

CDF beam width measurement

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- Outline:
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 - Online Beam Width measurement
 - History
 - Summary

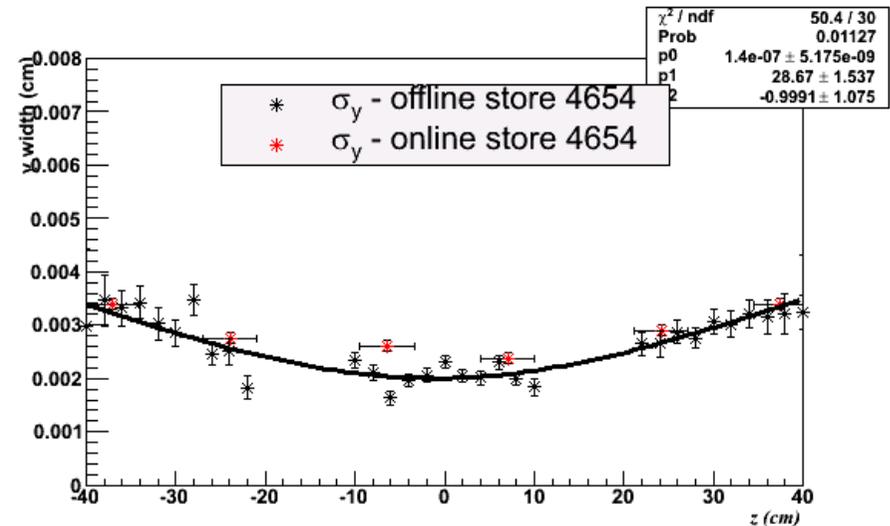
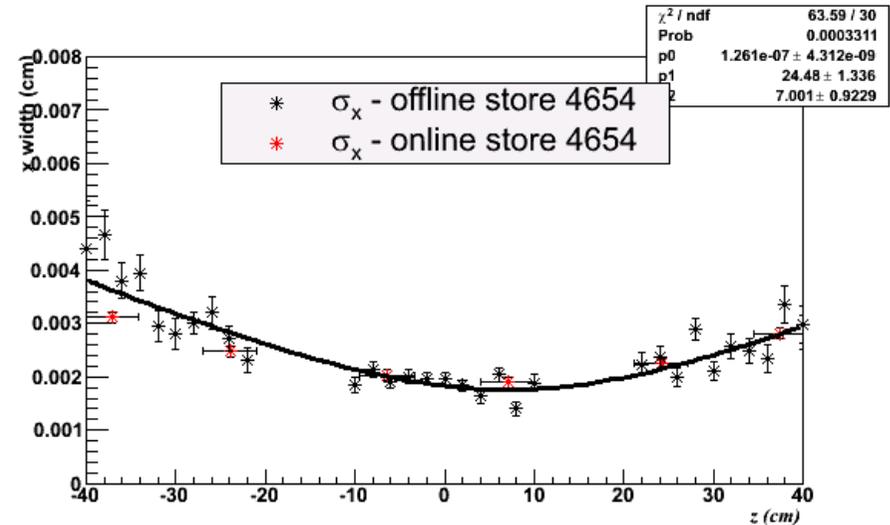
Review

- Online measurement is using two well-separated trigger track pairs in each silicon half-barrel.
 - There are six half-barrels in z, which contributes each beam point.
 - Consider track pairs 100 min after Silicon turned on.
 - This method gives quick response to beam status.
 - What is not good...
 - Only 6 points are used... β^* fit not very precise
 - Store-to-store variation and in-store fluctuation of beam width.
- Offline measurement of β^* done using reconstructed primary vertices
 - Nice measurement
 - However large latency – time lag between run and measurement availability
- Recent online measurement improvements:
 - Improved statistics in online beam fit code.
 - OLD: accepts two-track event only → NEW: allows events having up to 10 tracks.
 - Save beam width measurement in SVDD bank (in progress).

