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# RHIC long-range experiments with a DC wire

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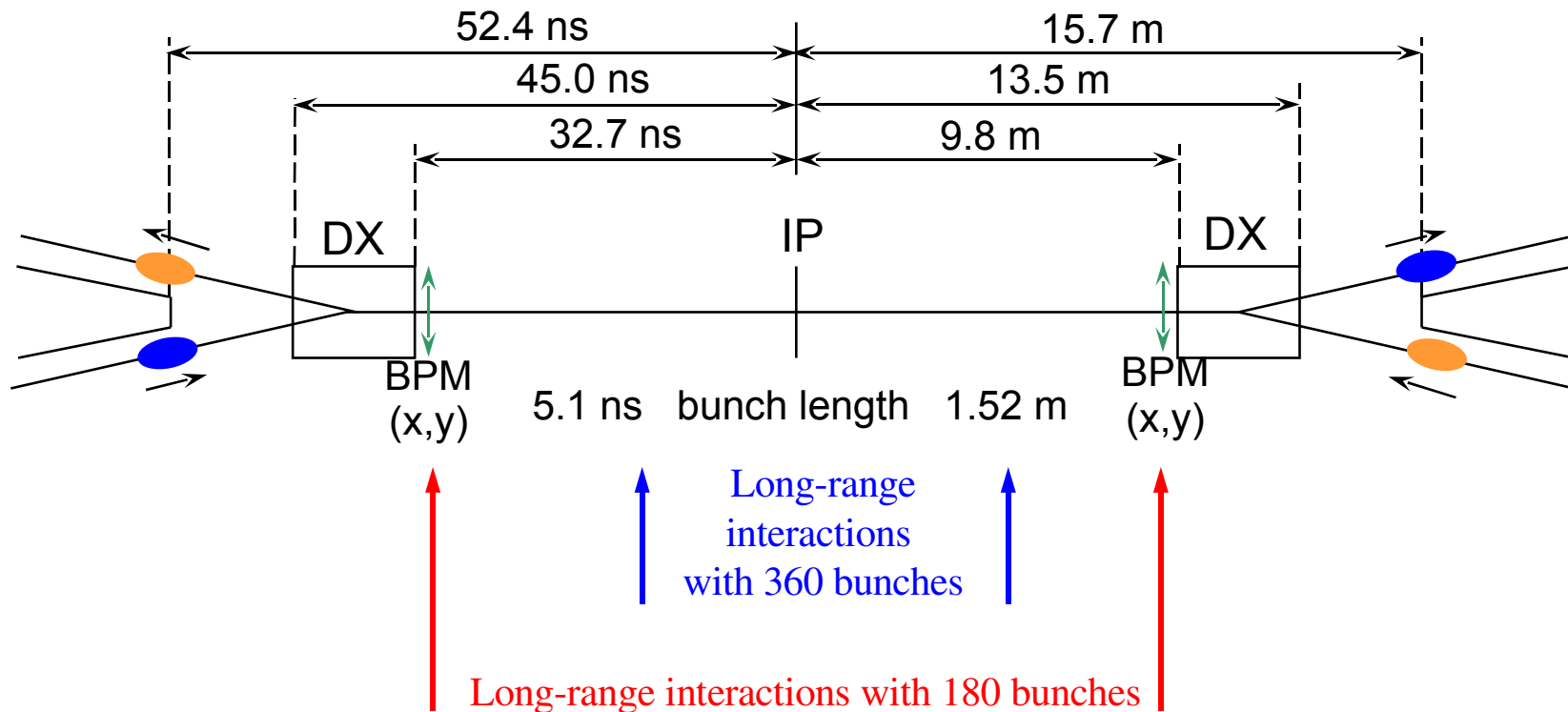
Jul 31, 2007

*Ack: U. Dorda, J. Koutchouk, G. Sterbini, F. Zimmermann, BNL-OP, Wire Engineers*

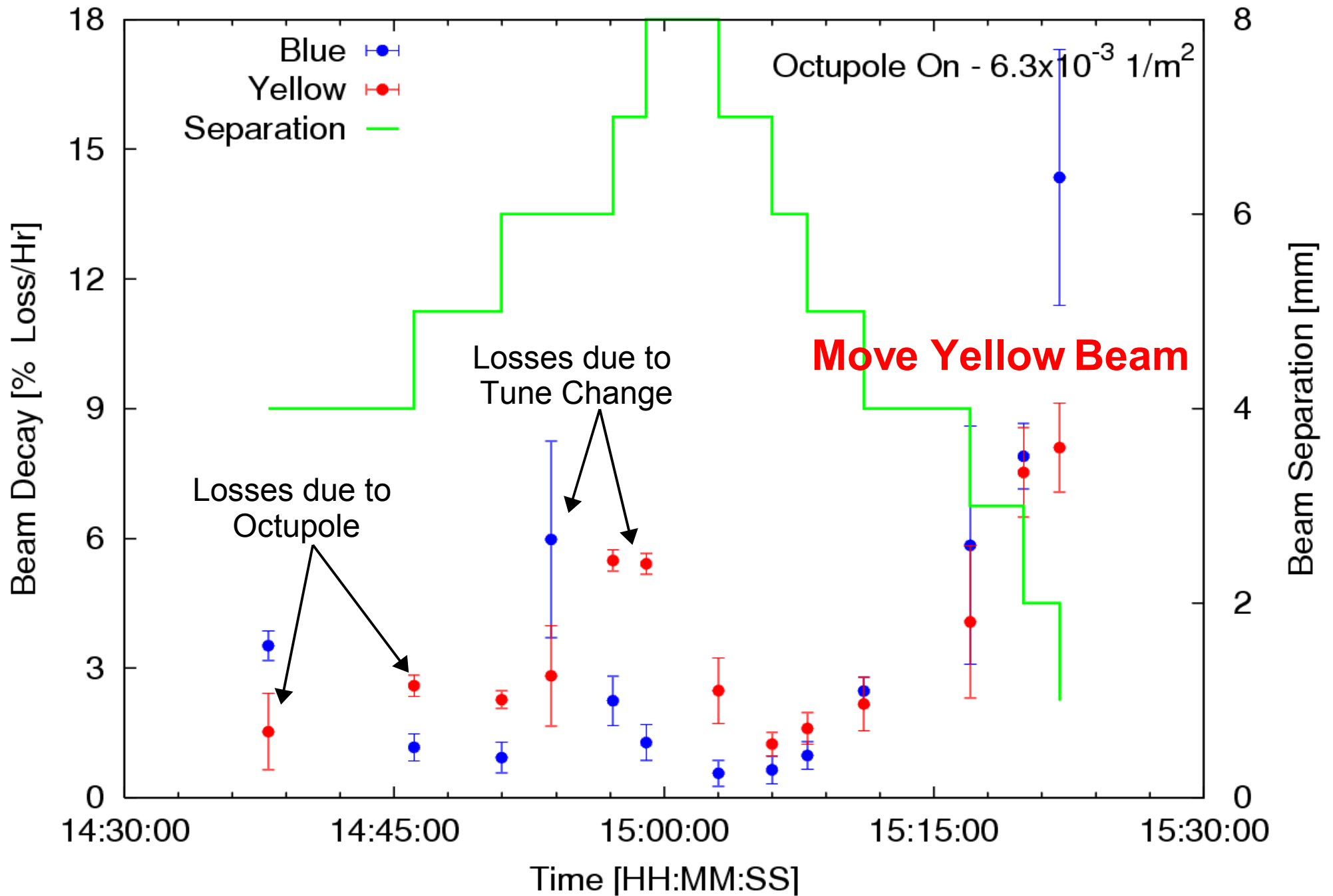
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# RHIC Interaction Region

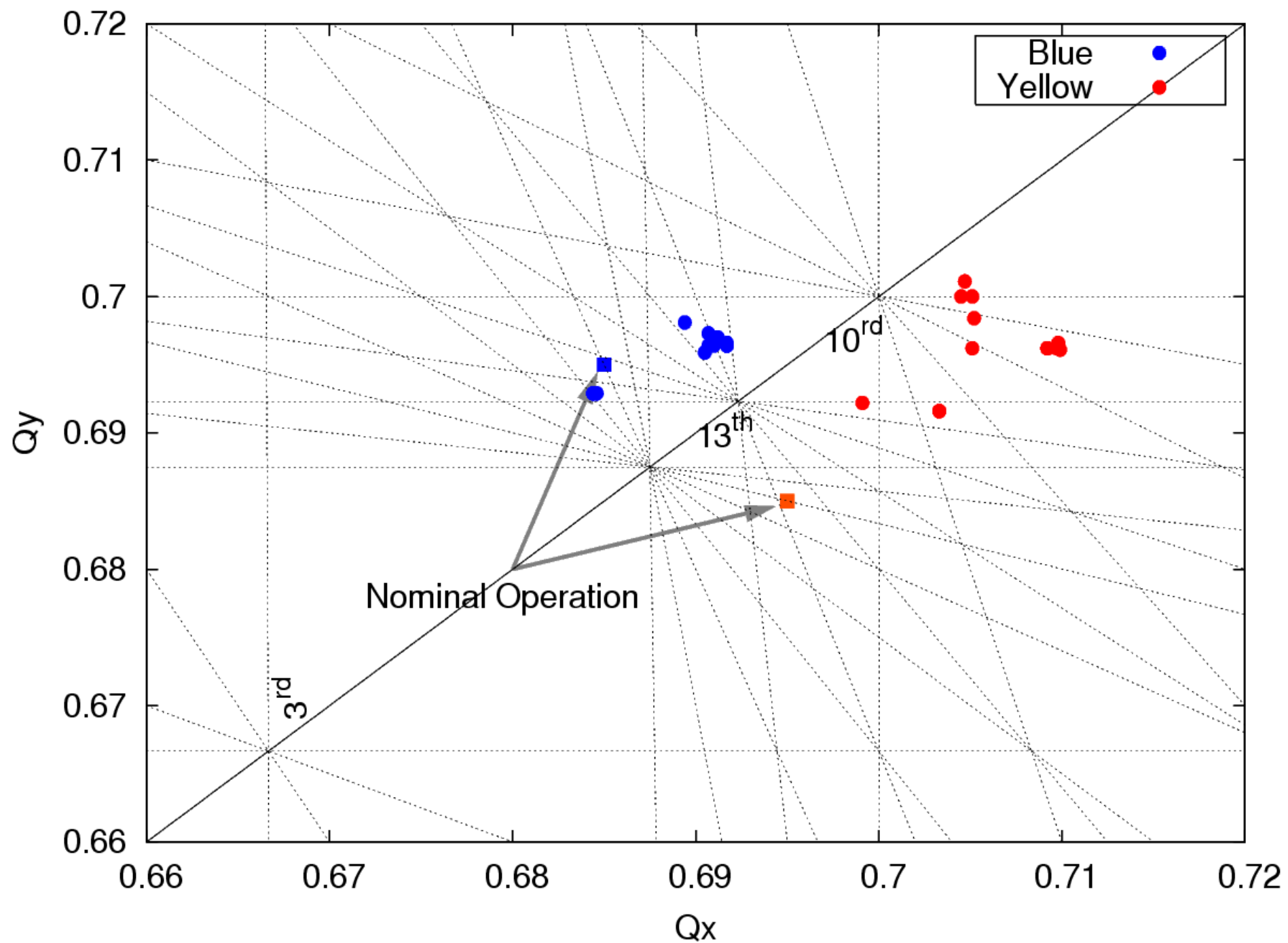
- With  $> 120$  bunches we see long-range beam-beam interaction
- Test bed for LHC long-range interactions and compensation



