Professur für Experimentalphysik (E62) - Dense and Strange Hadronic Matter
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How many electrons can fit in a GEM hole?

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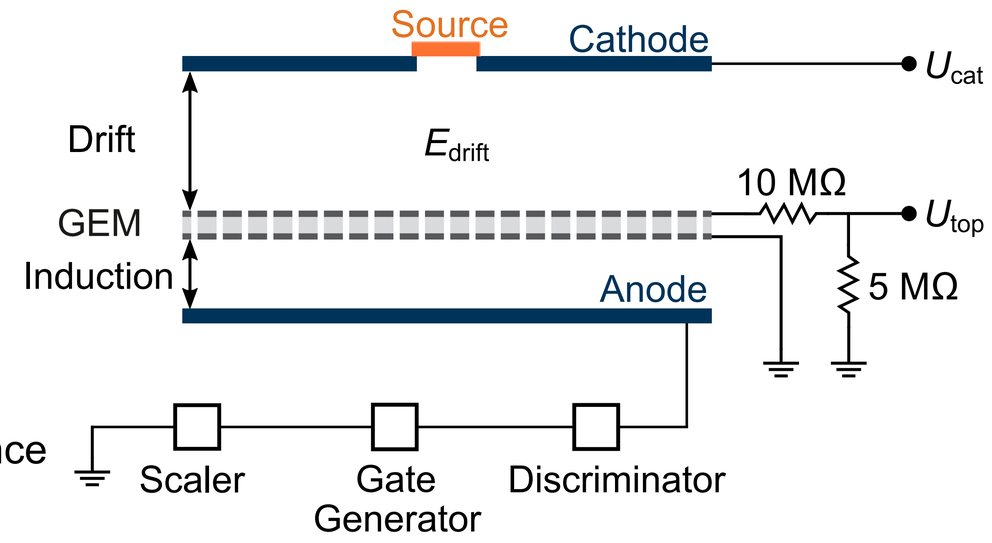
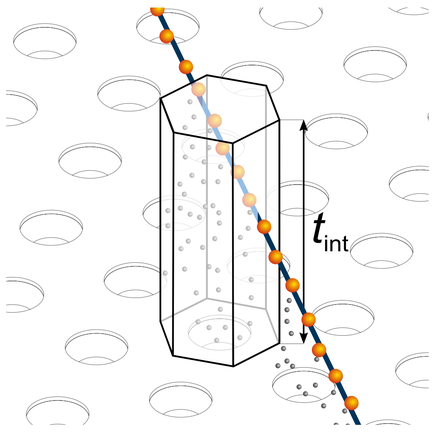
Experiment

- Single GEM detector, 10x10 cm^2, variable drift gap, E_{drift} = 400 V/cm
- Ar- and Ne-based gas mixtures
- Mixed alpha source: ^{239}Pu + ^{241}Am + ^{244}Cm, rate ~ 600 Hz
- Discharge probability measured as a function of absolute gain and a distance between the source and the GEM (d_{source})



GEANT simulations

- Energy loss of the incident alpha particle and translation into primary electron-ion pairs
- Drift and diffusion of the electrons in the drift gap
- Collection of the electrons in a given time window t_{int} above the readout
- The electrons are sorted into the single GEM holes and multiplied by absolute gain
- Spark event: number of the electrons inside a single hole exceeds a critical threshold value Q_{crit}
- χ^2 minimization of both parameters by comparison to measured data



