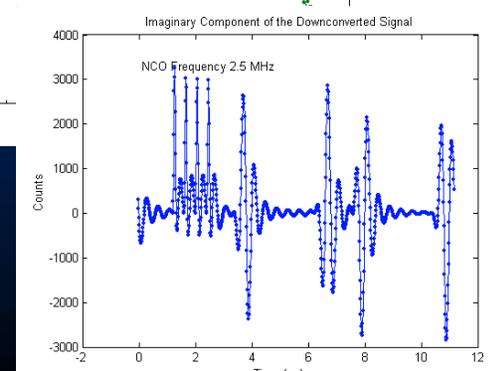
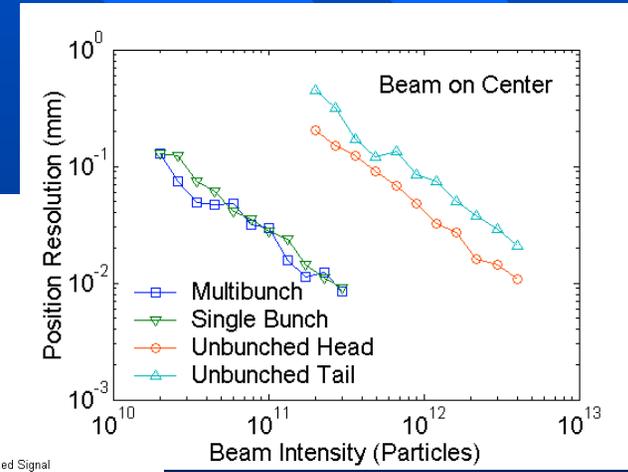
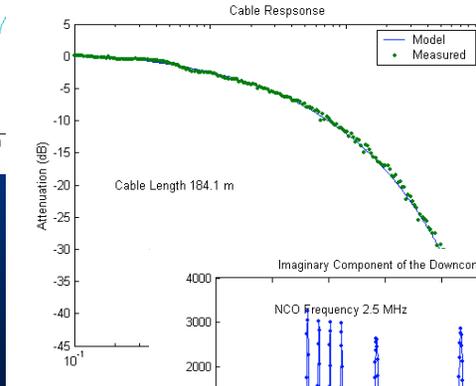
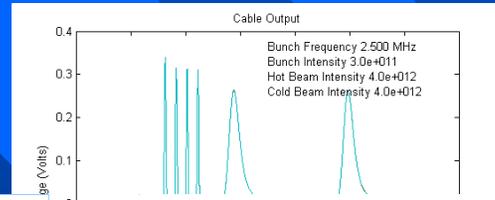
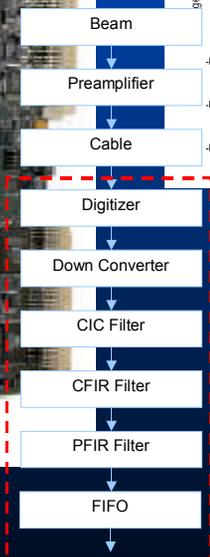
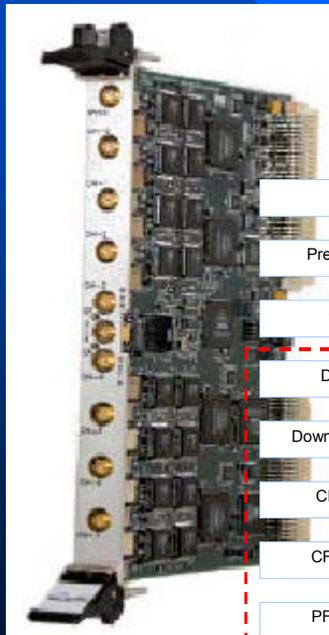


