Triple-GEM perfomance in He-based mixtures

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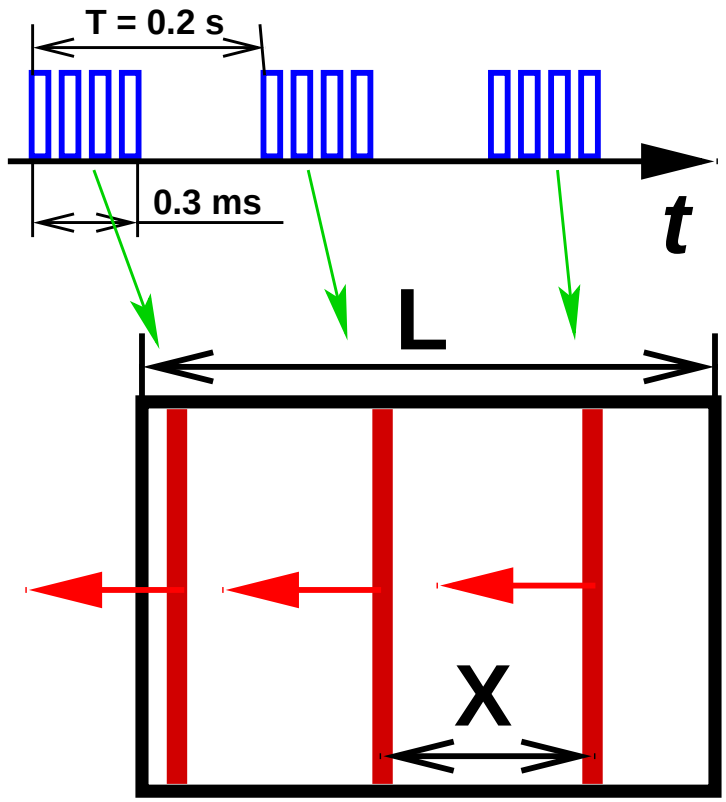


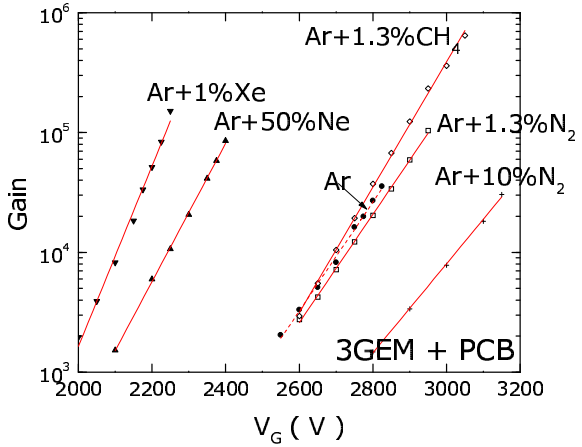
$$Q = \frac{L}{E\ K_0}\ i_{prim} \times Gain \times F$$

for micropattern detectors feedback is proportional to drift field, so Q does not depend on drift field!

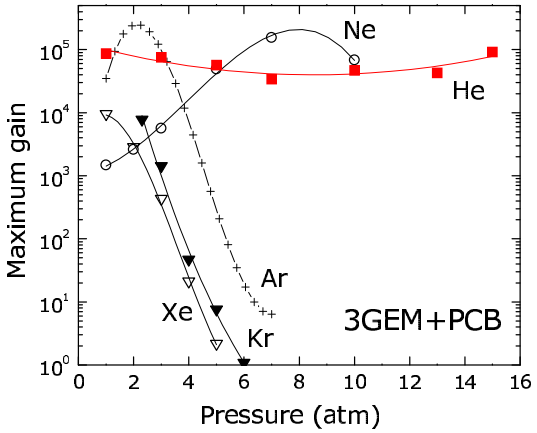
gas	He		Ne		Ar	
ion	He^+	He_2^+	Ne^+	Ne_2^+	Ar^+	Ar_2^+
$K_0, \frac{cm^2}{V \times s}$	10.4	16.7	4.1	6.5	1.5	1.86

