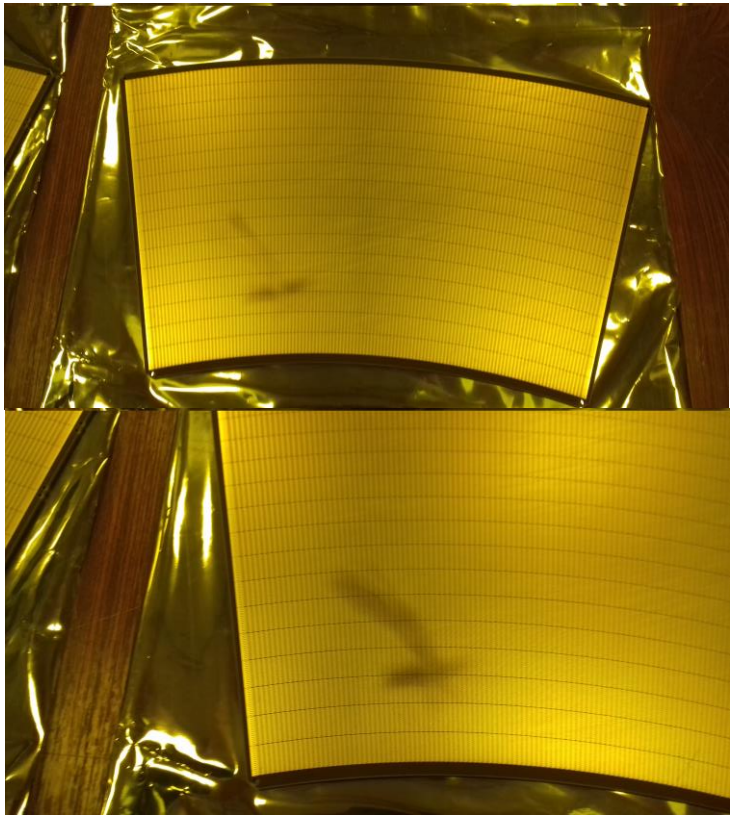
Some news from MicroMega (MMG) test bench at Saclay for sPHENIX R&D

July 20, 2018

Jamie Nagle, Hugo Pereira Da Costa

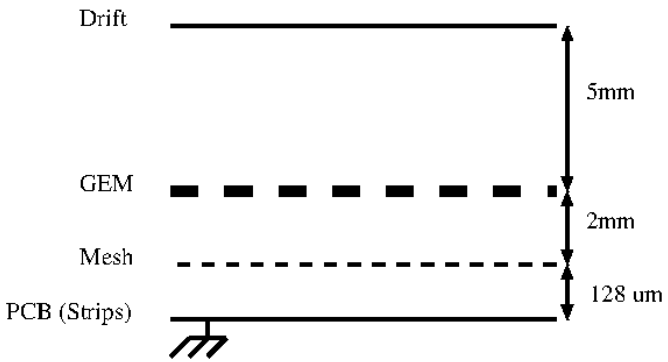
1. sPHENIX prototype PCBs shipped from SUNY SB now at Saclay for MMG mounting
2. MMG + GEM prototype under test
3. Ion Back Flow picoAmmeter on loan from SUNY SB arrived. First tests with MMG single layer look good.

Pictures from the prototype PCB boards received from SUNY SB for mounting bulk MicroMega (MMG) here for next test beam



