Low Level RF Effects on the Ring

J. Holmes (ORNL)

Overview

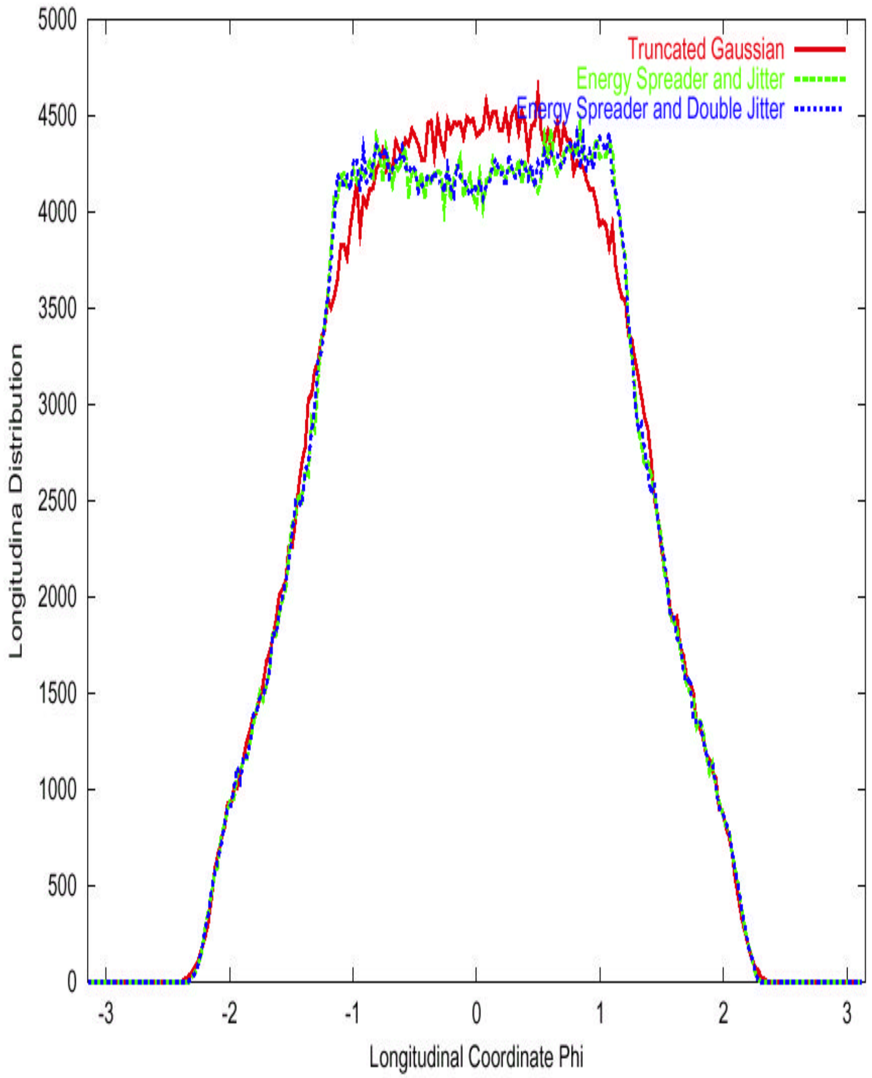
- **Most previous ring injection studies have been carried out using fixed analytic (truncated Gaussian) linac energy distributions at the foil:**
  - **Typically Sigma-E = 5 MeV truncated at +/- 5 MeV.**

