Update on corrected alignment and z-resolution

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Lepcol meeting

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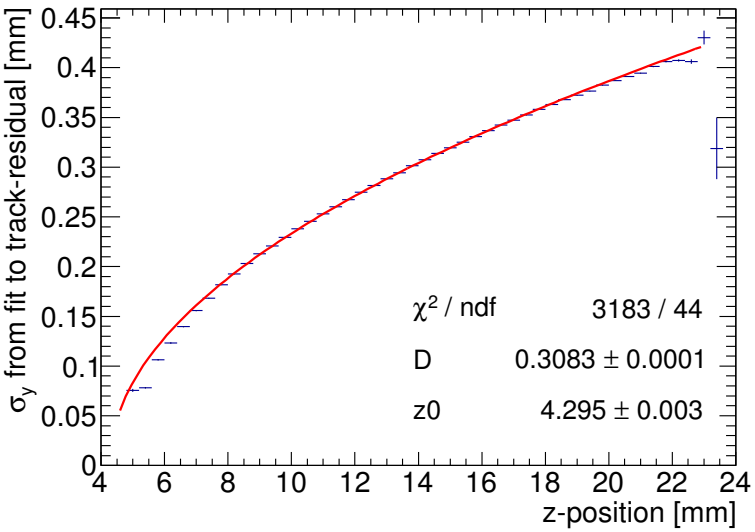
Outline

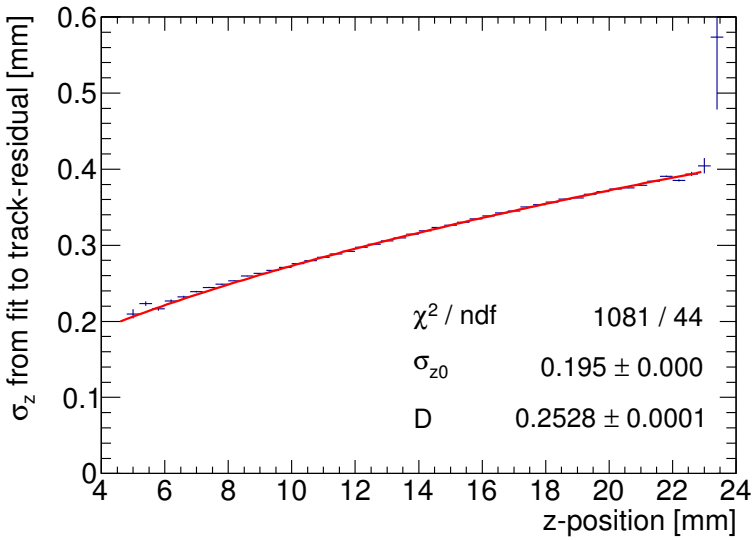
1. Improved alignment
2. z-resolution

Both are work in progress

Old σ_{z0} resolution

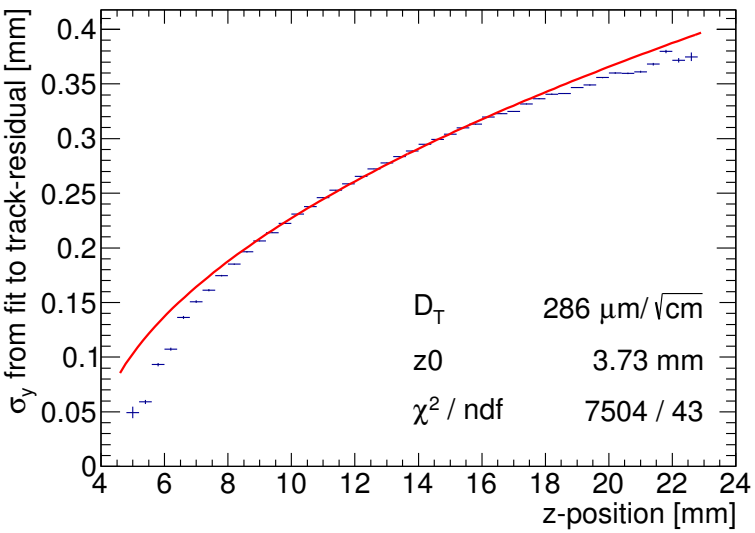
The z-resolution $\sigma_{z0} = 0.195\,\text{mm}$ close to the grid was higher than expected

