GORG

Simulation Studies

ND-GAr Meeting Update 12/17/2024

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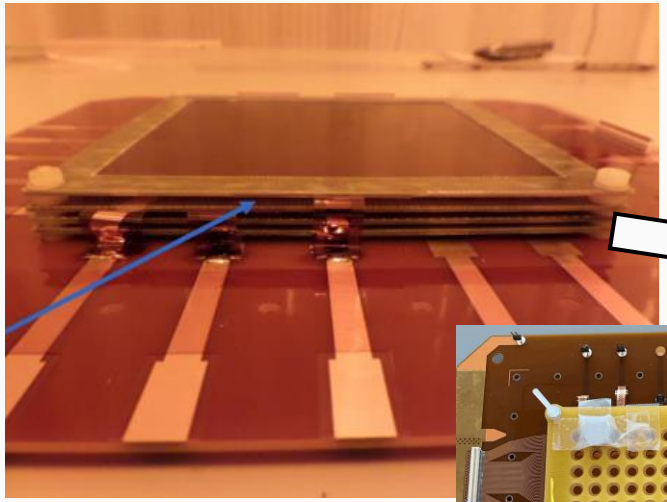
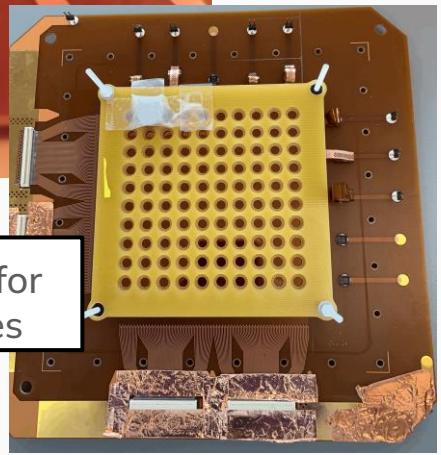
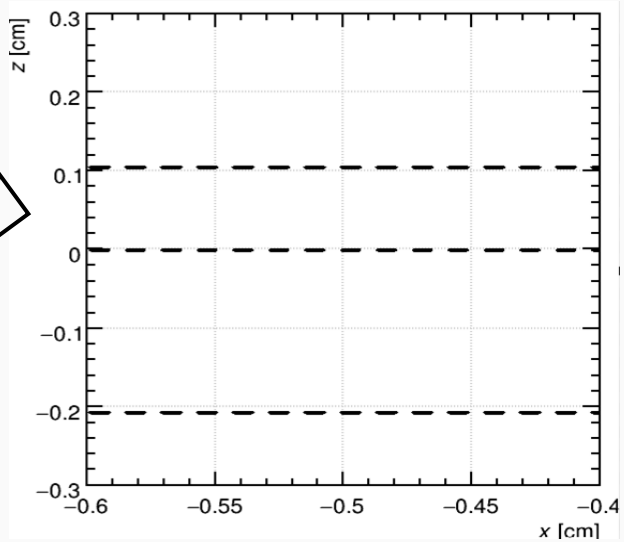
Recap: GEM Simulations



