Hard Edge Simulation of TETRA Ring in GEANT (again)

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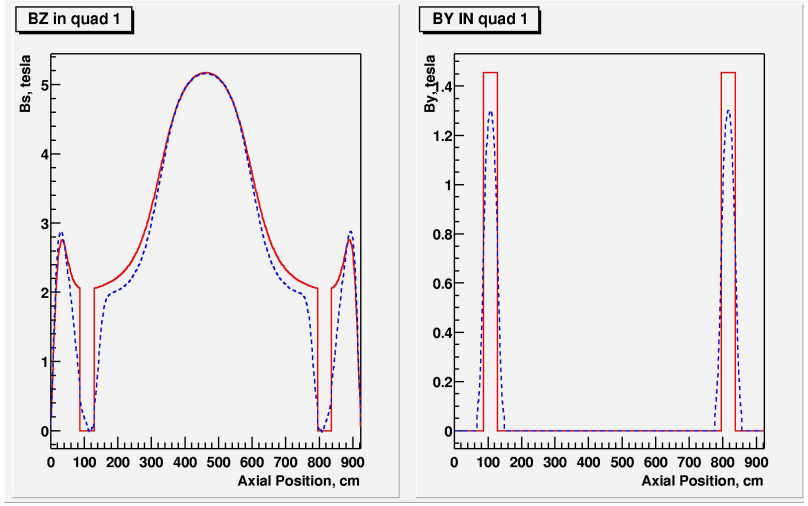
Why No Progress With Realistic Fields

- Need to Understand the GEANT with Hardedge Fields before Attempting Realistic Fields.
  - My attempts (and others) have reported large losses in using GEANT with this simulation.
- Valeri Balbekov has shown that one can achieve a reasonable amount of cooling with reasonably good transmission through this TETRA ring.
  - Rick Fernow has similarly achieved similarly good results with a high FoM for the TETRA ring in ICOOL.