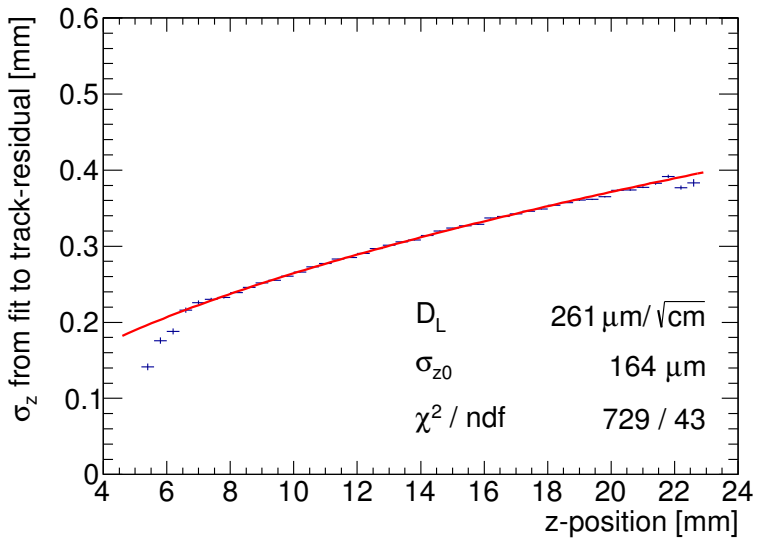




Old diagram

Fit without telescope

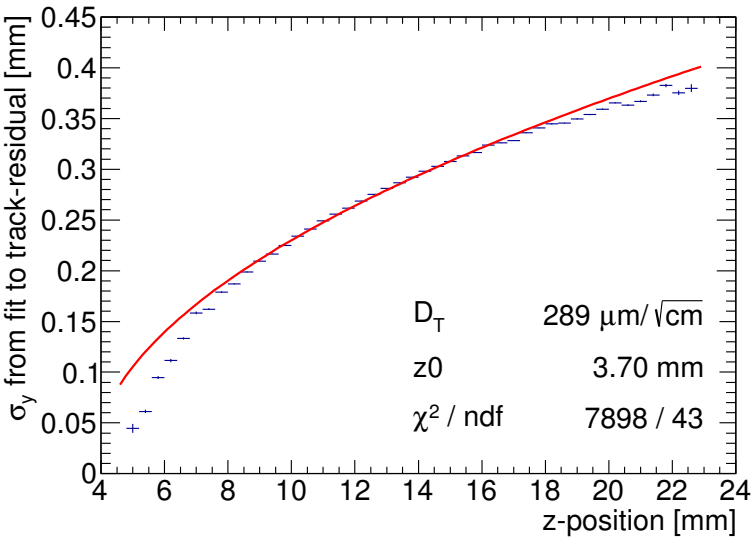


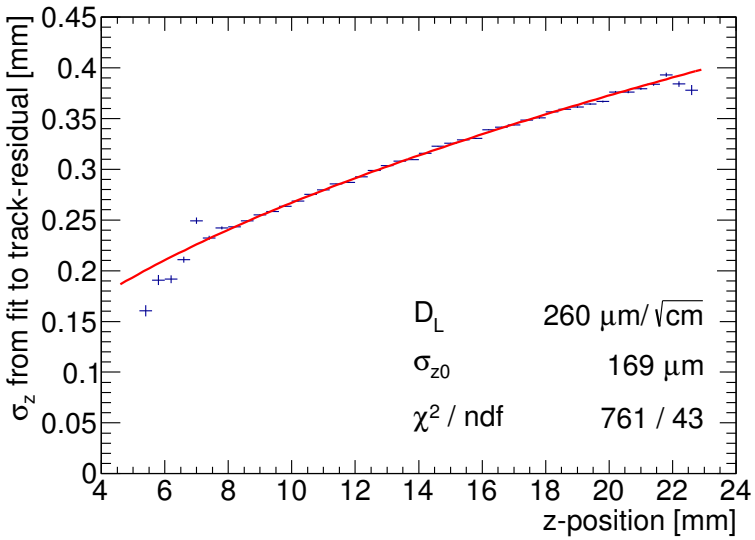


Very different results in the TPC only fit (without telescope)

Improved alignment and fitted only on hits in fiducial area

Improved alignment and using only hits in fiducial area
(z errors also improved as shown in second section of these slides)





Now with similar results
The higher σ_{z0} is offset by a lower diffusion coefficient D_L

Contributions to z-resolution

