Thoughts on why G0 needed position feedback and HAPPEX didn't

The practical reason why G0 needed position feedback and HAPPEX didn't is simple:

- Values of HAPPEX position differences (with no feedback) were typically < 20 nm (see figures in following slides)
- For G0, typical position differences (before feedback turned on) were ~ 100 - 200 nm

so clearly G0 needed position feedback to get down to the desired < 20 nm level.

Why the difference in "no-feedback" values (as observed in experimental halls)?

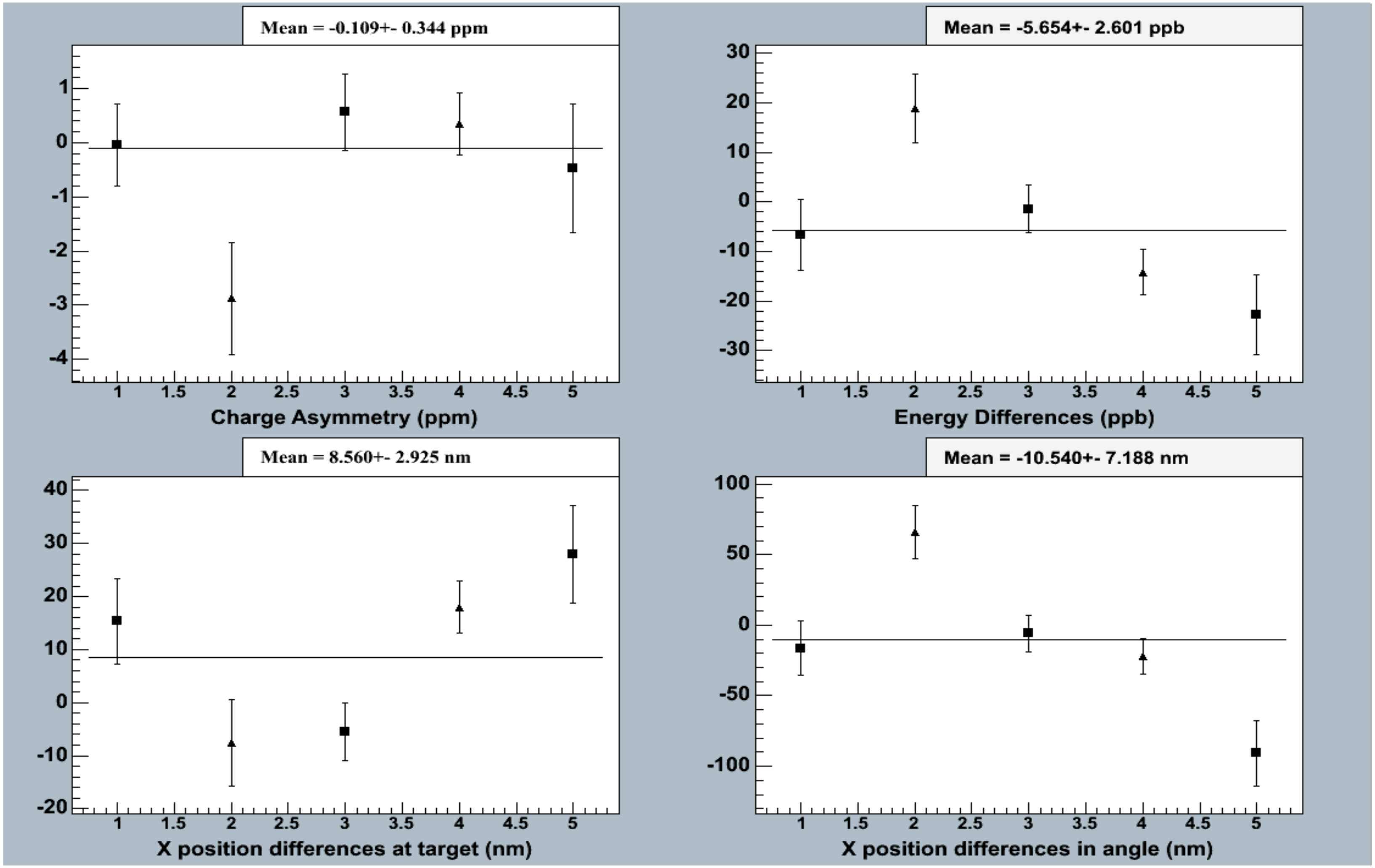
1. Did HAPPEX have smaller "analyzing power" than G0 for their crystal? (probably unlikely)