Online vs. Offline

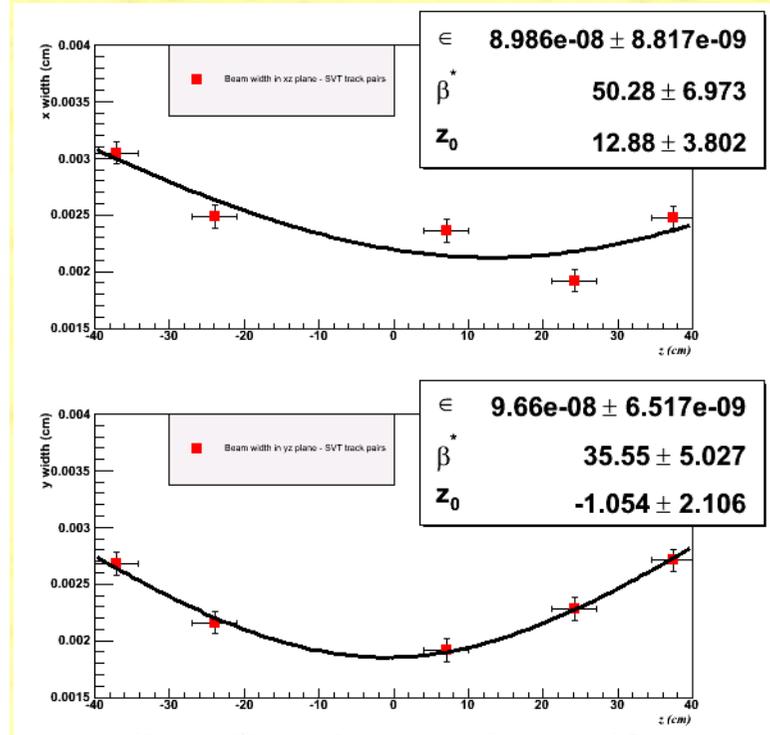
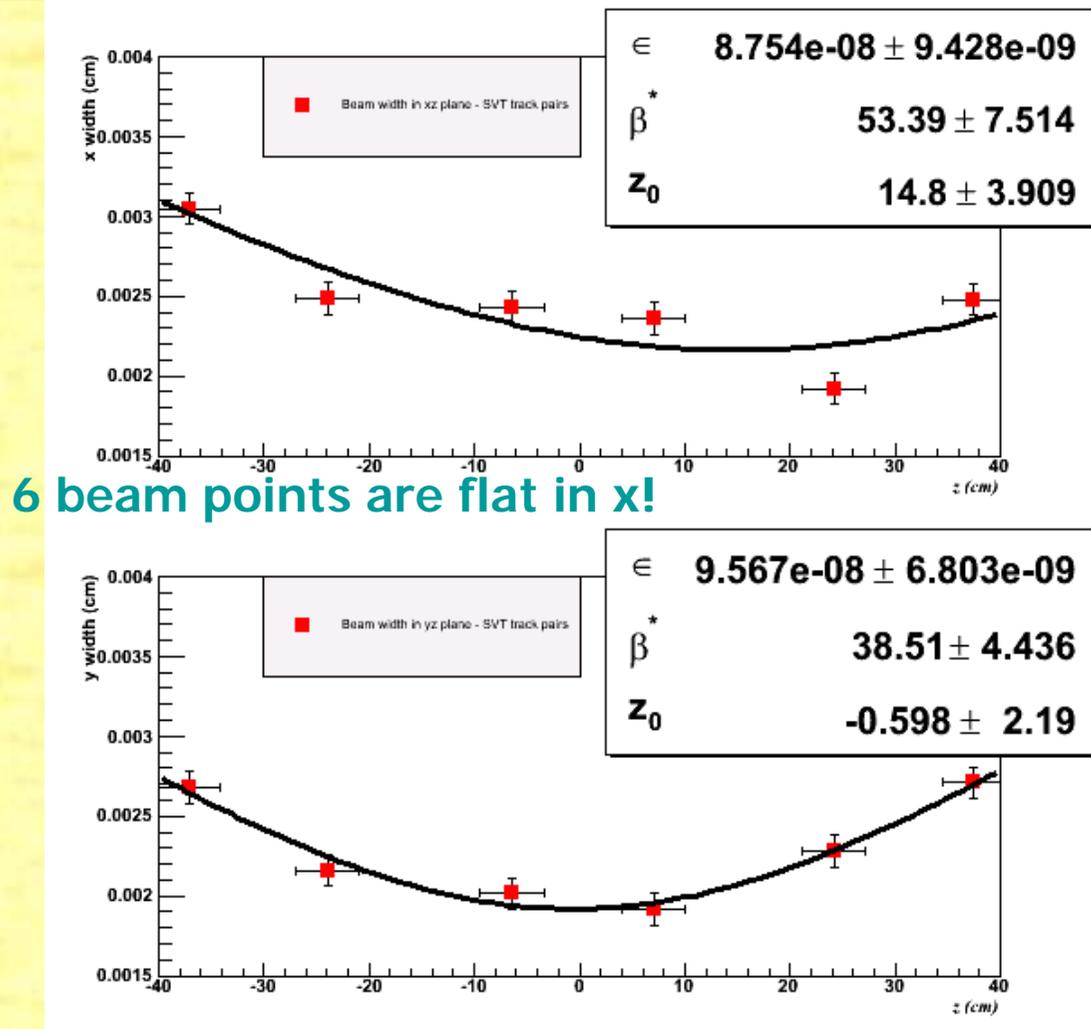
- store 4654 (Feb 2006)
- Online points are overlaid on the offline vertices.
- First two in β^*_x and middle two in β^*_y are .

	online		offline	
	x	y	x	y
β^*	31.47 ± 3.2	39.2 ± 3.95	25.8 ± 1.4	31.6 ± 1.8
z0	3.65 ± 1.87	0.12 ± 2.0	4.96 ± 0.9	-2.26 ± 1.17
emit.	1.1e-7 $\pm 7e-9$	1.5e-7 $\pm 1e-8$	1.4e-7 $\pm 5e-9$	1.3e7 $\pm 5e-9$



