Photoelectron extraction and collection efficiency studies in CsI-THGEM for Ne based mixtures

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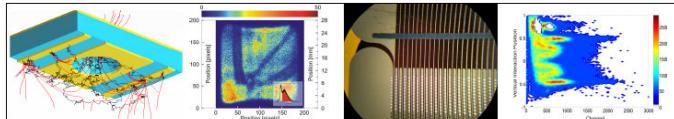
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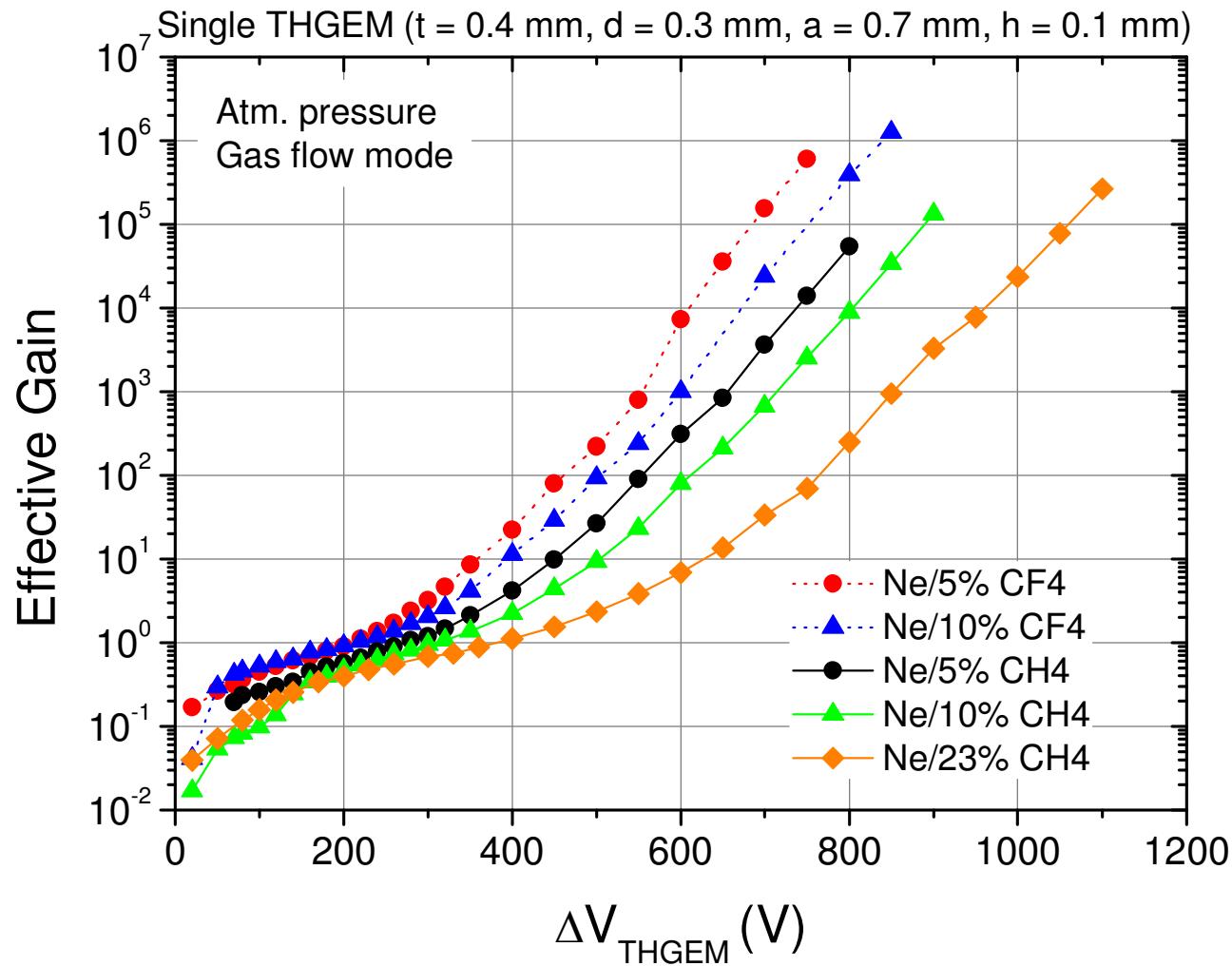
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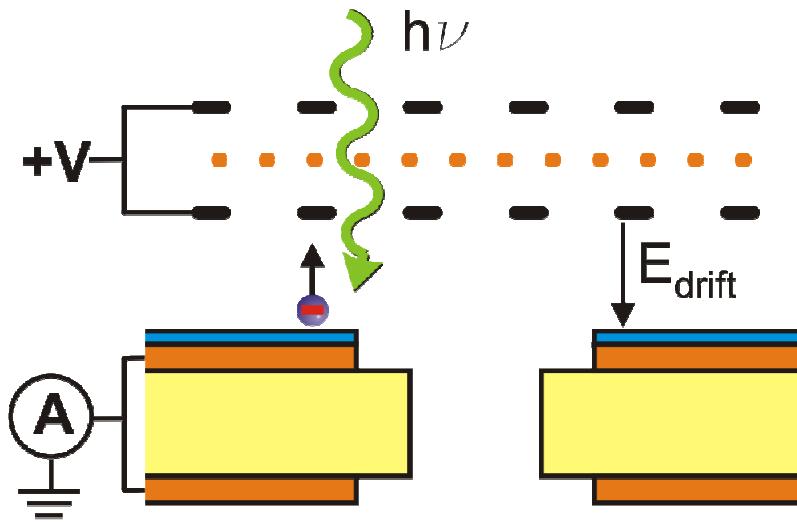
- **THGEM in Ne mixtures**

