

## Thoughts on why GO needed position feedback and HAPPEX didn't

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

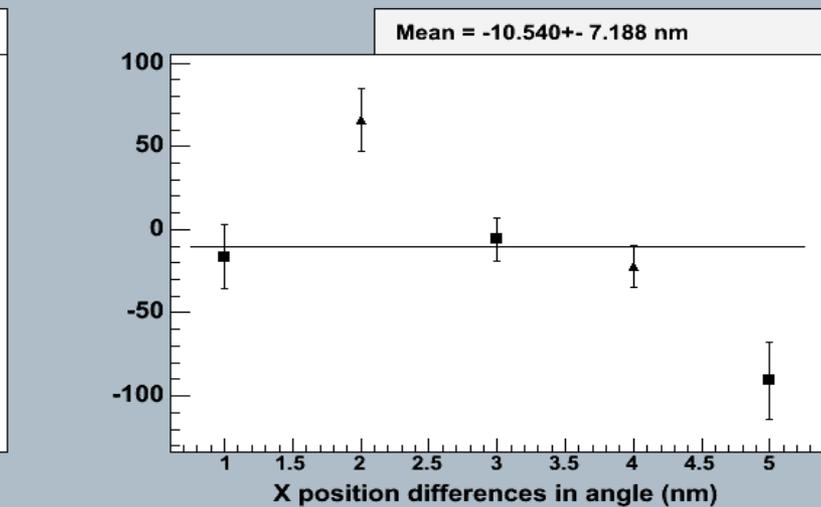
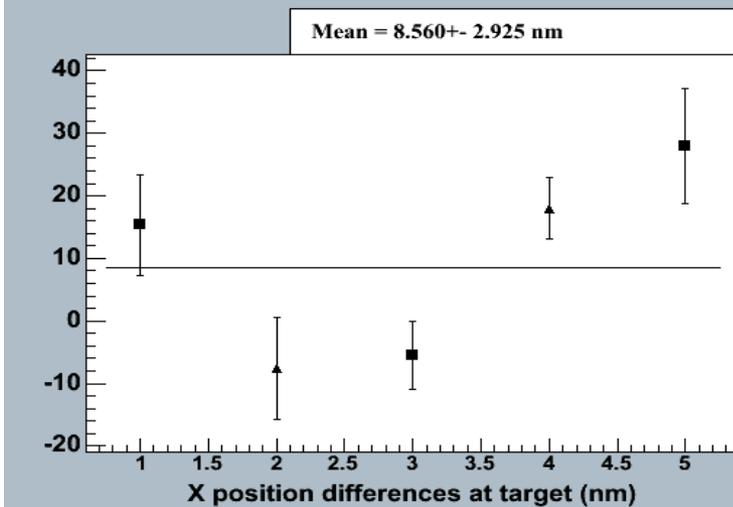
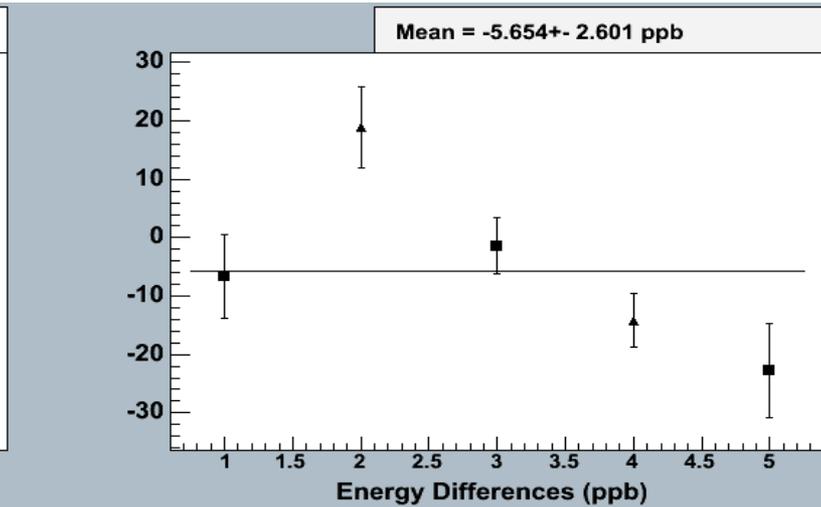
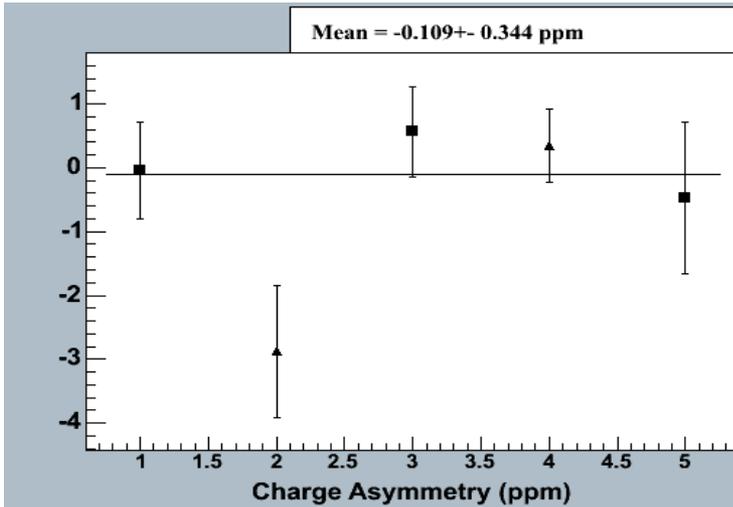
- Values of HAPPEX position differences (with no feedback) were typically < 20 nm (see figures in following slides)
- For GO, typical position differences (before feedback turned on) were ~ 100 - 200 nm