2. Did HAPPEX choice of Pockels cell and alignment procedures lead to smaller gradient induced position differences? (one way to compare would be to look at a RHWP scan at the first 100 keV BPM for HAPPEX and G0 and see if the amplitude of the position difference curves differs, assuming comparable intensity asymmetry amplitudes)

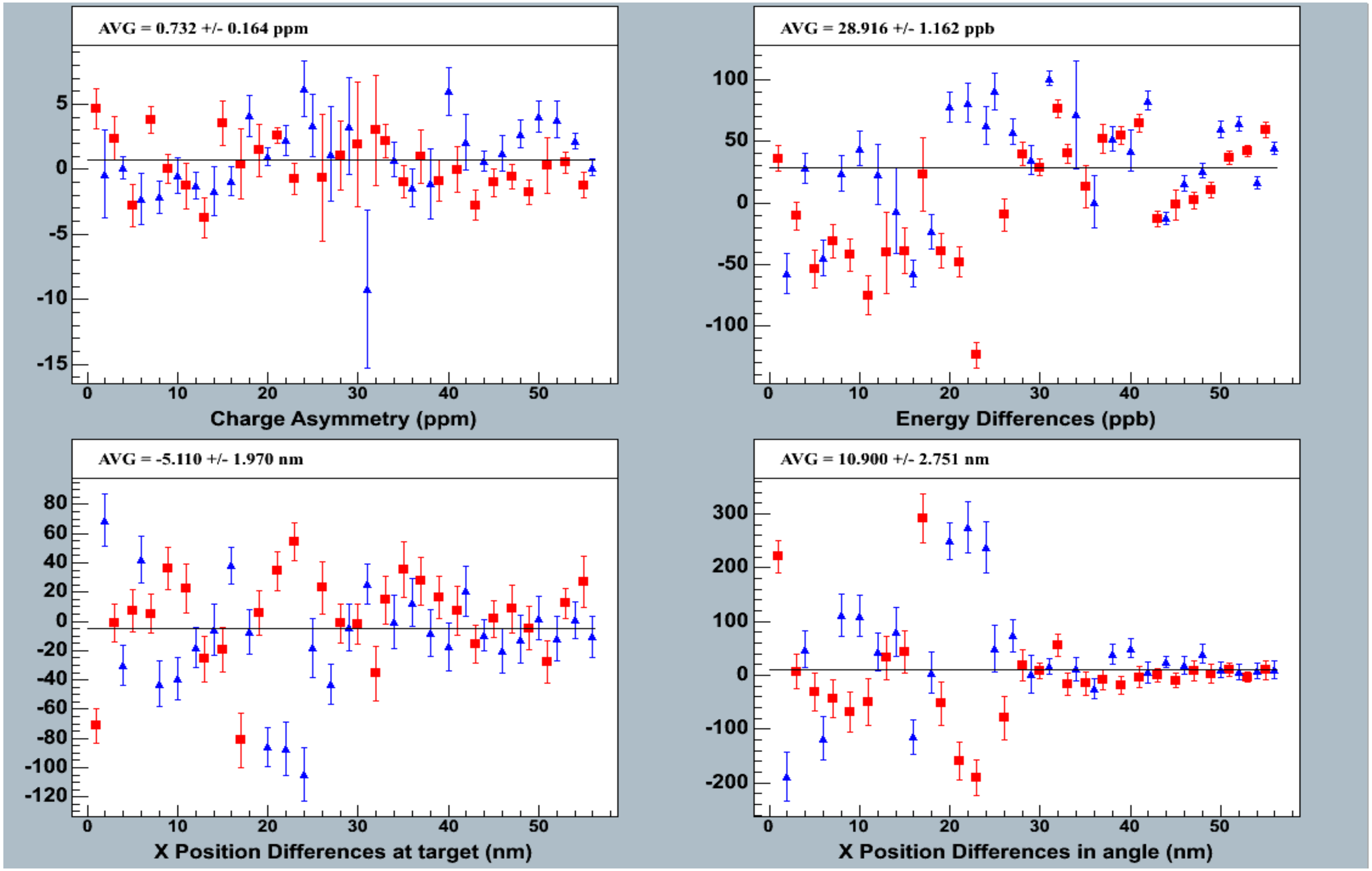
3. Did HAPPEX's choice of RHWP and PITA settings lead to a better "simultaneous" null of intensity and positions coming off the crystal? (to check one would need to compare typical position differences between HAPPEX and G0 at the first injector BPM at 100 keV; if such data exists).

