

Evaluation of PSF

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Content

- Calculated PSF in ΔX and ΔY , not in $\Delta\theta$
- Examined the dependence of $\Delta X/\Delta Y$ on the values of $V_{txS}[XX/YY]$ ($[x-x/y-y]$ element of the covariance matrix; square of error on $[x/y]$)
- Searched for method of evaluating (parameterizing) the PSF (function fitting?)
- Motivation: We want to see whether $V_{txS}[XX/YY]$ can be better parameters of PSF than detected energy. Because they should contain direct information on PSF.

Used Event Files & Event Selection

Full Brems data

Merit Root Files

Beam Angle = 0°

Run ID: 700001445–700001455

Beam Angle = 30°

Run ID: 700001686 &
700001223–700001455

Beam Angle = 50°

Run ID: 700001688 &
700001262–700001271

Selection of Events Applied

$\text{TkrNumTracks} == 2 \ \&\& \ \text{CalEnergyRaw} > 10 \ \&\& \ \text{TkrISSDVeto} > 3 \ \&\& \ \text{TkrThinHits} > 2 \ \&\& \ \text{TkrBlankHits} > 3$

Same criteria as David's work

Calculation of PSF

When $\theta = \text{BeamAngle}$

$$\begin{aligned}\vec{V}_{\text{beam}} &= (\text{BeamXDir}, \text{BeamYDir}, \text{BeamZDir}) \\ &= (-\sin \theta, 0, -\cos \theta)\end{aligned}$$

$$\vec{V}_{\text{recon}} = (\text{VtxXDir}, \text{VtxYDir}, \text{VtxZDir})$$



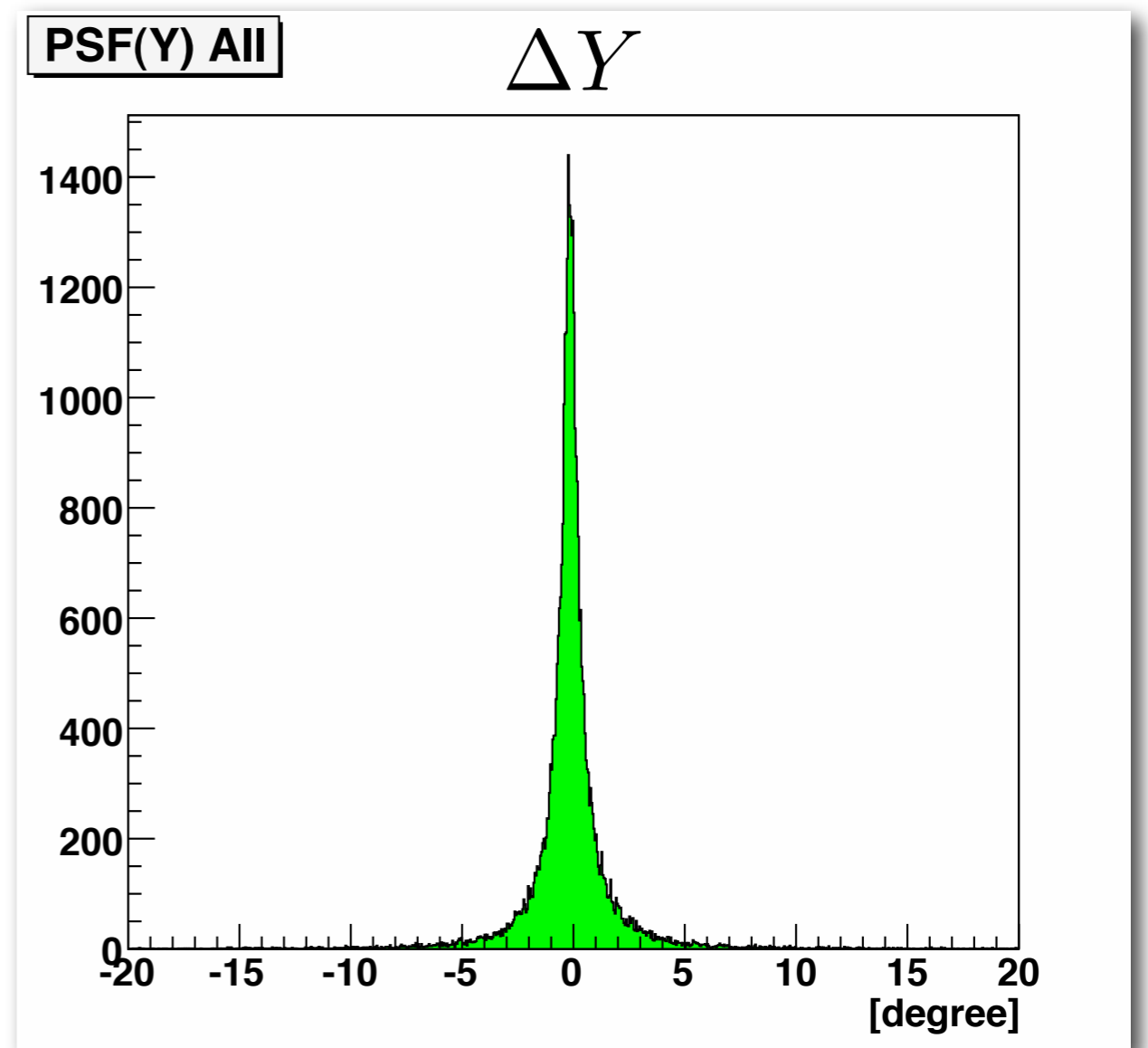
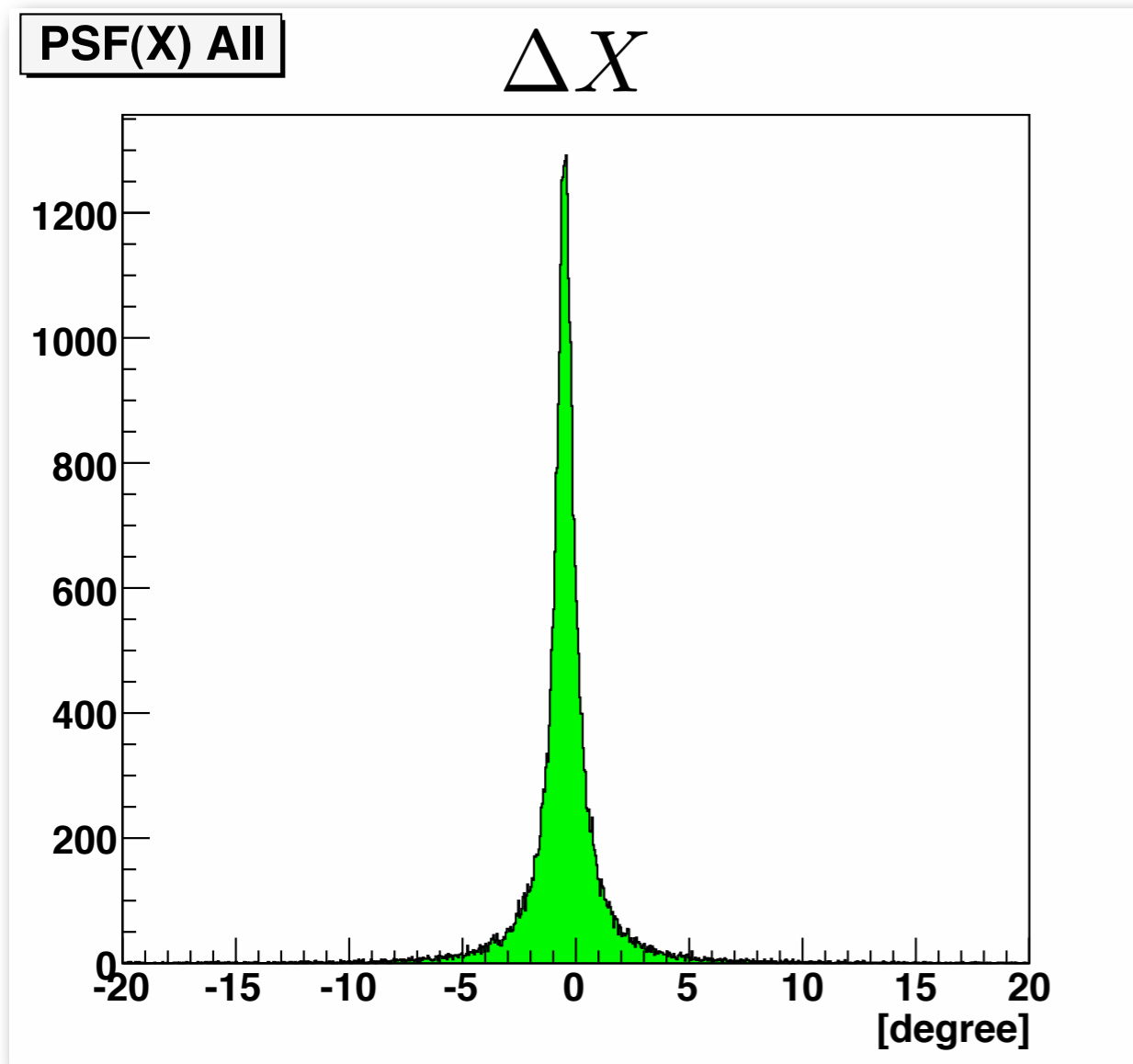
$$\Delta X = \arccos(\text{VtxXDir}) - \arccos(\text{BeamXDir})$$