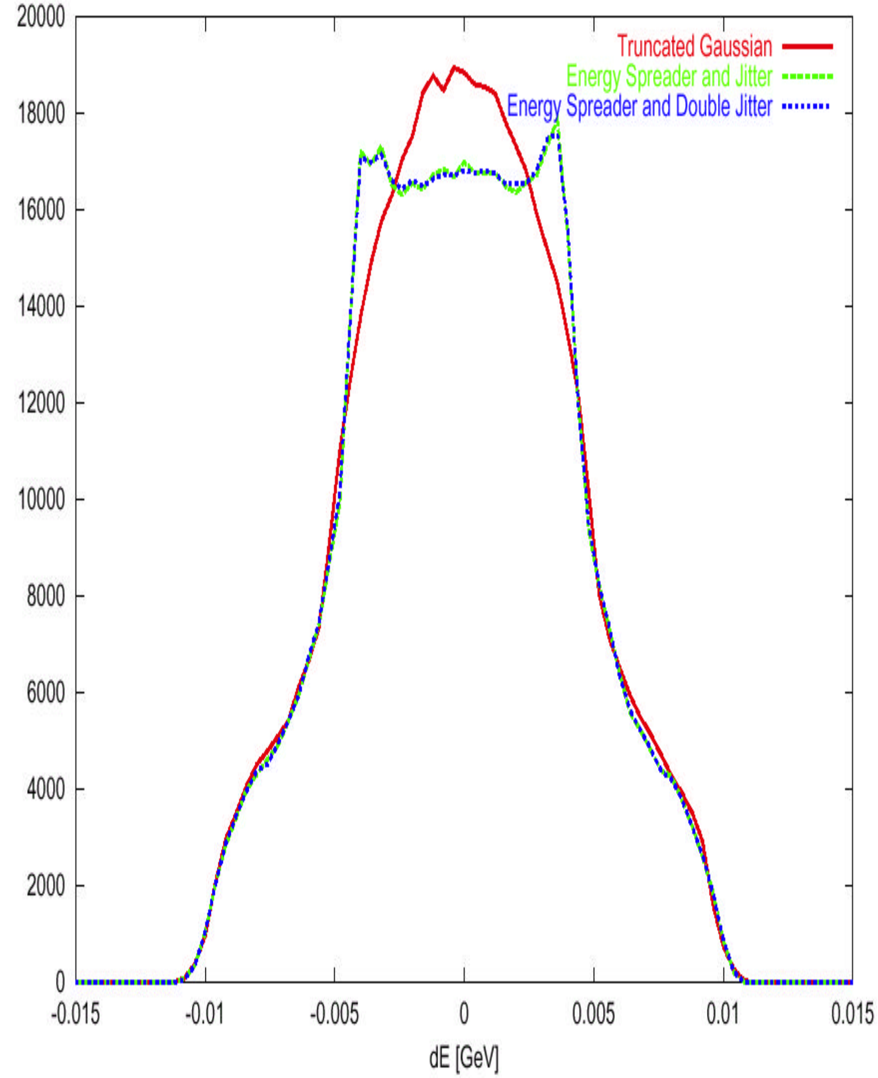
- **The present study is carried out using a time dependent linac energy distribution with three parameters:**
  - **Gaussian linac bunch with 99% energy spread = 0.33 MeV**
  - **Gaussian linac energy centroid jitter with 99% spread of 0.2 MeV (also did 0.4 MeV for comparison)**
  - **Time dependent sinusoidal energy spreader with amplitude of 4 MeV and frequency of 0.1 MHz.**

Case Considered

- **We carried out calculations for the 1060 turn SNS injection case at 2 MW. Assumptions included:**
  - **Standard correlated painting**
  - **Standard dual harmonic RF**
  - **3D space charge or longitudinal space charge**
  - **Natural or zero chromaticity**
  - **No impedances**
  - **Scrapers with collimation at 220 pi [mm-mrad]**
  - **All other apertures and collimators as black absorbers**

