

進捗報告

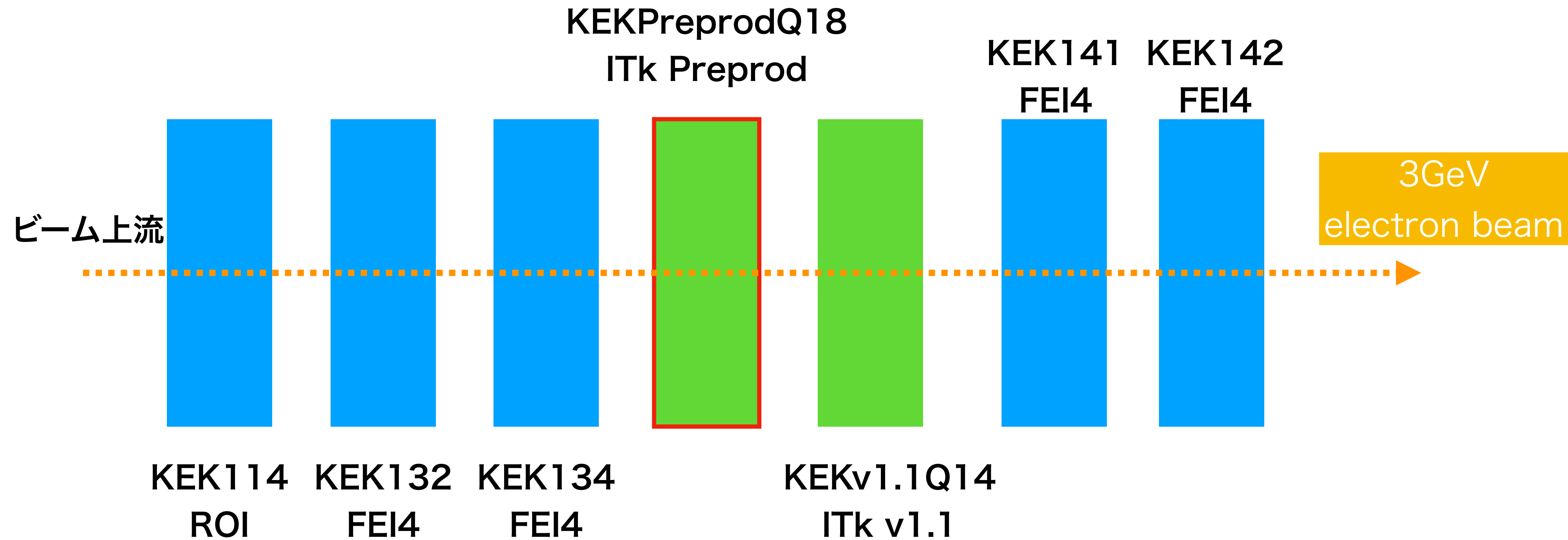
2024/02/02

倉持花梨

Today's topics

- ARTB 2023/06 ITk pix efficiency 解析

ARTB TestBeam setup



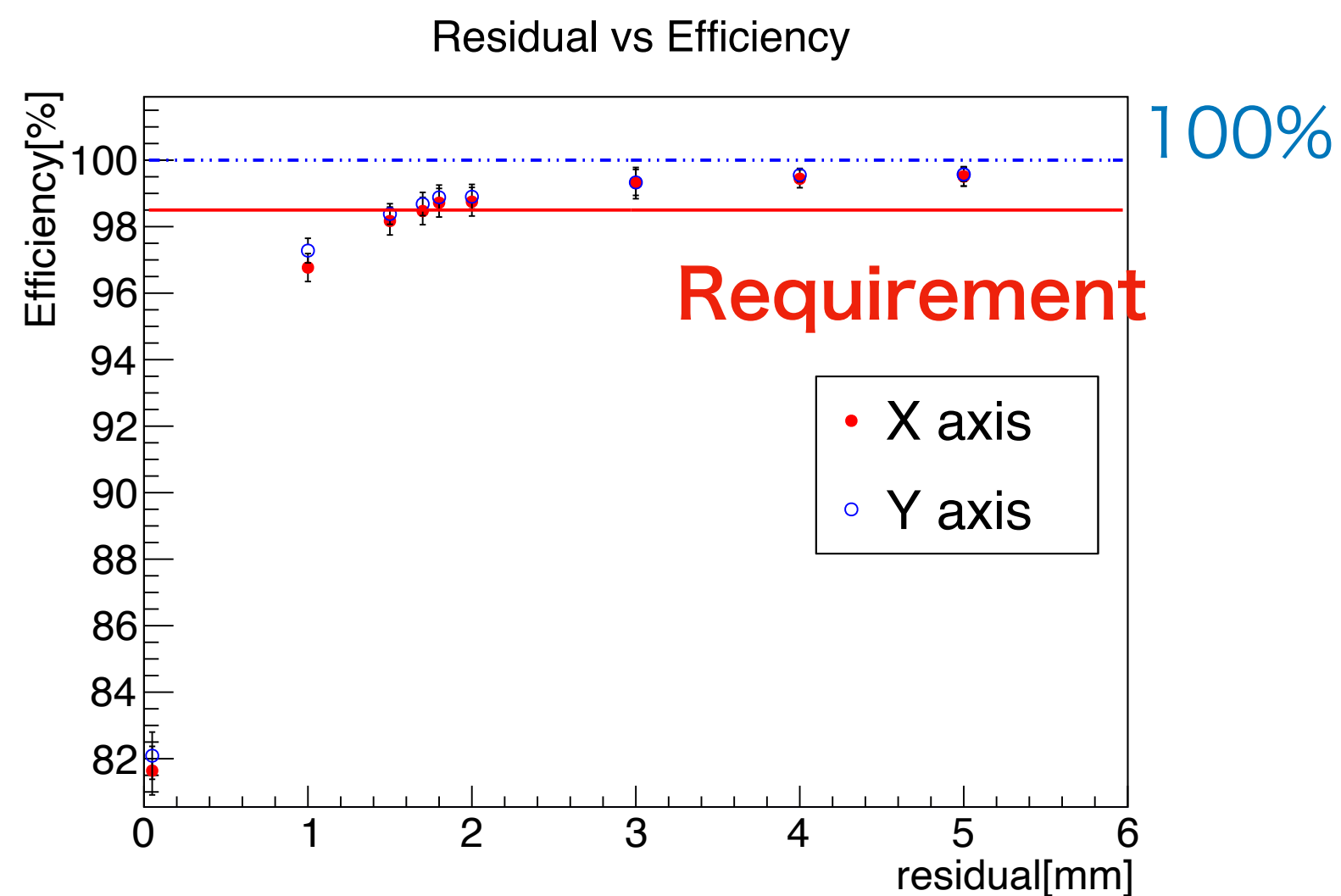
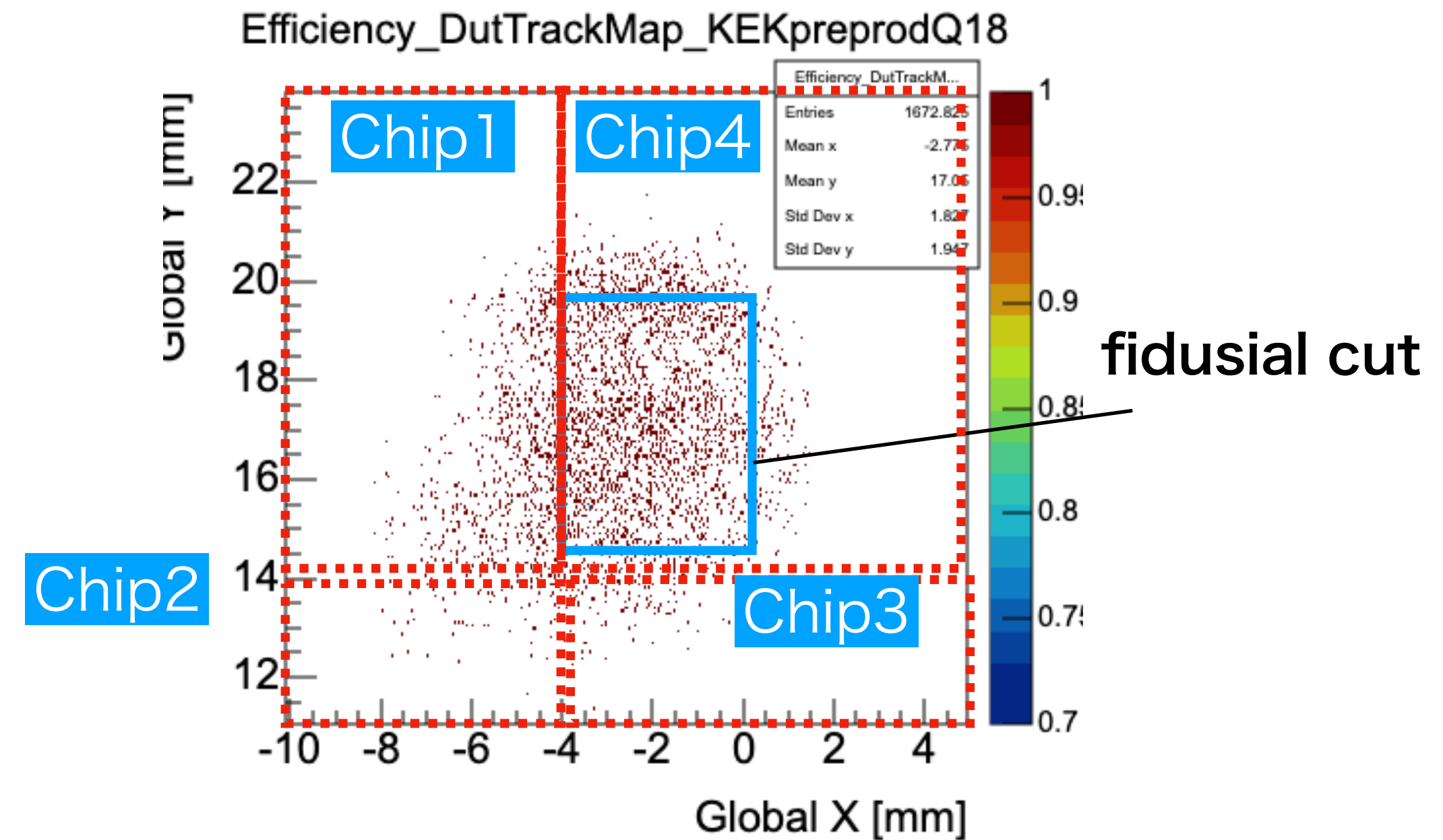
2023/06/01~06/09まで行われたTestBeam

ITk Pixの試験量産品である **KEKPreprodQ18** をDUTとして解析

解析項目: 未照射モジュールEfficiency (ATLASの要求 98.5%)