  - **High gain @ low voltages**

    - **reduced discharge probability**

    - **discharge energy**

    - **charging-up effects**

  - **Single photoelectron detection capability**

    - **Collection and extraction efficiency**

   - **Effective photon detection efficiency**

Single THGEM (t = 0.4 mm, d = 0.3 mm, a = 0.7 mm, h = 0.1 mm)
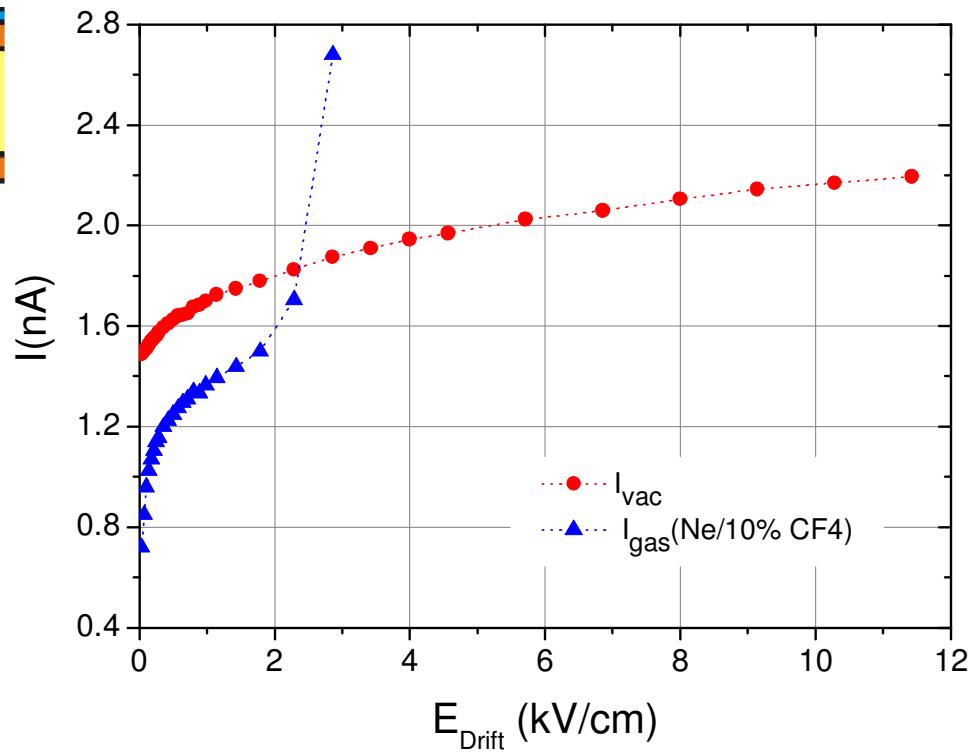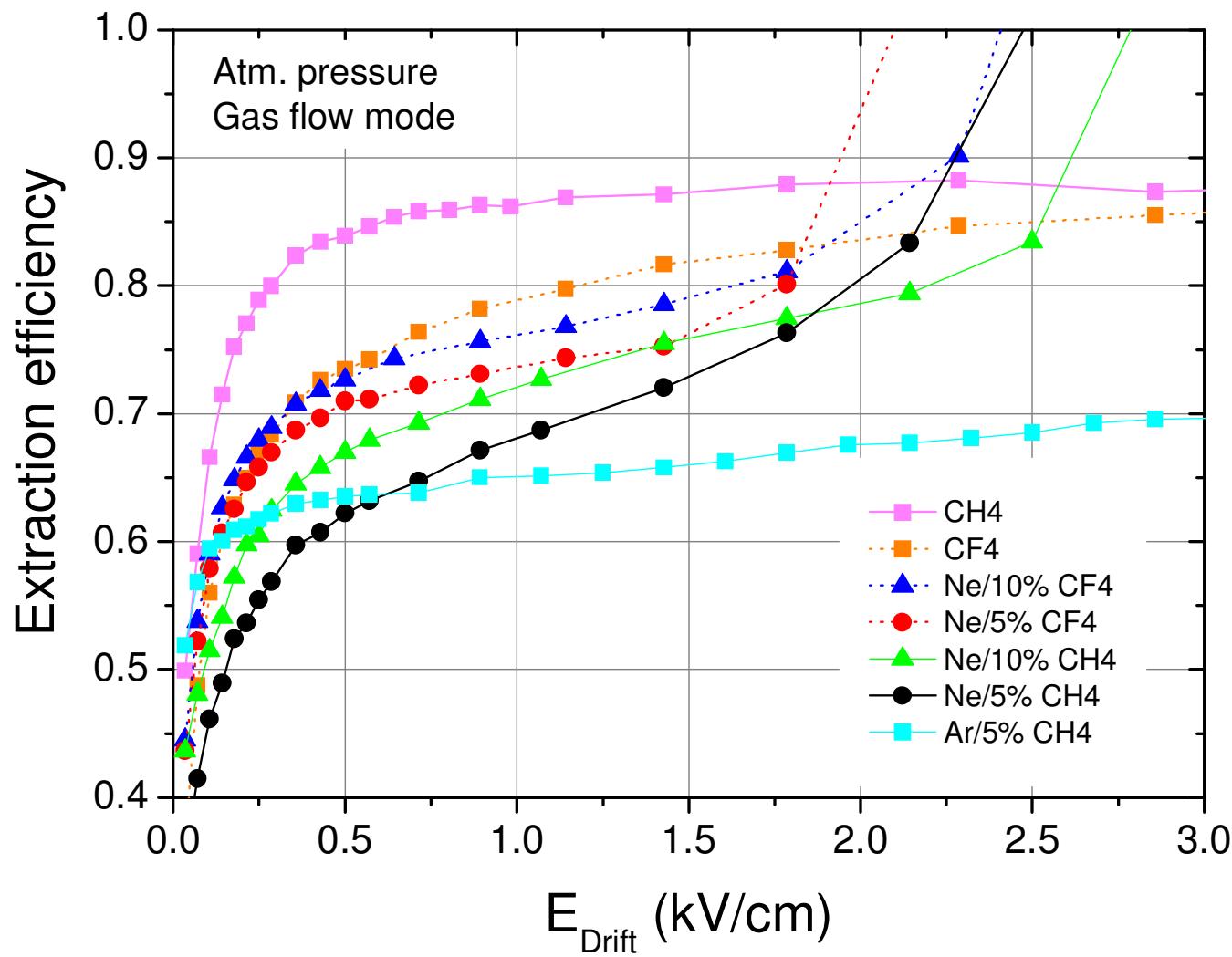
Extraction efficiency (ε_{extr})
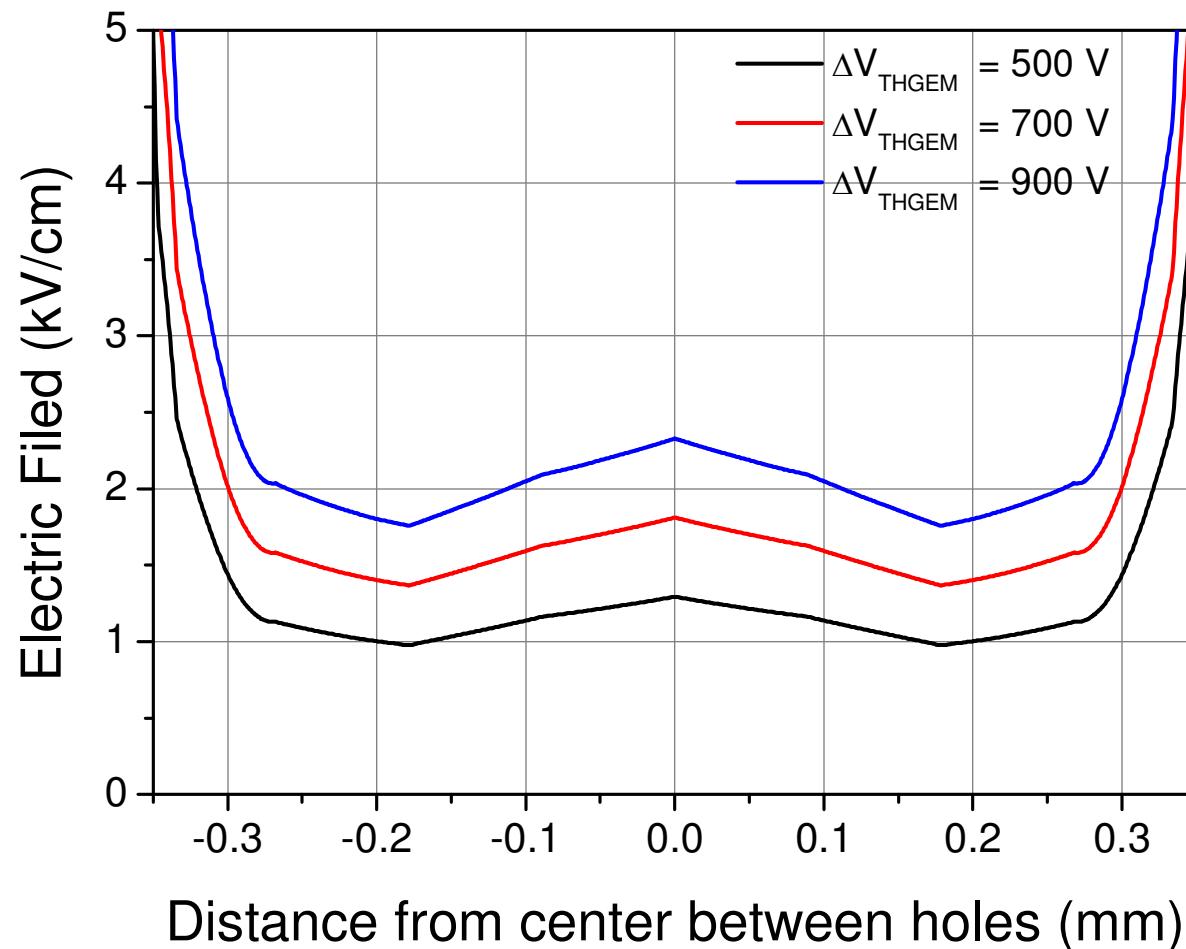
$$\varepsilon_{extr} = \frac{I_{gas}}{I_{vac}}$$

