Negative ion measurements

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Lepcol meeting

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Negative ion measurements by Fred

Run 1042

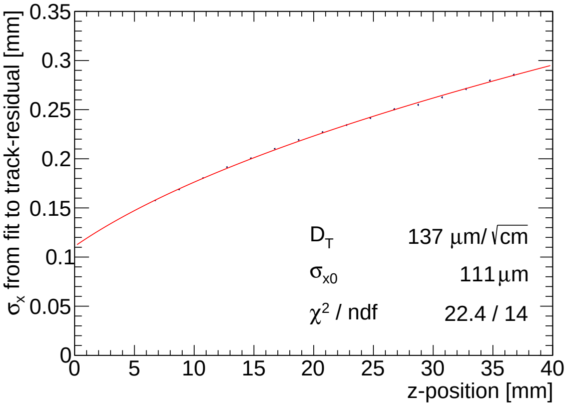
- Ar/iC4H10/CS2 95/4.5/0.5 gas mixture
- Drift field is $-280\,\mathrm{V/cm}$
- Grid voltage is $-380\,\mathrm{V}$

Run 1043 – 1051

- Ar/iC4H10/CS2 95/5/1.4 gas mixture
- Drift field is $-150\,\mathrm{V/cm}$ to $-400\,\mathrm{V/cm}$
- Grid voltage is $-380\,\mathrm{V}$

Diffusion in pixel plane

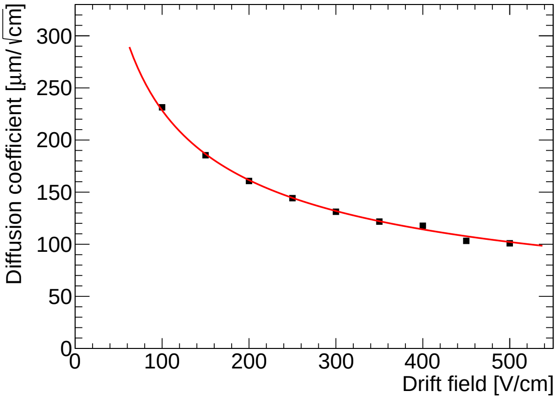
Run 1042



$$\sigma_x^2 = D_T^2 z + \sigma_{x0}^2$$

Diffusion as a function of E-field

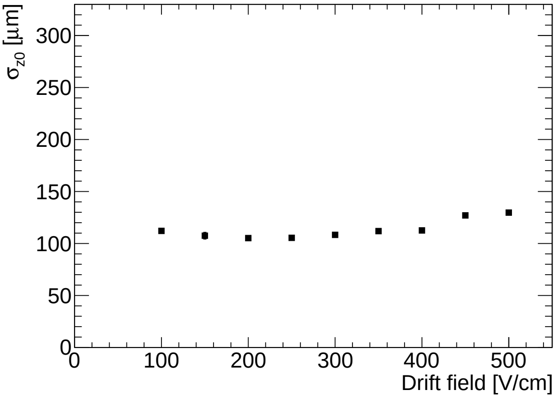
Run 1043 – 1051



Fitted with $c/\sqrt{E}$

σ_{x0} as a function of E-field

Run 1043 – 1051



Fit of all z-residual slices per run

Use exponentially modified Gaussian distribution for main peak:
exGaus(constant, σ, λ, μ*)* $+$ *gaus(constant*$_2, \sigma_2, \mu_2$*)*$+$ *offset*

Global fit (per run):

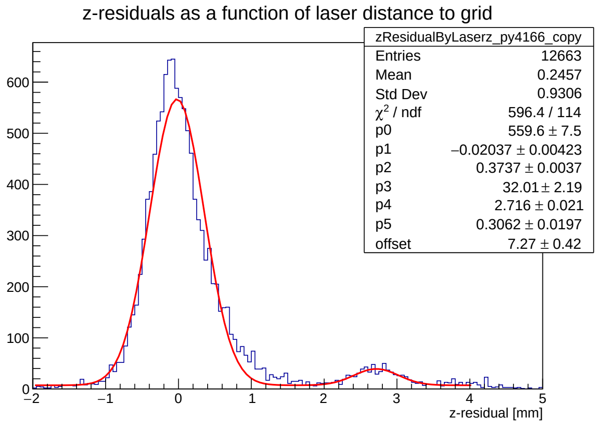
- ratio of peak heights (fixes constant$_2$)
- exponential slope λ
- ratio of mobility (fixes μ_2)

Per slice:

- σ and σ_2
- 1 μ
- 1 constant
- offset

Fit of z-residuals at a specific drift distance

Run 1050

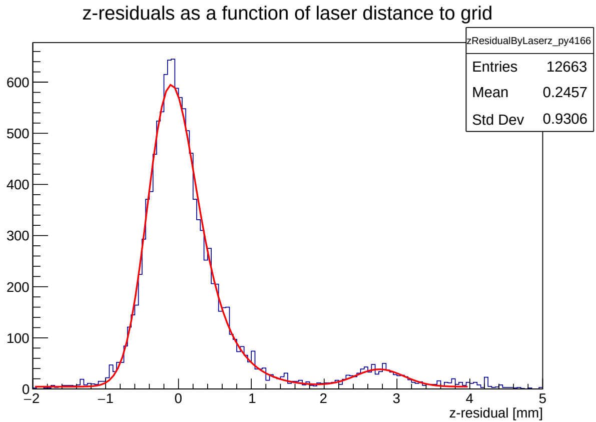


E-field is 450 V/cm and z = 36.66 mm

Fit with *gaus(p0,p1,p2)* + *gaus(p3,p4,p5)* + *offset*

Fit of z-residuals at a specific drift distance

Run 1050

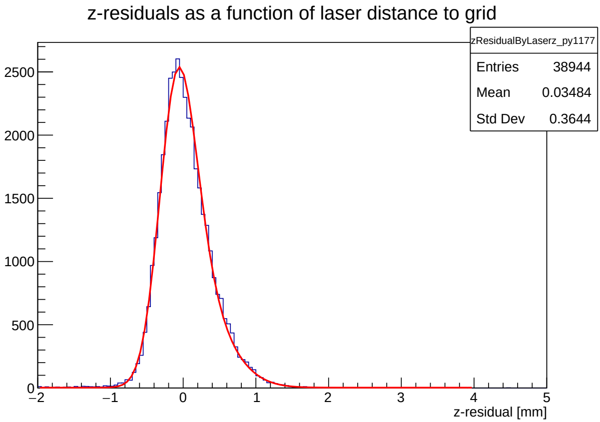


E-field is 450 V/cm and z = 36.66 mm

Fit with *exGaus(constant,* σ, λ, μ*)* + *gaus(constant*$_2, \sigma_2, \mu_2$*)*+ *offset*