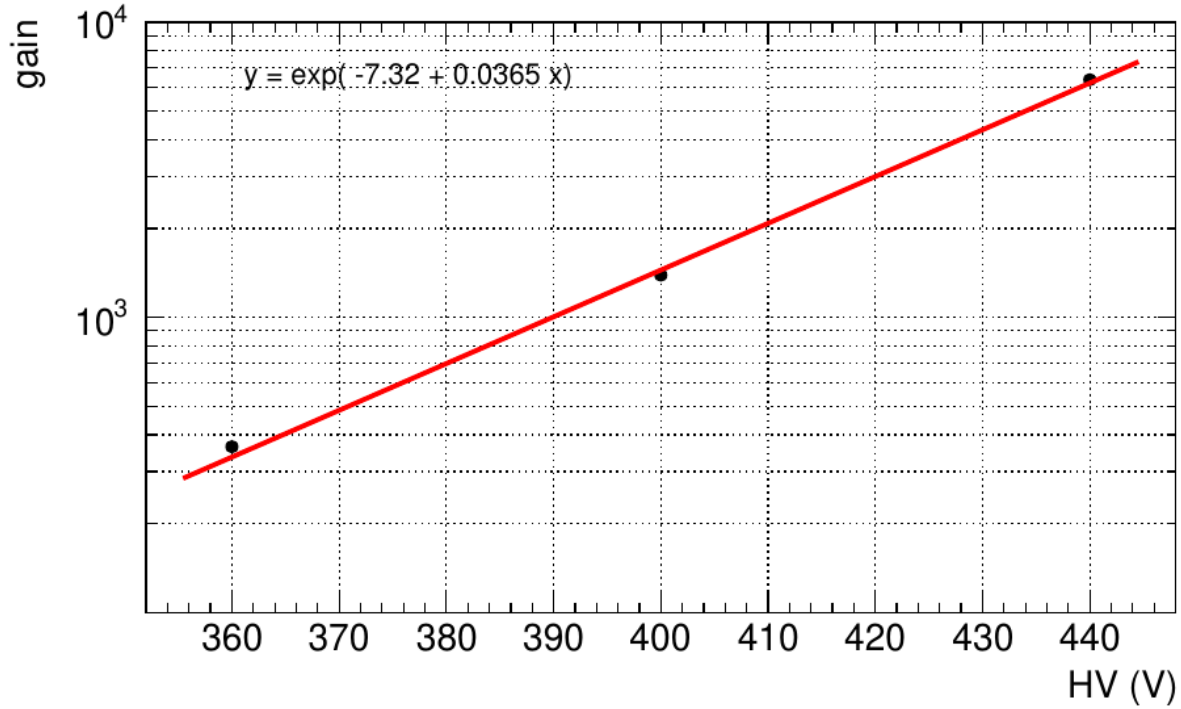
Both PCB show regions that look somehow brushed or visually distorted (?). These features were probably there before shipping. We wanted to check with you if these are known ? Problematic ? And confirm whether the boards were checked for shorts, and/or dead channels.

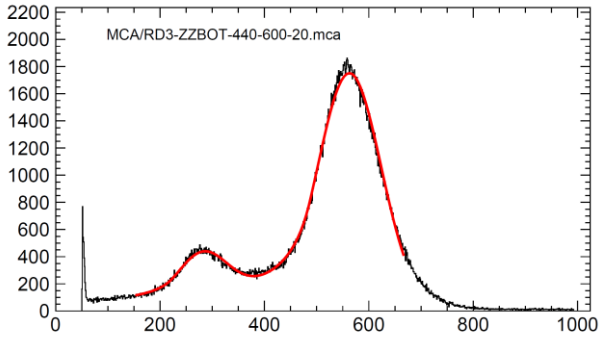
Operation of a standard Micromegas detector



Detector consists of a 128um Micromegas and a Drift electrode located 5mm above the Mesh.

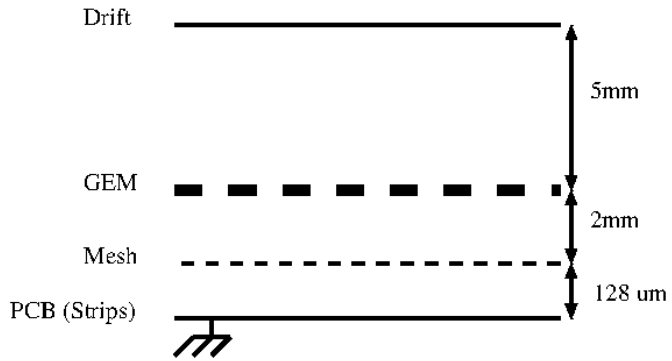
Gain is measured using a Fe55 x-ray source and an ORTEC amplifier reading the current on the Micromegas Mesh



