Preliminary quad test beam results

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Lepcol meeting

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Data from setup

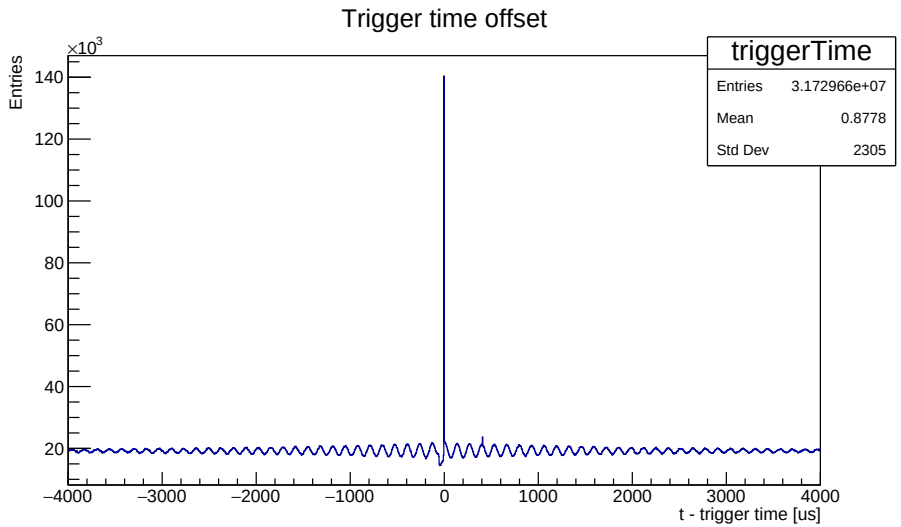
Registered data:

- Trigger time and trigger number
- Hit time, ToT, row, col (for all 4 chips)
- Telescope frame number, trigger numbers, row, col (for all 6 planes)
- Temperature, pressure, Oxygen concentration, relative humidity

Most of plot from run 627 with old quad (quad 3)

- $V_{\text{drift}} = 280\,\text{V/cm}$, which is not at maximum drift velocity because of oxygen concentration around 4000 ppm
- $V_{\text{Grid}} = 300\,\text{V}$, set lower to solve problems with the limited link speed
- Threshold at ∼650 e (65 DAC counts above noise)

Time matching of telescope and Timepix3



- Timepix3 and telescope are both in data driven mode
- Each telescope frame (115.2 μs) can have a range of triggers
- Decode trigger number in Timepix3 using rising edge only
- Save Timepix3 tracks in a ± 500 ns window around a trigger

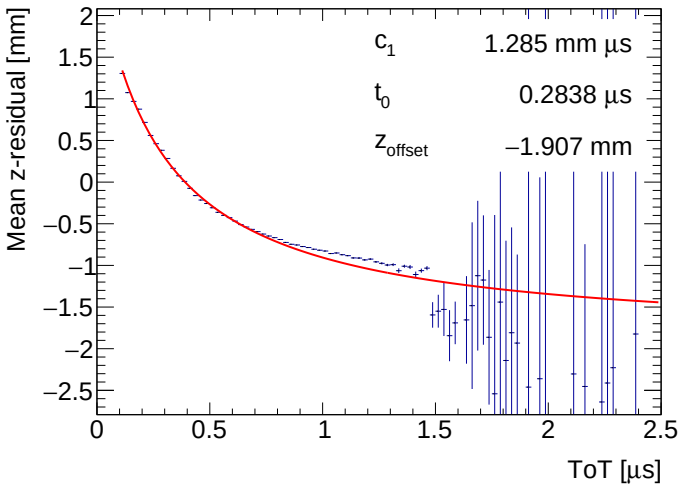
Look for additional hits up to $4 \times 409.6\,\mu s$ later
For each frame, attempt to match all events of the Timepix3 with triggers in the range

Selection

Selection
$-500\,\text{ns} < t_{\text{hit}} - t_{\text{trigger}} < 500\,\text{ns}$
Hit ToT $> 0.10\,\mu\text{s}$
Reject outliers ($r_x < 1.5\,\text{mm}, r_z < 3\,\text{mm}$)
$N_{\text{hits}} > 20$
$(N_{r_x<1.5\text{mm}} \;/\; N_{r_x<5\text{mm}}) > 0.8$
$\overline{x_{\text{hit}}} - x_{\text{track}} < 0.3\,\text{mm}$

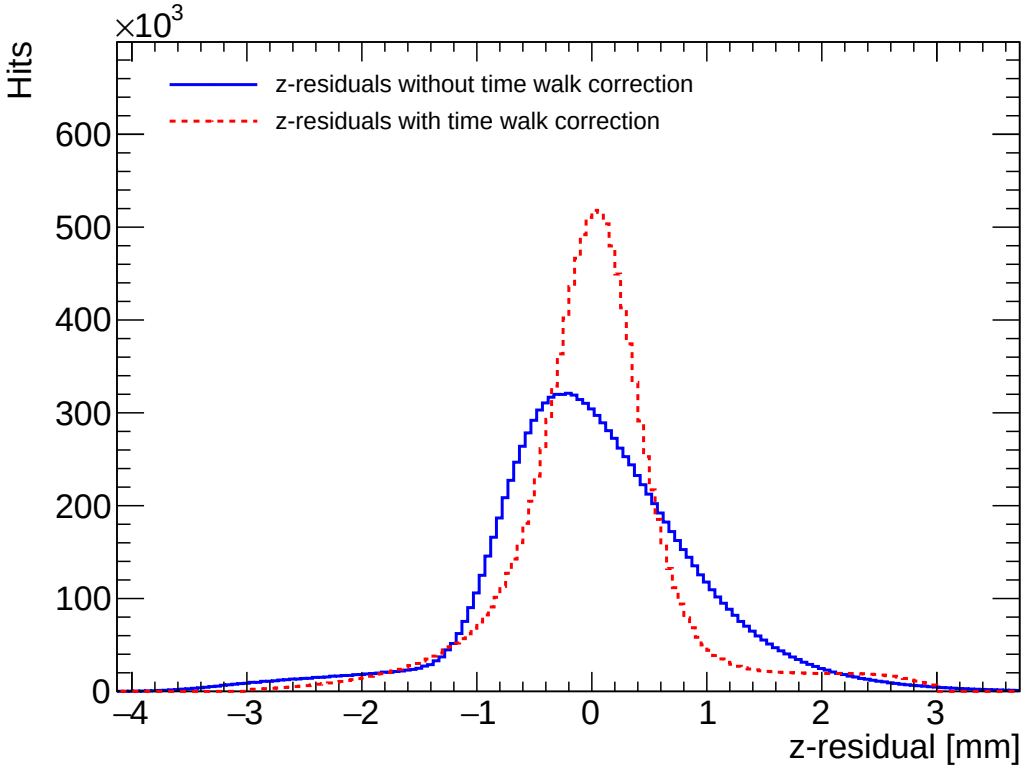
- Define $t_{\text{drift}} = t_{\text{hit}} - t_{\text{trigger}}$
- Calculate $z_{\text{hit}} = t_{\text{drift}} v_{\text{drift}}$
- Define residual $\boldsymbol{r}_{\text{hit}} = \boldsymbol{p}_{\text{hit}} - \boldsymbol{p}_{\text{expected}}$

Time walk correction



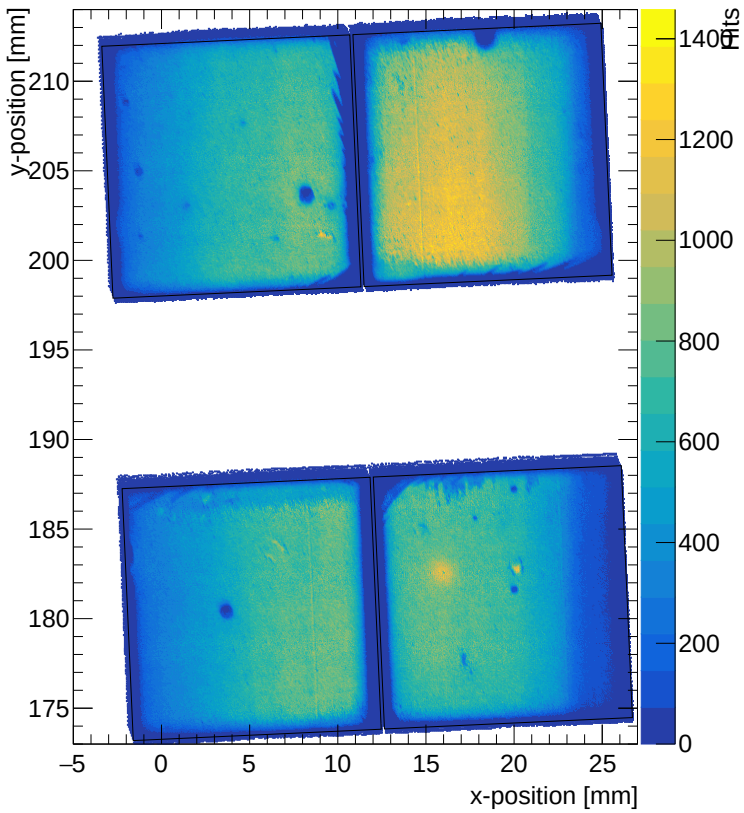
$$\delta z_{\text{timewalk}} = \frac{c_1}{t_{\text{ToT}} + t_0} + z_0$$

