TOTEM
Preliminary Physics Results

LPCC
6 Aug 2010

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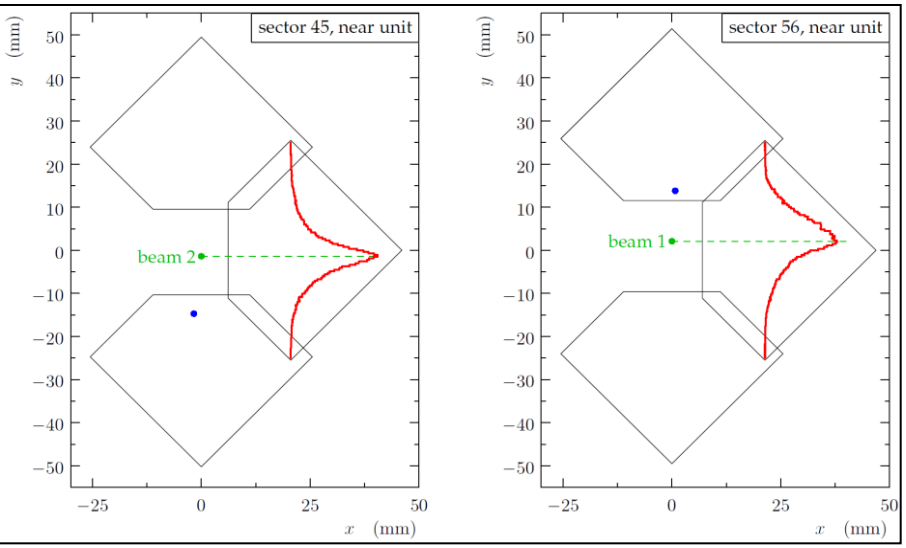
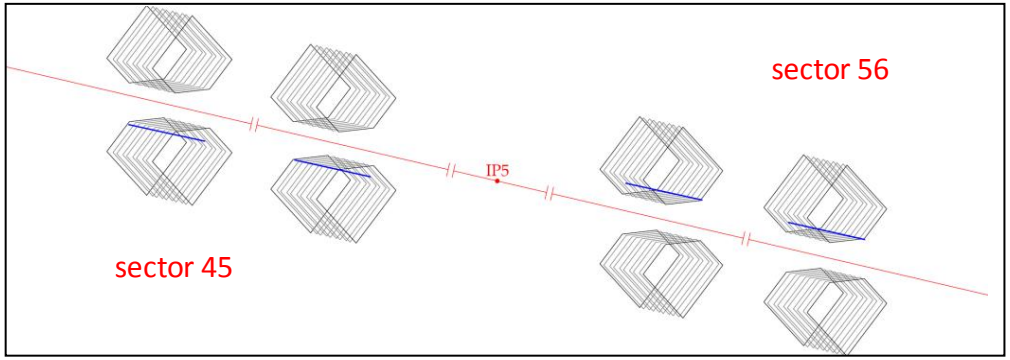
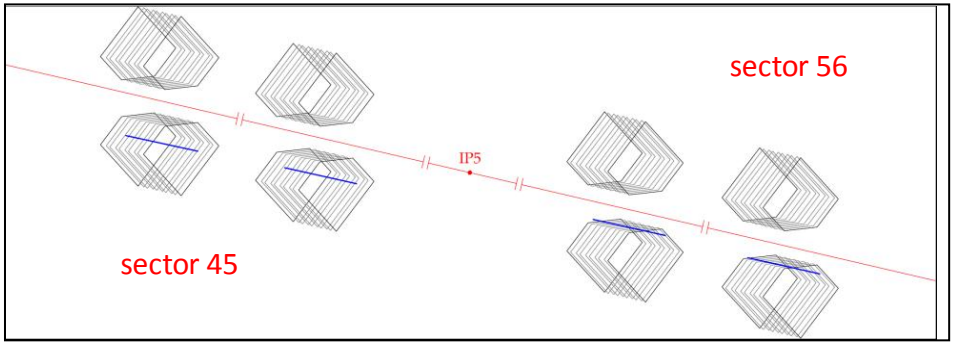
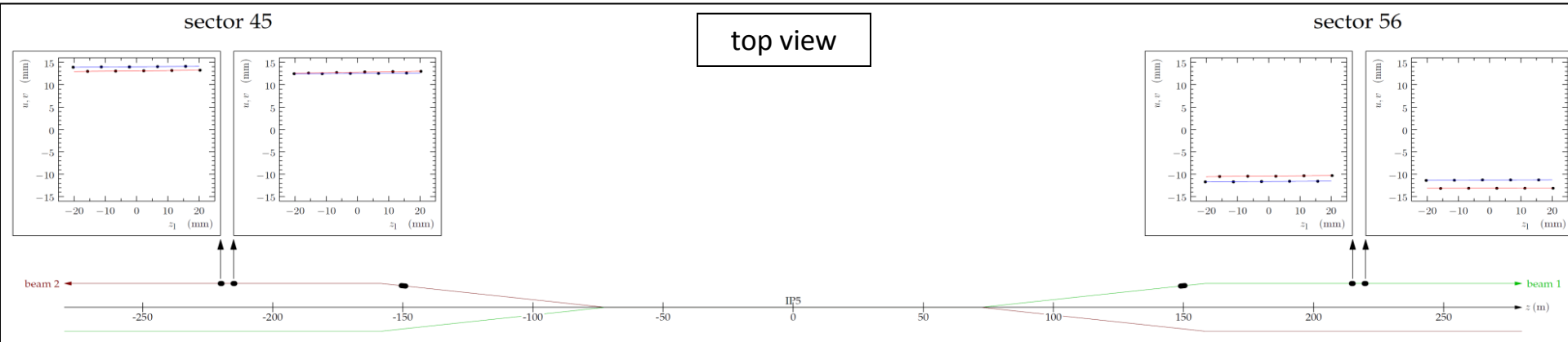
on behalf of the TOTEM Collaboration