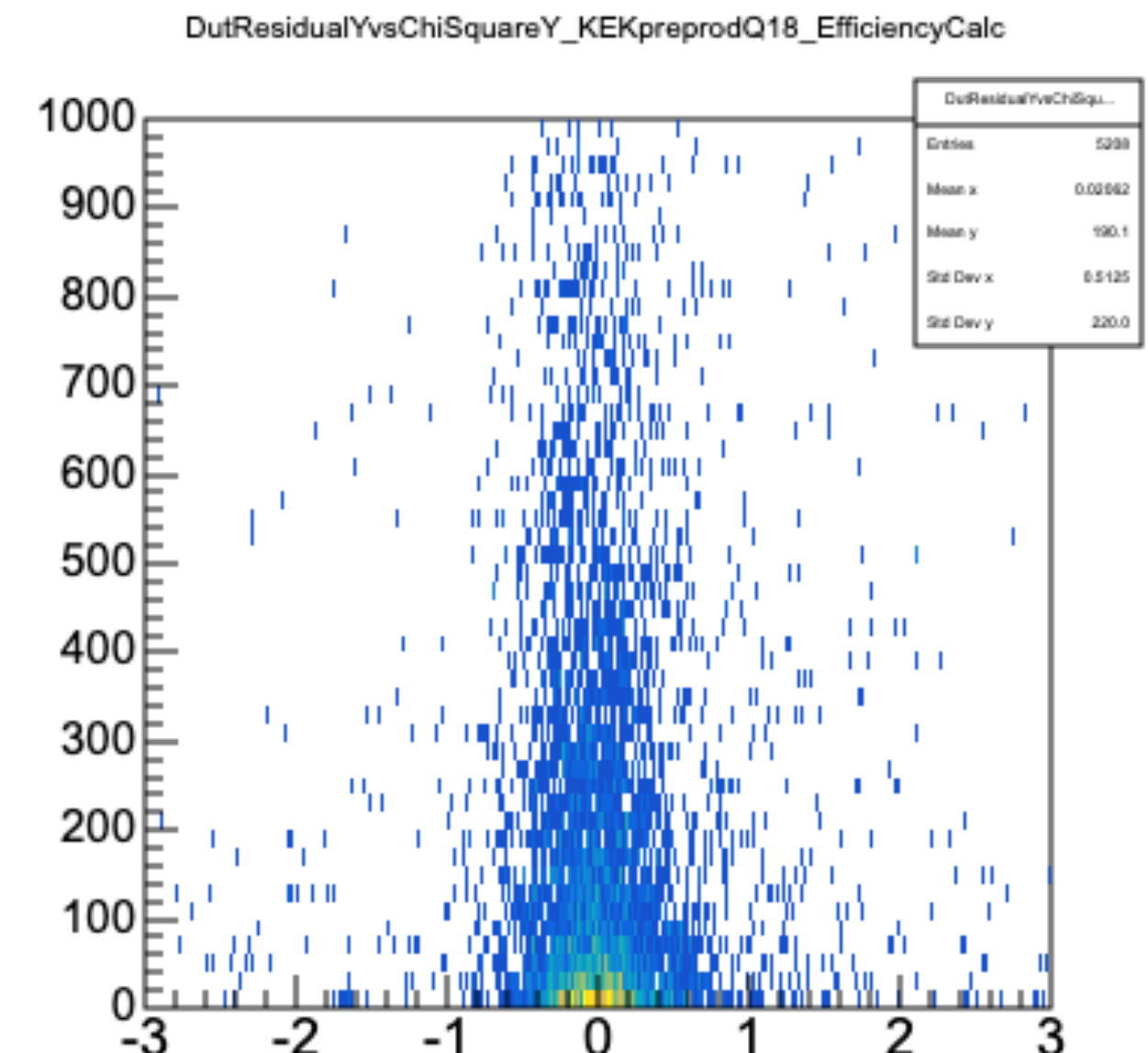
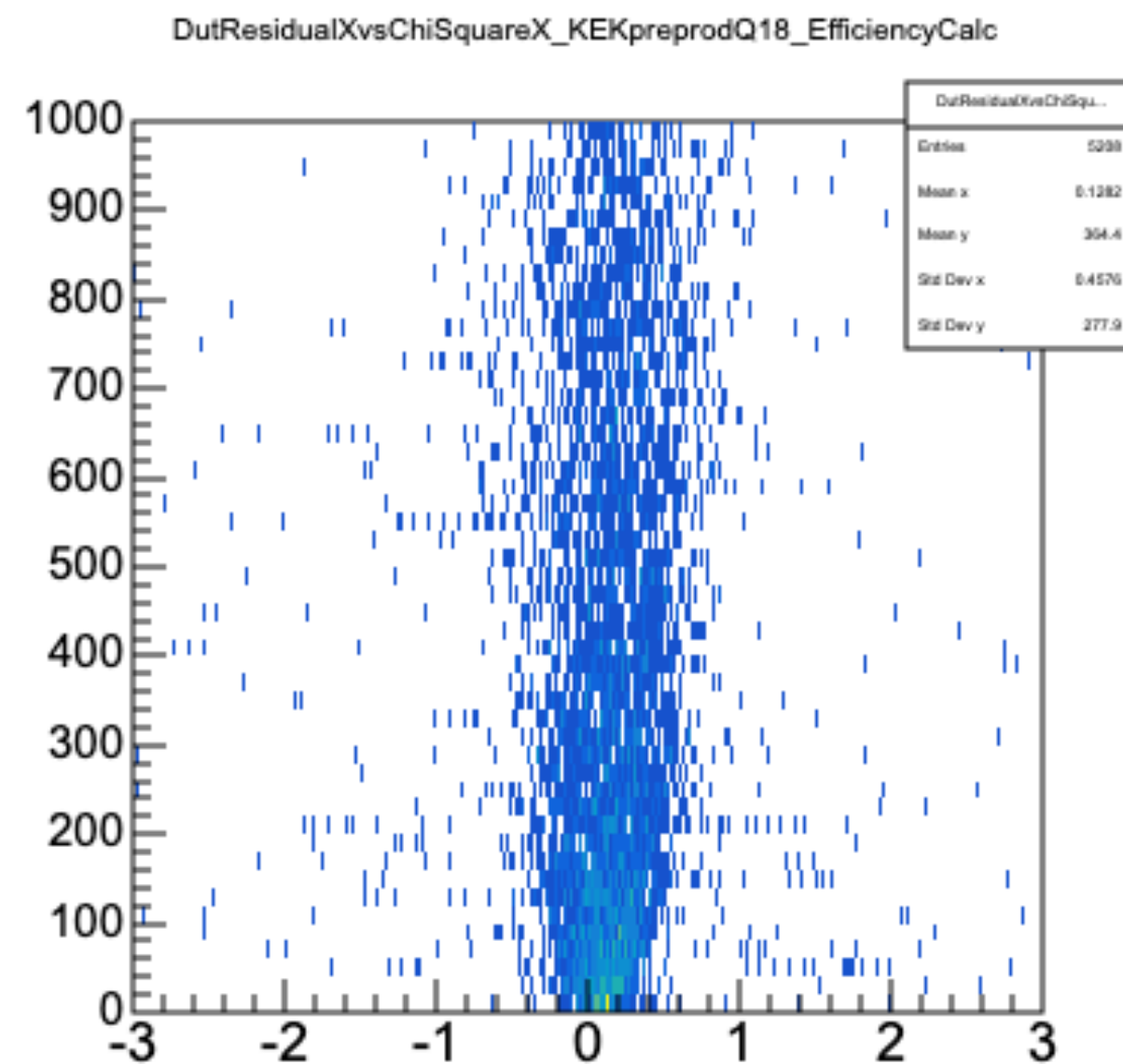
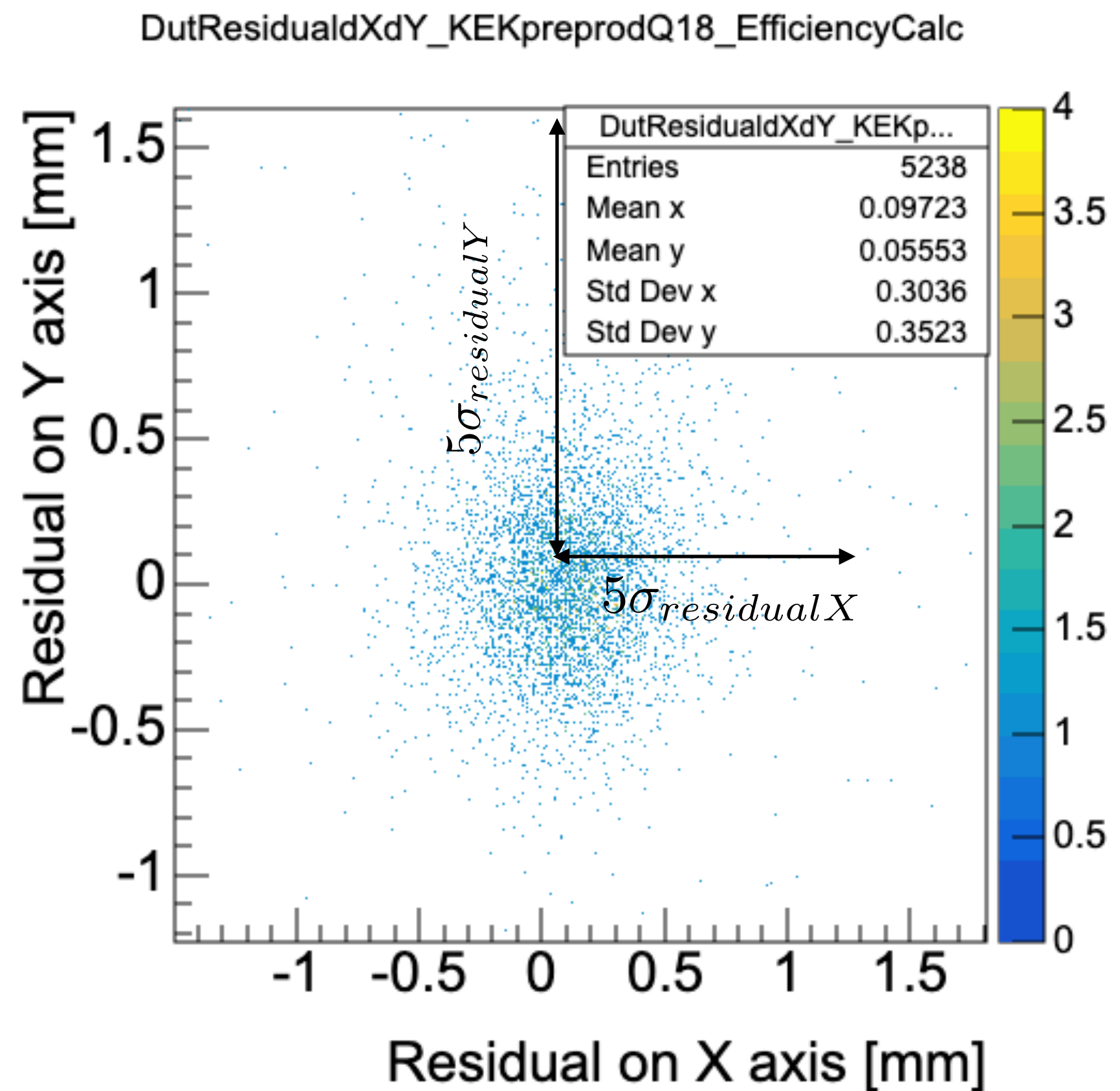
ARTB Efficiency導出

パラメーター	
総event数	580001
nClusterCutPerLayer	10
clustersizeCutPerDUT	5
perTracker	5
fidusial Cut(Global)	[-4,0] [14,20]



- residual (Dut内のHit位置 - TrackのHit位置)Cut をpixel sizeと同じ 0.05 mmにした結果 Efficiency < 98.5 %
- 3GeV electron beamなので 1pixel単位の位置分解能が出ない
- residualCut ~ 1.7mm, no Chisquare Cut で EfficiencyXY > 98.5%

residual & ChiSquare Cuts



residualX vs ChisquareX

- Cut parameterの妥当性を調べる

- residualのdXdYの分布

$$5\sigma_{residualX} = 1.5180$$

$$5\sigma_{residualY} = 1.7615$$

- Chisquareの分布からChiSquare

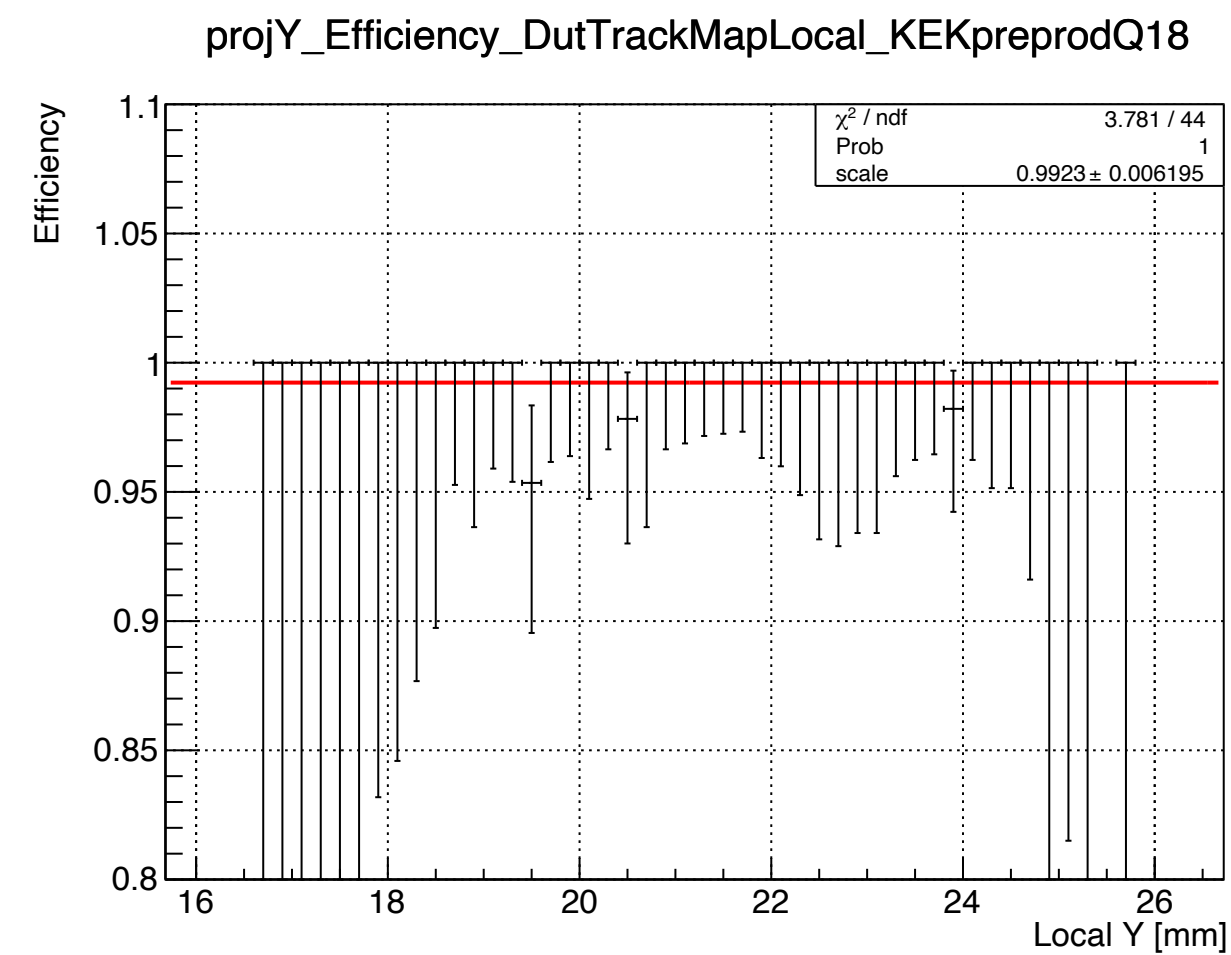
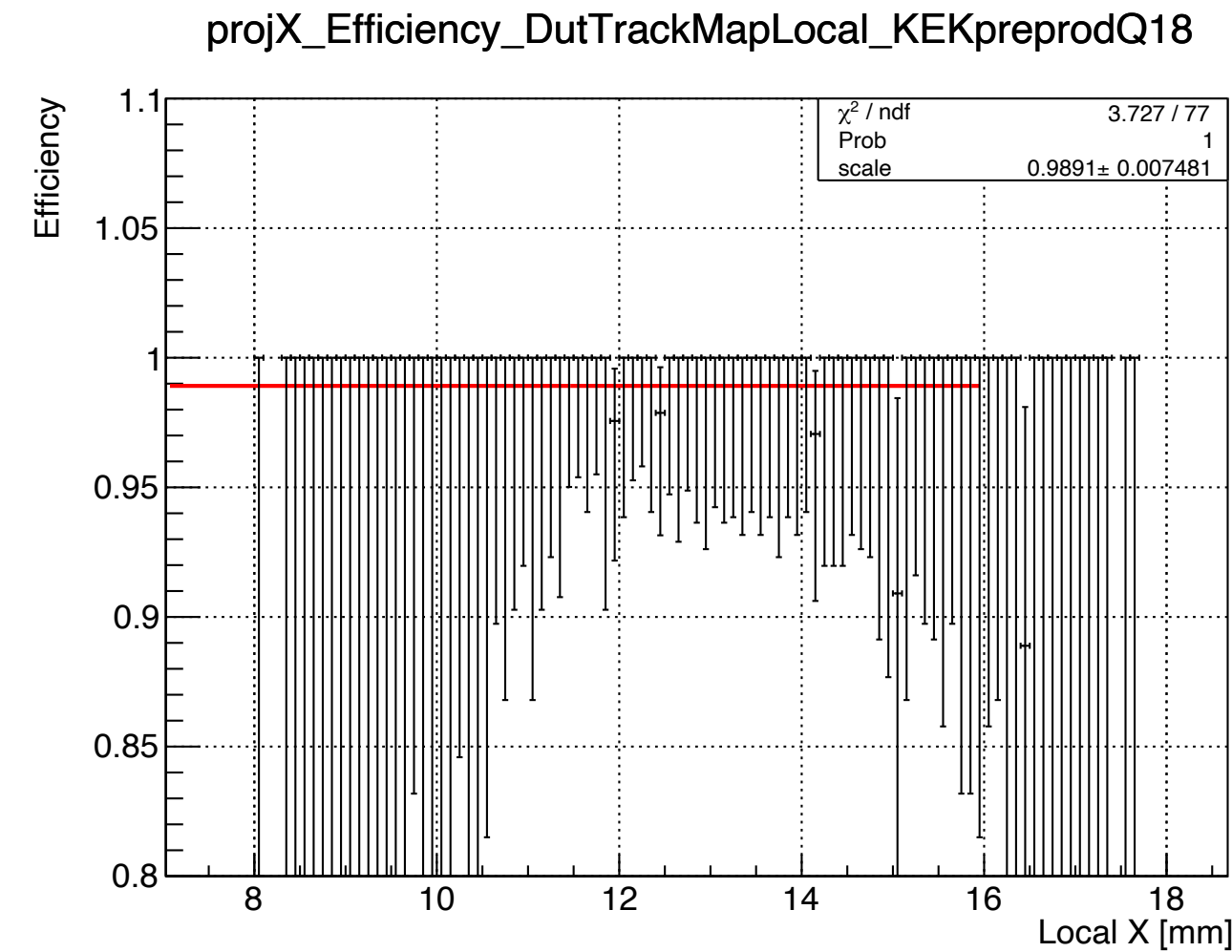
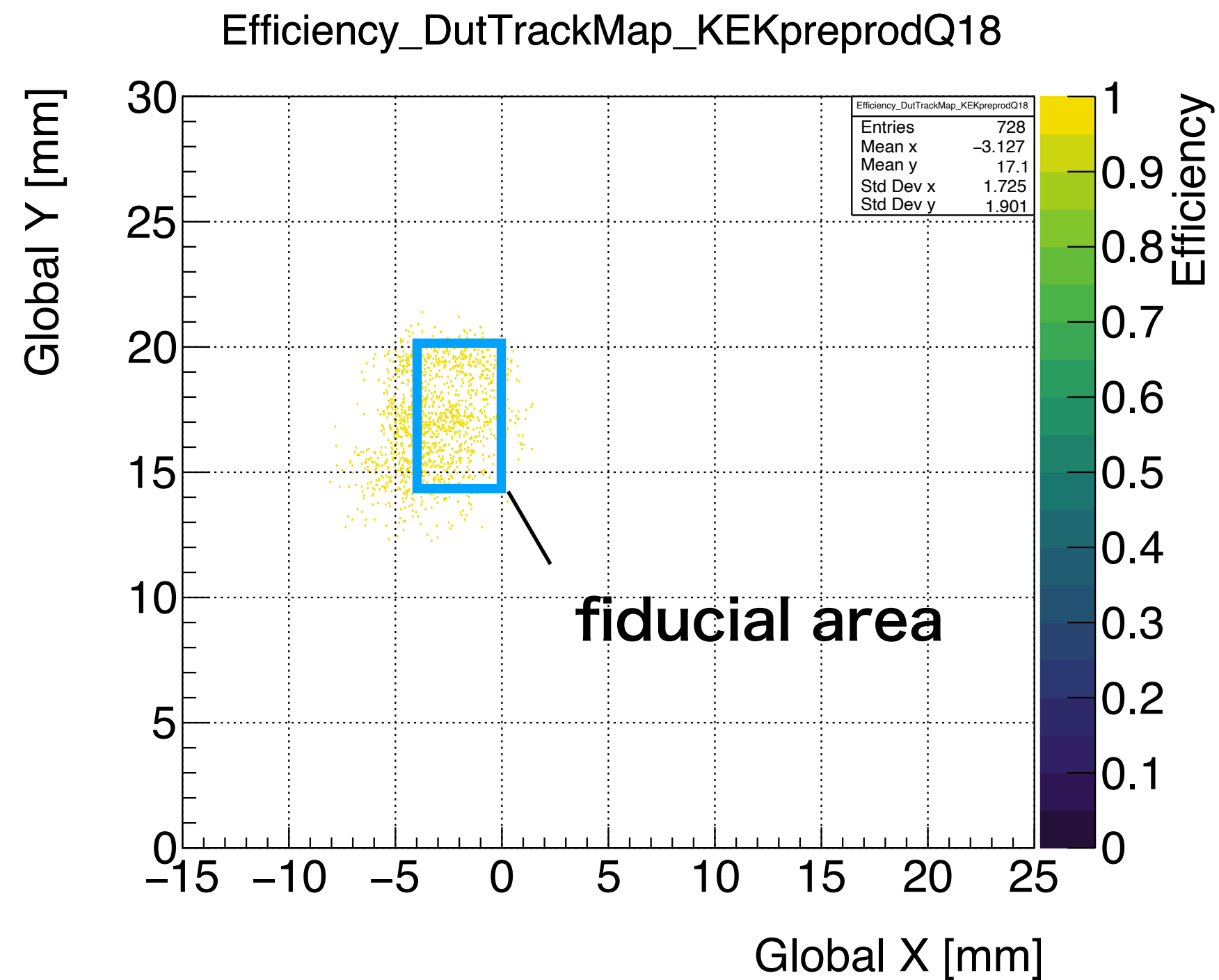
$$\sigma_X = 280, \sigma_Y = 220$$