Time walk correction

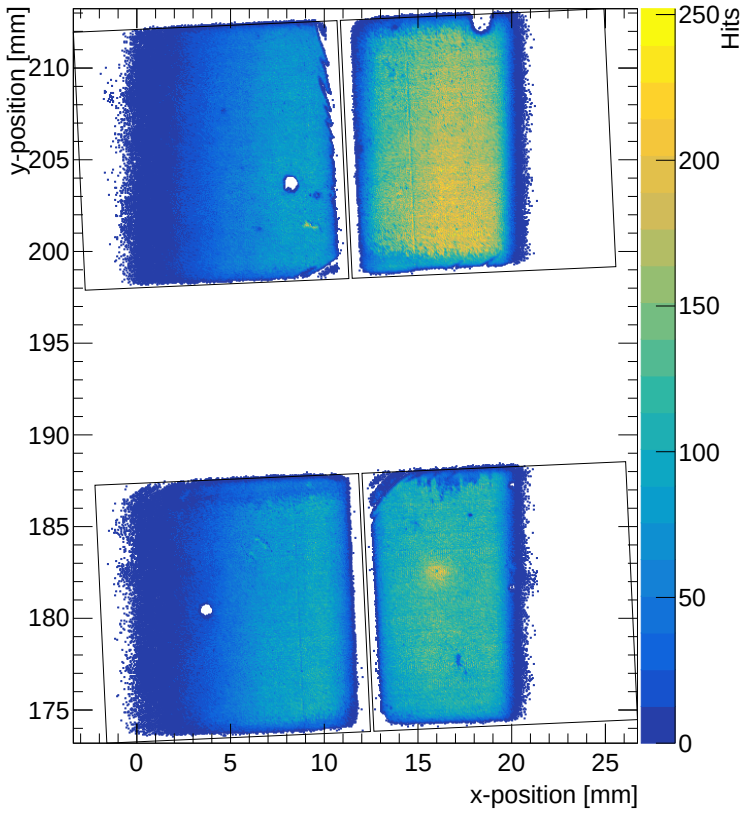


Hitmap of all hits for a part of the run

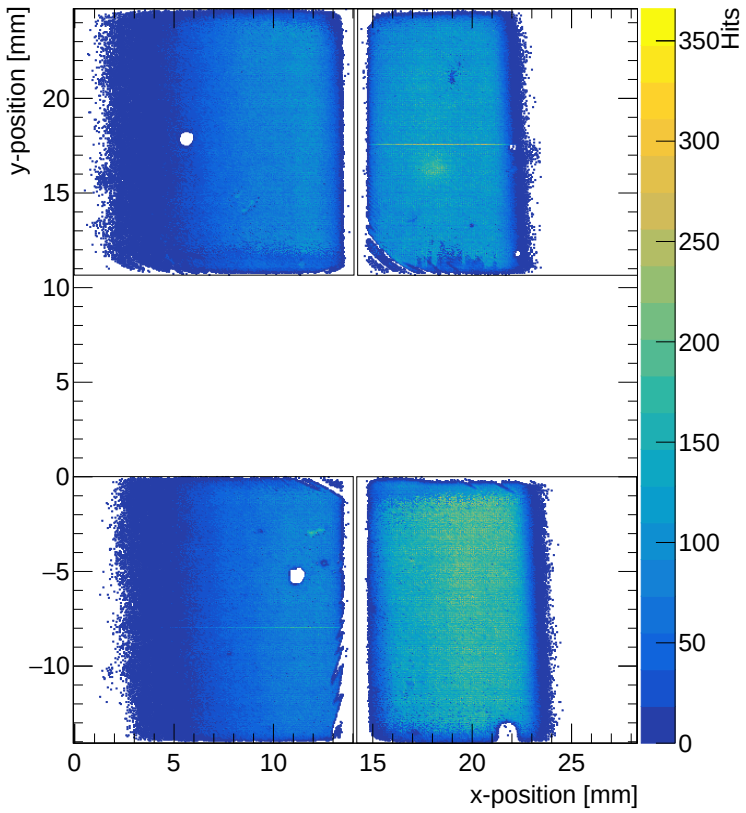
In global coordinates, projected in the xy plane



