VDC Resolution Check

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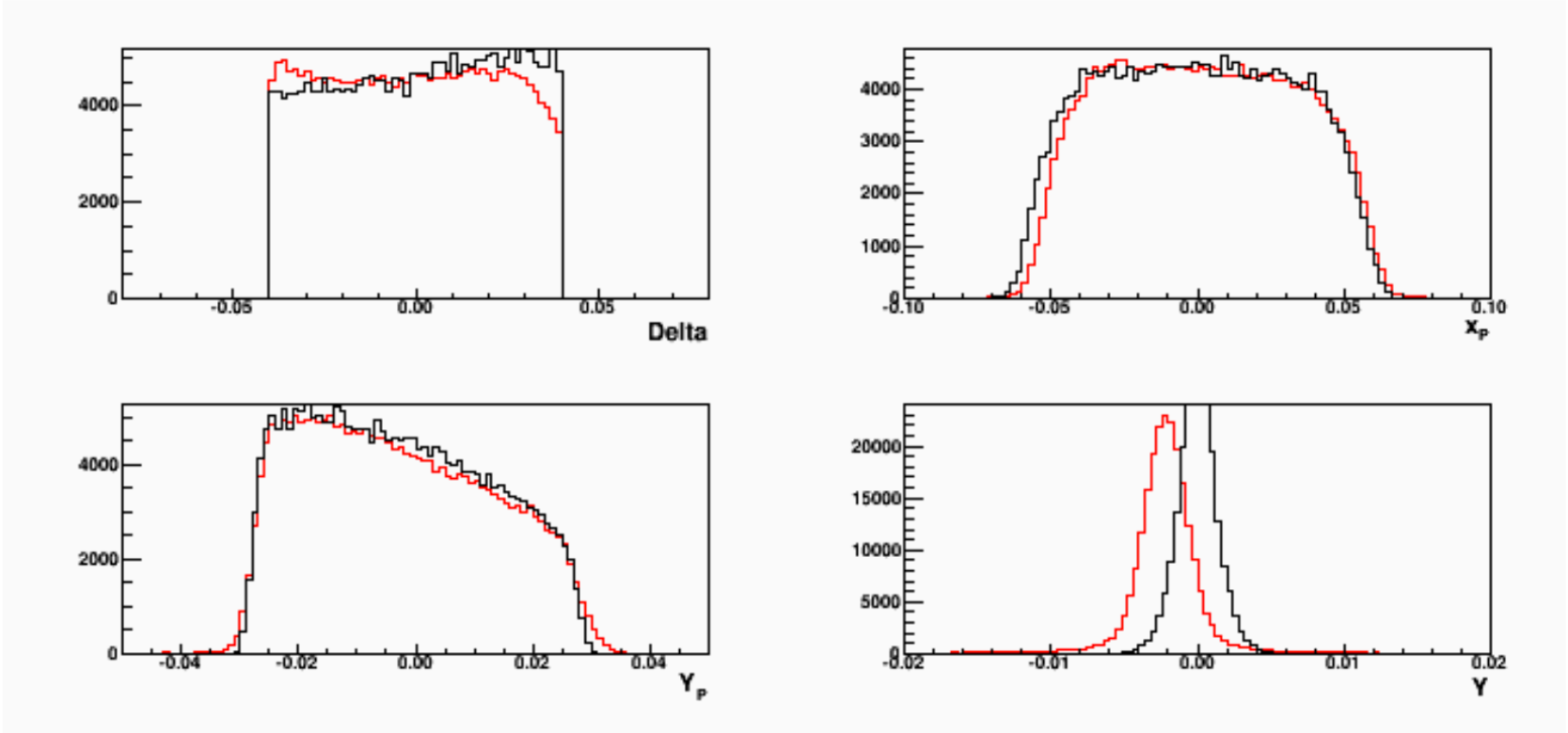
with Longwu, Yang, Barak
March, 2017

- Motivation:

In delta scan comparison, we saw different ytar resolution in data and simulation. (pics from Dien)



- Motivation:

In delta scan comparison, we saw different ytar resolution in data and simulation.