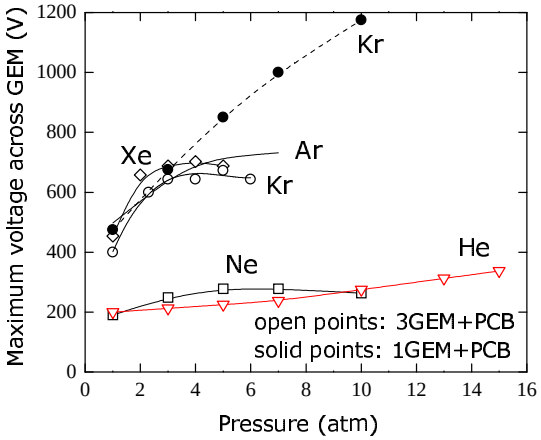
GEM operation in noble gases: previous results

Weismann Institute & Budker Institute & CERN: NIM A 443(2000)164

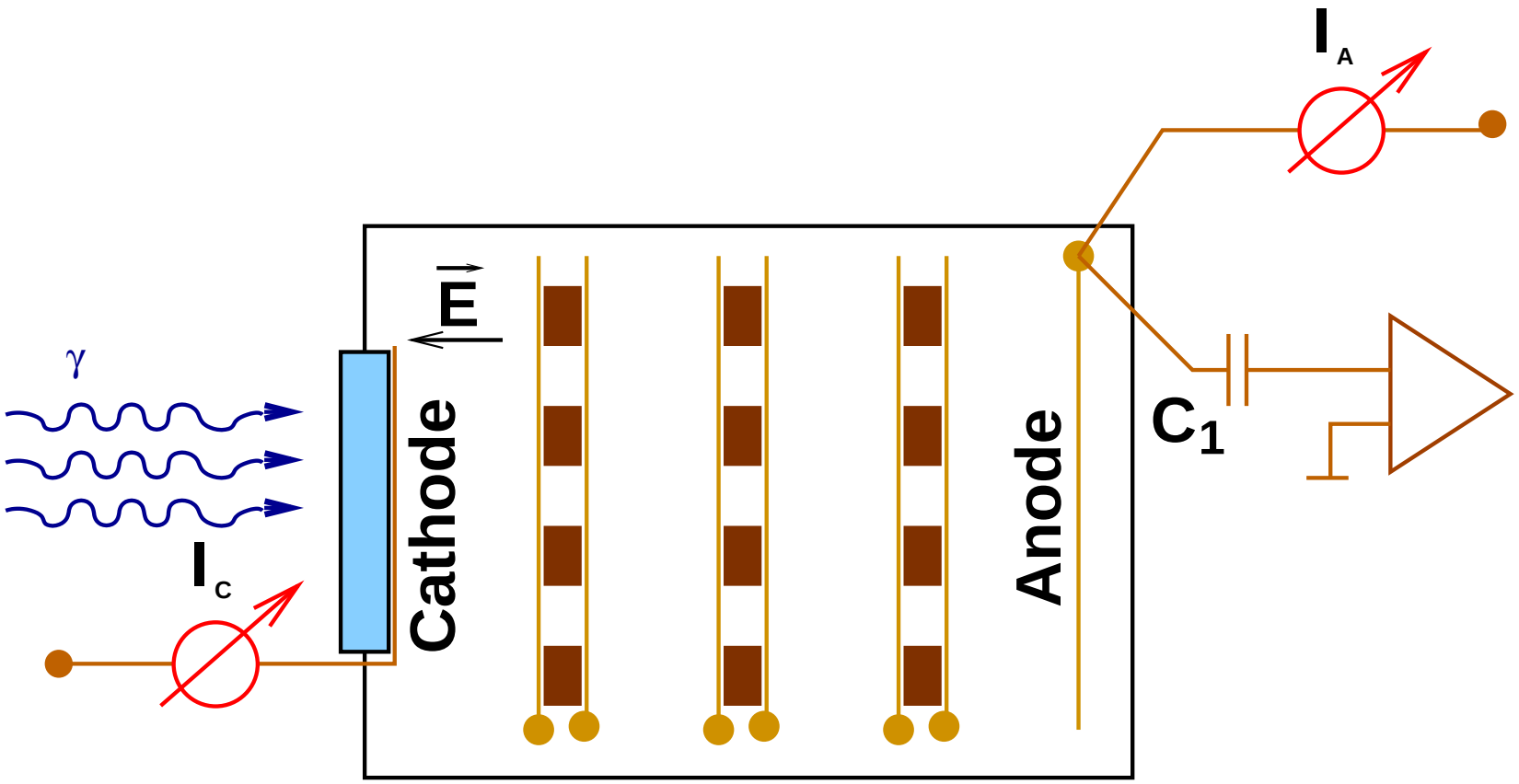


Budker Institute: NIM A 493(2002)18; 494(2002)148; 513 (2003) 256

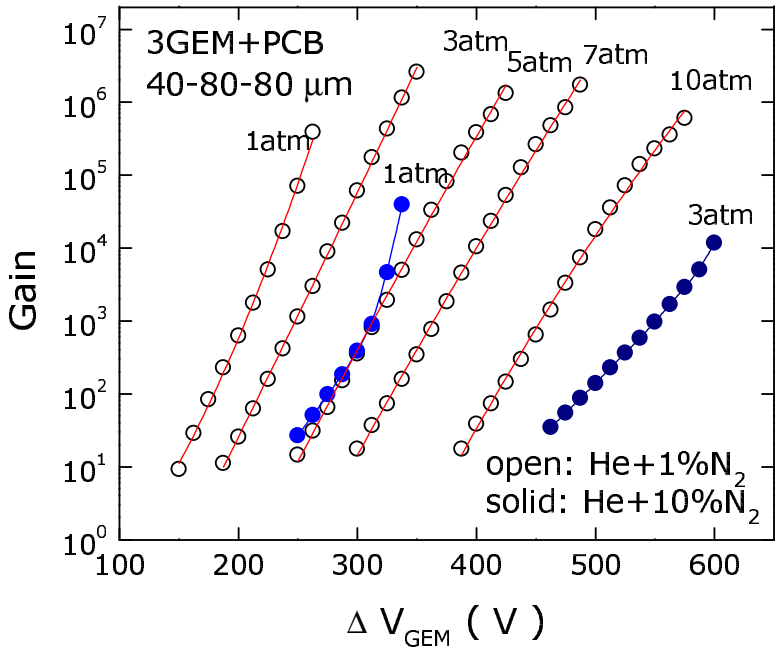


