

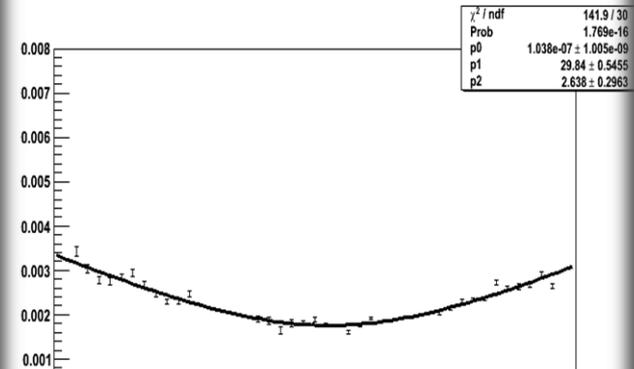
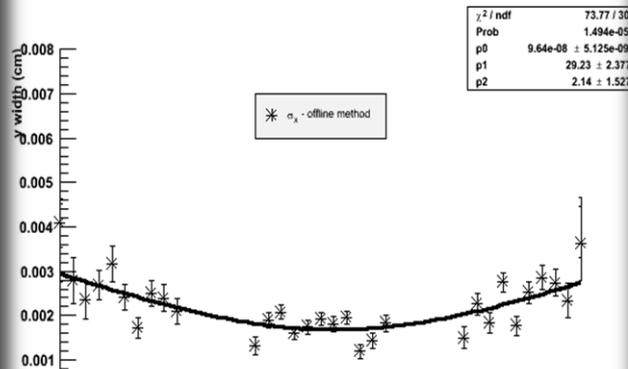
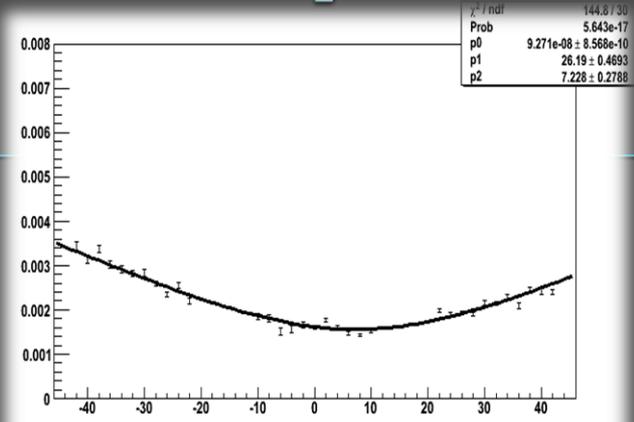
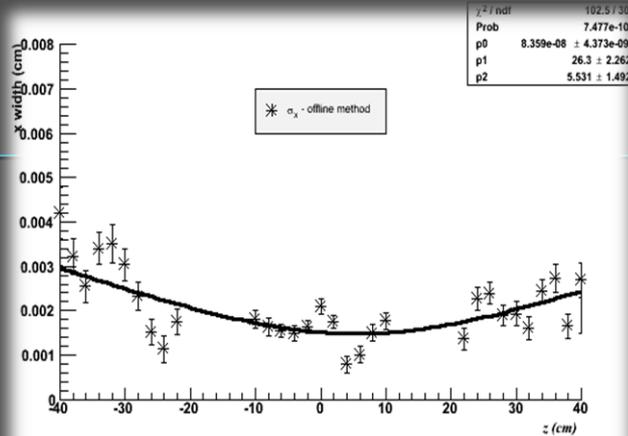
Beam width measurement at CDF

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Introduction

- **Beam width @ CDF can be measured by**
 - **Online method**
 - Use two displaced track with silicon hits
 - Quick result but not precise
 - only fitting 6 points in z!
 - **Offline method**
 - Use primary vertex distribution in fully reconstructed data
 - Precise result but long latency from data taken
 - Also: currently not available due to conflict with software upgrade
 - **Z vertex distribution method**
 - Quick and precise, but no x-y separation
 - **Using Calibration data method (new)**
 - Use primary vertex distribution - same as offline method
 - Not many corrections applied
 - No precisely refitted tracks...
 - No corrections for beam position in tracks...
 - Quick (~a week from data taken) *and more precise!*
- **Focus: use calibration data for beam width measurement**
 - Instead of investing time in improving online method.