Fit of z-residuals at a specific drift distance

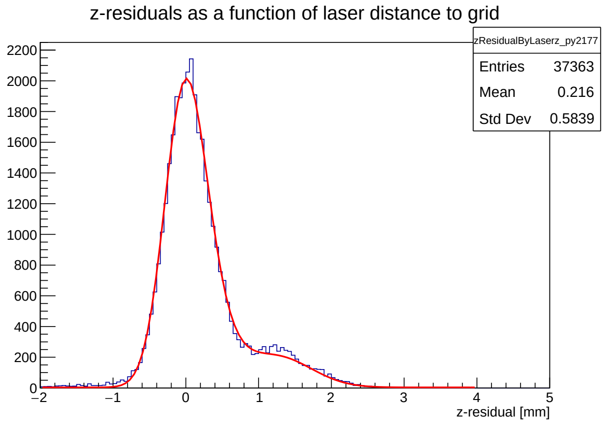
Run 1042



At $z = 6.76$ mm

Fit of z-residuals at a specific drift distance

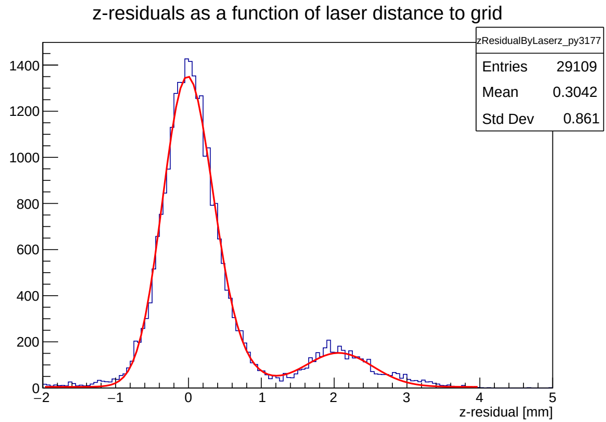
Run 1042



At $z = 16.77$ mm

Fit of z-residuals at a specific drift distance

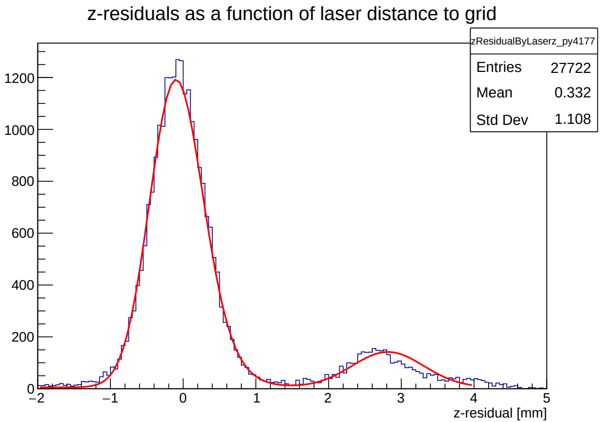
Run 1042



At $z = 26.77$ mm

Fit of z-residuals at a specific drift distance

Run 1042

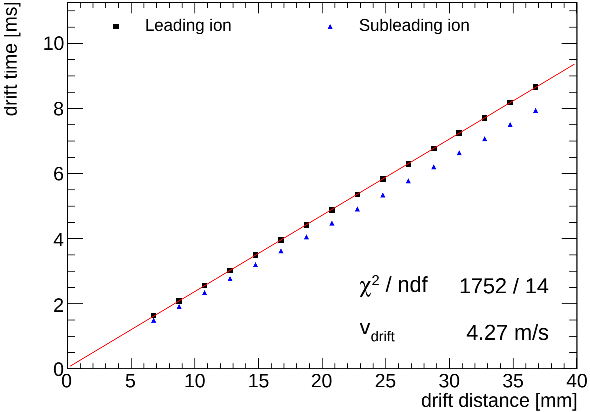


At z = 36.77 mm

Fit the second peak also with an exponentially modified Gaussian?