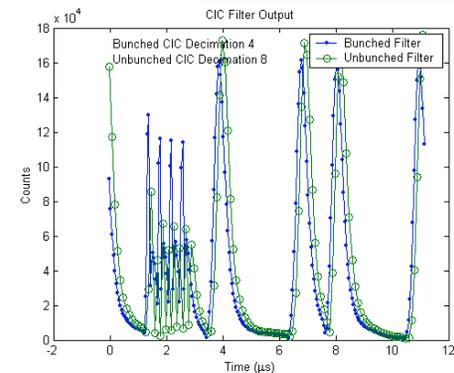
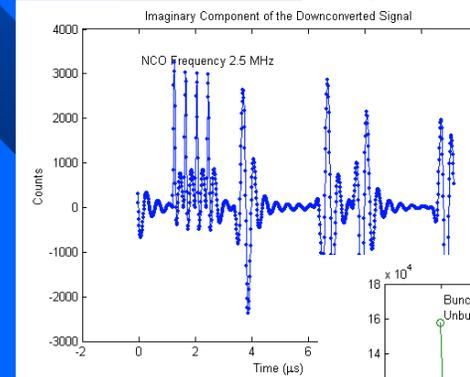
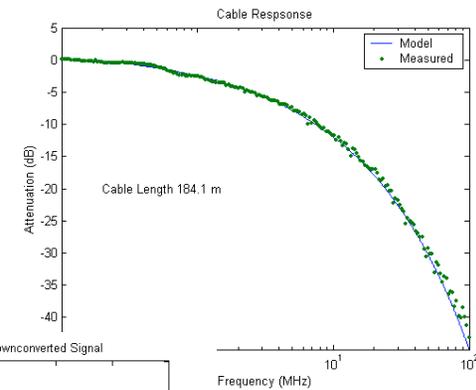
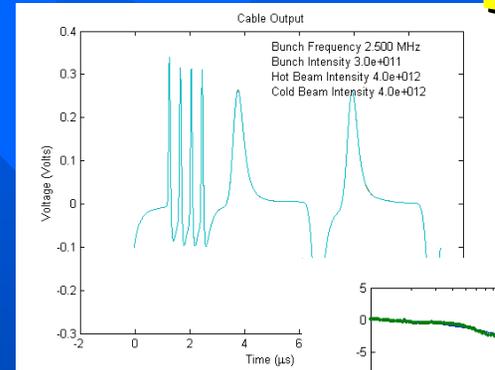
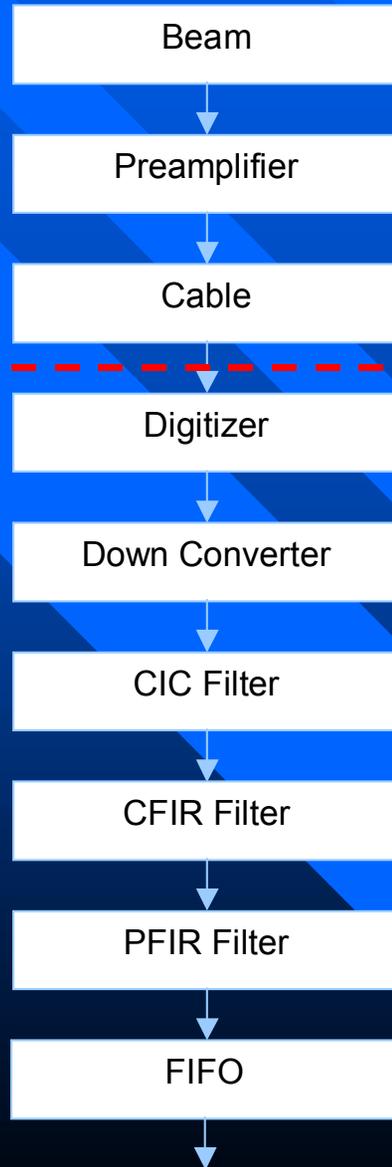
# A Matlab Simulation of the Proposed Recycler BPM Signal Processing