# Long-Range with Proton Beams (2006)

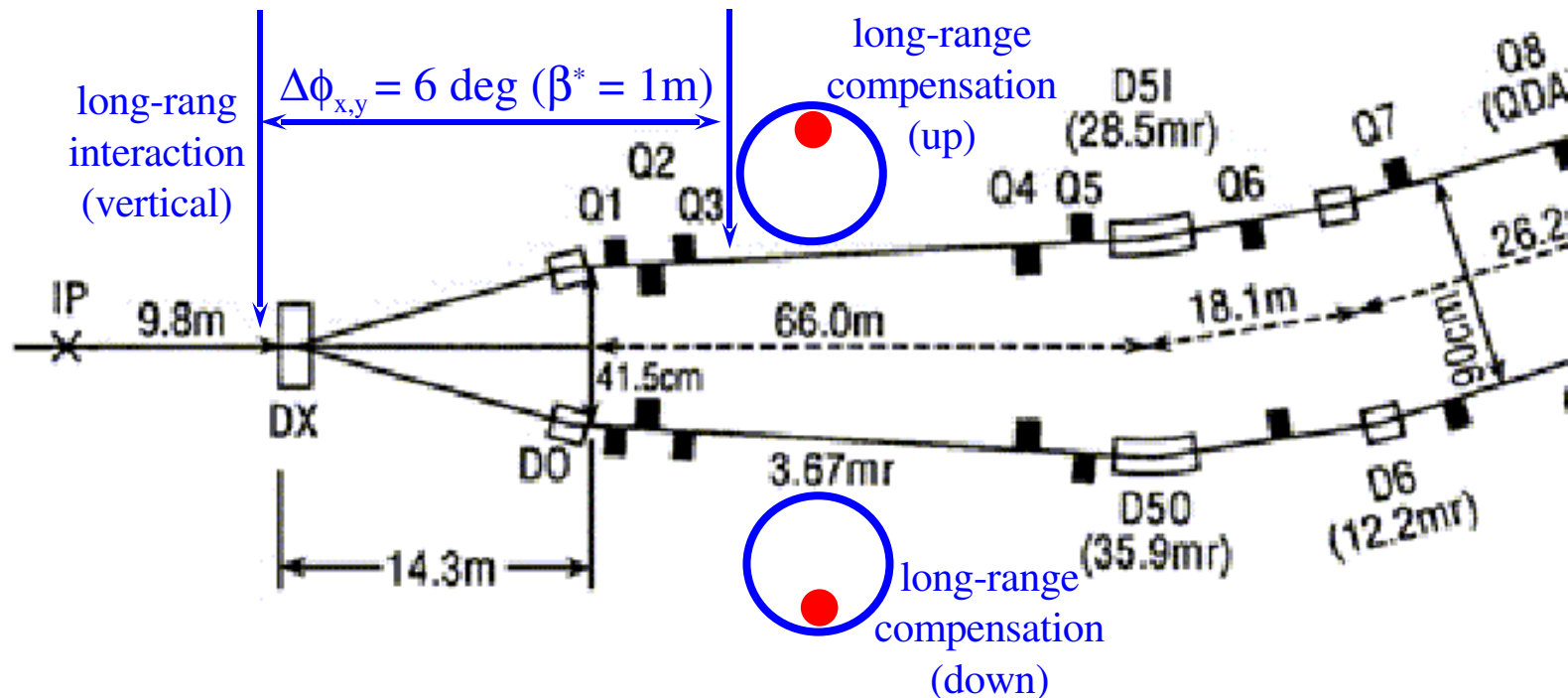
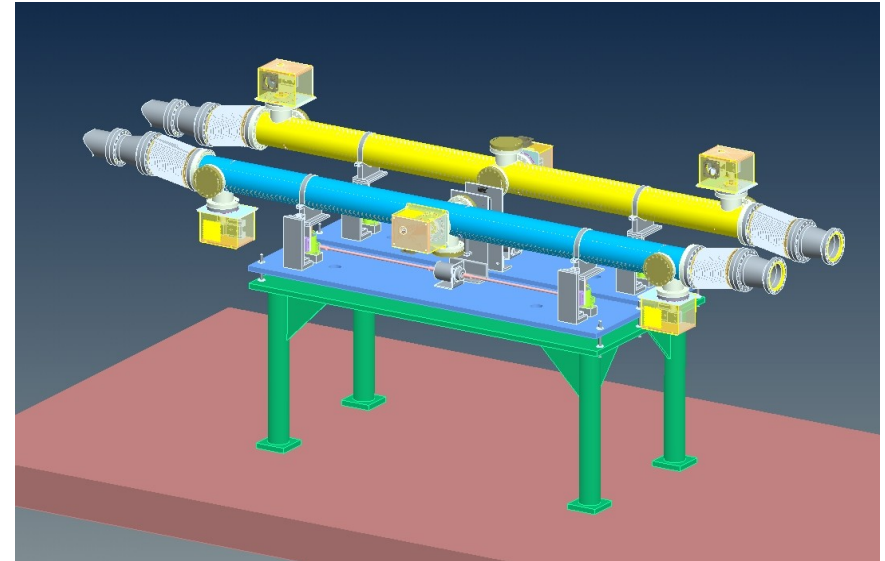


# Tunes During Scan



# DC Wires in RHIC (2007)

quantity	unit	Blue	Yellow
beam energy $E$	GeV/n	100	
rigidity ( $B\rho$ )	Tm	831.8	
number of bunches	...	23	
max. wire current $I_{max}$	A	50	
distance IP6 to wire center	m	40.92	
parameter $K$ (at 50 A)	nm	-30.1	
wire length $L$	m	2.5	
position range $d$	mm	0...65	-65...0
$\beta_x$ at wire location	m	1091	350
$\beta_y$ at wire location	m	378	1067
curr ripple $\Delta I/I$ (at 50 A)	$10^{-4}$	< 1.7	



# Long-Range Exps with DC Wire (Au-Au)

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Experiment II: Apr 24, 2007 (2 Hrs)

Blue & Yellow **Nominal Tunes**

Wire Scan with 5 Amps & 50 Amps

Experiment III: May 09, 2007 (2 Hrs)

Blue & Yellow with **Tunes Swapped**

Wire Scan with 5 Amps & 50 Amps & Current Scan

Chromaticity Scan in Yellow

Experiment IV: End of June 20, 2007 (BNL + CERN Folk)

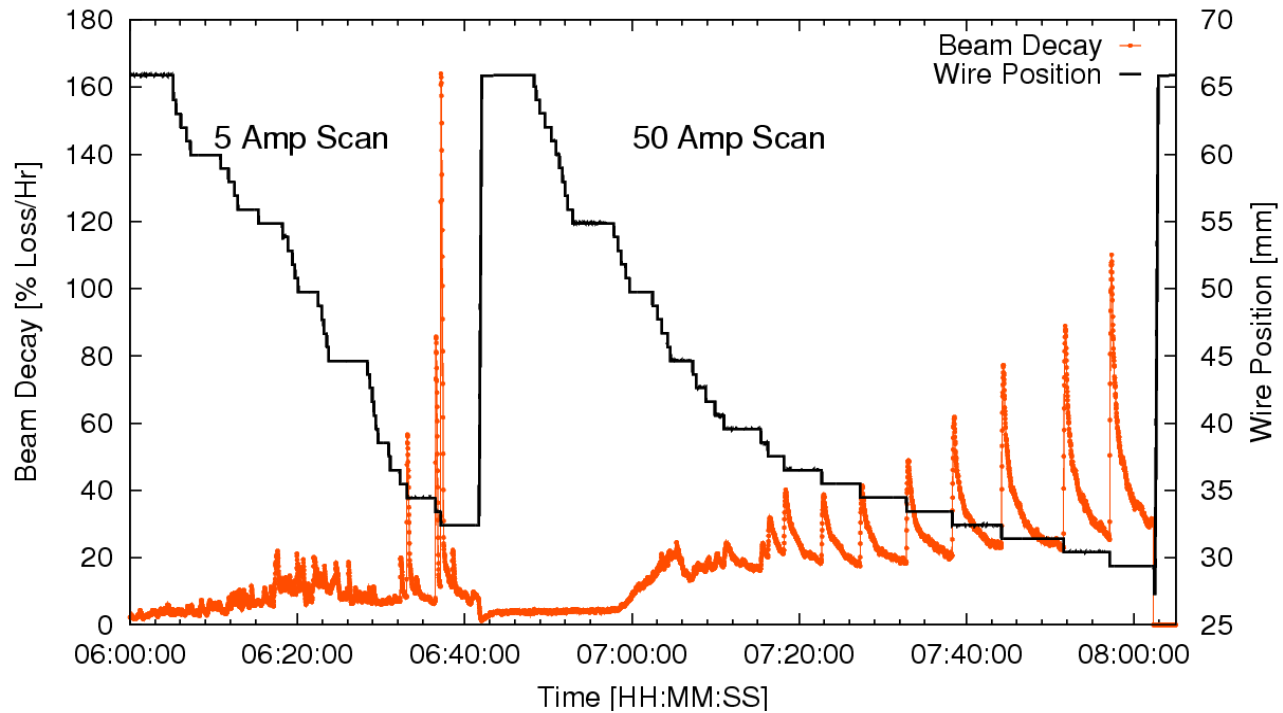
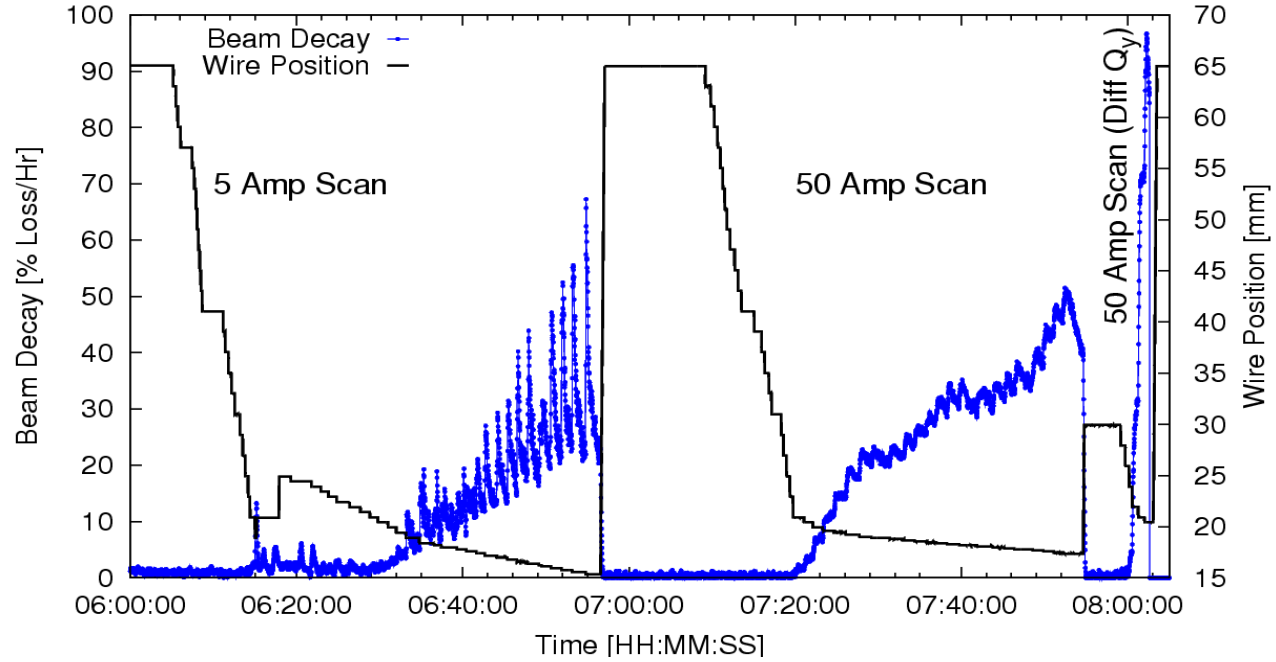
Wire scan with large beam, use end of store