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

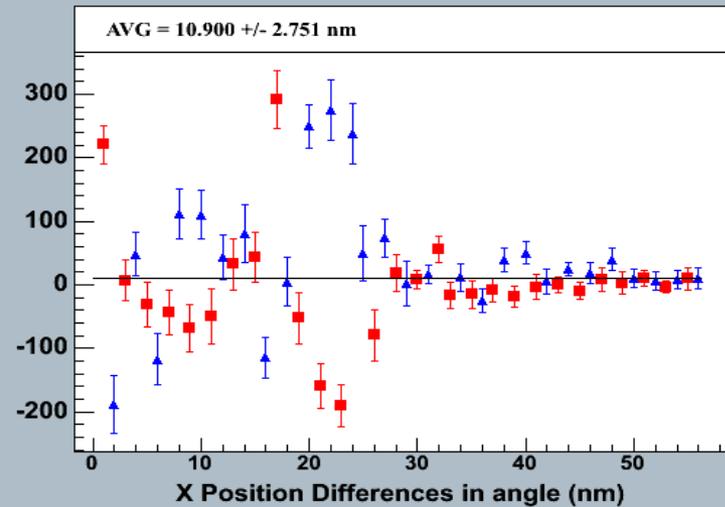
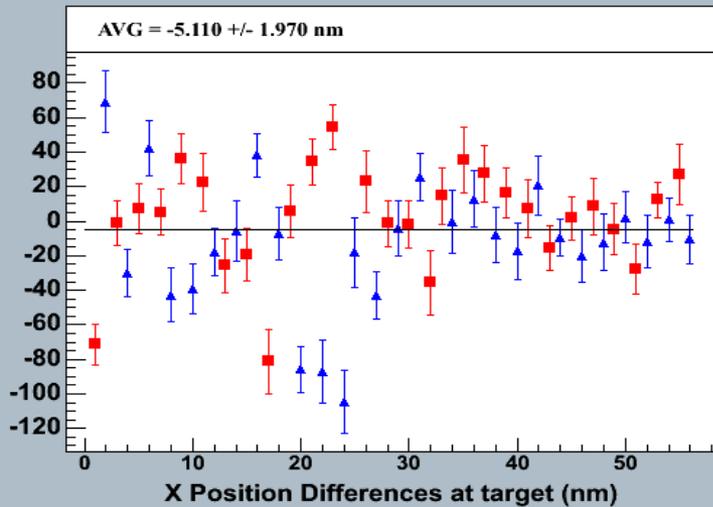
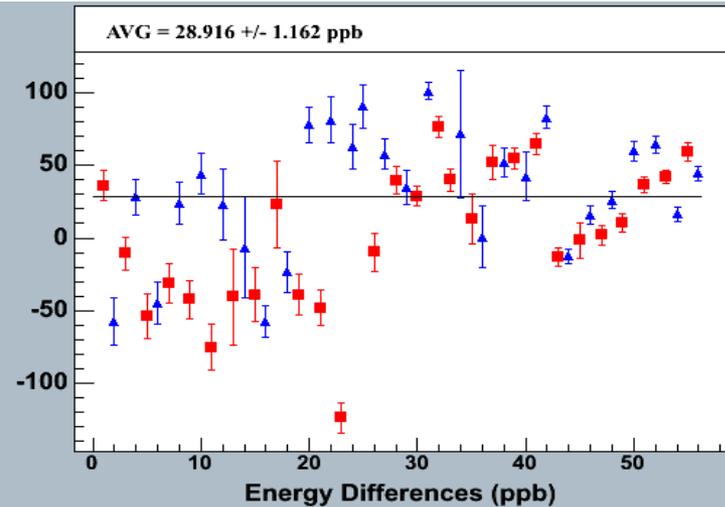
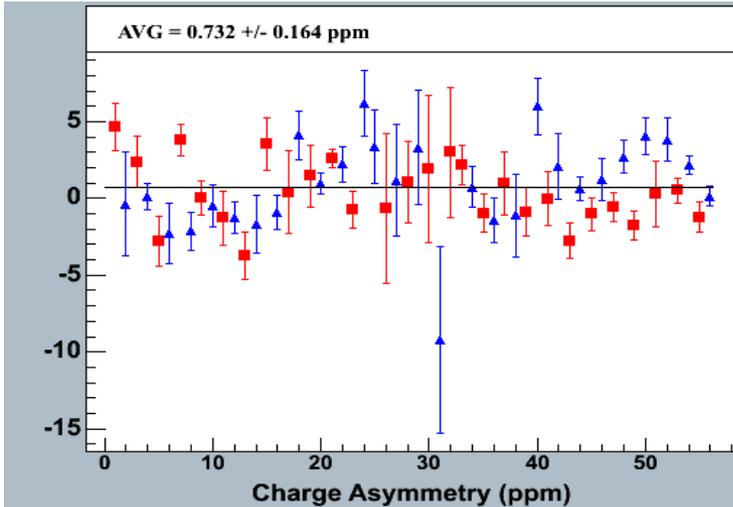
Why the difference in "no-feedback" values (as observed in experimental halls)?