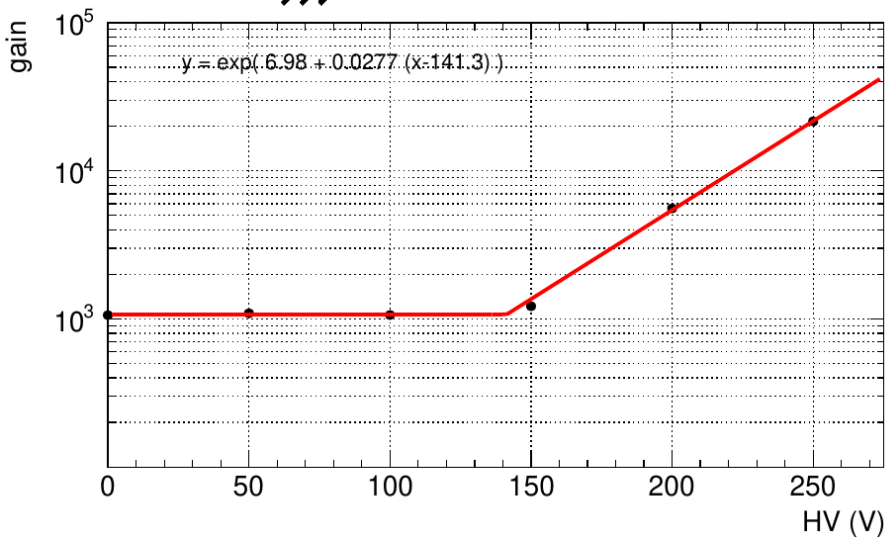


Gain near 2000 at HV ~ 400 V

Operation of a Micromegas + GEM detector

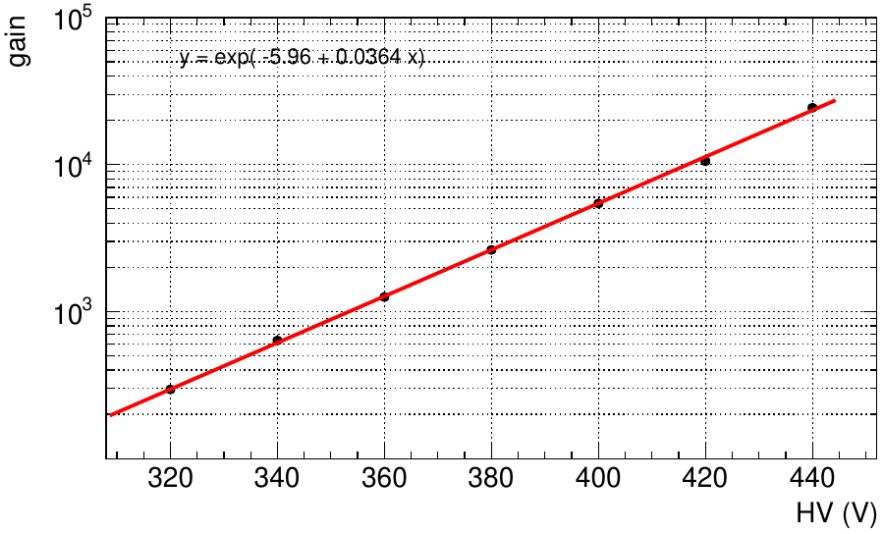


Detector consists of a 128um Micromegas, a GEM located 2mm above the Mesh, and a Drift electrode located 5mm above the GEM.



Gain in MMG+GEM, when increasing HV on the GEM, keeping the MMG at fixed Gain (~ 10^3)

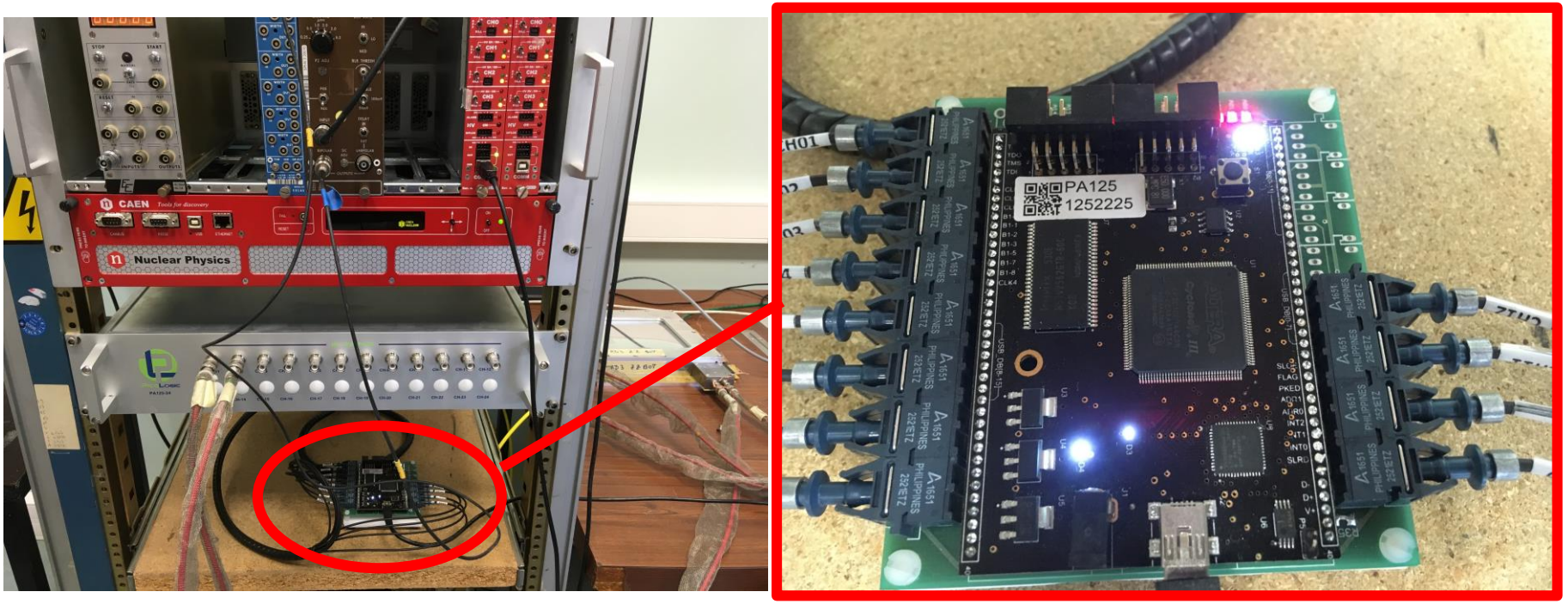
When HV < 150 there is no amplification in the GEM and in fact, primaries from above the GEM do not go through.