- From time resolution: $\tau v_{\text{drift}}/\sqrt{12} = 34\,\mu\text{s}$
- Systematics chip: from histogram 47 µm
- From uncertainty in track position: $\sigma_z/\sqrt{N} \approx 300\,\mu\text{m}/\sqrt{100} = 30\,\mu\text{m}$ (should be calculated from track fit)
- Angle and uncertainty in x-position: $\sigma_x \tan(\phi_y) = 300\,\mu\text{m} \tan(0.005) = 1.5\,\mu\text{m}$
- **From uncertainty in ToT**

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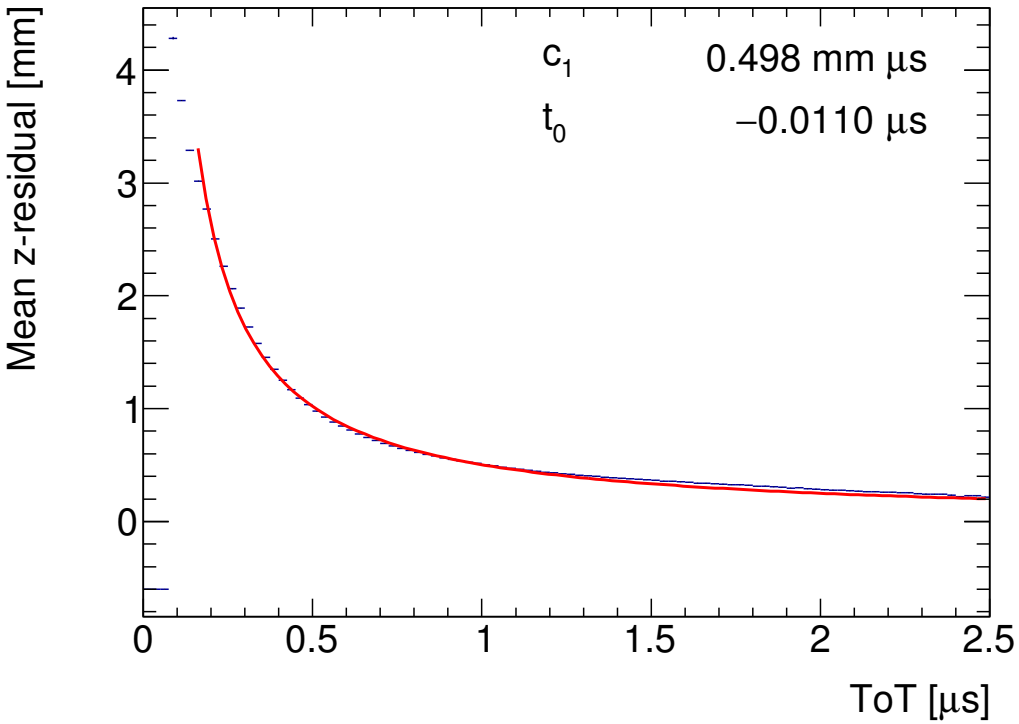
Time walk correction