- residual Cut XY = $5\sigma_{residual}$

ChiSquareCut = 250 でEfficiencyを調べる

residualY vs ChisquareY

Efficiency



- residual Cut $XY = 5\sigma_{residual}$
ChiSquareCut = 250
- Efficiency
X $98.91 \pm 0.75\%$
Y $99.23 \pm 0.62\%$
- requirement **満たす!**

Event数

- no Chisquare CutとChiSqaure 250で比較すると TrackHitevent数が1/3
- 他のrunもmargeしてevent数増やす

ChiSquare Cut	no Chisqaure Cut	250
総event数	580001	
TrackHitevent	4323	1500
TrackHitEvent with DUT Hit	4299	1495

まとめ

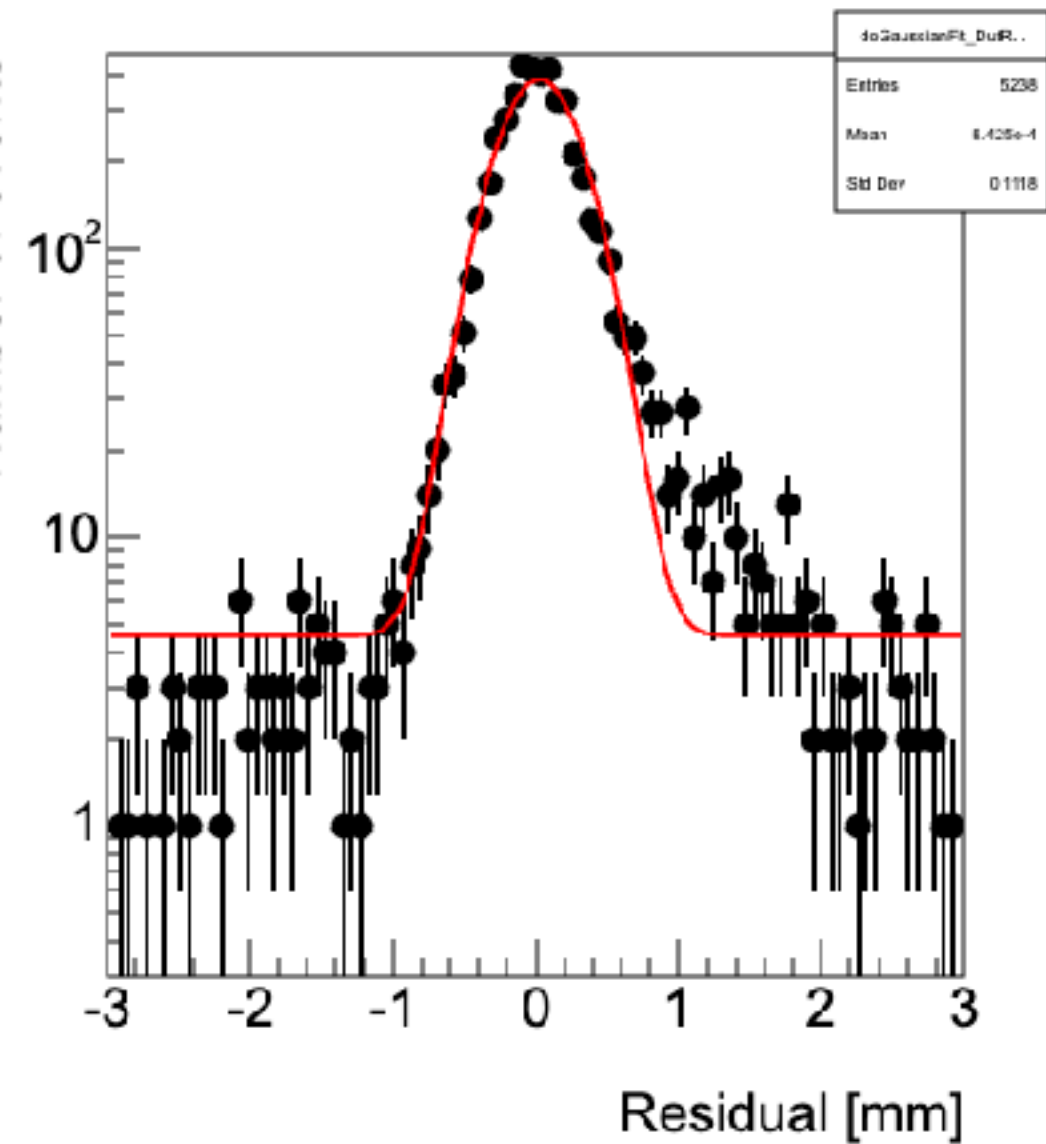
- ARTB ITkpix Preprod module Efficiency解析
- residualXY 5σ
Chisquare 1σ のCutで Efficiency解析
- Efficiency
X $98.91 \pm 0.75\%$
Y $99.23 \pm 0.62\%$ 要求を満たす
- Event数が1500と少ないので他のrunをmerge or ChiSquareCutもう少し緩くする?

To do

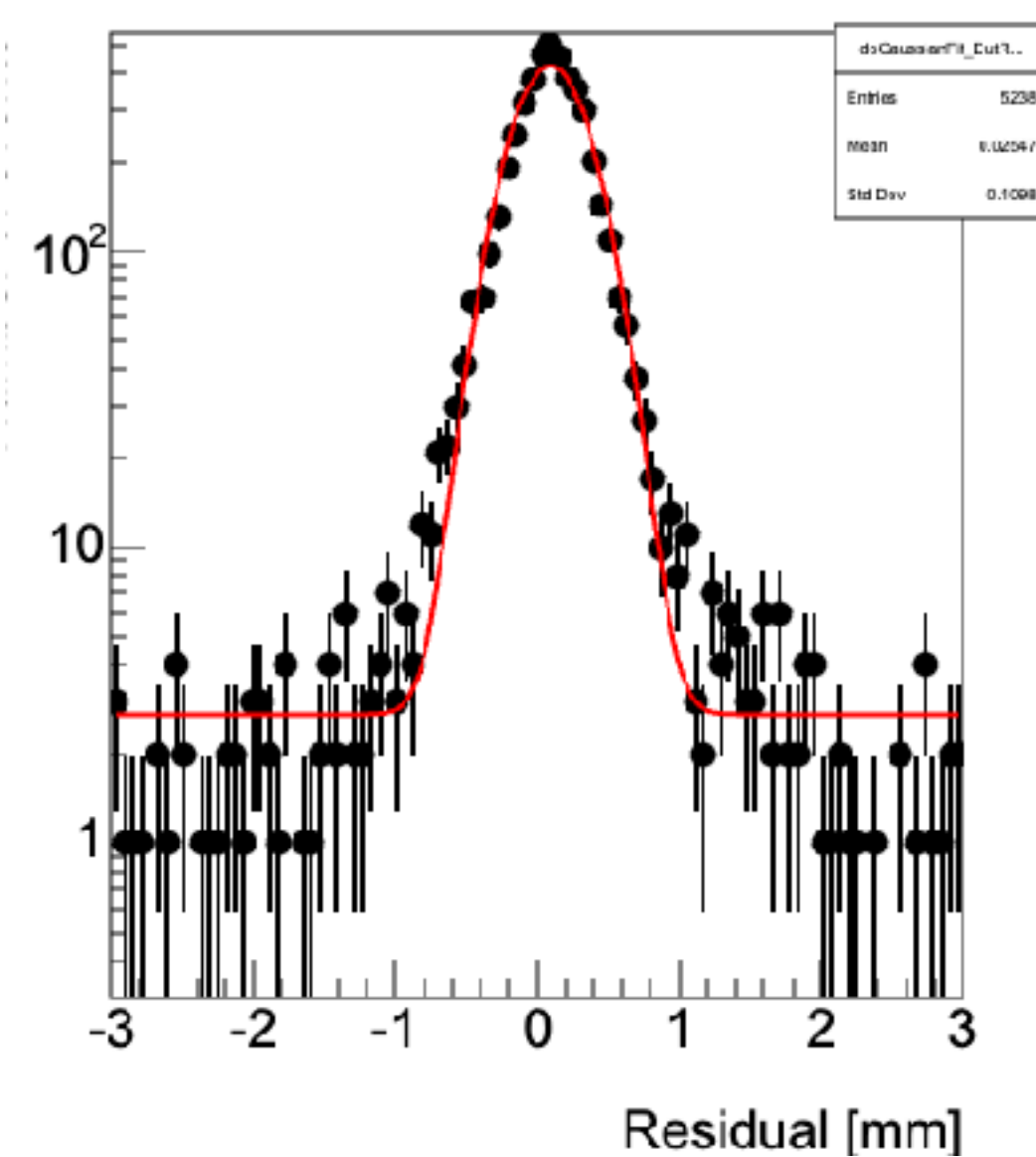
Back up

Where is noise?