4. Did HAPPEx have better typical "adiabatic damping" than G0 did? (some data exists on it but it might be comparing apples and oranges; see following slides)

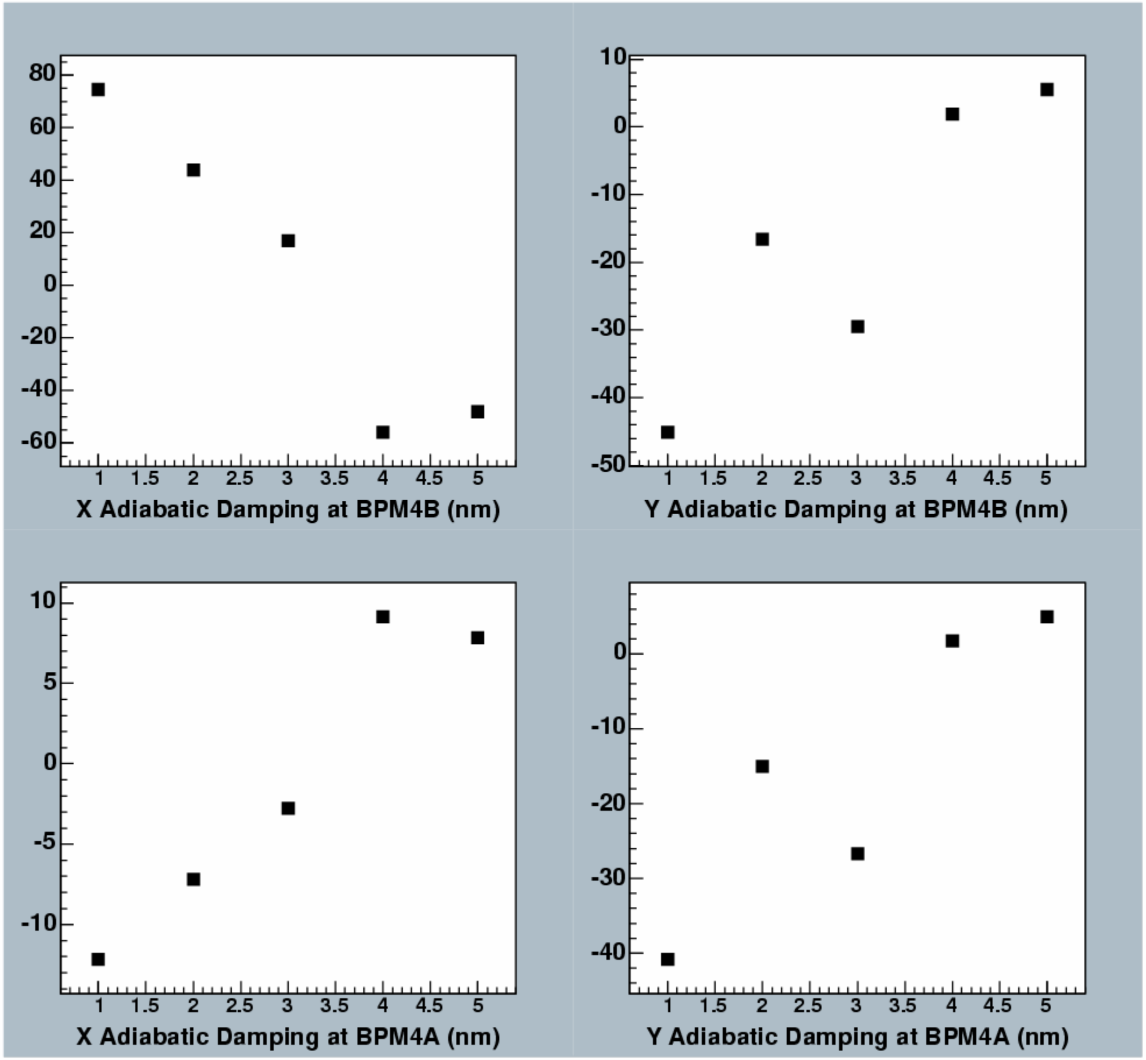
Helicity-Correlated Beam Properties: Experience during HAPPEx Helium