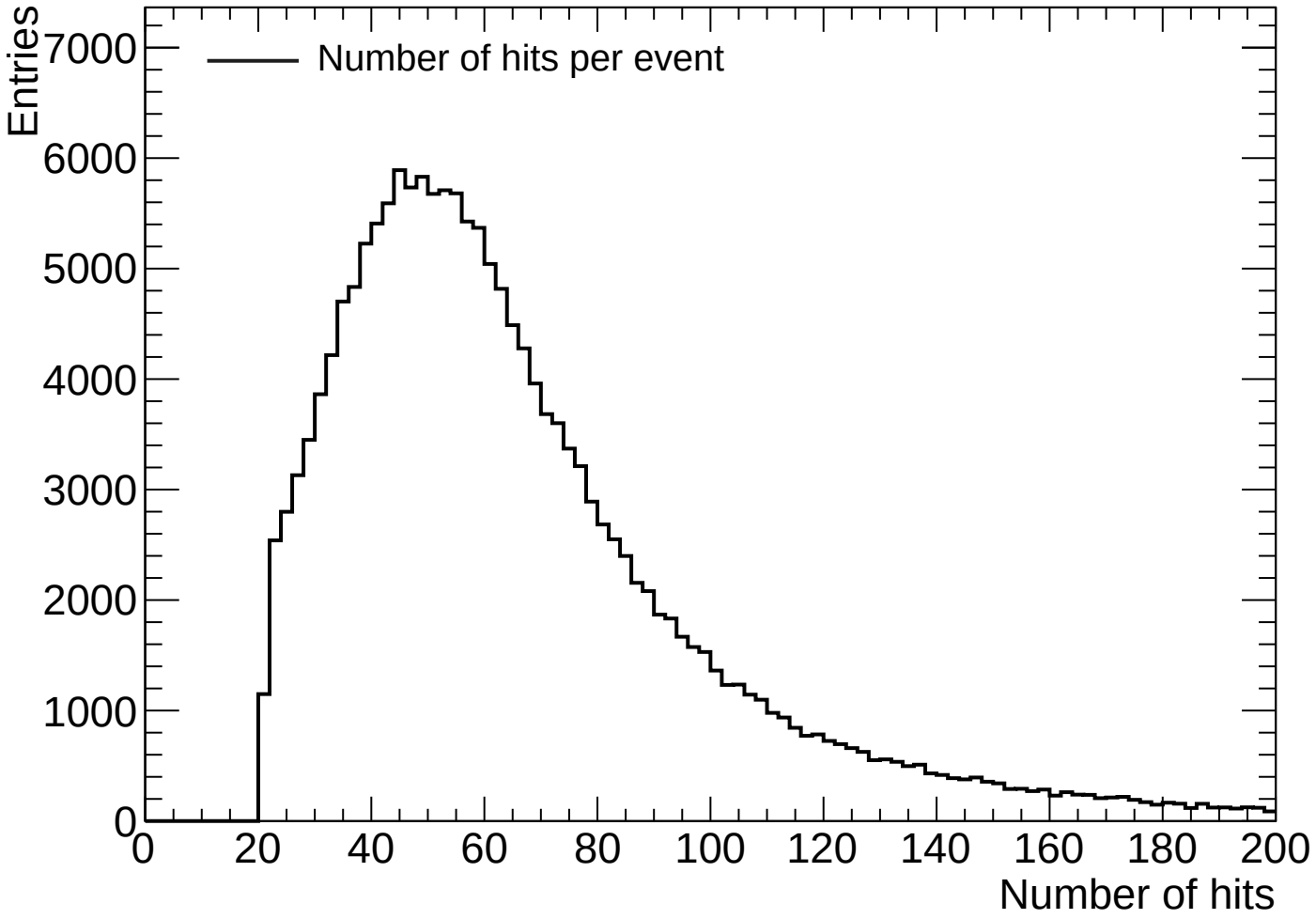
Hitmap of selected hits



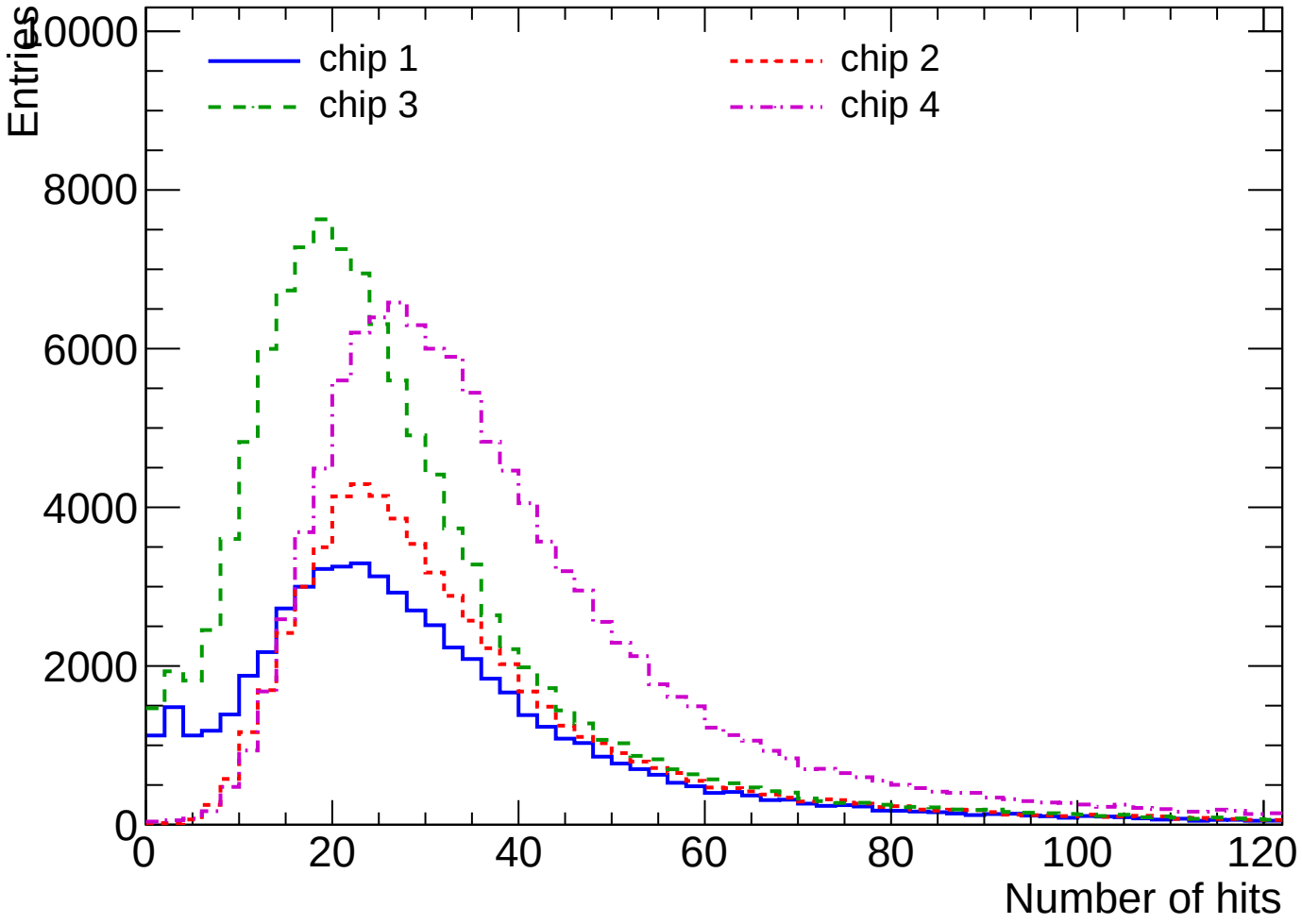
Hitmap of selected hits



Total number of selected hits

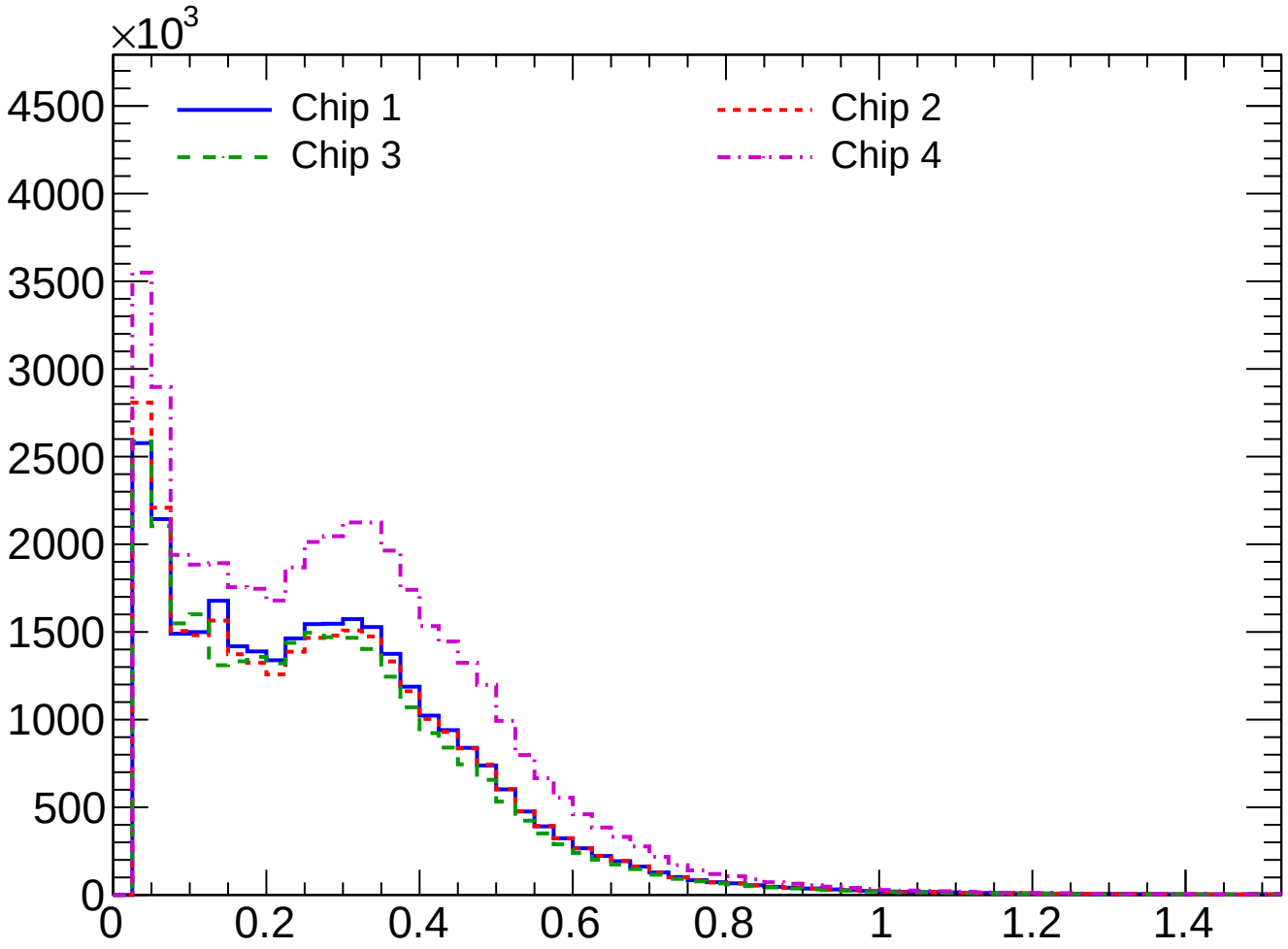


Selected number of hits per chip

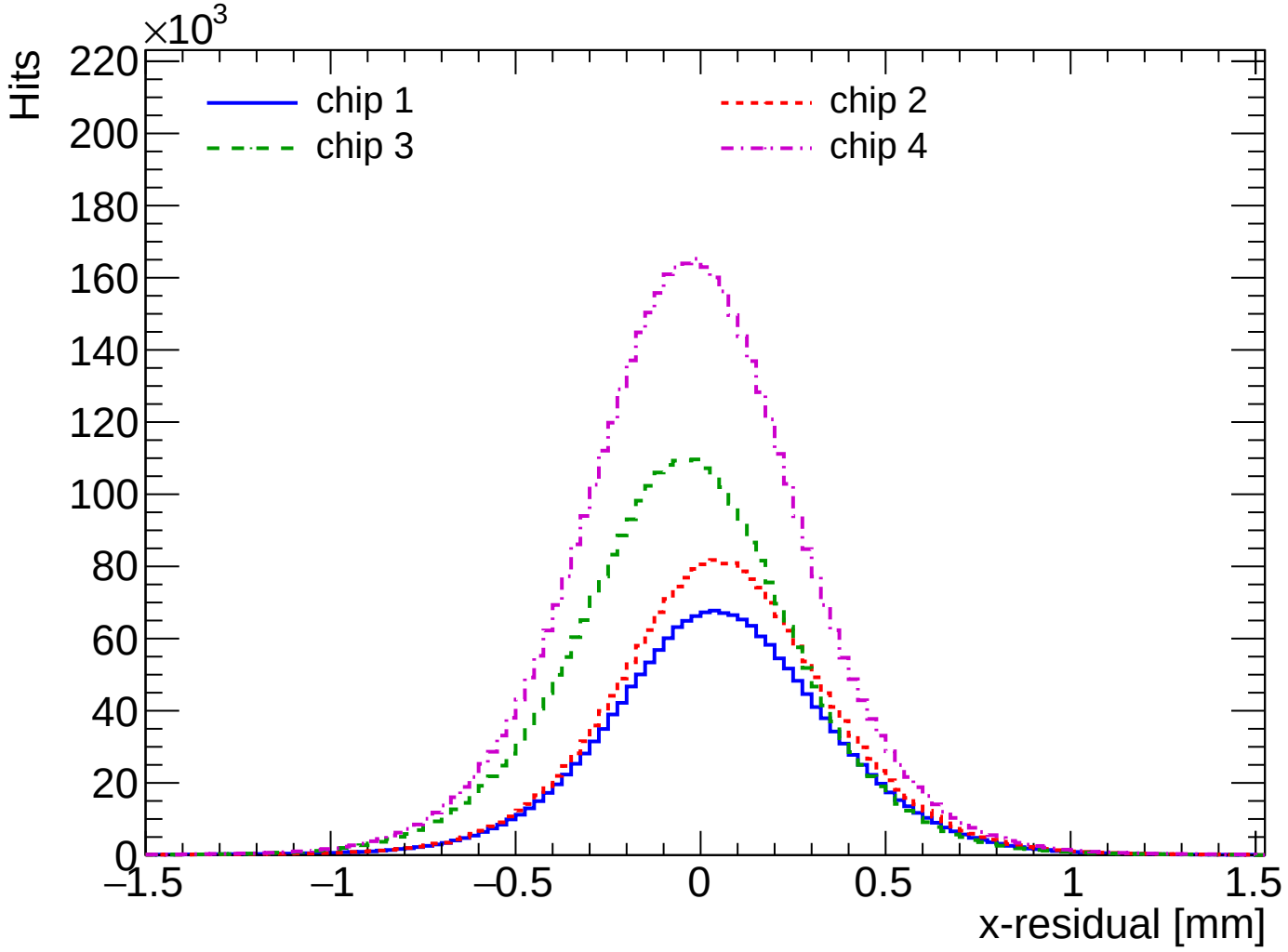


Time over threshold

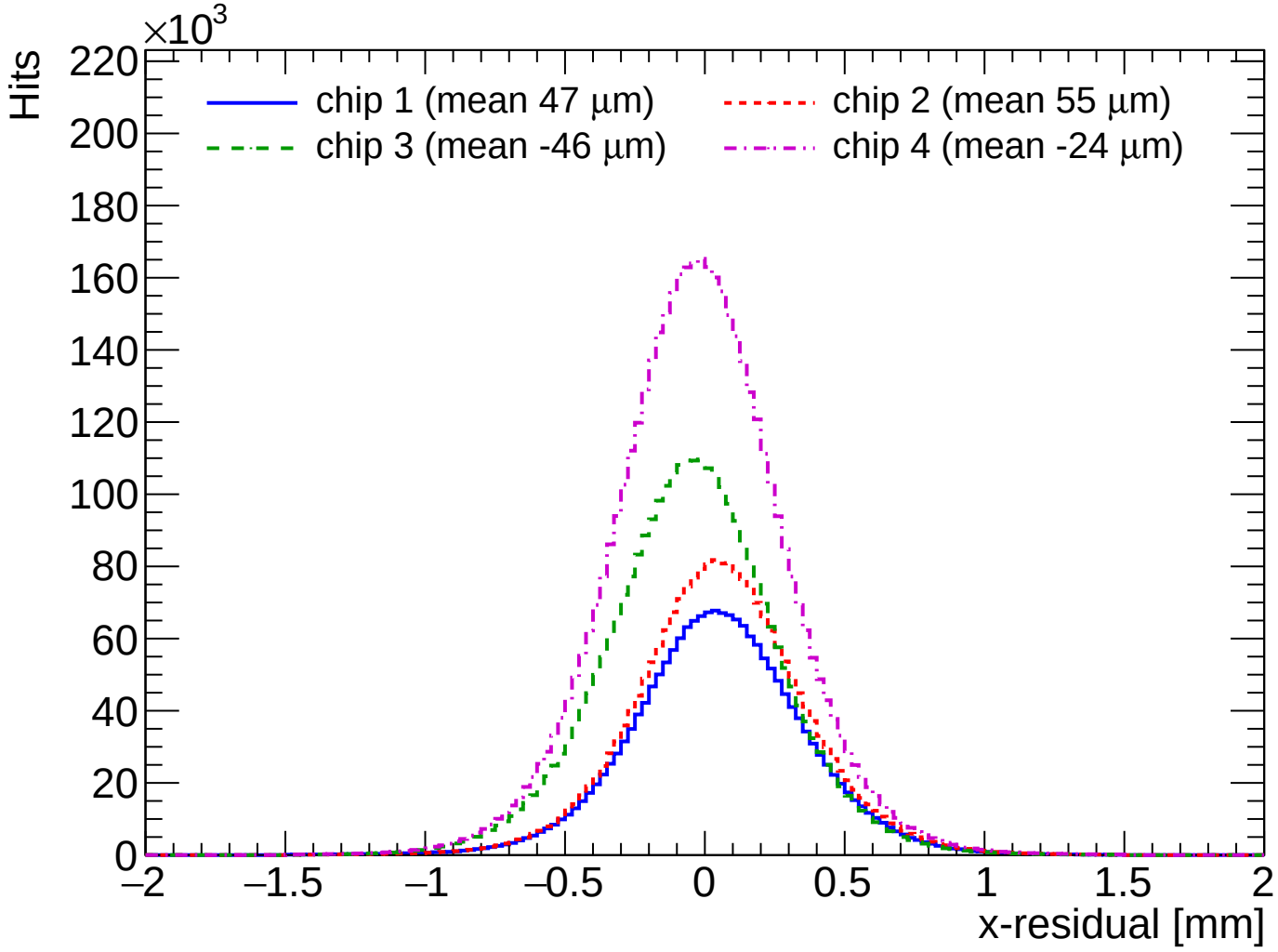
of all hits



x-residual