no ChiSquareCut

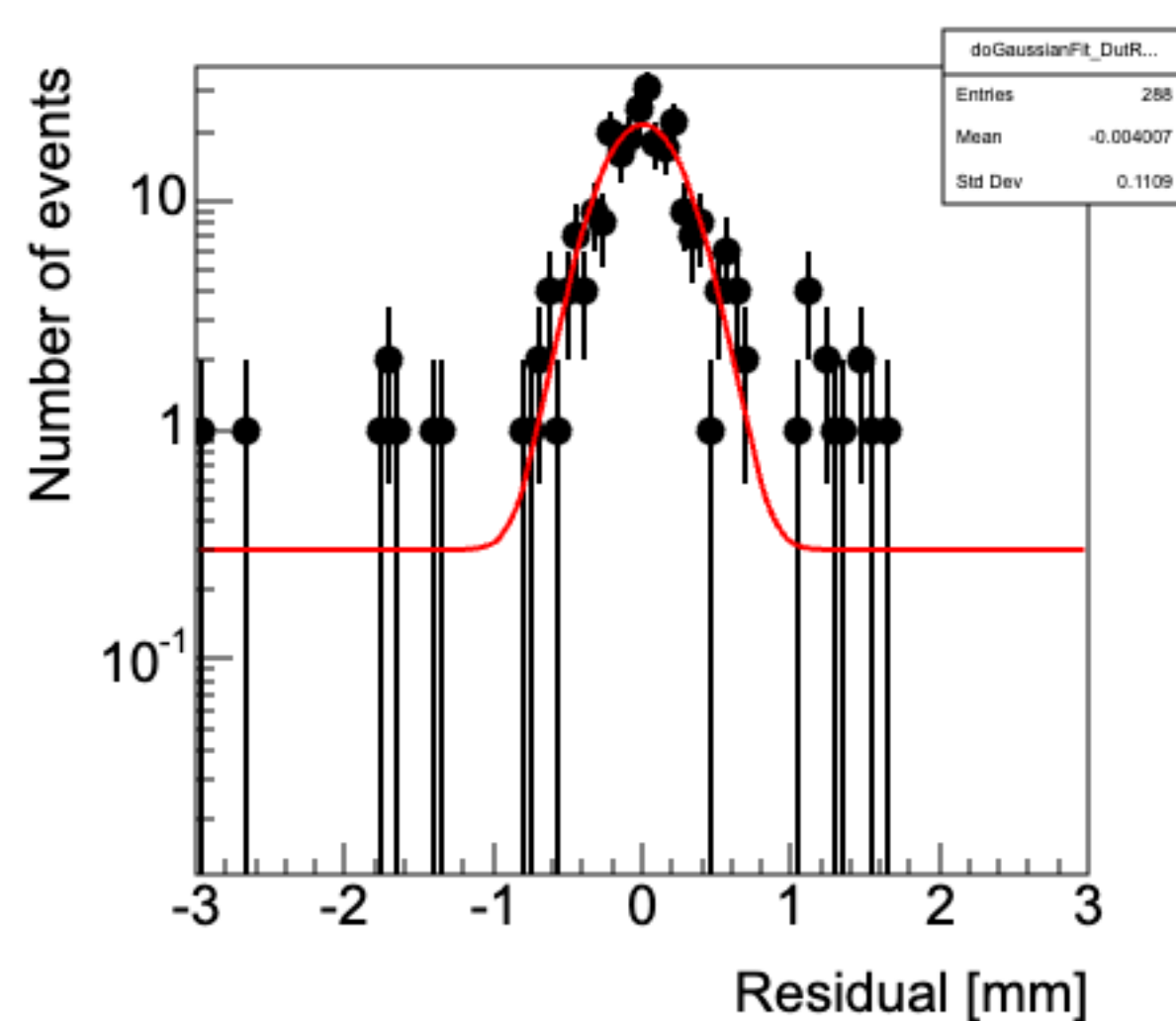
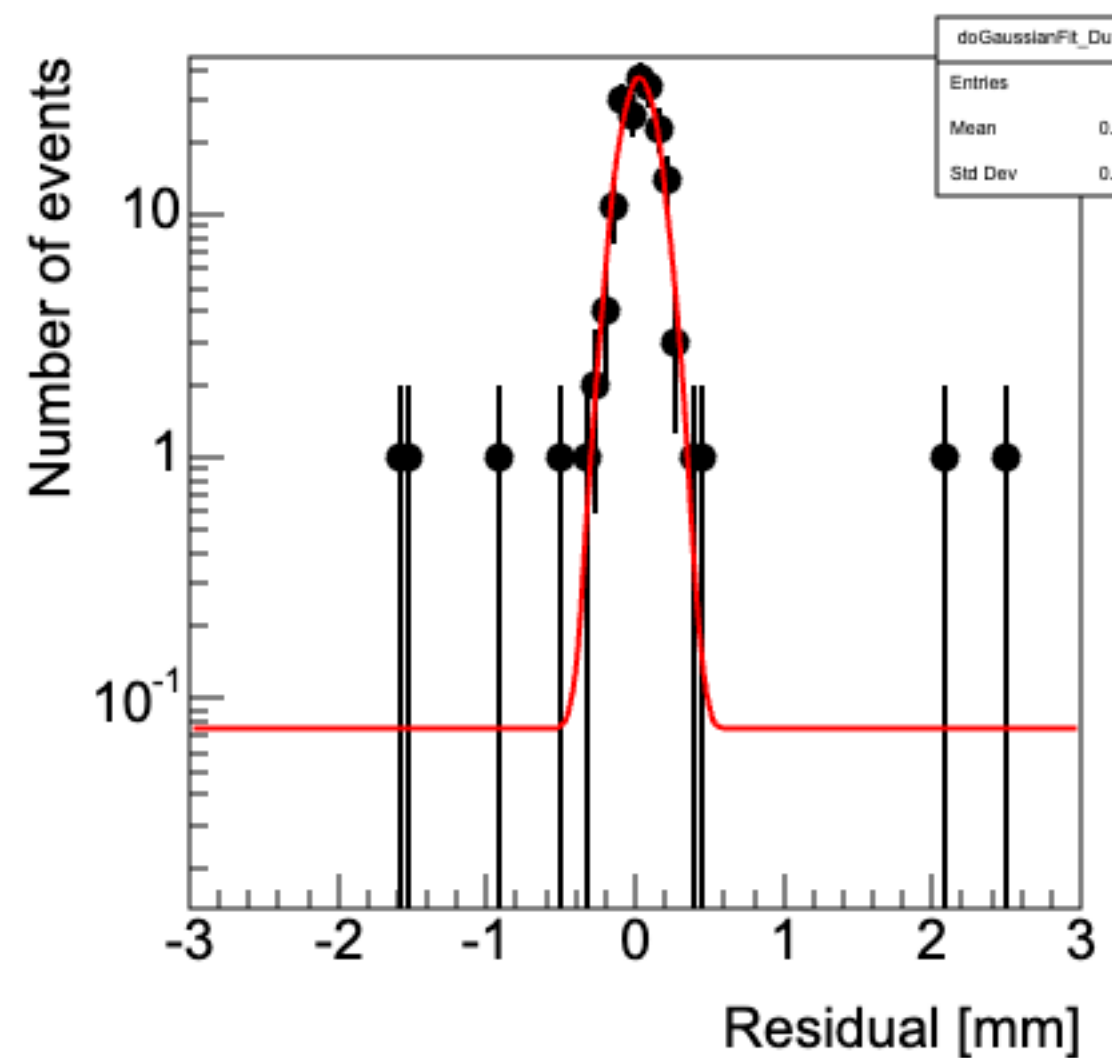


X方向のgaussian fit



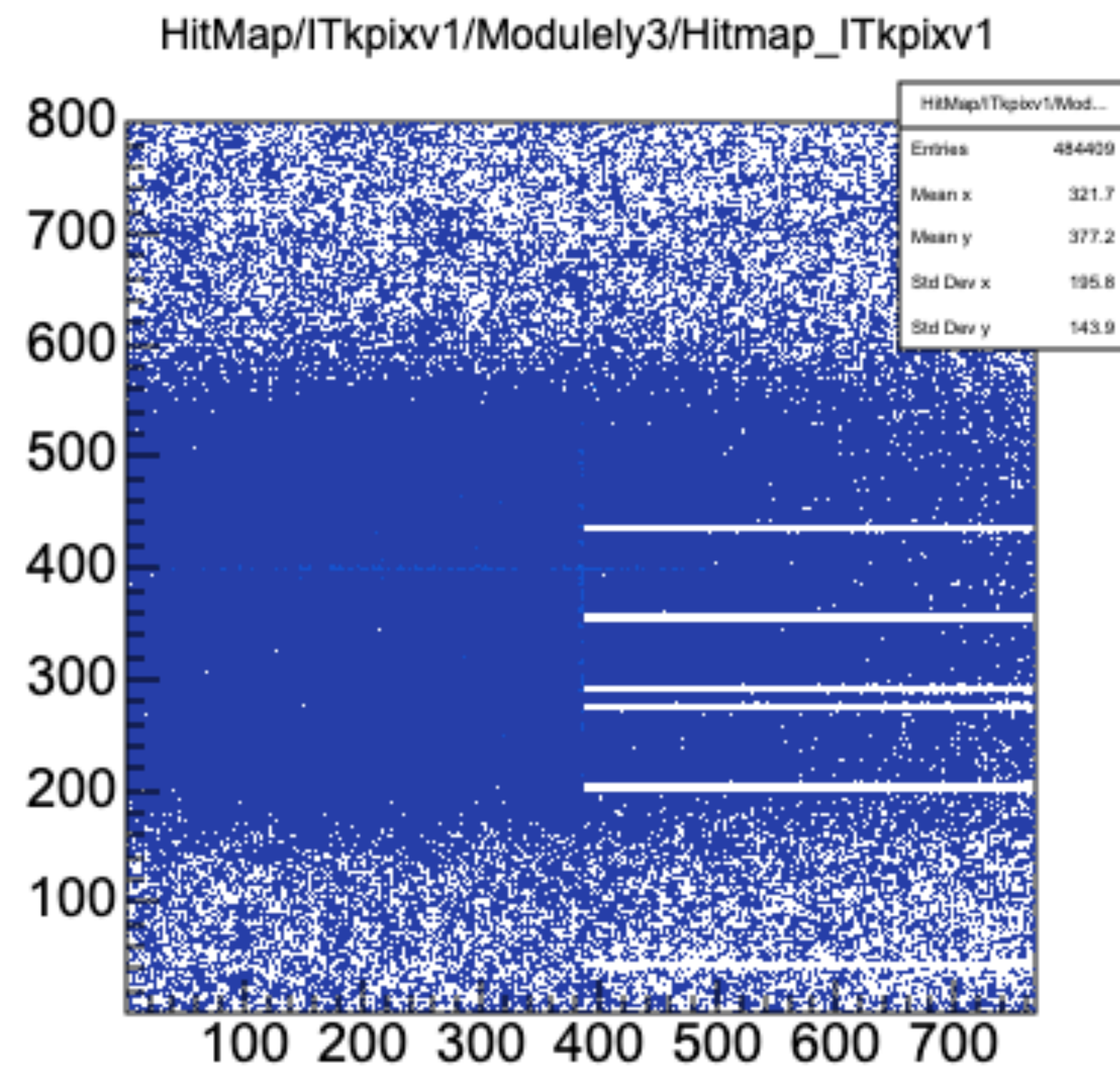
Y方向のgaussian fit

ChiSquareCut 250

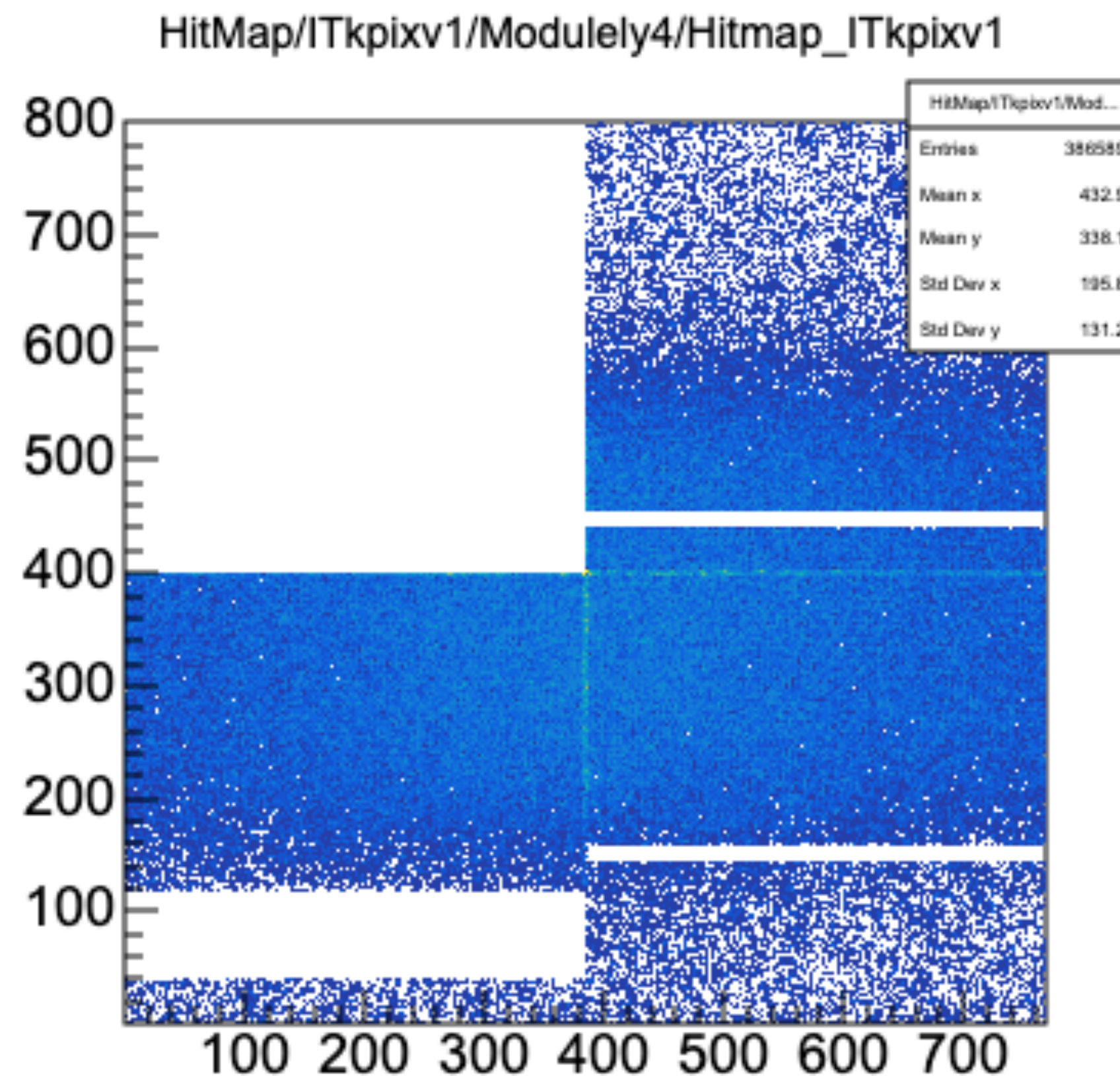


- KEKPreprodQ18 gaussian fit, 縦軸log
- tail引いてるのがnoise
- ChiSquareCut 250でtail引いてるのは減っているものでnoiseとかはcutできてる？