Helicity-Correlated Beam Properties: Experience during HAPPEx Hydrogen



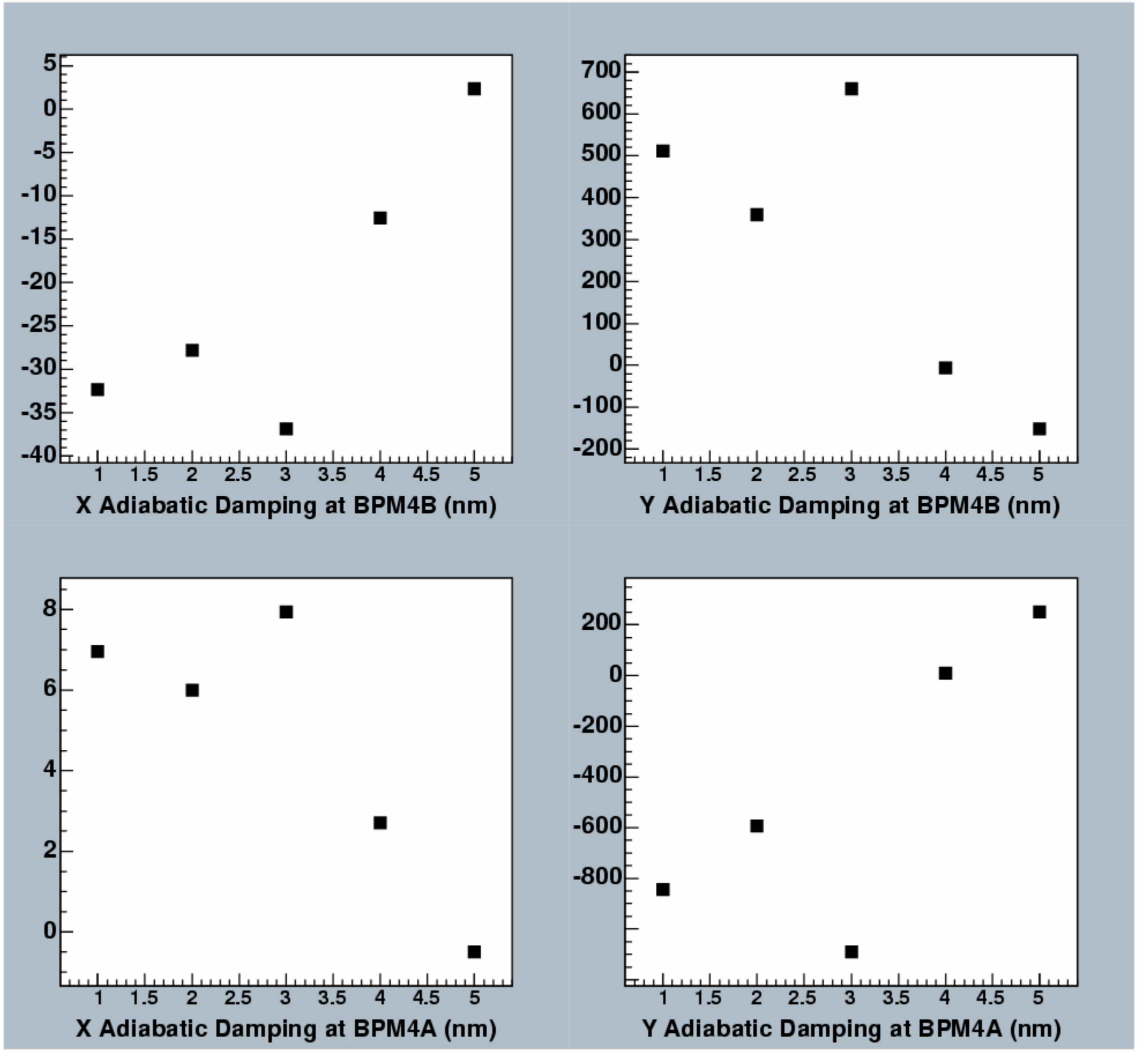
HAPPEX adiabatic damping results from Ryan Snider