Online Results – one recent store

Online store 4900

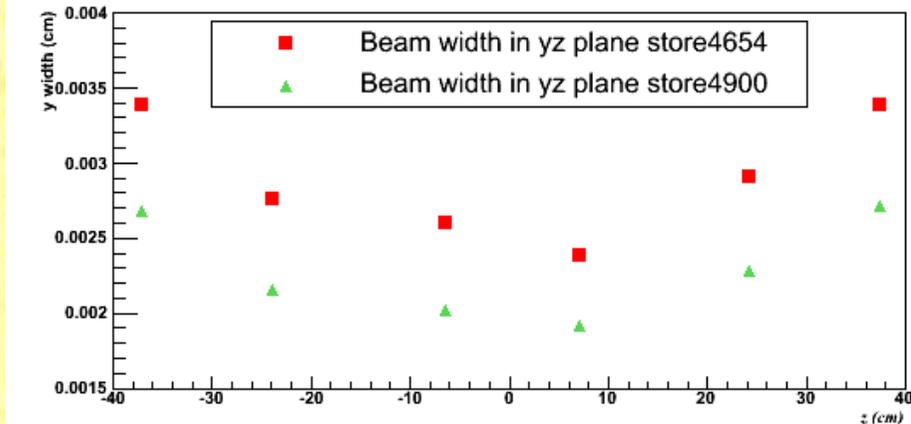
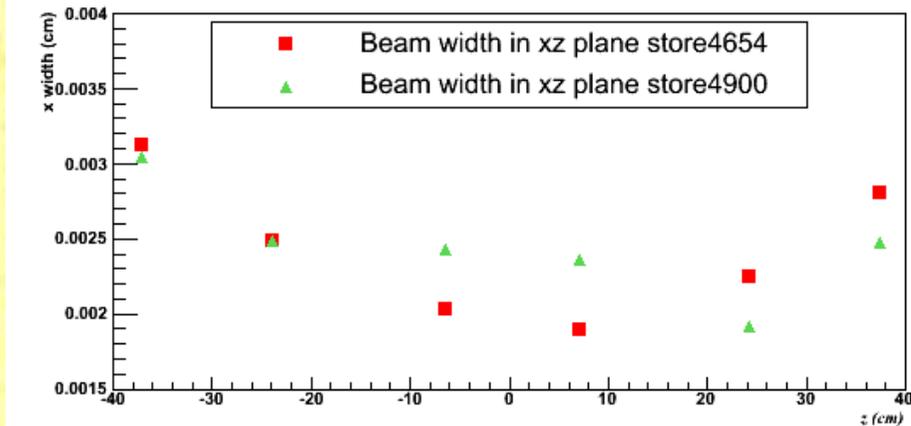


online fit without barrel2.
It is used only 5 points fit
for History plot.

Before vs. After shutdown

Online store 4654

Online store 4900



	before		after	
	x	y	x	y
β^*	31.47 ± 3.2	39.2 ± 3.95	53.4 ± 7.5	38.5 ± 4.4
z0	3.65 ± 1.87	0.12 ± 2.0	14.8 ± 3.9	-0.6 ± 2.2
emit.	1.1e-7 $\pm 7e-9$	1.5e-7 $\pm 1e-8$	8.8e-8 $\pm 9e-9$	9.5e-8 $\pm 7e-9$

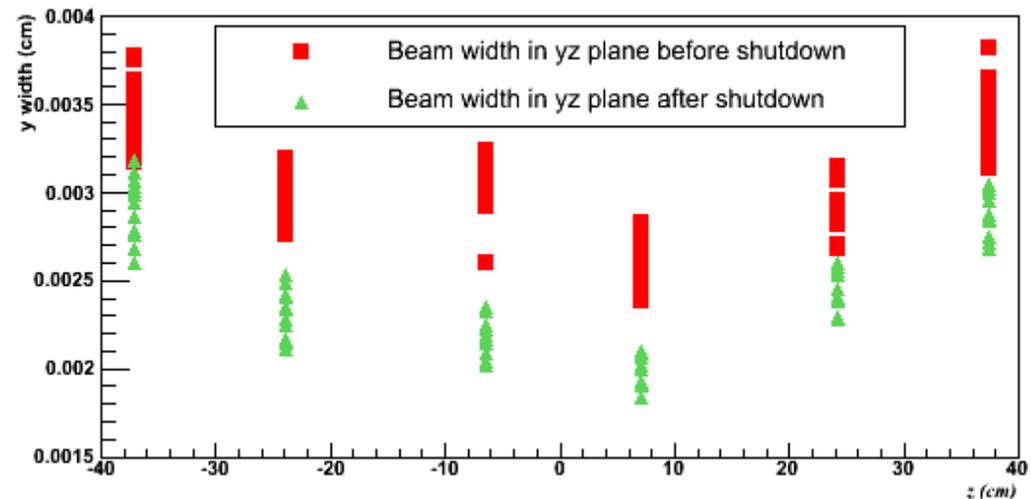
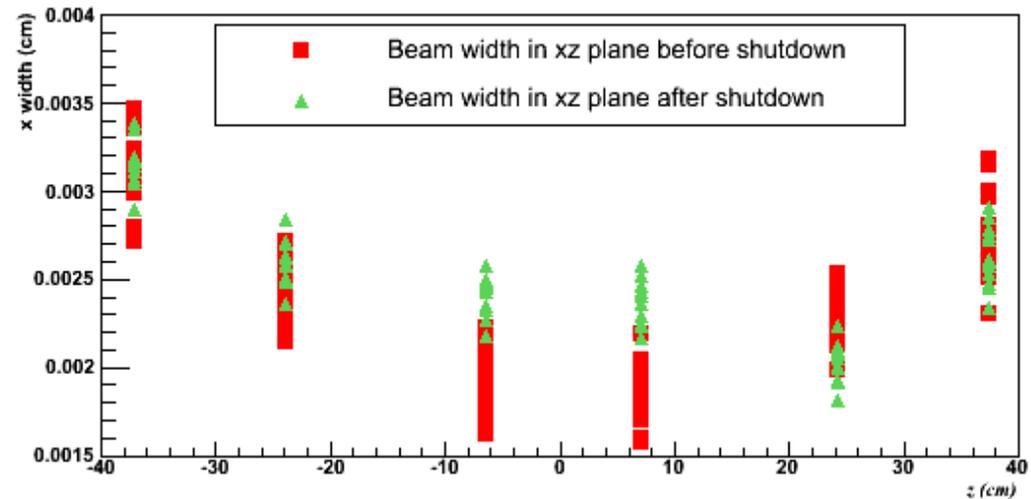
After shutdown, obviously all beam points in y go down. However those in x don't make parabola anymore.