$$\Delta Y = \arccos(\text{VtxYDir}) - \arccos(\text{BeamYDir})$$

Calculation of PSF

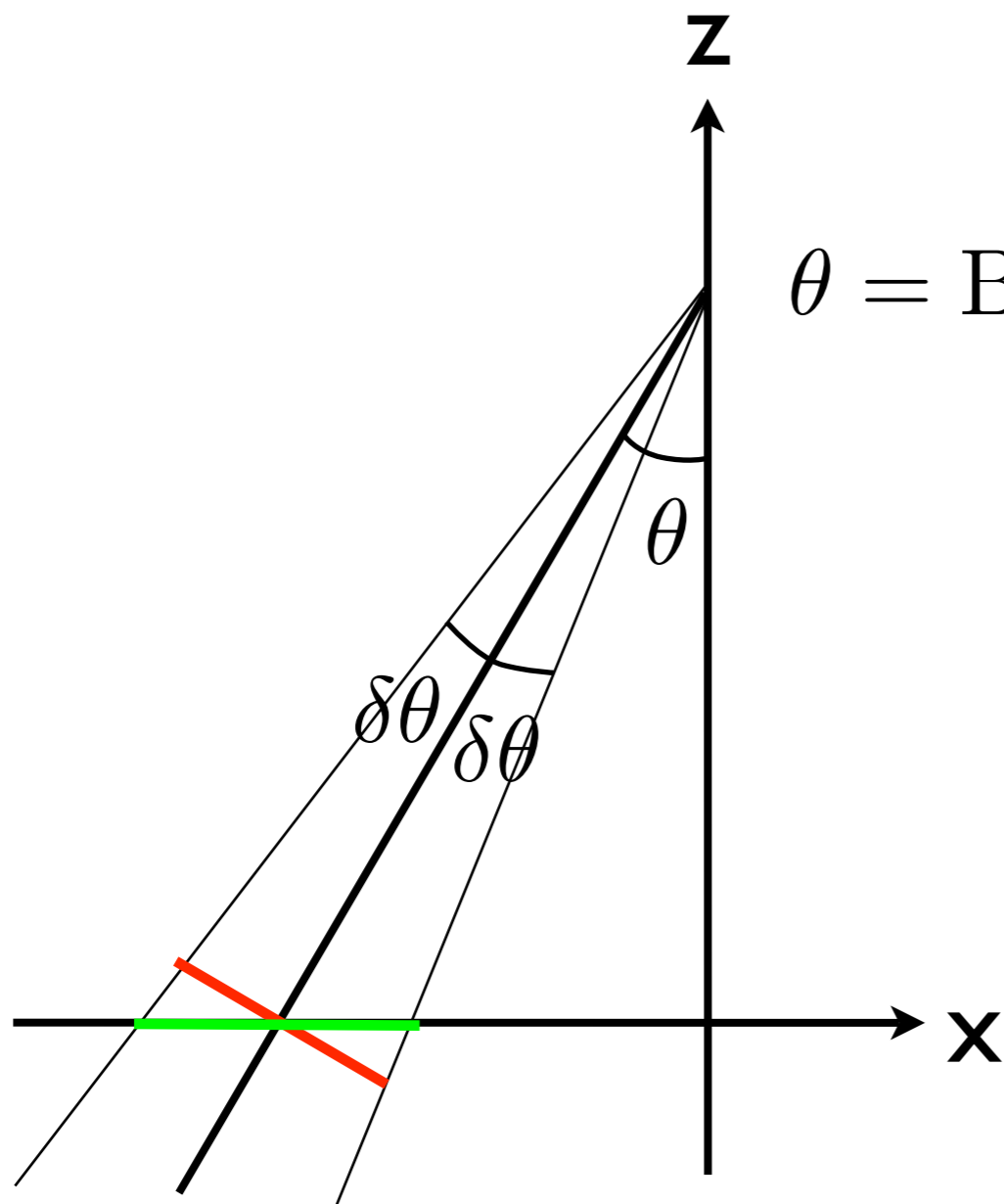
Beam Angle = 0°

All events that satisfy the selection criteria



Sorting by $V_{txS}[XX/YY]$

Sorted the events by $V_{txS}[XX/YY]$
But need to be corrected for incident angles



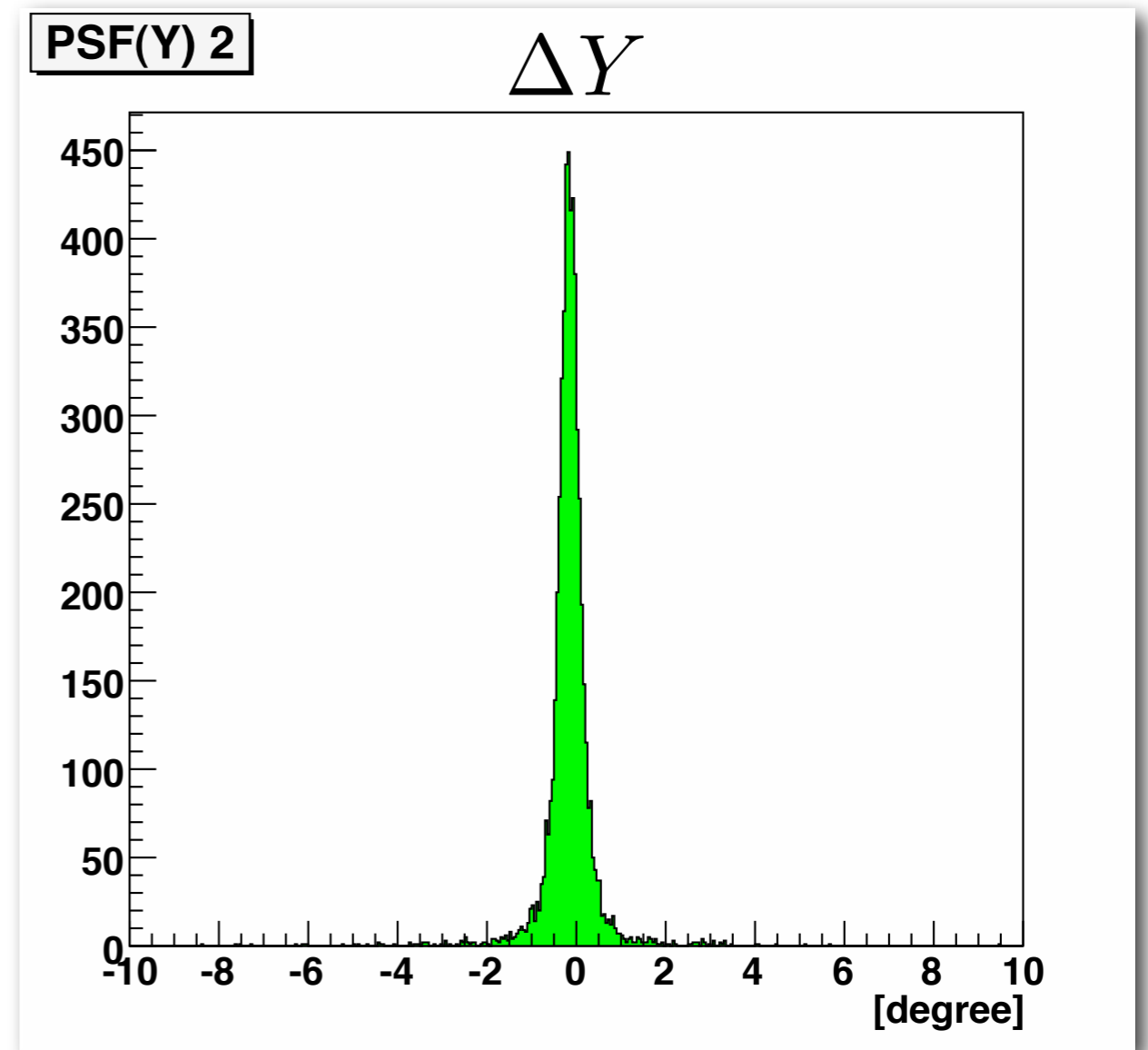
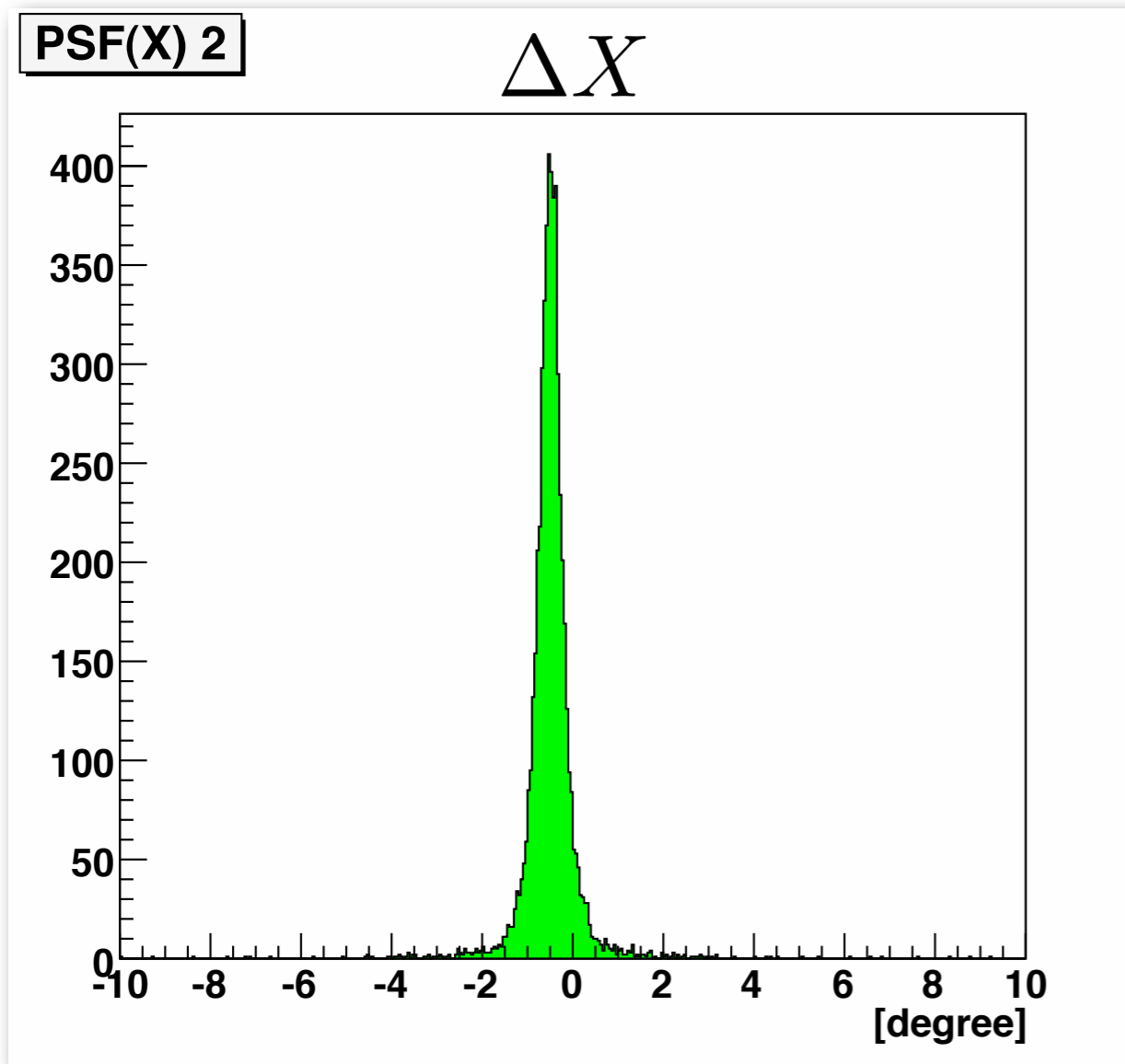
$\theta = \text{BeamAngle}$