Ring Longitudinal Distributions at 1060 Turns

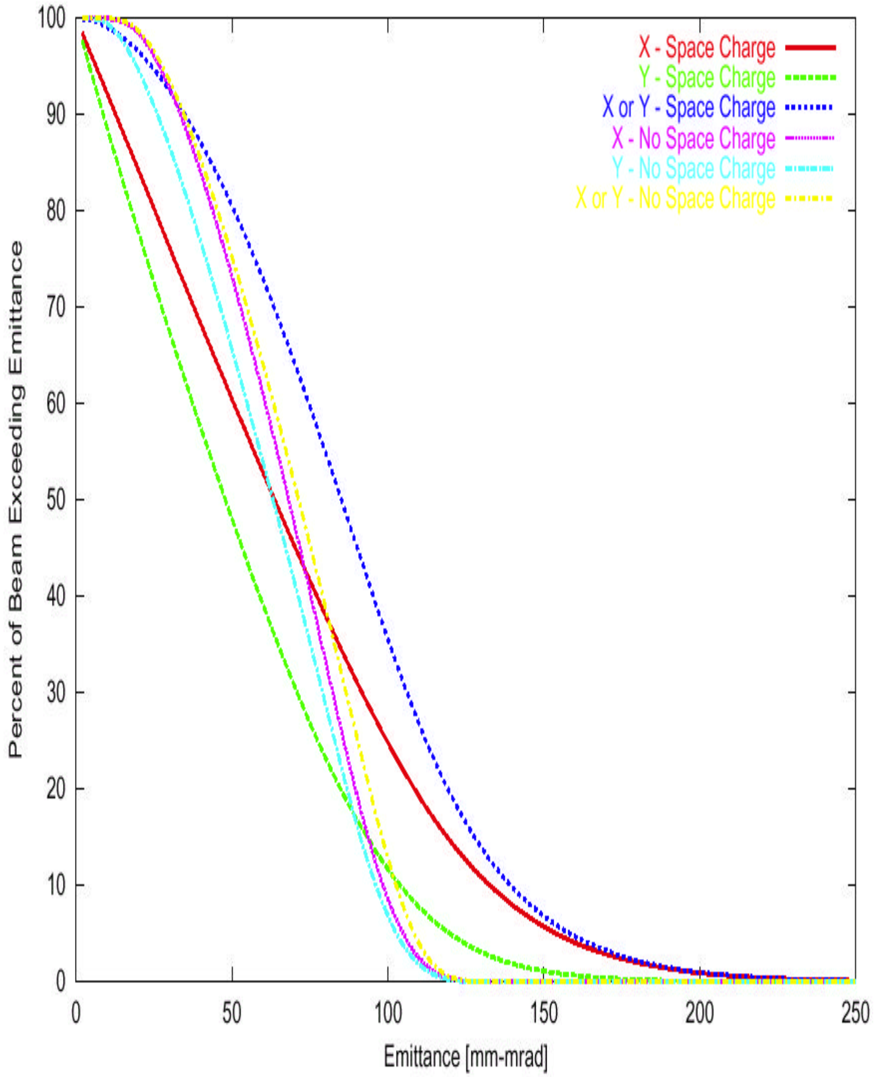


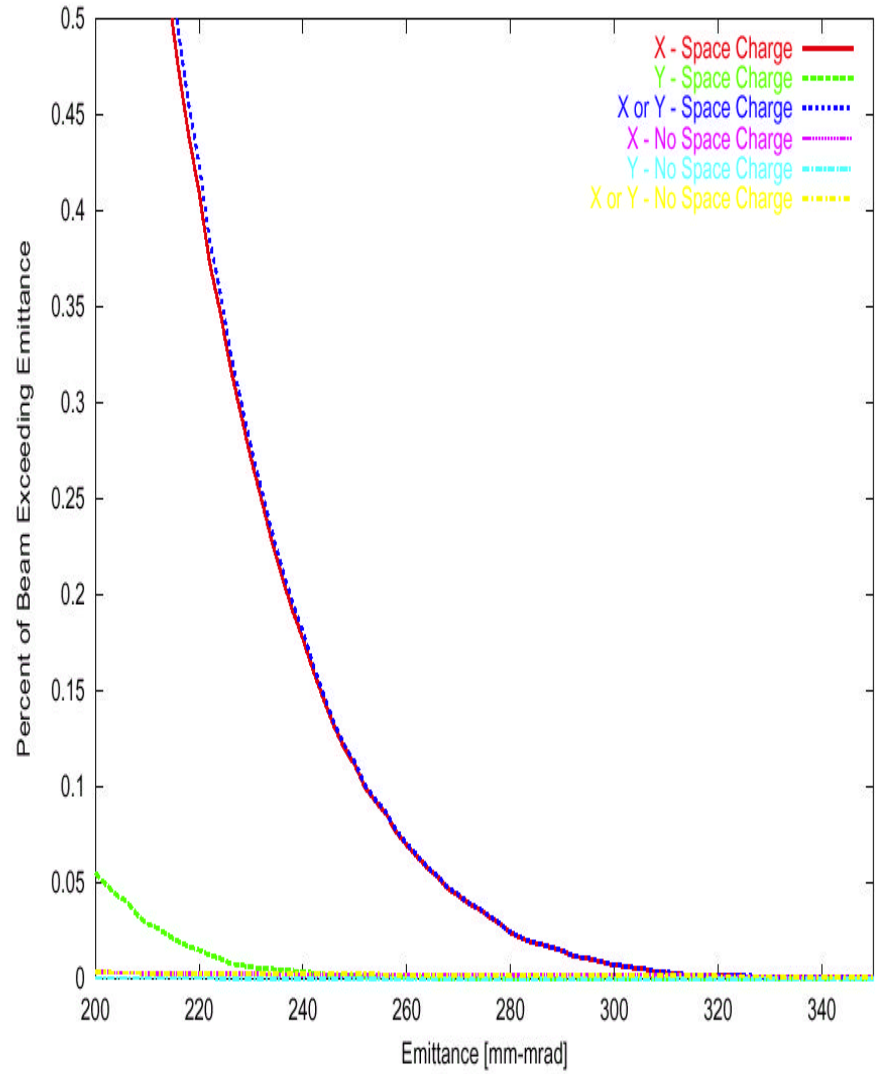


Ring Losses During Accumulation

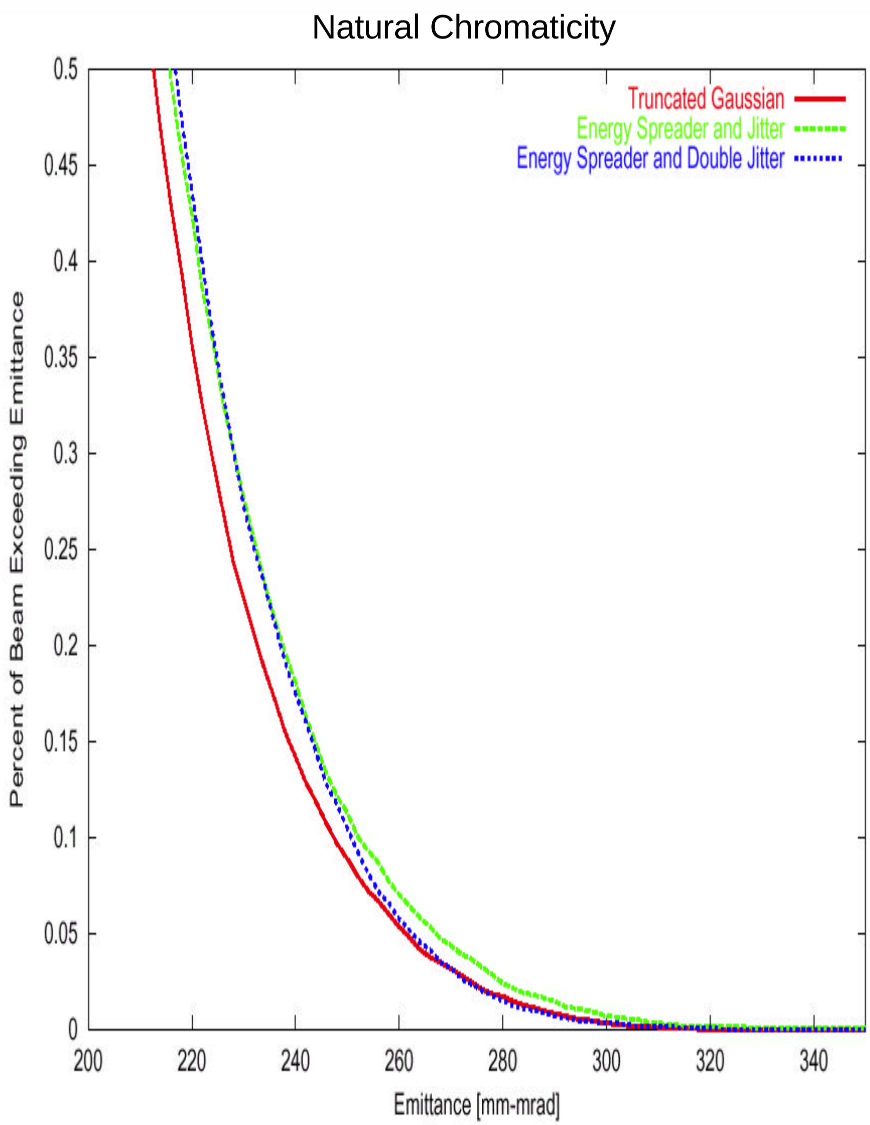
Case	% Lost (Natural Chrom.)	% Lost (Zero Chrom.)
No Space Charge:		
Truncated Gaussian	0.26	1.36
Espread & Jitter	0.23	1.42
3D Space Charge:		
Truncated Gaussian	0.99	1.80
Espread and Jitter	2.37	2.31
Espread & Double Jitter	2.26	2.45