Extraction efficiency (ϵ_{extr})

Atm. pressure
Gas flow mode

Legend:
- CH4
- CF4
- Ne/10% CF4
- Ne/5% CF4
- Ne/10% CH4
- Ne/5% CH4
- Ar/5% CH4

Axes: Extraction efficiency vs E_{Drift} (kV/cm)
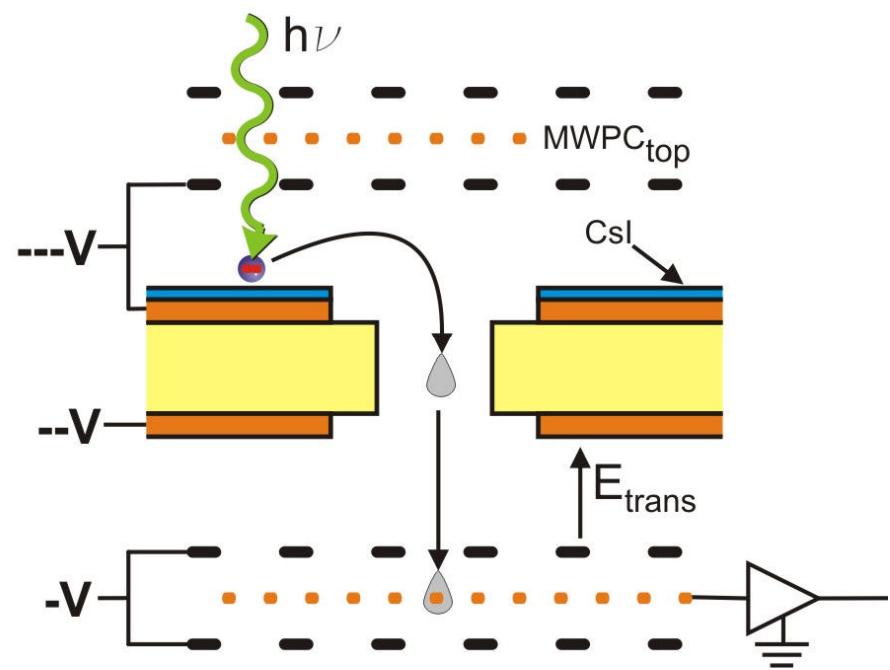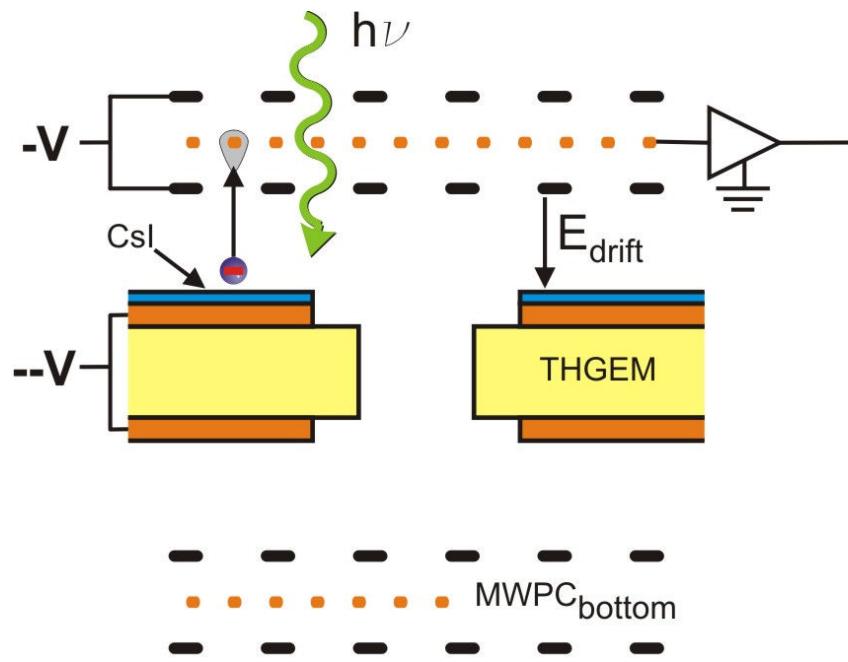
Photocathode Electric Field