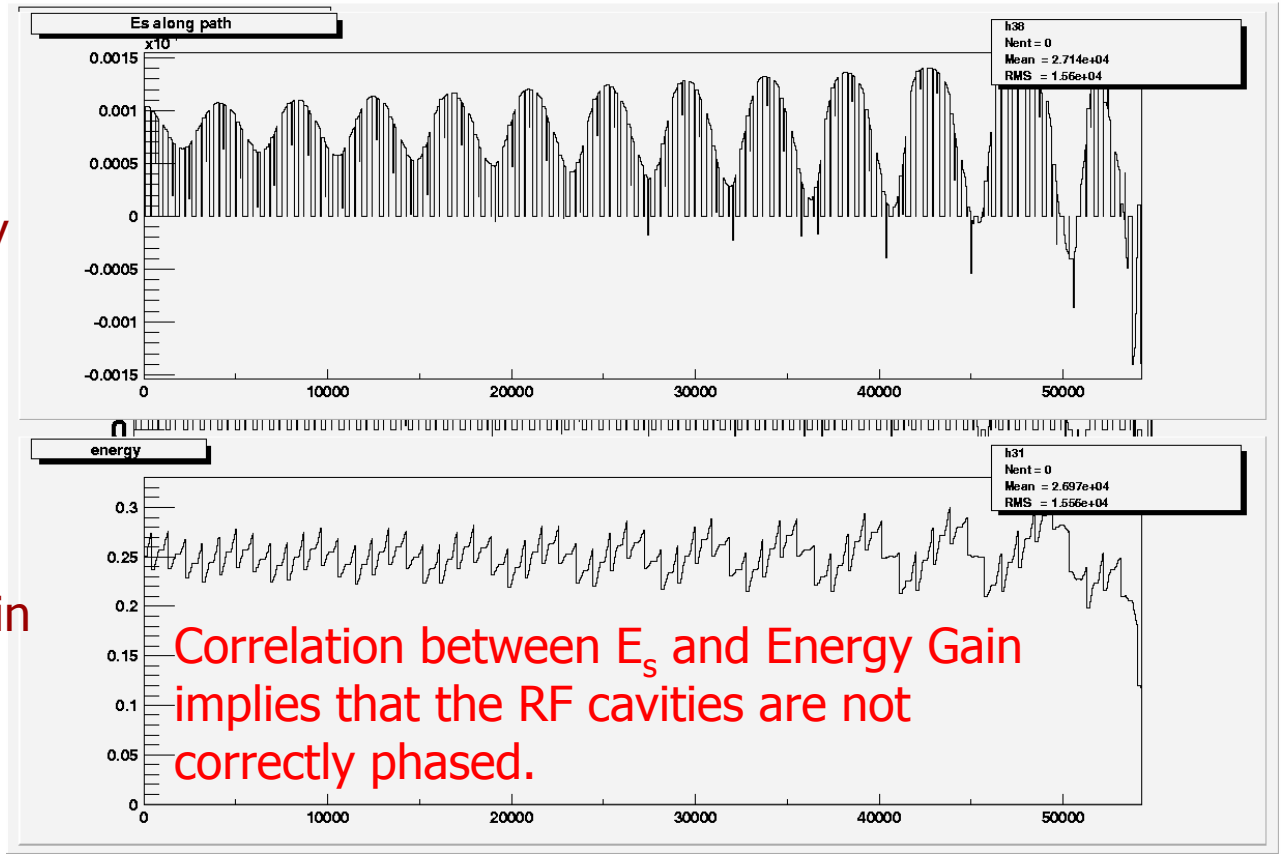


•Field maps of the solenoids have been supplied to Makino and Berz for use in their COSY model.

Concern whether RF is Properly Phased

E_s at cavity center

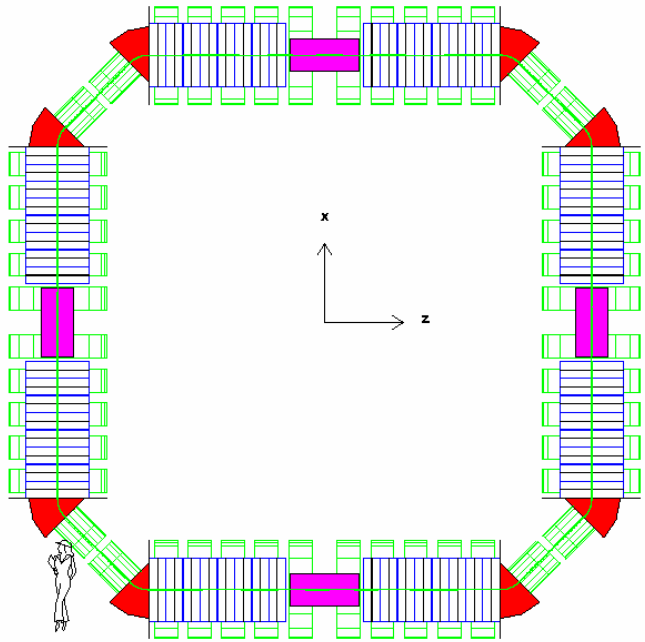
Energy Gain



Correlation between E_s and Energy Gain implies that the RF cavities are not correctly phased.

