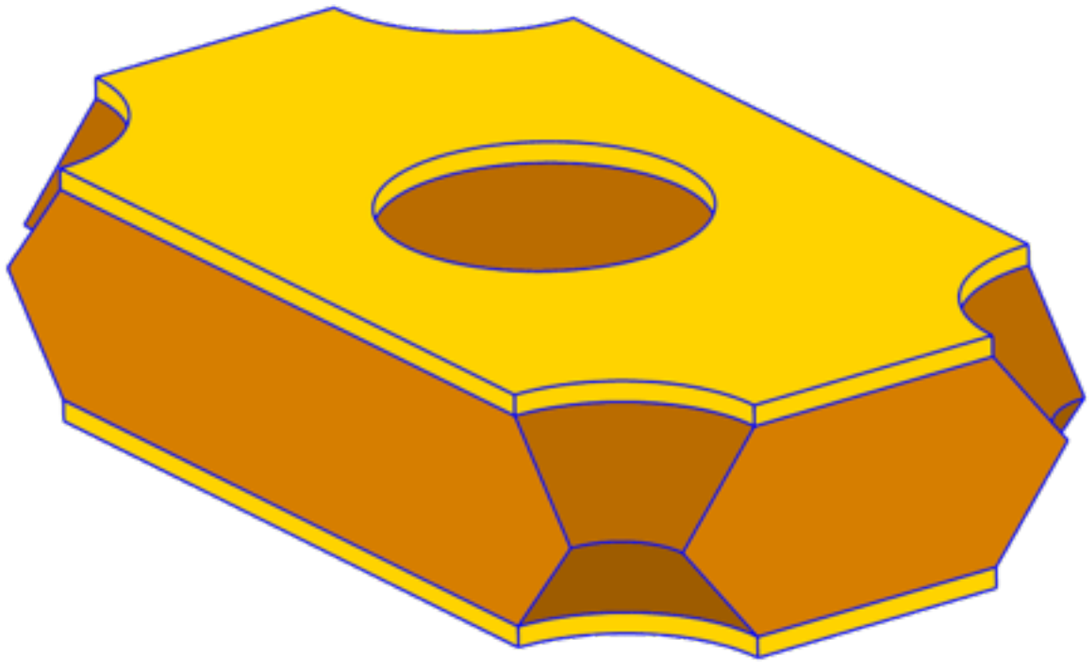