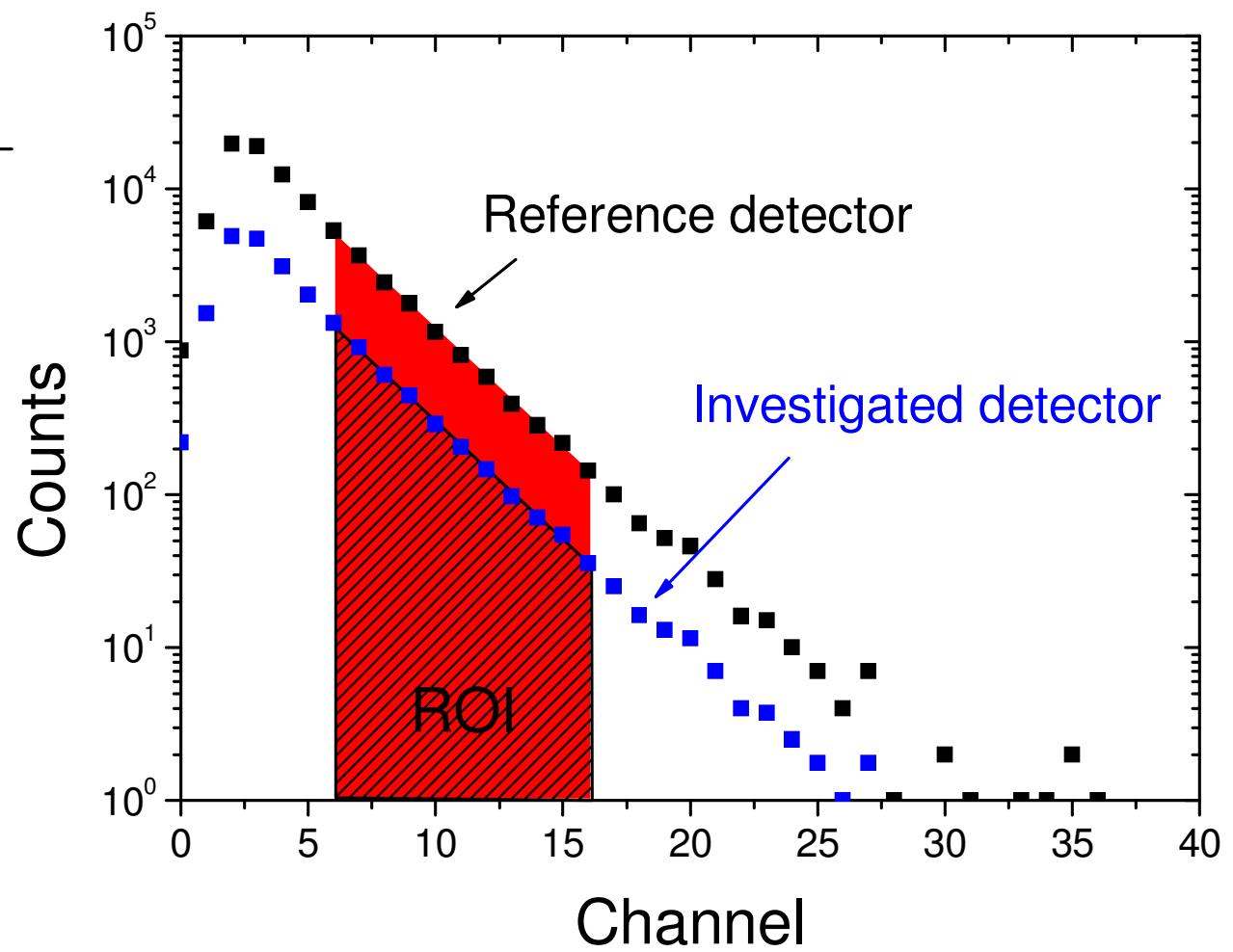
Collection efficiency (ε_{coll})
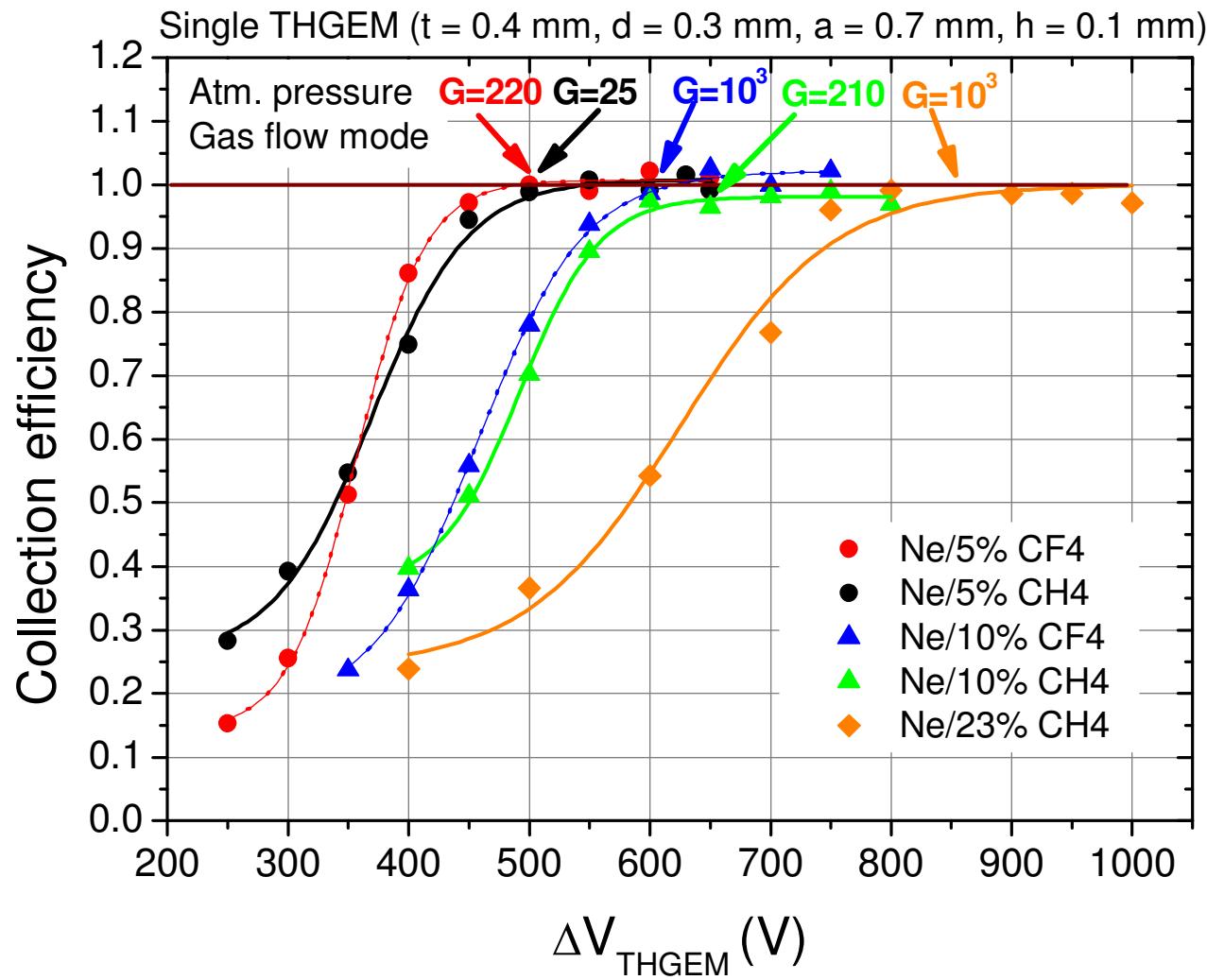
Collection efficiency (ε_{coll})