# RR BPM Signal Processing

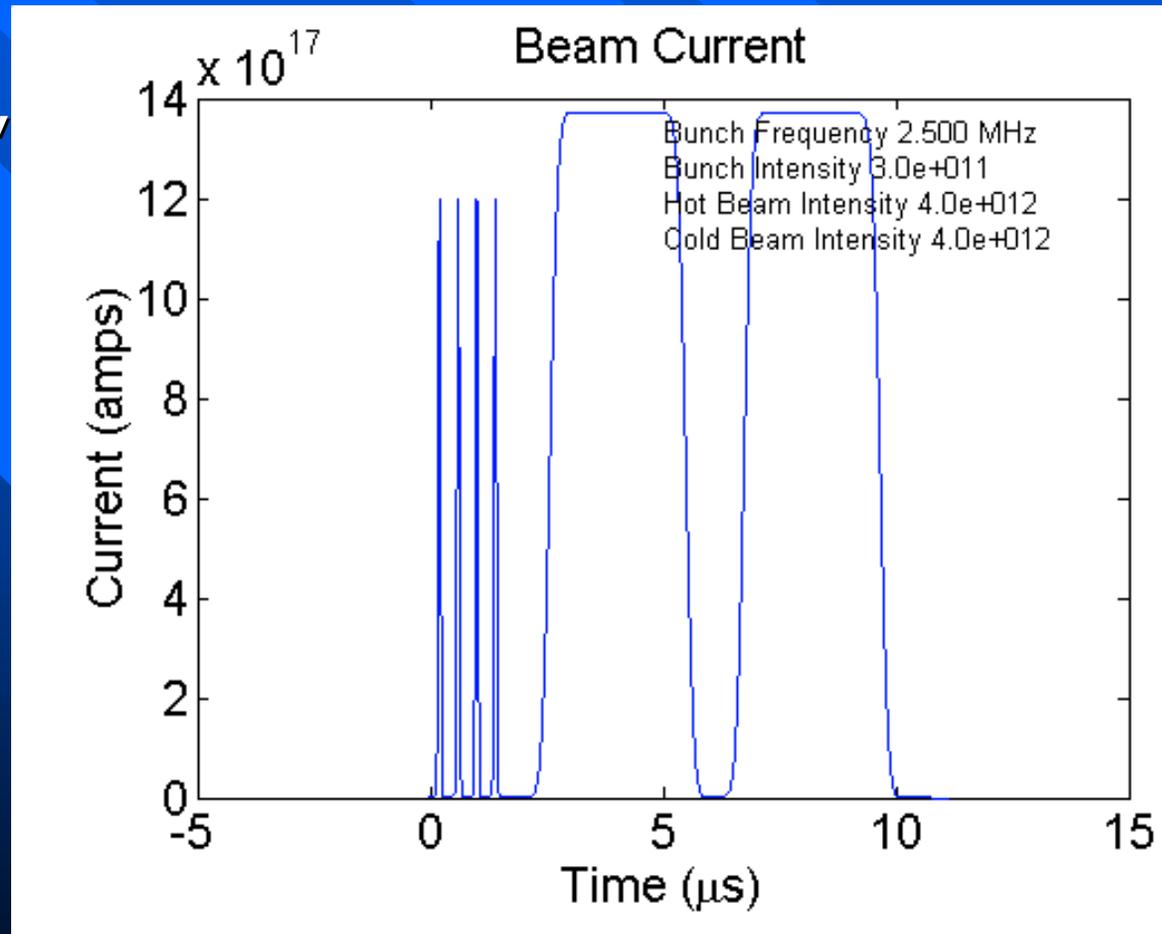
- Estimate
  - Resolution
  - Dynamic range
  - Systematic errors

- Each stage of the analog and digital signal processing chain has been simulated in Matlab



# Beam Configuration

- Simulated bunched beam, hot unbunched beam, cold beam
- Minimum separation between beam components
- Vary intensity and position of each component