$$V_{txSXX'} \cong V_{txSXX} \cdot \cos^2 \theta$$

Sorting by $V_{txS}[XX/YY]$

Beam Angle = 0°

$$V_{txS}[XX/YY] = 1.6 \times 10^{-6} - 6.3 \times 10^{-6}$$

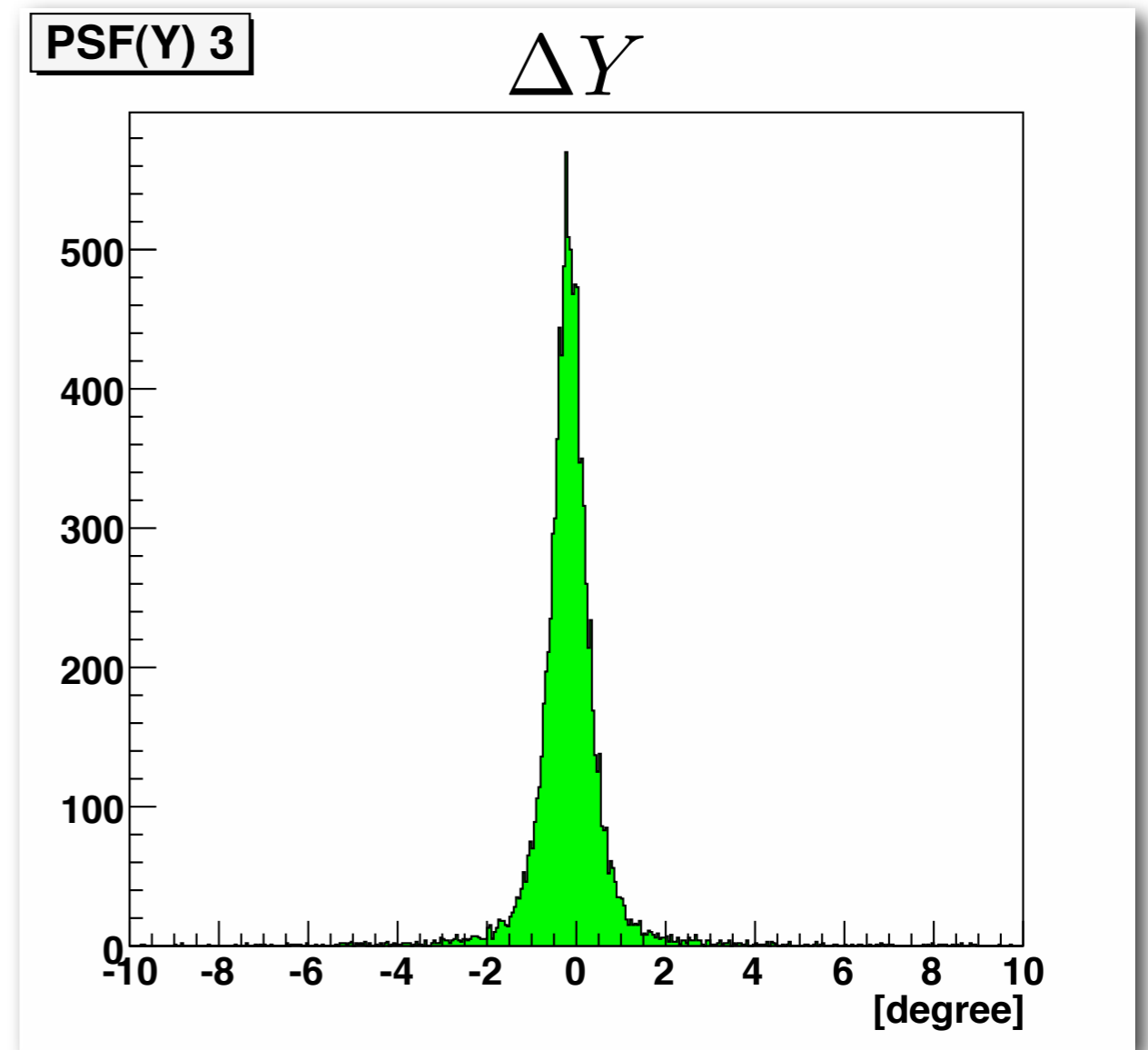
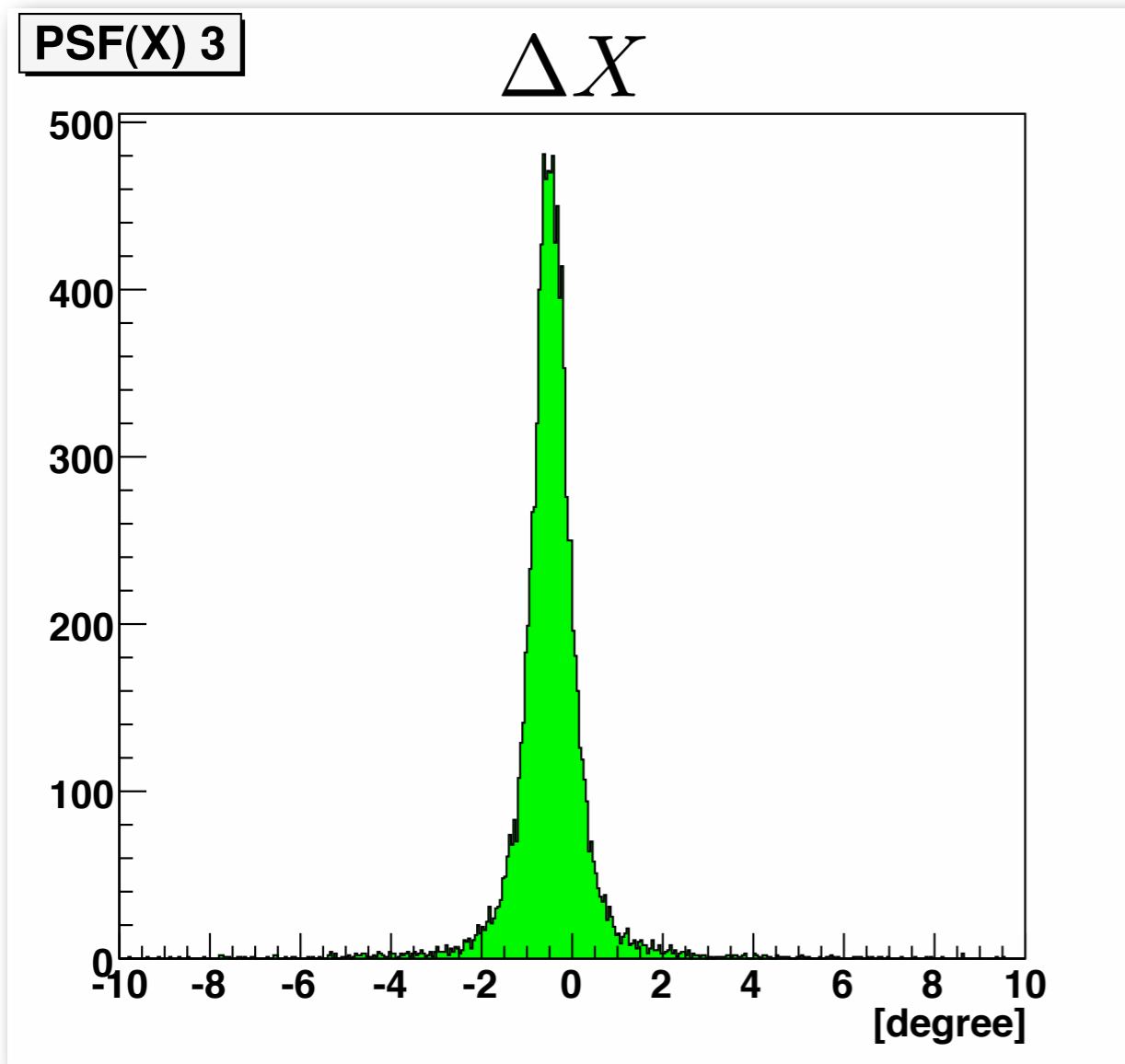


