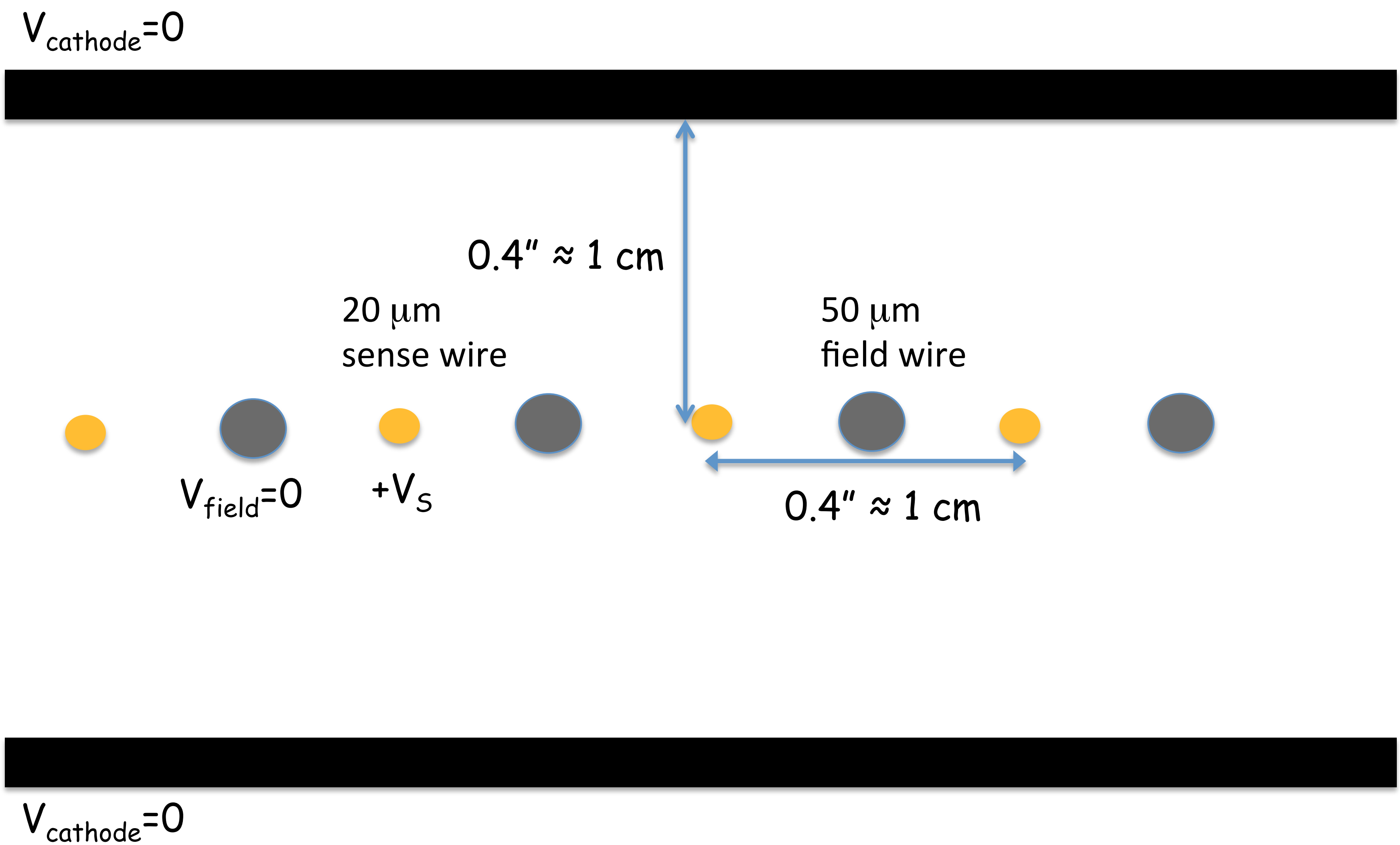
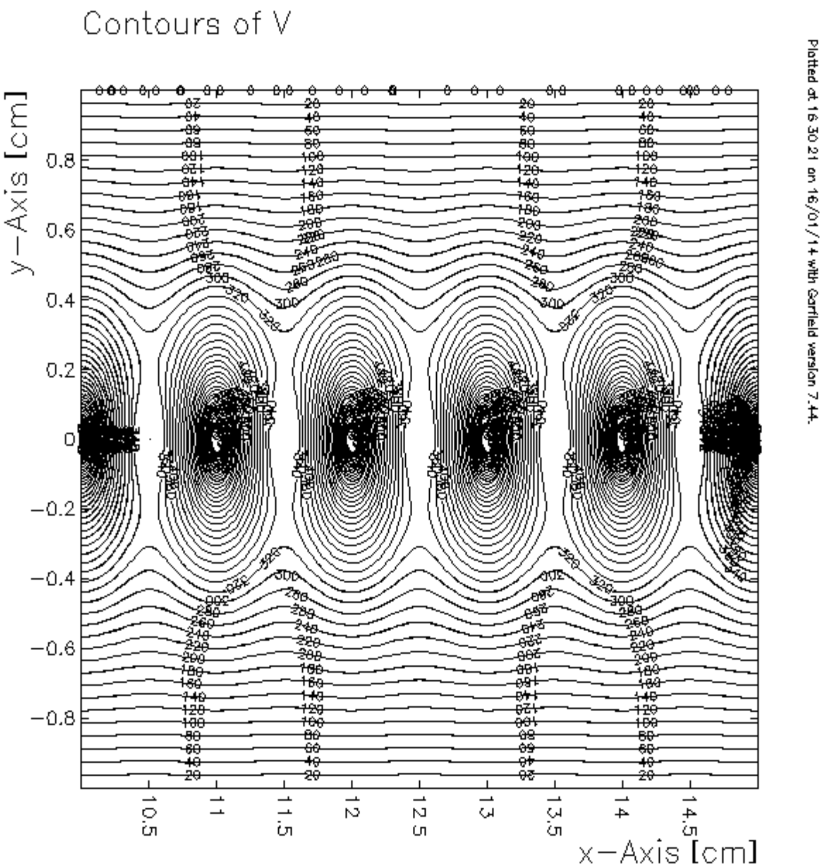
June 20, 2017