Beam width consistency check



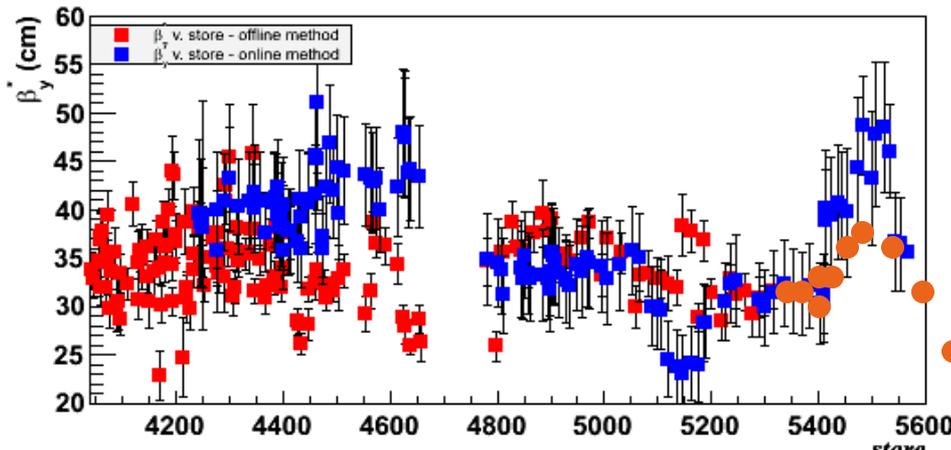
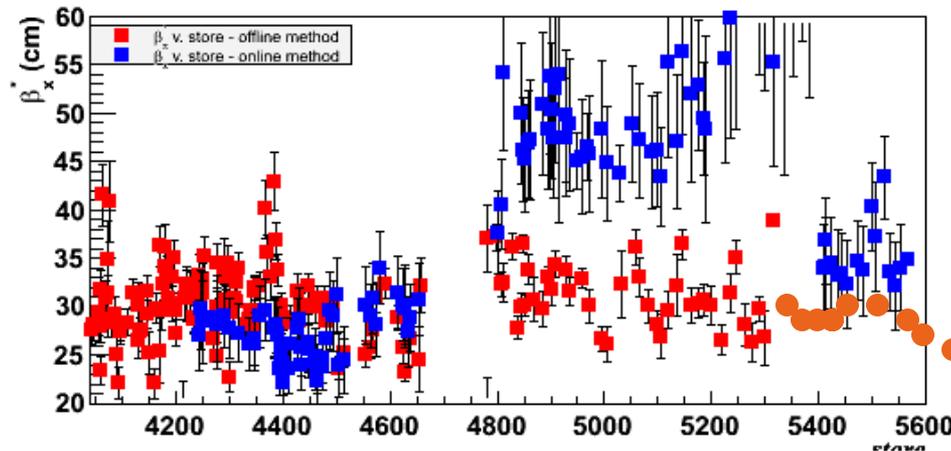
store5276	Production		Calibration	
	XZ-plane	YZ-plane	XZ-plane	YZ-plane
β^*	26.3 ± 2.3	29.2 ± 2.4	26.2 ± 0.5	29.8 ± 0.5
emitt.	$8.4e-8 \pm 4e-9$	$9.6e-8 \pm 5e-9$	$9.3e-8 \pm 9e-10$	$1.0e-7 \pm 1e-9$
z0	5.5 ± 1.5	2.1 ± 1.5	7.2 ± 0.3	2.6 ± 0.3

Same kind of jet data, different triggers -> more stats, better precision!

Beam width fits

	Date	Beta*_x	Beta*_y	Emit_x	Emit_y	Z0_x	Z0_y
5353	4/14/07	30.5±0.4	34.7±0.4	1.3e-7±9e-10	1.5e-7±1e-9	7.3±0.2	1.9±0.2
5370	4/23/07	29.5±0.4	33.7±0.5	1.3e-7±9e-10	1.4e-7±1e-9	6.9±0.2	1.3±0.2
5401	5/01/07	29.0±0.5	31.8±0.6	1.4e-7±1e-9	1.5e-7±1e-9	7.0±0.3	2.0±0.3
5409	5/03/07	30.7±0.8	35.0±1.1	1.2e-7±2e-9	1.1e-7±2e-9	5.1±0.4	0.1±0.5
5411	5/05/07	28.2±0.5	34.1±0.7	1.6e-7±1e-9	1.5e-7±2e-9	5.5±0.3	2.5±0.3
5471	6/03/07	31.5±0.4	37.1±0.5	1.4e-7±9e-10	1.5e-7±1e-9	4.5±0.2	2.4±0.2
5506	6/21/07	32.0±0.4	38.4±0.6	1.5e-7±1e-9	1.5e-7±1e-9	4.7±0.2	2.8±0.3
5544	7/10/07	30.1±0.4	37.7±0.6	1.5e-7±1e-9	1.4e-7±1e-9	4.3±0.2	3.4±0.3
5584	7/28/07	27.3±0.3	32.2±0.4	1.3e-7±7e-10	1.3e-7±8e-10	4.1±0.2	3.9±0.2
5681	11/03/07	25.9±0.5	26.0±0.5	9e-8±1e-9	9e-8±1e-9	1.6±0.3	2.0±0.3
5716	11/12/07	26.7±0.9	31.2±1.1	2e-7±3e-9	2e-7±4e-9	2.4±0.6	-2.3±0.7
5730	11/18/07	24.2±1.2	29.2±1.7	6e-8±2e-9	6e-8±2e-9	1.8±0.7	4.0±0.9
5741	11/21/07	29.1±0.9	33.0±1.2	8e-8±1e-9	8e-8±2e-9	4.1±0.5	0.2±0.6
5751	11/26/07	26.2±0.6	28.1±0.6	9e-8±1e-9	9e-8±1e-9	4.0±0.3	1.4±0.4