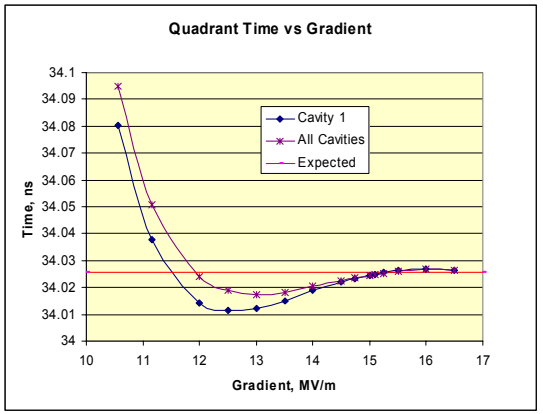
Reference Track to Phase RF Cavities

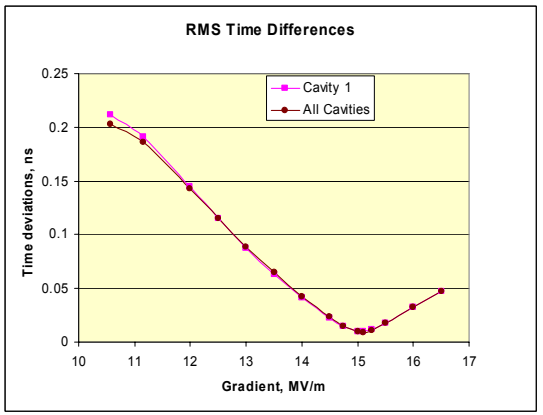
- Figure shows a reference muon circulating in the ring for 20 turns.
  - Reference track is launched on axis with ideal P_μ and no P_T.
  - RF cavities are active.
  - Absorbers are present.
    - dE/dx is turned on but no random processes are.
  - Track shows very little deviation from axis (shown on next transparency).



Phasing the RF — Looking at Path Time

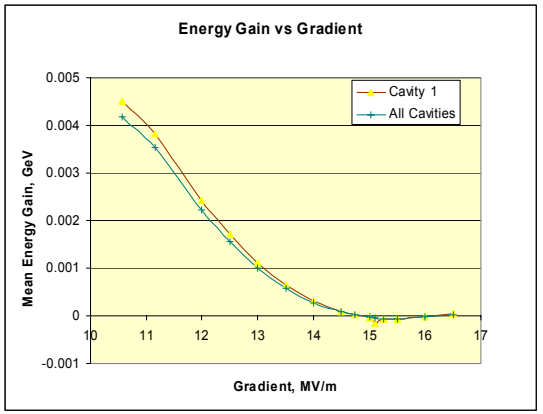
- The top figure shows the path time that the reference particle traverses one quadrant.
  - Only the gradient is varied.
  - RED line indicates what is expected from frequency.
- The lower figure shows the RMS variation of the path time for
  - Cavity 1 in the four quadrants of turn 1.
  - The quadrant path time for all cavities in turn 1.
- These figures indicate that the correct gradient is ~15.1 MV/m.

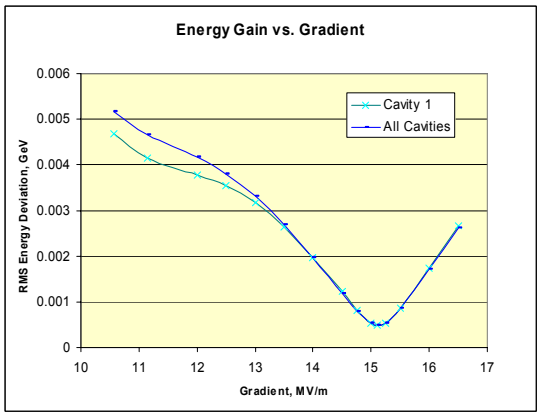




Phasing the RF — Looking at Energy Gain

- The top figure shows the mean difference in energy gain between corresponding cavities in adjacent quadrants for the 1st turn.
  - Ideally this difference should be zero. All cavities in all should have the same energy gain difference.
- The lower figure shows the RMS variation of the energy gain differences between corresponding cavities in adjacent quadrants.
- Both figures also imply that the ideal gradient should be ~15.1 MV/m.