Drift velocity

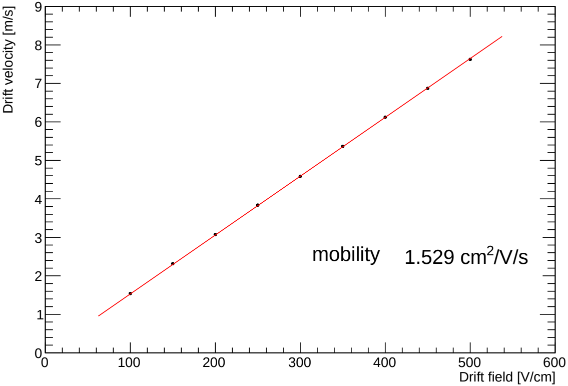
Run 1042



The first peaks lags the second peak by approximately 8%

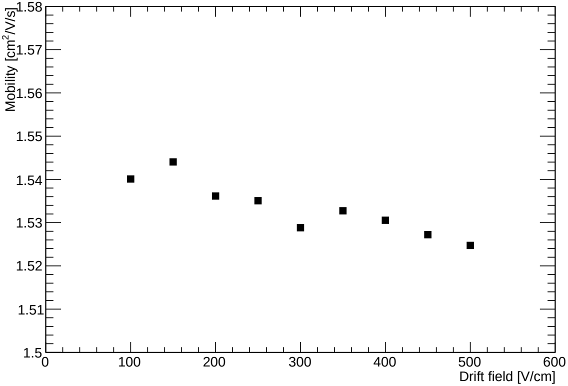
Drift velocity by E-field

Run 1043 – 1051



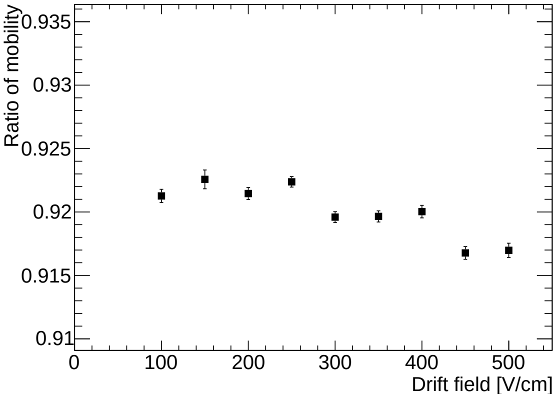
Ion mobility

Run 1043 – 1051



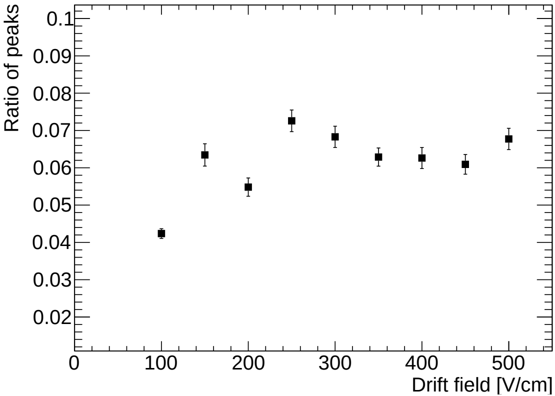
Ion mobility ratio

Run 1043 – 1051



Ratio of ion peak height

Run 1043 – 1051



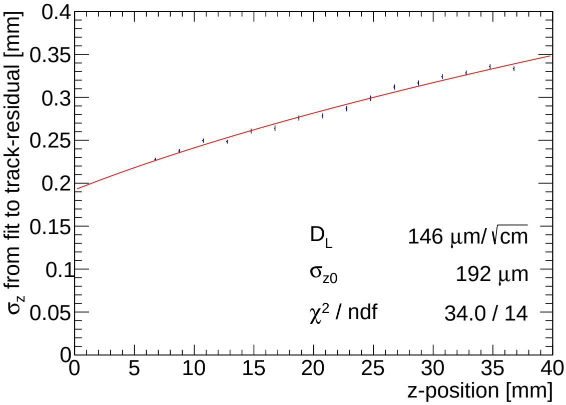
The height of the second peaks is about 6% of the first peak height

As Jan noted, the integral should be compared instead

Diffusion in drift direction

Run 1042

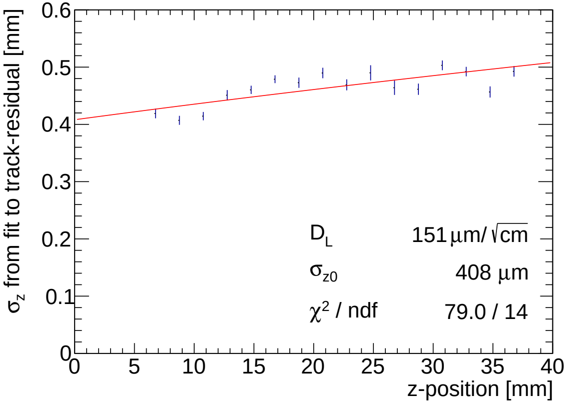
from width of leading peak



$$\sigma_z^2 = D_L^2 z + \sigma_{z0}^2$$

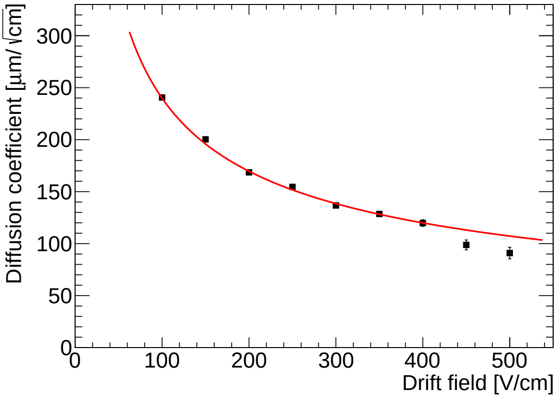
Diffusion in drift direction of subleading peak

Run 1042



Diffusion coefficient as a function of E-field

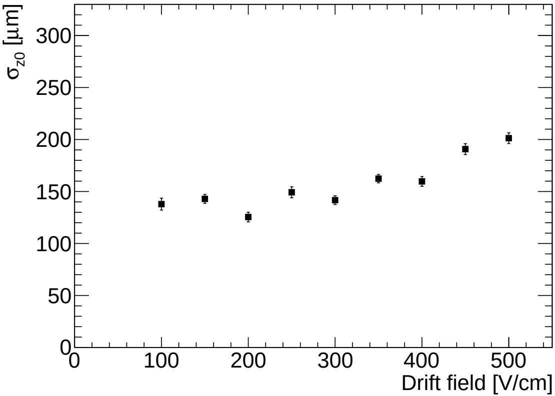
Run 1043 – 1051



Fitted with $c/\sqrt{E}$

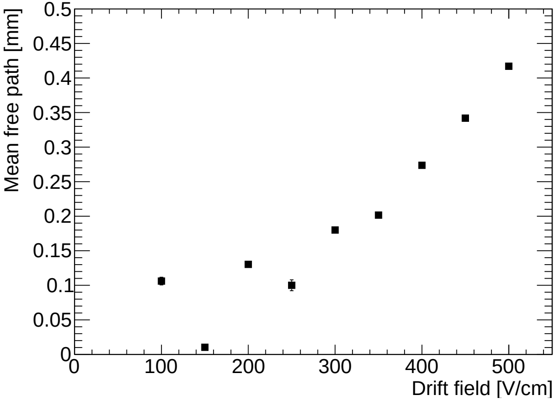
σ_{z0} as a function of E-field

Run 1043 – 1051



Mean free path as a function of E-field

Run 1043 – 1051



Conclusions

- The diffusion coefficients behave as expect
- The drift velocity and mobility can be determined
- At large field strengths, the mean free path is not negligible
- A global fit using a exponentially modified Gaussian improves the fit

Next steps:

- Fit the second peak also with (the same?) exponential Gaussian
- Take a high statistics run and try to resolve some ion peaks