RP menu: candidate pp elastic scattering events, single diffraction and DPE



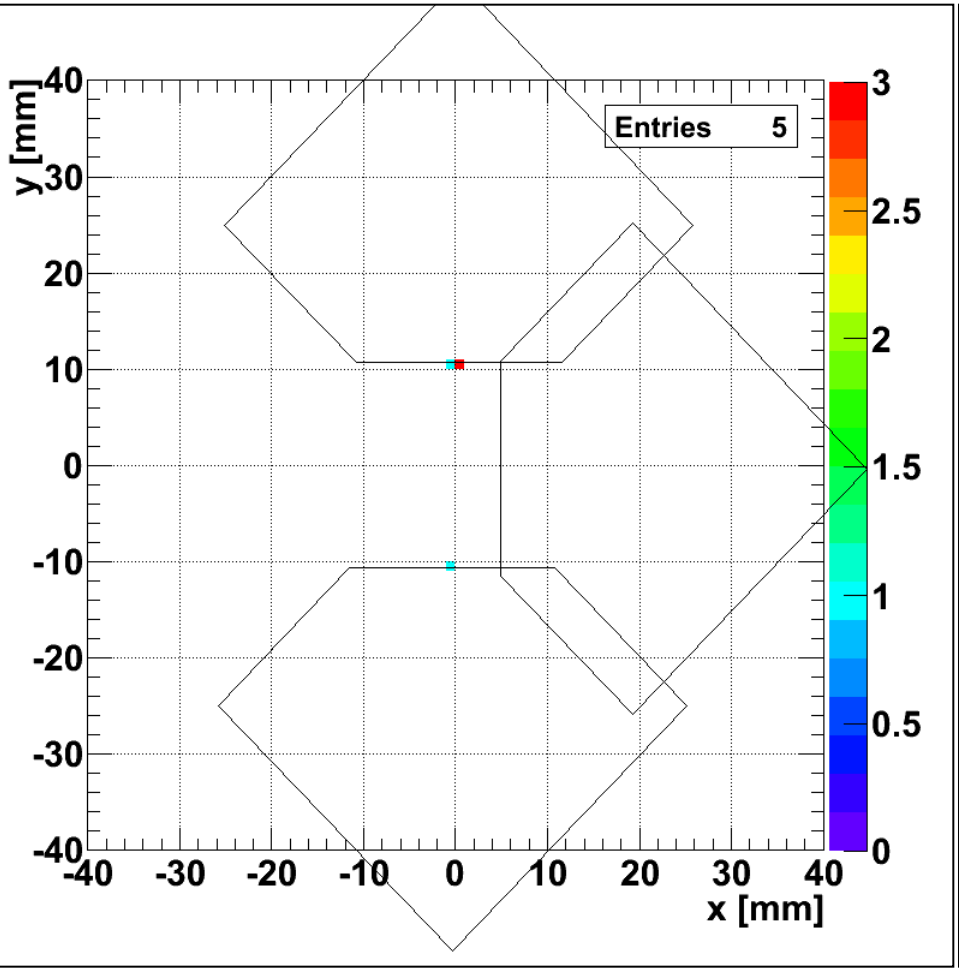




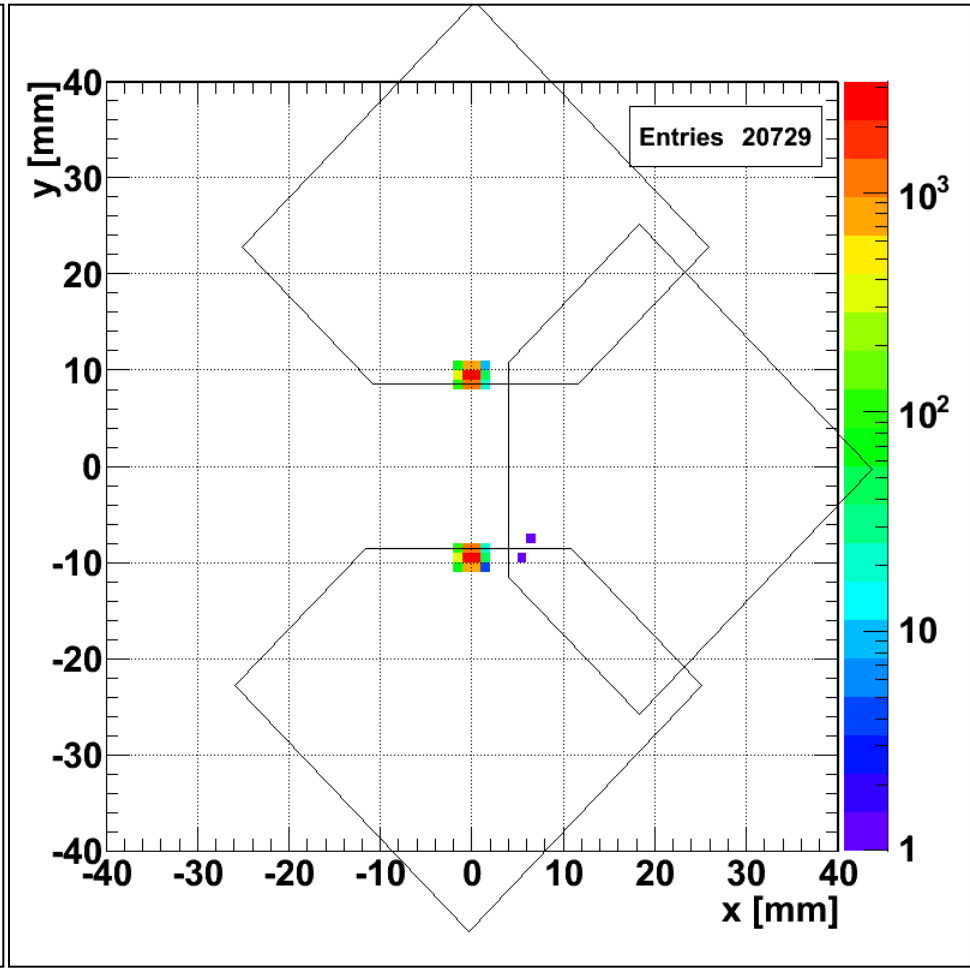


MC acceptance: pp elastic

@ 25σ



@ 20σ



y=10mm -> $|t_y|$ = 2.8 GeV^2 y=13mm -> $|t_y|$ = 4.7 GeV^2 $dt_y/dy \approx 0.6 GeV^2/mm$

LHC data 7 TeV

First set of Runs: RPs position at 25 σ from beam center

Total events processed: 1.8 M

Trigger: proton in vertical RPs

Integrated luminosity: 1.5 nb^{-1}

Event selection:
coincidence of single protons on both arms of IP5 and both RP units on each arm >>> 756 events.

Accelerator+Detector systematics

- Mis-Alignment of detector elements
- Beam position and beam divergence
- Background from other physics channels
  and from machine (halo, beam gas)

Full set of systematics sources under investigation.

Preliminary:
Beam/Alignments ≈ 1mm ; Optics/Transport ≈ 1mm ($\sigma_{Ly} \leq 10\%$)

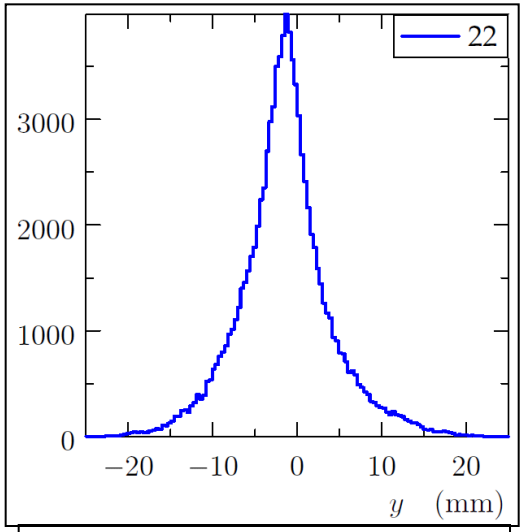
Vertical RPs - beam: Y alignment

Method based on vertical profile of diffractive peak on horizontal RPs
(and tracks in the overlaps for the detectors' relative alignment).

Nominal beam position at 25σ = 10.6 mm on average :

4,5 top far	4,5 top near	5,6 top near	5,6 top far
11.5 mm	11.2 mm	8.2 mm	9.0 mm
25.9 σ	26.3 σ	19.2 σ	20.4 σ
4,5 bot far	**4,5 bot near**	**5,6 bot near**	**5,6 bot far**
-10.0 mm	-9.8 mm	-12.4 mm	-13.9 mm
22.6 σ	23.1 σ	29.0 σ	31.4 σ

Systematics: ≈ 1mm ≈ 2.3σ

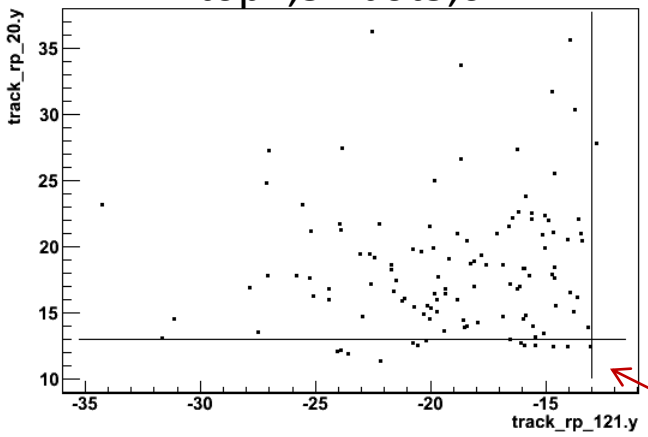


Example of diffractive peak in a horiz. RP unit

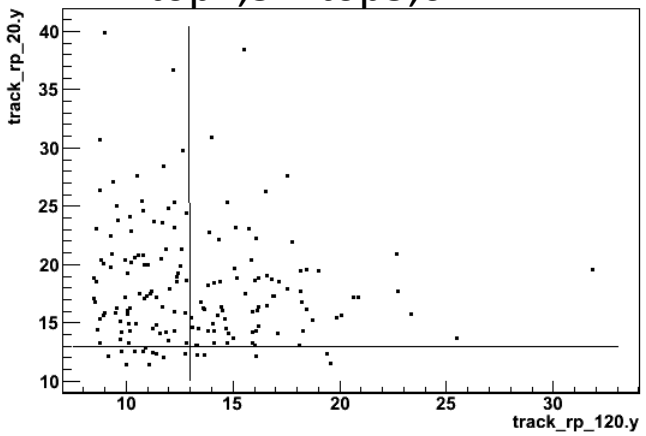
The diagonal from 4,5 bottom to 5,6 top has elastic scattering acceptance at about 20σ from the beam.