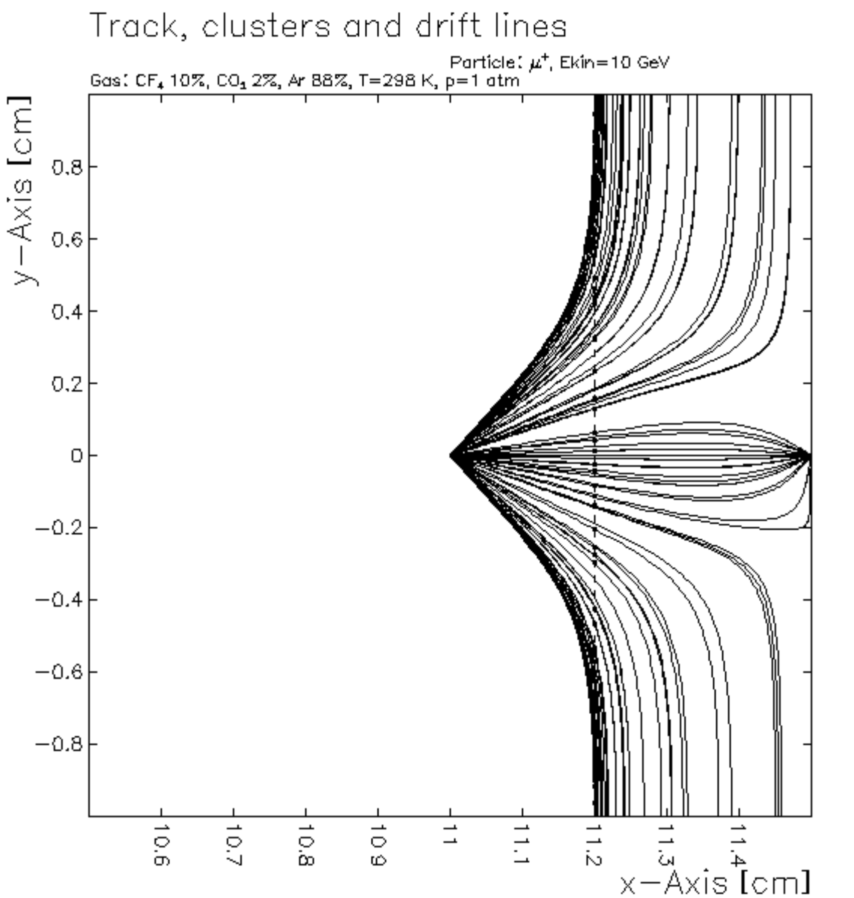
MWPC Latency



Cathode planes honeycomb plate



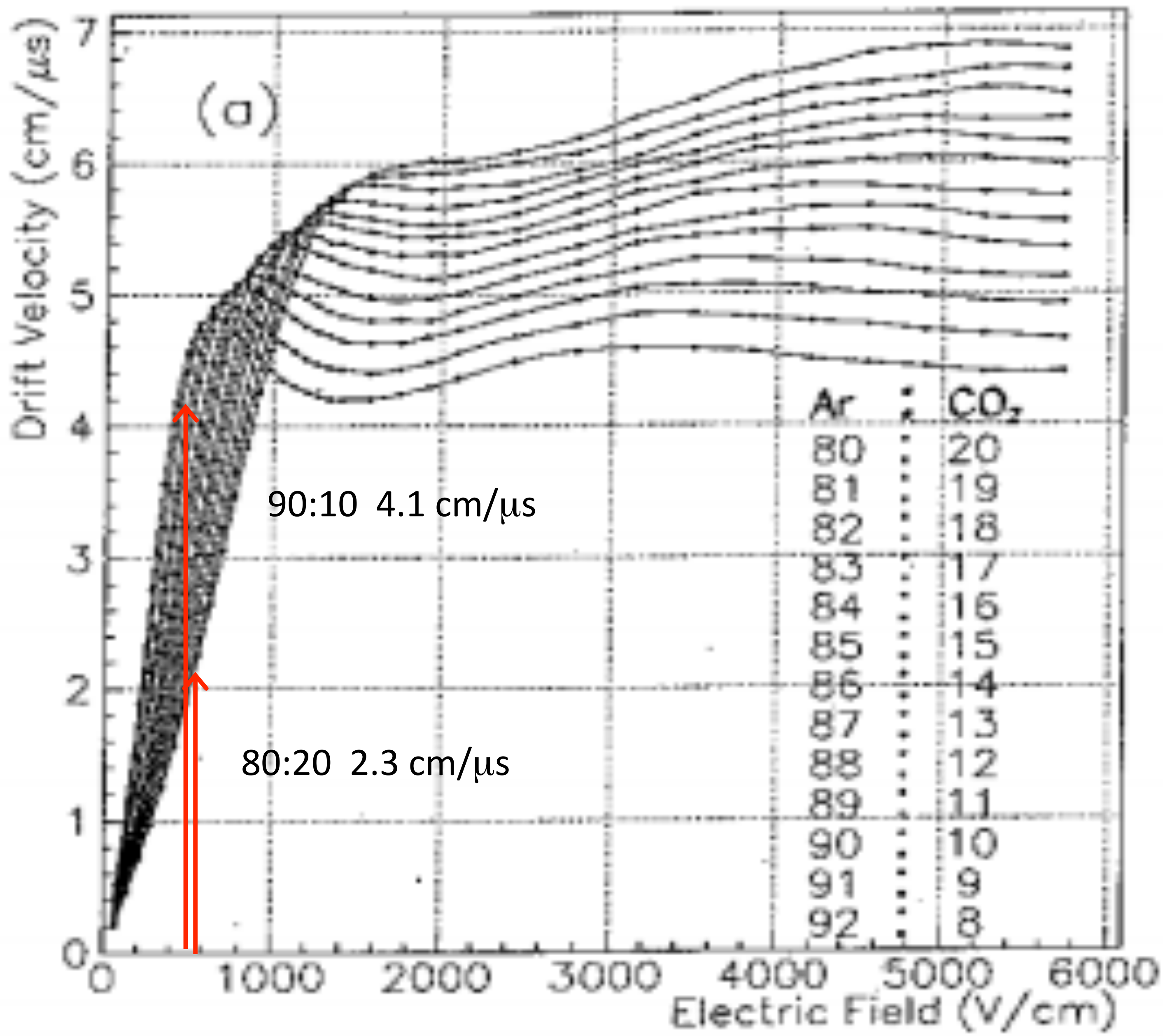
Contours of V
y−Axis [cm]
x−Axis [cm]
Plotted at 16.30.21 on 16/01/14 with Garfield version 7.44.