1=BPM0I05 2=BPM0L01 3=BPM0L02 4=BPM0L03 5= BPM0L04

BPM4A and BPM4B are in Hall A

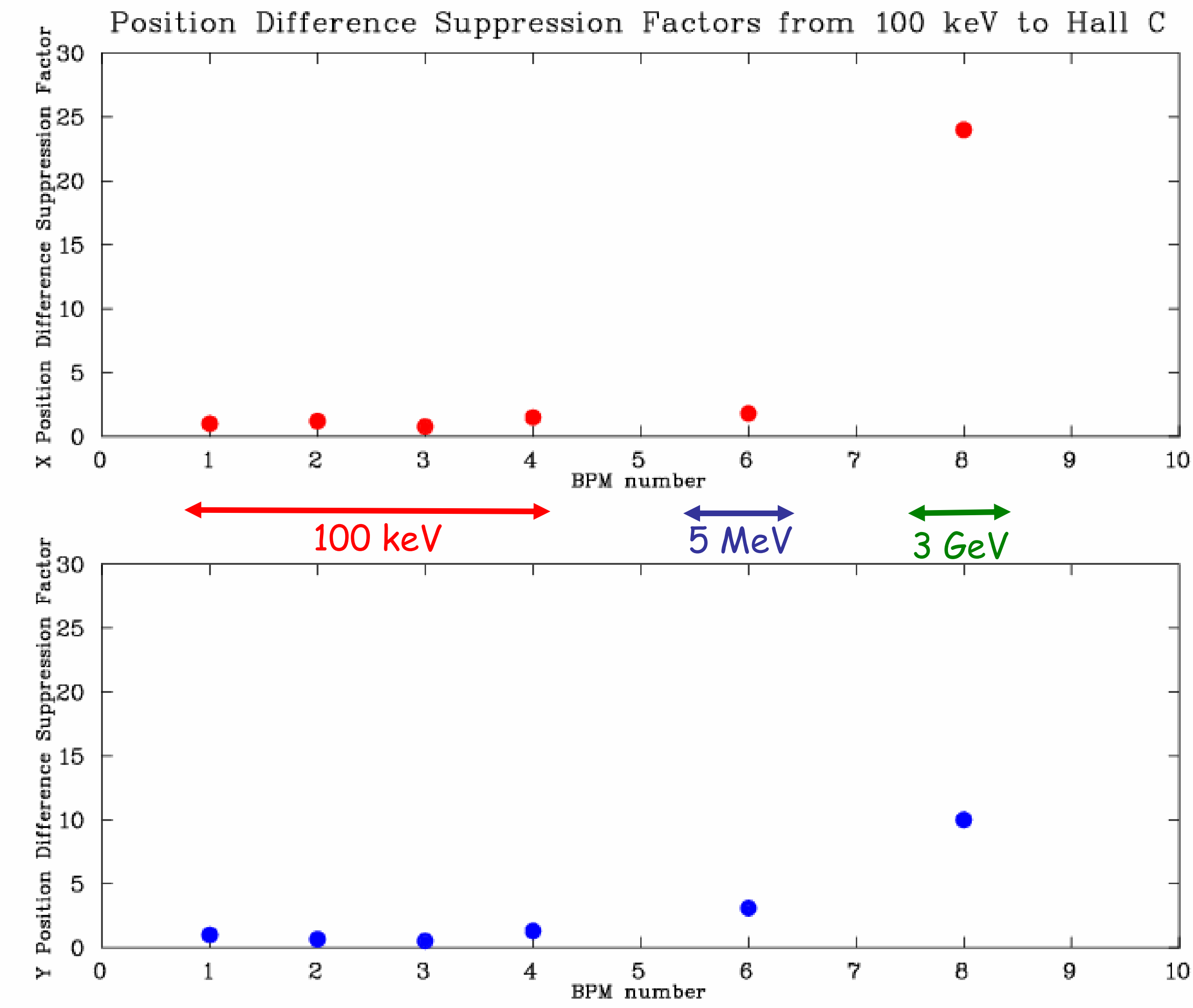
HAPPEX adiabatic damping results from Ryan Snider