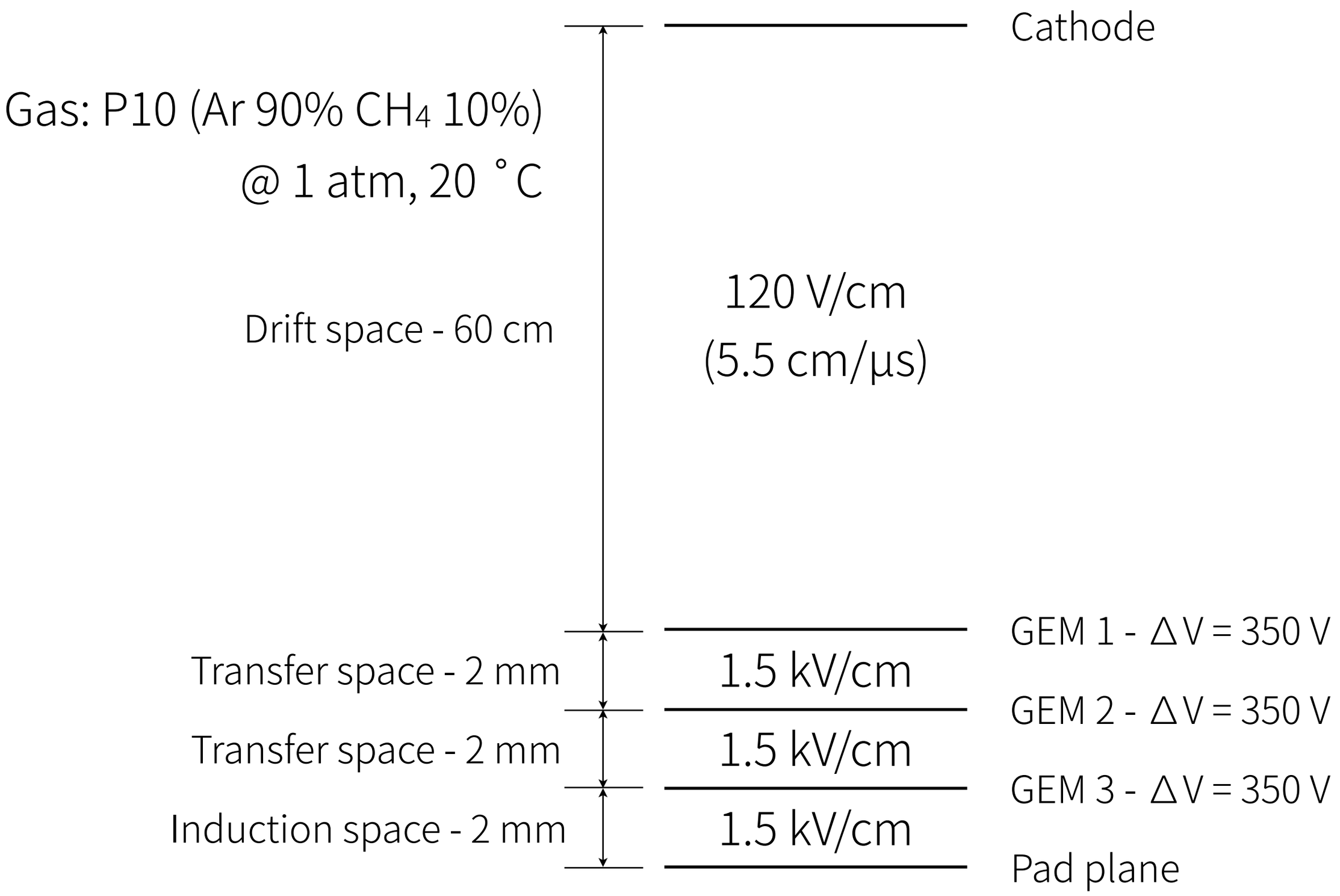
GEM Design