HitMap

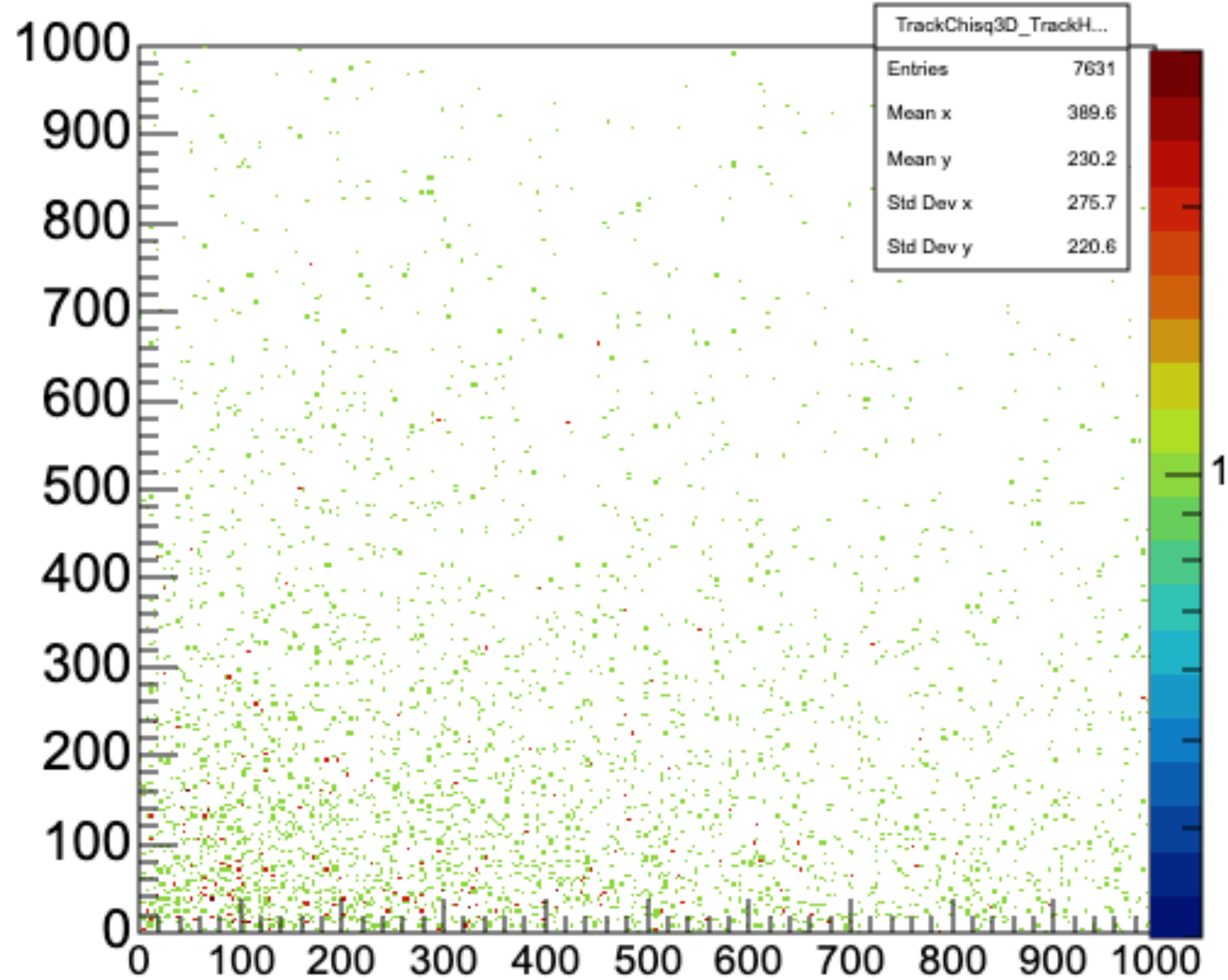


KEKPreprodQ18(DUT)

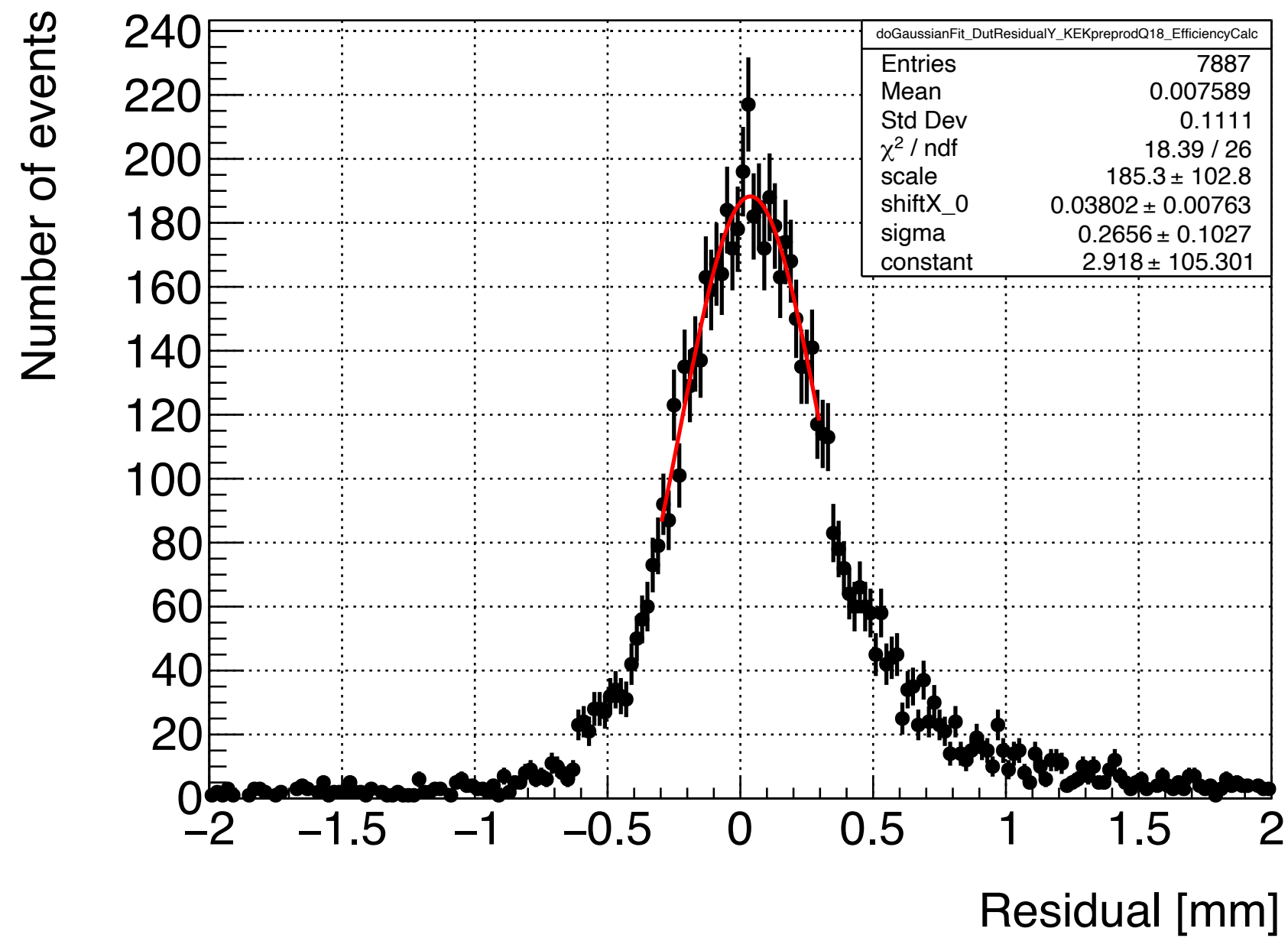


KEKv1p1Q14

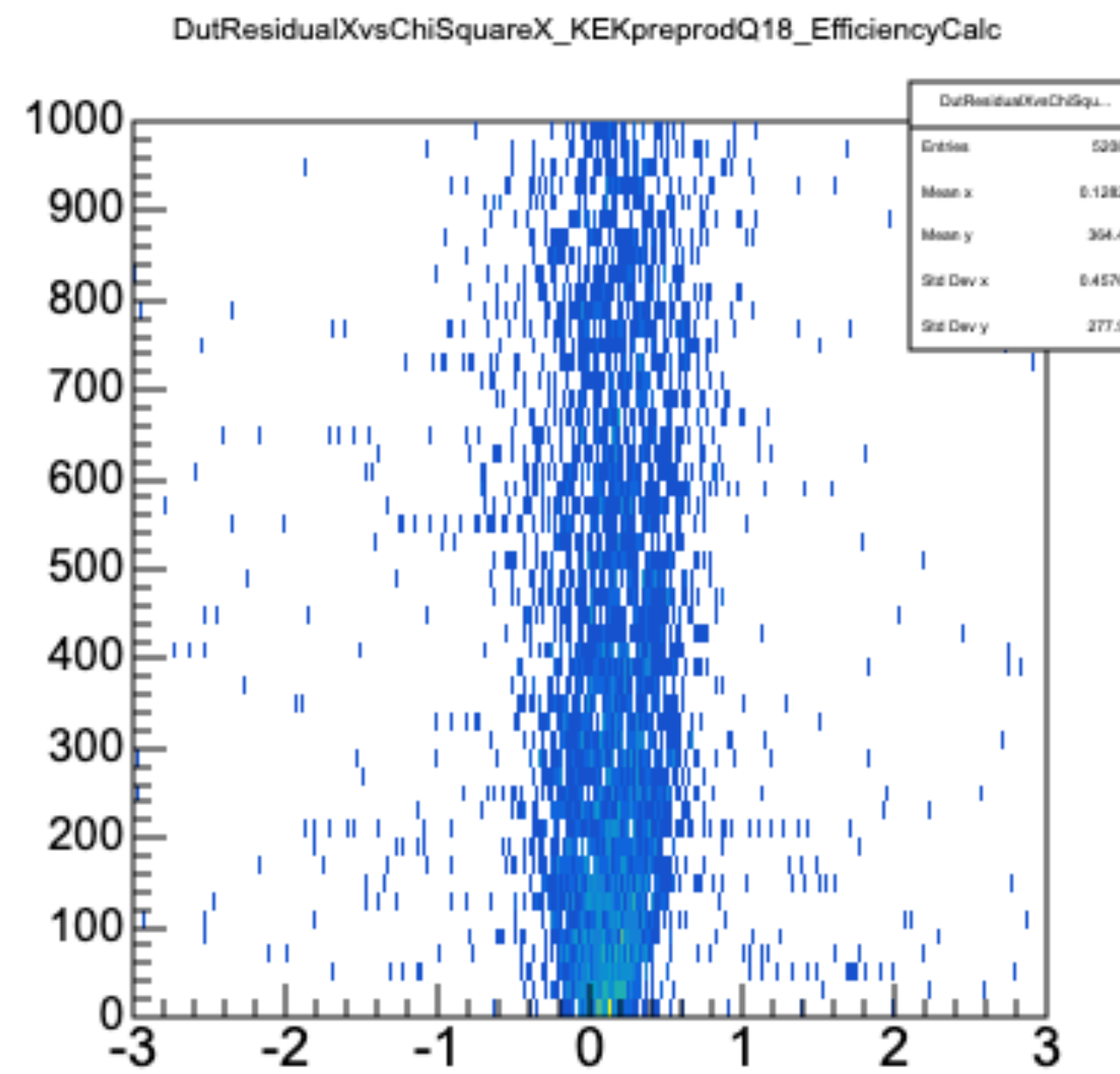
TrackChisq3D_TrackHitMaker



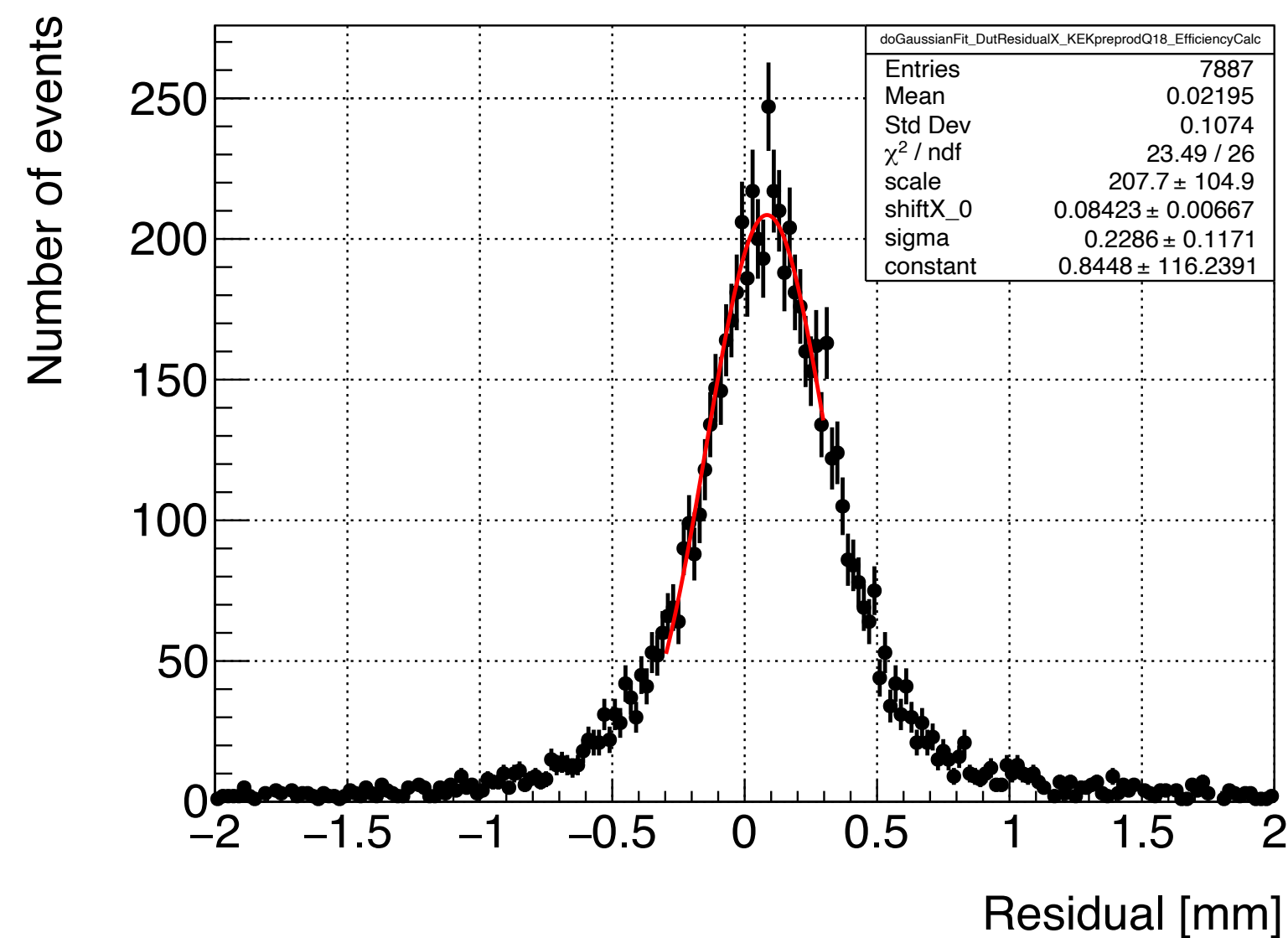
- いうてresidual cut
0.05mmのやつだし...