PSF becomes broader as $V_{txS}[XX/YY]$ becomes larger

Sorting by $V_{txS}[XX/YY]$

Beam Angle = 0°

$$V_{txS}[XX/YY] = 6.3 \times 10^{-6} - 2.5 \times 10^{-5}$$

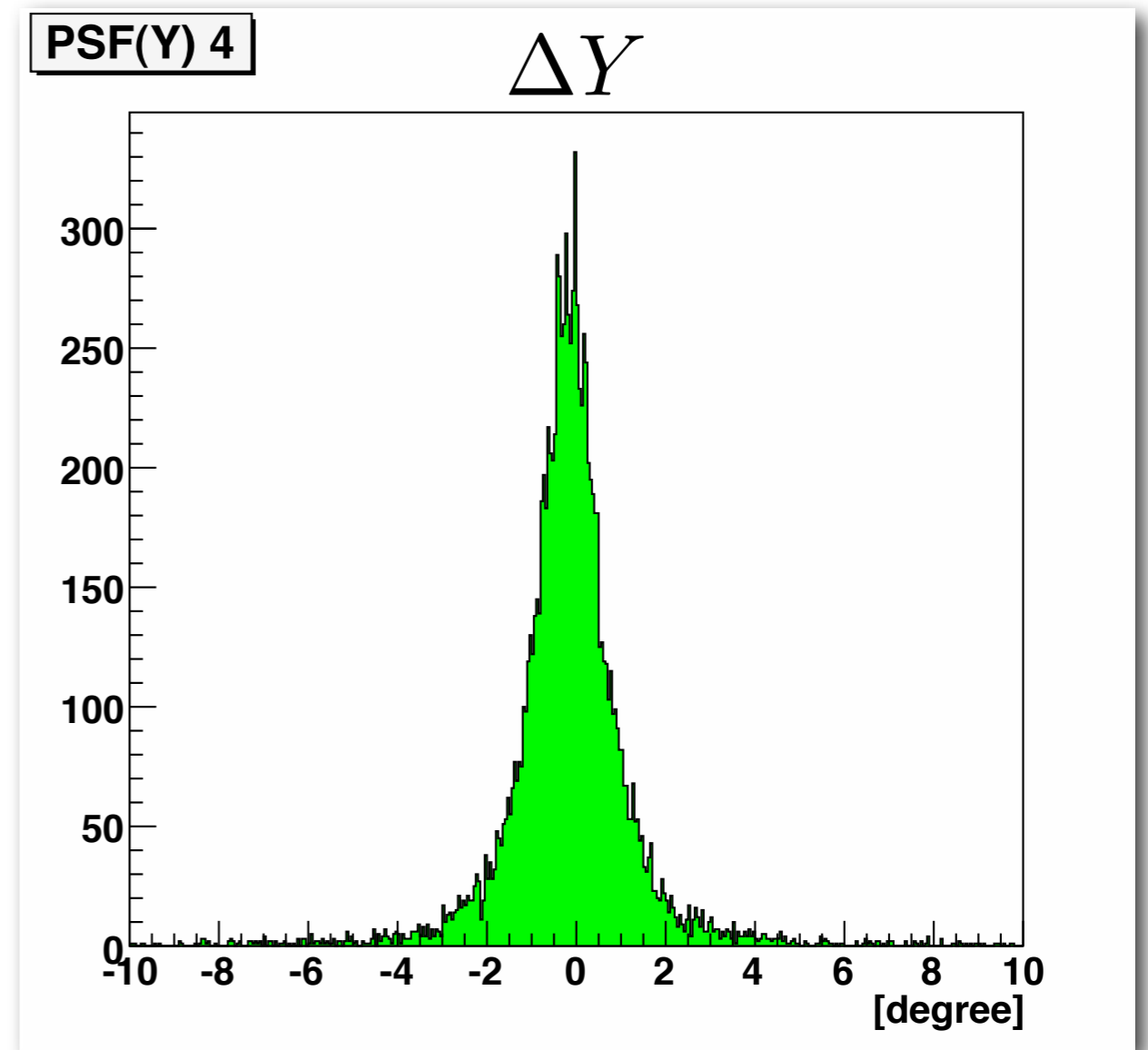
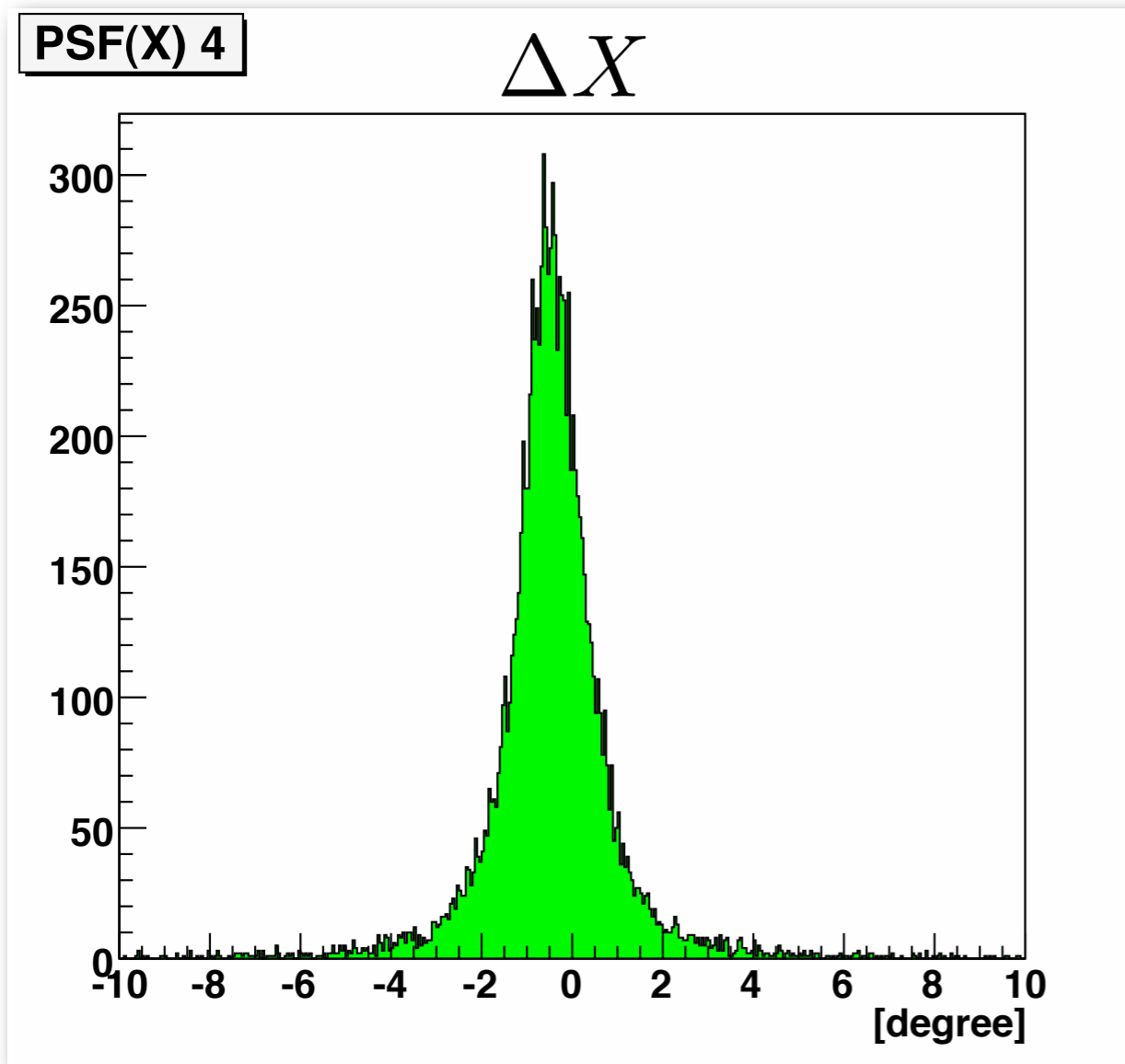


PSF becomes broader as $V_{txS}[XX/YY]$ becomes larger

Sorting by $V_{txS}[XX/YY]$

Beam Angle = 0°

$$V_{txS}[XX/YY] = 2.5 \times 10^{-5} - 1.0 \times 10^{-4}$$

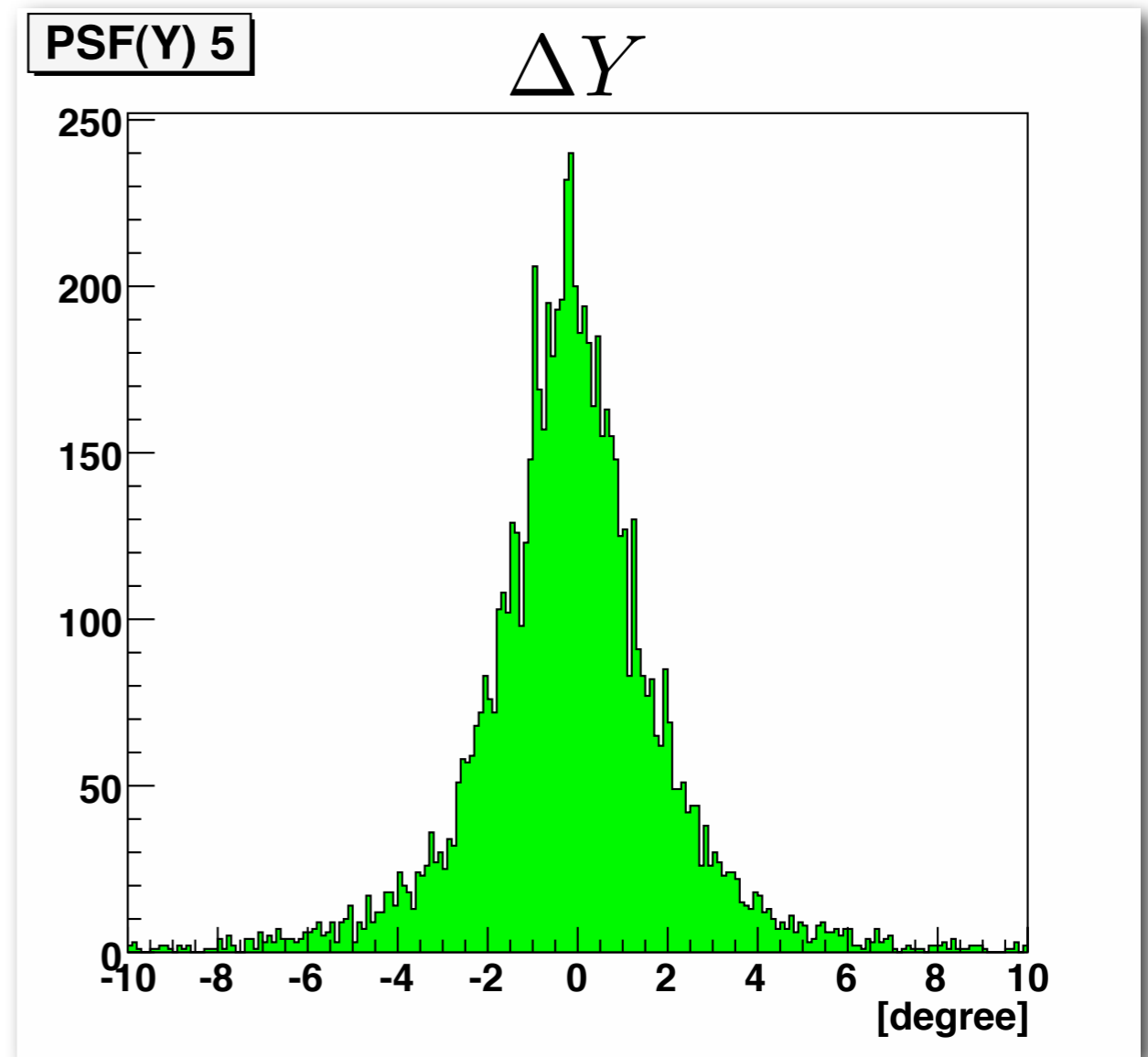
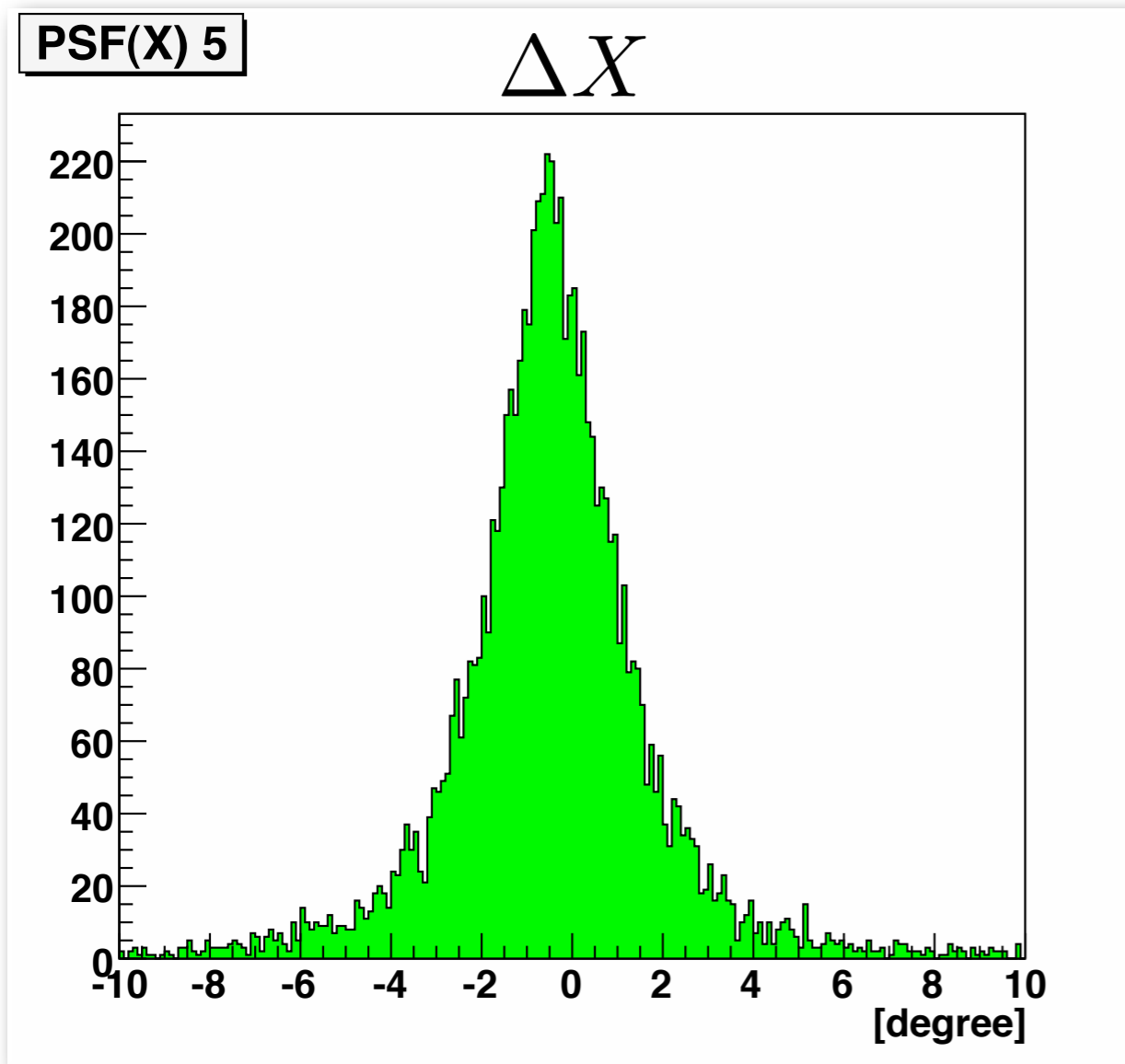