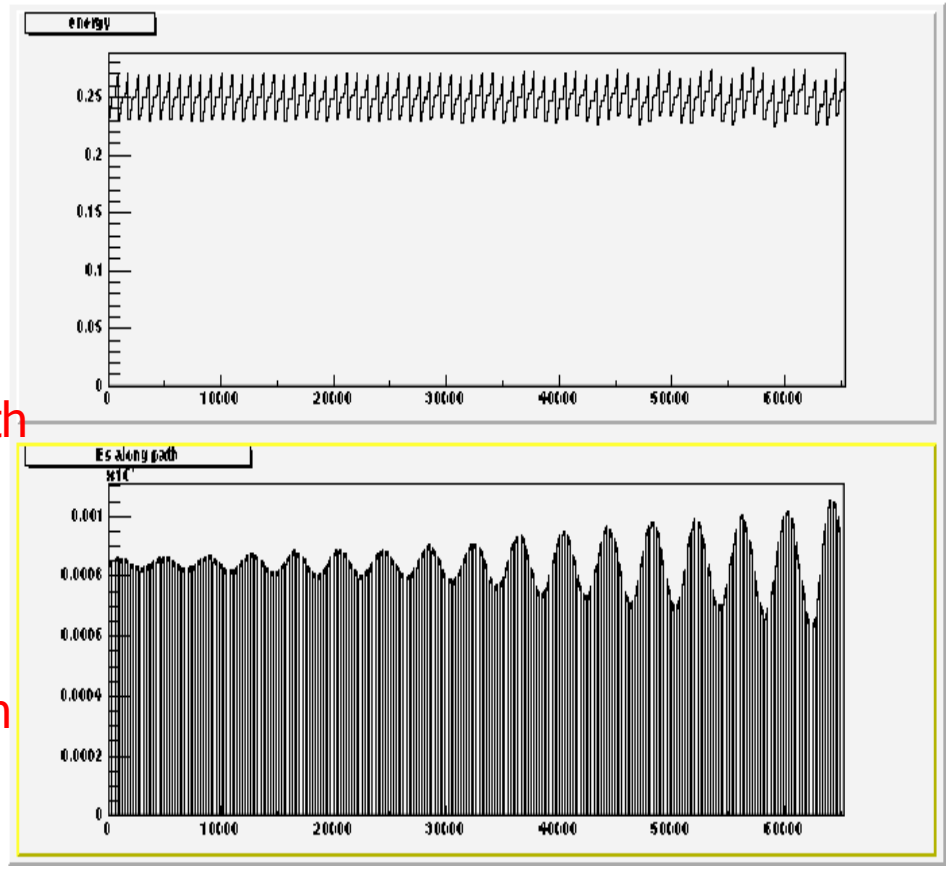




Using the Optimized Gradient

- The reference particle sees a more stable E_s and energy variation along its path at least during the early turns.