1=BPM0I05 2=BPM0L01 3=BPM0L02 4=BPM0L03 5= BPM0L04

BPM4A and BPM4B are in Hall A

G^0 results on "adiabatic damping" from PZT scans



Total observed damping from 100 keV to 3 GeV:
x ~ 24, y~ 10
Most of damping comes from 5 MeV → 3 GeV region

Recall: Beam Specs./Observed values for G^0 Forward Angle Run

Beam specifications table for G^0 forward angle run:

Beam Property	Nominal value	Maximum deviation from nominal (DC)	Maximum noise at the helicity reversal frequency	Maximum noise at all other frequencies	Maximum allowed run-averaged helicity-corrrelation
Energy(average)	3.0 GeV	± 0.01 %	0.001% (35μ at 35mm/%)	0.01% (350 μ at 35 mm/%	<2.5 x 10^{-8} 88 nm at 35 mm/%
Energy spread (1σ)	$\sigma_E/E < 5 \times 10^{-5}$	$\sigma_E/E < 5 \times 10^{-5}$			
CW average current	40 μA	± 5.0 %	0.2%	1.0%	< 1 ppm
Position at G^0 target	"0"	± 0.2 mm	20 μ	0.2 mm	< 20 nm
Angle at G^0 target	"0"	± 0.050 mr	2 μr	0.02 mr	< 2 nr
Angular divergence at G^0 target	$\sigma_{x'}, \sigma_{y'} < 100\ \mu r$	± 50%			
rms size (unrastered) at G^0 target	< 200 μ	± 25%	20 μ	0.2 mm	< 2 μ
Polarization	> 70%				
Beam halo at G^0 target	< 1 x 10^{-6} outside of a 3 mm radius				< 0.1% of nominal halo tolerance

Observed values during G^0 forward angle run:

Beam Parameter	**Achieved**	**"Specs"**
Charge asymmetry	-0.14 ± 0.32 ppm	1 ppm
x position differences	3 ± 4 nm	20 nm
y position differences	4 ± 4 nm	20 nm
x angle differences	1 ± 1 nrad	2 nrad
y angle differences	1.5 ± 1 nrad	2 nrad
Energy differences	29 ± 4 eV	75 eV