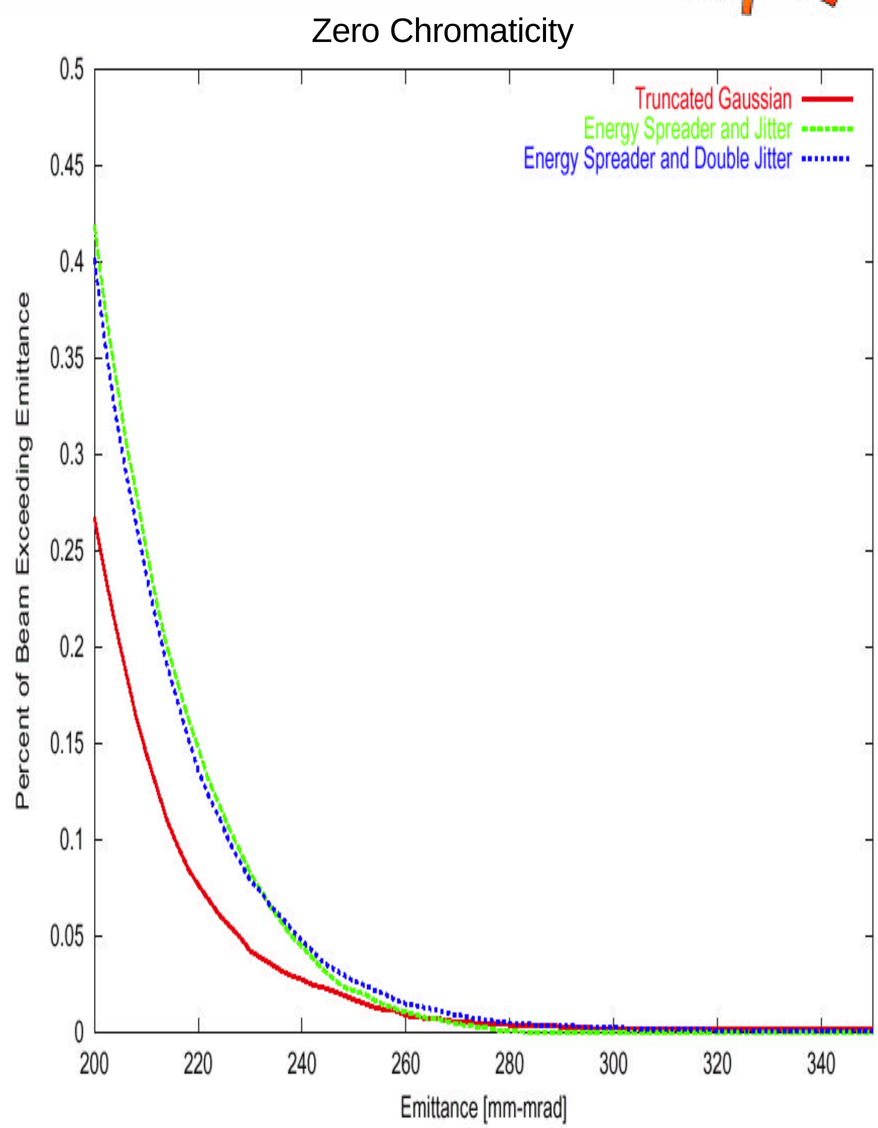
Large Horizontal Emittances are Found