Variations before/after shutdown

Online beam points variations
Before vs. After shutdown

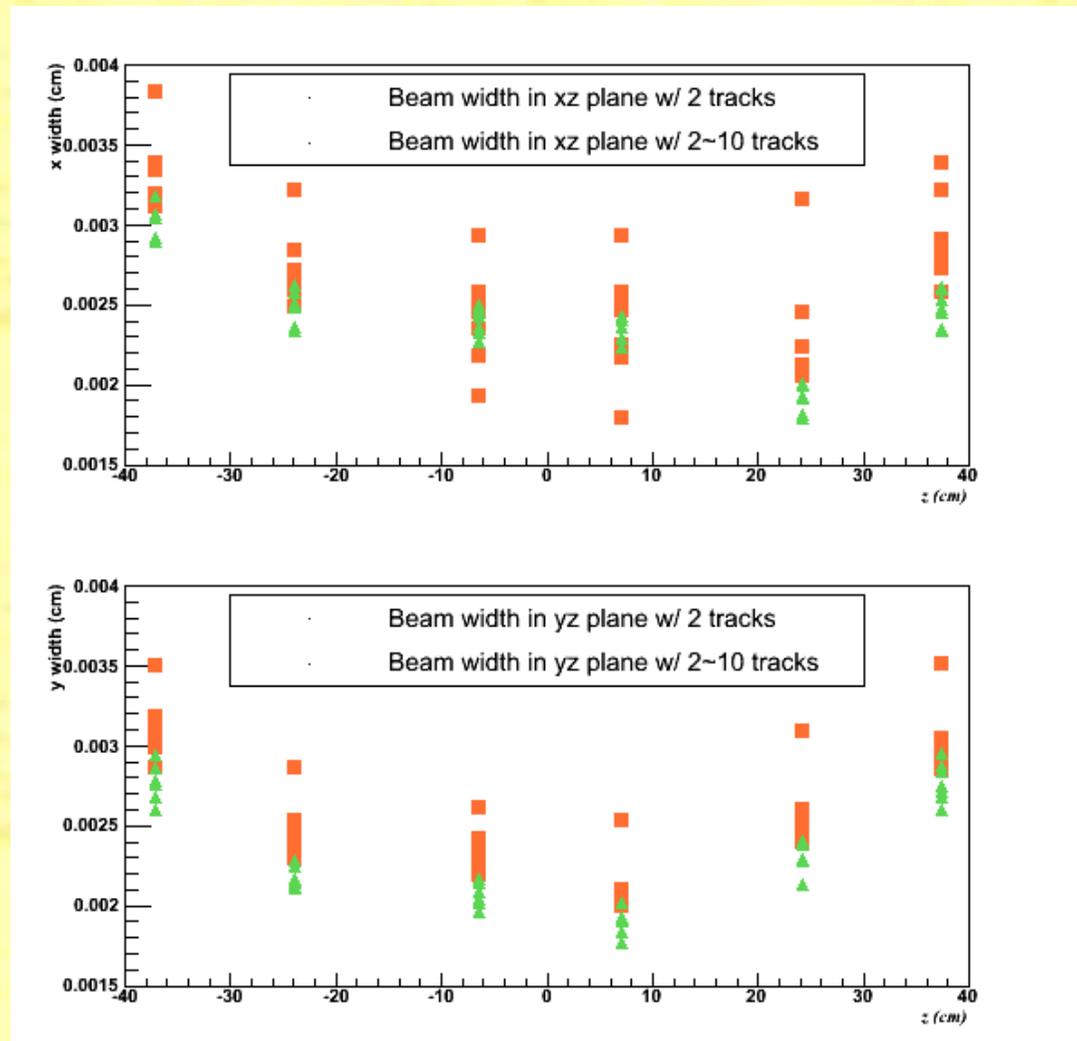
Online beam points varies store to store.