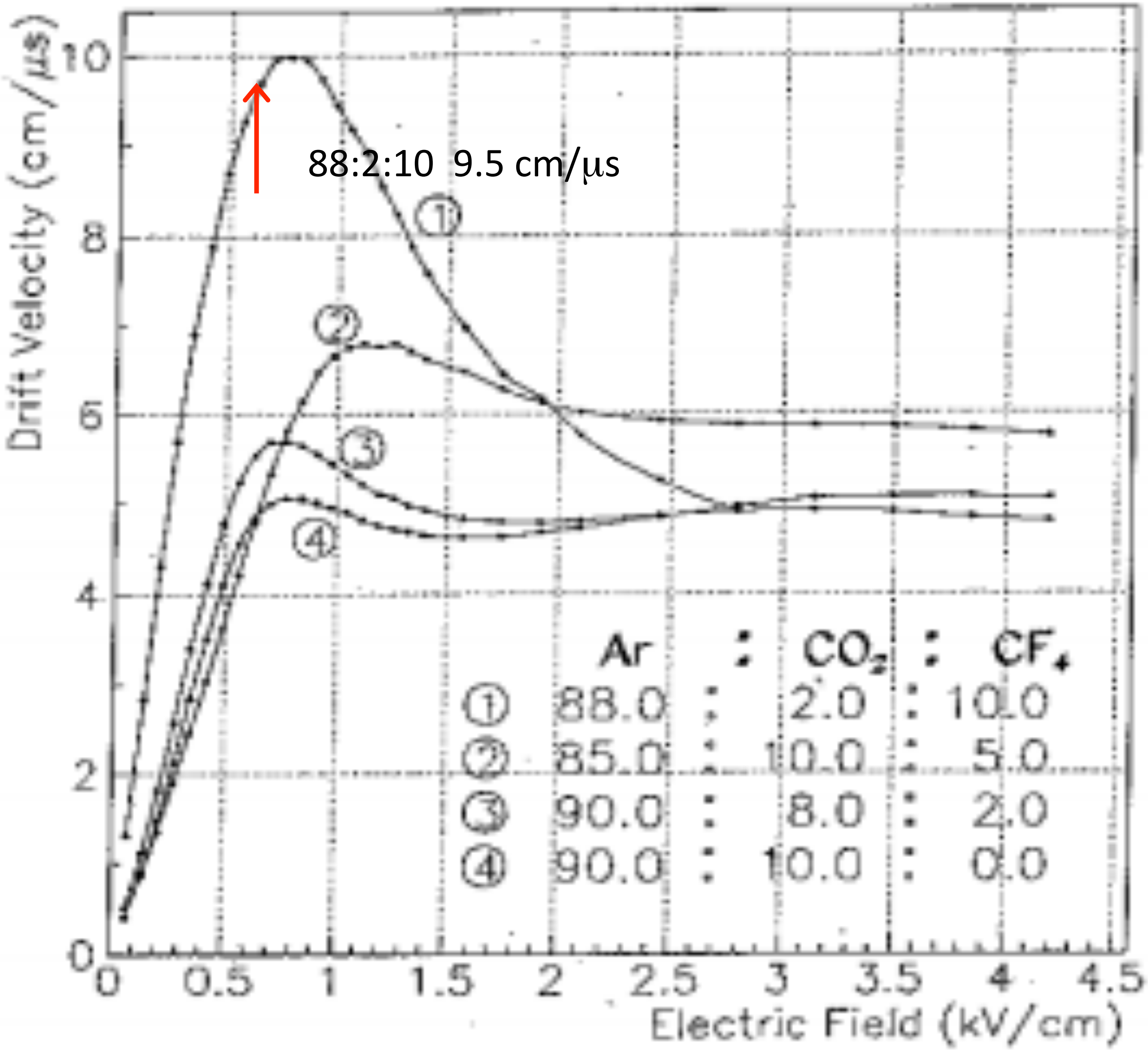
Track, clusters and drift lines
Particle: μ+, Ekin=10 GeV
Gas: CF4 10%, CO2 2%, Ar 88%, T=298 K, p=1 atm
y−Axis [cm]
x−Axis [cm]
Plotted at 16.25.47 on 16/01/14 with Garfield version 7.44.

Case 2

Gas	V @ 10^5 gain	Electric field @ cathode plane V/cm
Ar:CO_2 80:20	+2020 V	570
Ar:CO_2 90:10	+1820 V	513
Ar:CO_2-Freon 80:2:18	+2125 V	601