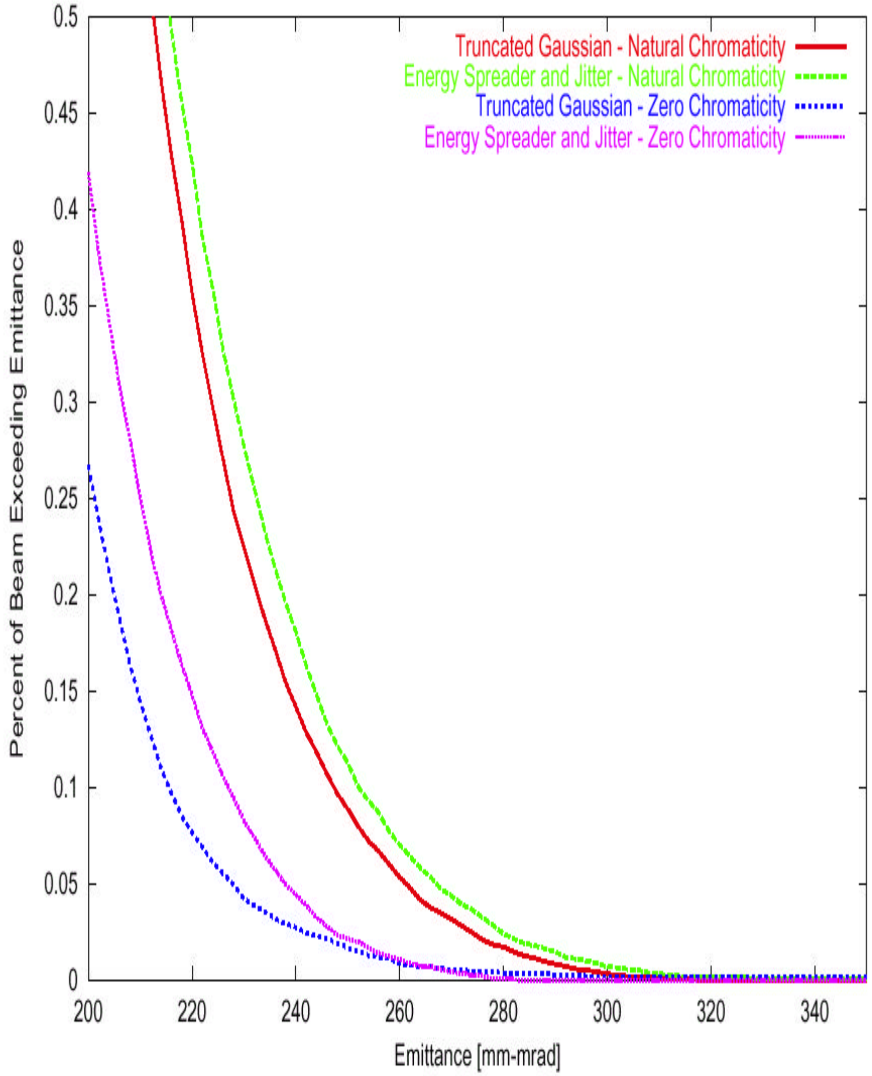


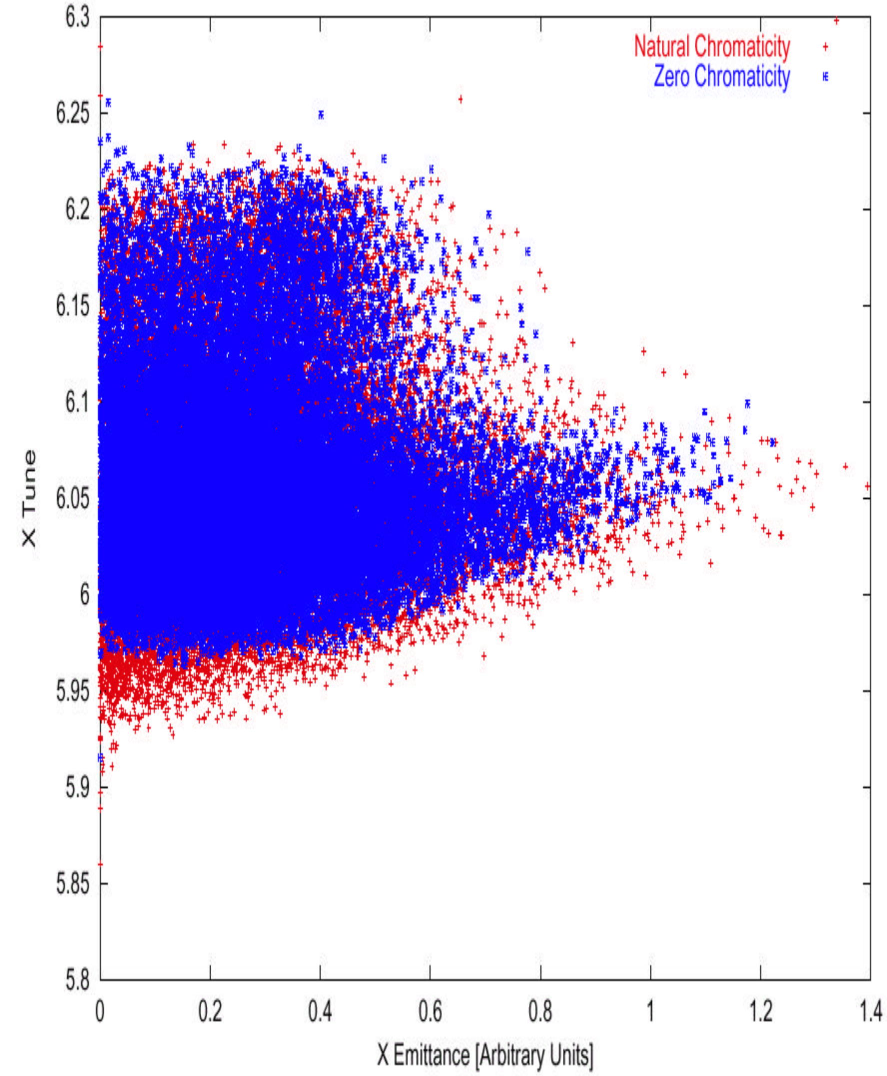
Large Horizontal Emittances are Found