Position Scan with 50 Amp (fresh beam). Move out to measure diffusion

Chromaticity & Tune scan

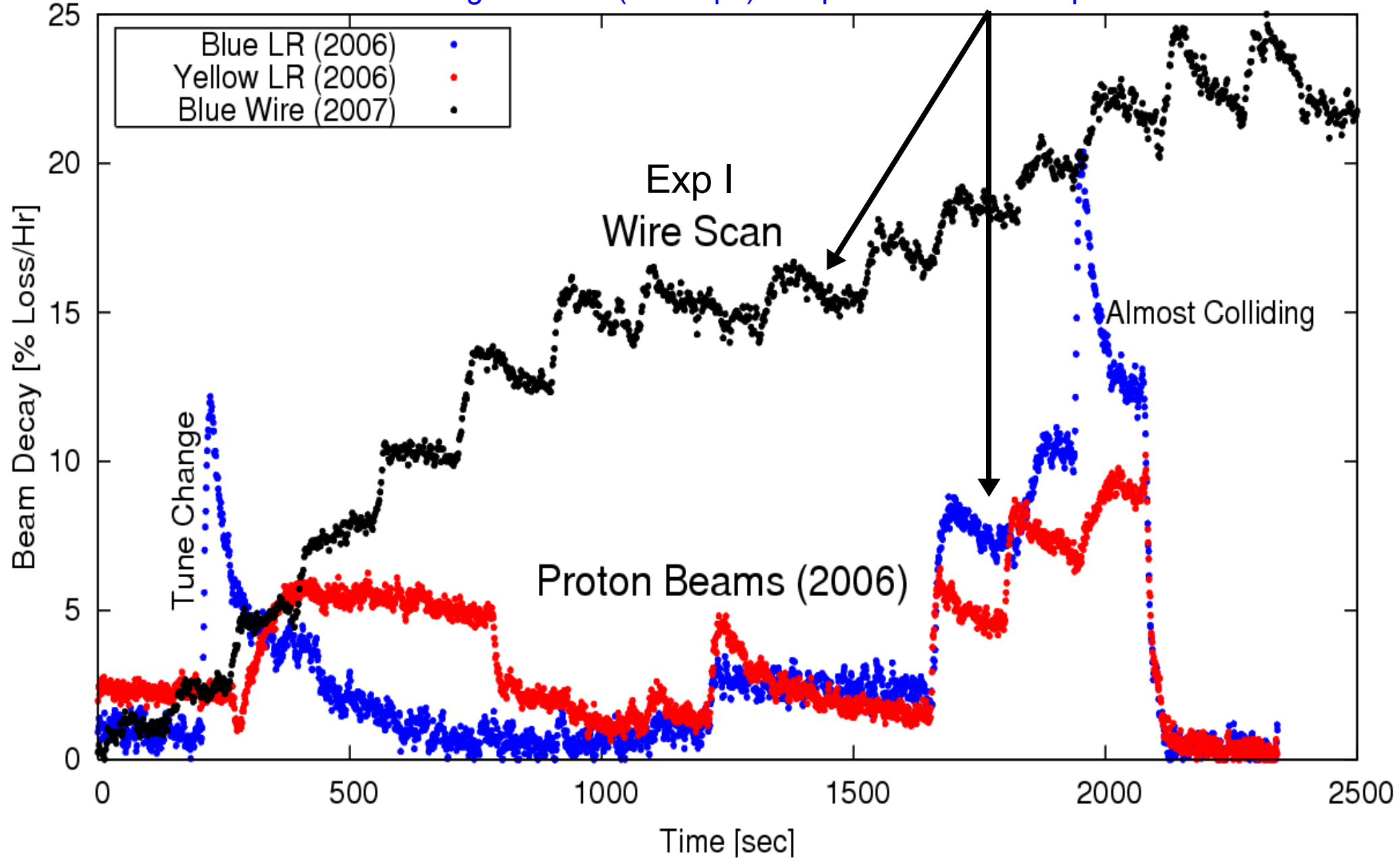
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# Exp I (Nominal tunes)



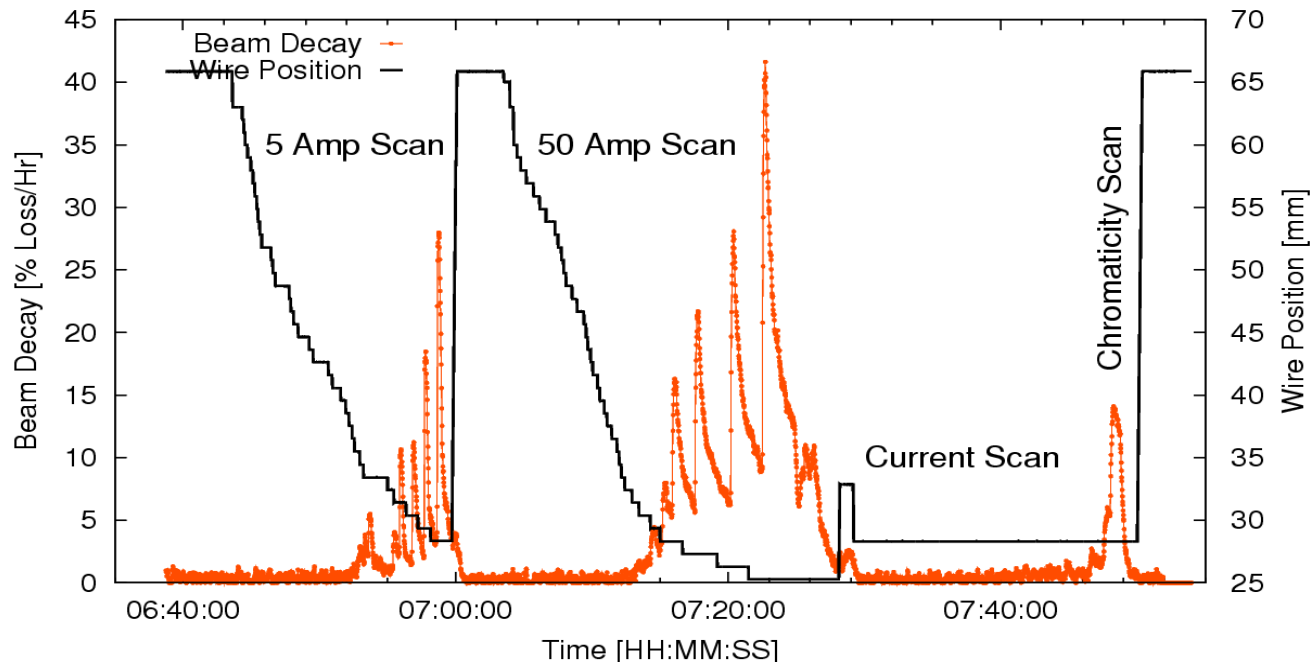
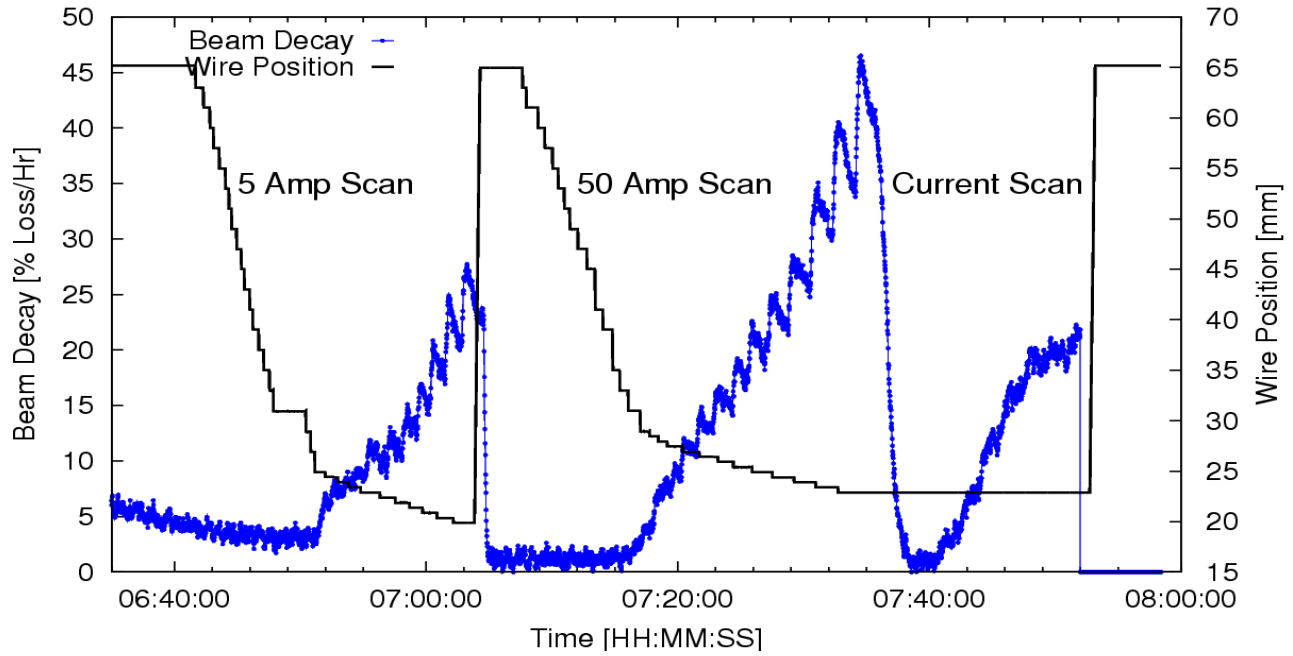
# Proton Beam Vs. Wire Scan