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Post shutdown online measurement two-track vs. up to 10 tracks

- Attention to two-track events only
- Increased statistics by accepting up to 10 track events
- With increased statistics, beam points show less fluctuations.



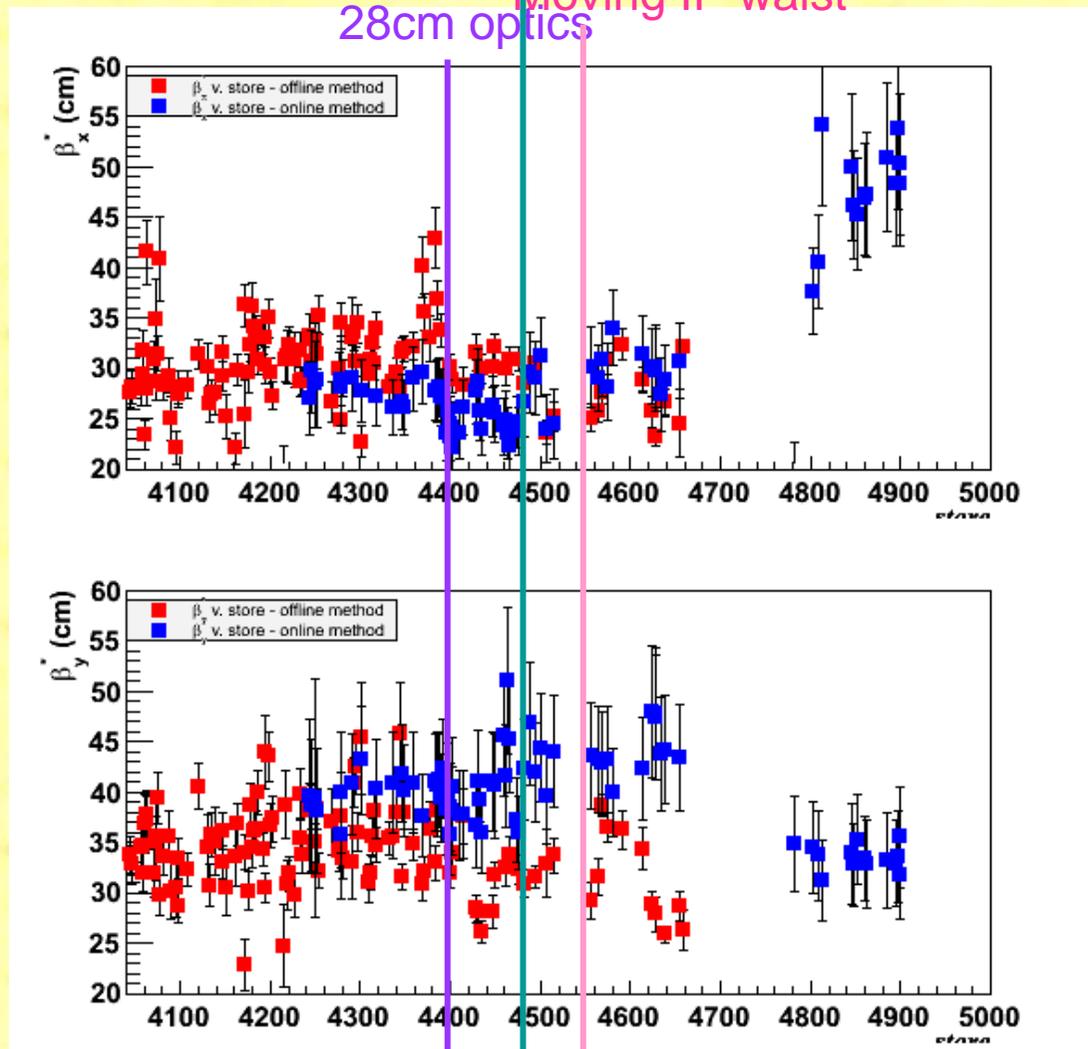
History of beta*

Z0 moving/new z template

Moving IP waist

28cm optics

Online ~ 4900