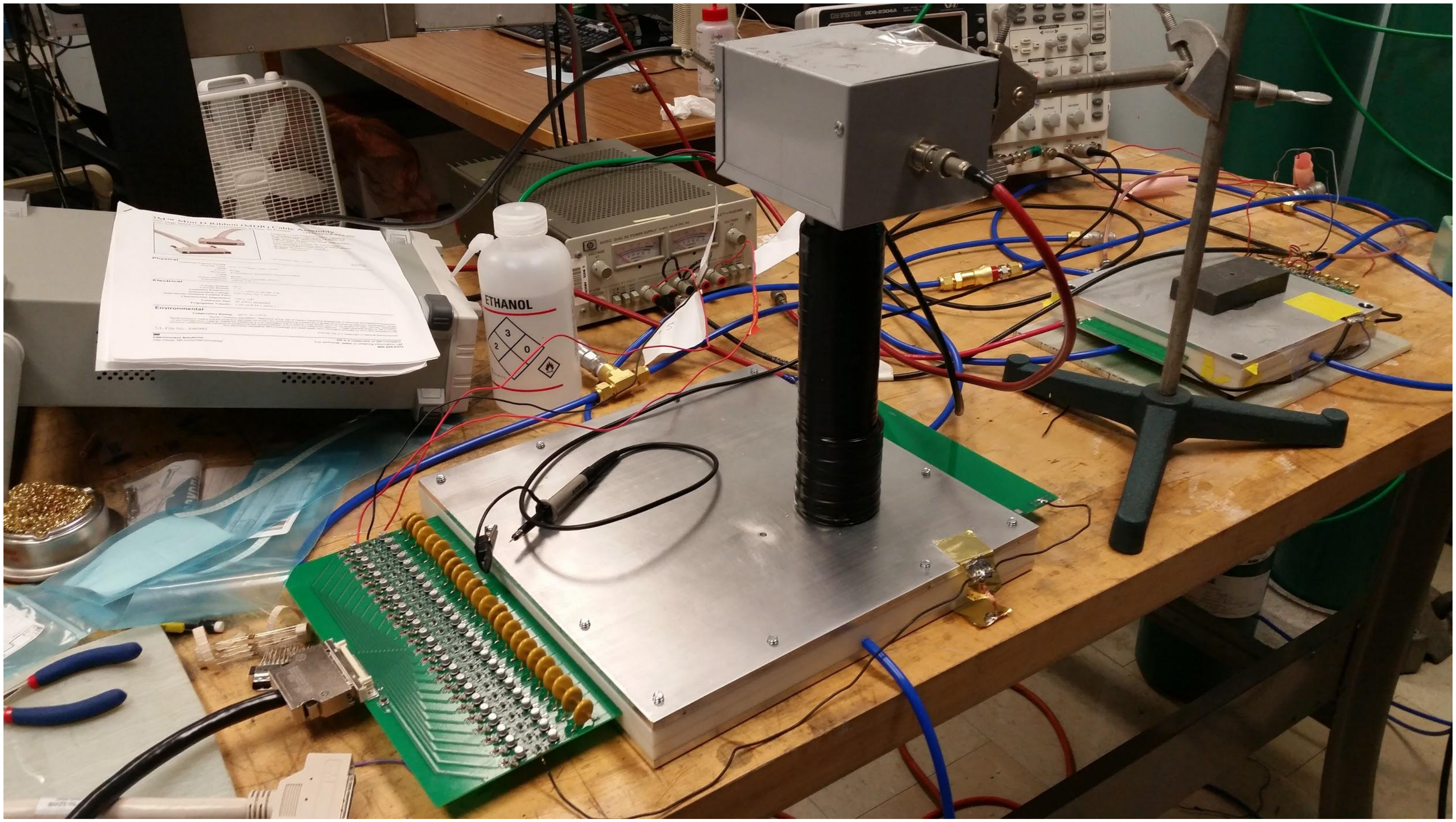


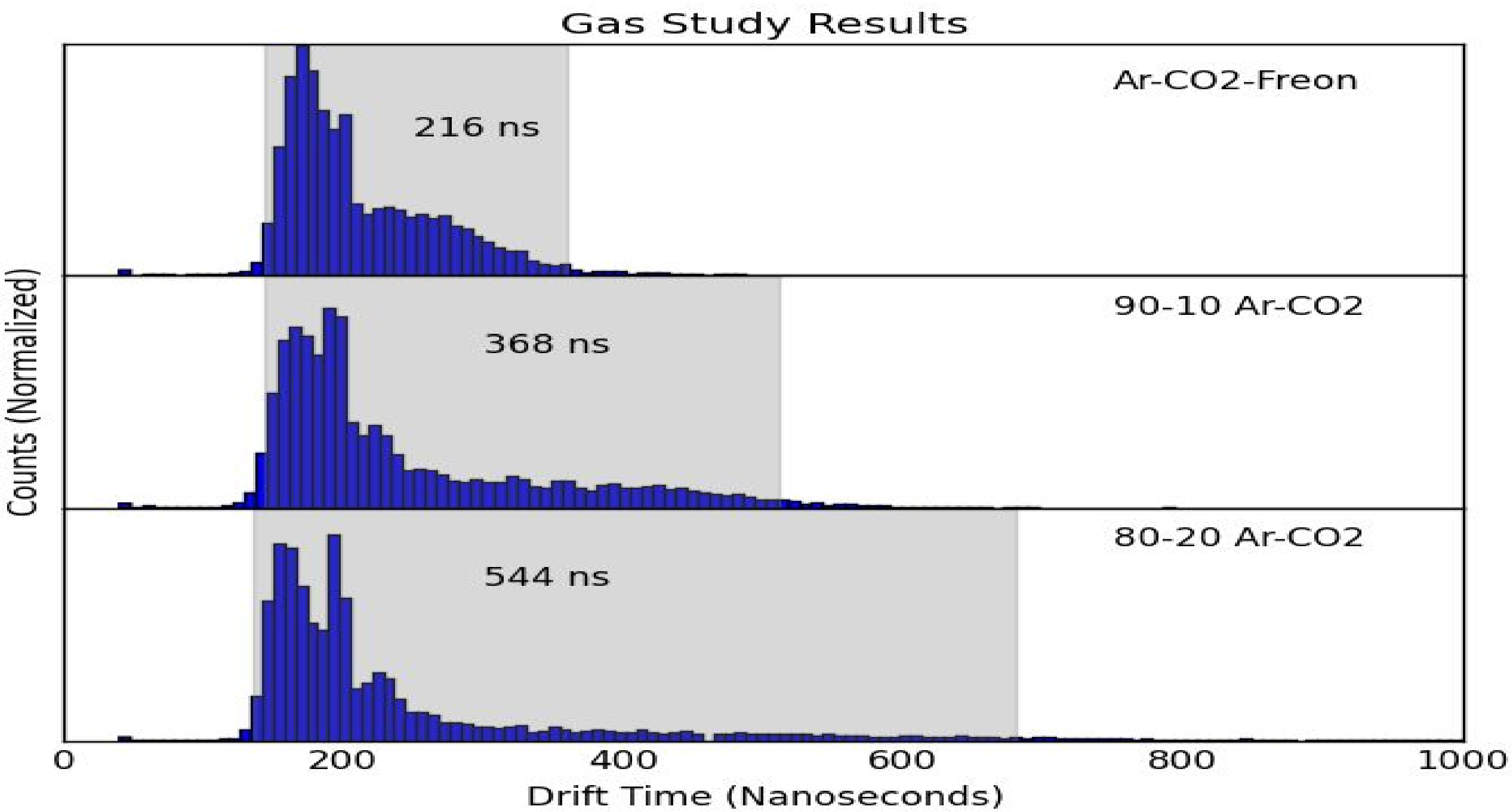
Zhao et al, Nucl. Inst. & Methods, 1993



Zhao et al, Nucl. Inst. & Methods, 1993