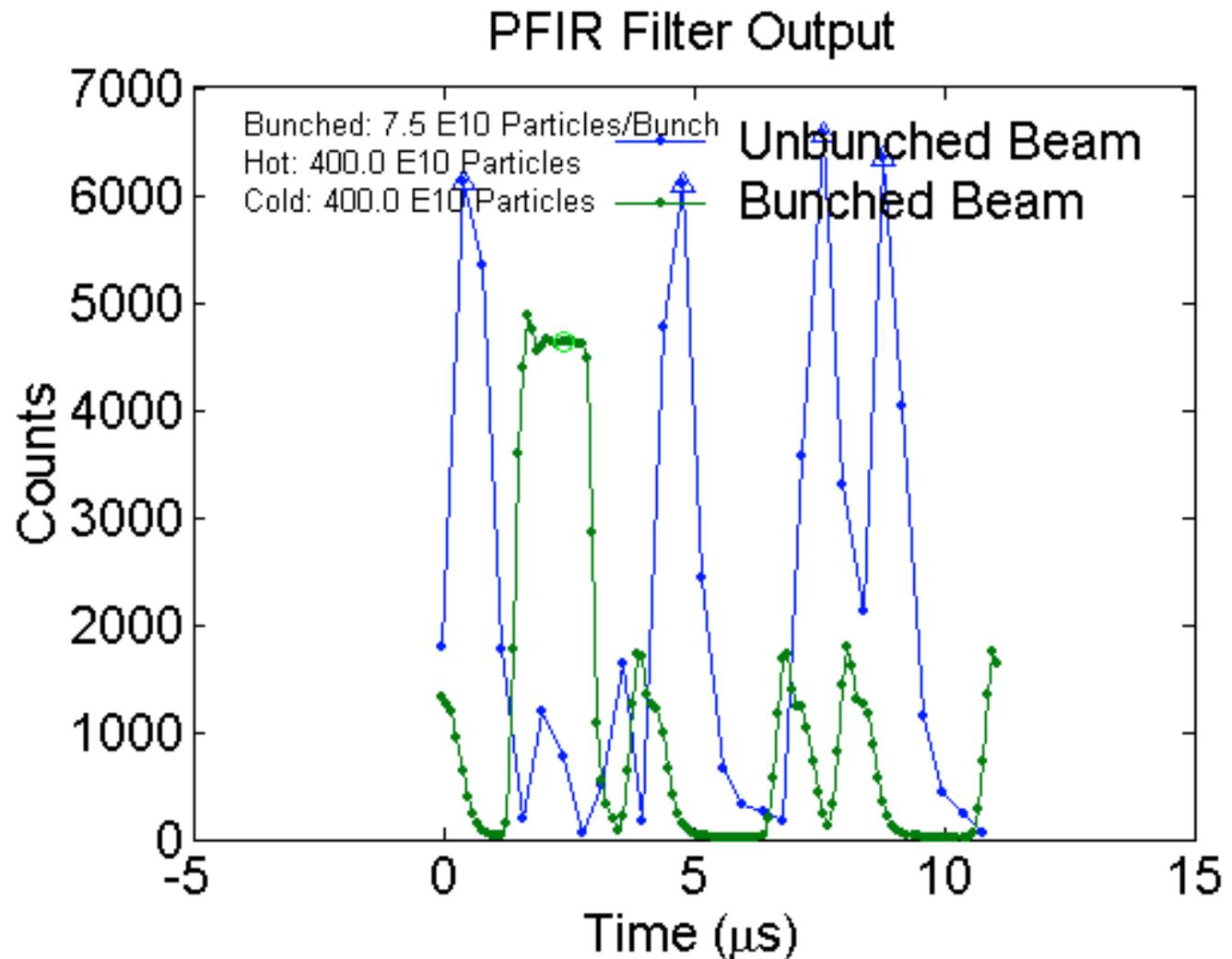


# Processing Configuration

Parameter	Bunched	Single	Unbunched
Sampling Rate	80 MHz	80 MHz	80 MHz
NCO Frequency	2.5 MHz	2.5 MHz	0 Hz
CIC Decimation	4	4	8
CFIR Length	2	2	5
CFIR Decimation	2	2	2
CFIR Profile	Square	Square	Triangular
PFIR Length	4	2	5
PFIR Decimation	1	1	2
PFIR Profile	Square	Square	Triangular
Cable Length	600 ft	600 ft	600 ft
Noise	3 Counts	3 Counts	3 Counts