1. Did HAPPEX have smaller "analyzing power" than GO 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 GO 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 GO at the first injector BPM at 100 keV; if such data exists).
4. Did HAPPEX have better typical "adiabatic damping" than GO did? (some data exists on it but it might be comparing apples and oranges; see following slides)

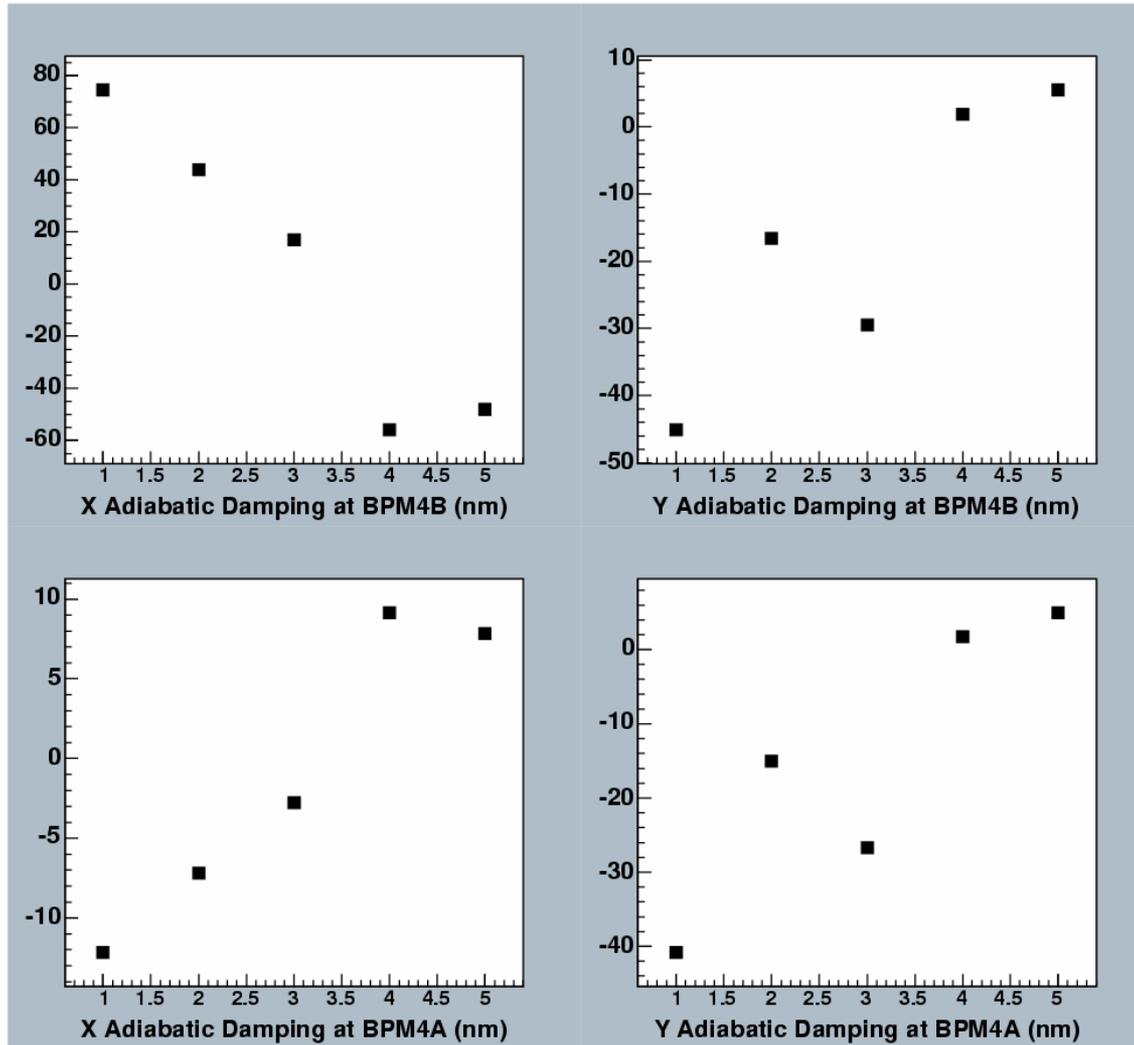
# Helicity-Correlated Beam Properties: Experience during HAPPEX Helium