Offline ~ 4658



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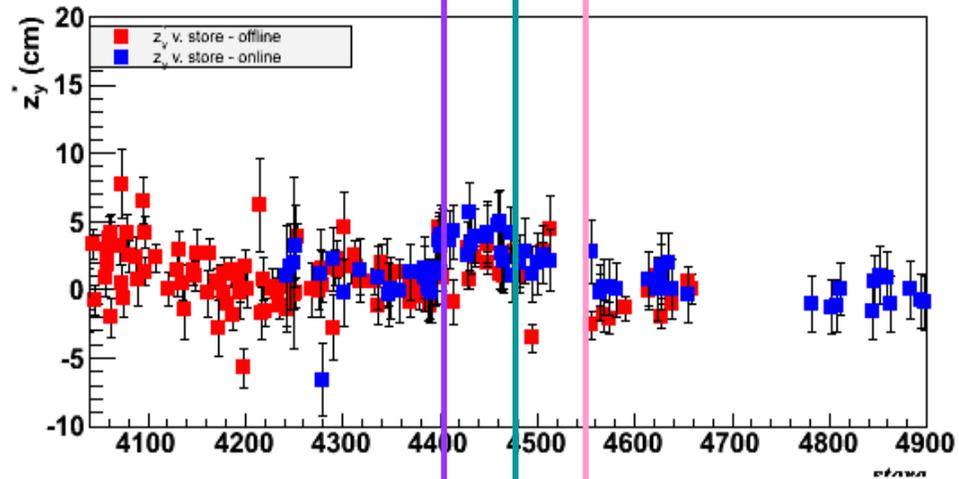
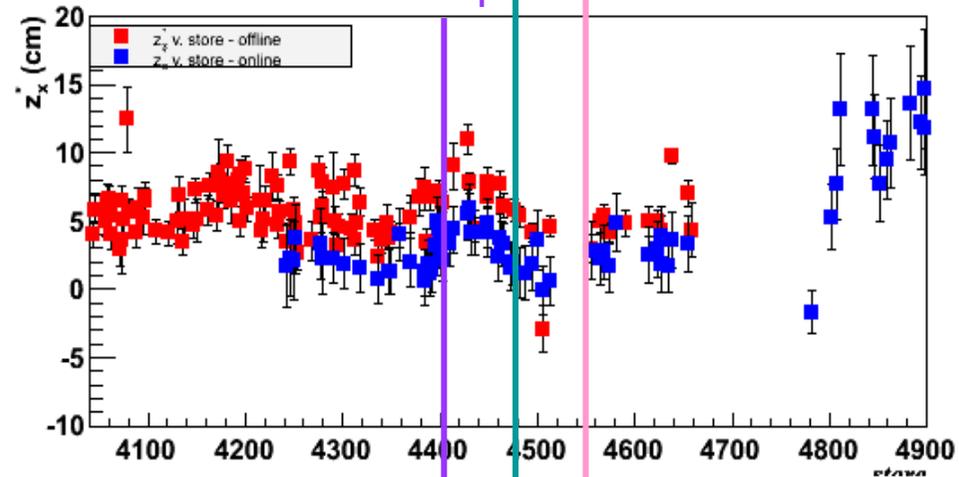
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History of Z0

Z0 moving/new z template

28cm optics Moving IP waist

Online ~ 4900
Offline ~ 4658



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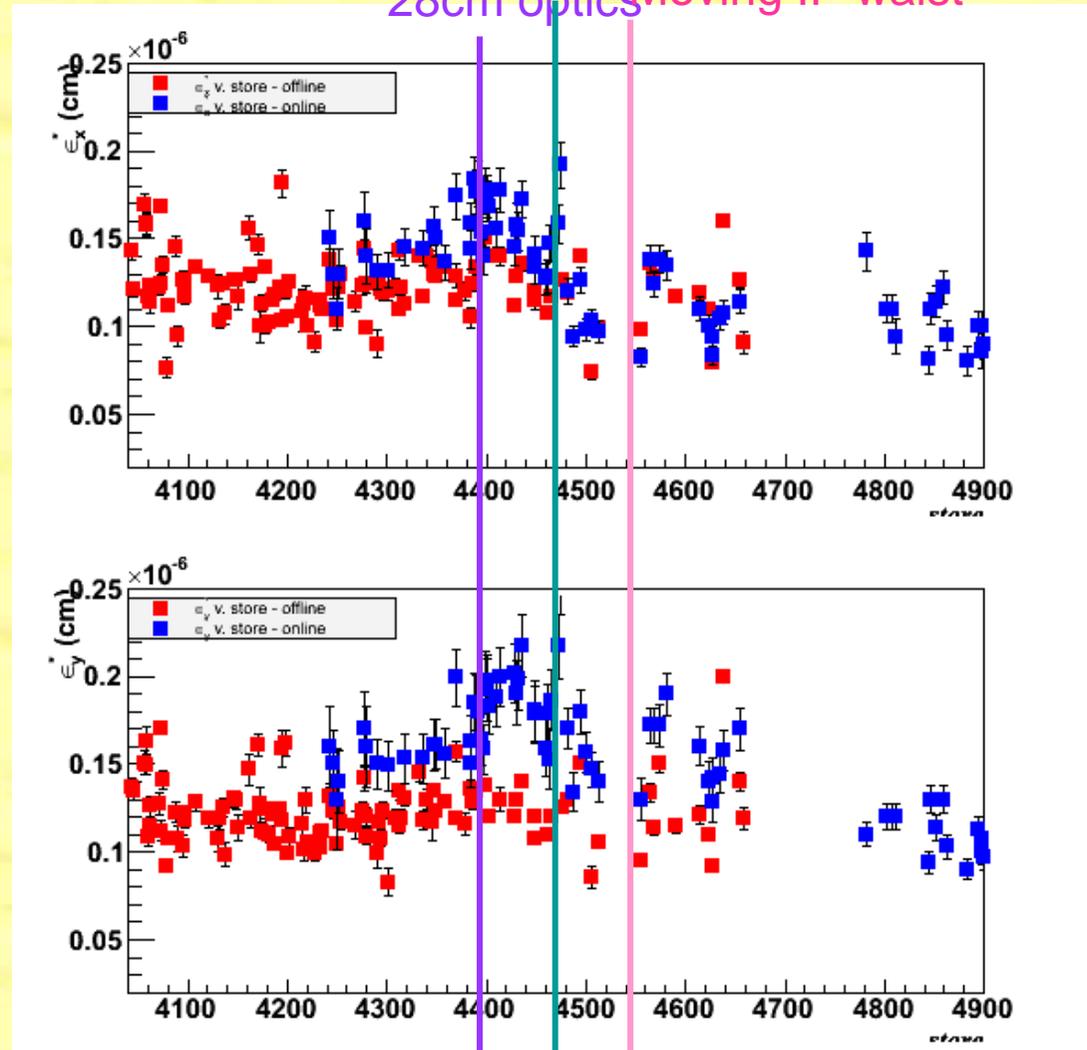
History of emittance