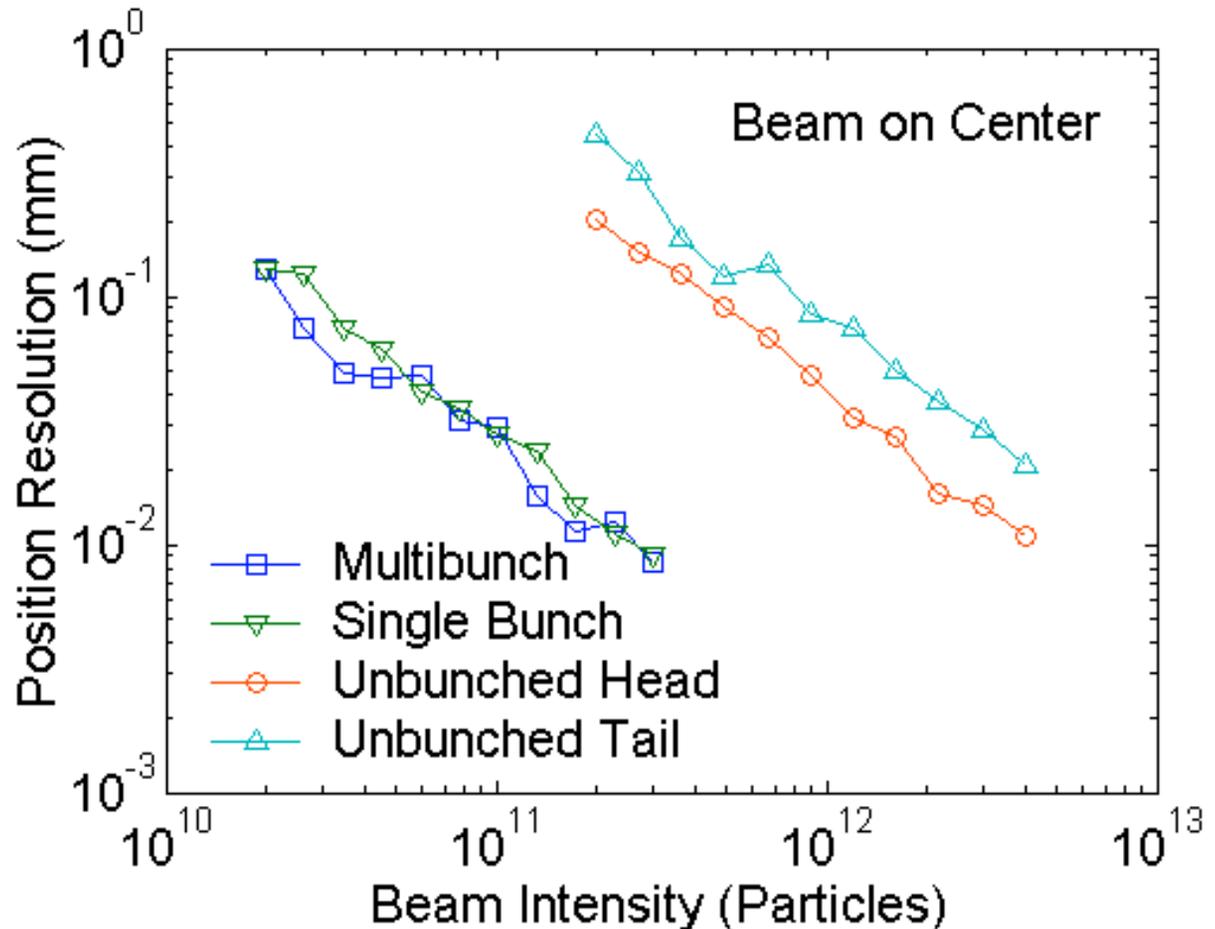
# Echotek Output

- Process simulated beam signals to obtain Echotek output



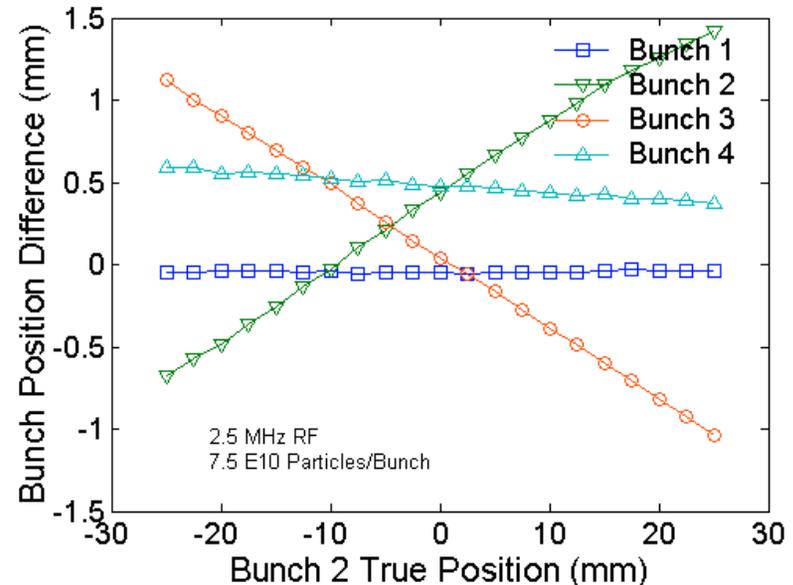