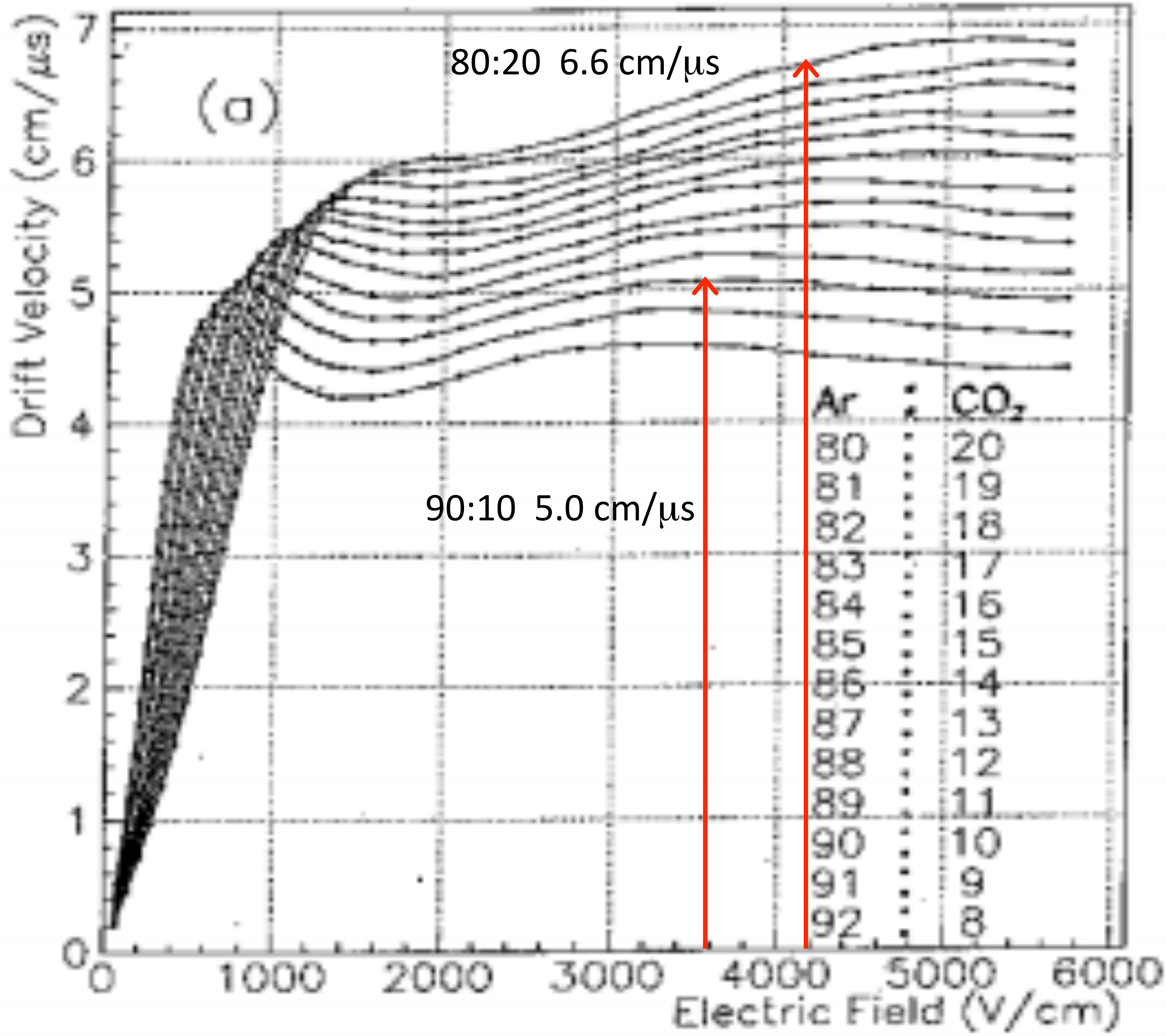
Gas	V @ 10^5 gain	Electric field @ cathode plane V/cm	Drift velocity cm/μs	Time to travel from cathode to sense wire, 1 cm (ns)
Ar:CO_2 80:20	+2020 V	570	2.3	434
Ar:CO_2 90:10	+1820 V	513	4.1	243
Ar:CO_2-Freon 80:2:18	+2125 V	601	9.5	105