PSF becomes broader as $V_{txS}[XX/YY]$ becomes larger

Sorting by $V_{txS}[XX/YY]$

Beam Angle = 0°

$$V_{txS}[XX/YY] = 1.0 \times 10^{-4} - 4.0 \times 10^{-4}$$

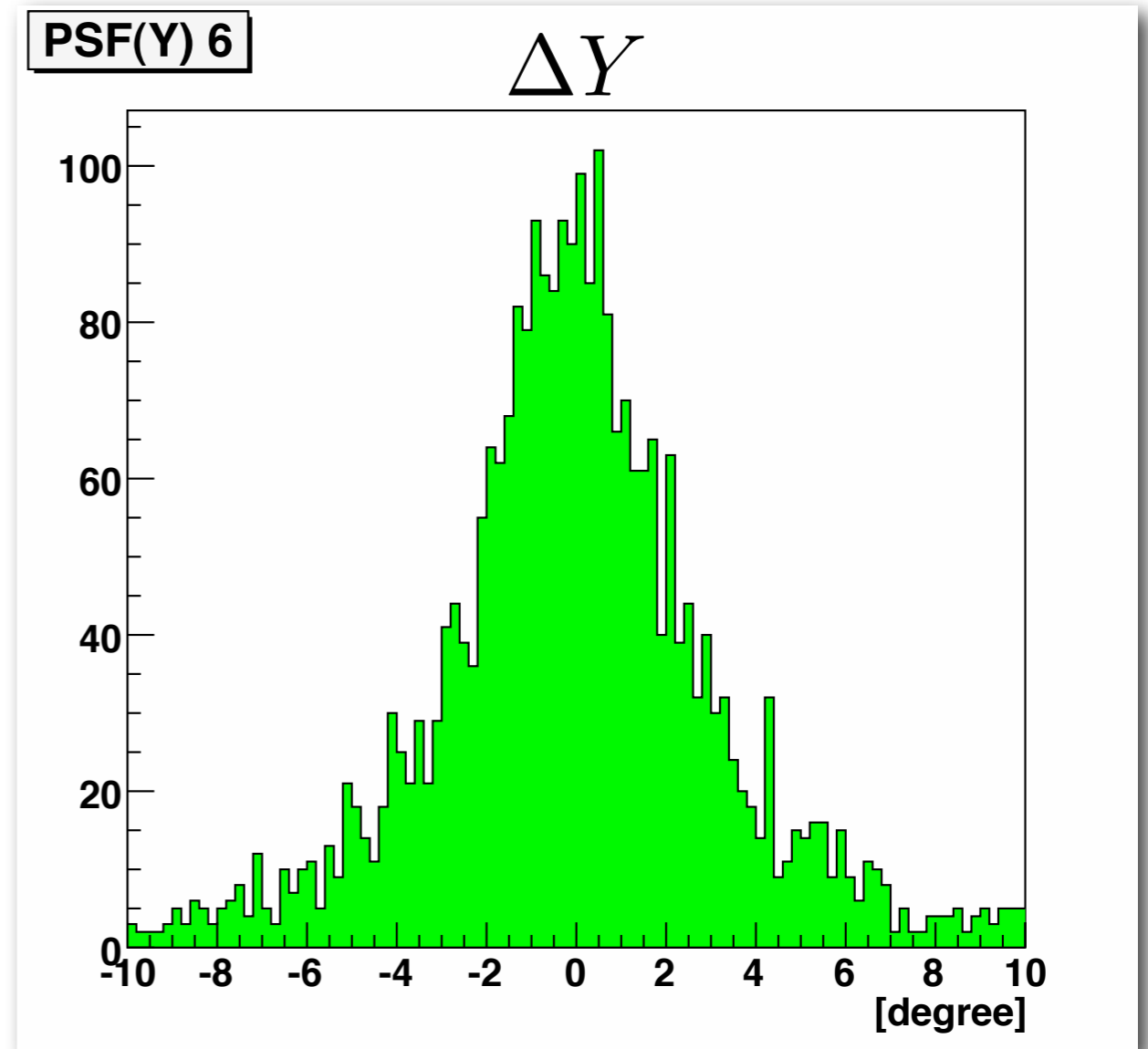
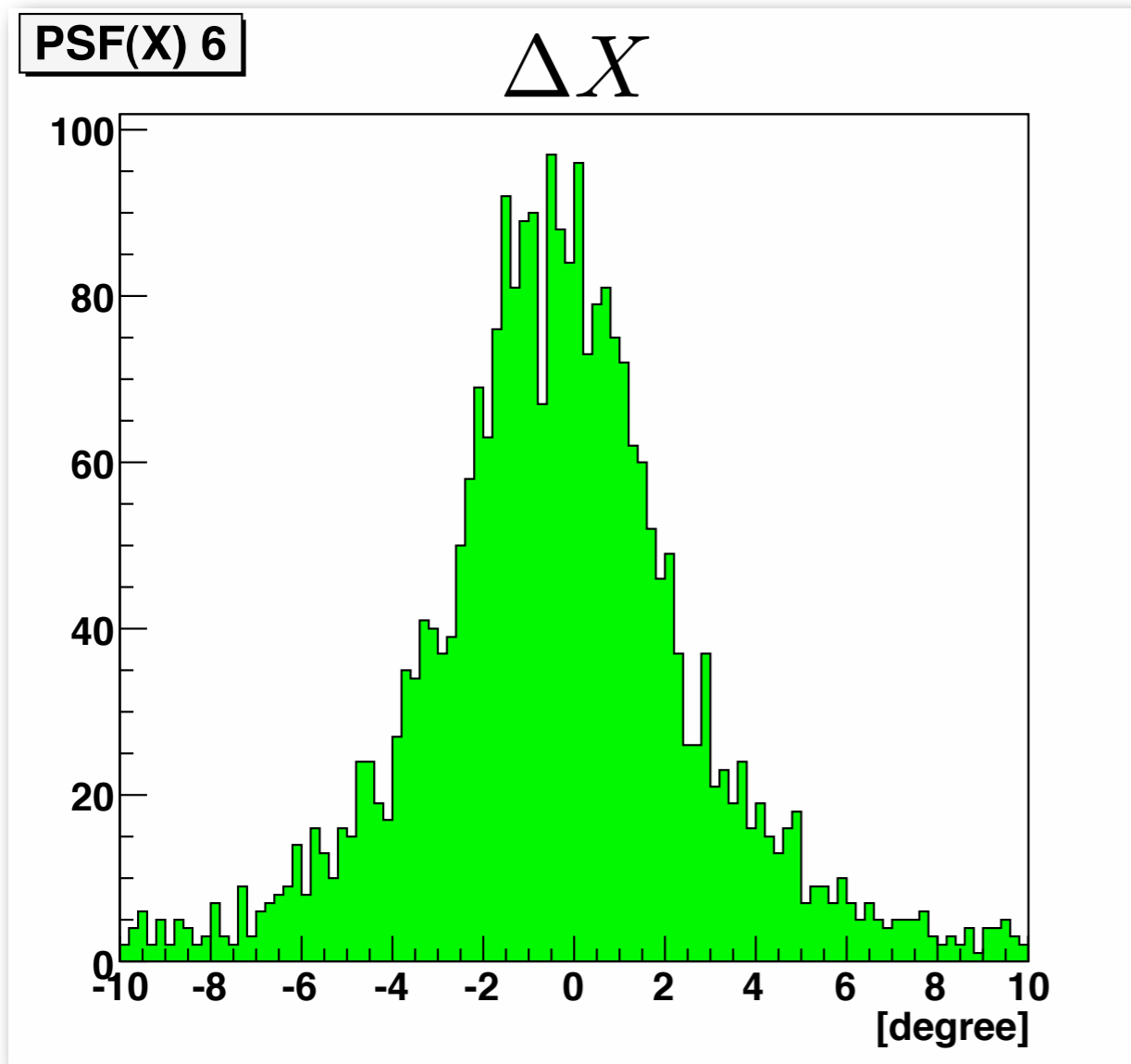