Gain in MMG+GEM, when increasing HV on the MMG Mesh, keeping the GEM at fixed gain (~5)

Ion back-flow measurements

PicoLogic (http://www.picologic.hr/) Zagreb PicoAmmeter ordered for Saclay (3 month delivery)
In meanwhile, SUNY SB loaned us a 12-channel unit (thanks!).



Main unit – 12 channels communicates via fiber to commercial control board.
Note USB powered, but Zagreb says if more channels or higher readout speed, may need auxiliary power input.

Worked out of the box!

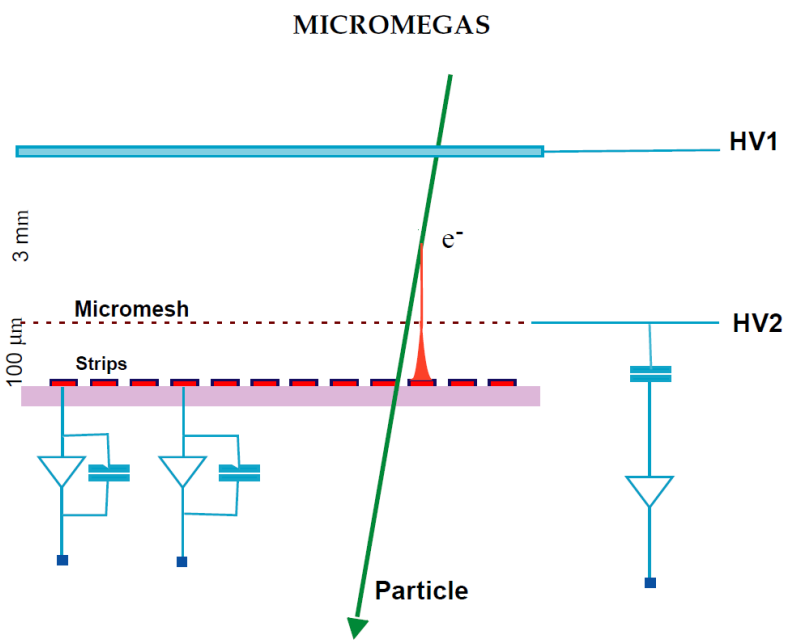
Ion backflow in the Micromegas TPC for the future linear collider

P. Colas[a], I. Giomataris[a], V. Lepeltier[b,*]

[a]*DAPNIA, CEA Saclay, 91191 Gif sur Yvette Cédex, France*
[b]*LAL, IN2P3 and Université de Paris-Sud, 91898 Orsay Cédex, France*