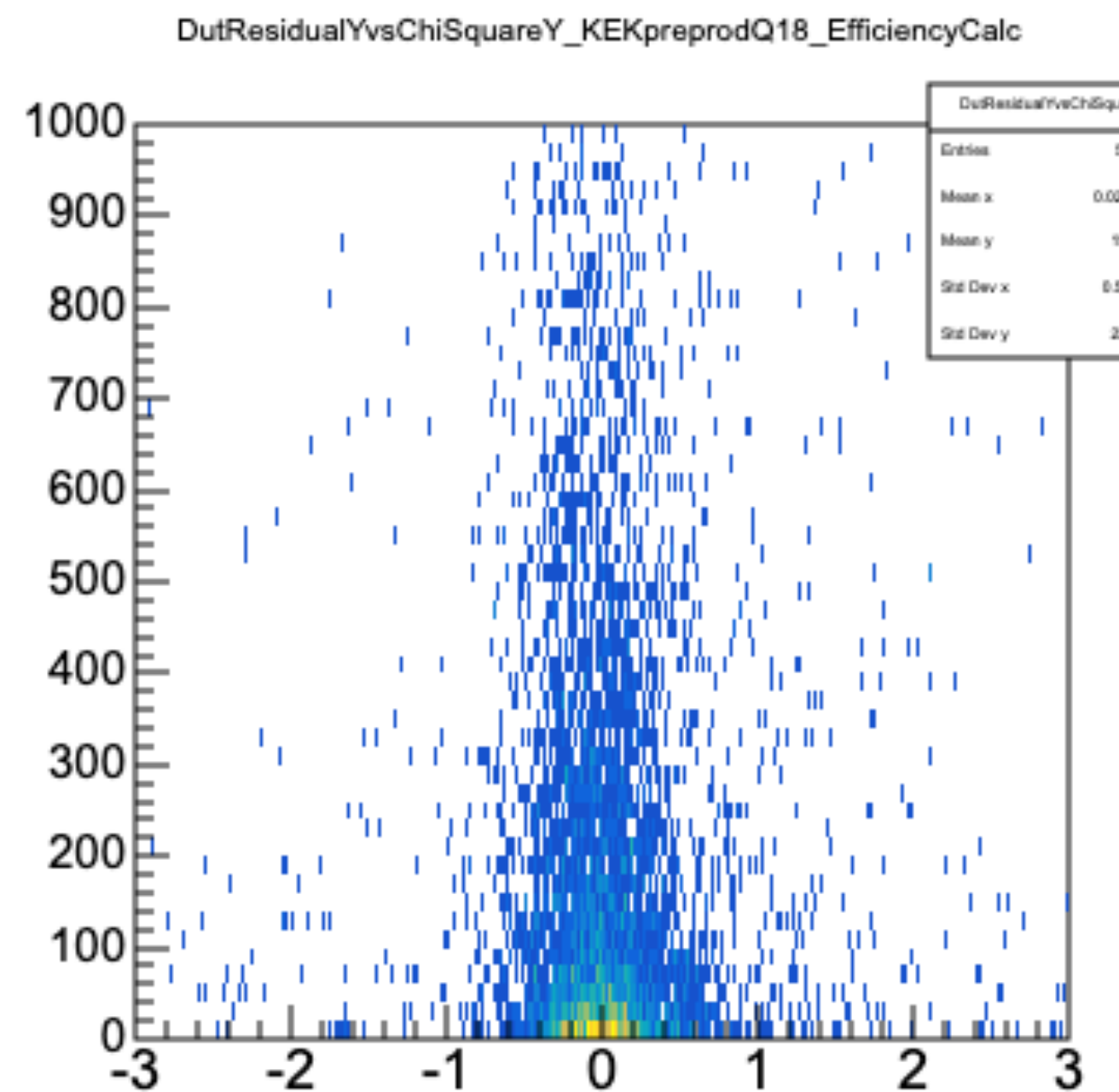
Residual X



- x,yともに residualが $\sigma \sim 0.5$ mm くらい



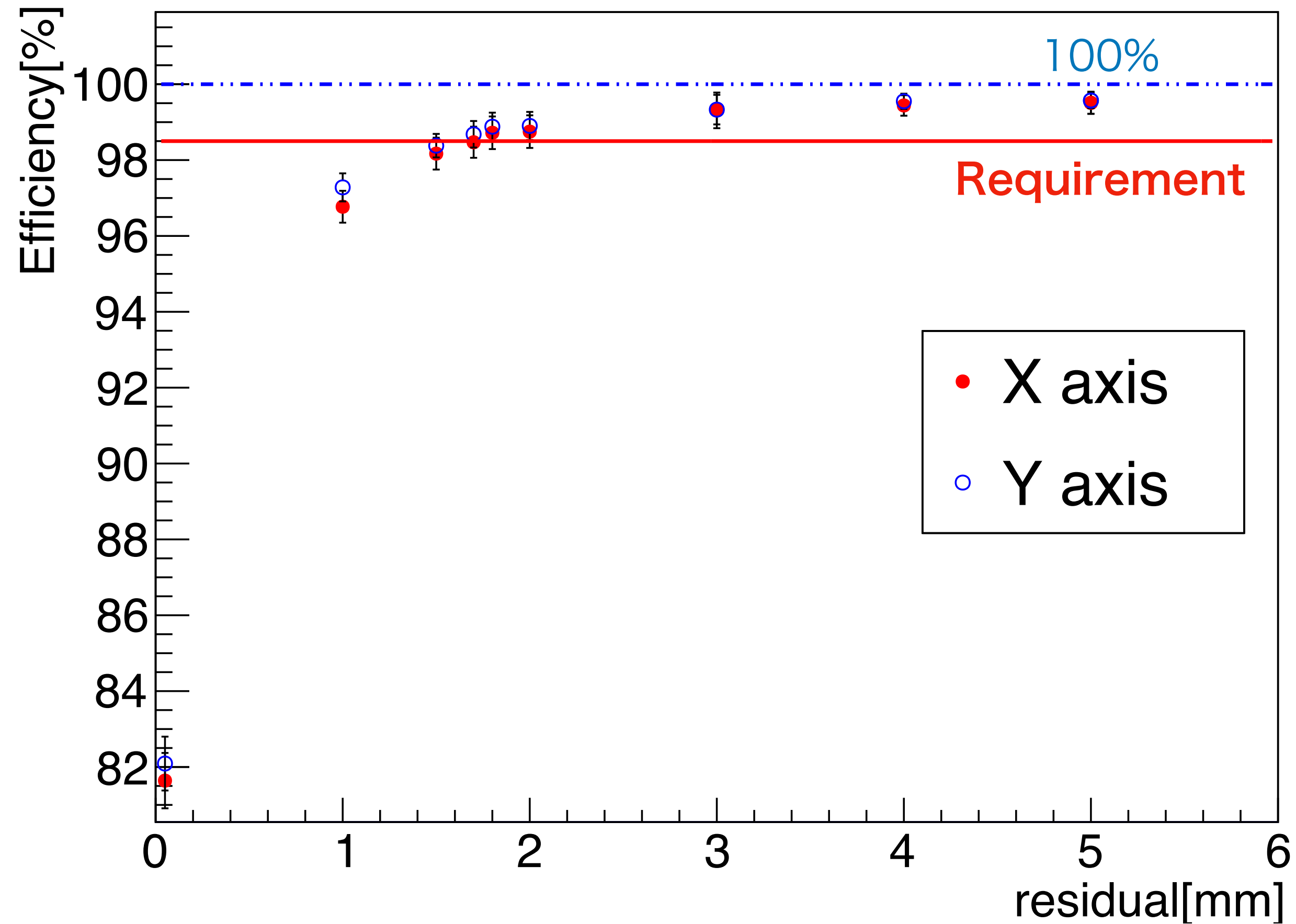
Residual Y



- ARTBだとそんなもん?

ARTB Efficiency導出

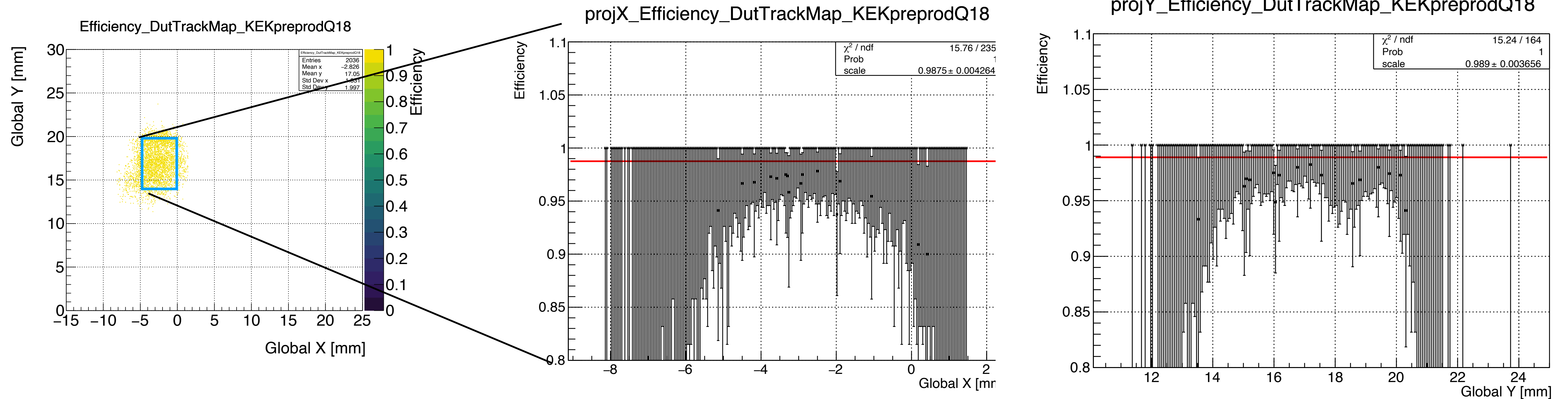
Residual vs Efficiency



Residual vs Efficiency

- residualを変えながらEfficiency算出
- residual cut ~1.7 mm付近まで要求を満たすEfficiency

Residual Cut 2mm



Efficiency (constant fit)