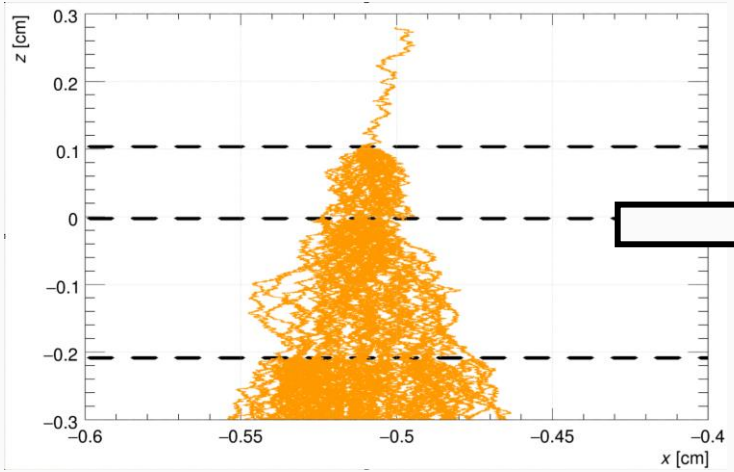


Developed framework for GEM simulation studies

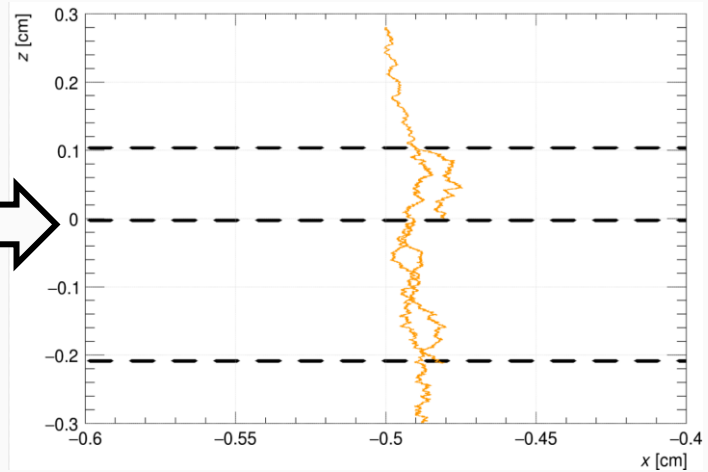


Garfield++ can simulate microphysics in GEM structures

Previous Results: GEMs in High Pressure



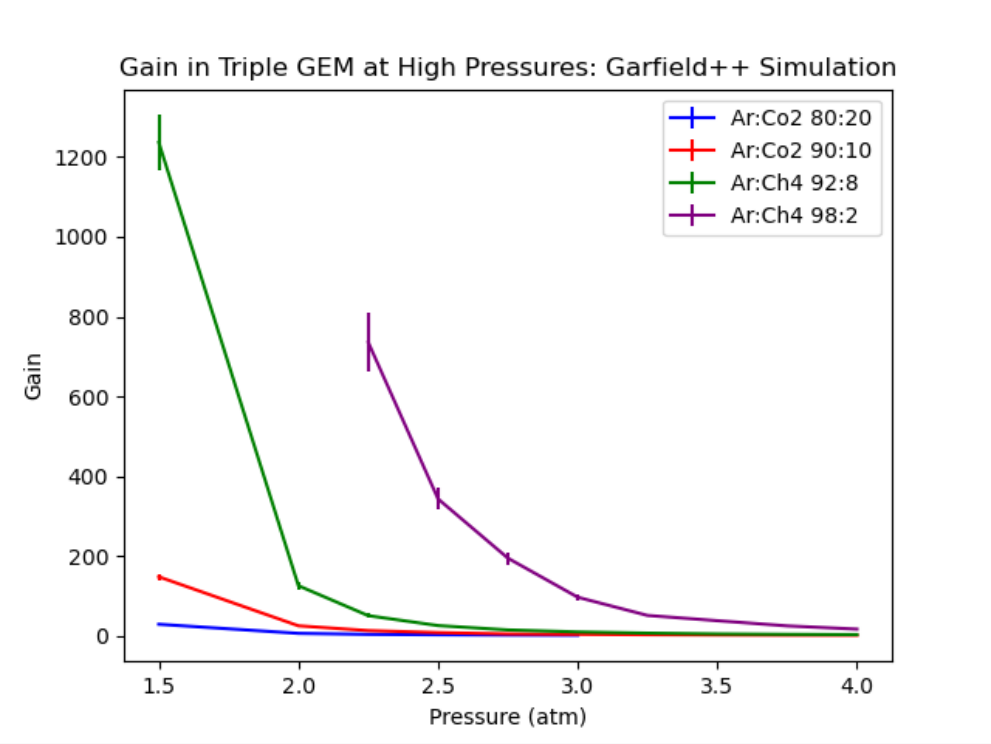
Avalanche – **Ar:Co2 80:20, 1 atm**



Avalanche – **Ar:Co2 80:20, 2 atm**

Increasing the pressure decreases mean free path of electron → **reduces gain**