Available online 1 October 2004

https://arxiv.org/abs/physics/0412057



Measurements have been performed using an intense (10 mA–10 keV) X-ray gun

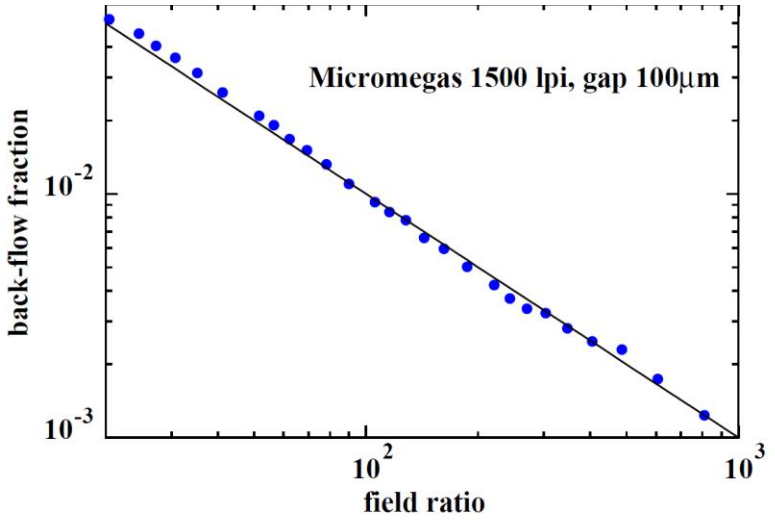
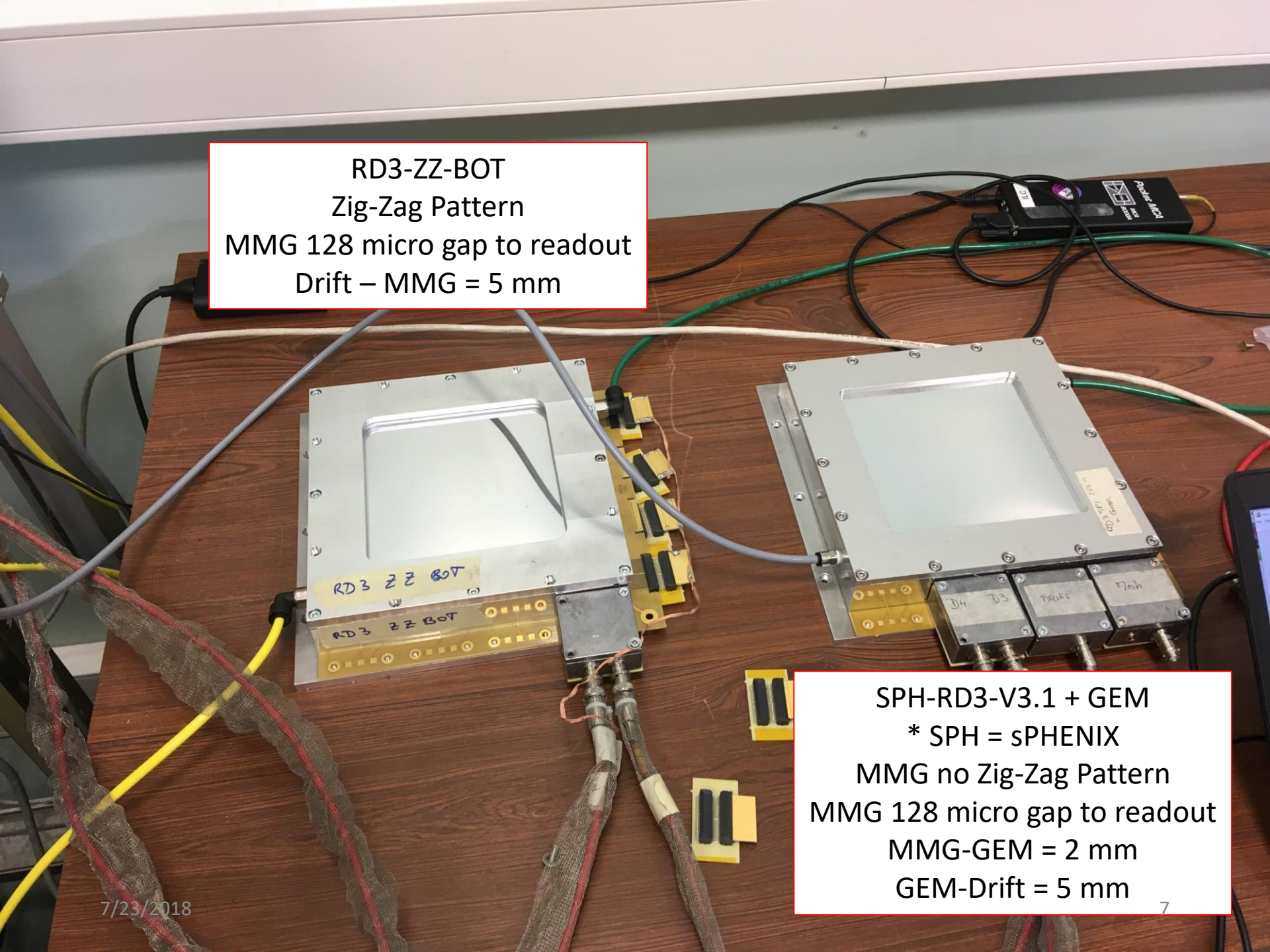


Fig. 7. Measurements of ion backflow vs field ratio for a 1500 lpi micromesh.