# Helicity-Correlated Beam Properties: Experience during HAPPEX Hydrogen



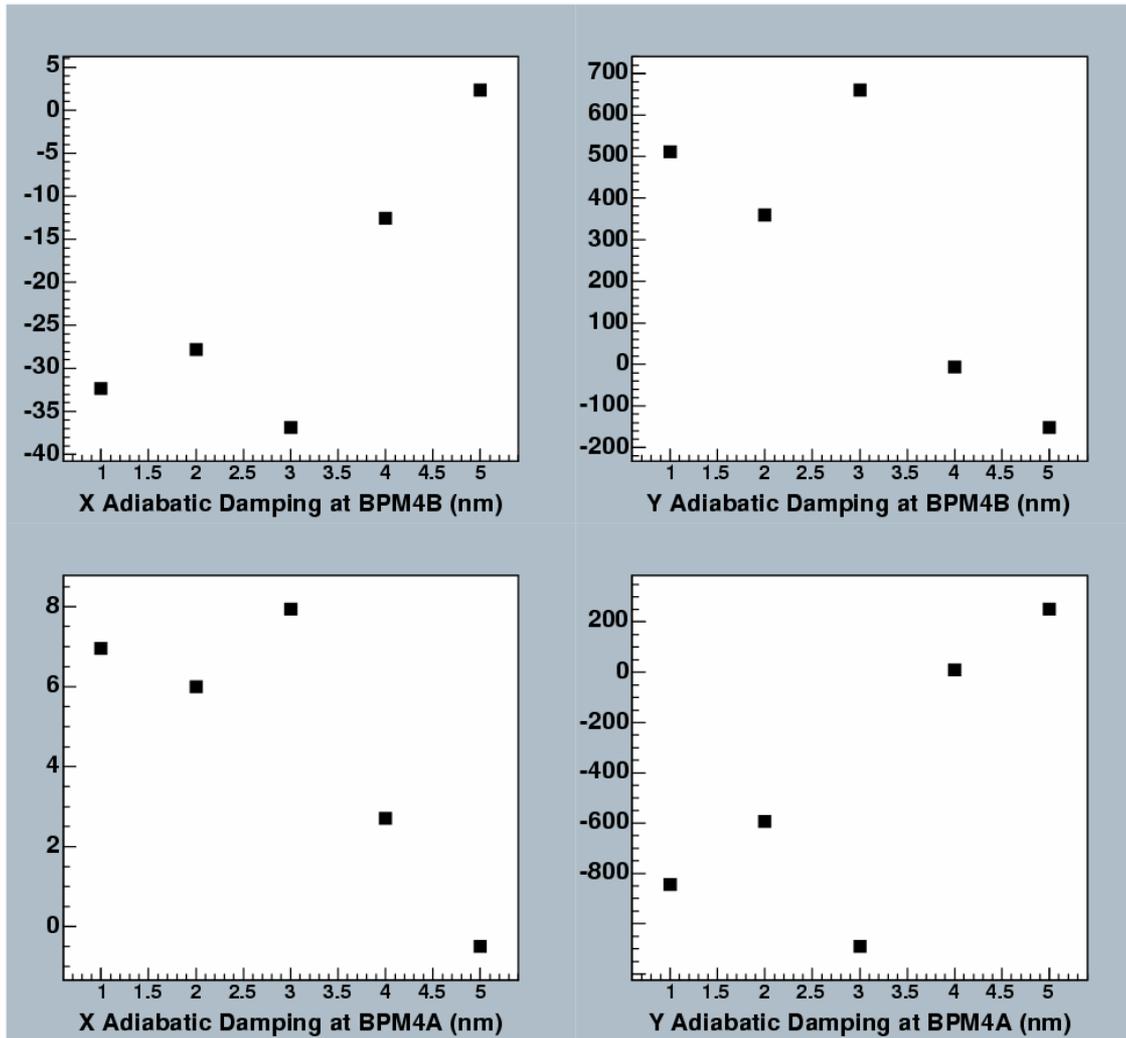
# HAPPEX adiabatic damping results from Ryan Snyder