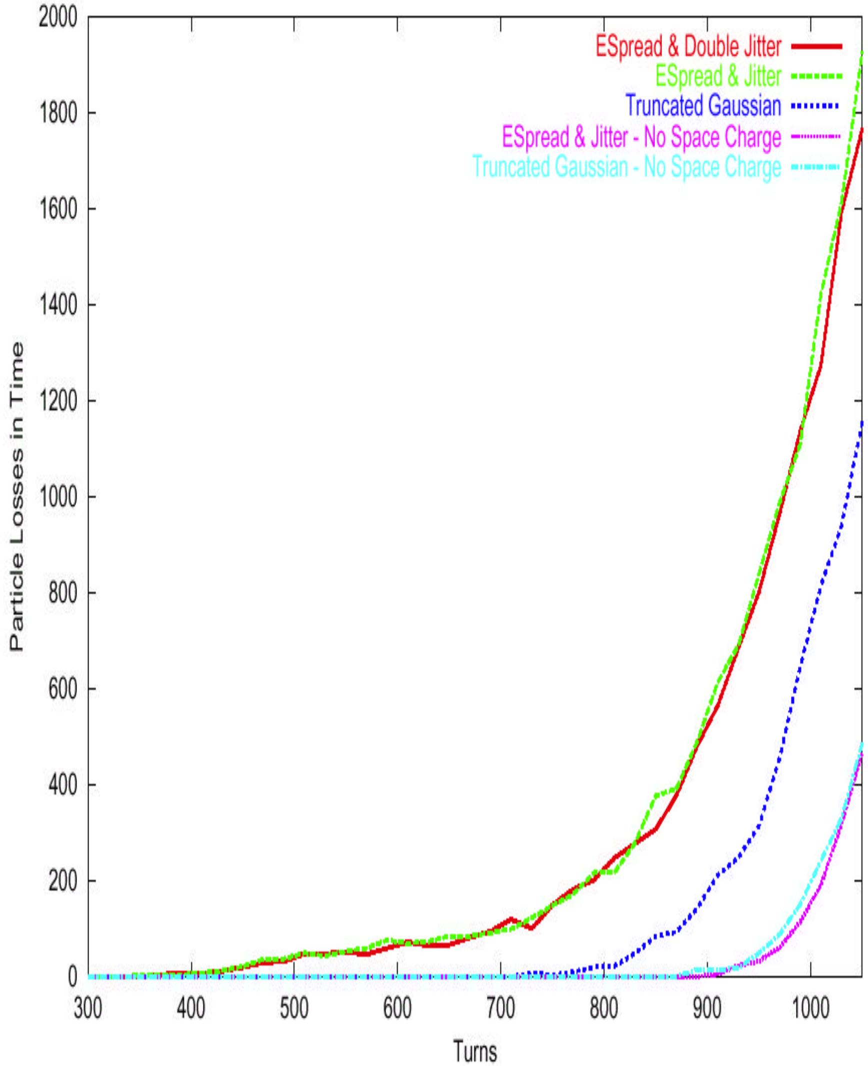
Largest Emittance Particles Have Tunes Just Above 6