$$\varepsilon_{coll} = \frac{N_{THGEM}}{N_{ref}}$$

Collection efficiency (ε_{coll})

Single THGEM (t = 0.4 mm, d = 0.3 mm, a = 0.7 mm, h = 0.1 mm)

Effective photon detection efficiency (ε_{effph})

$$\varepsilon_{effph} = QE \times A_{eff} \times \varepsilon_{extr} \times \varepsilon_{coll}$$

This geometry: t = 0.4 mm, a = 0.7 mm, d = 0.3 mm, h = 0.1 mm

| Gas	$\Delta V_{THGEM}(V)$	Gain	QE 170nm	A_{eff}	ε_{extr}	ε_{coll}	E_{effph}
Ne/CH$_4$(95/5)	800	5.4E4	0.3	0.54	0.73	1	0.12
Ne/CH$_4$(90/10)	900	1.3E5	0.3	0.54	0.79	1	0.13
Ne/CF$_4$(95/5)	750	6.0E5	0.3	0.54	0.76	1	0.12
Ne/CF$_4$(90/10)	850	1.2E6	0.3	0.54	0.83	1	0.14
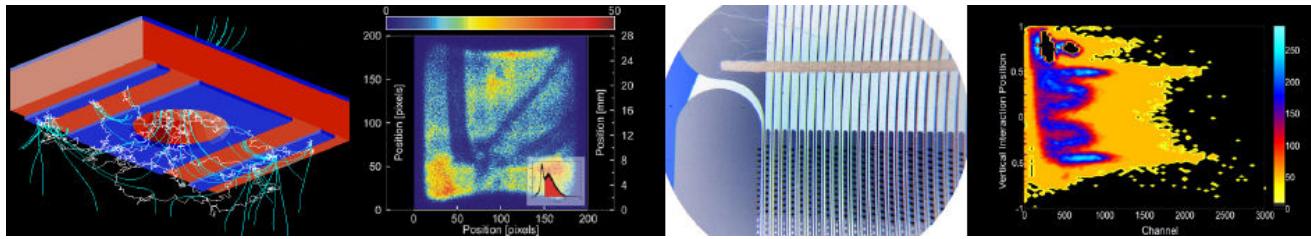
Perspectives for optimized geometry: t = 0.4 mm, a = 1 mm, d = 0.3 mm, h = 0.01 mm
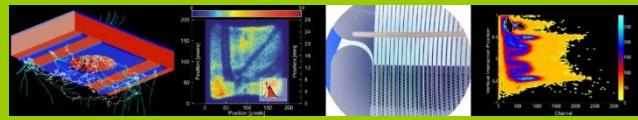
Gas	$\Delta V_{THGEM}(V)$	Gain	QE170nm	A_{eff}	ε_{extr}	ε_{coll}	E_{effph}
Ne/CH$_4$(95/5)	800	5.4E4	0.3	0.91	0.73	1	0.20
Ne/CH$_4$(90/10)	900	1.3E5	0.3	0.91	0.79	1	0.22
Ne/CF$_4$(95/5)	750	6.0E5	0.3	0.91	0.76	1	0.21
Ne/CF$_4$(90/10)	850	1.2E6	0.3	0.91	0.83	1	0.23

Conclusions

- **Gain > 10^5 were reached in all mixtures**
  - **10^6 in Ne/10%CF4**

- **Extraction efficiency (ε_{extr}) > 72% @ 1.5 kV/cm**
  - **83% @ 2 kV/cm in Ne/10%CF4**

- **Full collection efficiency (ε_{coll}) @ realistic operation conditions**
- **Effective photon detection efficiency 12 < ε_{effph} < 14%**
  - **20% < ε_{effph} < 23% with optimized geometry**
  - **83% @ 2 kV/cm in Ne/10%CF4**

Thanks for your attention

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