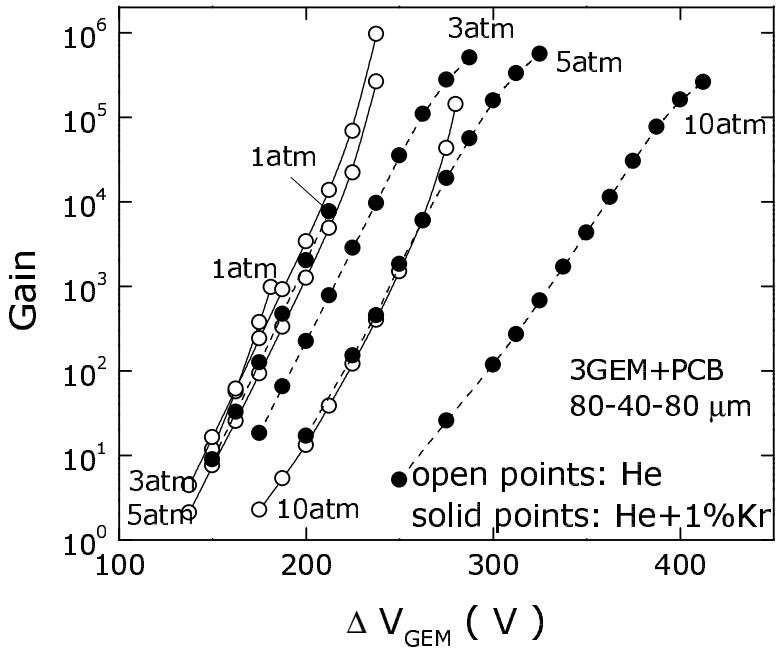


Experimental setup: 3GEM+PCB

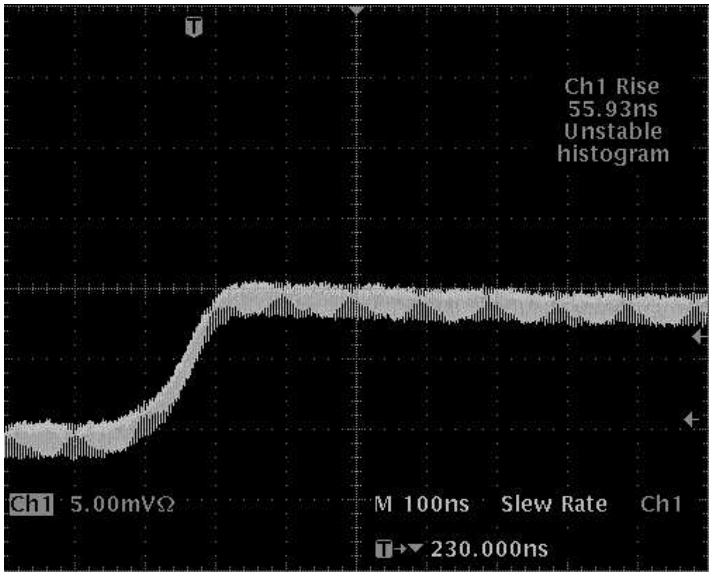


GEM operation in He-based mixtures





N_2 addition to make signal faster

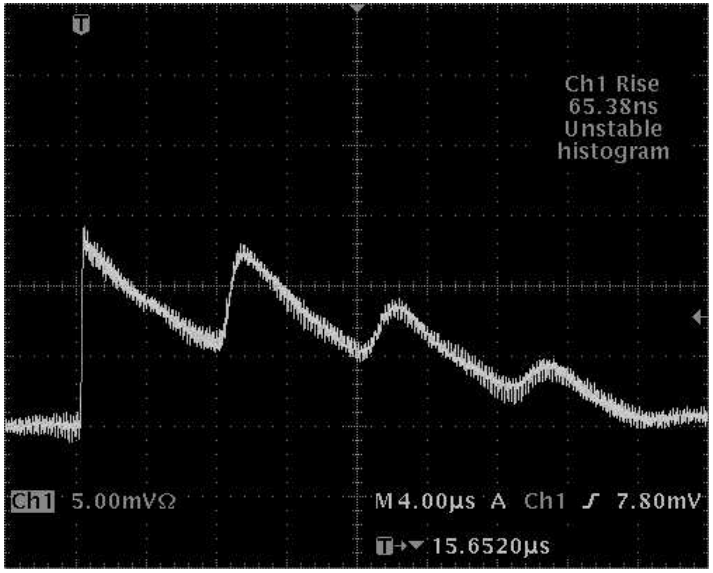


100 ns/div

$He + 10\%N_2, 1Atm$