ETHANOL

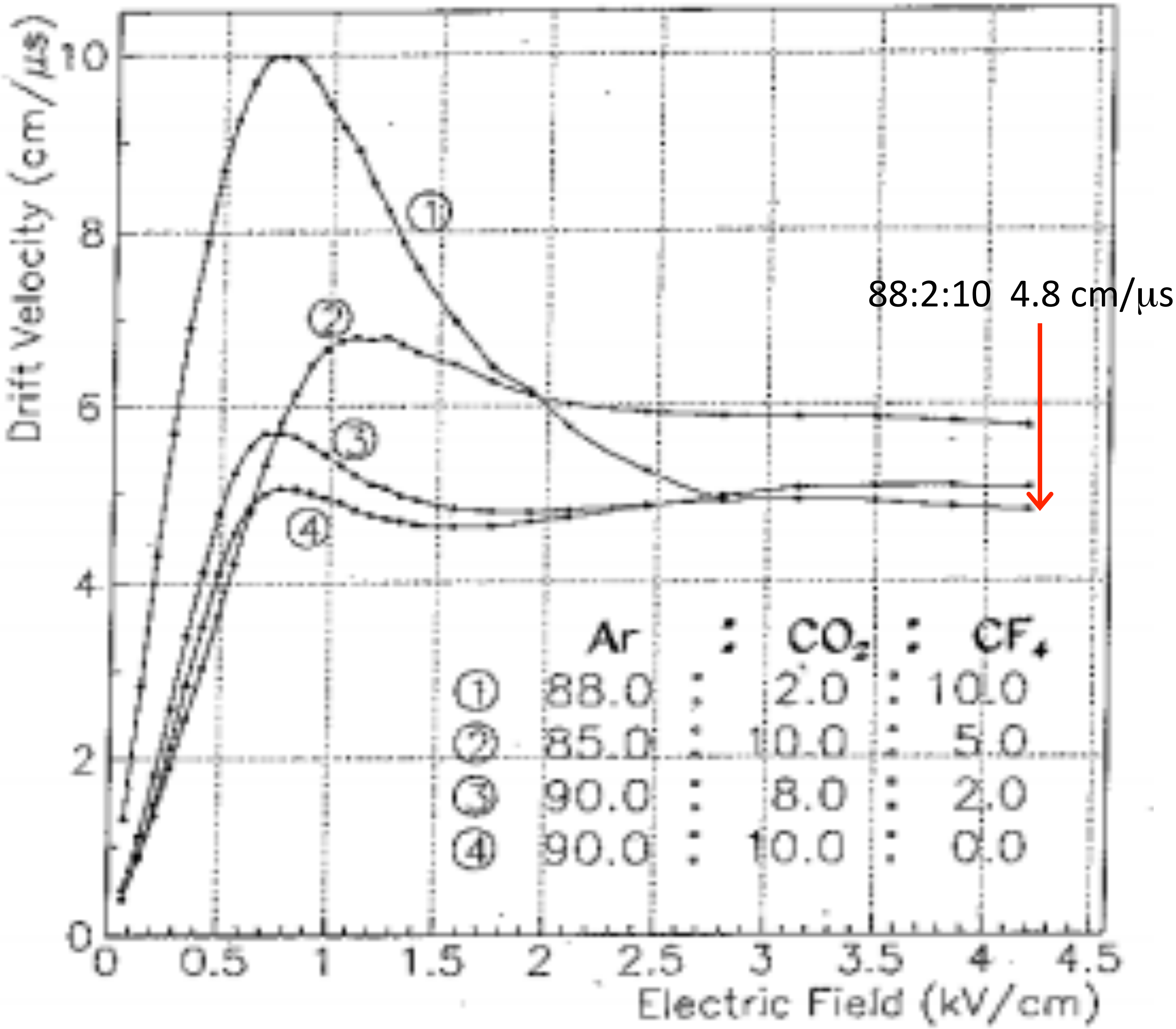


Analyzing the signal from all wires

Gas	V @ 10^5 gain	Average electric field between sense and field wires	Drift velocity (cm/μs)	Time to travel from field to sense wire, 0.5 cm (ns)
Ar:CO_2 80:20	+2020 V	4040 V/cm		
Ar:CO_2 90:10	+1820 V	3640 V/cm		
Ar:CO_2-Freon 80:2:18	+2125 V	4250 V/cm		