Things to check in simulation code:

1. multiple scattering
2. energy loss
3. VDC resolution

Vertical drift chambers for the Hall A high-resolution spectrometers at Jefferson Lab

K.G. Fissum[a,*], W. Bertozzi[a], J.P. Chen[a,1], D. Dale[a,2], H.C. Fenker[b], J. Gao[a,3], A. Gavalya[b], S. Gilad[a], C.R. Leathers[a,4], N. Liyanage[a,1], R.O. Michaels[b], E.A.J.M. Offermann[b,5], J. Segal[b], J.A. Templon[a,6], R. Wechsler[a,7], B. Wojtsekhowski[b], J. Zhao[a,8]

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VDC time resolution

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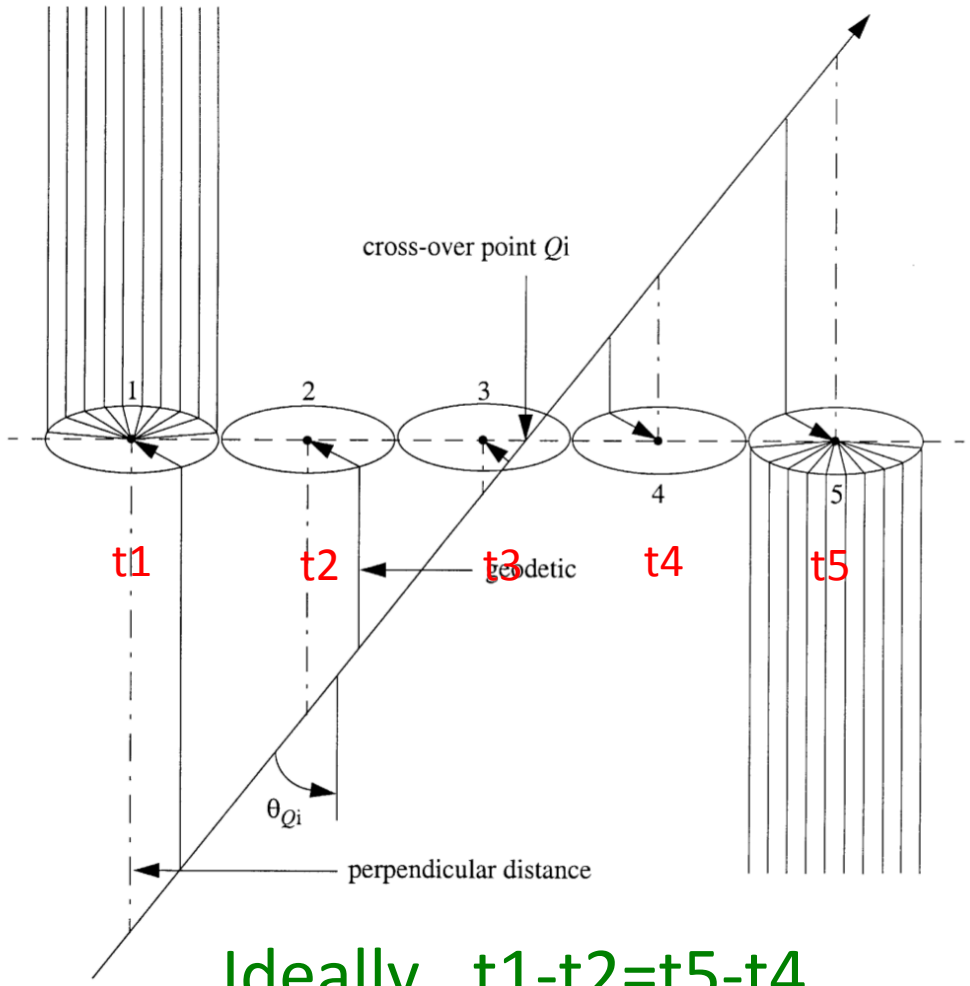
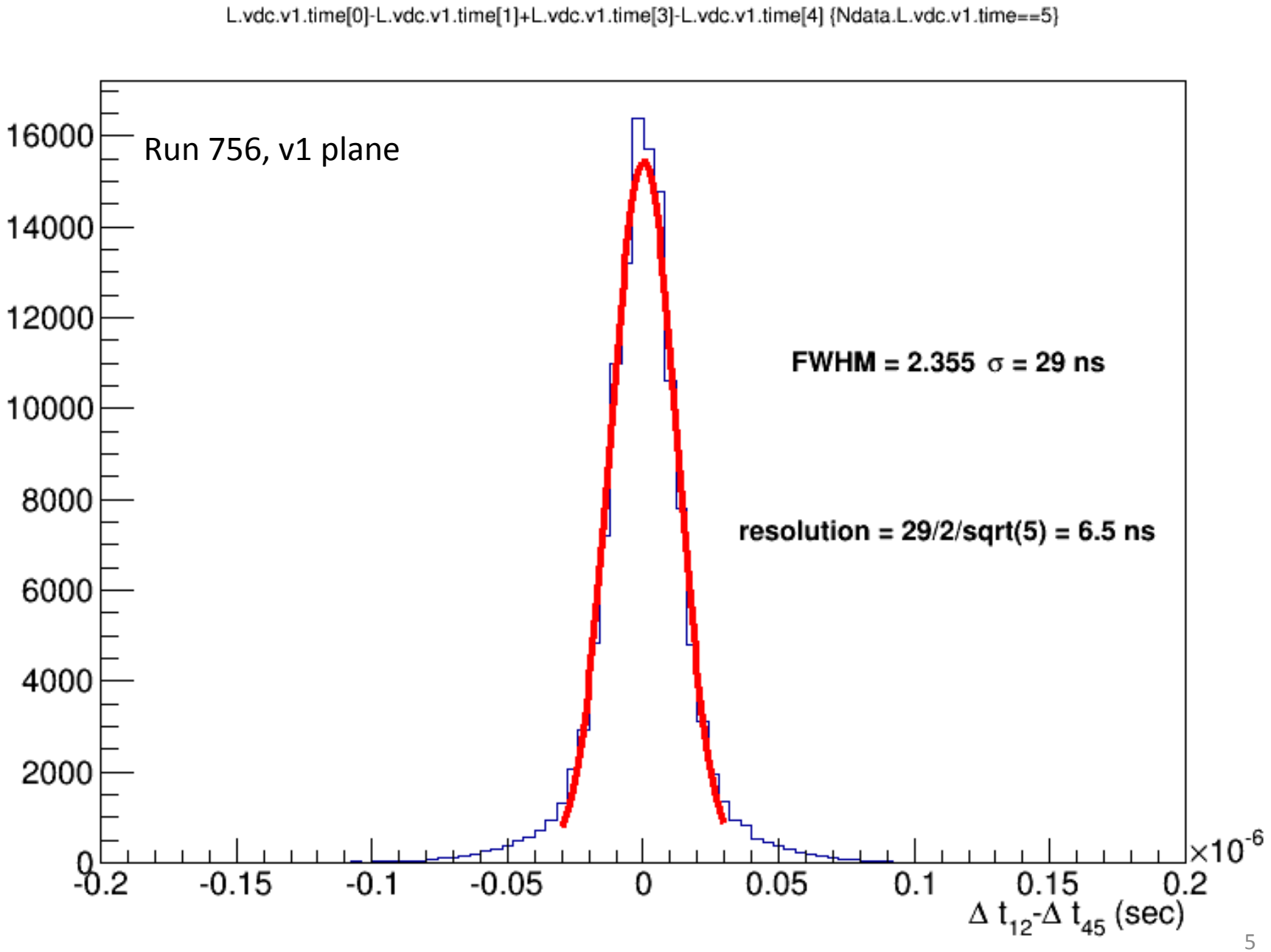