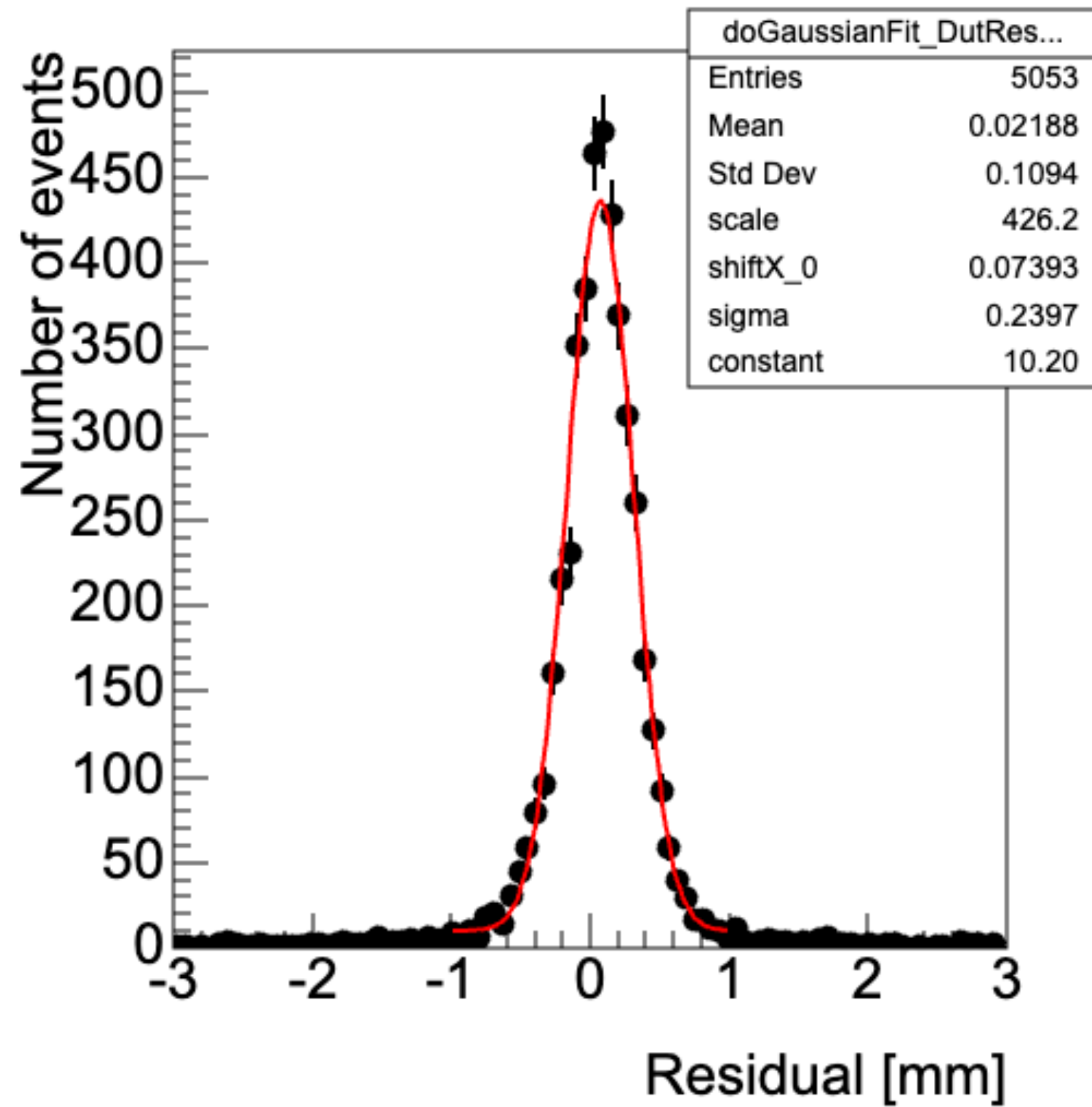
X

$98.75 \pm 0.43 \%$

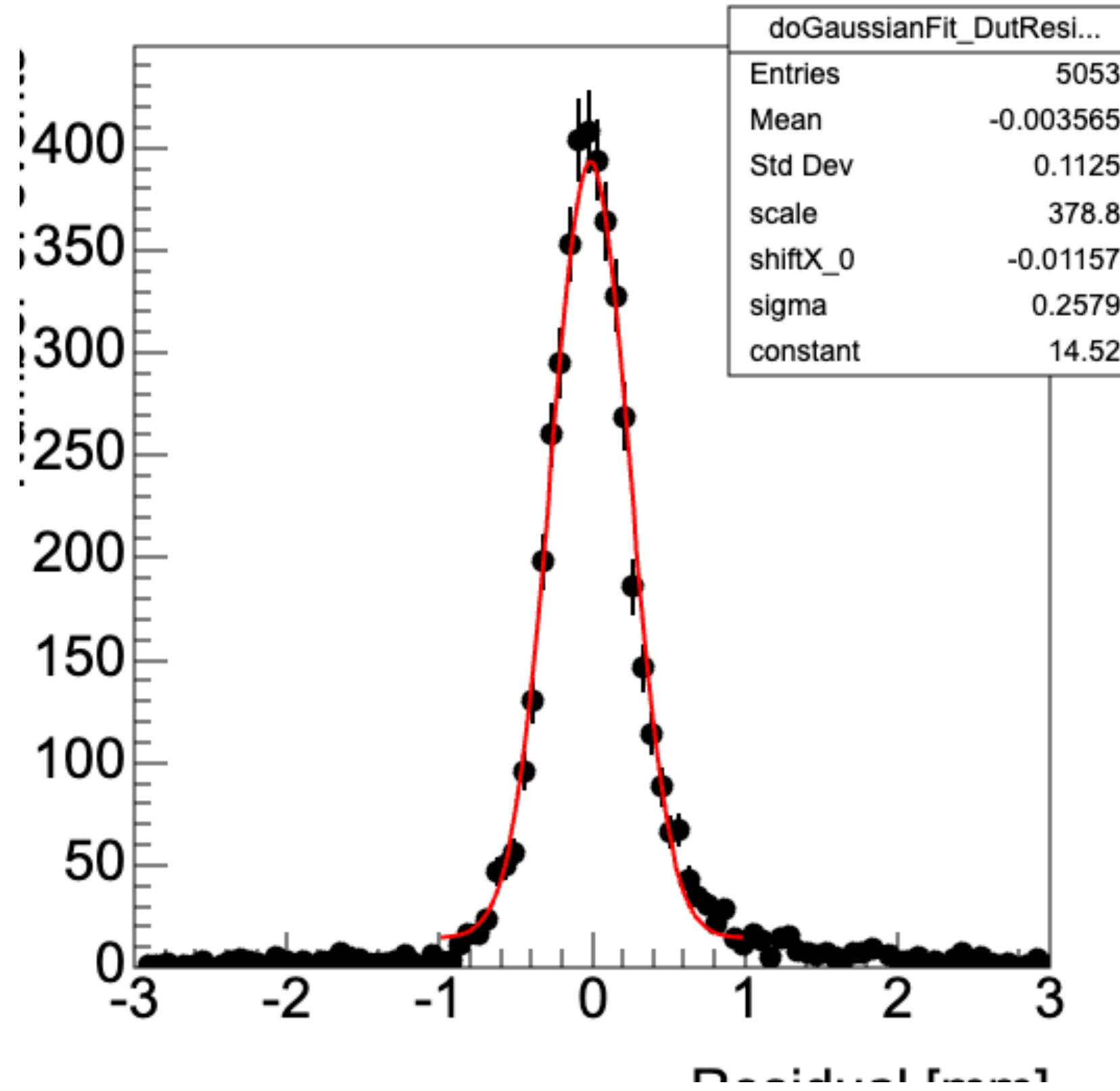
Y

$98.9 \pm 0.37 \%$

- residualCut XY 2mm
- XYともにconst fitでEfficiency > 98.5%



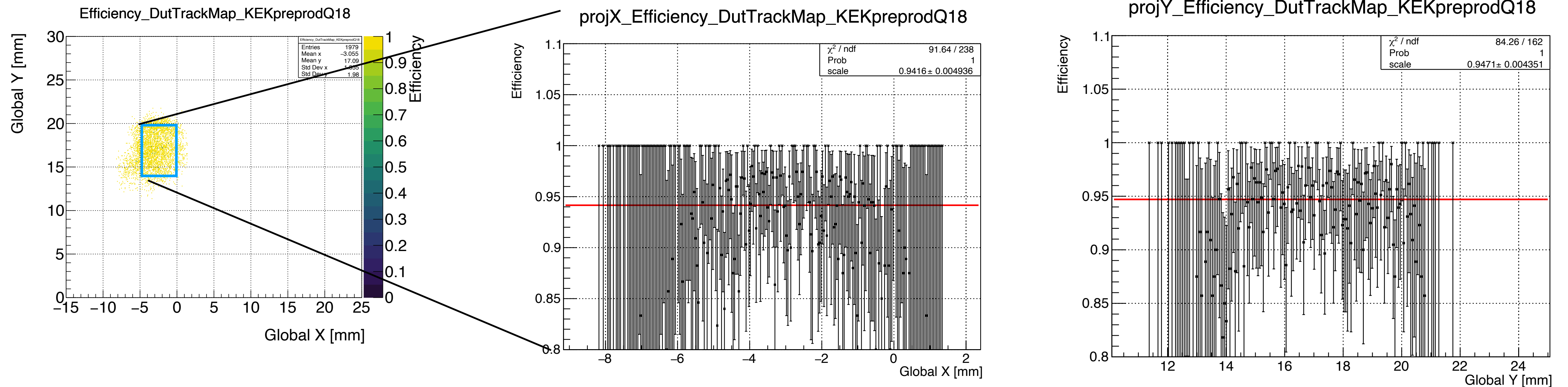
KEKPreprodQ18の残差分布(X)



KEKPreprodQ18の残差分布(Y)

- KEKPreprodQ18のresidual
- $\sigma \sim 250 \text{ um}$
 $3\sigma \sim 750 \text{ um}$
- 3σ Hitの存在
確率99.7%

Residual Cut 0.75mm



- residualCut XY $3\sigma \sim 0.75\text{mm}$
- XYともにconst fitでEfficiency < 98.5%
- 真ん中あたりで低いのはアライメントor 銅のscatteringのせい?

Efficiency (constant fit)	
X	$94.16 \pm 0.49 \%$
Y	$94.71 \pm 0.44 \%$

まとめ

- 2023 6月ARTB のITk Pix Preprod moduleのEfficiency解析
- residualXY Cut 2mm でEfficiency > 98.5% (ATLAS requirement)
- $3\sigma \sim 0.75\text{mm}$ residual Cutでは Efficiency < 98.5%
アライメント or 銅のscattering??
- どこまでやるべき?

rate max = 2.63 kHz, QSF = 7.5

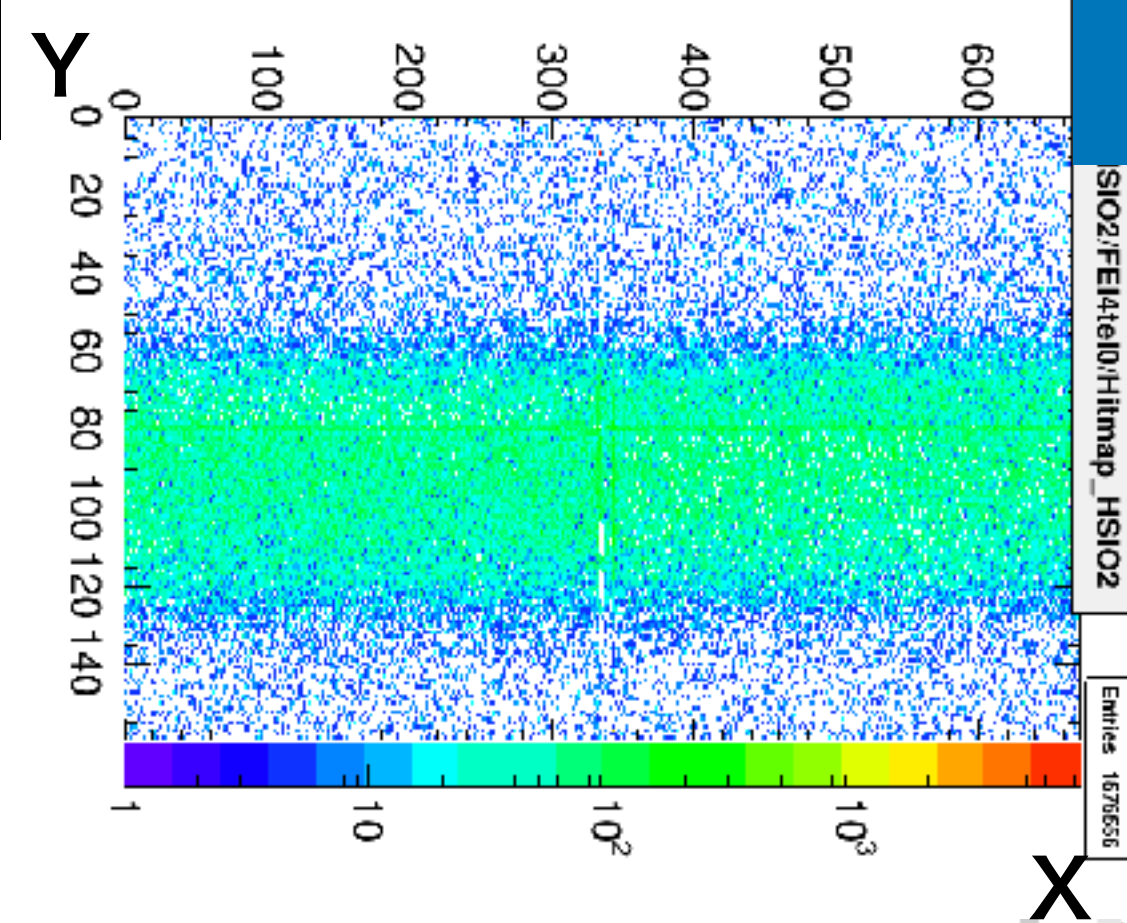
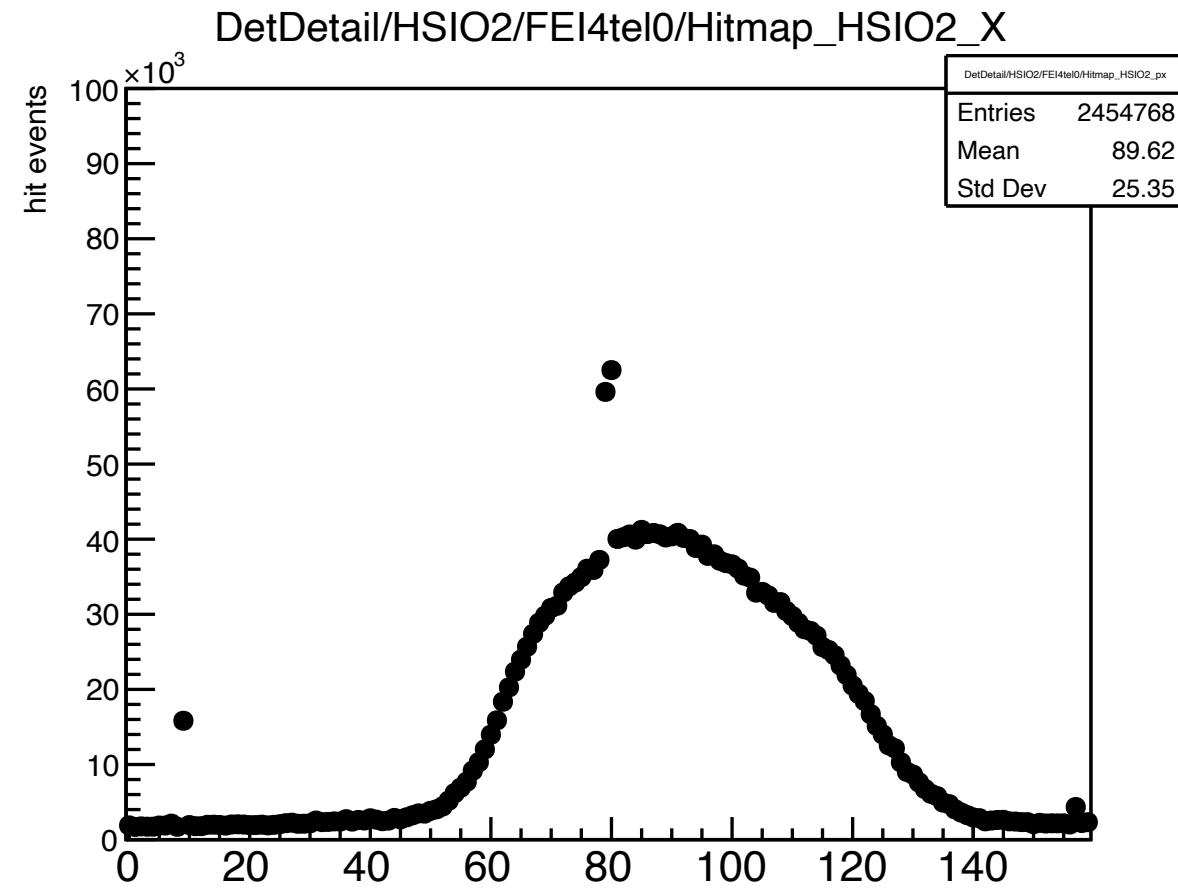
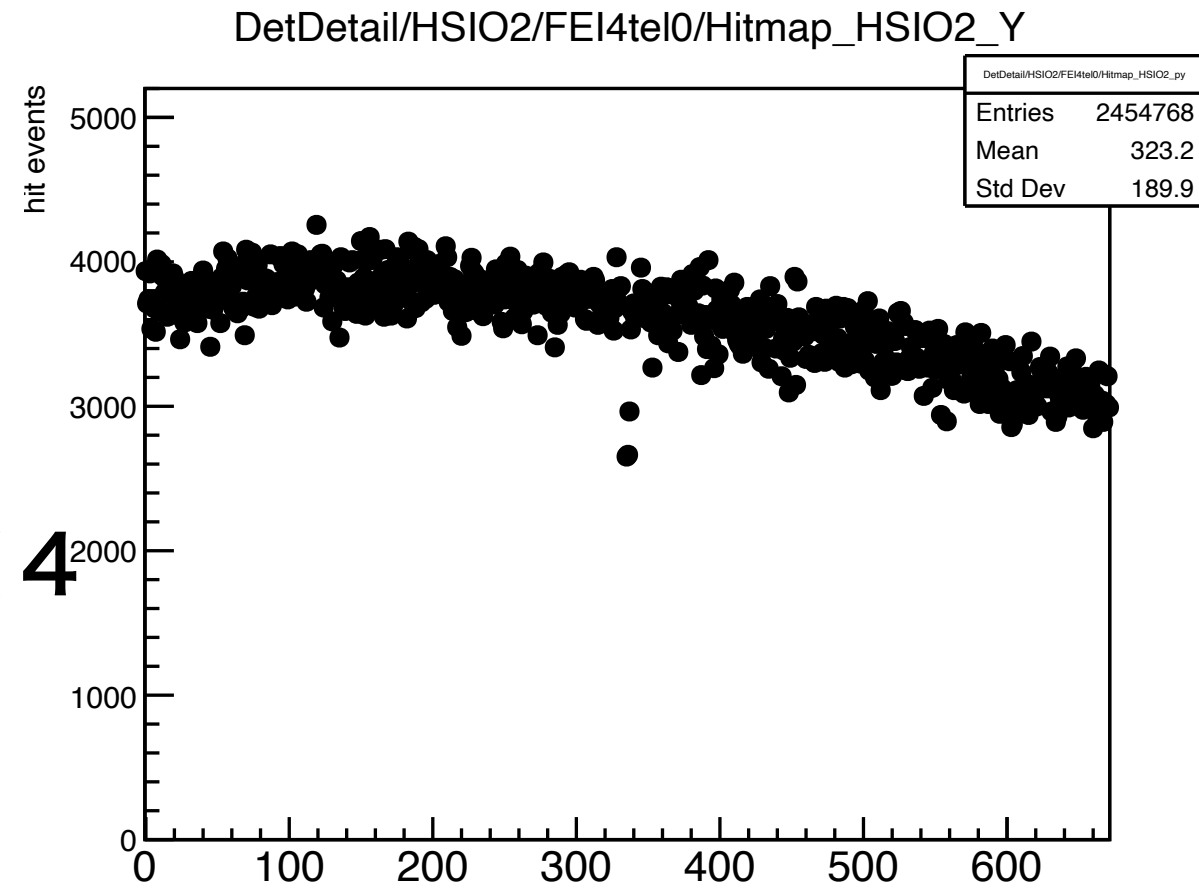
X