Previous Results: Effect of Gas Mixture



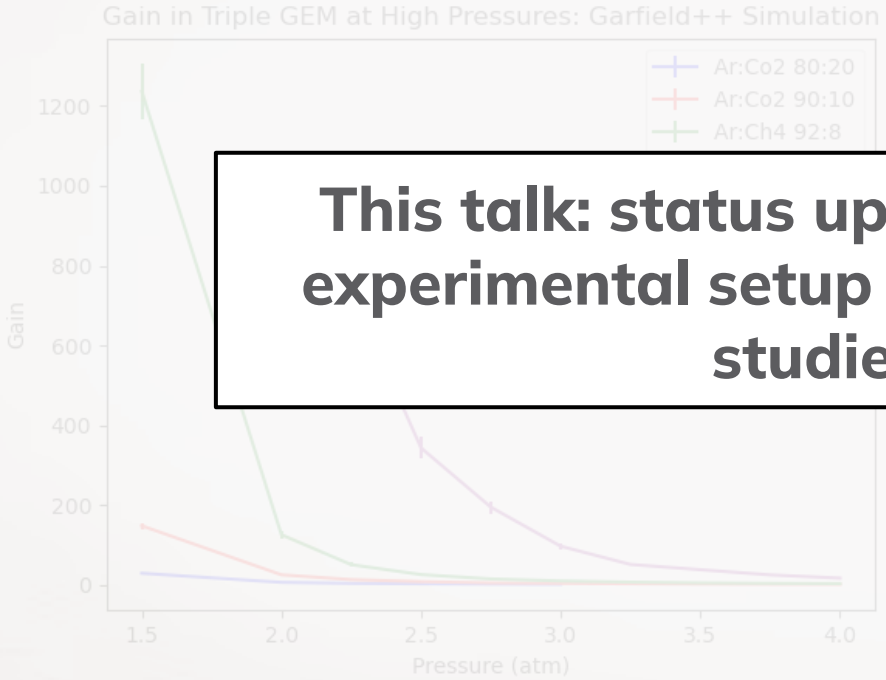
Ar:Ch4 98:2 outperforms other gas mixtures for sustaining gain

Note: plot is for unoptimized parameters:

~350V supplied to GEM1

~ET1 ≈ 6.0kV/cm

Recap: Effect of Gas Mixture



Ar:Ch4 98:2 outperforms other gas mixtures for sustaining gain

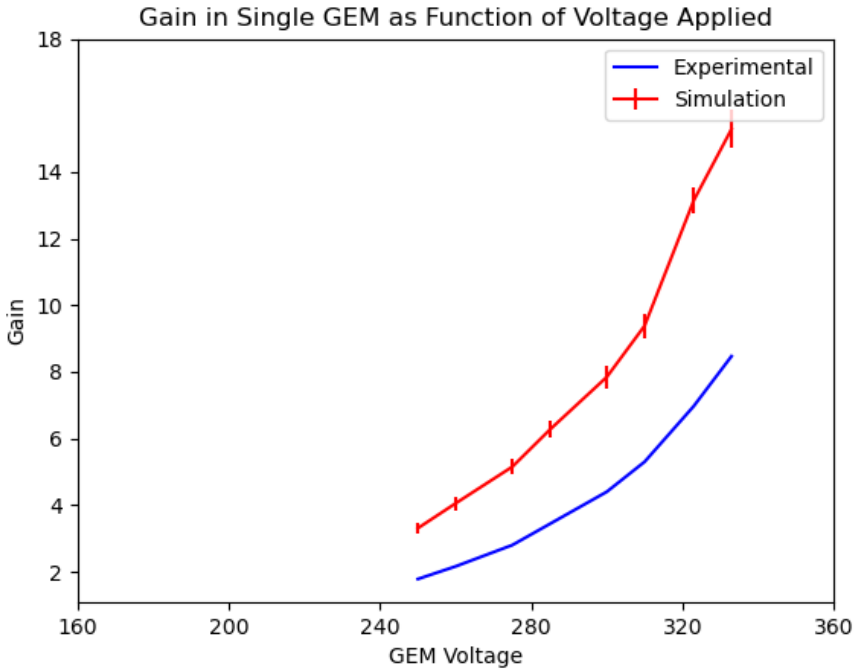
This talk: status update on GORG experimental setup and simulation studies