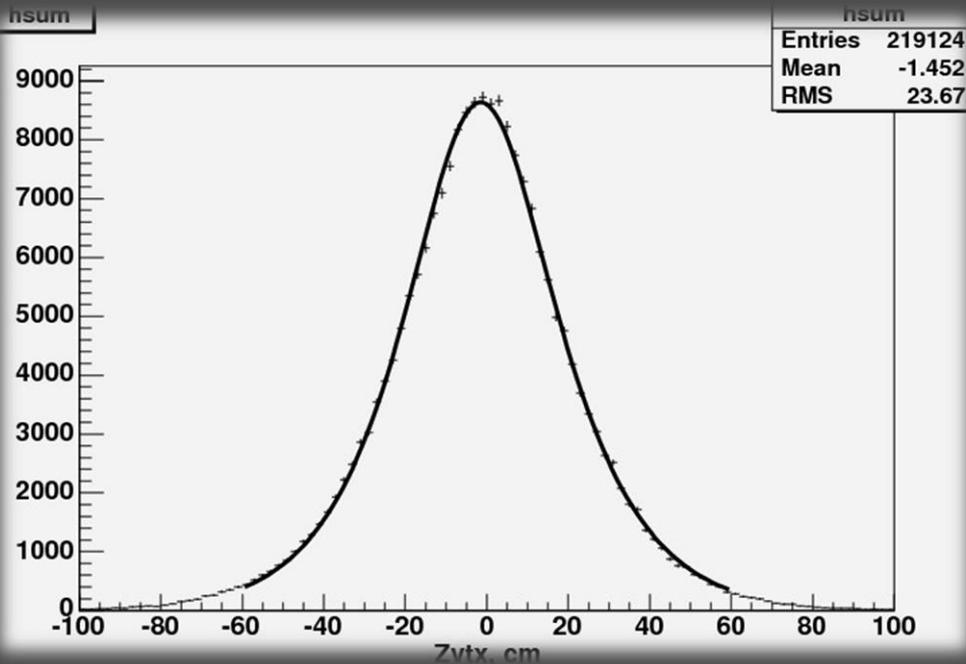
History plot for β^*



Offline (~store 5314)
Online (~store 5567)
Calib (5353~5751)

- Online measurement has been unstable compared to the offline measurement.

Beam width using z vertices



Use $p\bar{p}$ luminosity function and fit data over $|z| < 60\text{cm}$.

$$\frac{dL(z)}{dz} \propto \frac{\exp(-z^2 / 2\sigma_z^2)}{\sqrt{\left[1 + \left(\frac{z - z_1}{\beta^*}\right)^2\right] \left[1 + \left(\frac{z - z_2}{\beta^*}\right)^2\right]}}$$

	σ_Z (cm)	β^* (cm)	z_0 (cm)
5412-5479 (May '07)	38.8 ± 0.2	28.3 ± 0.1	-0.7 ± 1.2
5737-5750 (Nov '07)	36.3 ± 0.4	26.5 ± 0.3	-1.9 ± 3.0

Summary

- Tried to use calibration data sample for beam width measurement
 - This is available in a week.
 - Precise result since using primary vertices.
 - Few corrections are applied – but result is not sensitive to these being absent!
 - Higher stats than offline method – more precise result!
- Online and offline method has problem to provide reasonable beam width values.
- Priority: making beam width from calibration data.

Beam width using calibration data

- Calibration data is available in a week.
- It uses quick vertex finding algorithm in calibration data.
- It uses same beam width fit and the beam width is calculated as observed vertices width subtracted by vertices uncertainties in quadrature. κ is known average scale factor for underestimated vertices uncertainties.

$$\sigma_{beam} = \sqrt{\epsilon(\beta^* + (z - z_0)^2/\beta^*)}.$$

$$\sigma_{beam} = \sqrt{\sigma_{observed}^2 - \kappa^2 \bar{\sigma}_{vtx}^2},$$

- Understanding the scale factor (κ) is left.