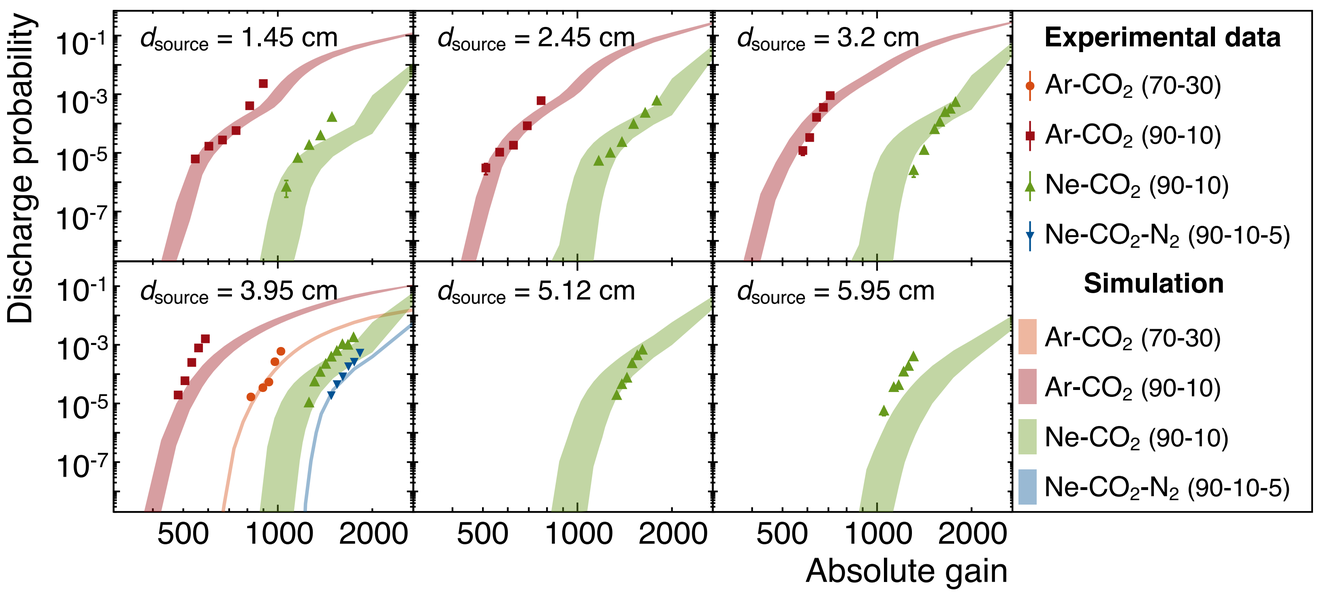
Charge density as a driving factor of discharge formation

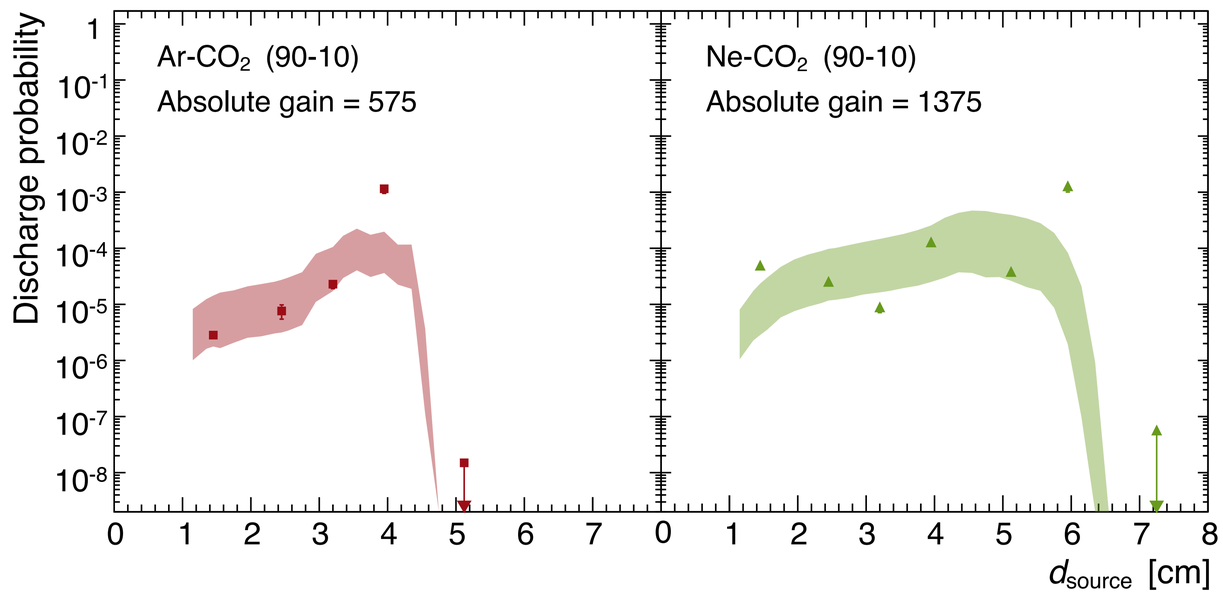
Discharge probability in Ar-CO_2 (90-10) significantly higher than in Ne-CO_2 (90-10)

(range of alphas in Ar is ~40% shorter than in Ne; number of primary electrons in Ar larger than in Ne).

Discharge probability drops abruptly for d_{source} larger than the range of alpha in a given gas

(strong effect of large energy deposits in the closest vicinity of GEM holes).





Model describes data fairly well over several orders of magnitude.

Charge density limit [e^-/hole]: Q_{crit} = (5.0±0.3)×10^6 in Ar-CO_2 (90-10); Q_{crit} = (7.3±0.9)×10^6 in Ne-CO_2 (90-10);

Collection time: t_{int} = 50–150 ns, same order as a drift time of ions produced in GEM → ion space-charge;

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