nized

~350V supplied to

GEM1

Benchmarking: Voltage Applied



Ar:Co2 80:20, 1 atm

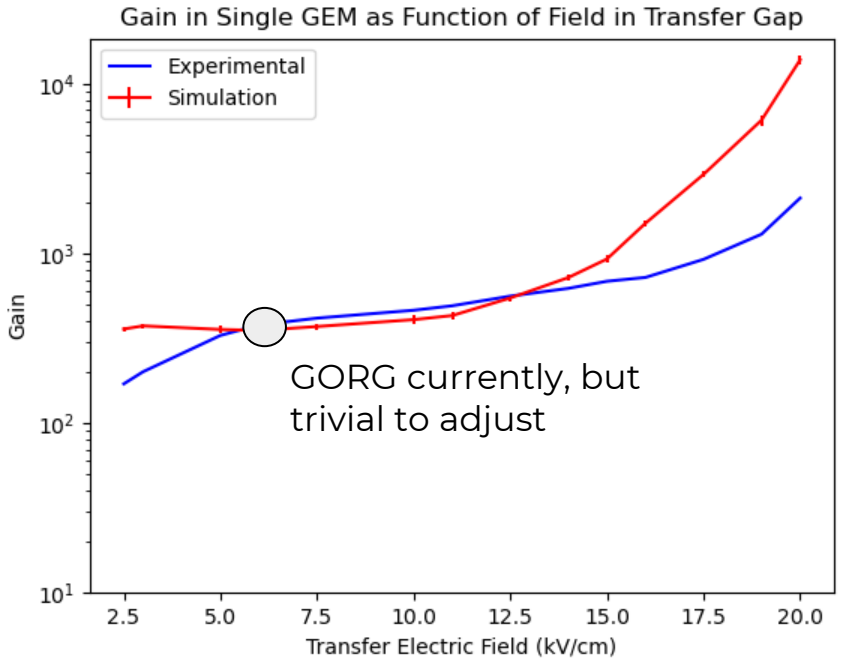
★ Simulation results overestimate but agree within a factor of 2

- Experimental data from:

High Energy Phys. 2016, 8561743. DOI: 10.1155/2016/8561743

~E_I = 1kV/cm
~Induction gap = 8.5mm

Benchmarking: Electric Field Strength



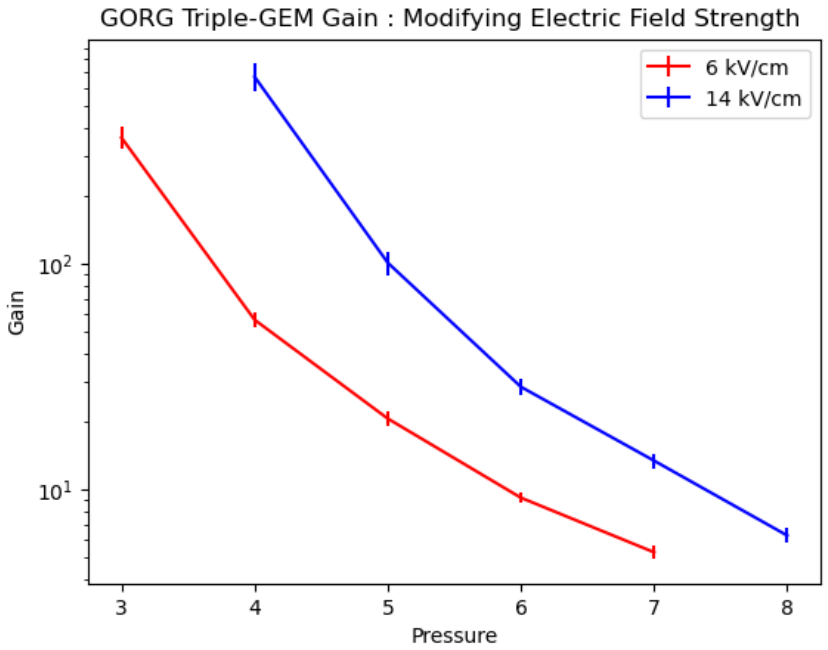
★ For a single GEM with:
Ar:CO_2 70:30 1 atm
500V across GEM
0.5mm induction gap

demonstrates up to an **18-fold increase in gain**!