pp events sample: arms 4,5 .AND. 5,6

top4,5 bot5,6

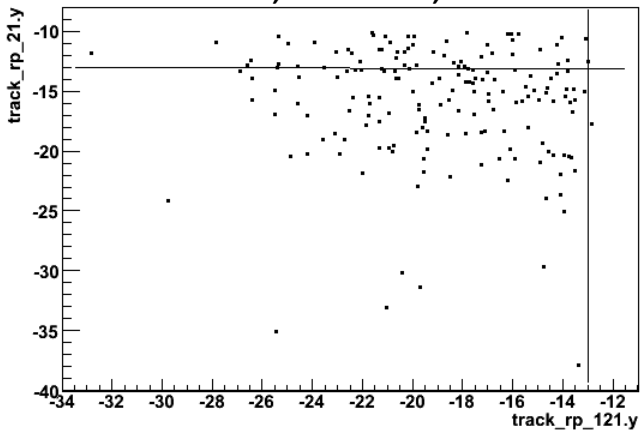


top4,5 top5,6

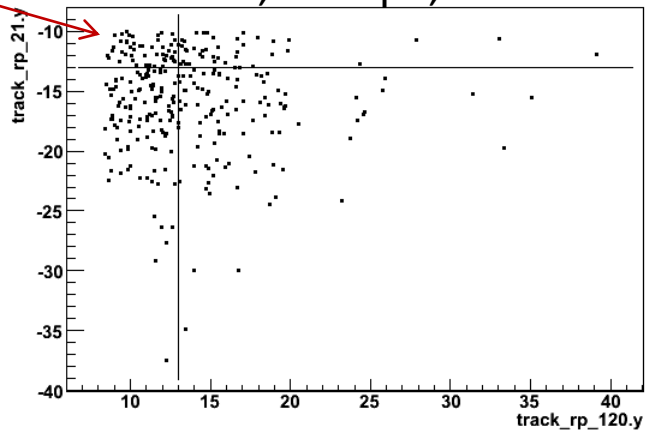


Elastic acceptance

bot4,5 bot5,6



bot4,5 top5,6



MC acceptance limit: 11mm ; systematics: 2mm

Rates, elastic, halo, DPE, beam-gas…

Under study:
background from DPE (running MC to evaluate acceptance) and halo (computing rates from no-colliding settings).

Halo example:
beam halo particles ($\theta_x=\theta_y=0$, $\xi=0$) transported to RP220 station:

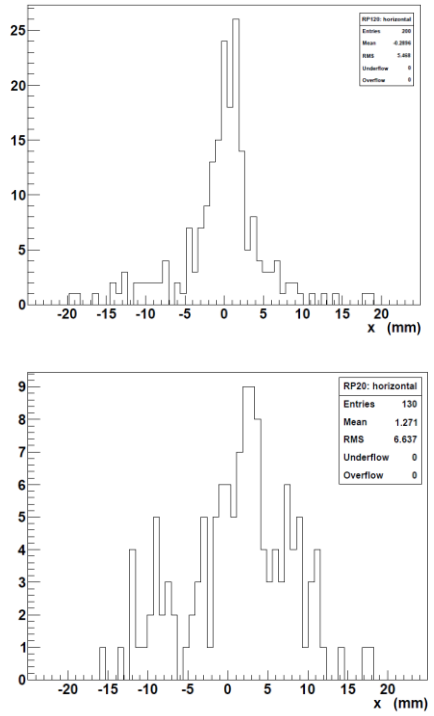
Vertex (x,y)@IP5 -> (x,y)@RP220 [mm,mm]
(3, 0) -> (9.3, 0)
(5,0) -> (-15.5, 0)
(0, 3) -> (0, -12.9)
(0, 5) -> (0, -21.5)

Pairs of halo protons in coincidence at ≥ 30σ @IP5 can reach the RPs at the large y values.

Rates, efficiency and combined probabilities under investigation.

Vertical RPs - beam: X alignment

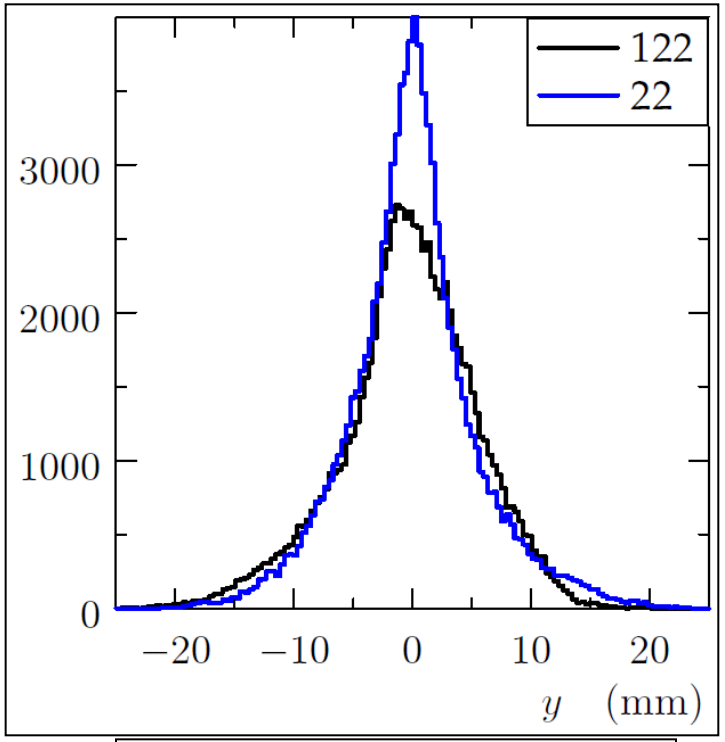
Method based on horizontal beam position determination via not-colliding bunches.