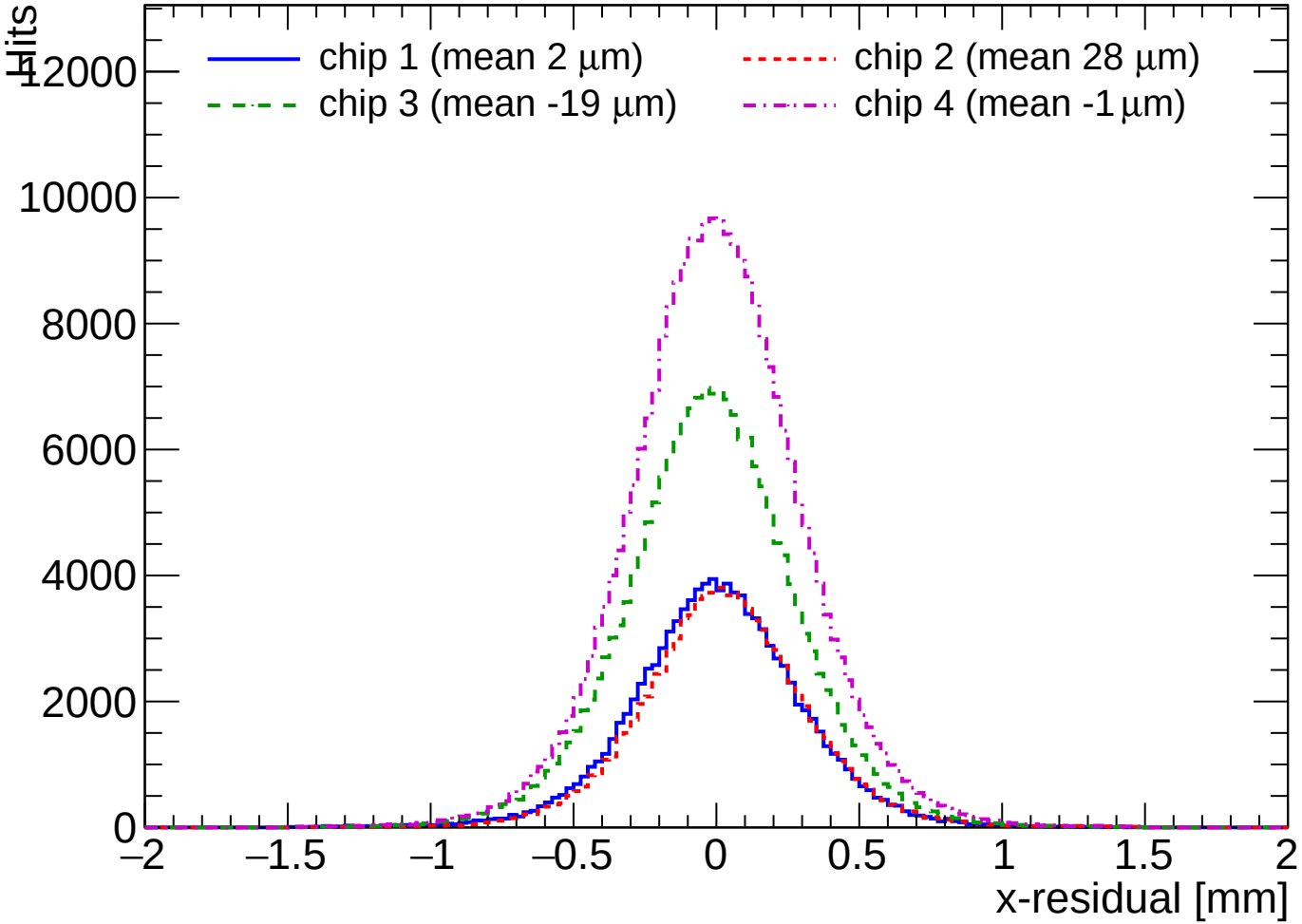

×10^3
Hits
220
200
180
160
140
120
100
80
60
40
20
0
chip 1
chip 2
chip 3
chip 4
–1.5
–1
–0.5
0
0.5
1
1.5
x-residual [mm]

x-residual

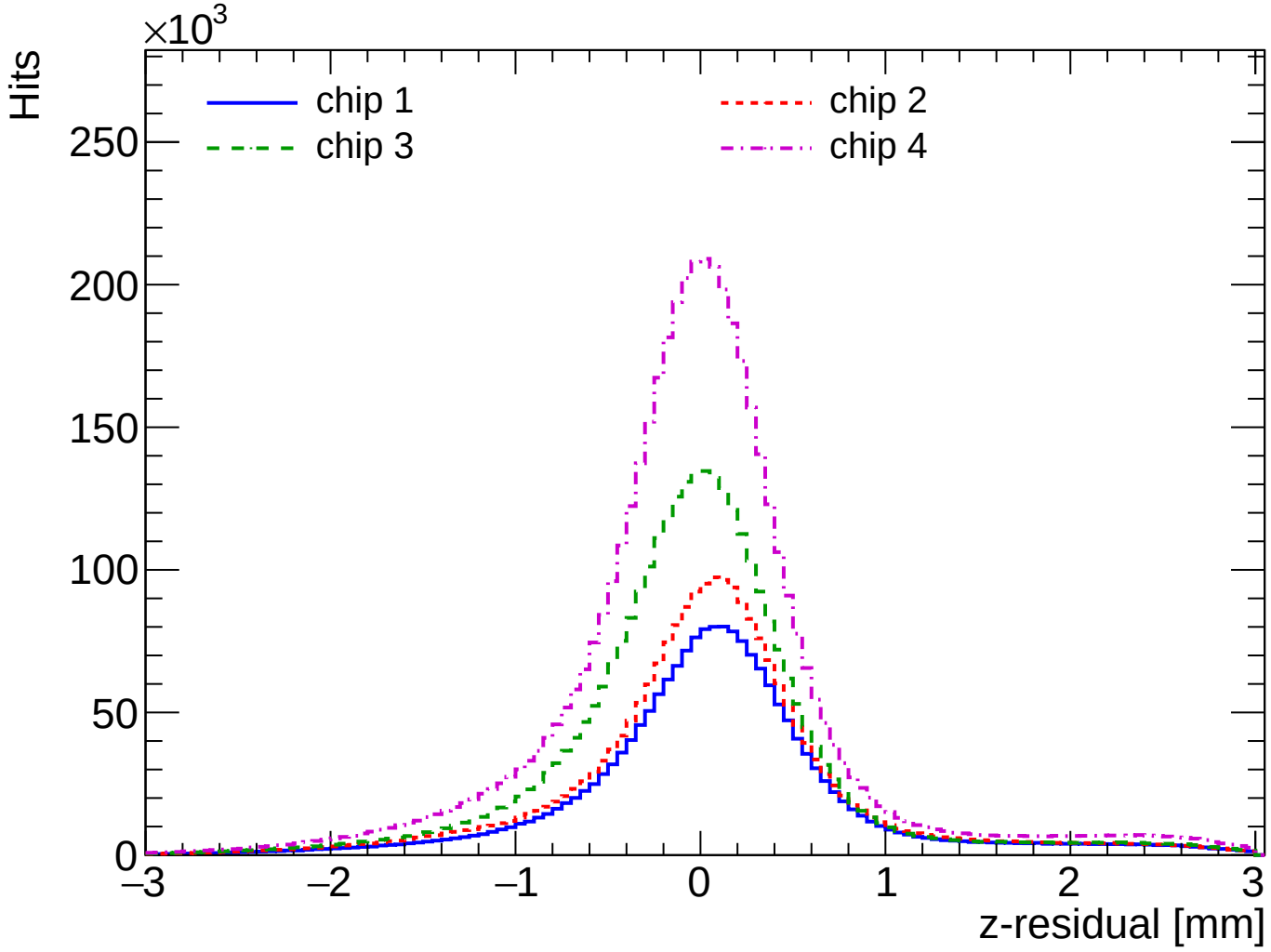

×10^3
Hits
220
200
180
160
140
120
100
80
60
40
20
0
chip 1 (mean 47 µm)
chip 2 (mean 55 µm)
chip 3 (mean -46 µm)
chip 4 (mean -24 µm)
–2
–1.5
–1
–0.5
0
0.5
1
1.5
2
x-residual [mm]