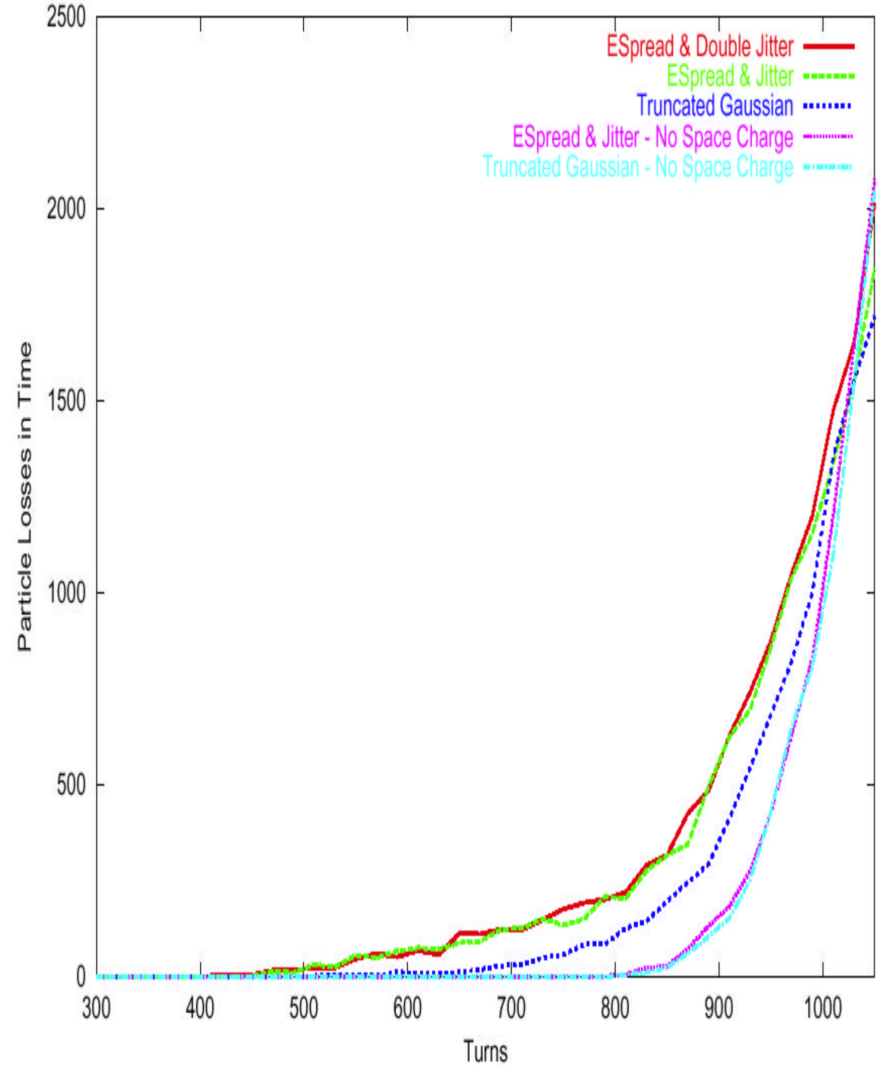


Particle Losses vs Time

Natural Chromaticity



Zero Chromaticity



Summary

- The effects of the energy spreader cavity and linac energy centroid jitter on SNS ring accumulation have been examined.
- The change in the longitudinal distributions associated with these effects leads to losses above 2%, with or without chromaticity correction.
- Some particles attain large emittances in the horizontal direction, and these large emittance particles tend to have incoherent tunes near 6.
- Most losses occur late in the accumulation, but we don’t yet have a detailed understanding of the mechanism.
- Moving the scrapers out will reduce losses in the simulations.
- The losses are not sensitive to linac beam centroid energy jitter for the parameters considered.