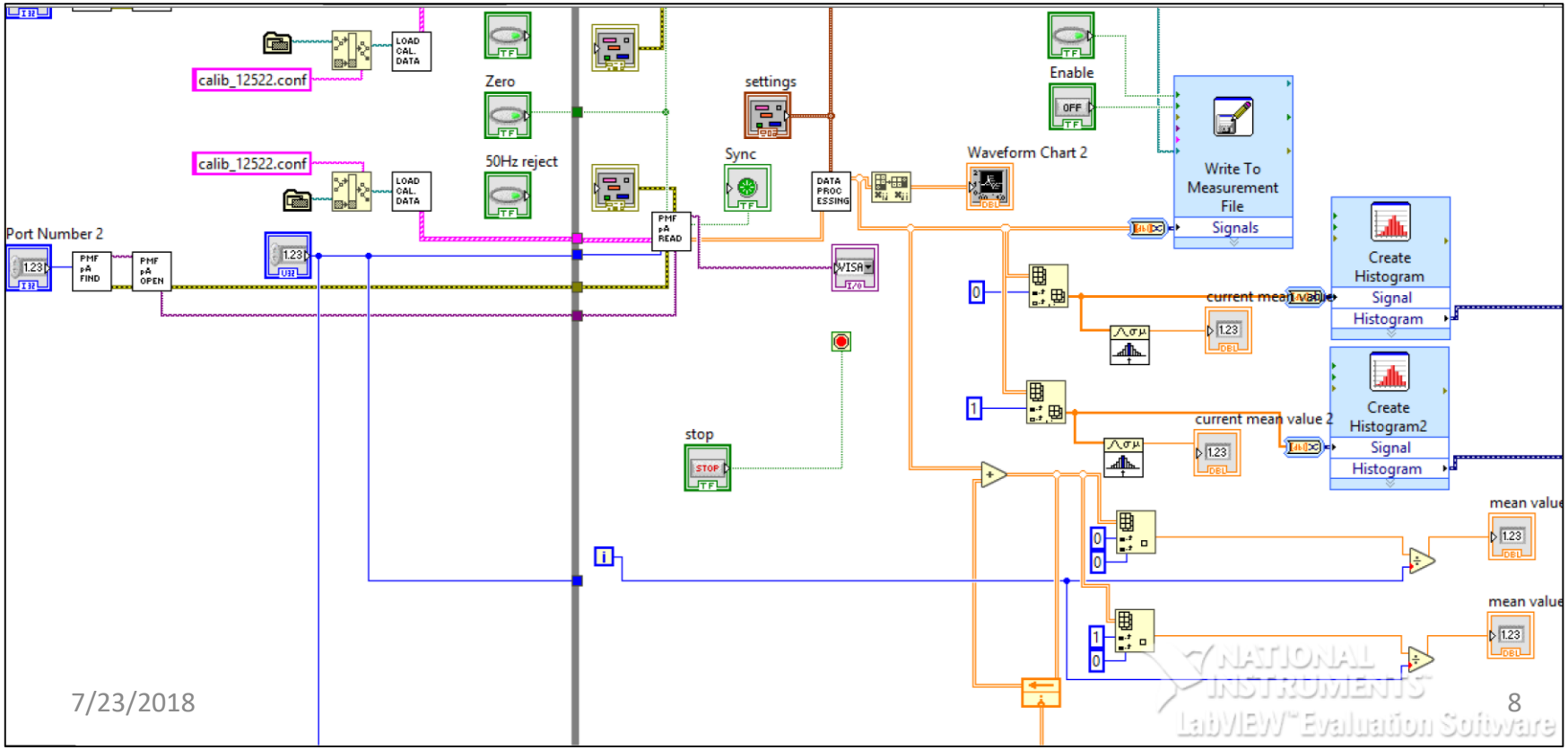
Ion back-flow fraction relates to field ratio (E_{MMG} / E_{drift}). Note the log-log scale above.