1=BPMOI05 2=BPMOLO1 3=BPMOLO2 4=BPMOLO3 5= BPMOLO4

BPM4A and BPM4B are in Hall A

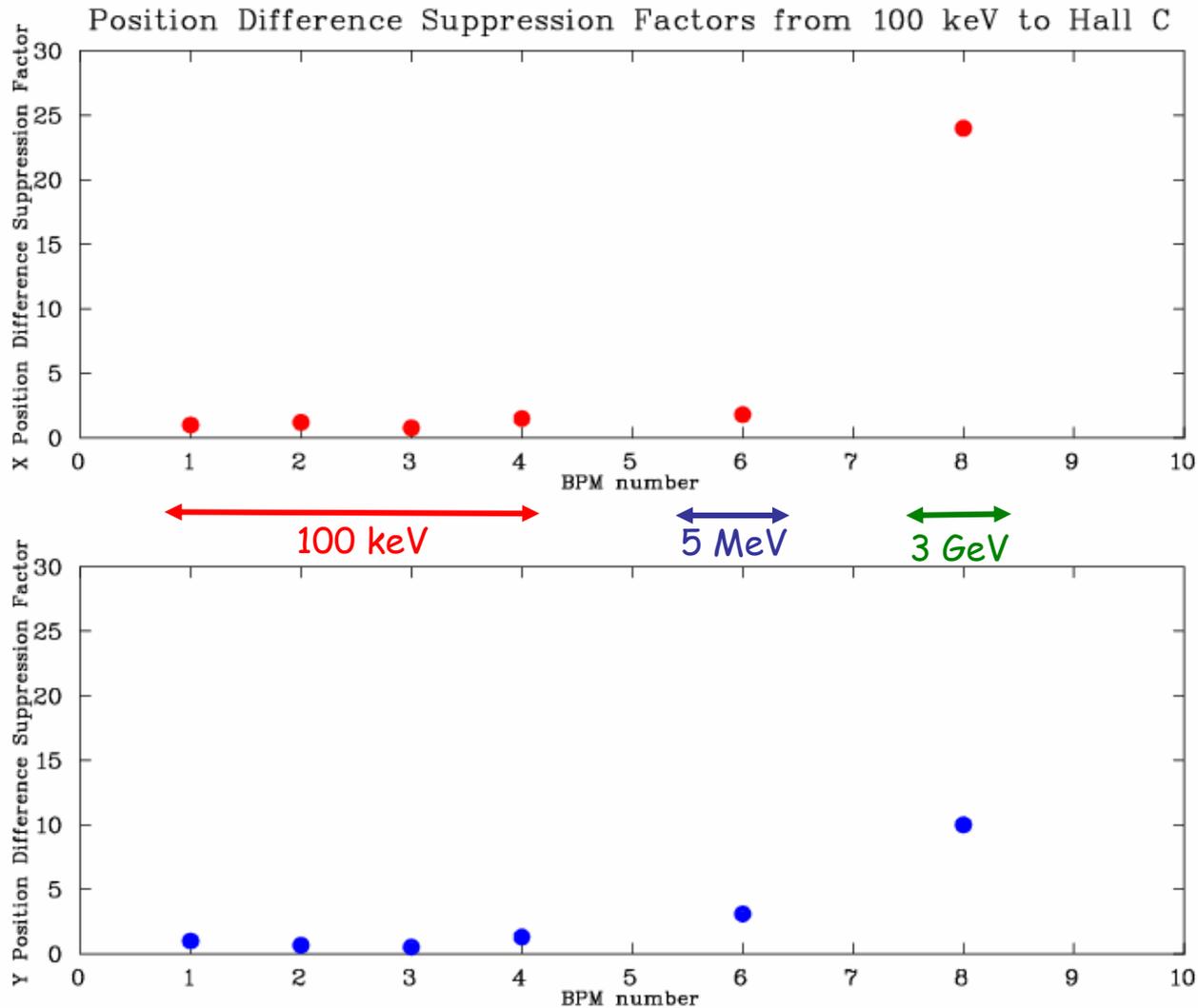
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# $G^0$ results on "adiabatic damping" from PZT scans



Total observed damping from 100 keV to 3 GeV:

$x \sim 24$ ,  $y \sim 10$

Most of damping comes from 5 MeV  $\rightarrow$  3 GeV region

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

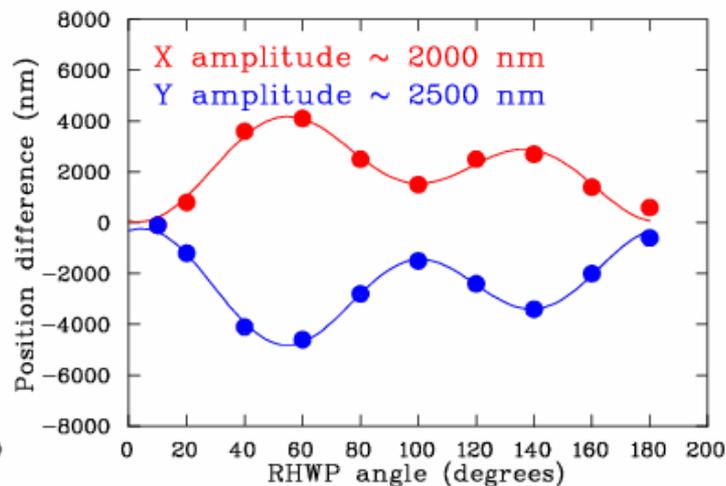
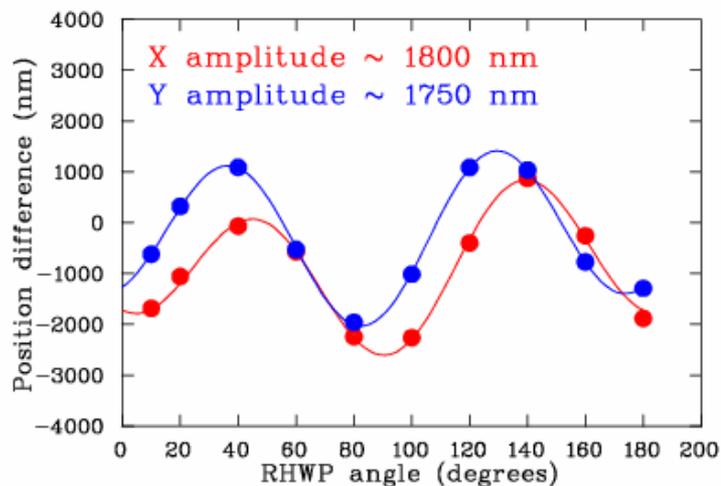
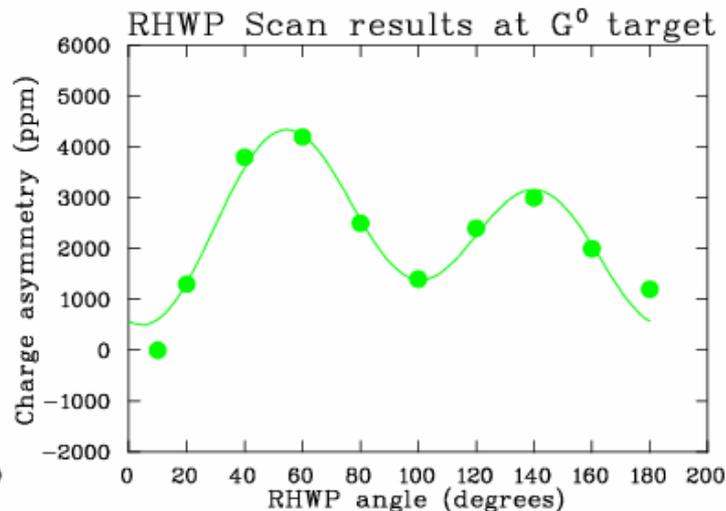
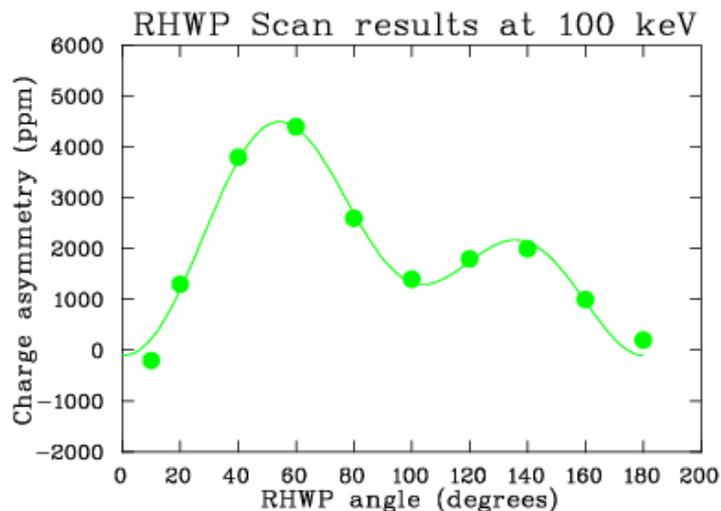
## Beam specifications table for $G^0$ forward angle run:

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-correlation
Energy(average)	3.0 GeV	$\pm 0.01 \%$	0.001% (35 $\mu$ at 35mm/%)	0.01% (350 $\mu$ at 35 mm/%)	$< 2.5 \times 10^{-8}$ 88 nm at 35 mm/%
Energy spread ( $1\sigma$ )	$\sigma_E/E < 5 \times 10^{-5}$	$\sigma_E/E < 5 \times 10^{-5}$			
CW average current	40 $\mu$ A	$\pm 5.0 \%$	0.2%	1.0%	< 1 ppm
Position at $G^0$ target	"0"	$\pm 0.2$ mm	20 $\mu$	0.2 mm	< 20 nm
Angle at $G^0$ target	"0"	$\pm 0.050$ mr	2 $\mu$ r	0.02 mr	< 2 nr
Angular divergence at $G^0$ target	$\sigma_x, \sigma_y < 100 \mu$ r	$\pm 50\%$			
rms size (unrastered) at $G^0$ target	< 200 $\mu$	$\pm 25\%$	20 $\mu$	0.2 mm	< 2 $\mu$
Polarization	> 70%				
Beam halo at $G^0$ target	< $1 \times 10^{-6}$ outside of a 3 mm radius				< 0.1% of nominal halo tolerance

## Observed values during $G^0$ forward angle run:

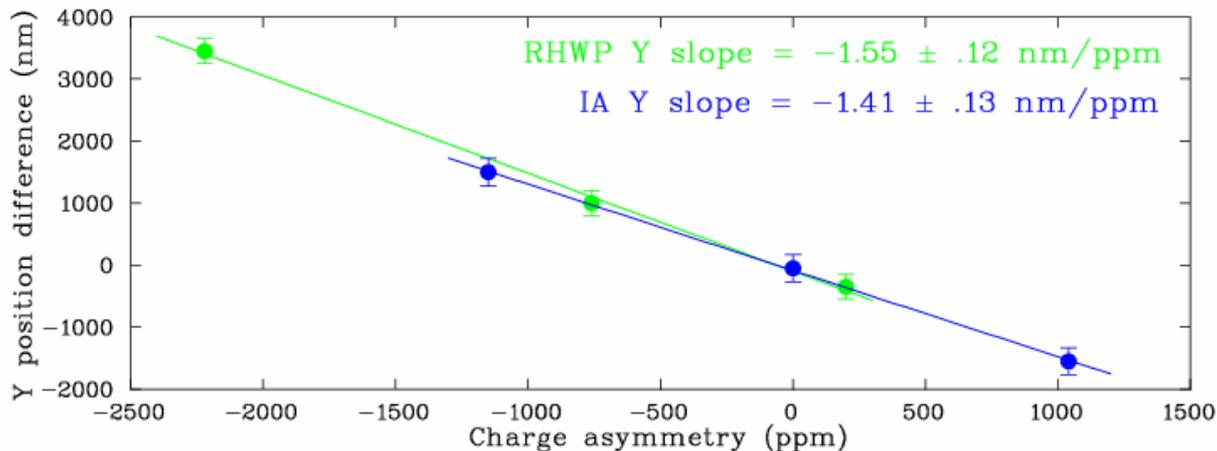
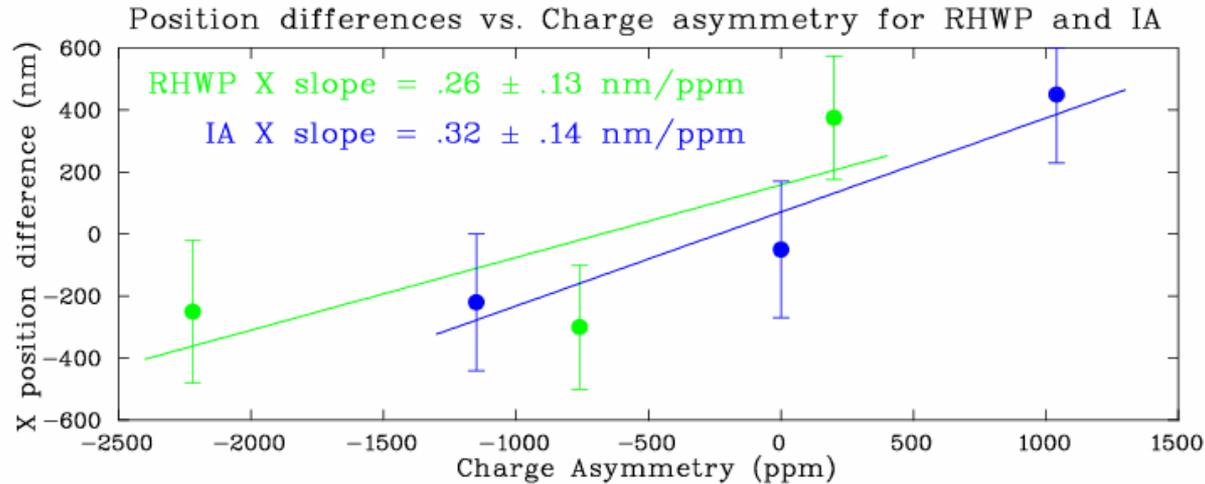
Beam Parameter	Achieved	"Specs"
Charge asymmetry	$-0.14 \pm 0.32$ ppm	1 ppm
x position differences	$3 \pm 4$ nm	20 nm
y position differences	$4 \pm 4$ nm	20 nm
x angle differences	$1 \pm 1$ nrad	2 nrad
y angle differences	$1.5 \pm 1$ nrad	2 nrad
Energy differences	$29 \pm 4$ eV	75 eV