Z0 moving/newz template

28cm optics

Moving IP waist

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Offline ~ 4658



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Consistency check with z0 fit

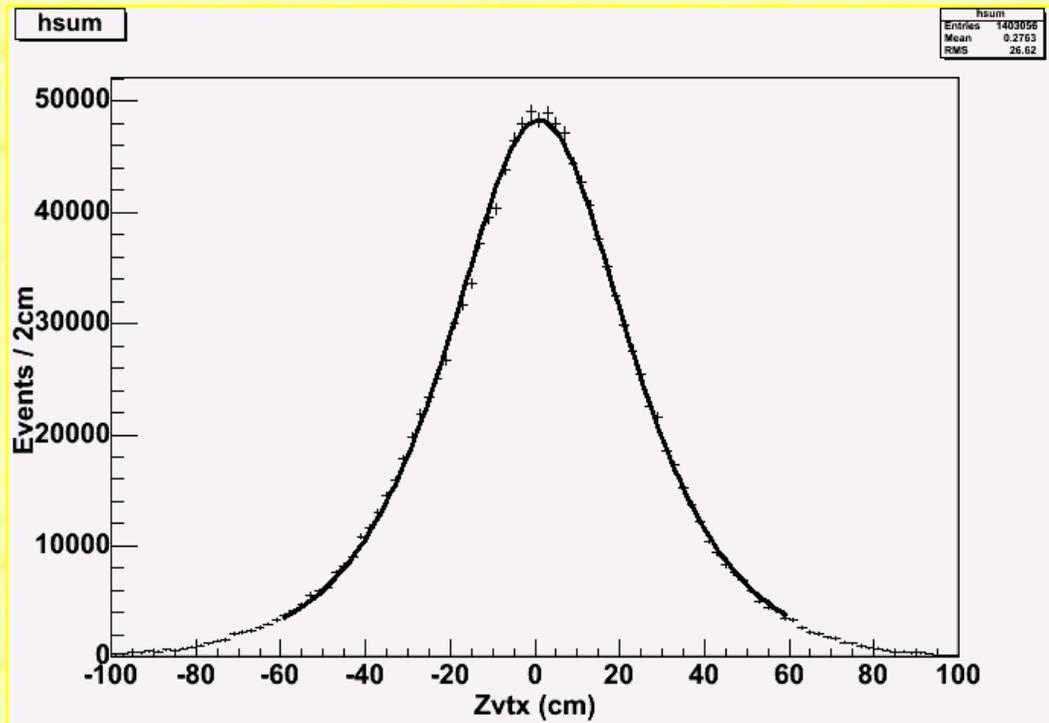
- There are used Central Outer Tracker(COT) only Z vertices in minimum bias events.
- Non-ppbar background is taken into account.
- Zvtx efficiency is flat in $|z| < 60\text{cm}$.
- Here is a simplified luminosity fit equation:

$$\frac{d\mathcal{L}(z)}{dz} = N_0 \frac{\exp(-z^2/2\sigma_z^2)}{\sqrt{[1 + (\frac{z-z_{01}}{\beta^*})^2][1 + (\frac{z-z_{02}}{\beta^*})^2]}}$$

cdf note 8318

- Assumed $b^*_x = b^*_y$ and two separate z, z01 and z02.

Consistency check with z0 fit



Willis' z0 fit

with post shutdown data

$$\sigma_z = 41.1 \pm 0.5 \text{ cm}$$

$$b^* = 30.7 \pm 0.4 \text{ cm}$$

$$z01 = 1.1 \pm 2.3 \text{ cm}$$

$$z02 = 1.4 \pm 2.3 \text{ cm}$$

$$\text{Effi.} = 0.963 \pm 0.001$$

- Cannot check b^*_x and b^*_y separately with this method.
- b^* is somewhat bigger but still consistent.