PSF becomes broader as $V_{txS}[XX/YY]$ becomes larger

Sorting by $V_{txS}[XX/YY]$

Beam Angle = 0°

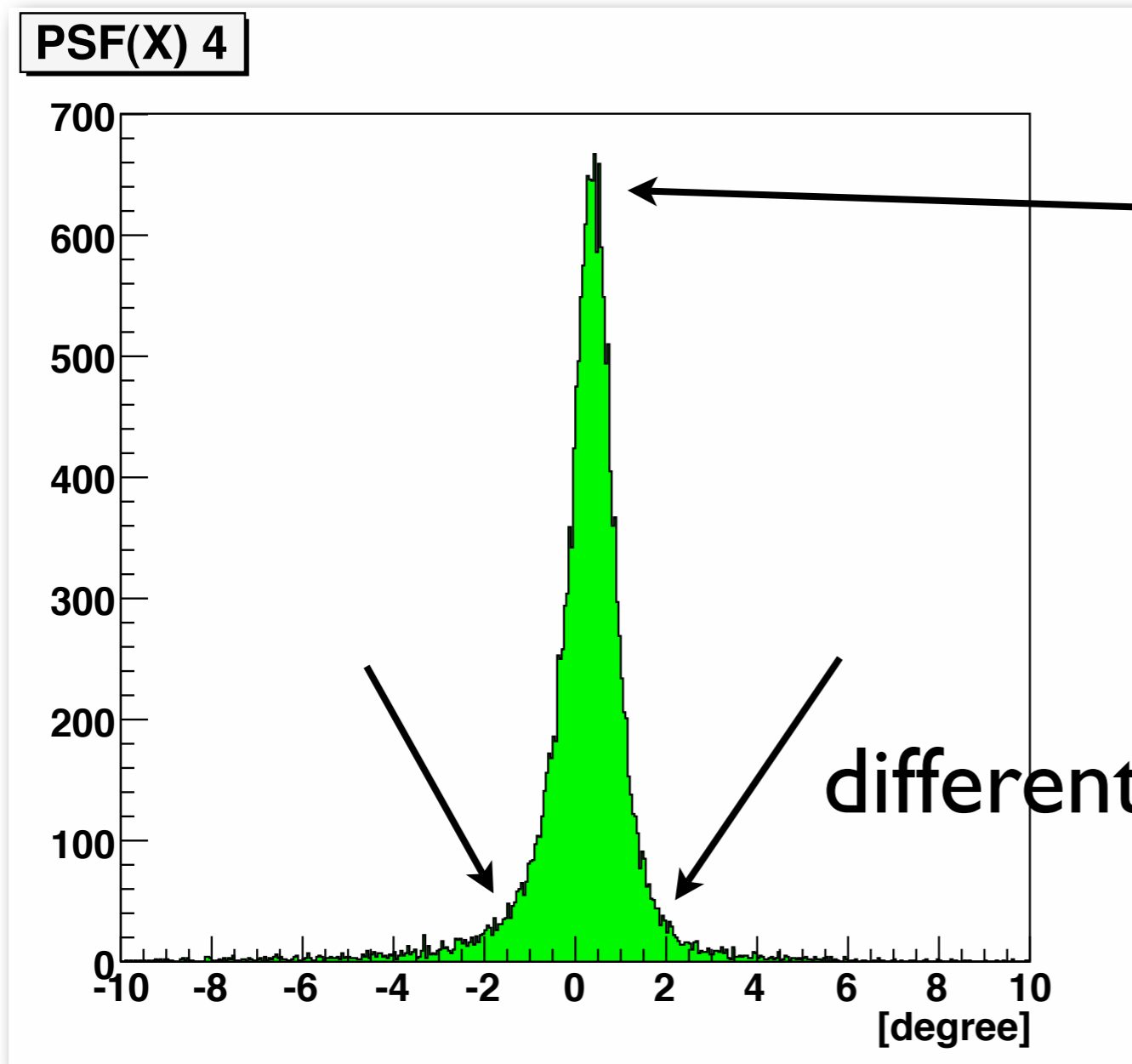
$$V_{txS}[XX/YY] = 4.0 \times 10^{-4} - 1.6 \times 10^{-3}$$



PSF becomes broader as $V_{txS}[XX/YY]$ becomes larger

Asymmetry?

Beam Angle = 50°



Peak Position = 0.33 deg

Beam direction is not correct?

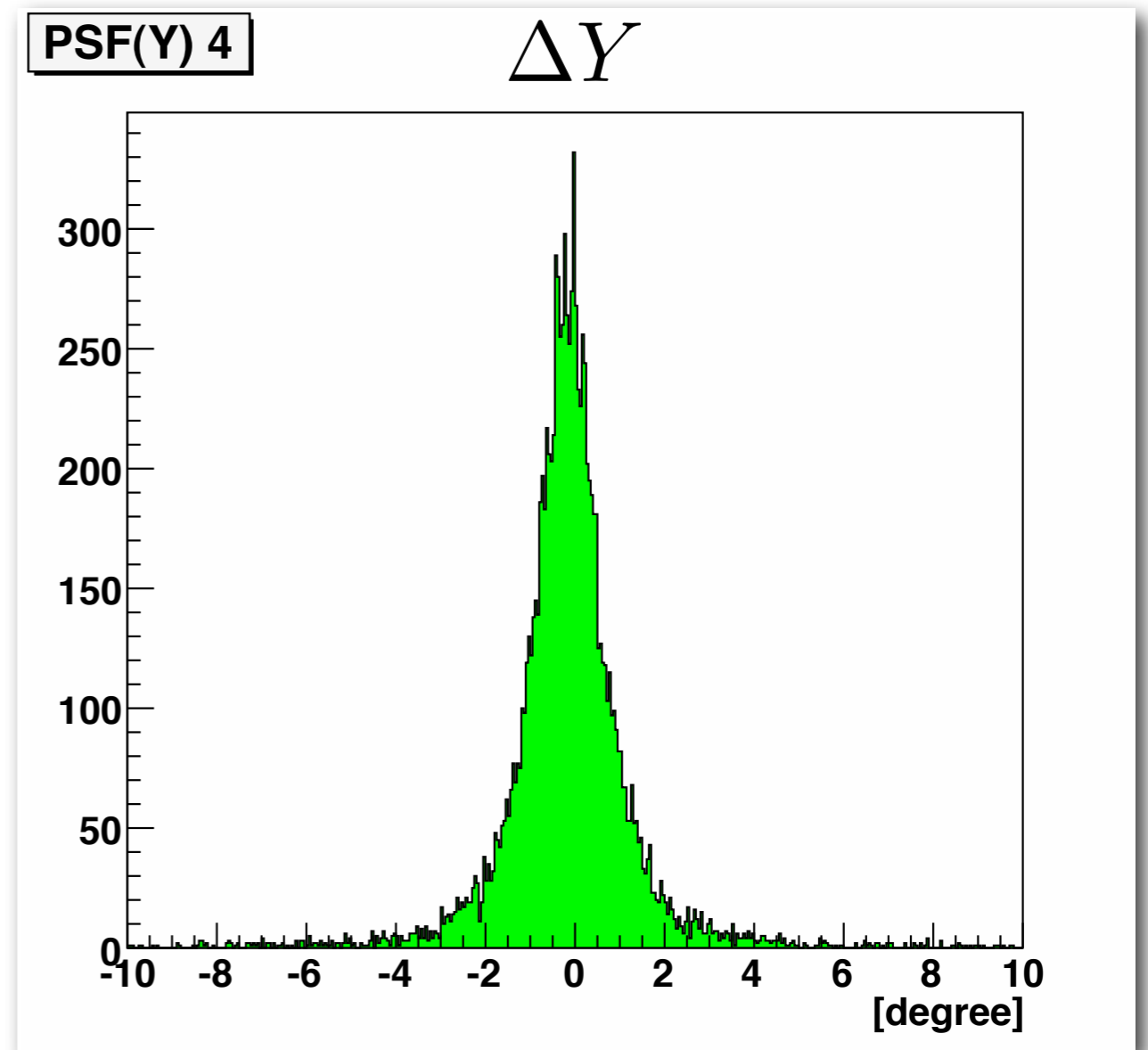
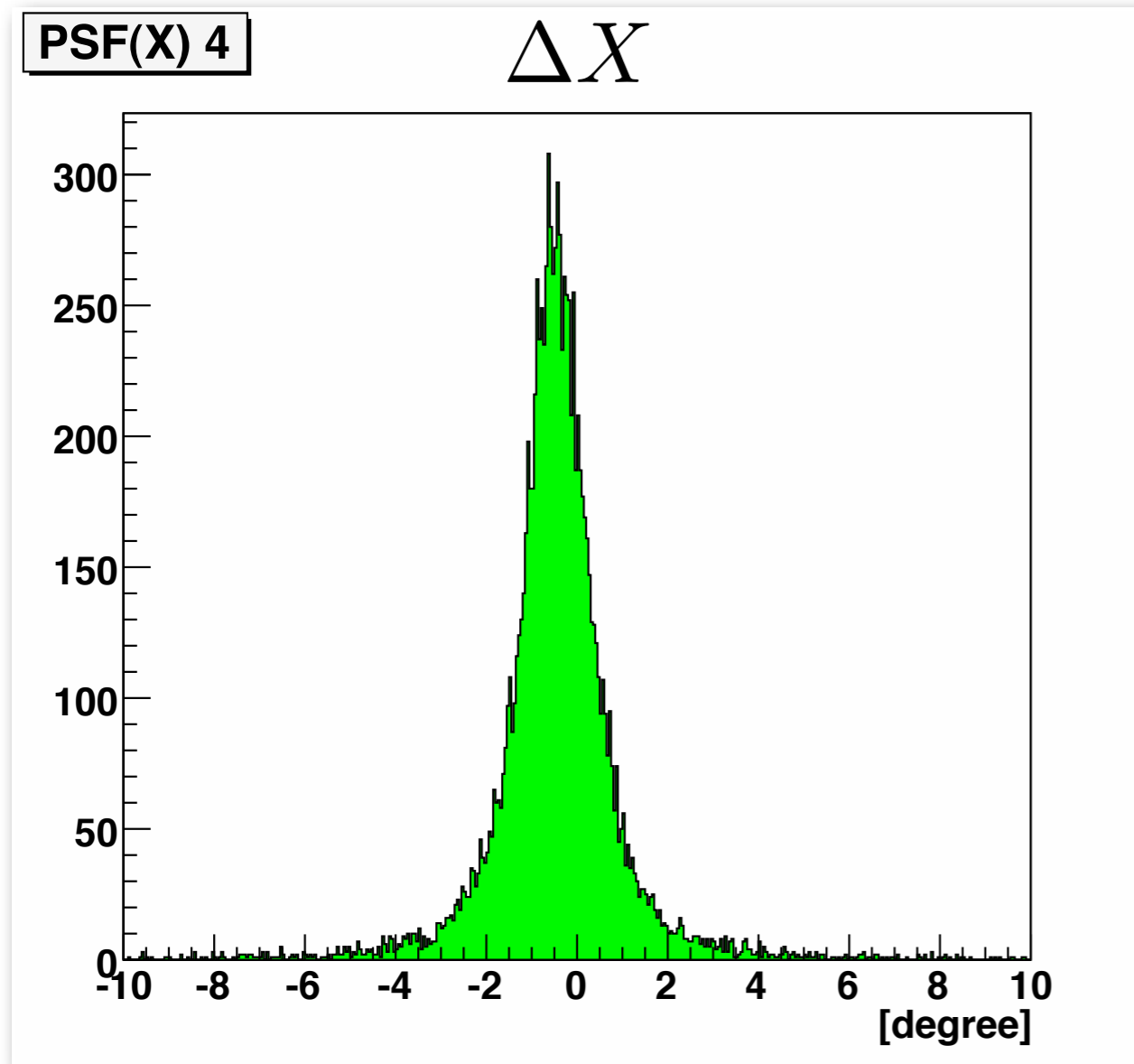
different shape

Only seen in ΔX

The differences become large when the Beam Angle is large

Beam Angle Dependency?