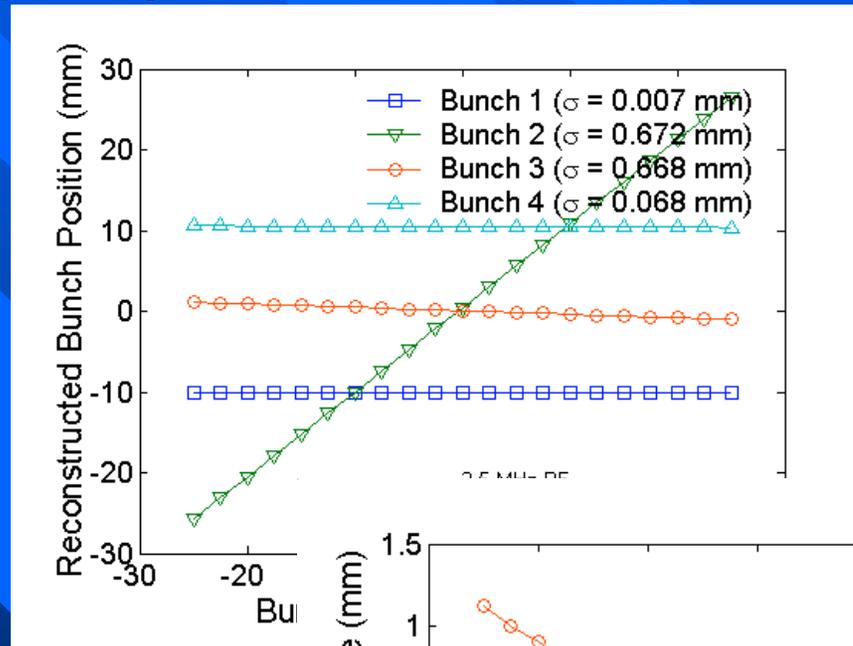
# Resolution

- Resolution varies between
  - 100-500  $\mu\text{m}$  at the lowest intensities
  - 10 to 20  $\mu\text{m}$  at the highest intensities