# $G^0$ results on "adiabatic damping" from RHWP scan



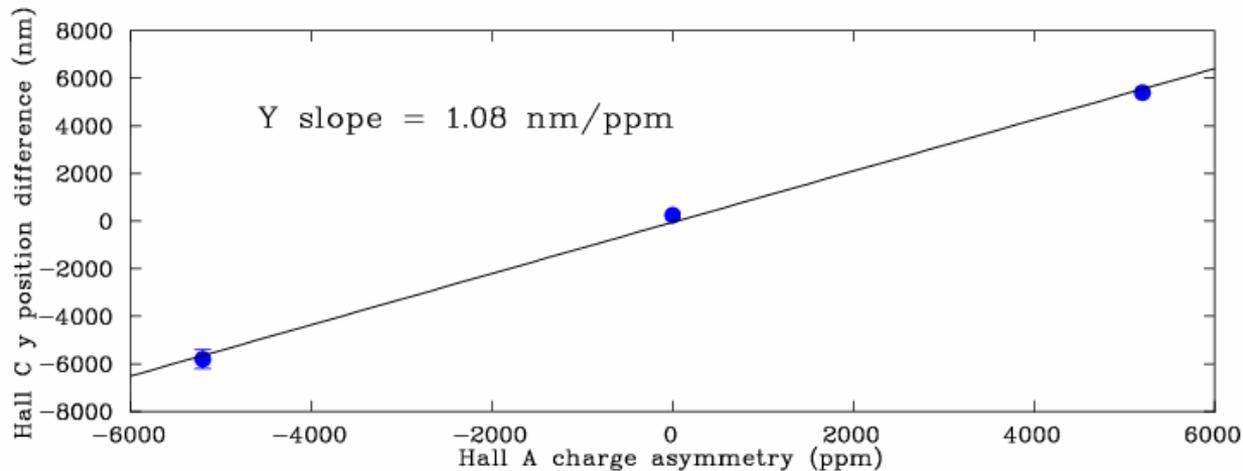
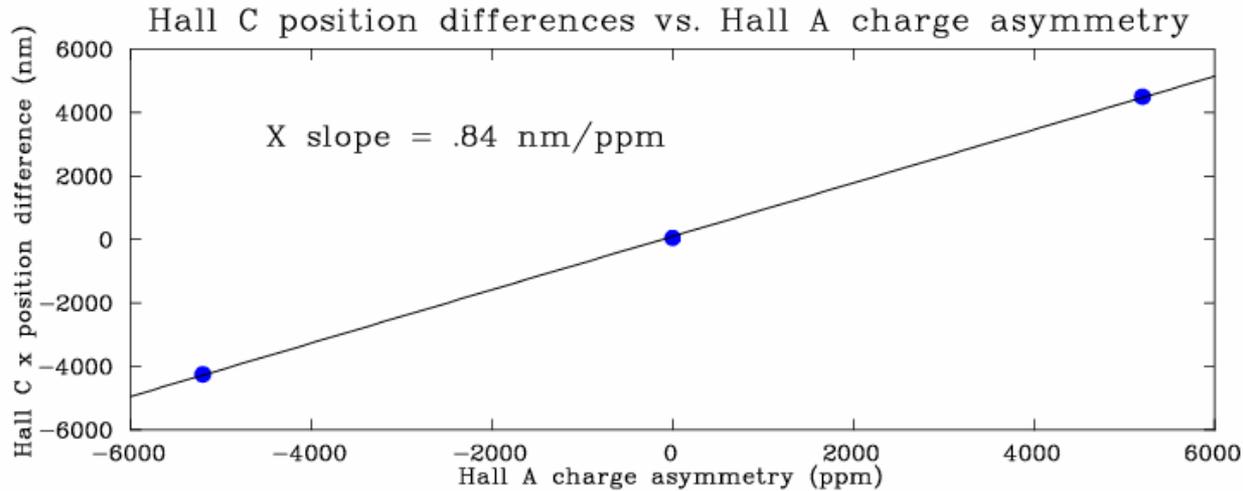
There appears to be no damping at all in the position differences induced by the RHWP (rotating halfwave plate).

# Position differences in hall correlated with charge asymmetries



The position differences in the hall seem to be correlated with the charge asymmetry, independent of how the charge asymmetry is generated.

# Correlation between Hall C position differences and Hall A charge asymmetry (Hall A $\sim 100 \mu A$ , Hall C $\sim 20 \mu A$ )



A similar correlation is seen with the Hall A beam, which occurs at least 2 nsec different in time than the Hall C beam.