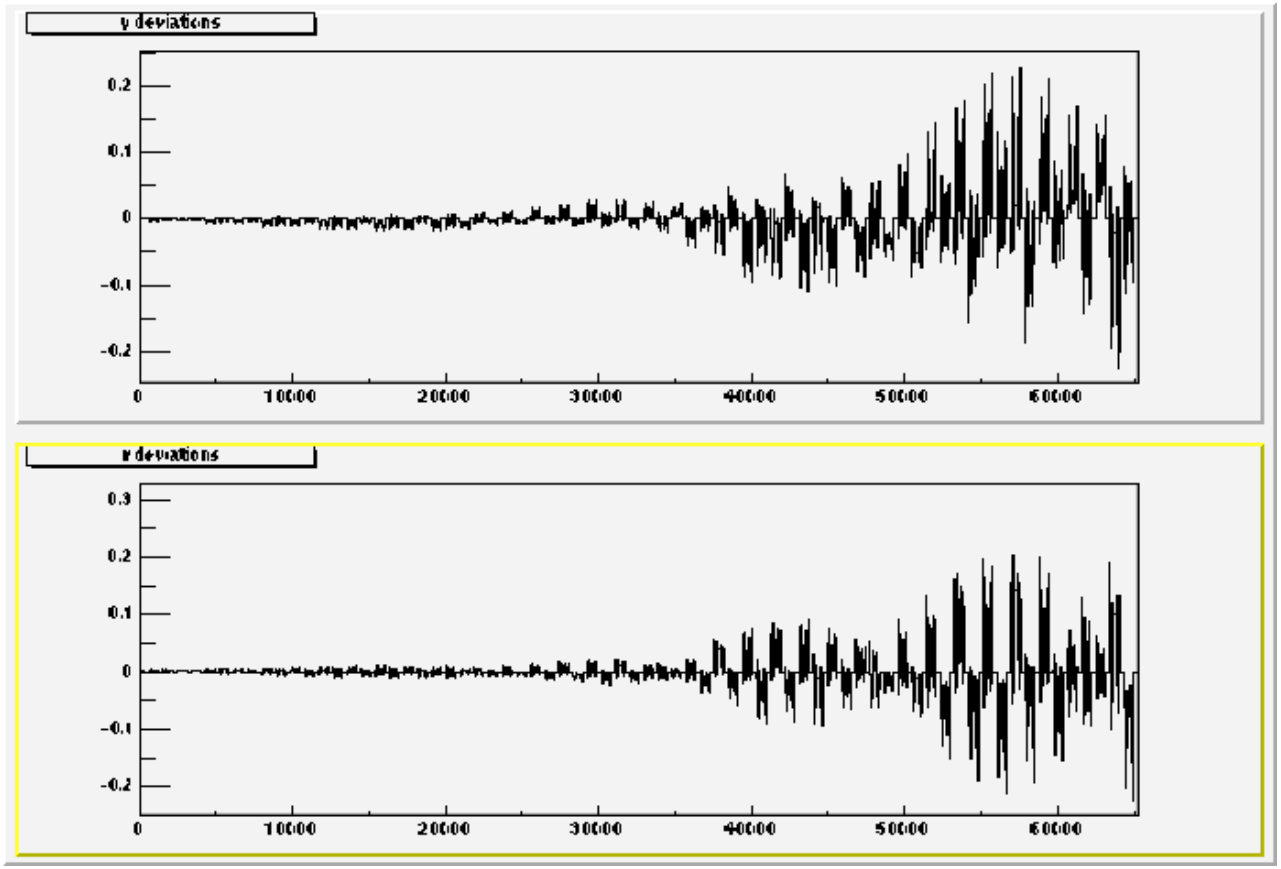
Energy along Reference Path



- There is still room for improvement.