$Gain \sim 4500$

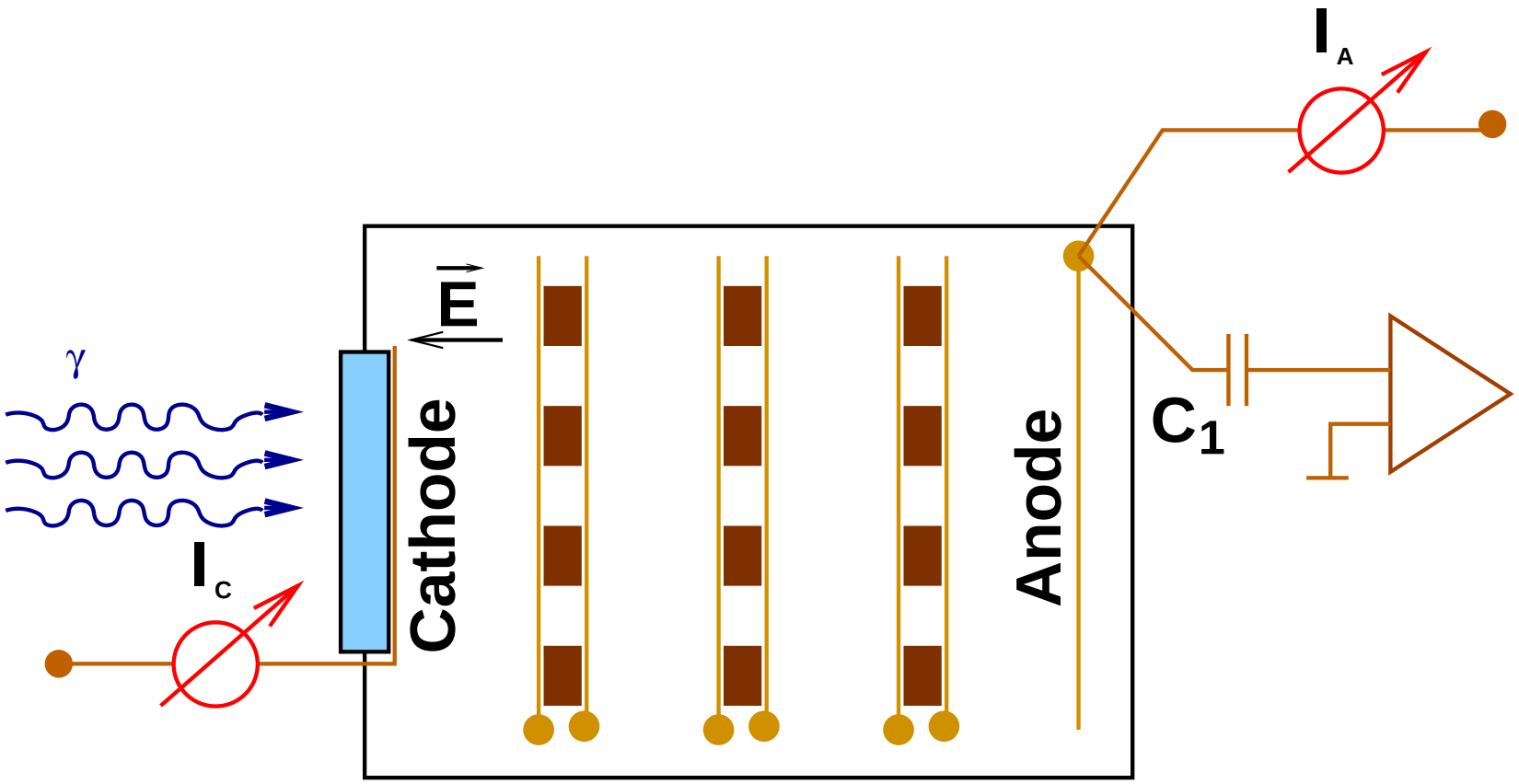
charge-sensitive amplifier



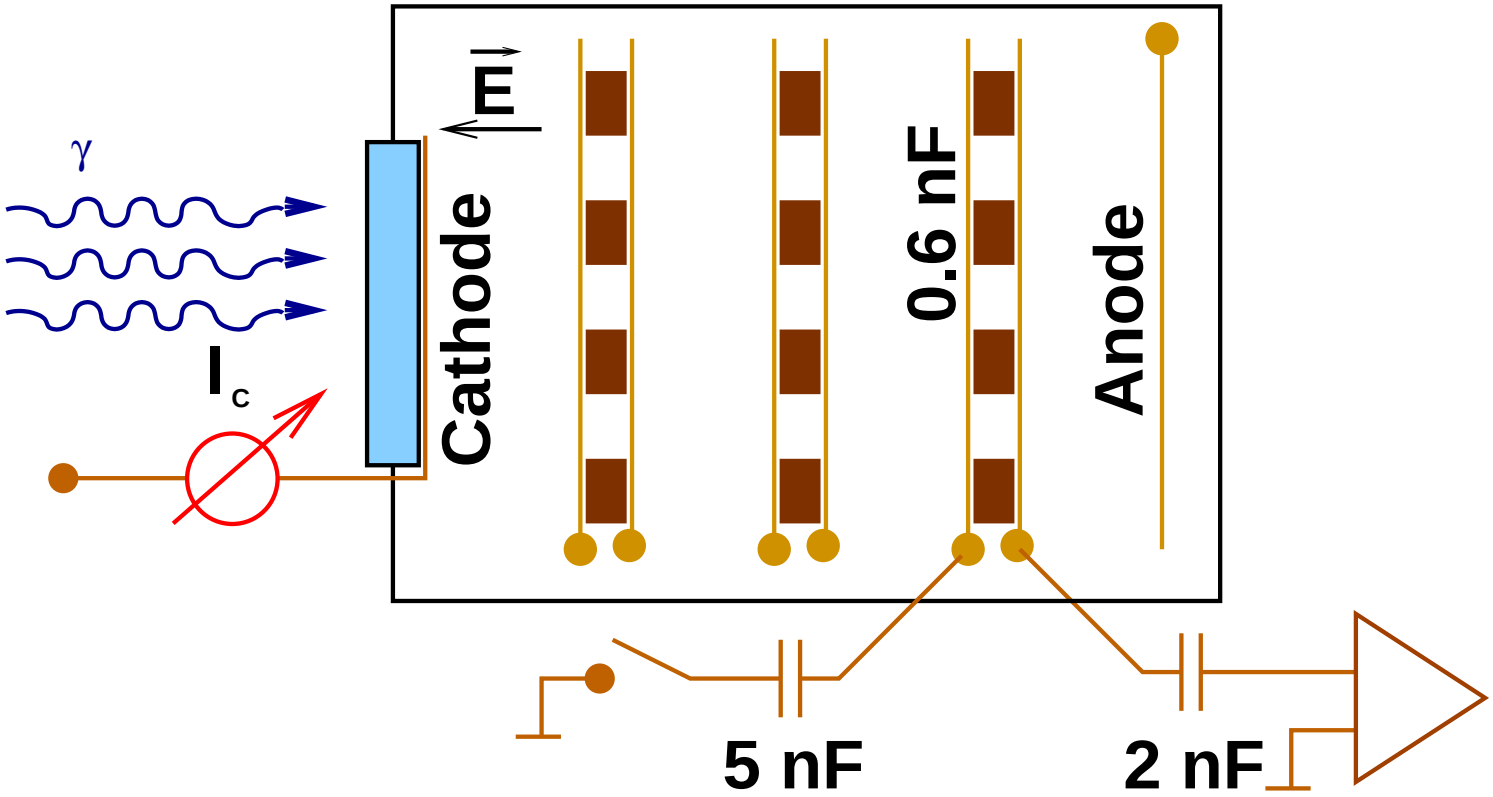
4 $\mu s/div$

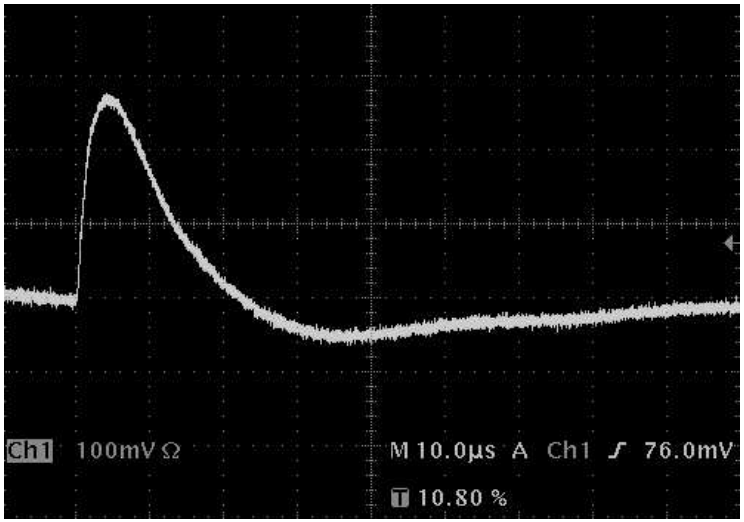
$K_0 = 14.5 \frac{cm^2}{V \times s}$

Experimental setup: 3GEM+PCB



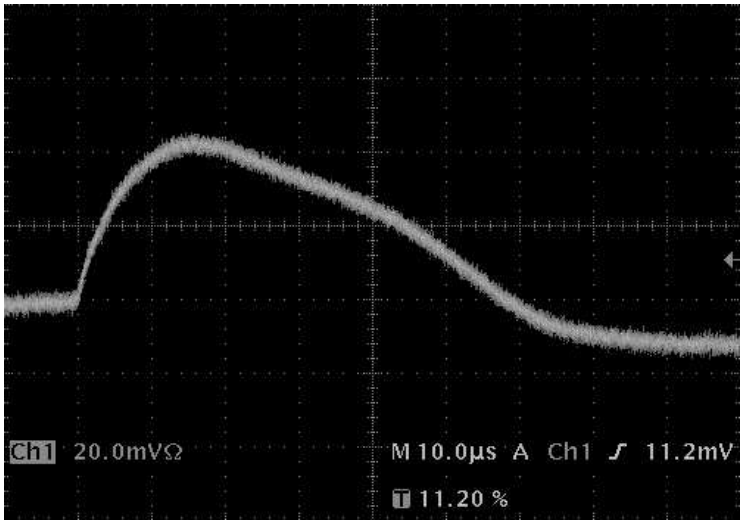