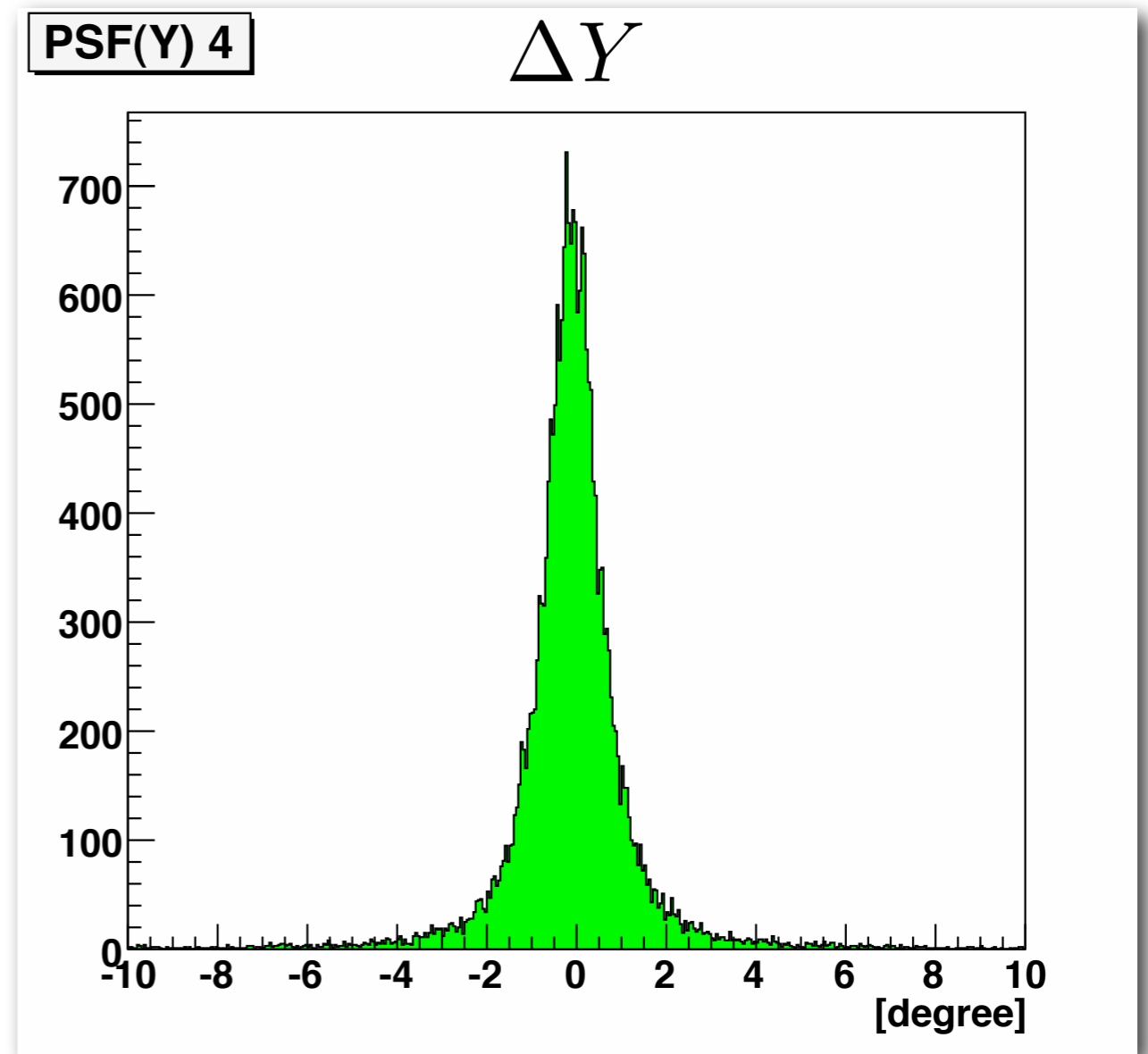
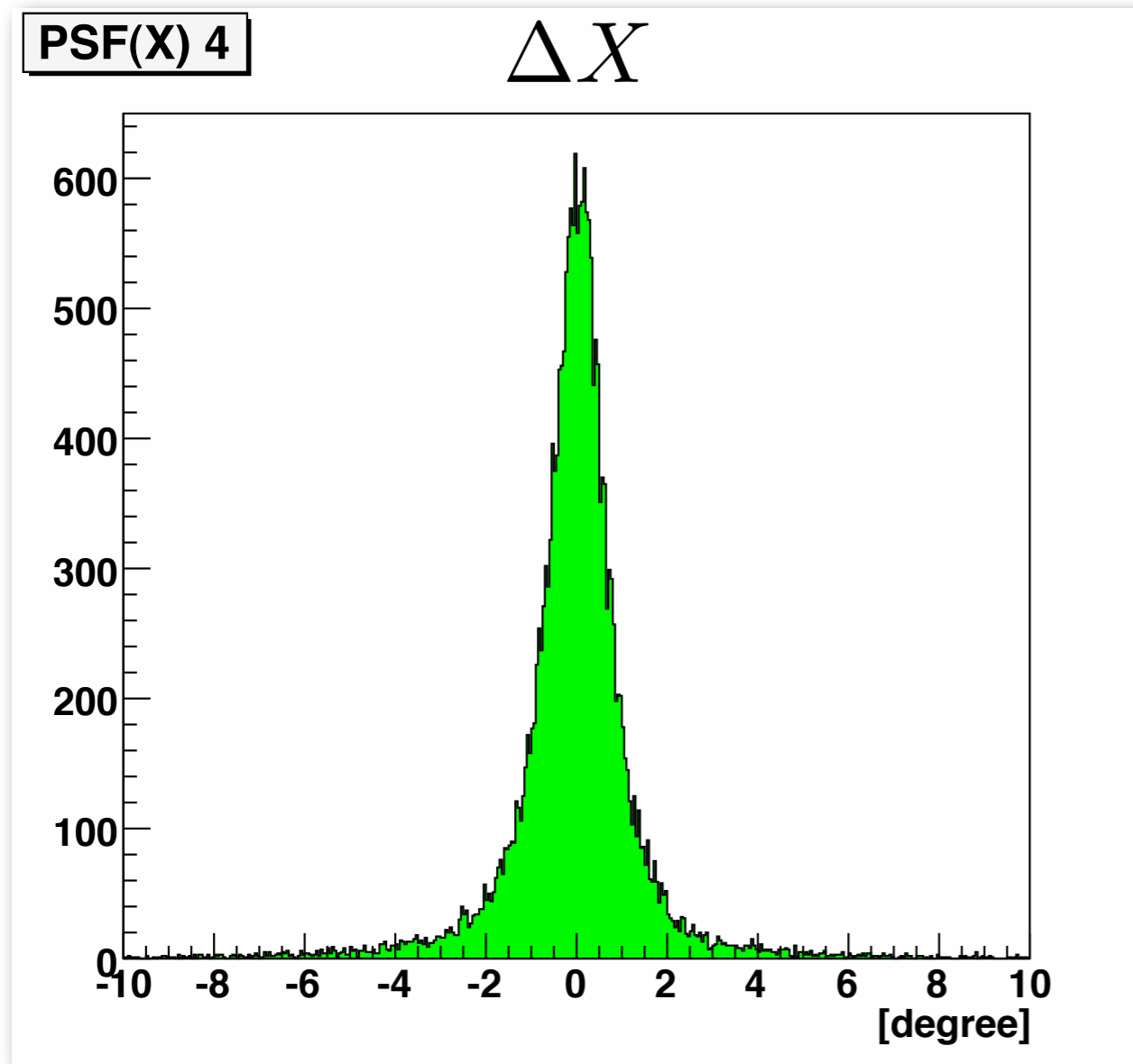
Beam Angle = 0°



Becomes narrower with Beam Angle?

Beam Angle Dependency?