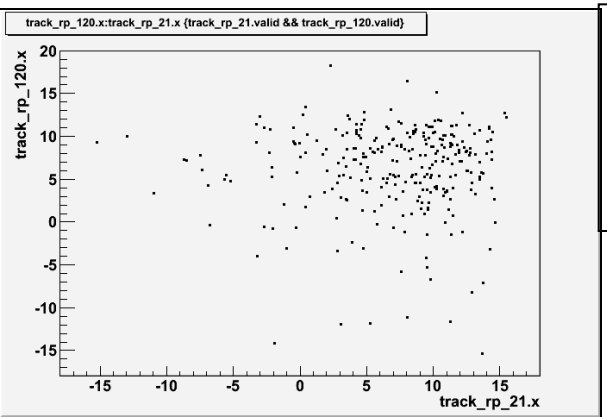


5,6:
near = +0.3 mm
far = +0.8 mm
ave = +0.5 mm

4,5:
near = 2.8 < x < 4.2 mm
far = +2.6 mm
ave = +3 mm

Systematics: ≈ 1mm



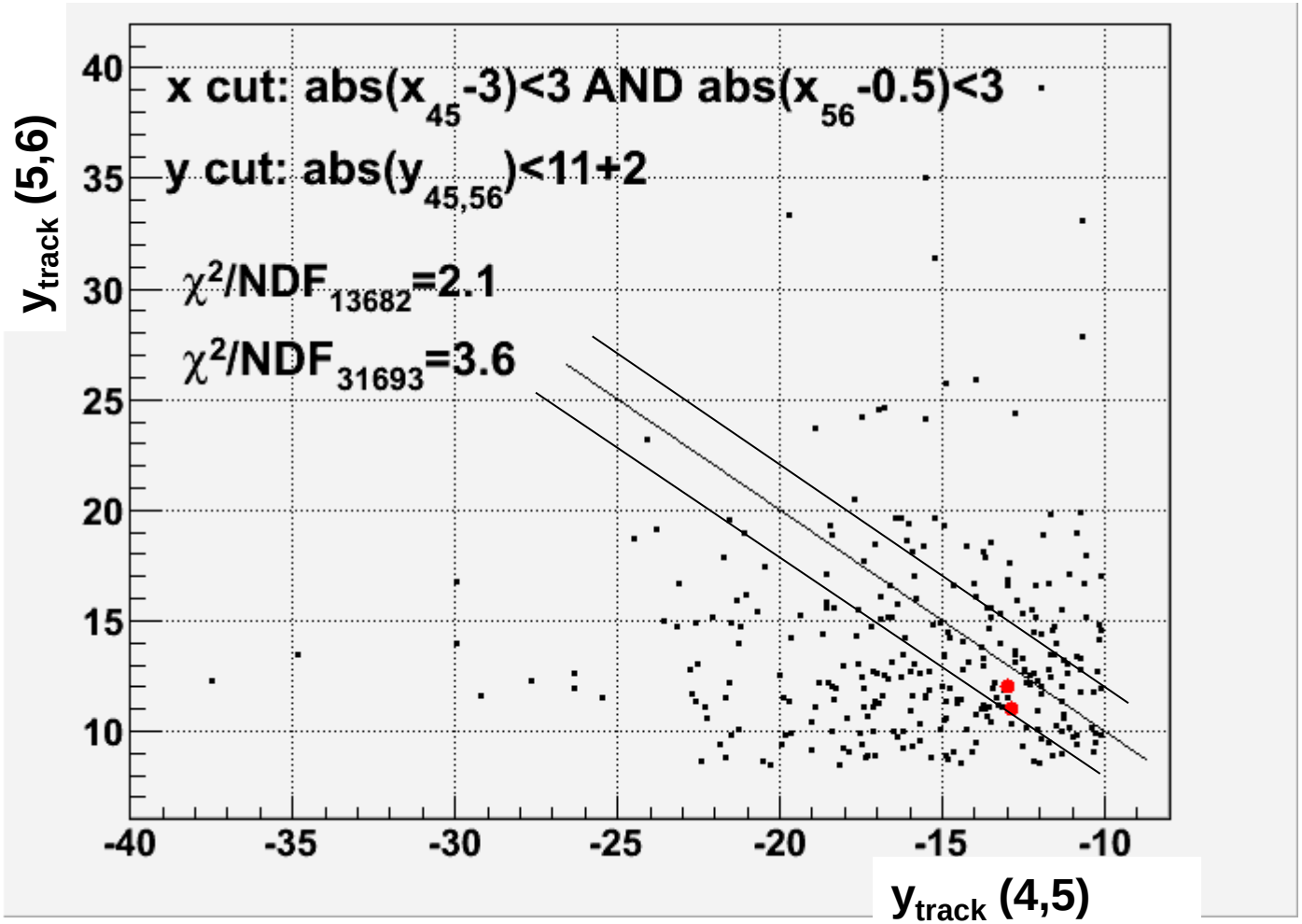


Bot4,5 vs. Top5,6 x distribution with colliding bunches:
diffractive peak displaced in x due to geometry and chromaticity.