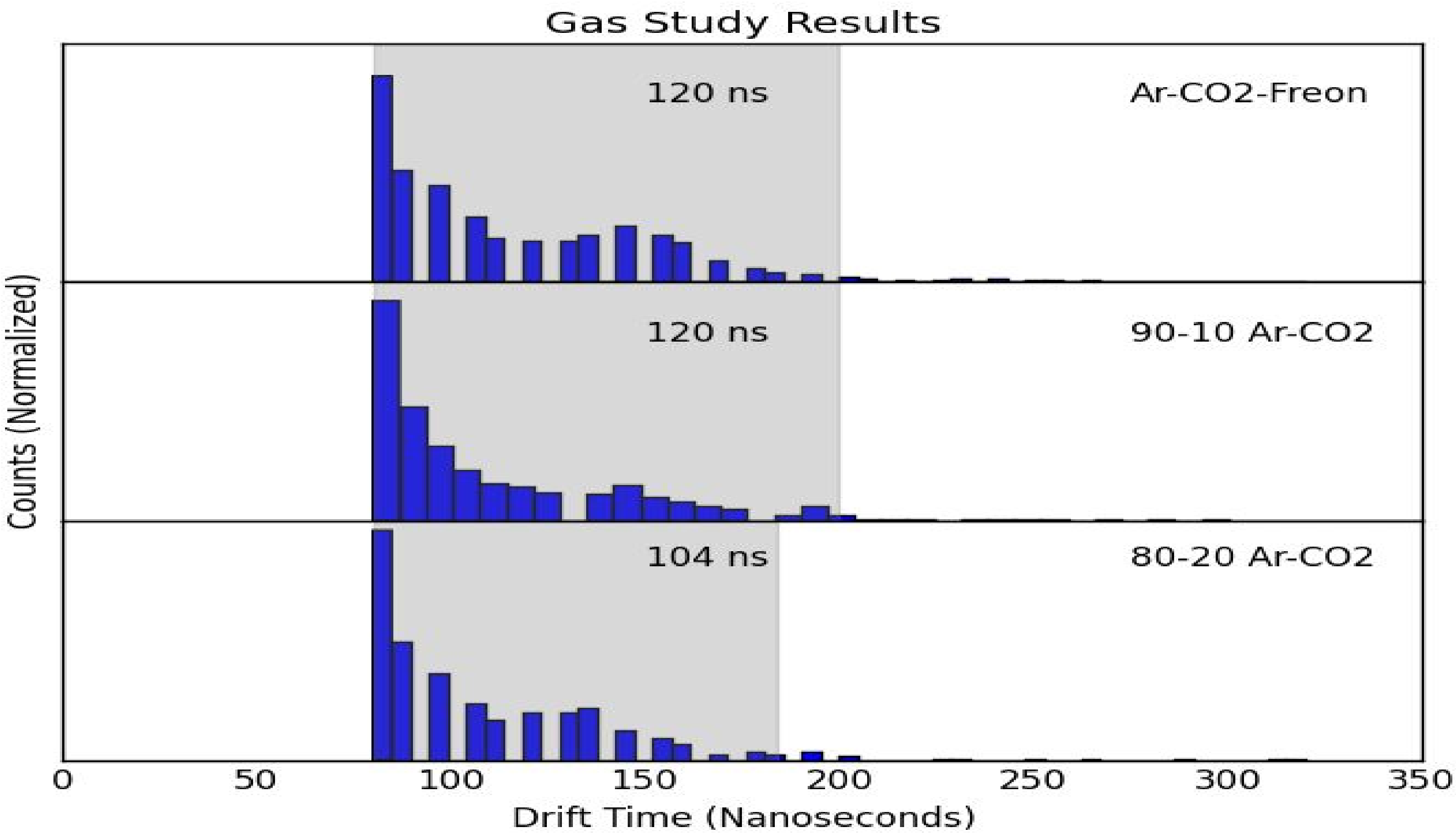


Zhao et al, Nucl. Inst. & Methods, 1993



Zhao et al, Nucl. Inst. & Methods, 1993

Gas	V @ 10^5 gain	Average electric field between sense and field wires	Drift velocity (cm/μs)	Time to travel from field to sense wire, 0.5 cm (ns)
$Ar:CO_2$ 80:20	+2020 V	4040 V/cm	6.6	76
$Ar:CO_2$ 90:10	+1820 V	3640 V/cm	5.0	100
$Ar:CO_2$-Freon 80:2:18	+2125 V	4250 V/cm	4.8	104



Just analyzing one wire (the 7th in, directly under the PMT)

Observations, questions, and conclusions

- Need to take more cosmic ray data with small prototype
- Latency depends on the trajectory of the track through the cell, and the chamber gas.
- For perpendicular track angles, latency is about 100 ns, nearly independent of gas.
- For tracks that clip the edge of a cell near the cathode plane, latency from 200 to 500 ns, depending on chamber gas.
- Do we care that ionization arrives late in a cell, provided that ionization in an adjacent cell is prompt?
- Comment: wire chambers are slow devices compared to scintillators. The advantage of wire chambers is in the higher segmentation that can be achieved: each wire is an independent detector. In the MVA we should utilize the information that comes from the 1 cm wire spacing. <u>Don't treat the MWPCs like very slow 1.5 x 1. 5 m^2 scintillators.</u>