Loss Pattern in Blue Ring with wire (50 Amps) comparable to LR loss pattern from 2006

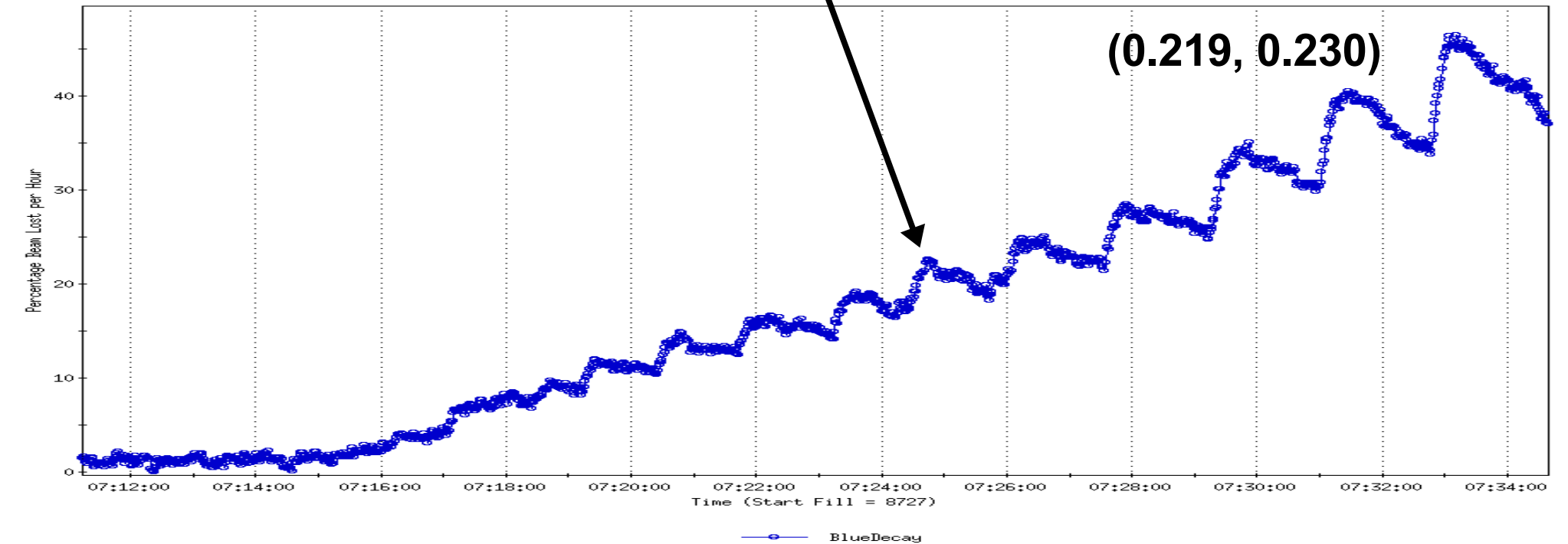
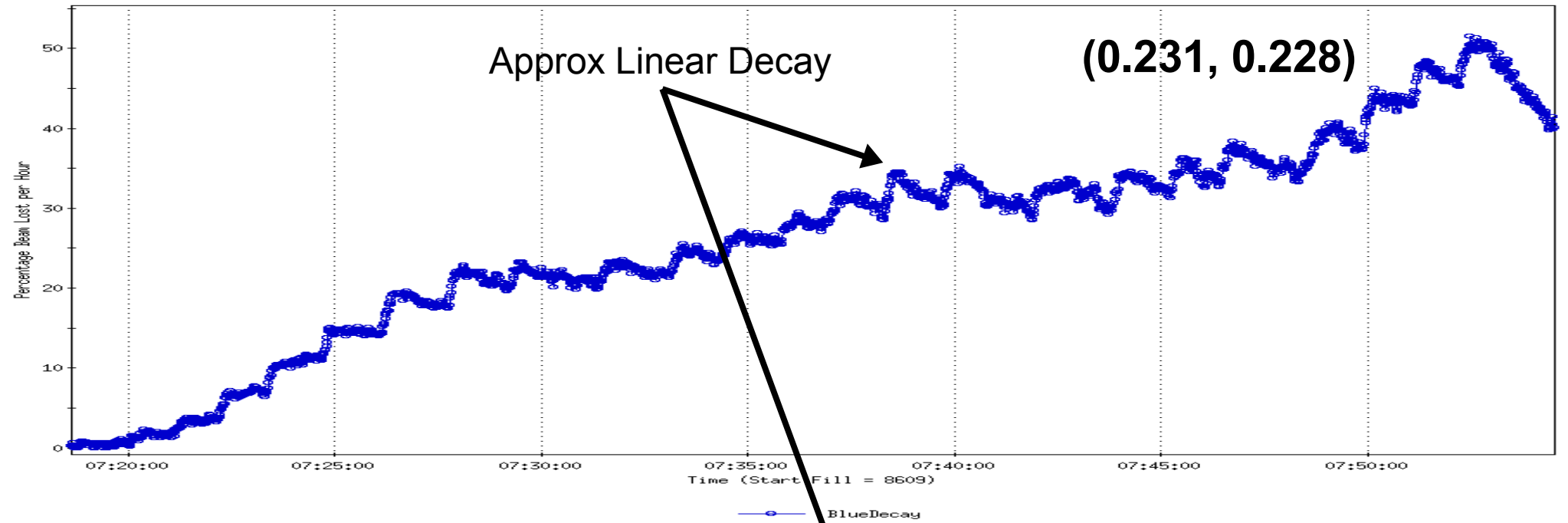




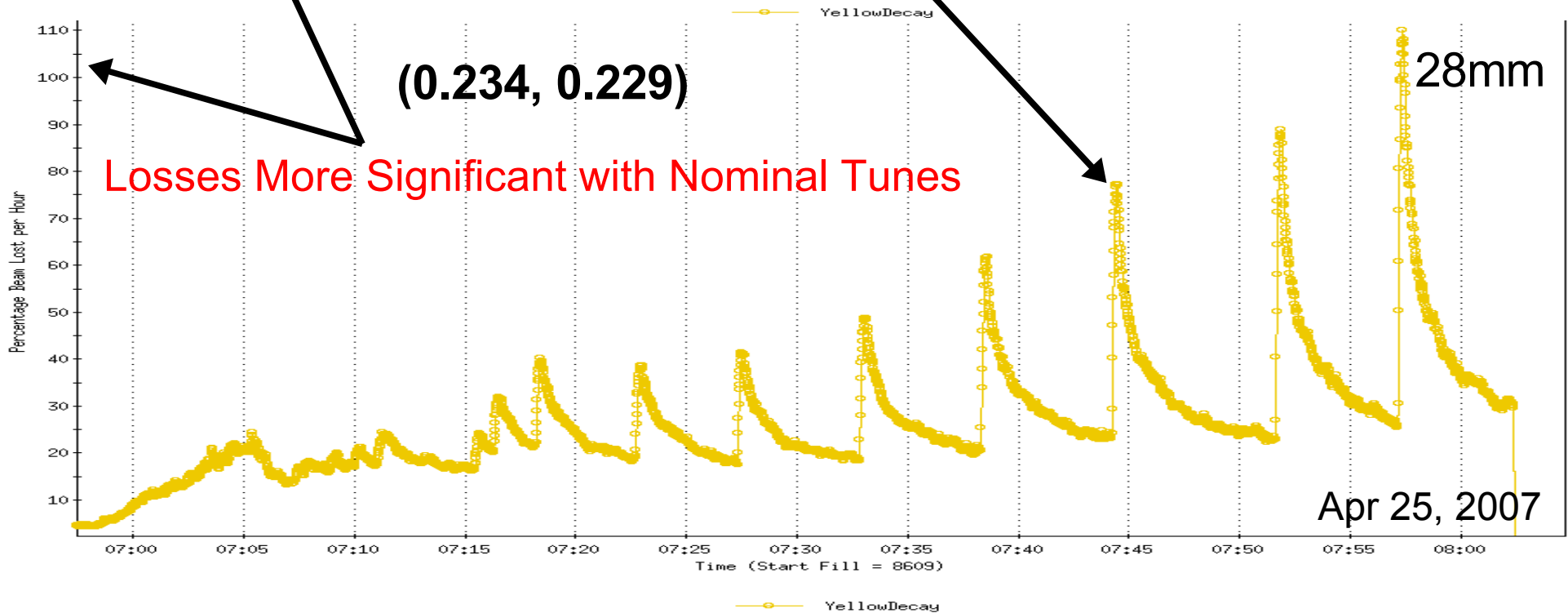
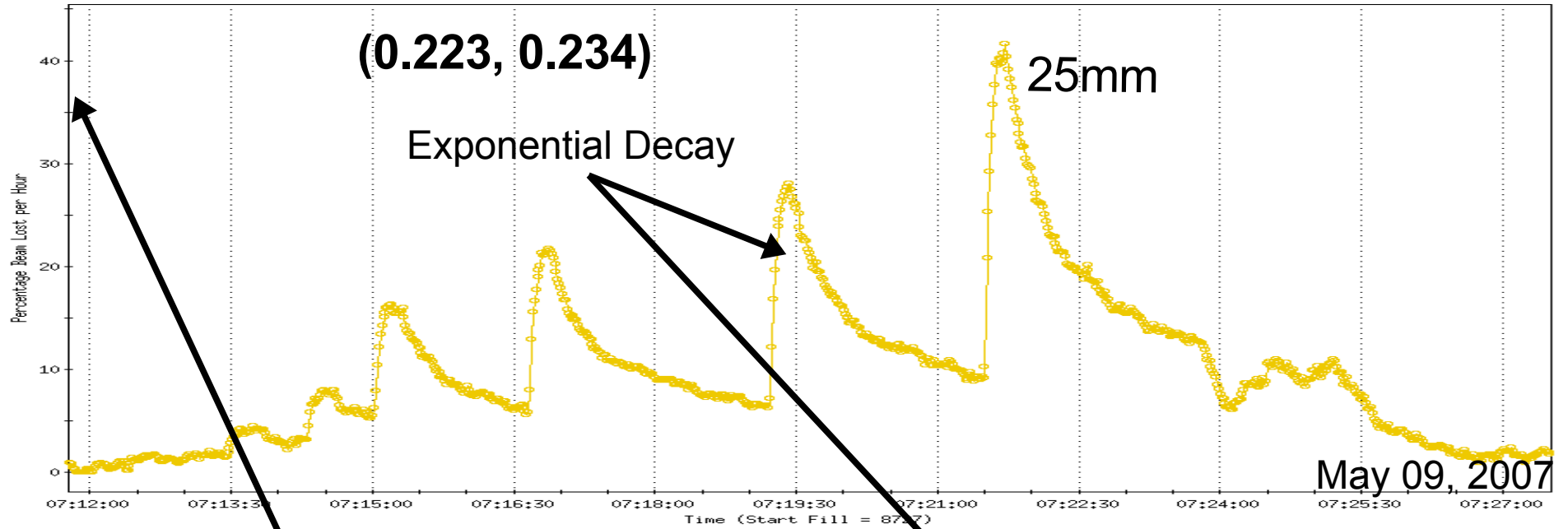
# Exp II (Swapped Tunes)