Experimental results from:

A. Bondar, et al., Nuclear Instruments and Methods A 419 (1998) 418.

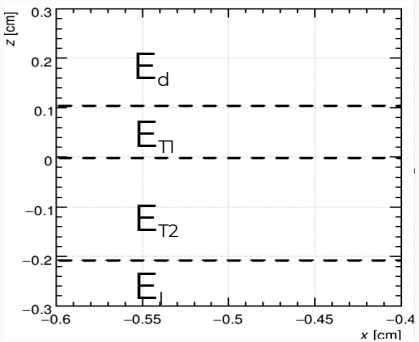
GORG Simulations: Electric Field Strength



Ar:Ch4 98:2 , 500V to GEM1

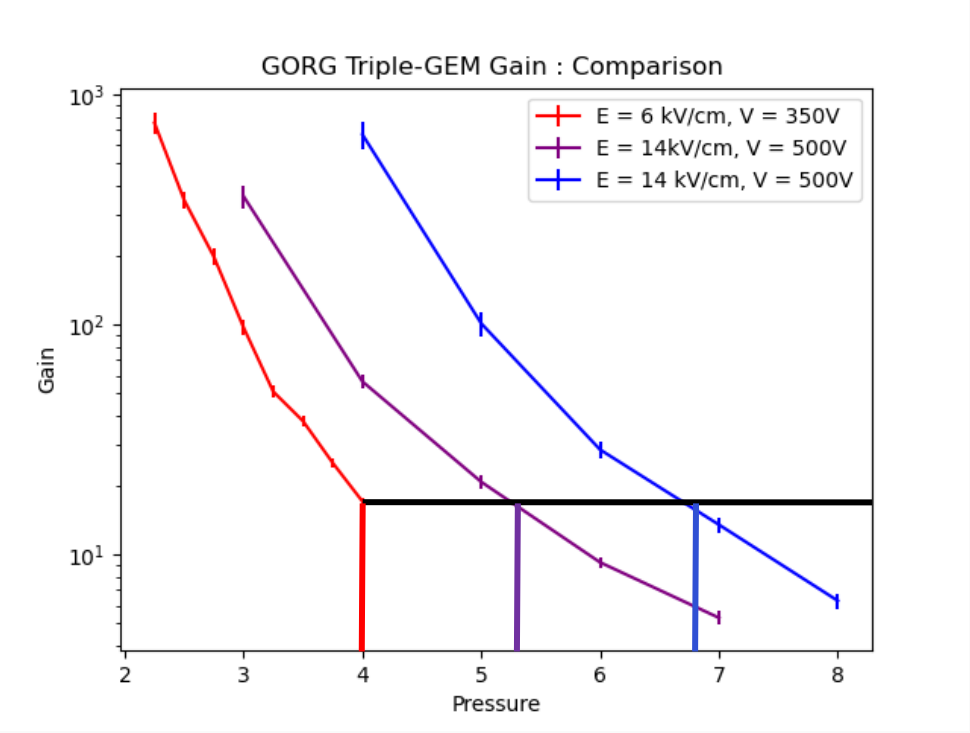
- Electric field strength modified only in transfer gap between GEM1 and GEM2:

E_d ~ 2.5 kV/cm
E_{T2} ~ 3.0 kV/cm
E_I ~6.0 kV/cm



- **an increased 500V to GEM1**
- Can increase achievable gain at high pressures!