- Hole pitch: 150 µm
- Hole
  - Outer diameter: 75 µm
  - Inner diameter: 35 µm
- Copper thickness: 5 µm
- Kapton thickness: 50 µm

Simulation Configuration



Magboltz - gas property calculation

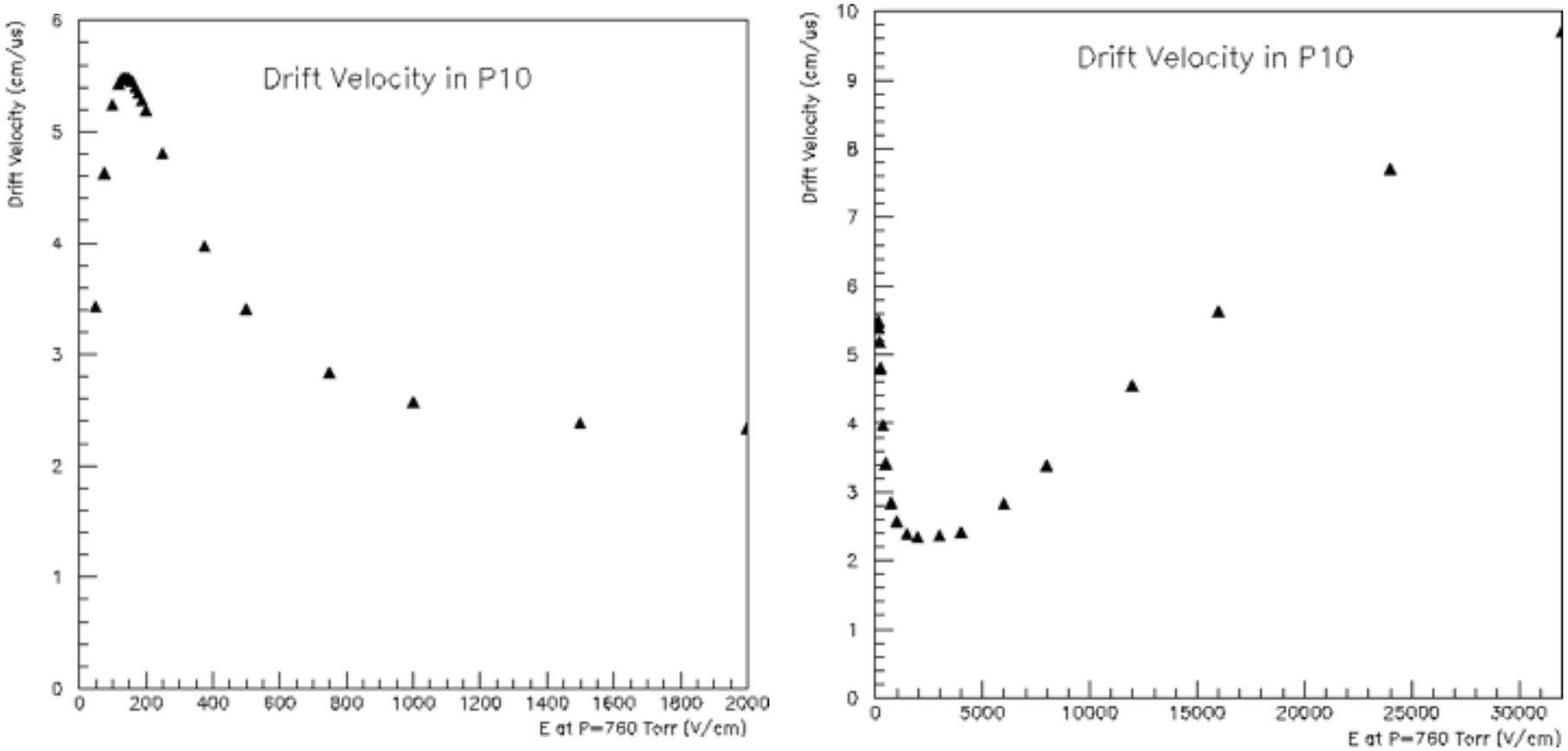
- Magboltz calculates
  - Drift velocity inside E-field and B-field with $|\mathbf{E}| \cdot |\mathbf{B}| \neq 0$
  - Diffusion constants (Logitudinal and transversal)
  - Townsend coefficient
  - Attachment coefficient
- It can take into account (not included in this calculation)
  - Penning effect
  - Ion mobility

Magboltz - gas property calculation

- Calculation is done for
  - the electric field: 10 V/cm ~ 71.01 kV/cm in every 100 V/cm
  - the magnetic field: 0.45, 0.50, 0.55 (T)
  - the angle between E and B: 0, 30, 60, 90, 120, 150, 180 (degrees)
- In total, $720 \times 3 \times 7 = 15{,}120$ combinations

Information

https://www.star.bnl.gov/public/tpc/hard/tpcrings/p10_magboltz2.html



- We're using the highest drift velocity of P10 in relatively low electric field.
- Since the drift length is 60 cm,
  - with 25 MHz sampling rate, we can cover the length with 273 time buckets
  - with 50 MHz sampling rate, we can only cover about 56 cm of the length.

Note

Townsend coefficient

- λ
  - the mean free path of the electron for a secondary ionizing collision.
- α = 1/λ (Townsend coefficient)
  - the probability of an ionization per unit path length
- Reference: Leo p. 135

Electron attachment coefficient

- η (attachment coefficient)
  - the probability of an attachment per unit path length
  - unit is the same as Townsend coefficient

Electron attachment involves the capture of free electrons by electronegative atoms to form negative ions,

$$e^- + X \rightarrow X^- + h\nu \ . \qquad (6.11)$$

These are atoms which have an almost full outer electron shell so that the addition of an extra electron actually results in the release of energy. The negative ion formed is consequently stable. The energy released in this capture is known as the *electron affinity*. Clearly, therefore, the presence of any electronegative gases in the detector will severely diminish the efficiency of electron-ion collection by trapping the electrons before they can reach the electrodes. Some well known electronegative gases are O_2, H_2O, CO_2, CCl_4 and SF_6. The noble gases He, Ne, Ar, in contrast, have negative electron affinities.

- Reference: Leo p. 132