Y

rate(kHz)	2.63
QRF[A]	25
QRD[A]	0
QSF[A]	7.5
QSD[A]	15.08

上流

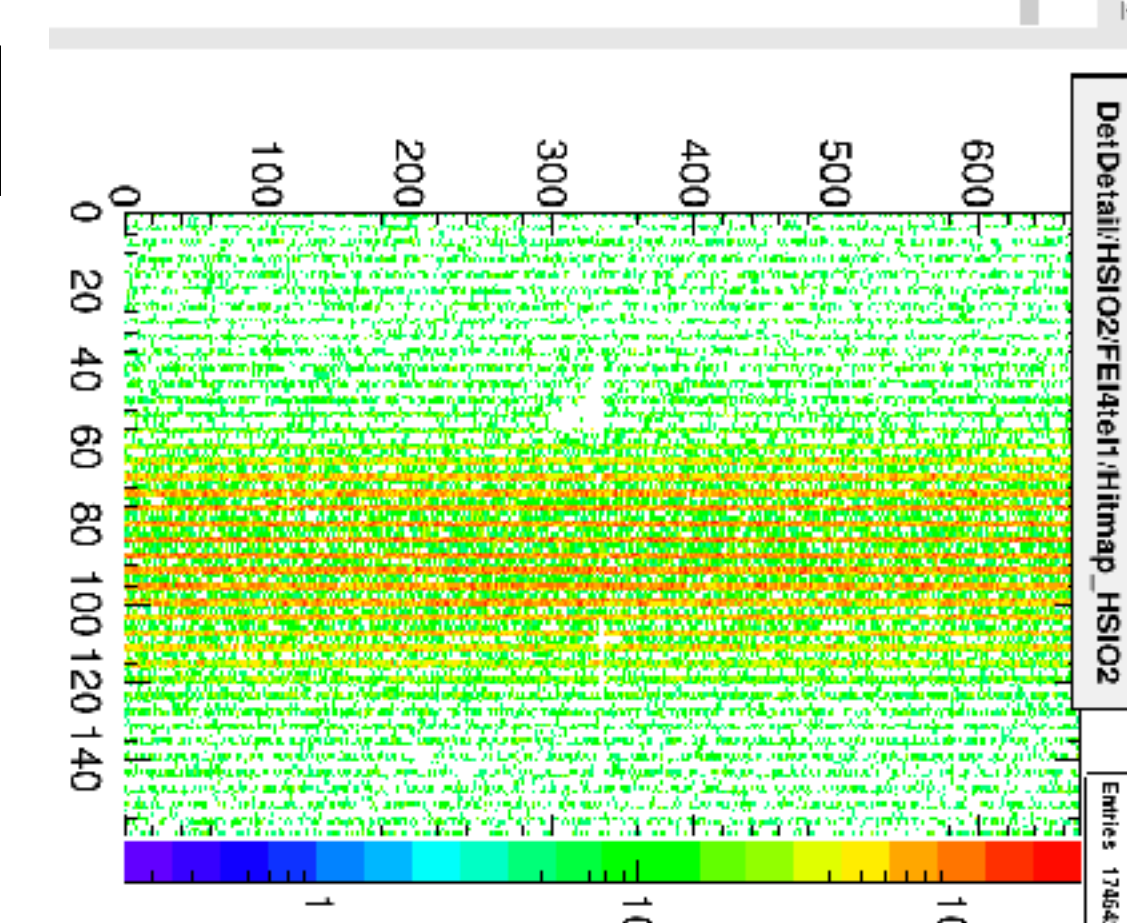
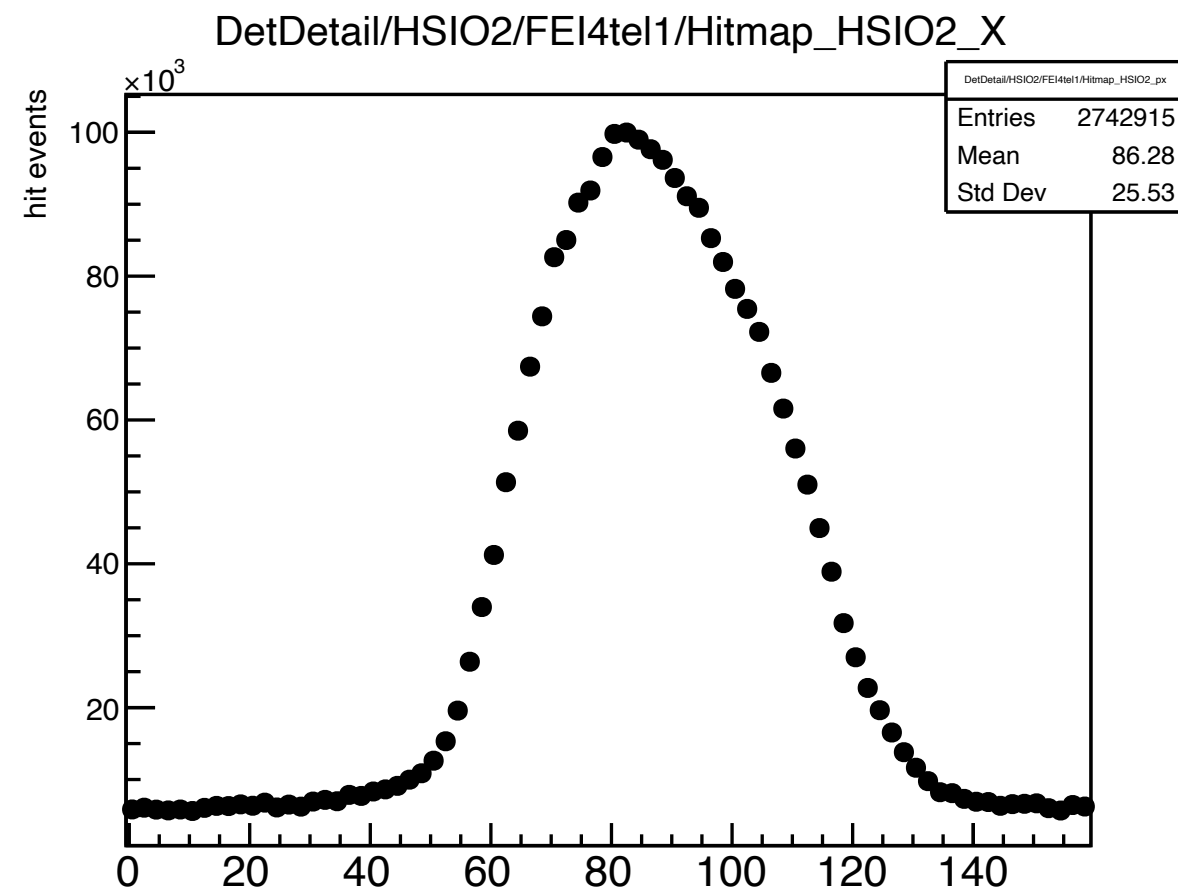
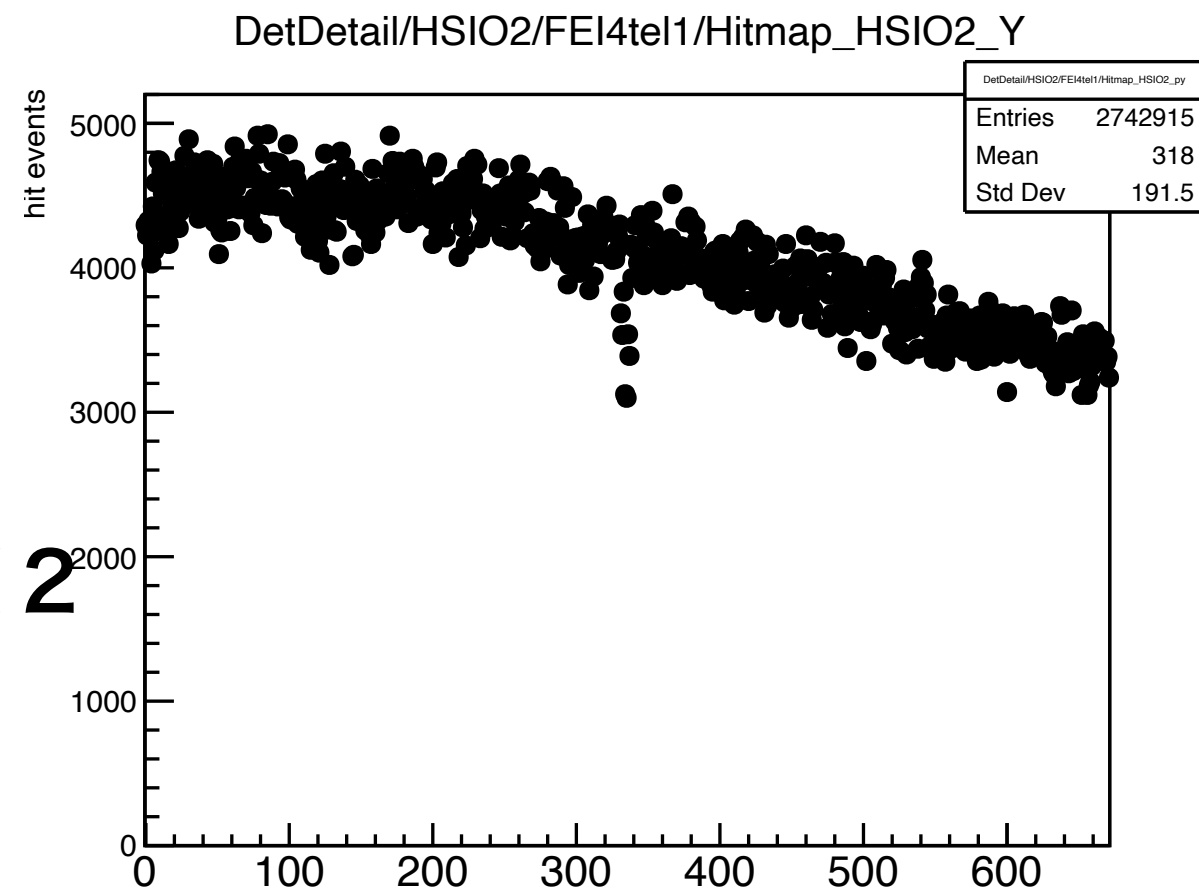
KEK114



QSFを小さくしていくと
Y方向の対称性がY=0(上
方向)にズれていく

下流

KEK112



X方向のfocusを緩めた
ためx方向のビームの
ピークが緩くなった