Check: diffractive peaks in horizontal pots at 4,5 and 5,6 have different integral and peak height.

Correction applied before cut distributions in X:
≈2mm width ; ≈1mm systematics

Geometry+Optics constraint at RPs

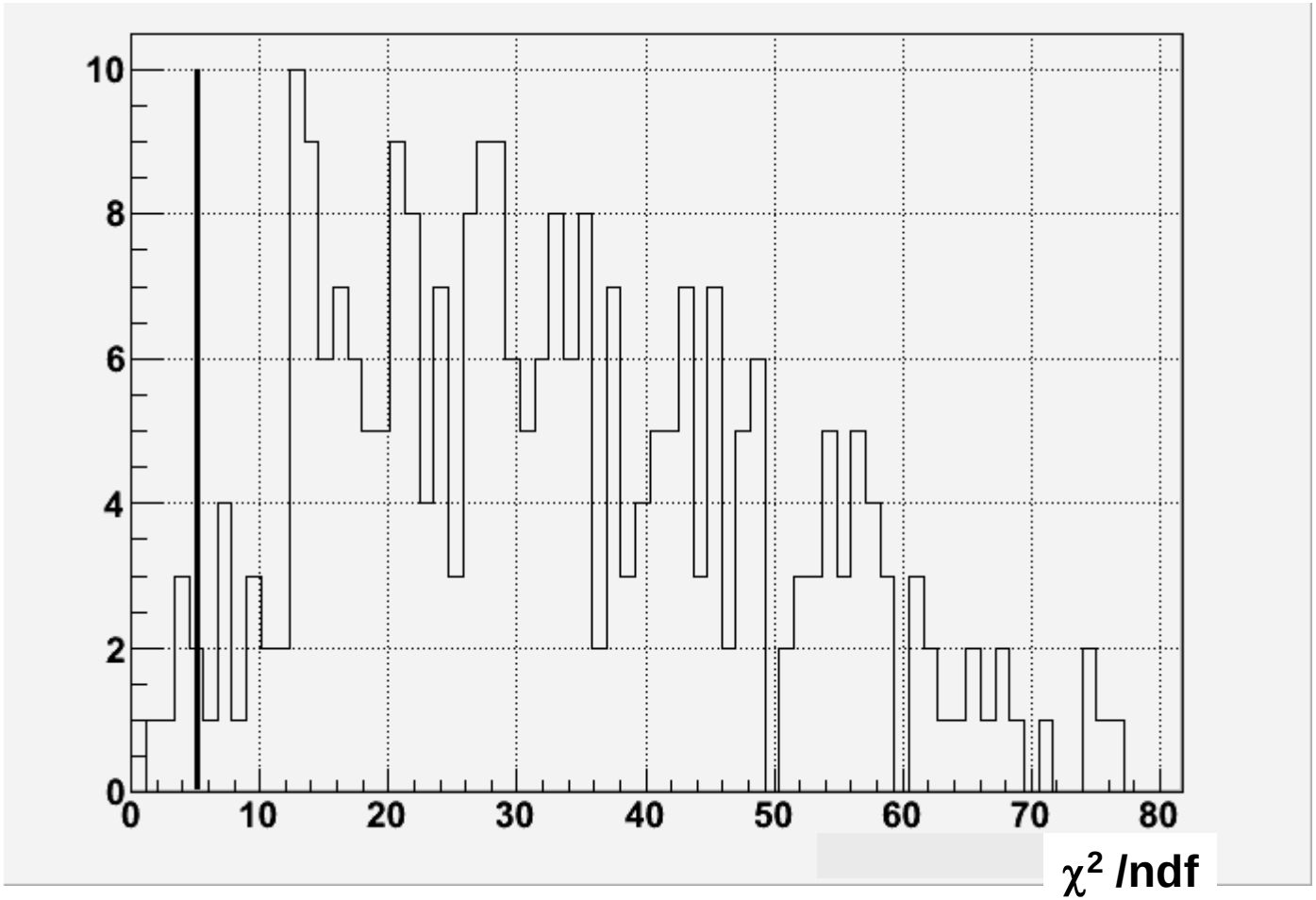


Acceptance (geometry+optics) test passed.