x-residual

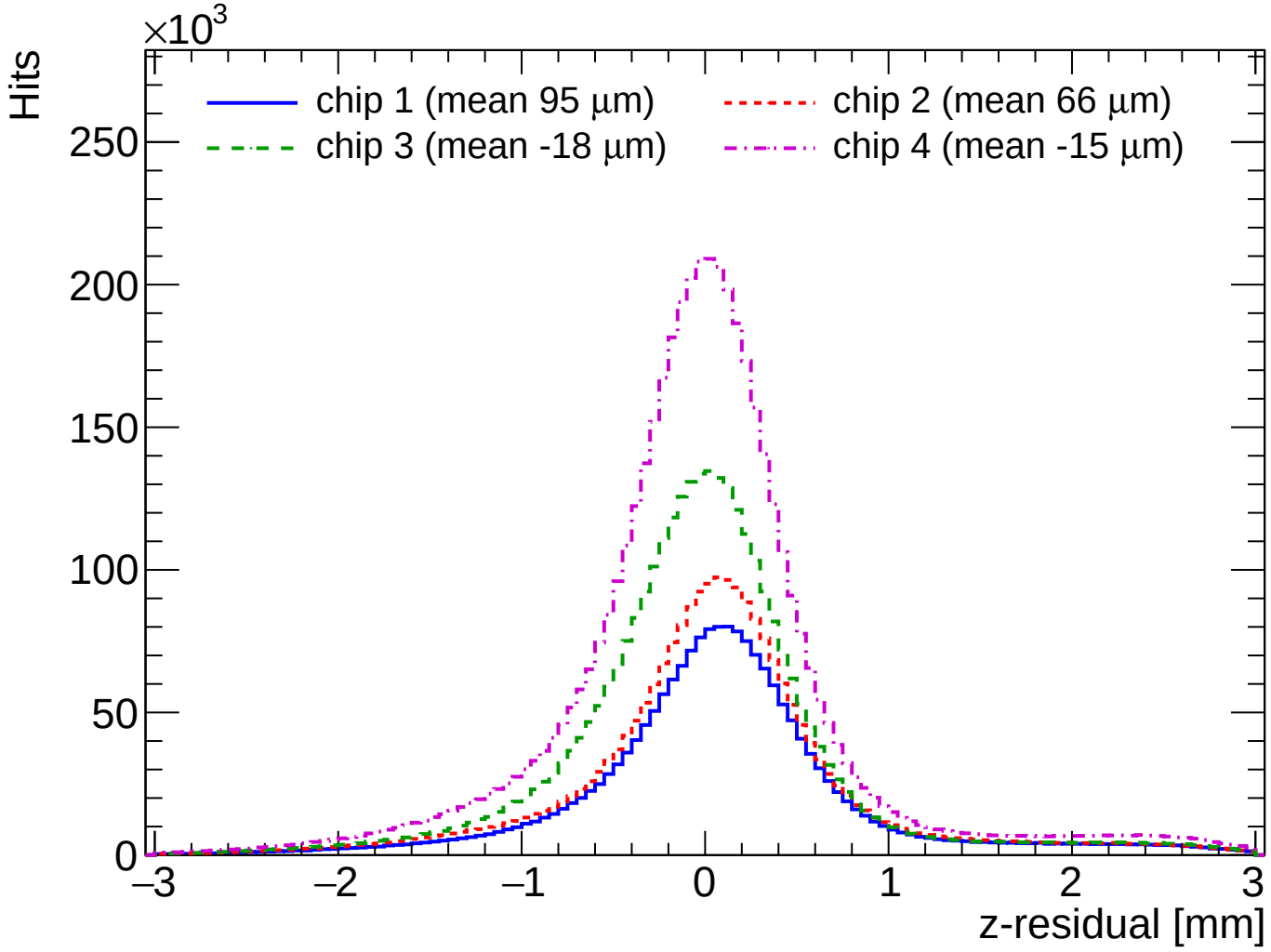
In fiducial area



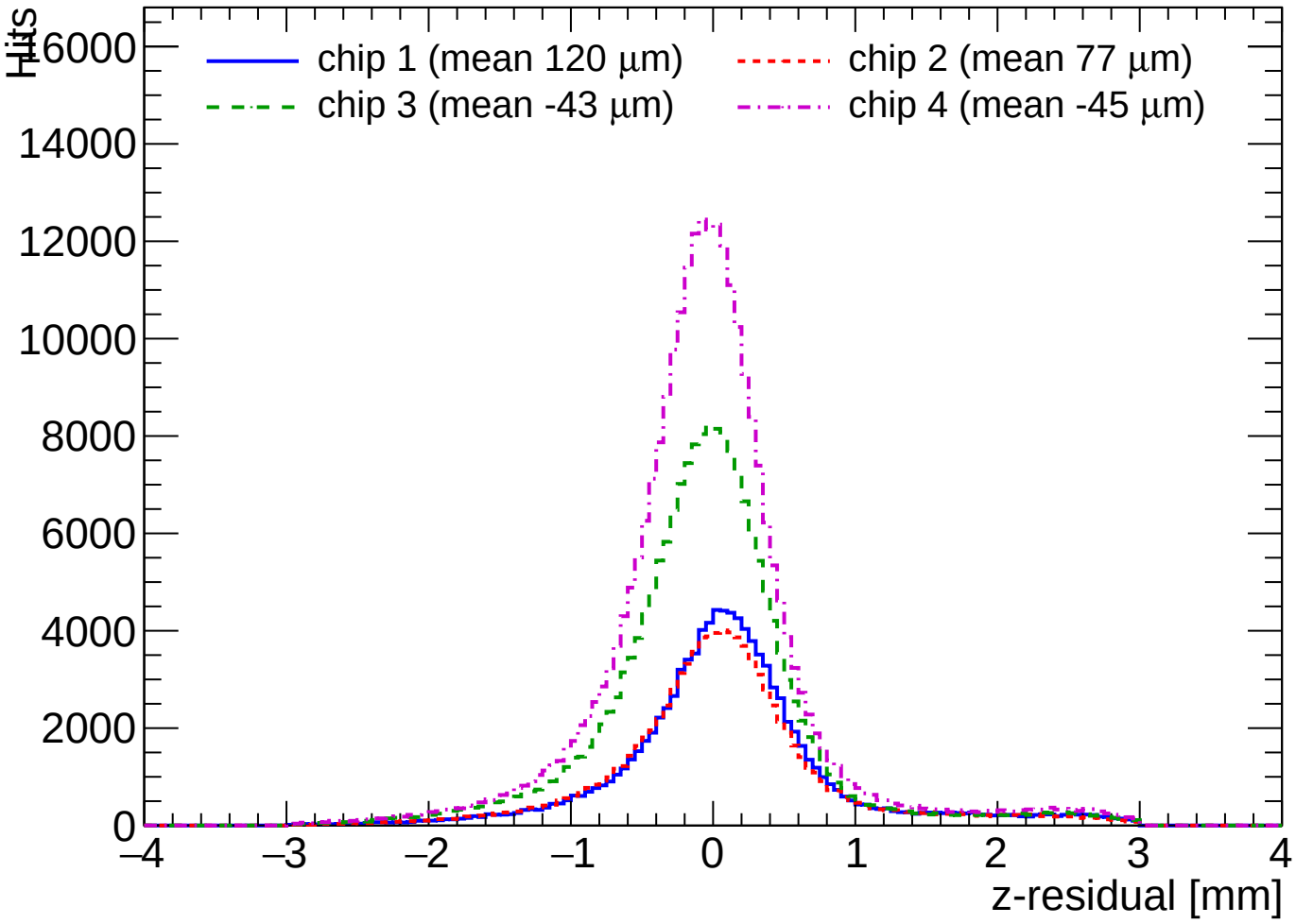
z-residual


×10^3
Hits
chip 1
chip 2
chip 3
chip 4
250
200
150
100
50
0
–3
–2
–1
0
1
2
3
z-residual [mm]

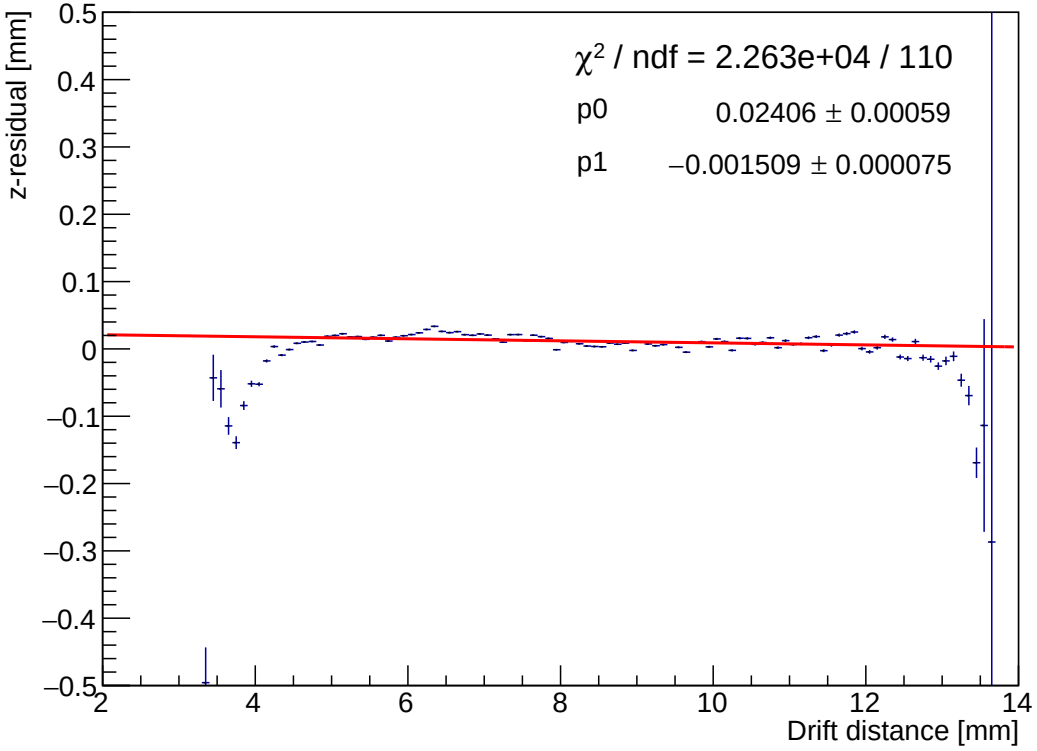
z-residual


×10^3
Hits
chip 1 (mean 95 μm)
chip 2 (mean 66 μm)
chip 3 (mean -18 μm)
chip 4 (mean -15 μm)
250
200
150
100
50
0
–3
–2
–1
0
1
2
3
z-residual [mm]

z-residual

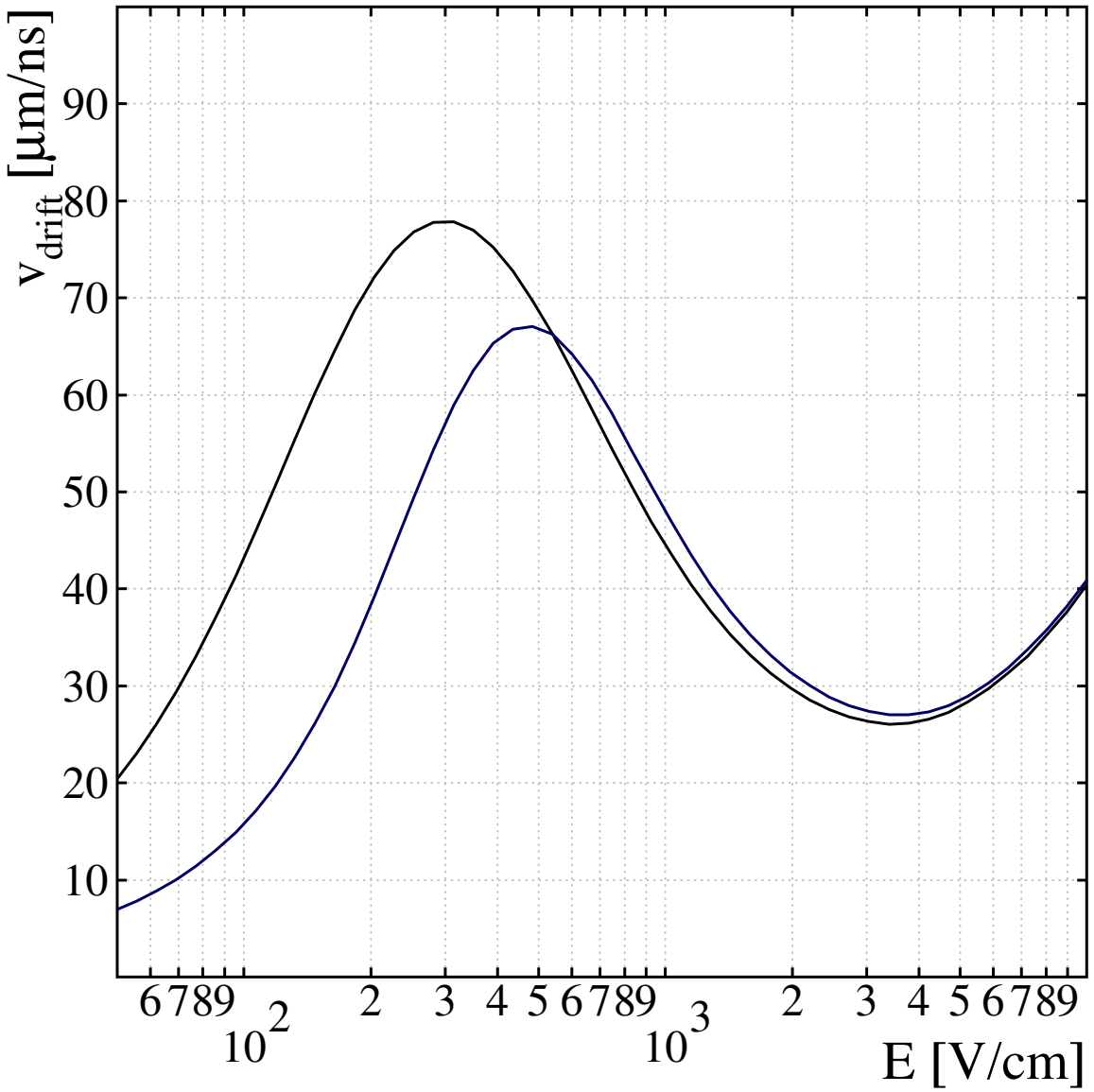

Hits
16000
14000
12000
10000
8000
6000
4000
2000
0
–4
–3
–2
–1
0
1
2
3
4
z-residual [mm]
chip 1 (mean 120 μm)
chip 2 (mean 77 μm)
chip 3 (mean -43 μm)
chip 4 (mean -45 μm)

