Negative ion measurements

Kees Ligtenberg

Lepcol meeting

March 22, 2020



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Negative ion measurements by Fred

Run 1042

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

Run 1043 - 1051

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

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Diffusion in pixel plane Run 1042



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

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Diffusion as a function of E-field Run 1043 – 1051



Fitted with c/\sqrt{E}

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 $\sigma_{\rm x0}$ as a function of E-field Run 1043 – 1051



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Fit of all z-residual slices per run

Use exponentially modified Gaussian distribution for main peak: exGaus(constant, σ , λ , μ) + gaus(constant₂, σ_2 , μ_2)+ offset

Global fit (per run):

- ratio of peak heights (fixes constant₂)
- exponential slope λ
- ratio of mobility (fixes μ_2)

Per slice:

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

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Fit of z-residuals at a specific drift distance $_{\mathsf{Run}\ 1050}$



E-field is 450 V/cm and z = 36.66 mmFit with gaus(p0,p1,p2) + gaus(p3,p4,p5) + offset

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Fit of z-residuals at a specific drift distance $_{\mathsf{Run}\ 1050}$



E-field is 450 V/cm and z = 36.66 mm Fit with $exGaus(constant, \sigma, \lambda, \mu) + gaus(constant_2, \sigma_2, \mu_2) + offset$

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Fit of z-residuals at a specific drift distance Run 1042



At z = 6.76 mm

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Fit of z-residuals at a specific drift distance Run 1042



At z = 16.77 mm

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Fit of z-residuals at a specific drift distance Run 1042



At z = 26.77 mm

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Fit of z-residuals at a specific drift distance $_{\mathsf{Run}\ 1042}$



At z = 36.77 mm Fit the second peak also with an exponentially modified Gaussian?

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Drift velocity Run 1042



The first peaks lags the second peak by approximately 8%

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Drift velocity by E-field Run 1043 - 1051



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lon mobility Run 1043 – 1051



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lon mobility ratio Run 1043 – 1051



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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

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Diffusion in drift direction

Run 1042

from width of leading peak



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

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Diffusion in drift direction of subleading peak Run 1042



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Diffusion coefficient as a function of E-field Run 1043 – 1051



Fitted with c/\sqrt{E}

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 σ_{z0} as a function of E-field Run 1043 - 1051



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Mean free path as a function of E-field Run 1043 – 1051



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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

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