Comparison with Previous Results



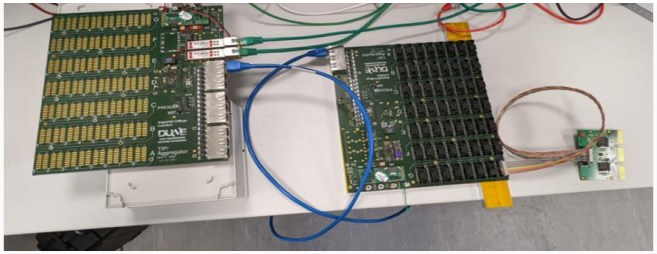
Ar:Ch4 98:2

E_d ~ 2.5 kV/cm
E_{T2} ~ 3.0 kV/cm
E_I ~6.0 kV/cm

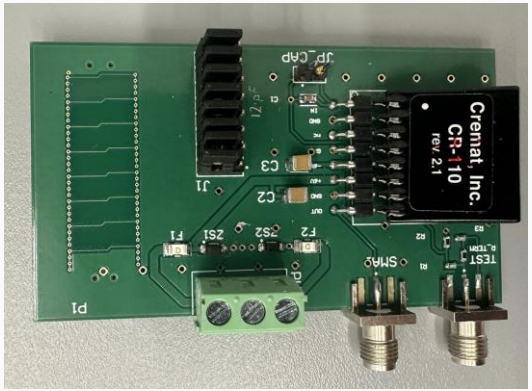
- Achieve similar gains at ~+3 atm!
- More to optimize:
  - Transfer gaps
  - GEM geometry: pitch, thickness, hole diameter

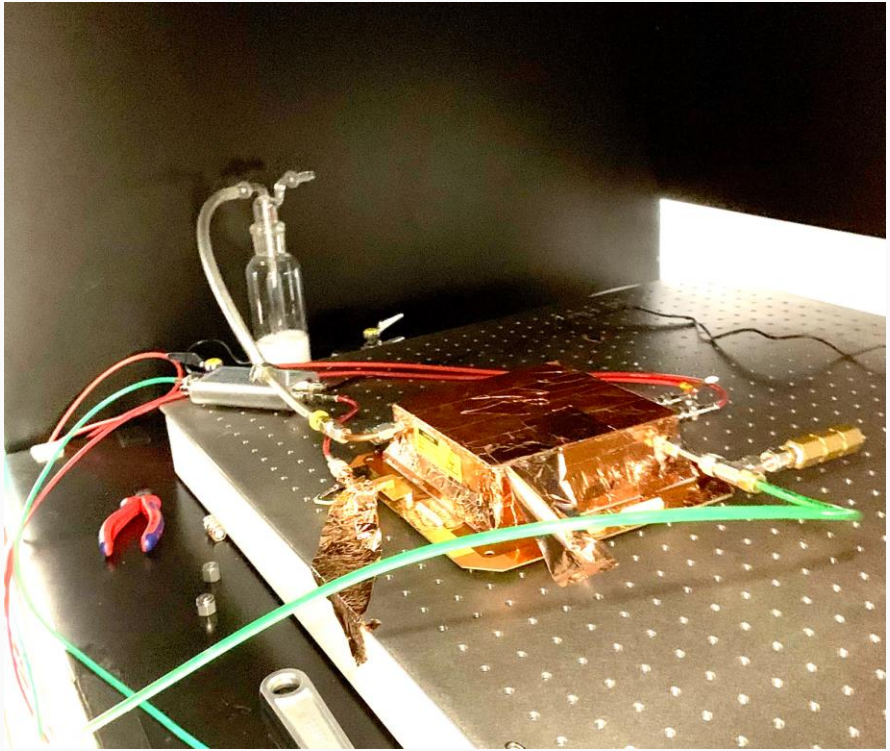
Electronics Upgrades Underway

Full chain of electronics under development by Imperial colleagues



Low Noise Cremat II Card being tested at FNAL





Summary

- Benchmarked simulation results with established experimental data
- Evaluated the effect of electric field strength on GEM gain
    - Other parameters that can be optimized in simulation to further increase gain:
        - Transfer gaps
        - GEM pitch
        - GEM hole diameter
- Progress experimentally in electronics upgrades; preparing for pressure vessel operation at Fermilab, setup underway at Indiana University!