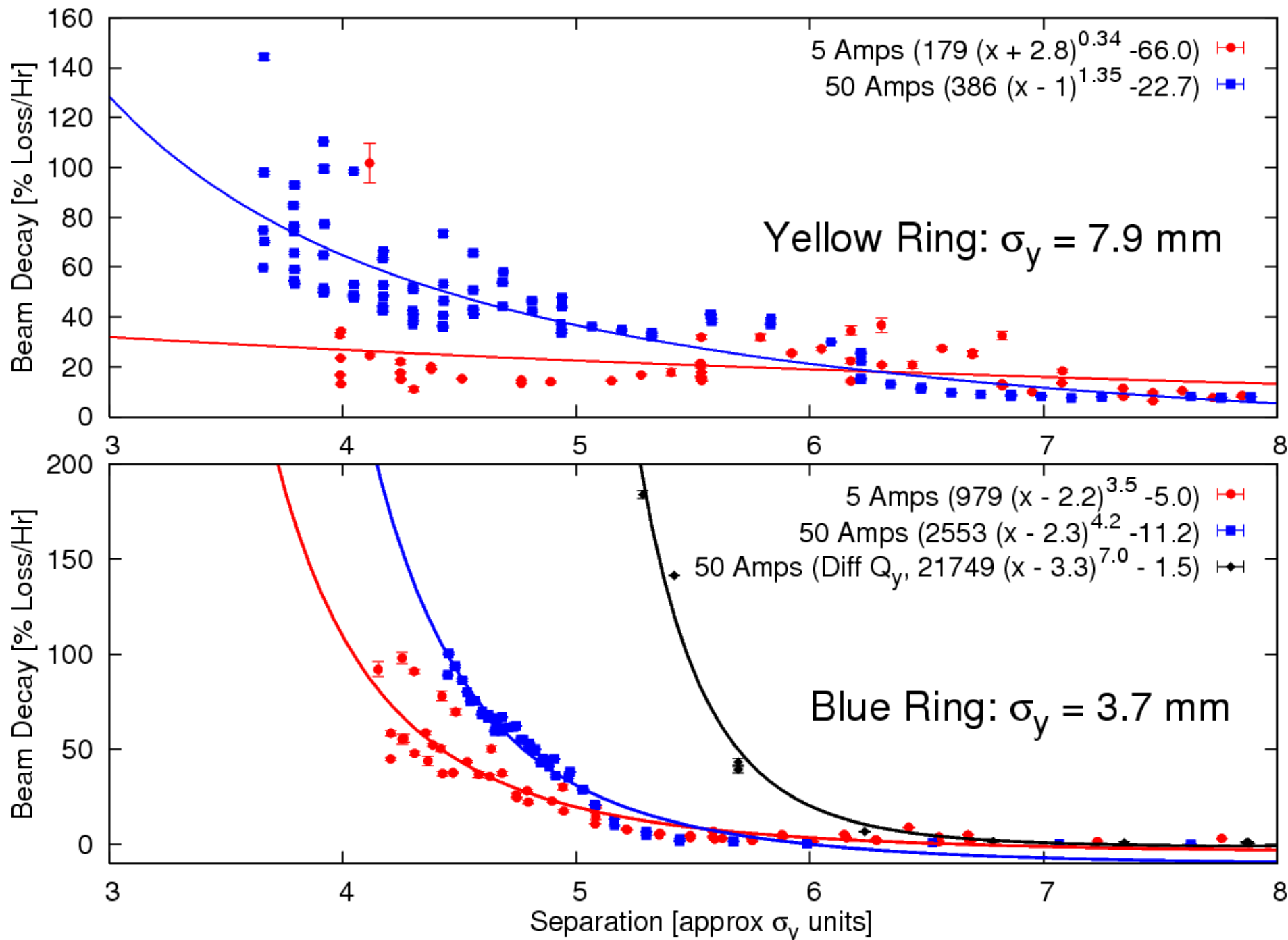
# No Effect due to Swapping Tunes



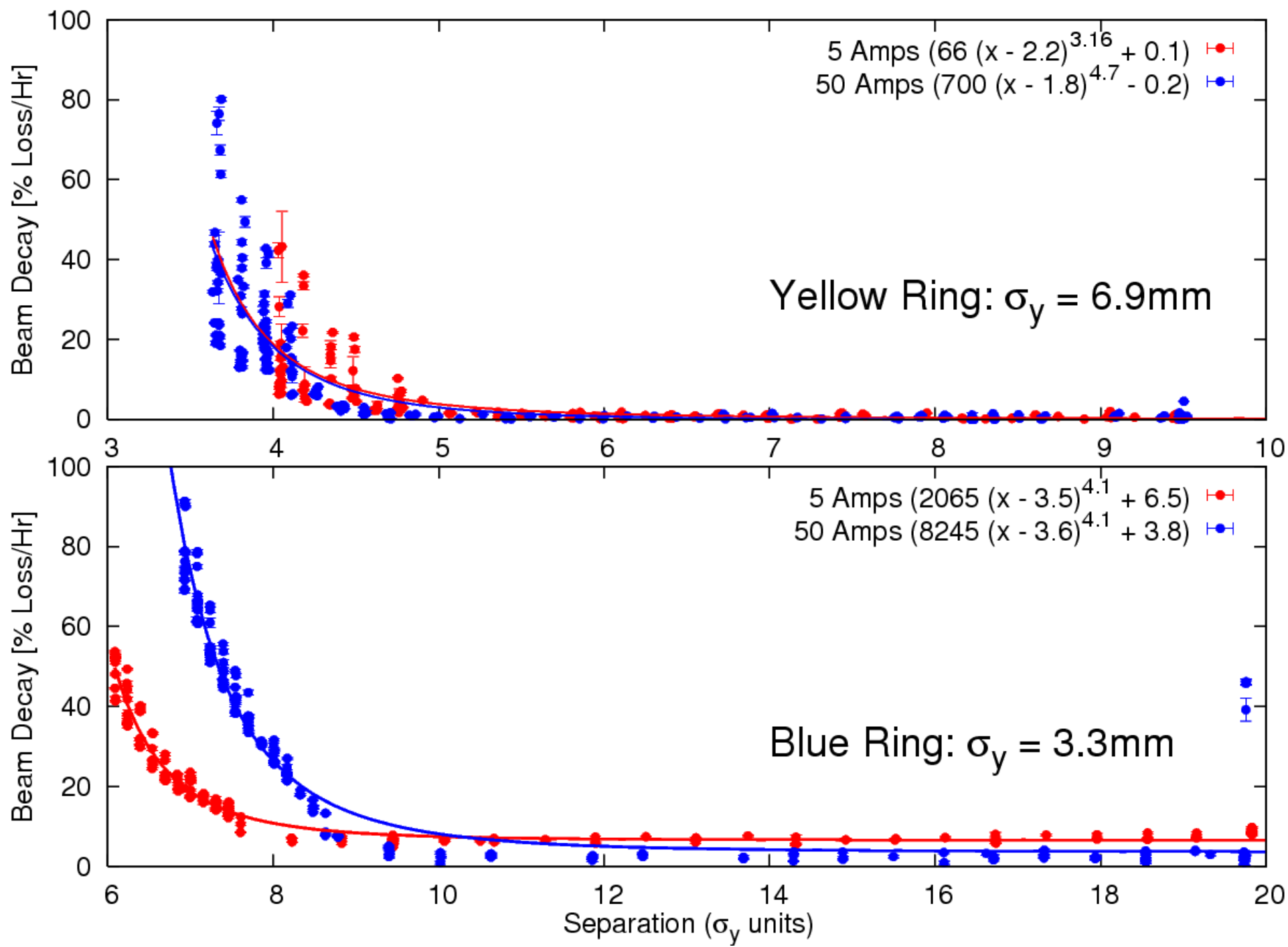
# Effect of Swapping Tunes



# Loss Vs. Wire Position (Exp I)

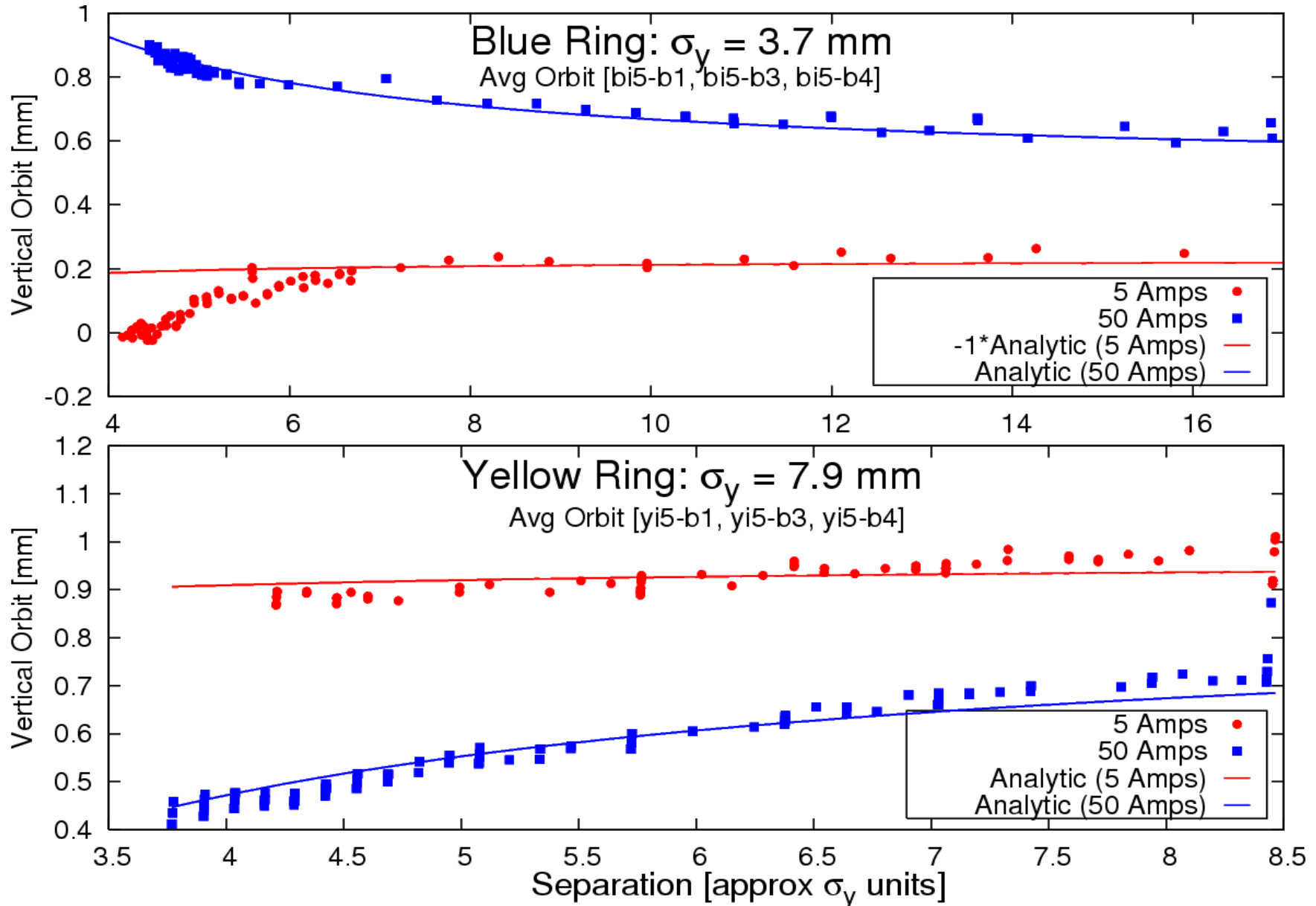