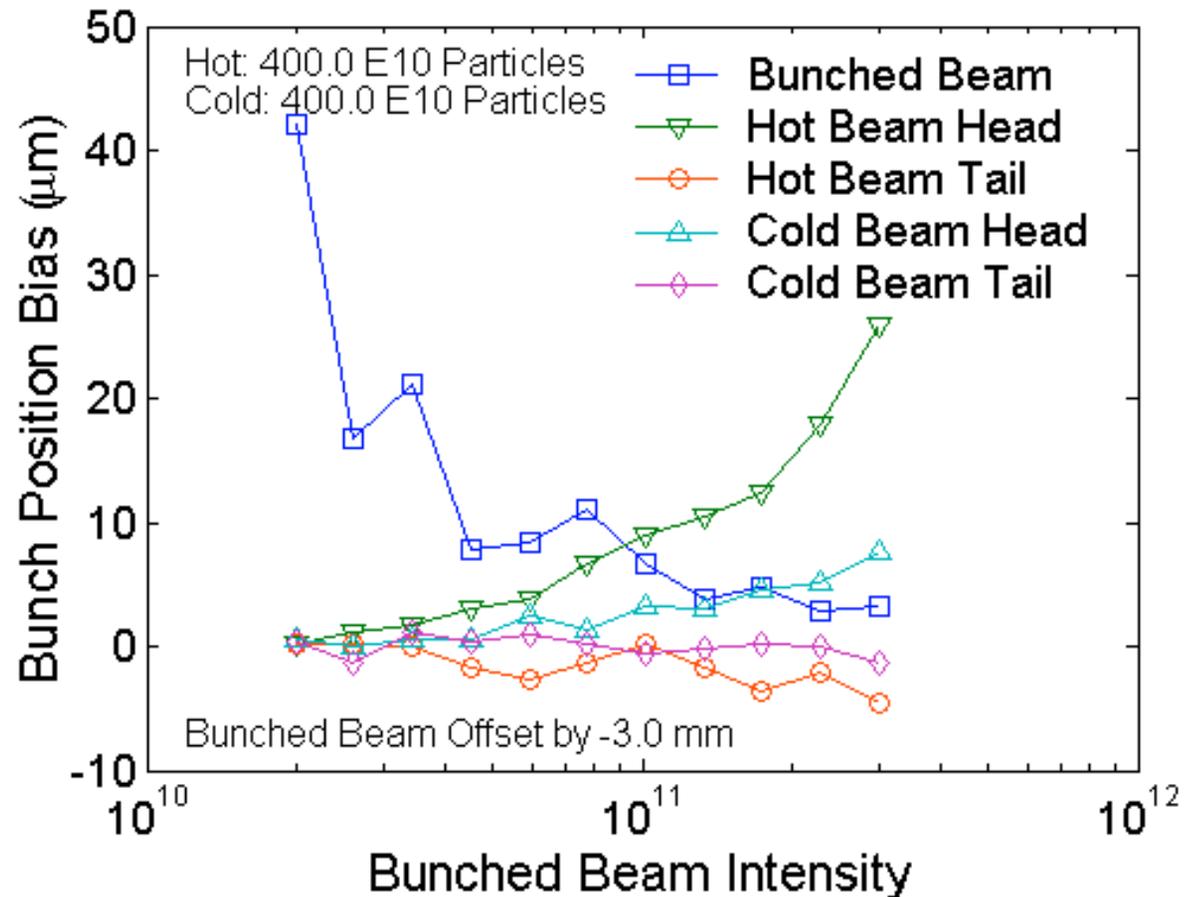
# Position Dependent Systematic Effects

- Fix all intensities, vary position of one beam component
- Bias is a linear function of position offset
- 1mm offset leads to  $40\mu\text{m}$  systematic bias