Drift time: t1 t2 t3 t4 t5

Ideally, t1-t2=t5-t4


L.vdc.v1.time[0]-L.vdc.v1.time[1]+L.vdc.v1.time[3]-L.vdc.v1.time[4] {Ndata.L.vdc.v1.time==5}
Run 756, v1 plane
FWHM = 2.355 σ = 29 ns
resolution = 29/2/sqrt(5) = 6.5 ns
16000
14000
12000
10000
8000
6000
4000
2000
0
-0.2
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
0.2
×10^-6
Δ t12-Δ t45 (sec)

VDC time resolution was 4.5 ns on NIM paper

Gmp got 6.5 ns

Ar run 756 got 6.5 ns

What changed:

- New readout card

- high voltage from -4kV to -3.3 kV

VDC position resolution = time resolution x drift velocity

VDC Drift Velocity

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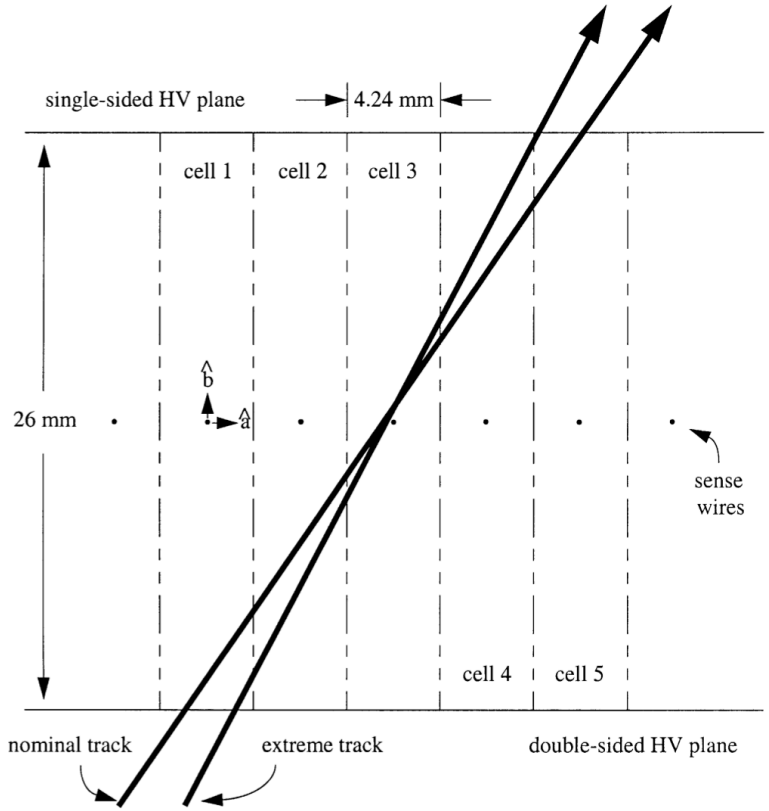


Field strength

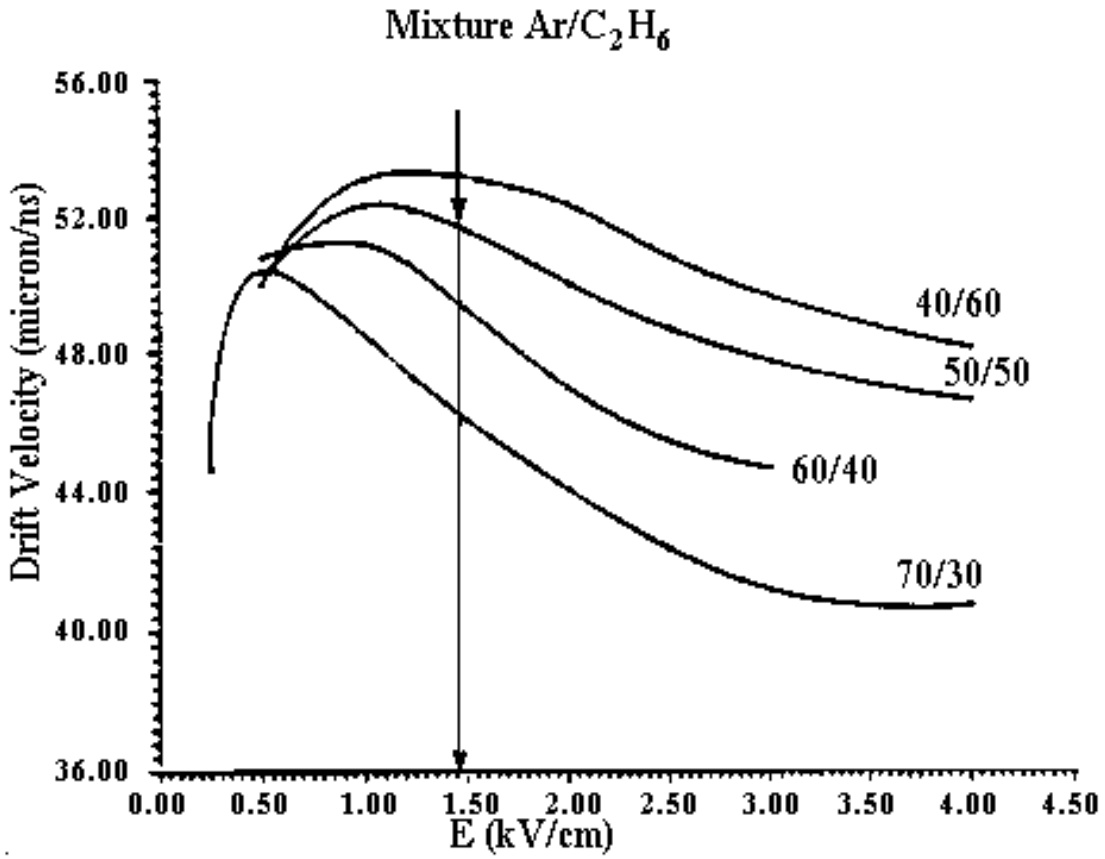
3.3 kV/(26mm/2) = 2.54 kV/cm
4 kV /(26mm/2) = 3.08 kV/cm