# Loss Vs. Wire Position (Exp II)

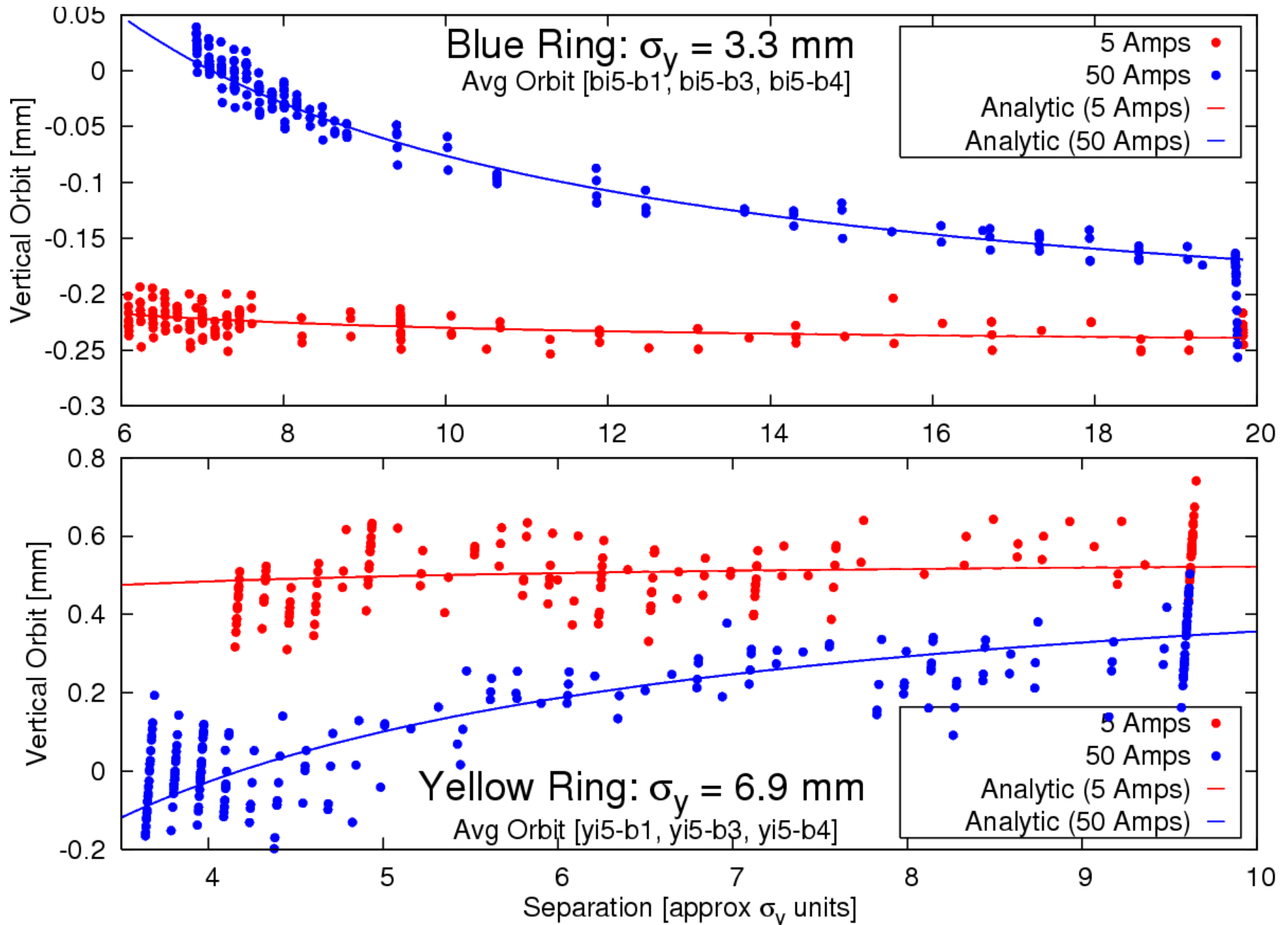


# Orbit Vs. Wire Position (Blue Ring)

$$\Delta y = \frac{K \beta_y}{2d} \frac{\cos(\pi Q_y)}{|\sin(\pi Q_y)|}$$

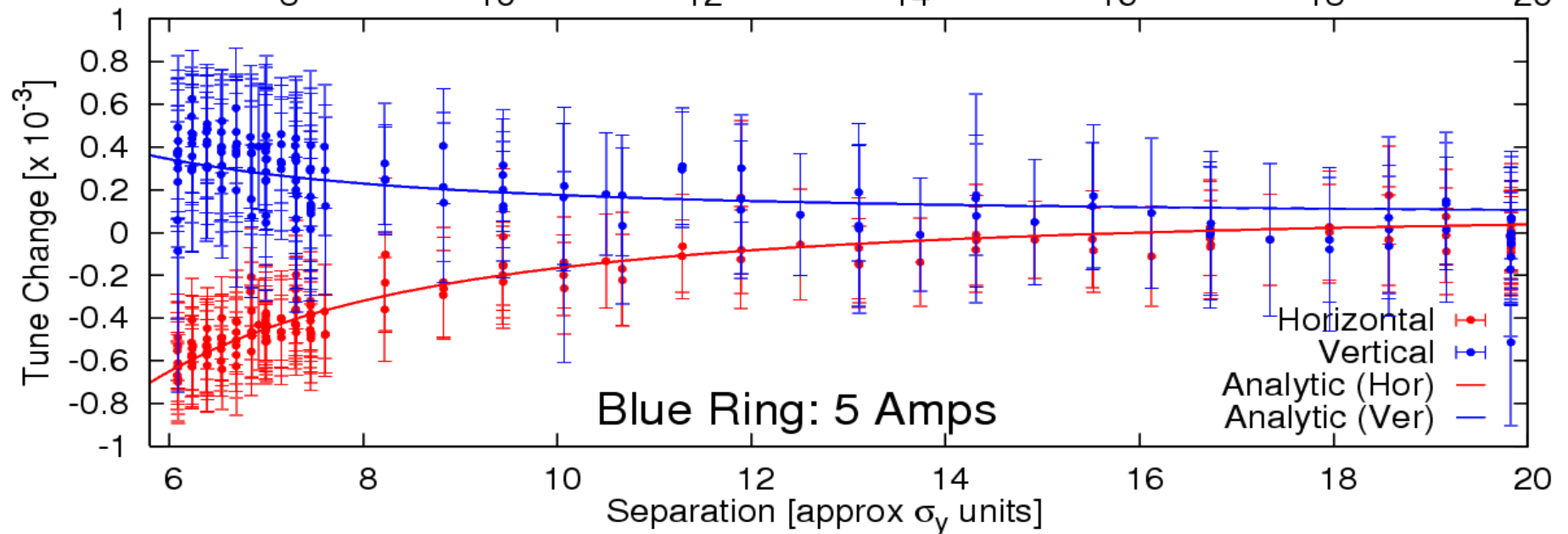
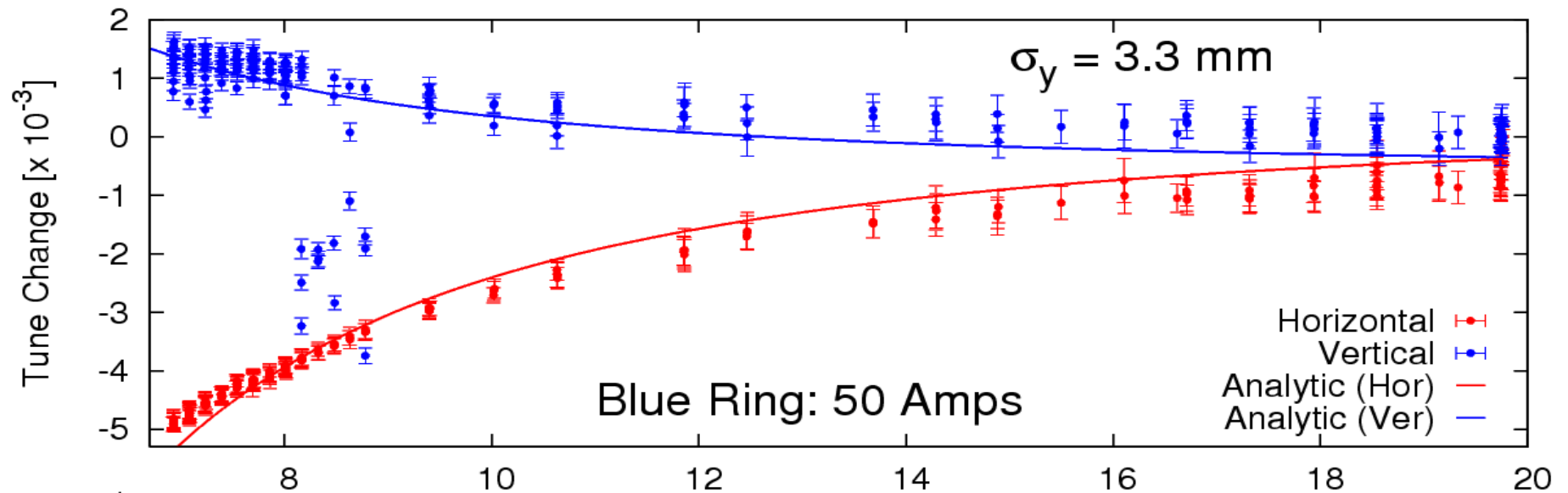