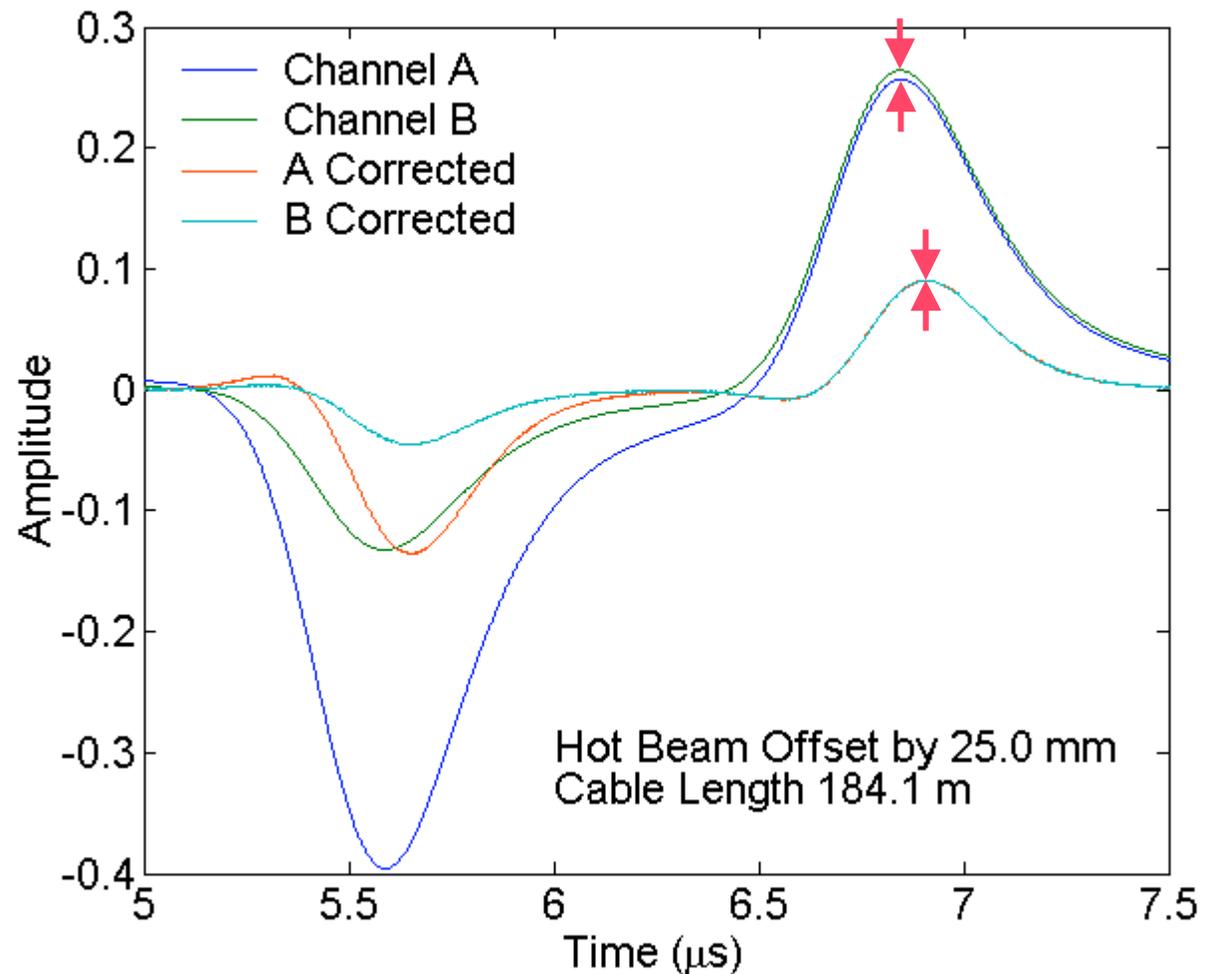
# Intensity Dependent Systematic Effects

- Fix all positions and and vary intensity of one component
- Intensity dependent position bias of  $\leq 40 \mu\text{m}$  for 3 mm offset



# Source of Systematic Effects

- Systematic effects are primarily due to cable dispersion



# Conclusion

- Proposed RR BPM system able to measure position of
  - Multiple bunches -  $150\ \mu\text{m}$  to  $10\ \mu\text{m}$
  - Single bunches -  $150\ \mu\text{m}$  to  $10\ \mu\text{m}$
  - Unbunched beam –  $500\ \mu\text{m}$  and  $10\ \mu\text{m}$
- Position and intensity dependent systematic effects are comparable to the resolution for expected position and intensity variations
- Systematic effects are primarily due to cable dispersion