RD3-ZZ-BOT
Zig-Zag Pattern
MMG 128 micro gap to readout
Drift – MMG = 5 mm
SPH-RD3-V3.1 + GEM
* SPH = sPHENIX
MMG no Zig-Zag Pattern
MMG 128 micro gap to readout
MMG-GEM = 2 mm
GEM-Drift = 5 mm

LabView interface and driver working on Windows 10 machine

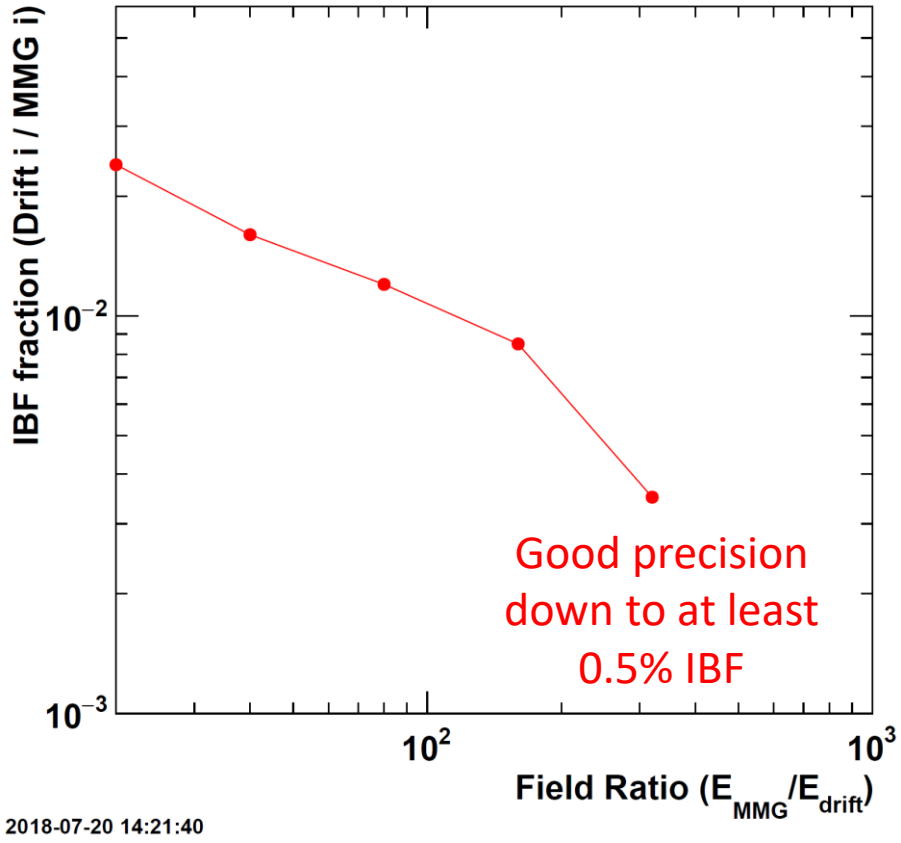
Minor modifications to LabView main.vi to include running average current and histograms…

There is some dark current, but we take data with and without ^{55}Fe source



First test RD3-ZZ-BOT with just MMG…

MMG at 400 Volts and vary the Drift Voltage to change the ratio E_{MMG} / E_{drift}



First measurement, rough agreement with earlier paper. Note different gas, different mesh size (?), etc.

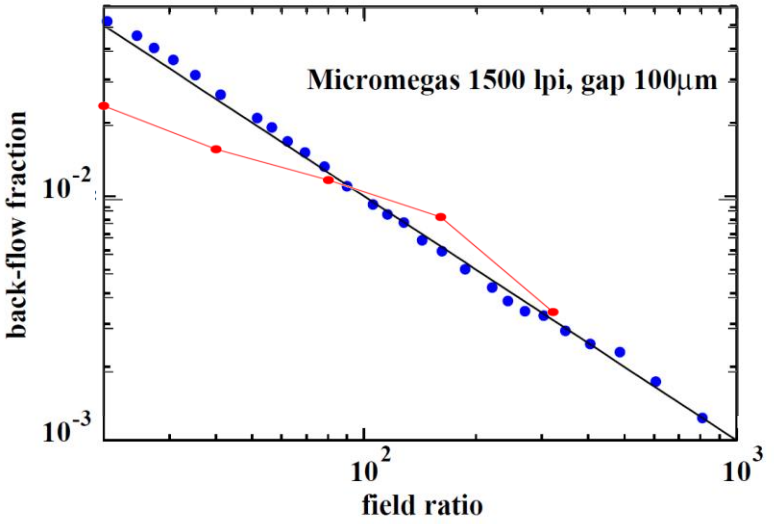


Fig. 7. Measurements of ion backflow vs field ratio for a 1500 lpi micromesh.