History of z0 fit parameters

		σ_z	b^*	$z01$	$z02$	Effi.
b* optics z0moving IPwaist	202301–204548	41.5 ± 0.3	32.8 ± 0.2	1.8 ± 1.6	1.8 ± 1.6	0.959 ± 0.001
	204549–206168	40.4 ± 0.3	28.5 ± 0.2	4.4 ± 1.4	4.4 ± 1.4	0.968 ± 0.001
	206169–208791	43.3 ± 0.3	27.8 ± 0.2	2.1 ± 1.4	2.1 ± 1.4	0.962 ± 0.001
	208792–212133	40.5 ± 0.2	28.9 ± 0.1	1.1 ± 1.1	1.1 ± 1.1	0.967 ± 0.001

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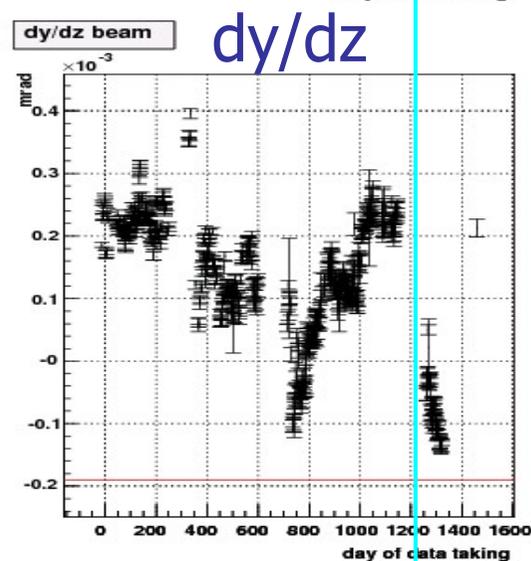
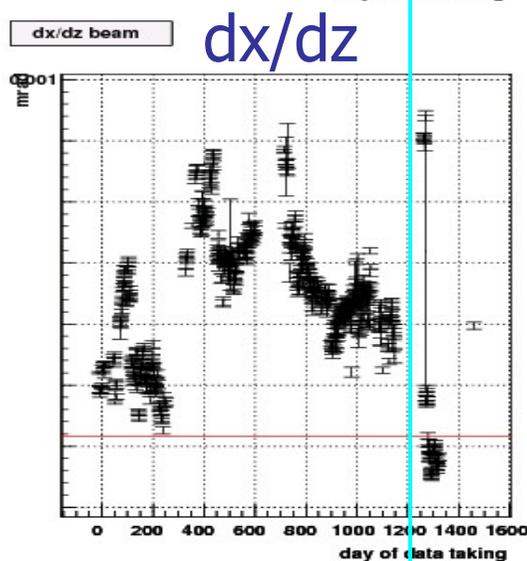
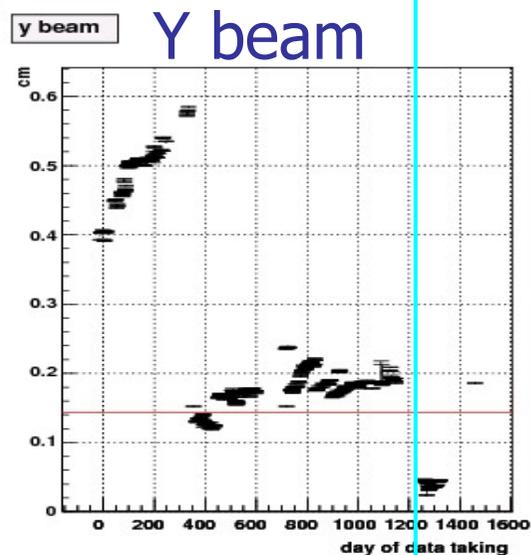
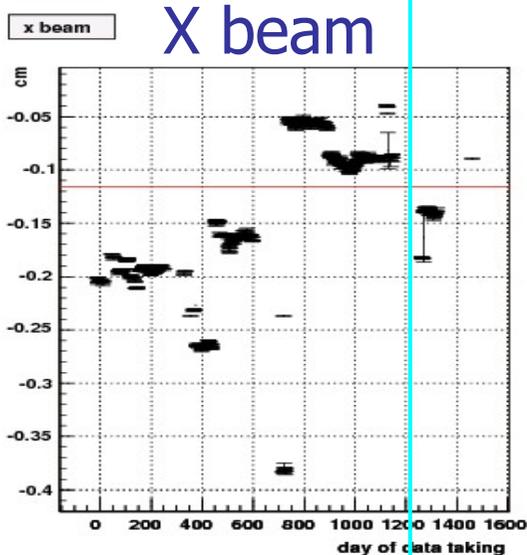
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Summary

- Post-shutdown β^* , especially in x , look strange, which is not understood.
- Willis' plot shows β^* is somewhat bigger but still consistent with pre-shutdown data. However, this does not show β^* in x and y separately.
- Improved online beam fit method reduces store-to-store BW fluctuation.
- Still barrel 2 is an outlier in y .
- Working on saving online beam width information in SVDD bank with SVT group.
- Documentation being worked on.

Beamline has been moved..



- Line separates beam history before and after recent long shutdown.
- Red line shows silicon alignment.
- post shutdown beam looks closer to detector alignment.