Corrected with $z_{tw} = \frac{c_1}{t_{ToT}+t_0}$

The error in the ToT should be propagated to the z-coordinate:

$\sigma_z^2 = (\sigma_{z0}(t_{ToT}))^2 + D_L^2(z - z_0)$

Propagation of ToT error to σ_z

Propagate error:

$$\sigma_{z0}(t_{\mathrm{ToT}}) = \sigma_{ToT} \frac{\partial z_{tw}}{\partial t_{ToT}} \tag{1}$$

Derivative is:

$$\frac{\partial z_{tw}}{\partial t_{ToT}} = -c_1 (t_{ToT} + t_0)^{-2} \tag{2}$$

Assume:

$$\sigma_{ToT} = k_0 + k_1 (t_{ToT} + t_0) \tag{3}$$

Full error becomes:

$$\sigma_z(t_{ToT}) = \sqrt{\frac{(k_0 + k_1(t_{ToT} + t_0))^2 c_1^2}{(t_{ToT} + t_0)^4} + \sigma_0^2} \tag{4}$$

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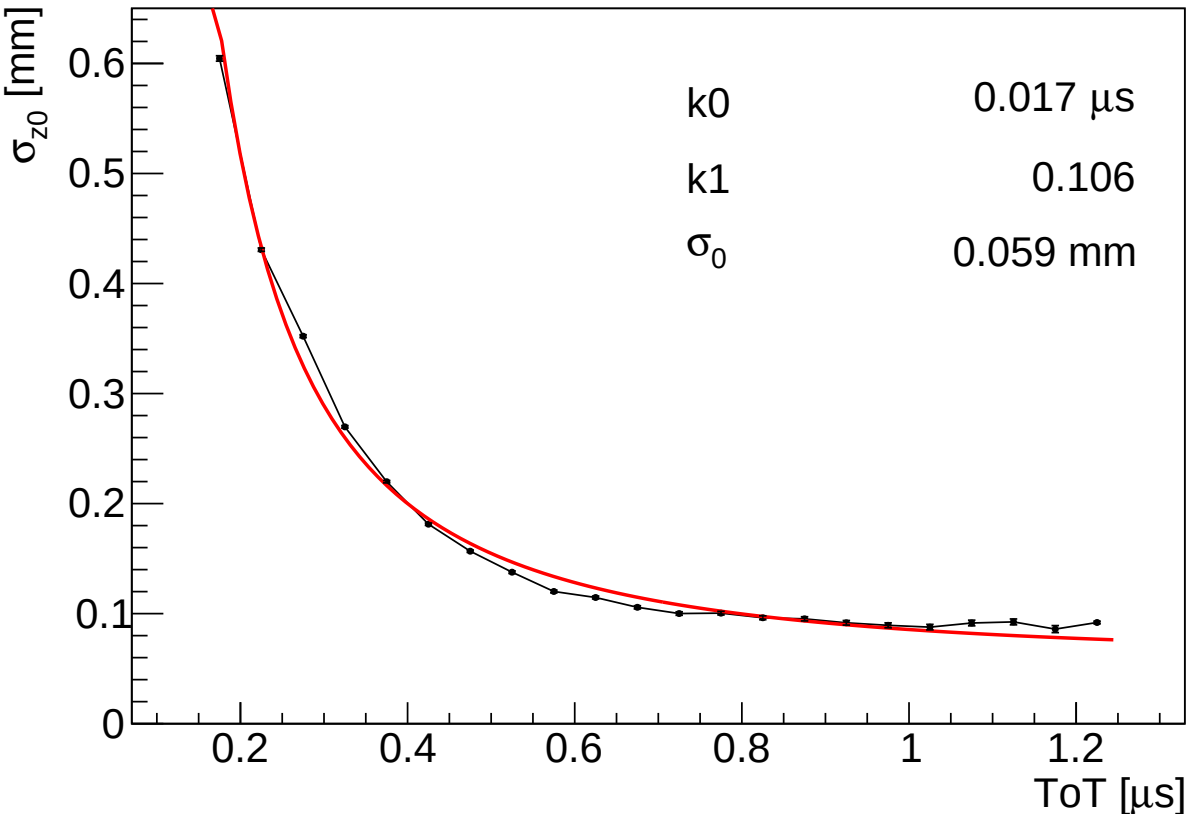
Fit to points from slices