# Orbit Vs. Wire Position (Blue Ring)



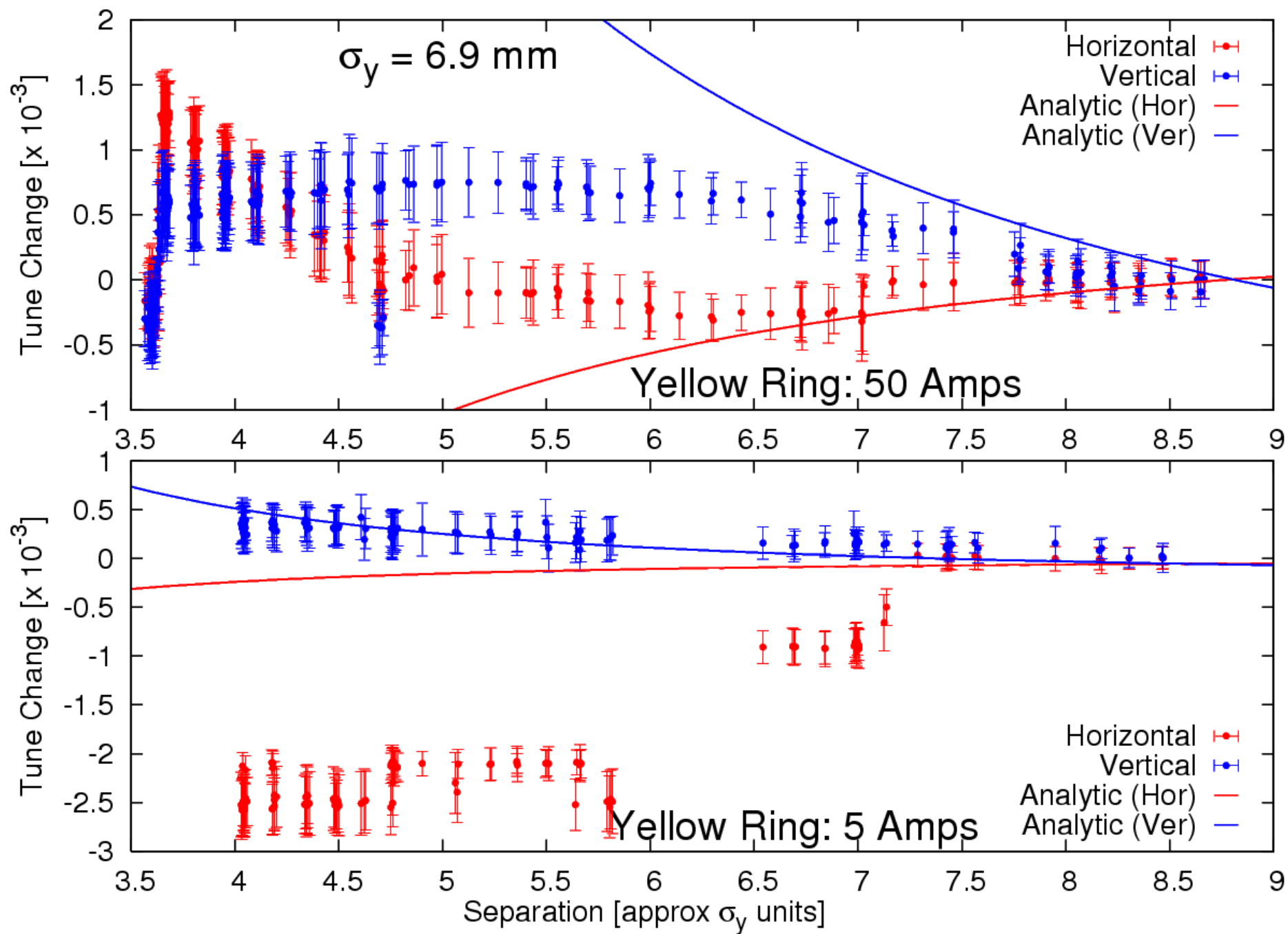
# BBQ Tune: Blue Ring (Exp II)

$$\Delta Q_{x,y} = \pm \frac{K \beta_{x,y}}{4\pi} \frac{1}{d_y^2}$$

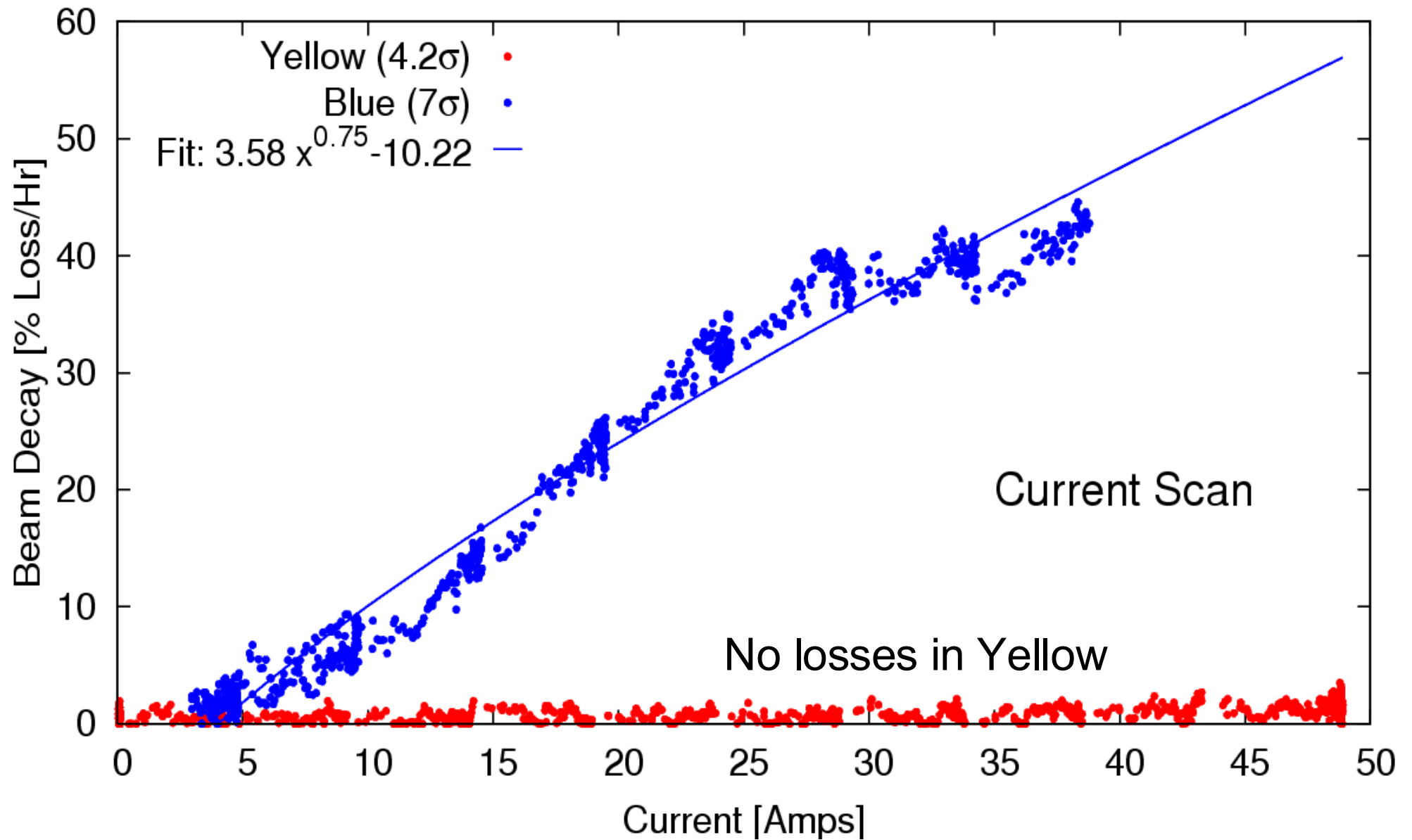




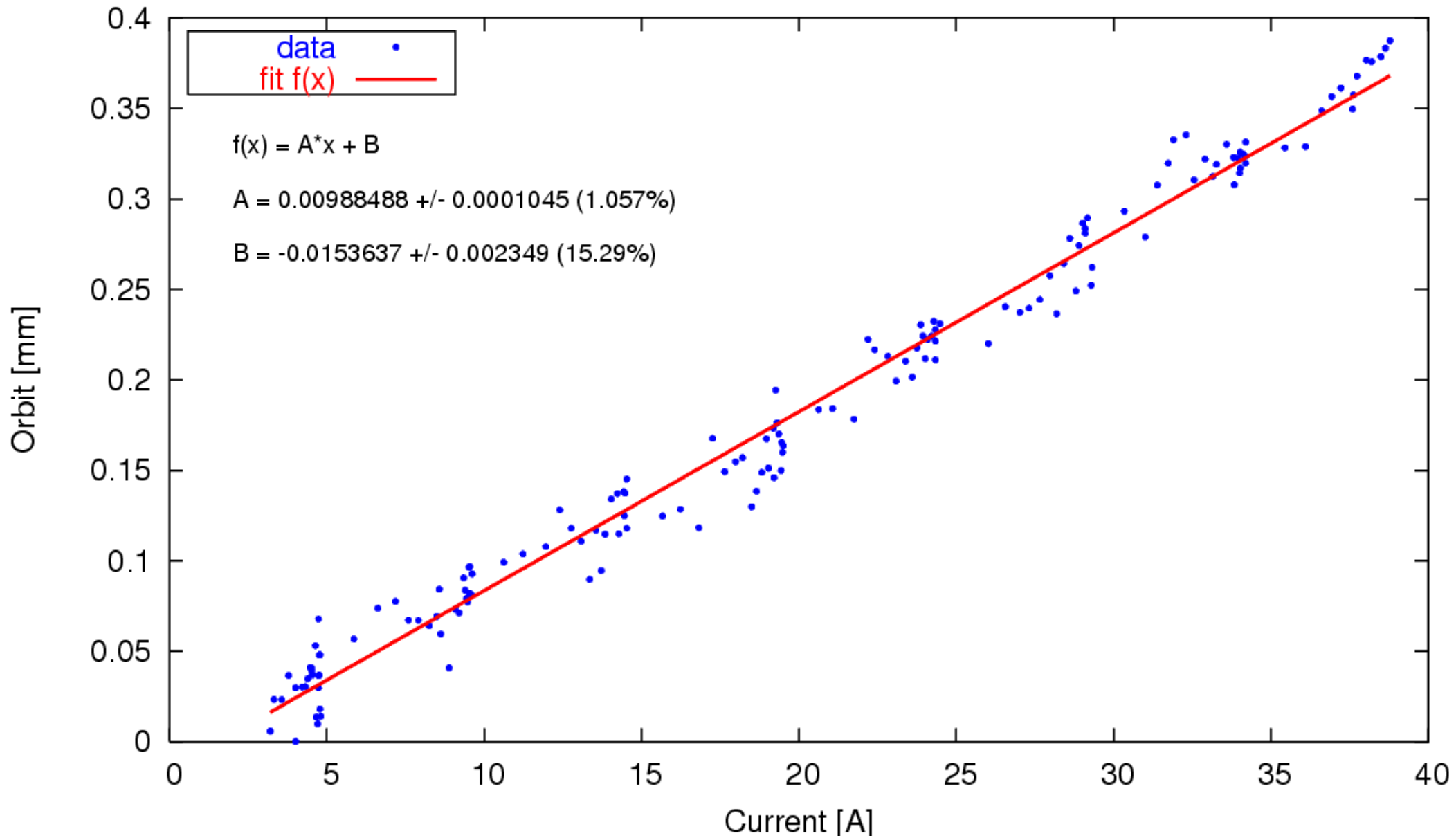
# BBQ Tune: Yellow Ring (Exp II)



