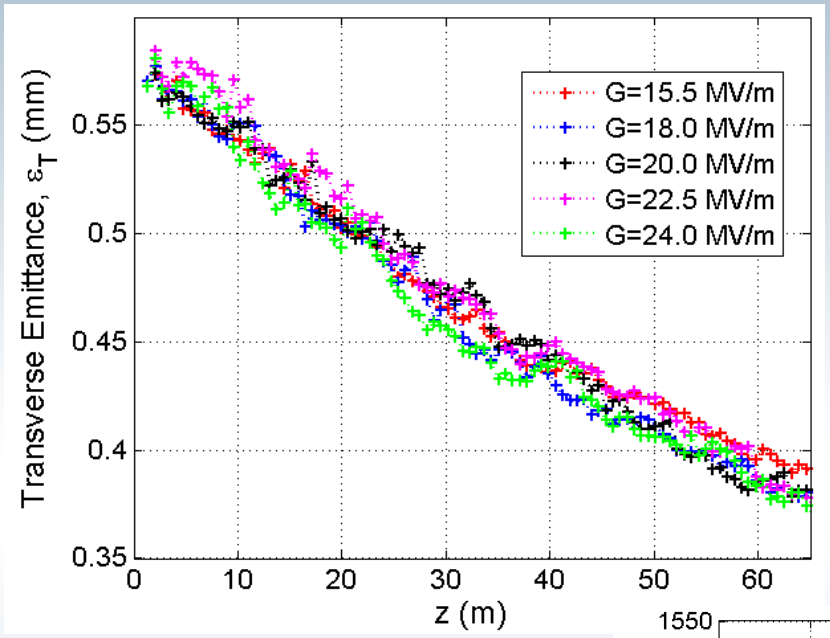
# Muon Cooling with Space-Charge

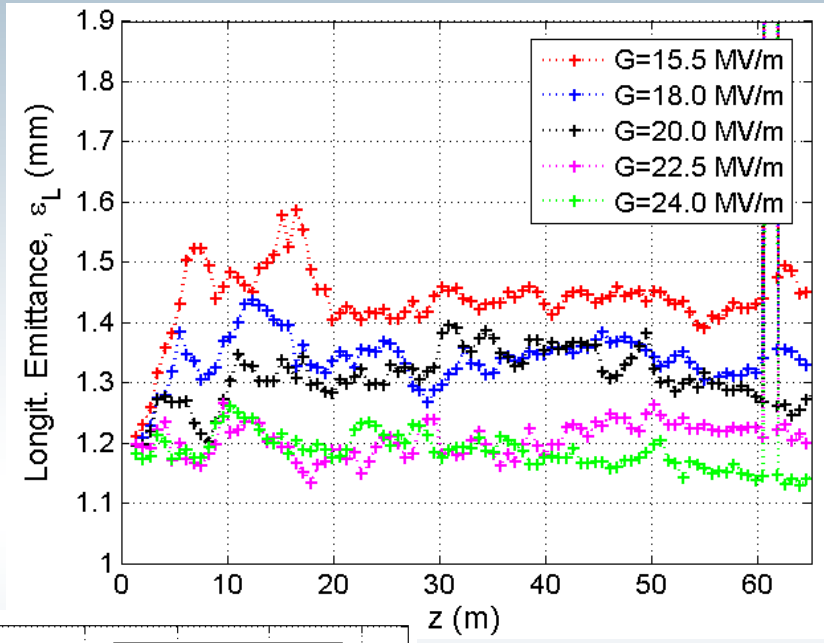


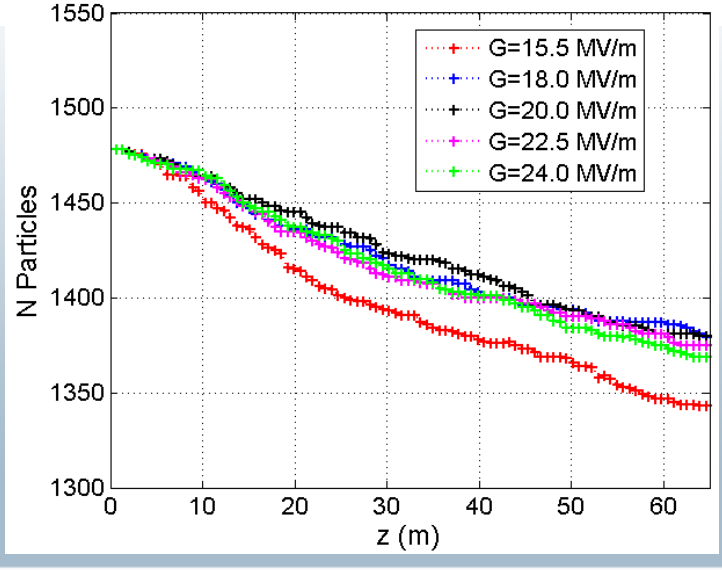



# Varying rf gradient for Q=4x10$^{12}$



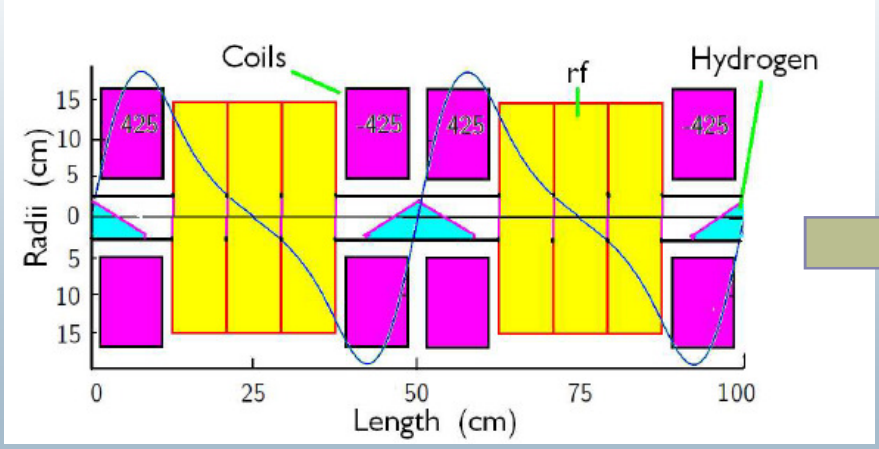



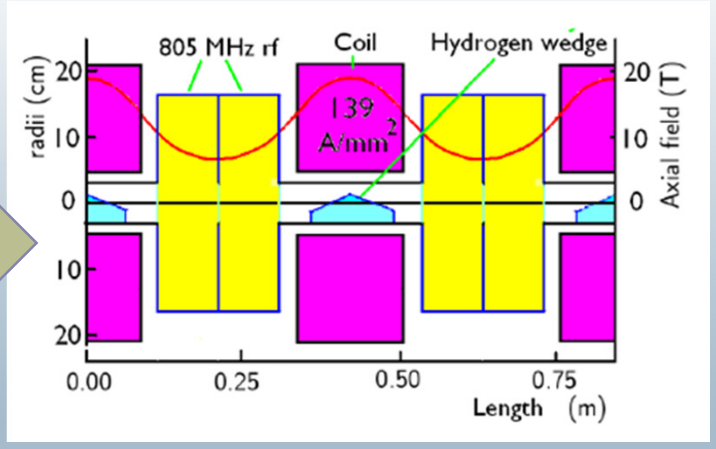
# Next Steps & Conclusions

- Muon bunch at post merging stages has Q~4-5x$10^{12}$
  - WARP calculations suggest that if Q is greater than 3x$10^{12}$ space-charge forces are present
  - Space-charge can be compensated by increasing rf gradient. Stage 7 with > 20 MV/m will work.
  - Next, I will vary the pipe radius
  - Next, find the optimum longitudinal emittance.
    - Still some simulation issues with Stage 1 or Stage 2
  - Increase number of particles
    - “Generate” a distribution with similar rms parameters

# Non-Flip Lattices (Fernow/ Palmer) (1)

- Palmer proposed a non-flip lattice for the post-merge Guggenheim to reduce space-charge effects
- So far, simulation only in 2D and longitudinal cooling is done with and emittance-exchange matrix.
- Rick and I are working on a full 6D cooling simulation
- Develop models in ICOOL and G4BL



# Modeling first stage in G4BL

- Ring was created in G4BL
- Next step is to track particles and compare with ICOOL