Experimental setup: 3GEM



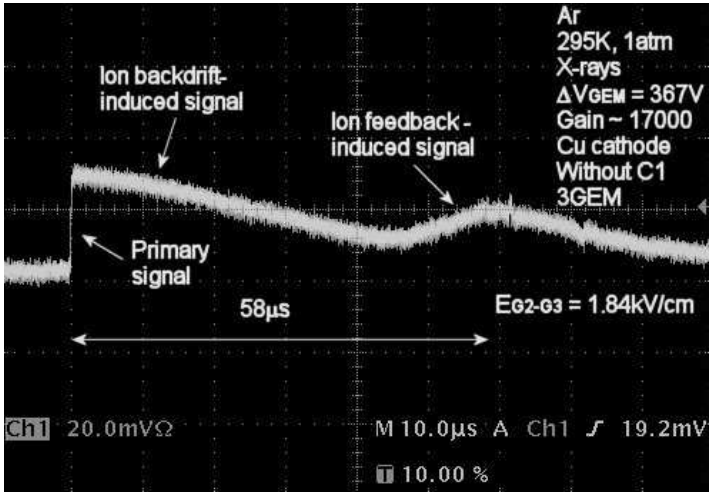


with capacitor
100 mV/div
primary (electron) signal

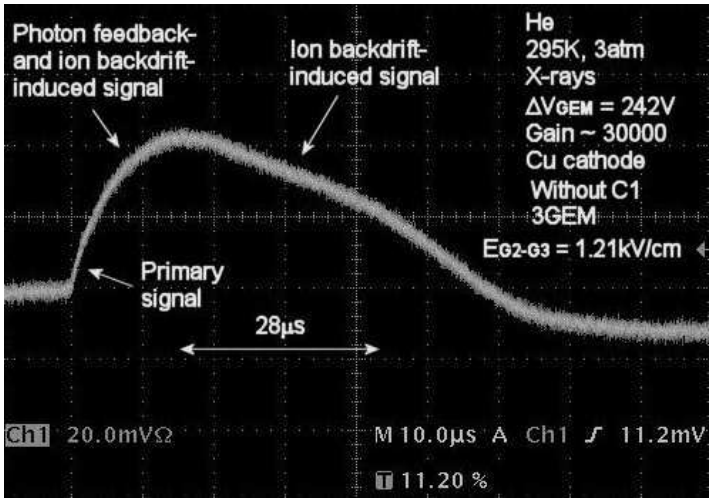
He, $Gain \sim 30000$



without capacitor
20 mV/div
ion-backdrift induced signal



Ar, $P = 1Atm$,
$Gain \sim 17000$,
$K_0 = 1.74 \frac{cm^2}{V \times s}$
(Compare to 1.50 and 1.86 $\frac{cm^2}{V \times s}$ for Ar^+ and Ar_2^+, respectively)



He, $P = 3Atm$,
$Gain \sim 30000$,
$K_0 = 16.4 \frac{cm^2}{V \times s}$
(Compare to 10.4 and 16.7 $\frac{cm^2}{V \times s}$ for He^+ and He_2^+, respectively)

Summary

- One can reduce space-charge in TPC using a mixture with higher ion mobility.
- This mixture could be pure He or He-based plus some non-ageing components or else pure Ne or Ne-based. GEM works well whatever the case.
- Ion mobility of given mixture could be estimated with multi-GEM structure.