VDC Drift Velocity

Electron drift velocity in 50/50 Ar/Ethane gas is:

~ 50 um/ns @ 2. 54 kV/cm -> 3.3 kV

~ 49 um/ns @ 3.08 kV/cm -> 4.0 kV



https://www.phenix.bnl.gov/WWW/tracking/dc/experts/Drift_Chamber__Principle_of_operation.html

- Drift velocity from database:

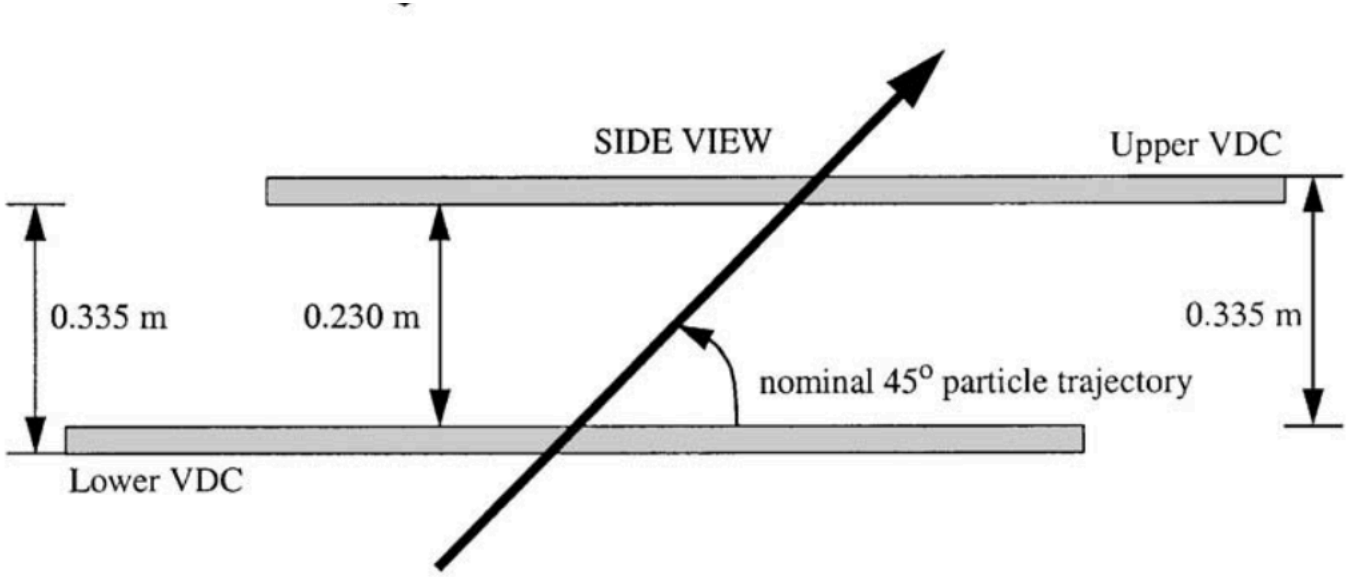
  49710 m/s = 49.7 um/ns for V1

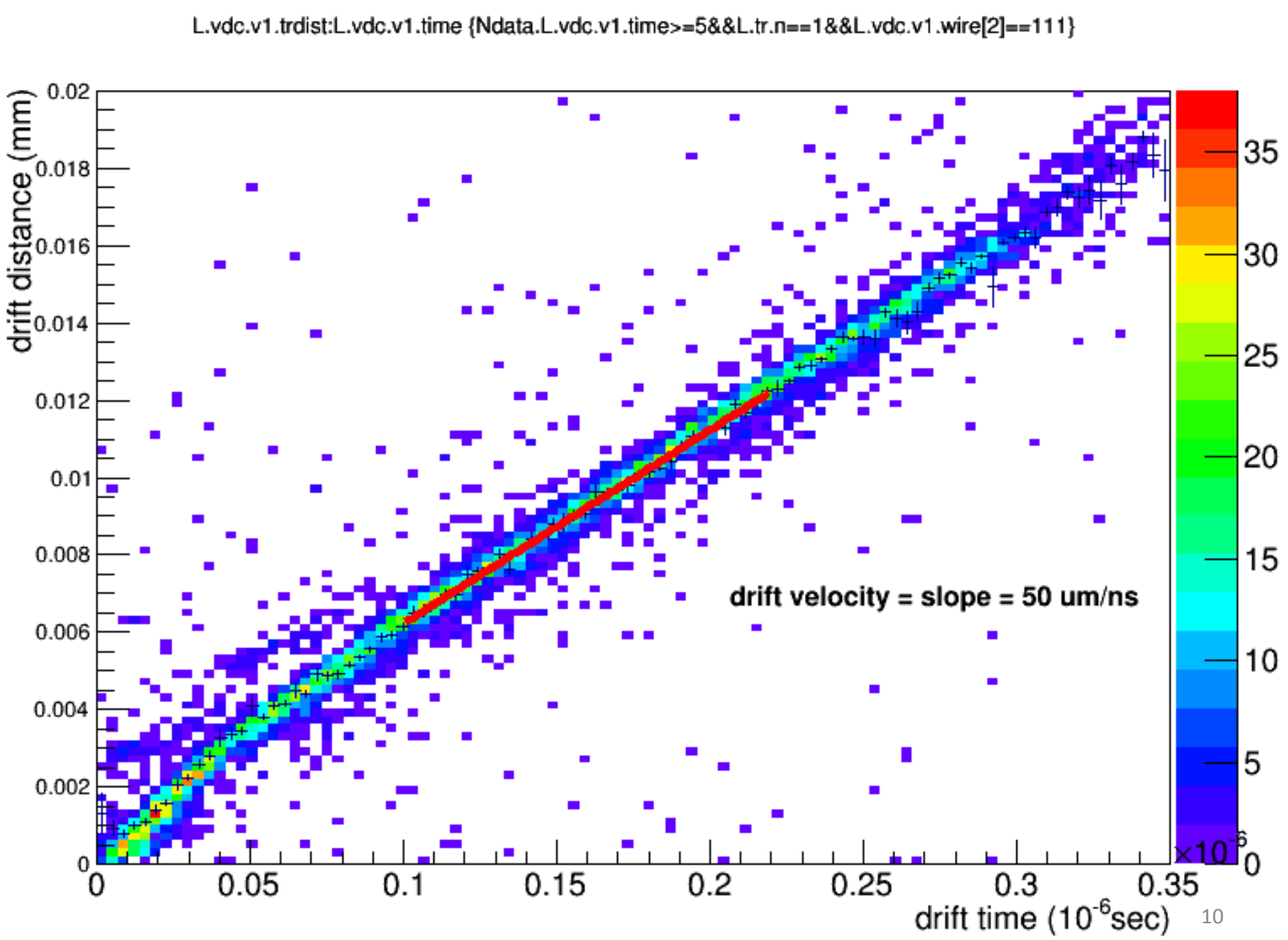
- Drift velocity from data:

  Velocity = drift distance / drift time

~~L.vdc.v1.dist: drift time x velocity from database~~

L.vdc.v1.trdist: distance from wire to reconstructed track




L.vdc.v1.trdist:L.vdc.v1.time {Ndata.L.vdc.v1.time>=5&&L.tr.n==1&&L.vdc.v1.wire[2]==111}
drift distance (mm)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
drift time (10^{-6}sec)
drift velocity = slope = 50 um/ns
35
30
25
20
15
10
5
0
$\times 10^{-6}$

VDC Position Resolution

- From NIM paper: 4.5ns x 50 um/ns = 225 um
- From this study: 6.5ns x 50 um/ns = 325 um