Fit Elastic Scattering

Event 13682
χ^2/ndf = 2.1

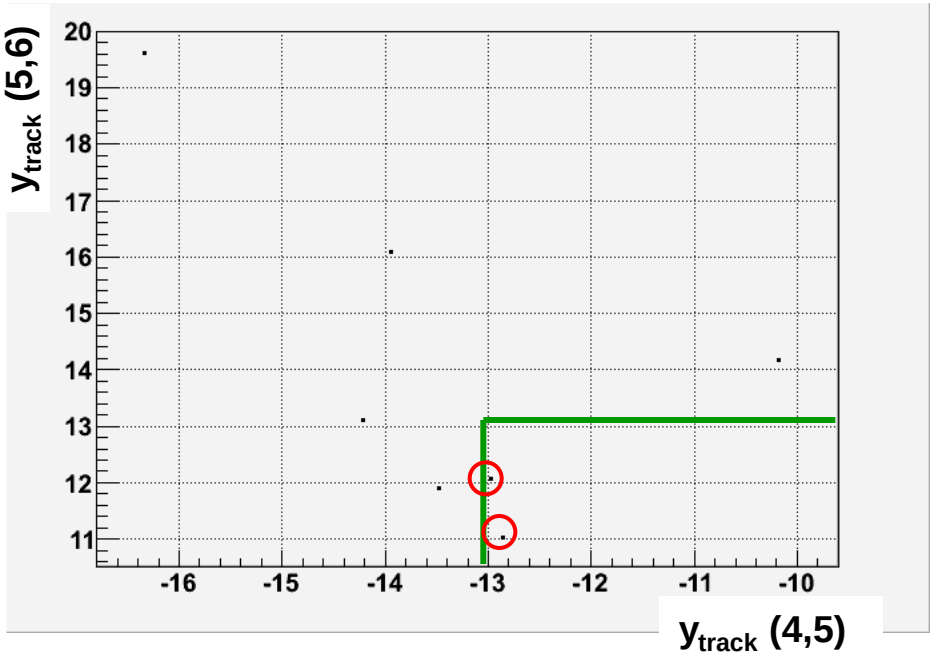
Event 31693
χ^2/ndf = 3.6

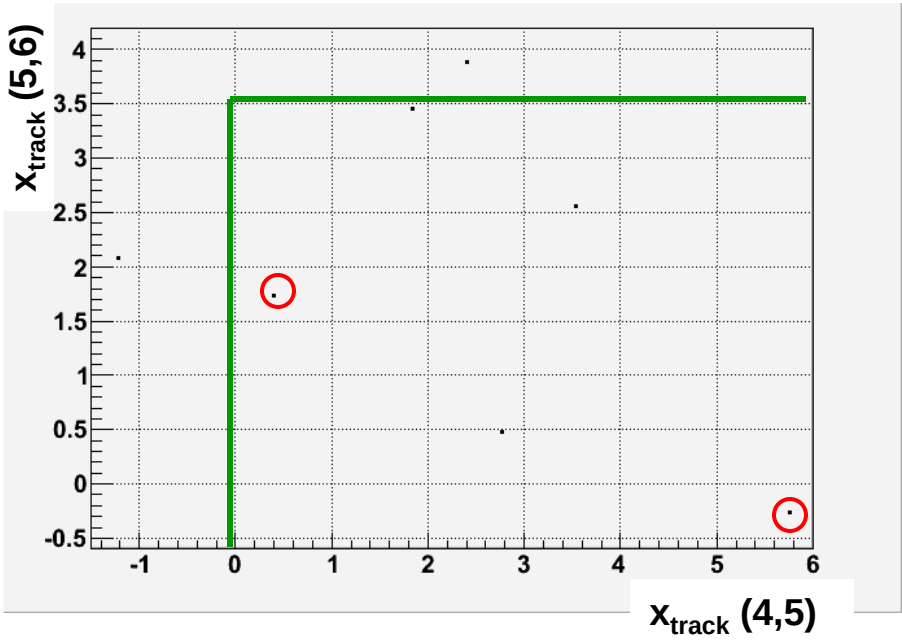


Kinematics test passed.

Cross-check

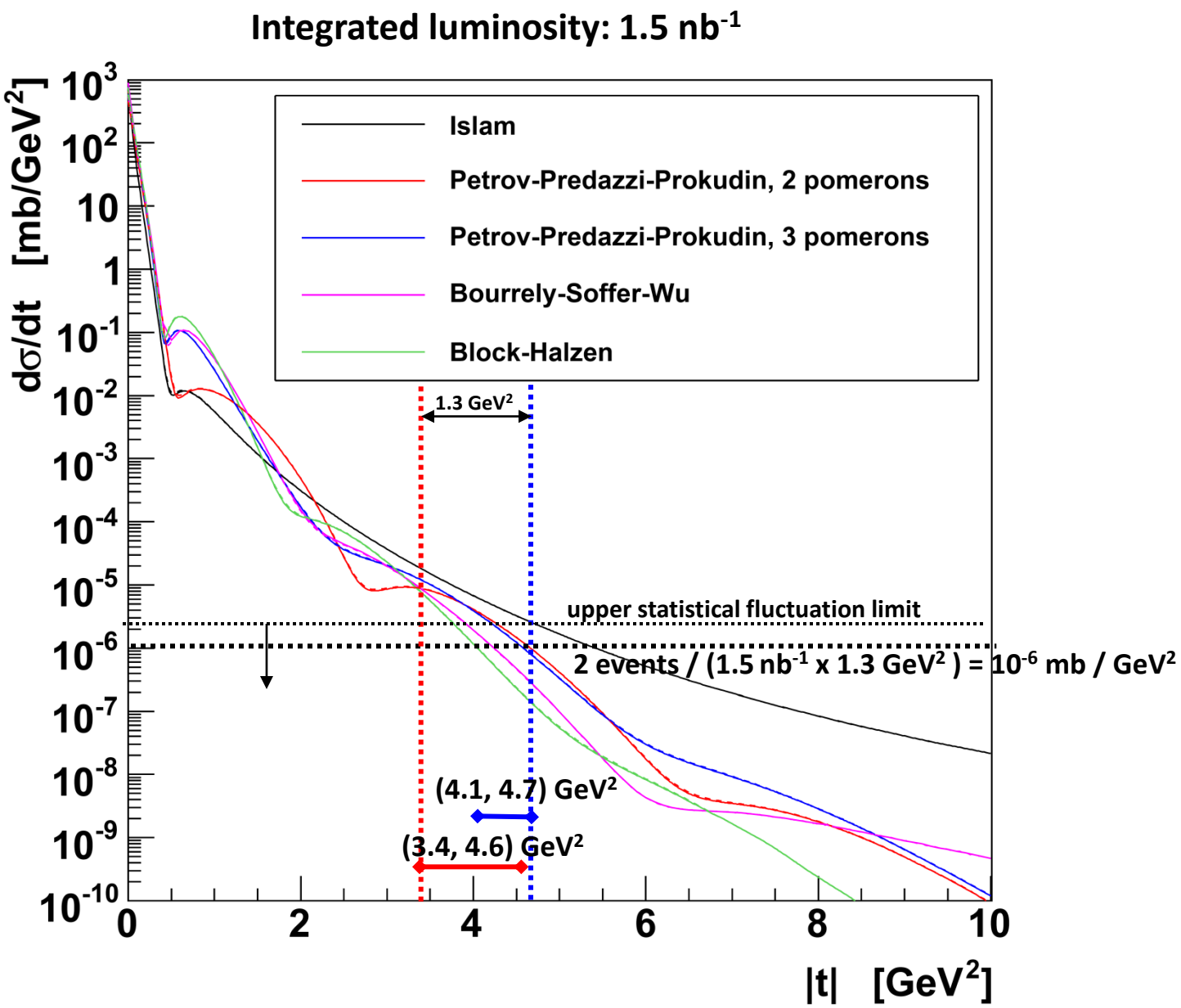
acceptance test for all candidates that passed the χ^2 test