Drift velocity



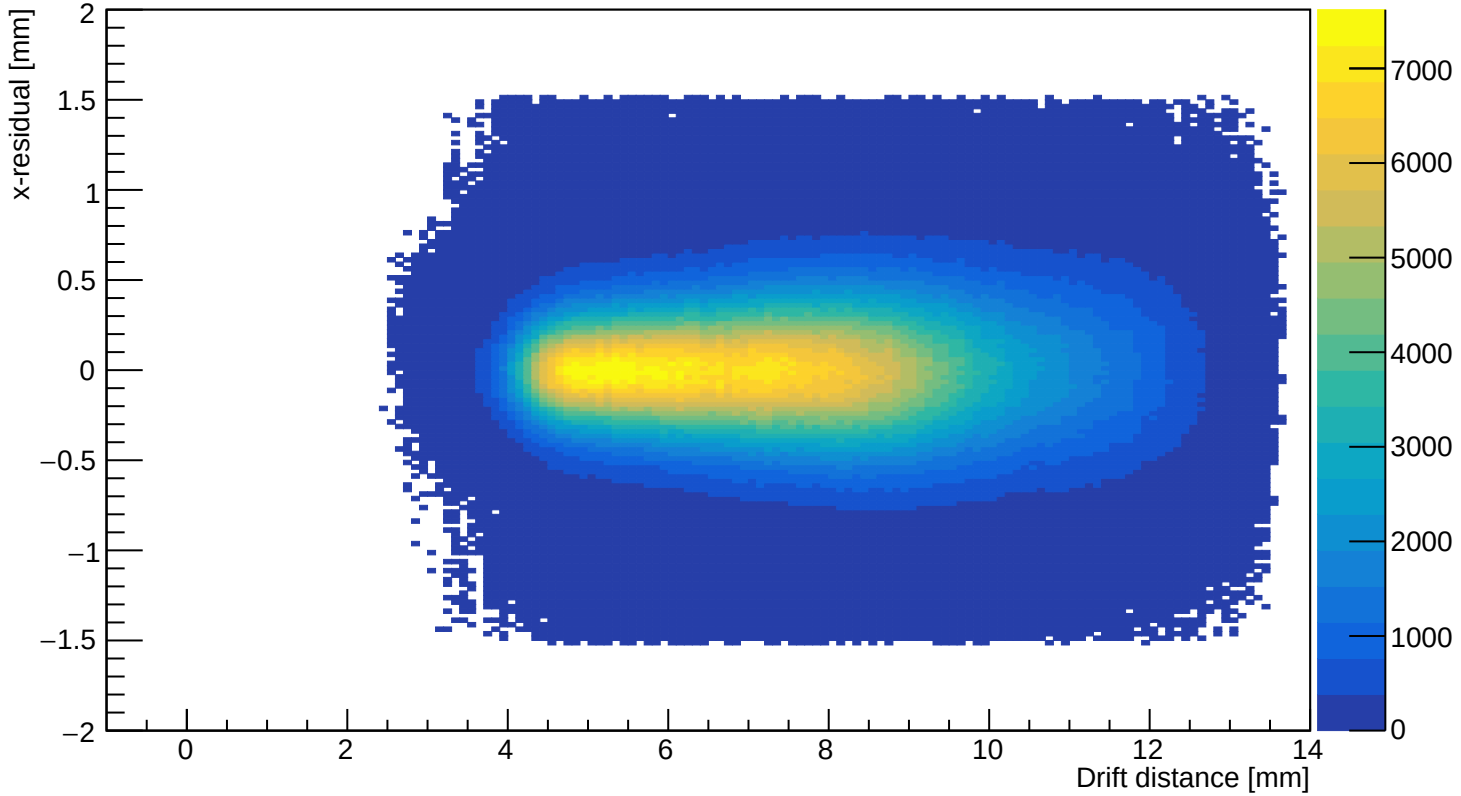
The drift velocity is 56.7 μm/ns

Drift velocity

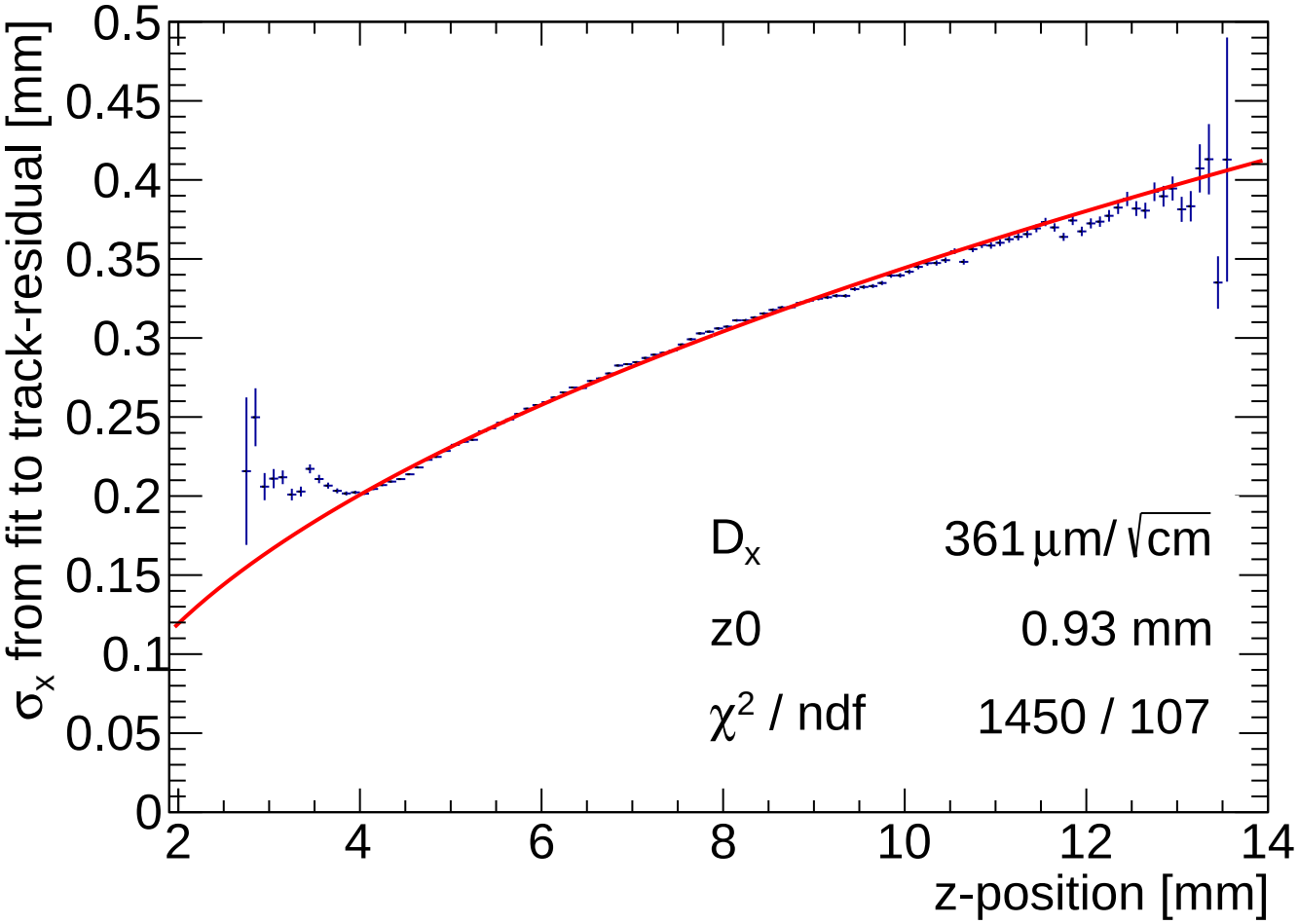


T2K gas: blue is with 0.4% water vapor, black without

x-residual by drift distance

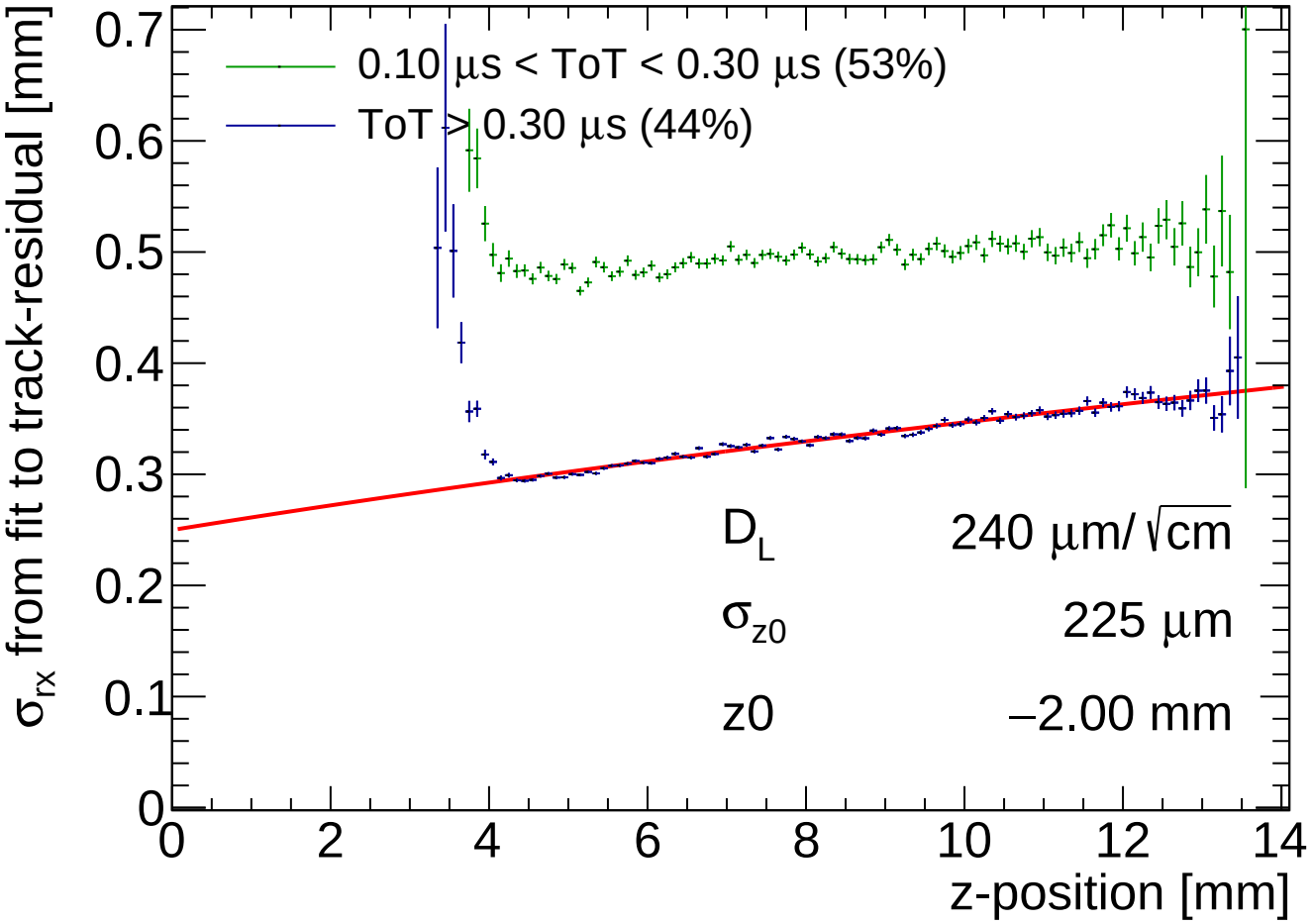


Transverse diffusion



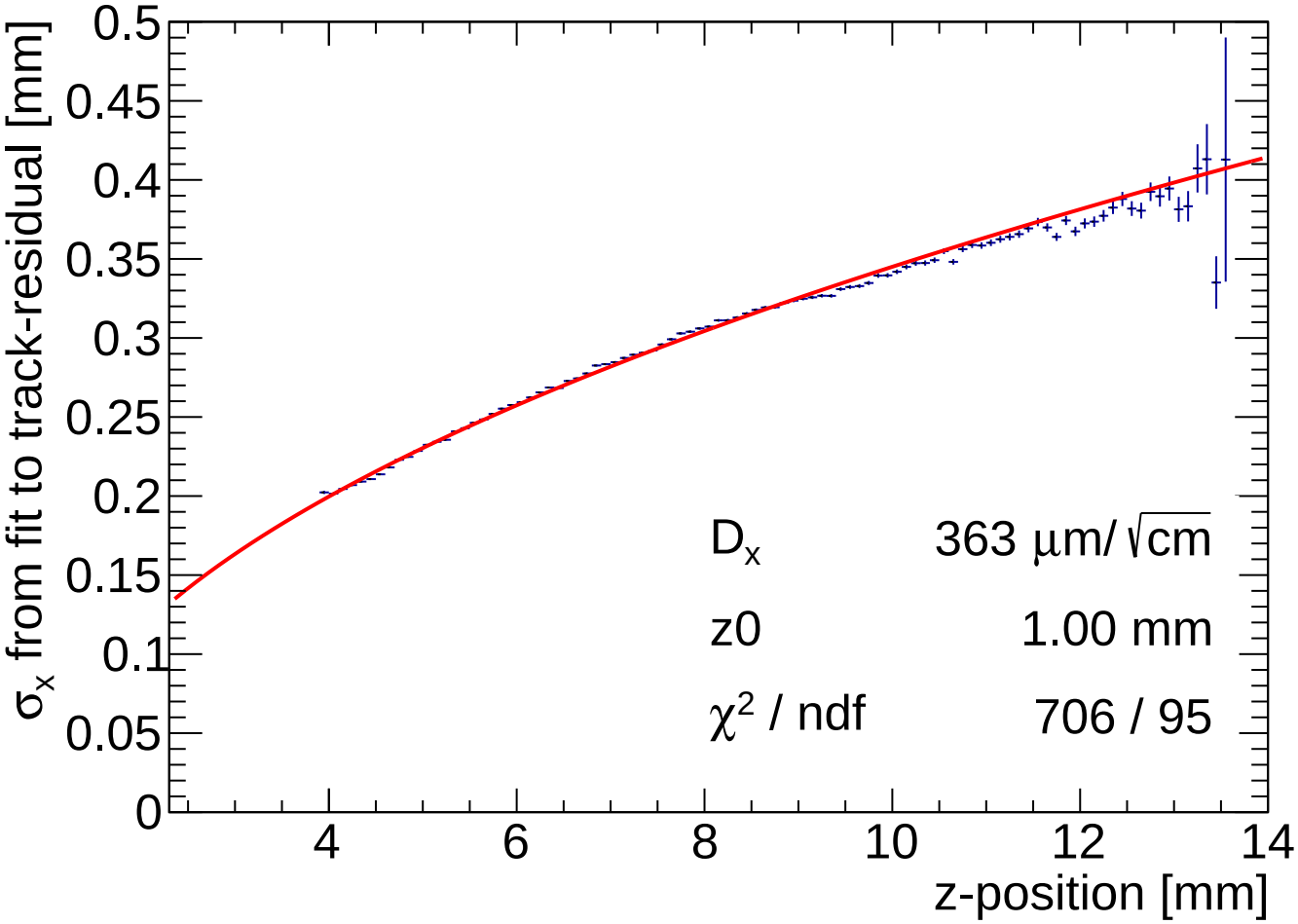
$$\sqrt{\sigma_0^2 + D^2(z - z_0)}$$

Longitudinal diffusion



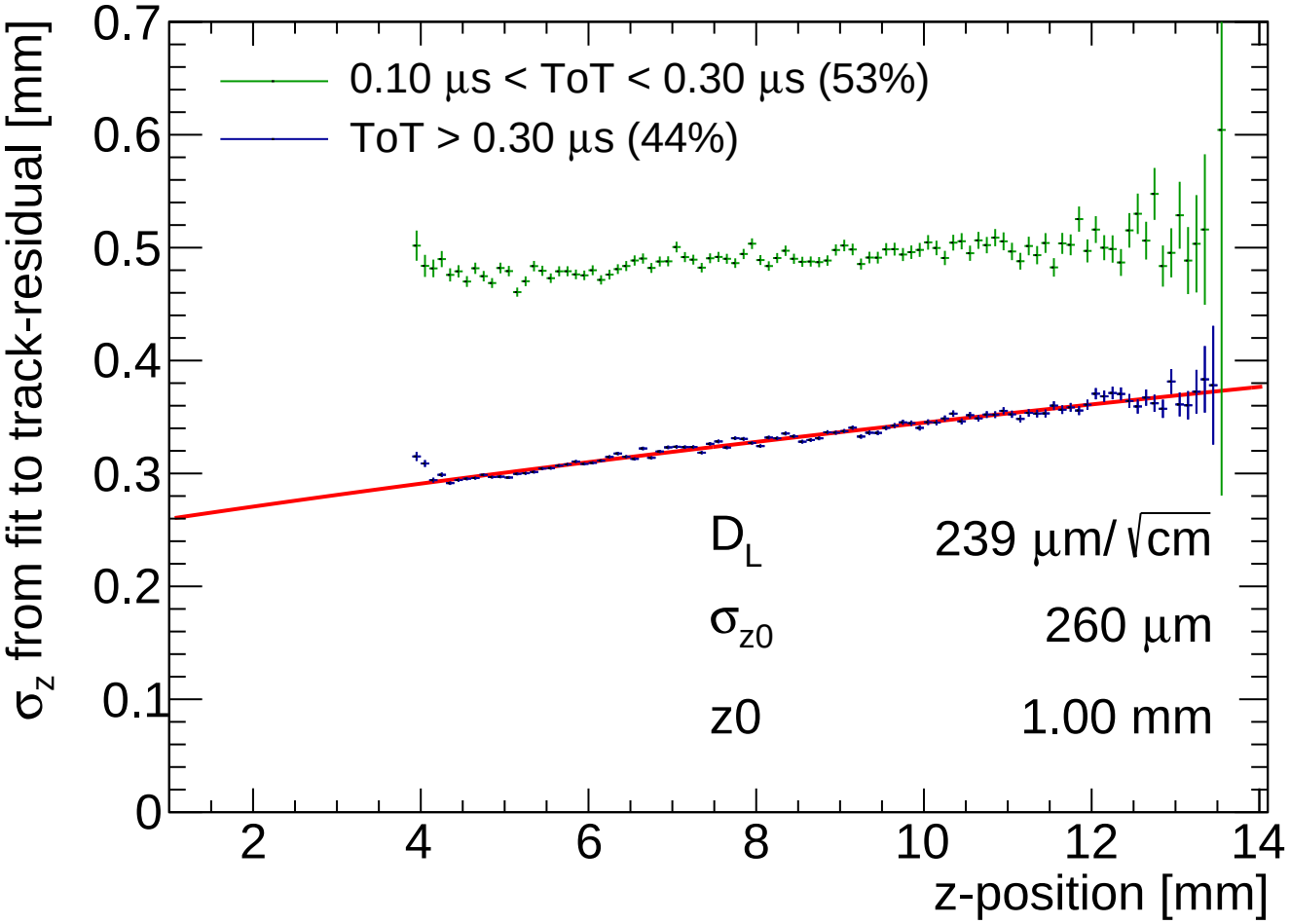