Integrating running average current over 2 minutes with source and without source (subtract).
Reproducible, though some issues if there is a trip/spark.
Note dark current of ~ 400 pA (MMG) and 20-80 pA (Drift) without source to subtract.
Need to determine uncertainties on each measurement – simple software…

Promising first results…

Plan to measure IBF with SPH-RD3-V3.1 + GEM starting Monday, July 23, 2018!

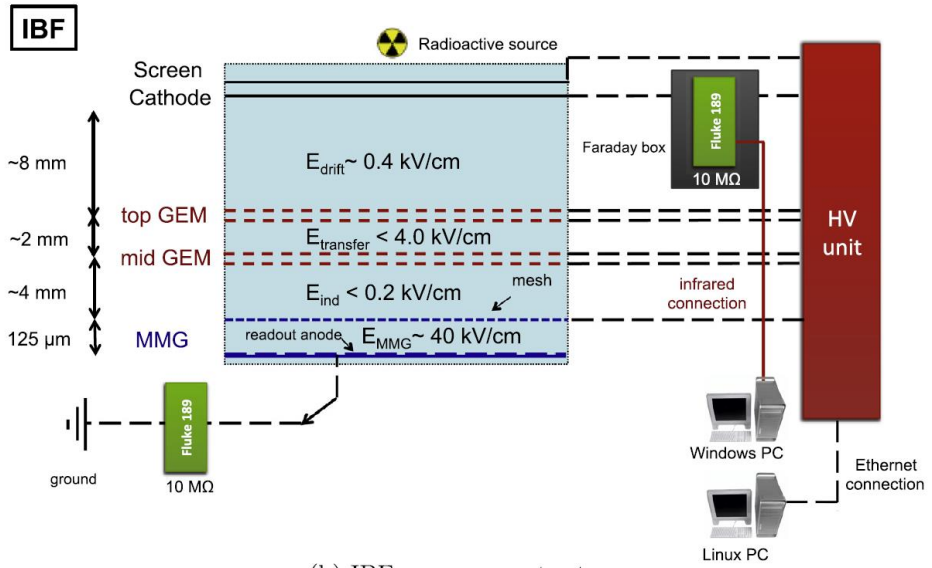
We have a second GEM and will add that after to attempt to reproduce Yale results.

Combination of two Gas Electron Multipliers and a Micromegas as gain elements for a time projection chamber

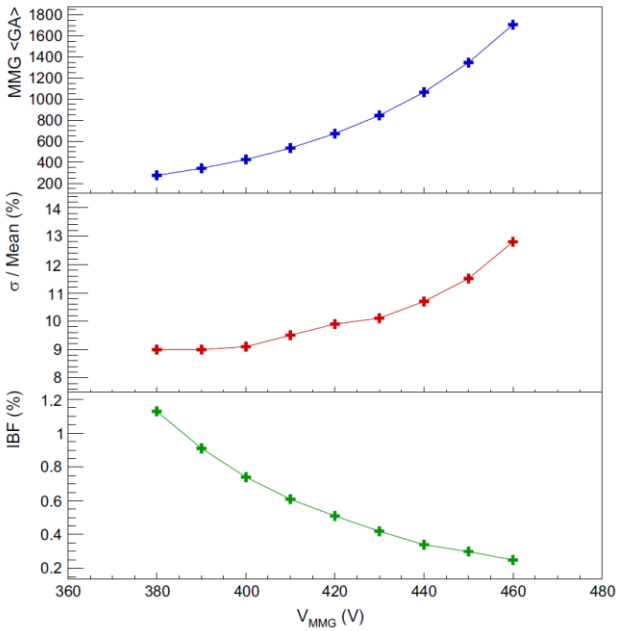
S. Aiola [a], R.J. Ehlers [a], S. Gu [a], J.W. Harris [a], R. Majka [a], J.D. Mulligan [a], M. Oliver [a], J. Schambach [b], N. Smirnov [a,*]

[a] Yale University, New Haven, CT, USA
[b] University of Texas at Austin, Austin, TX, USA

https://arxiv.org/abs/1603.08473



(b) IBF measurement setup.



Future plans

- more extensive IBF measurements on the standard MM (varying the gain, and the source intensity)
- IBF measurements on Micromegas + GEM prototype
  Are there measurement results to compare with here?
- Add a second GEM on top of the prototype and try reproduce the measurement from Smirnov et al.
- Try other exotic solutions: double Micromegas; Micromegas + Double-Mesh, etc.