Except the two identified candidates, the other events with good kinematic matching fail the acceptance test in X and/or Y.

Reconstructed t – Elastic cross-section



TOTEM : 2 candidate elastic pp scattering events found within an integrated luminosity of 1.5 nb^{-1} in a $|t|$ [$= p^2\theta^2$] range of a few GeV^2

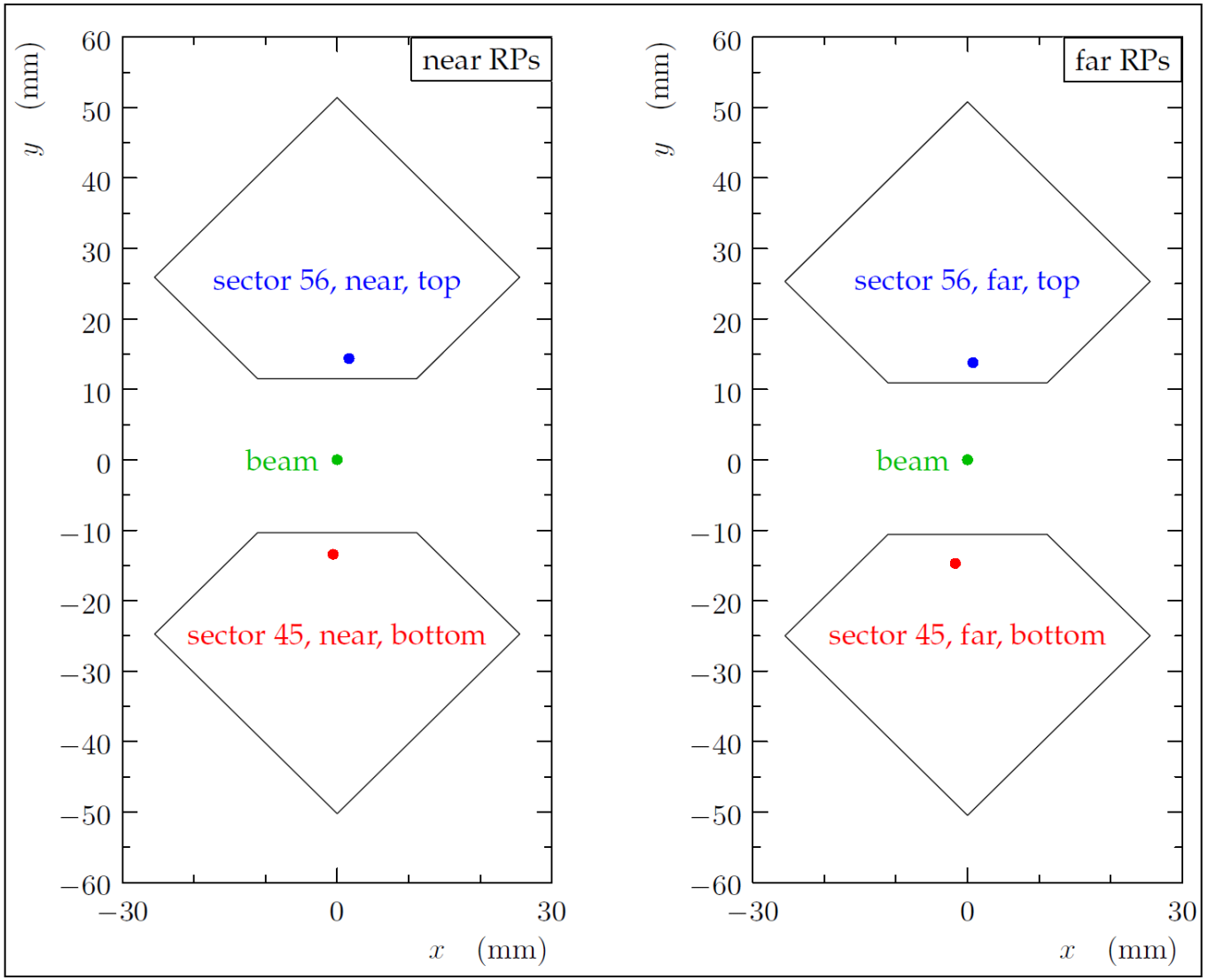
Next...

Accumulate statistics: factor 100 (taking into account dedicated coincidence trigger).

Move RPs to 20 nominal σ from the beam.

pp elastic scattering event candidate

Run 1964_004 Event 13682



T2

Track $dN_{ch}/d\eta$ (statistical error only)