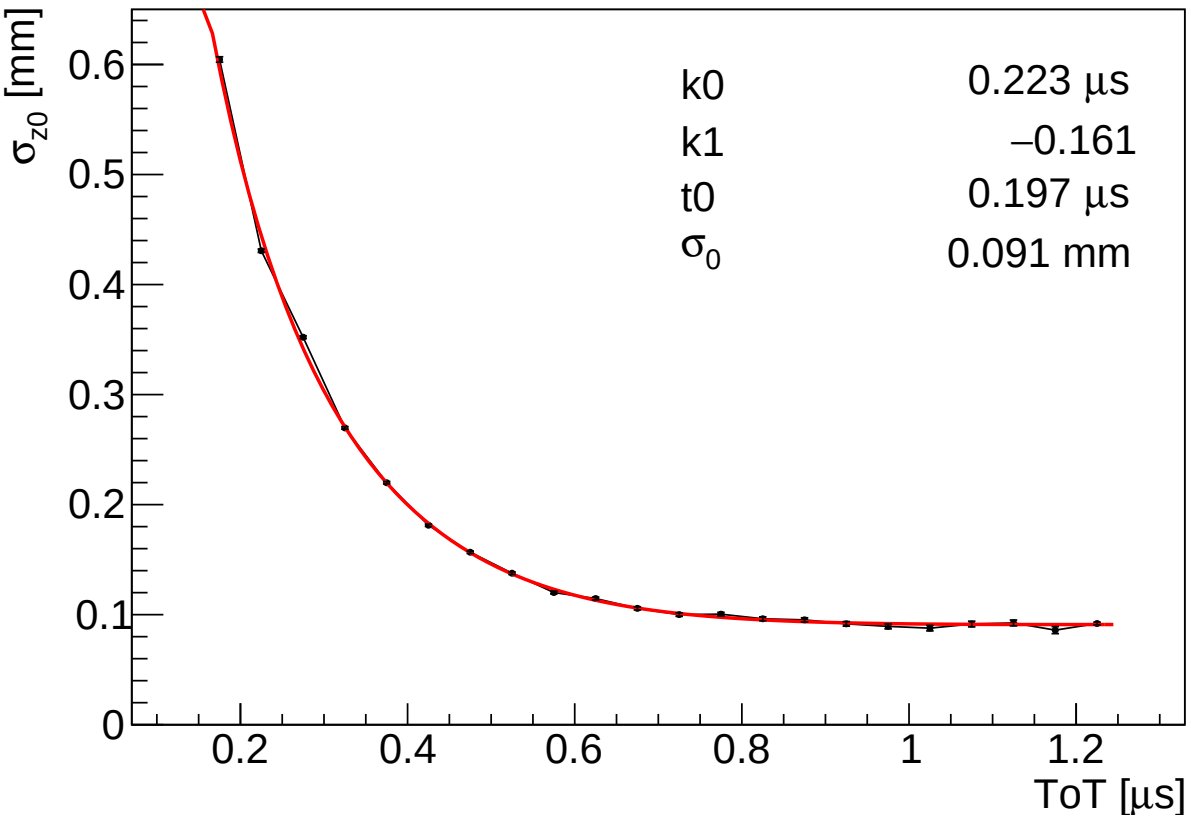
Fit σ_{z0} for slices in ToT of width 0.05 µs, and graph these points



Fix c_1 and t_0 from time walk and fit k_0, k_1 and σ_0

More free parameters improve fit

Fit with also t_0 as a free parameter



More free parameters improve the fit, but makes it harder to interpret physically

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