$$\sqrt{\sigma_0^2 + D^2(z - z_0)}$$

Transverse diffusion



$$\sqrt{\sigma_0^2 + D^2(z - z_0)}$$

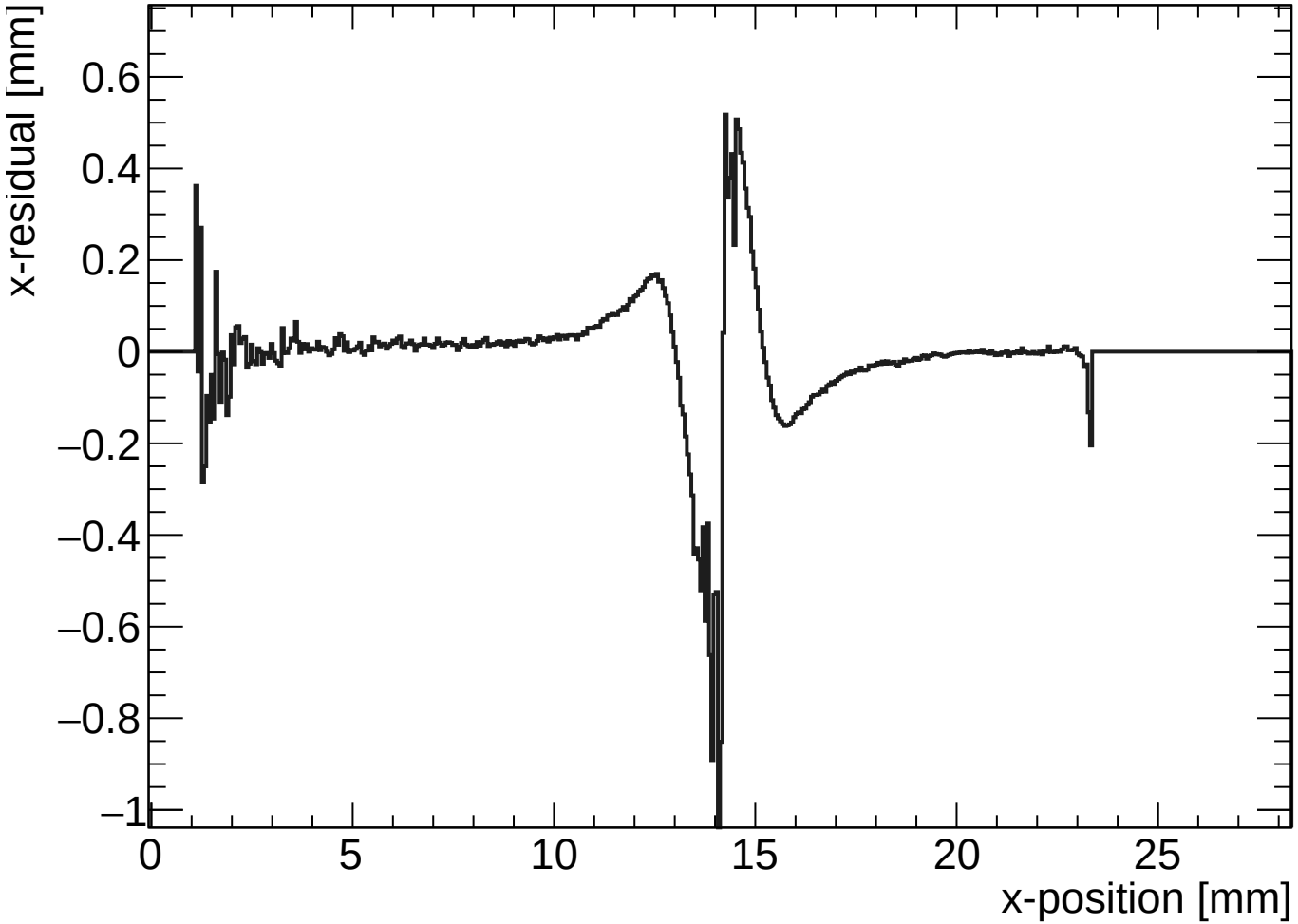
Longitudinal diffusion



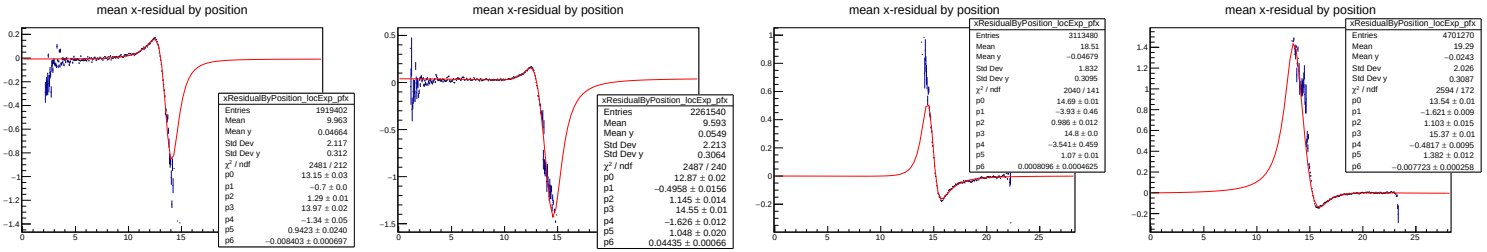
$$\sqrt{\sigma_0^2 + D^2(z - z_0)}$$

Deformations in the plane as a function of x

Before correction



Corrections for the deformations in the plane



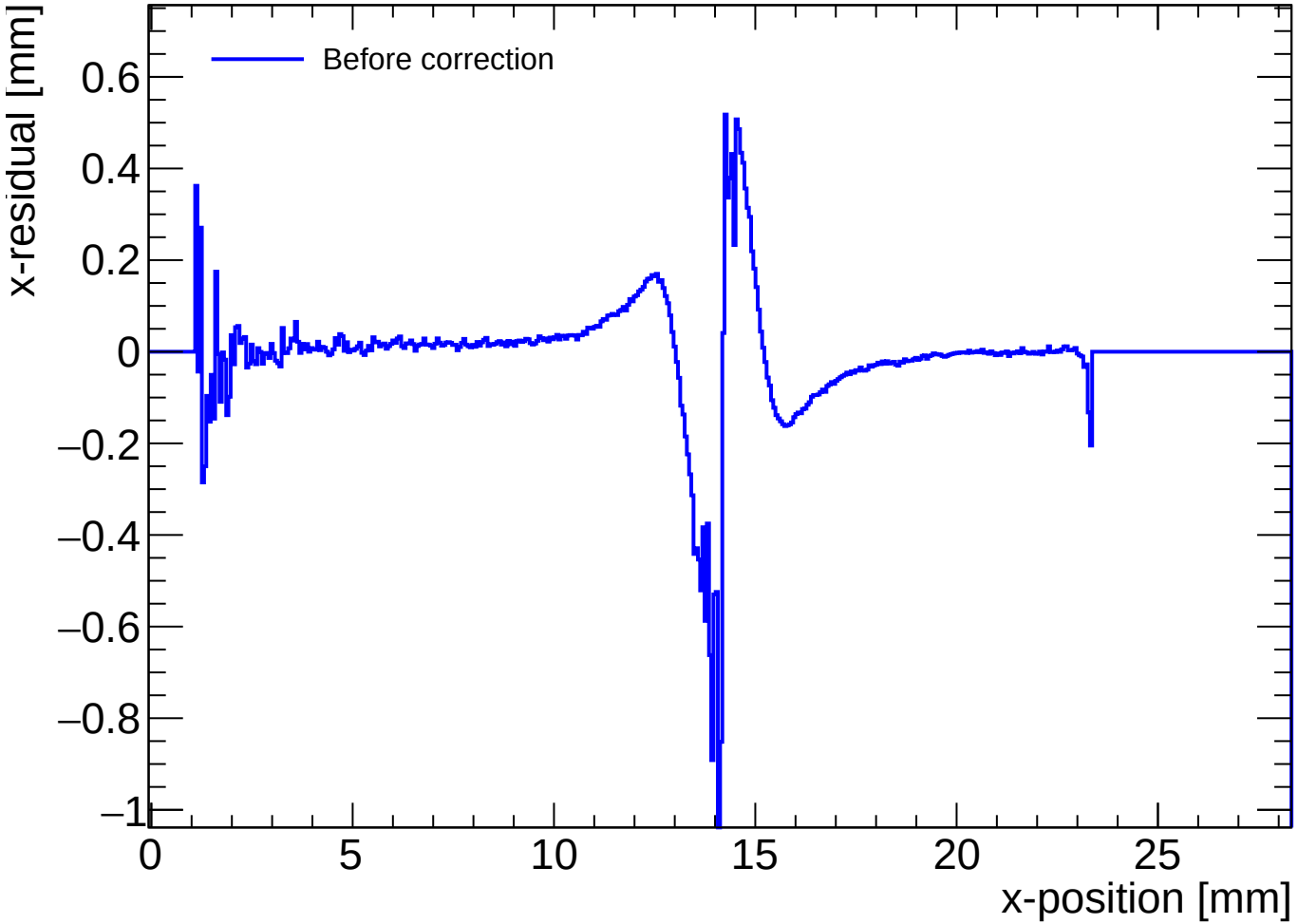
Use a combination of two Breit-Wigners to fit the deformation due to the electric field and due to edge effects:

$$\delta x_{\text{correction}} = \frac{p_1}{1 + (x - p_0)^2/p_2^2} + \frac{p_4}{1 + (x - p_3)^2/p_5^2} + p_6,$$

where p is a set of parameters and x the projected position onto the track

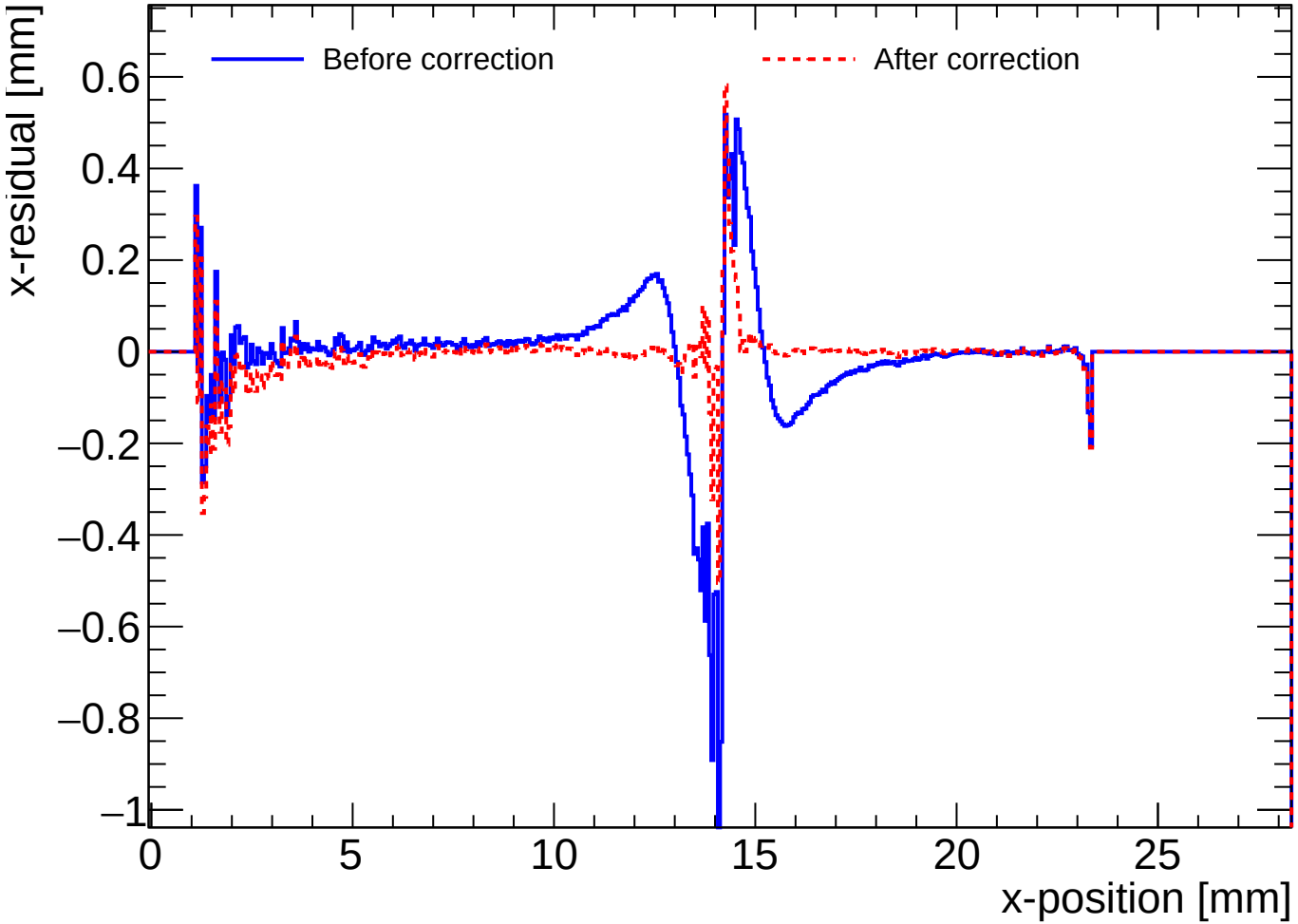
Deformations in the plane as a function of x

Before correction



Deformations in the plane as a function of x

after correction



x residual by position

after correction