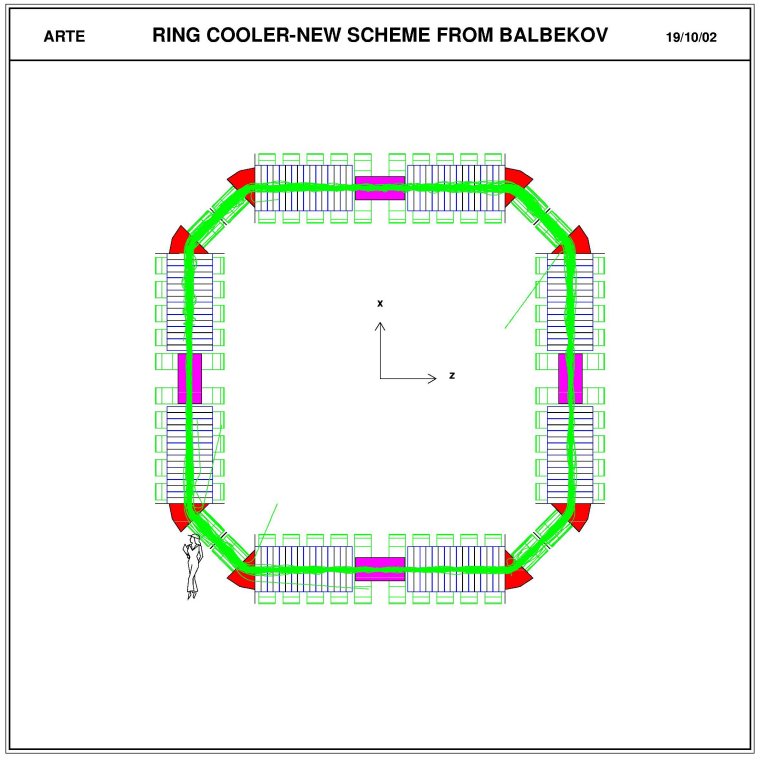
E_s along Reference Path

Deviations of Reference Particle from Ideal Orbit



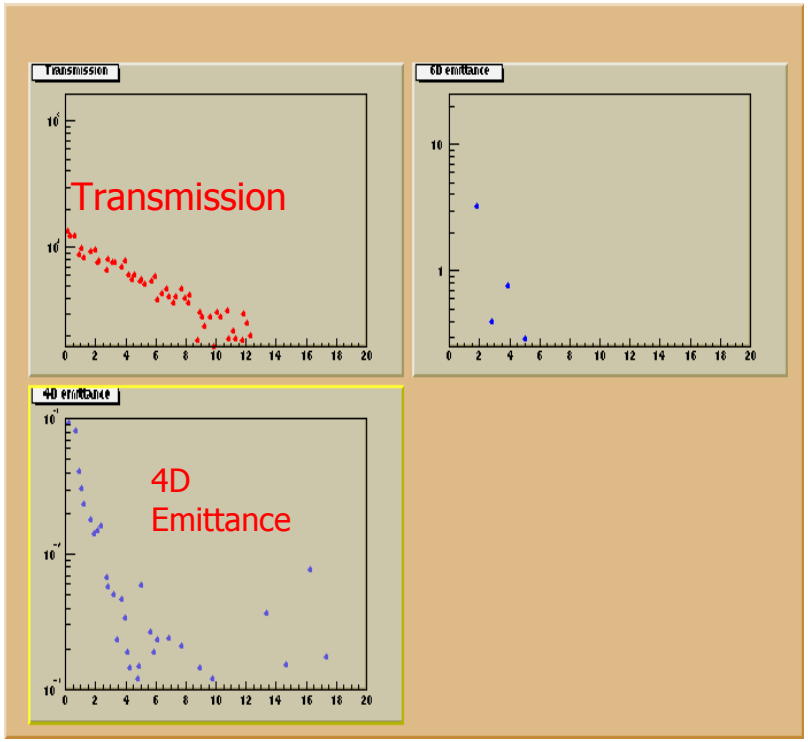
Typical Run

- Figure shows 20 particles passed through ring with RF on and wedges in place:
  - $\sigma_x = \sigma_y = 4$ cm, $\sigma_{ct} = 8$ cm
  - $\sigma_{PT} = 32$ MeV/c, $\sigma_E = 18$ MeV
  - Correlation between E, P_T, B
  - No decays
  - No random processes
    - dE/dx is mean value
- Figure illustrates losses that typically occur in corner regions.



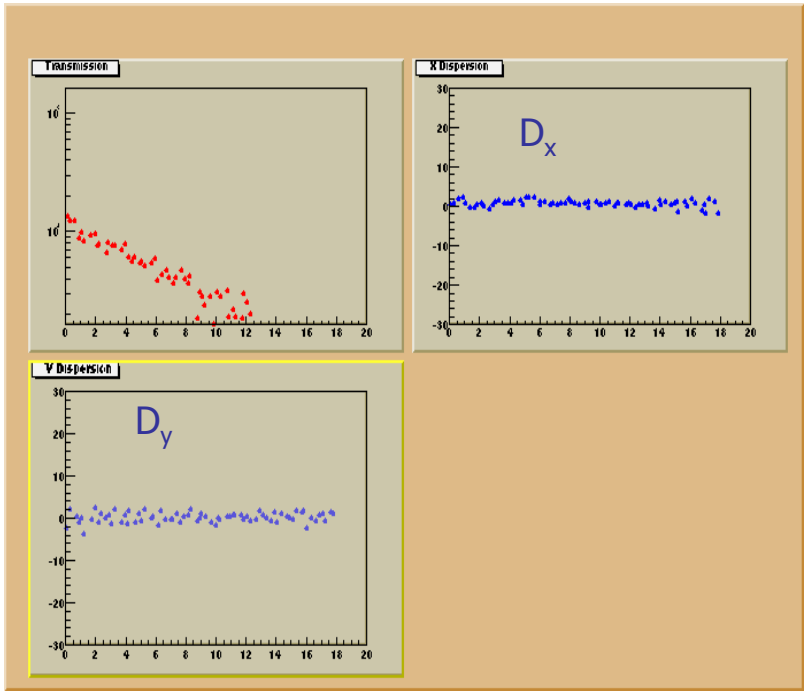
Emittance Calculations

- The figure shows the transmission, transverse emittance. (Ignore the 6D emittance, there is a problem with it).
  - The transmission drops to ~10% in 12 turns.
  - Emittance drops significantly but that is due to losses more than cooling.