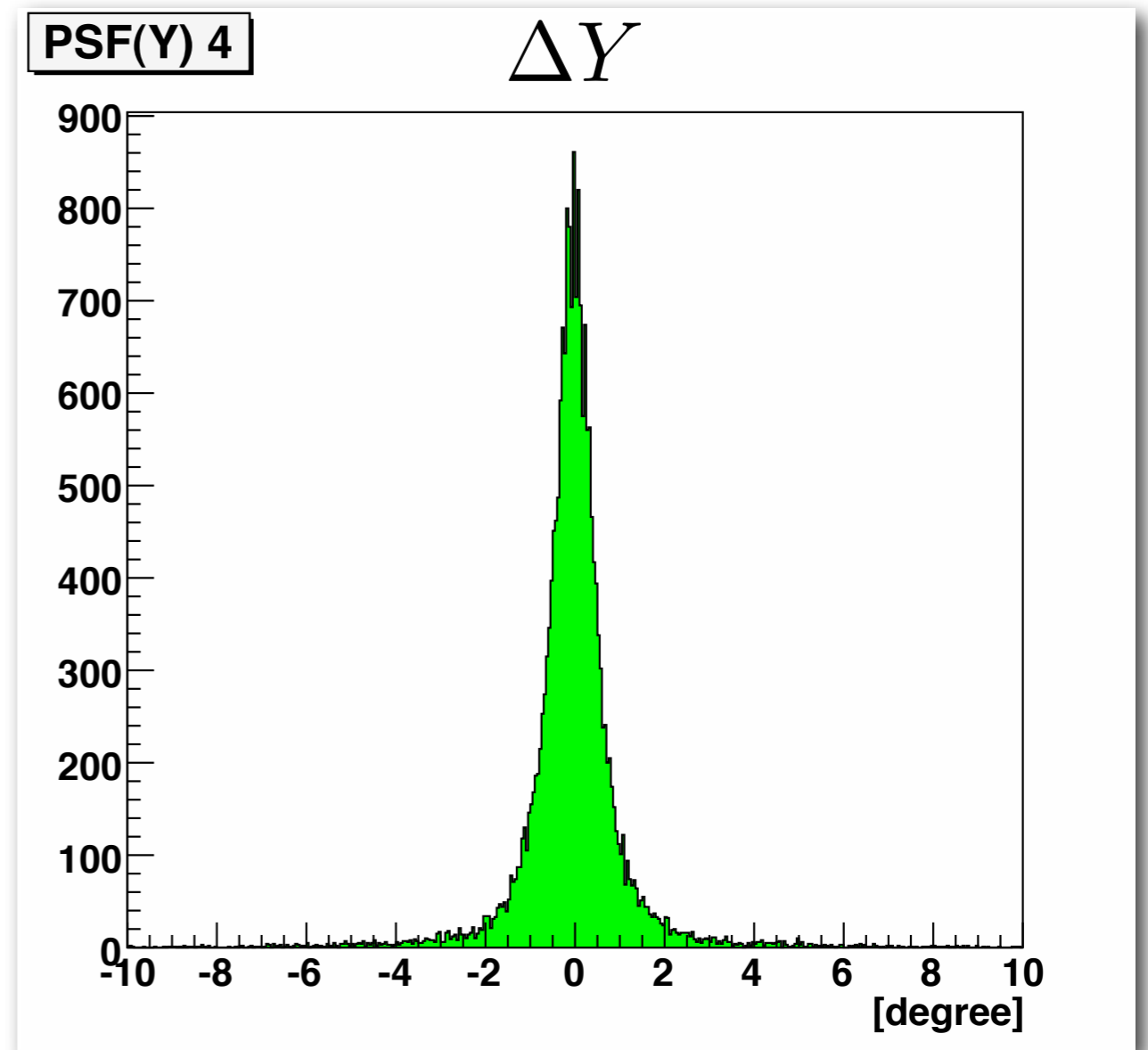
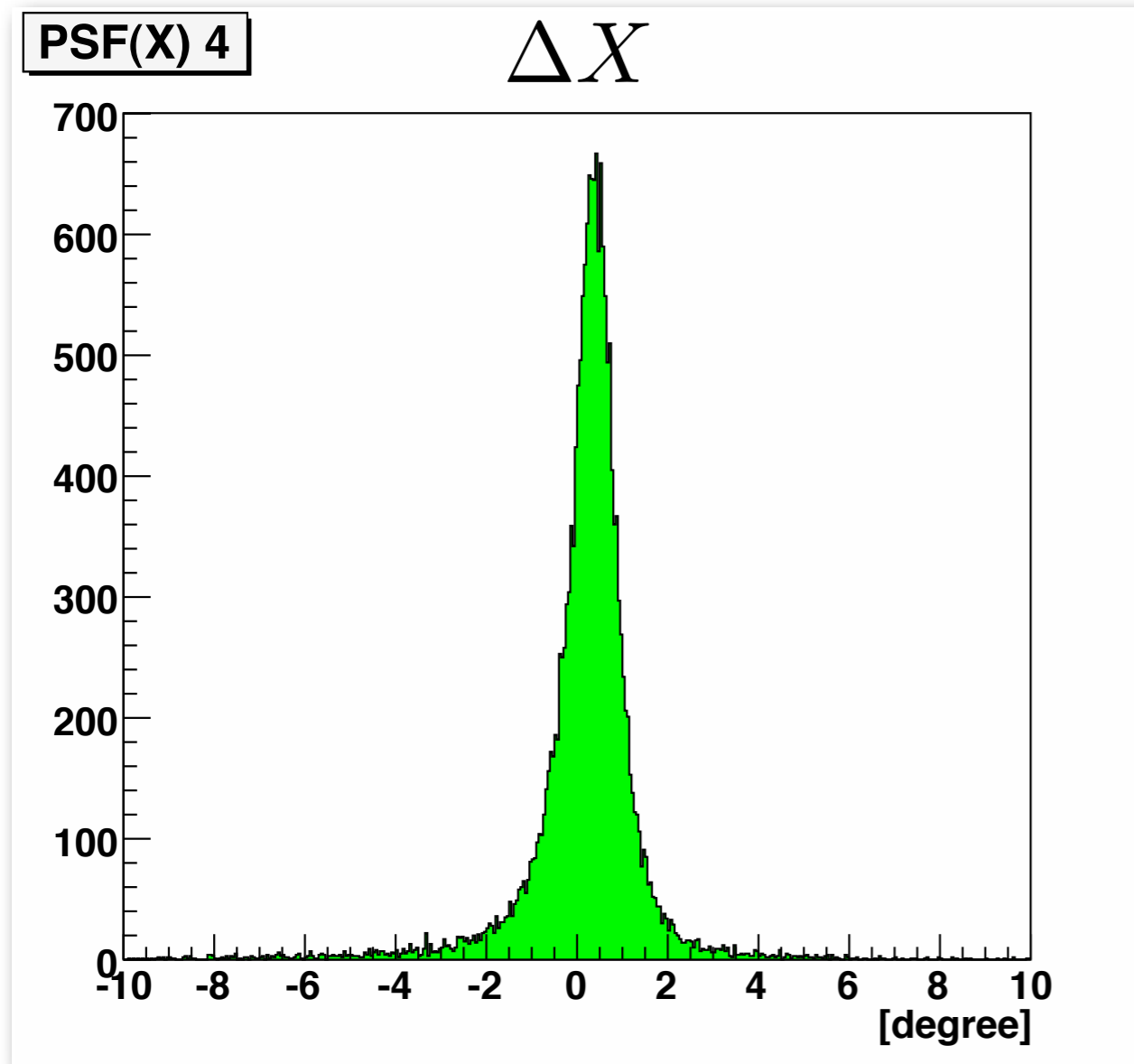
Beam Angle = 30°



Becomes narrower with Beam Angle?

Beam Angle Dependency?

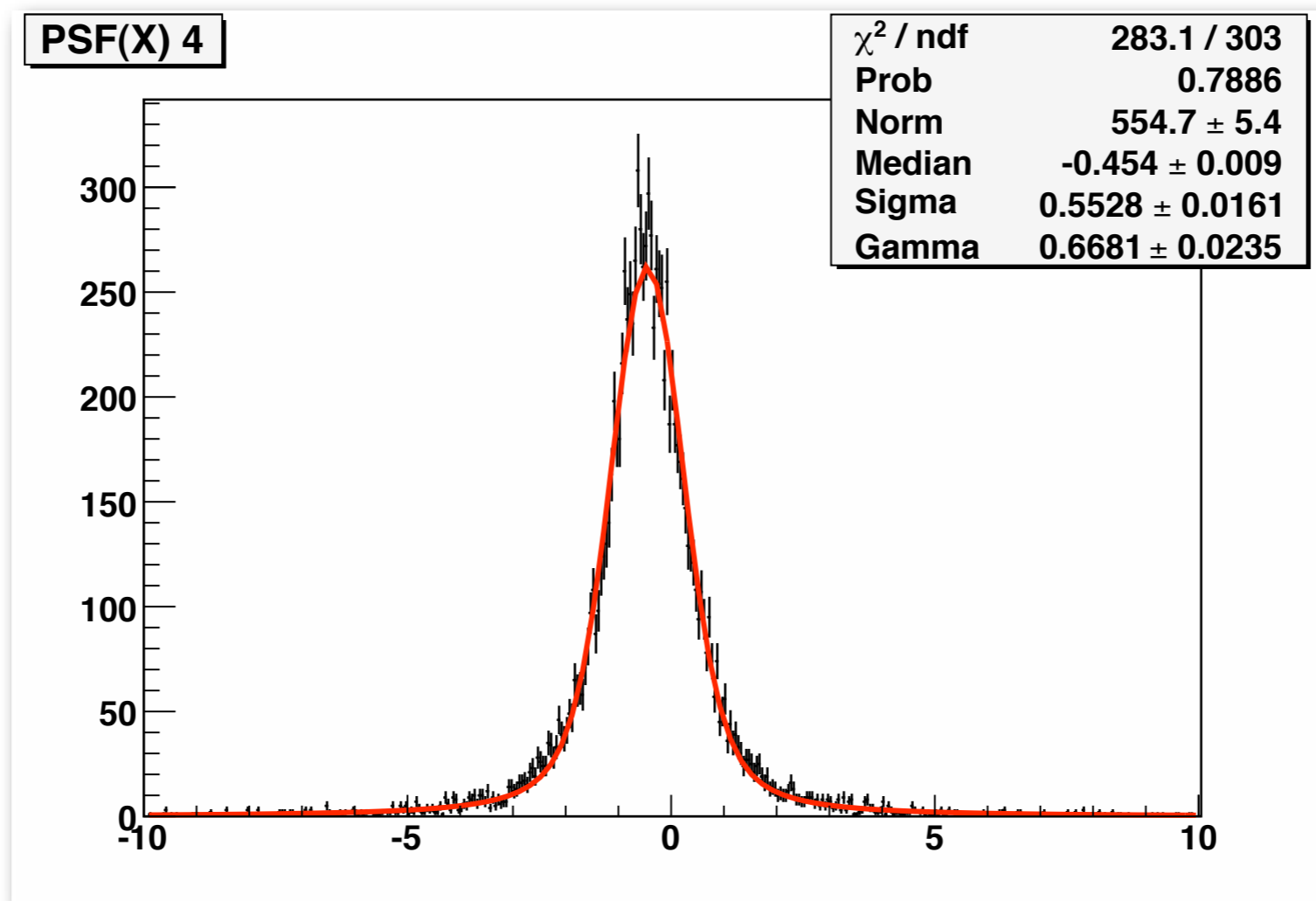
Beam Angle = 50°



Becomes narrower with Beam Angle?

Function Fitting

Voigt Function seems to give a good fit to the data
(Convolution of a Gaussian & a Breit-Wigner)



We'll try other functions.
ex) Two Gaussians (Broad + Narrow)