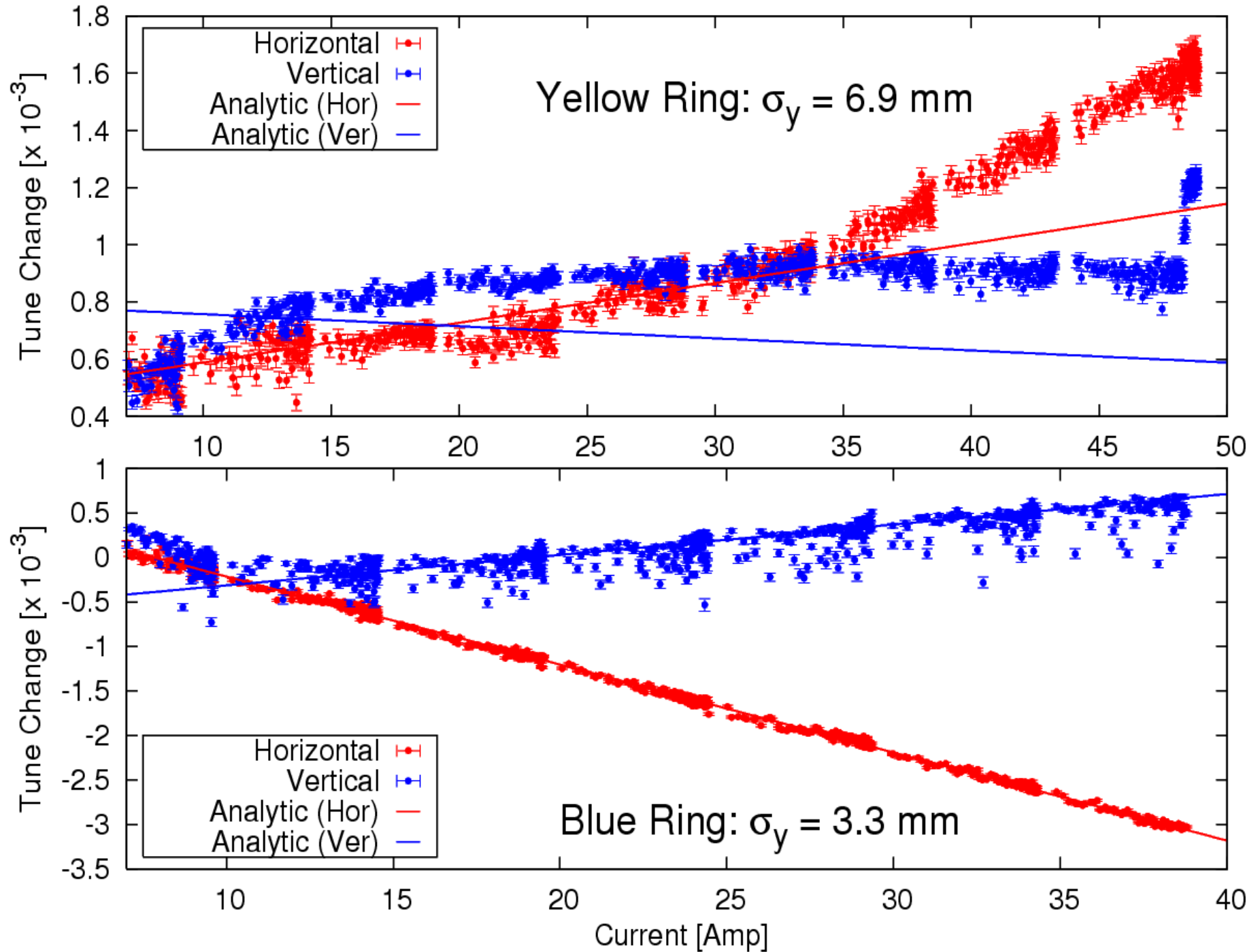
# Current Scan (Exp II)



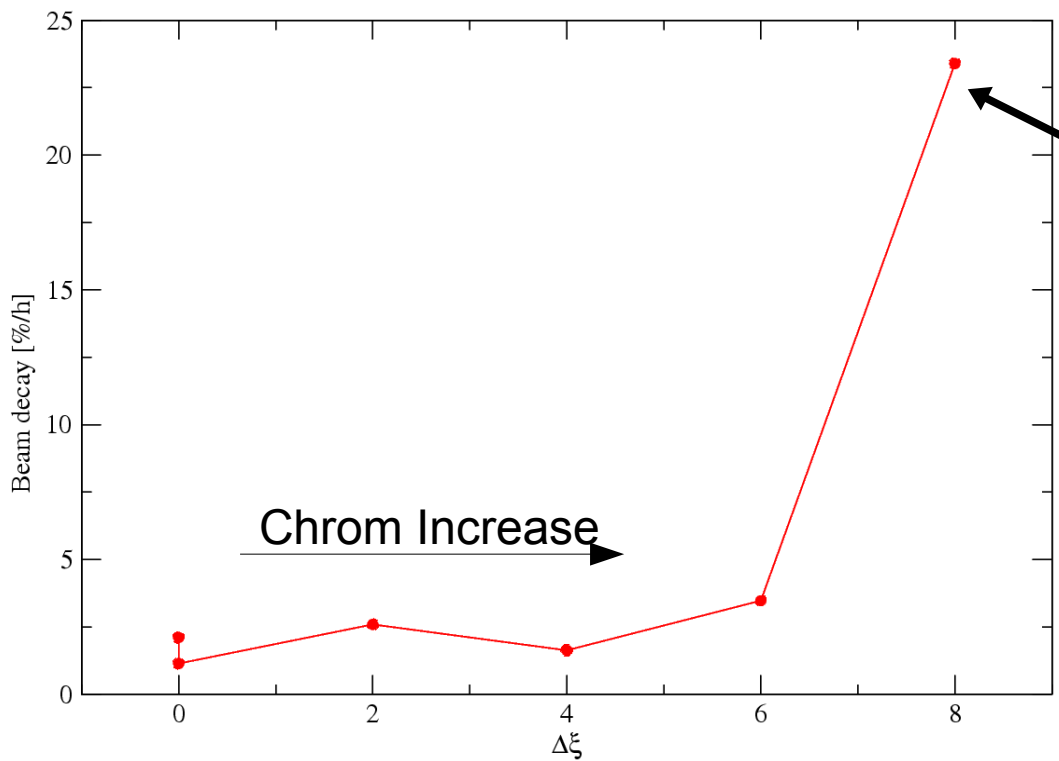
# Orbit Vs. Current (Blue Ring)



# Tune Change Vs. Current

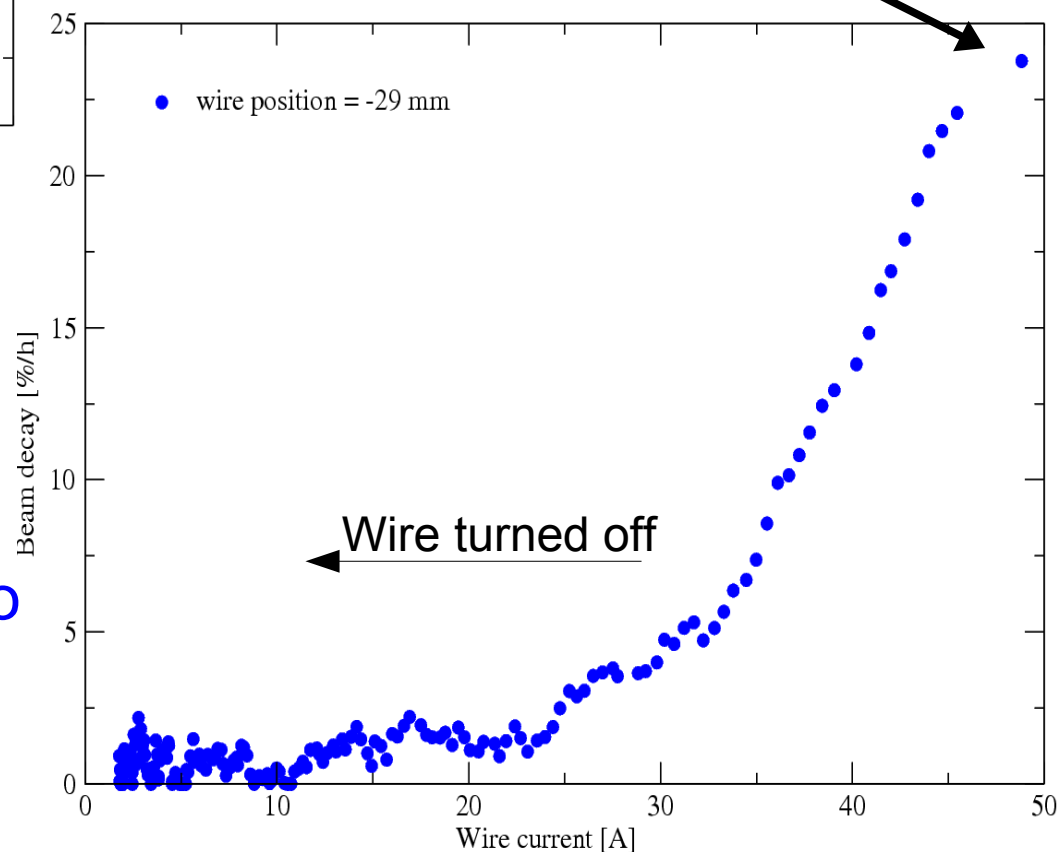


# Losses Vs. Chromaticity



Increase in losses with large Chrom ~8 Units

Losses come back to zero with decreasing current



# Future Exps & Simulations

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- Several more scans planned for Exp III but not very successful
  - SPS Exps from July 2007 (U. Dorda et al.)
  - Experiments with proton beams expected in 2008
  - Induce more losses than 2006 (Chrom, BB, Working point etc..)
    - Compensate using DC wires
    - Still limited to single long range interaction
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