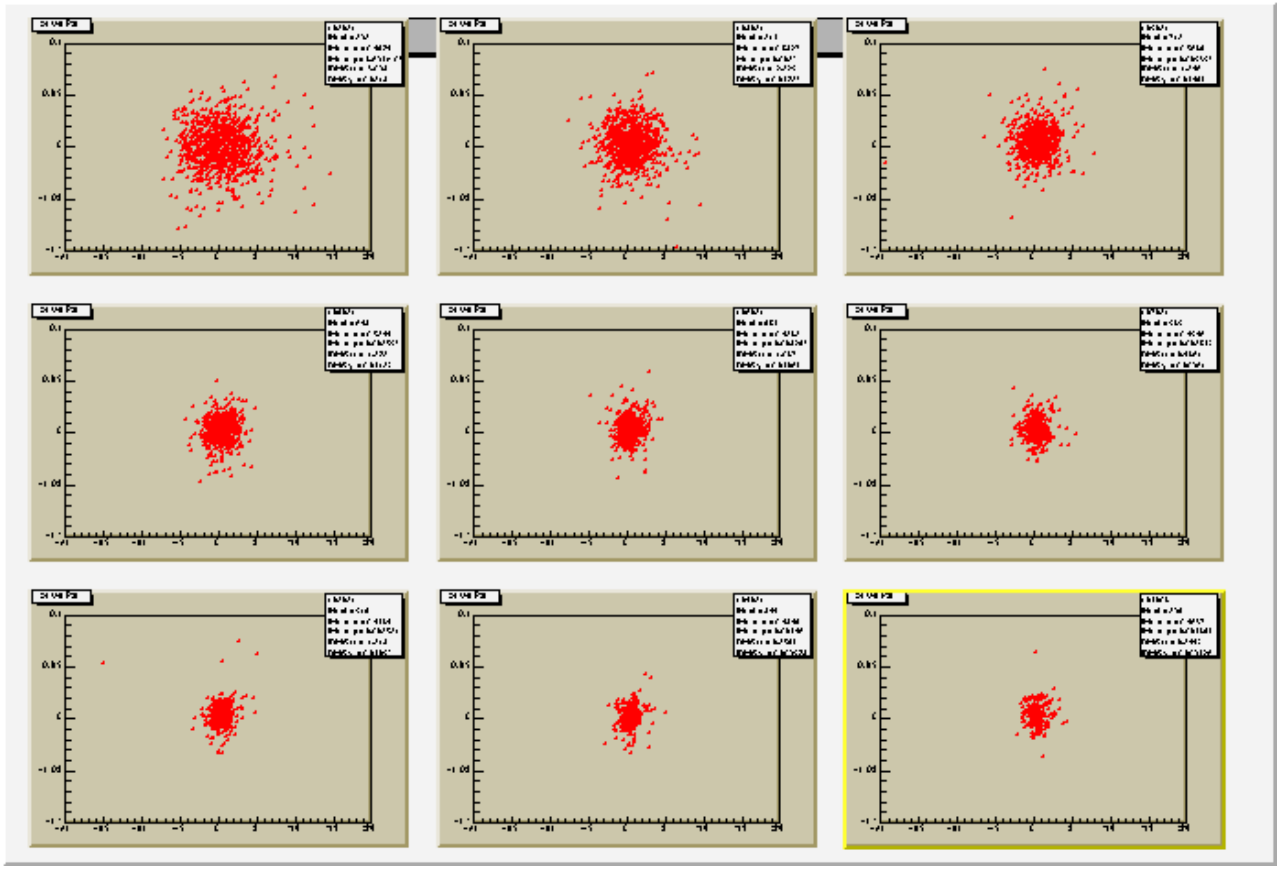
Dispersion Plots

- The figure shows the dispersion along the straight solenoid.



Transverse Phase Space Plots

P_x vs x at same position for 1st nine turns



Longitudinal Phase Plot

E vs. ct at same position for 1st nine turns