Using a COBRA_125 to increase the Light Yield

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Topics:

- COBRA_125 Layout
- GEM Mode Measurements
- Full COBRA Mode
- Comparison with a standard GEM
- Methane Admixtures

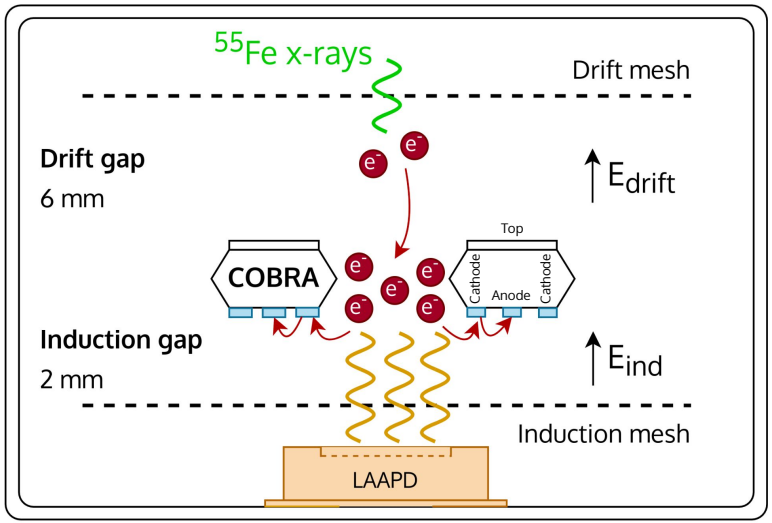
Experimental Setup

We have replaced our 50 µm GEM with a 125 µm COBRA:

- **Increased thickness:** more robust to electric discharges.
- **Third electrode:** additional multiplication region in the bottom strips.

Amaro, F. D., et al. "Operation of a novel large area, high gain, single stage gaseous electron multiplier." Journal of Instrumentation 16.01 (2021): P01033.

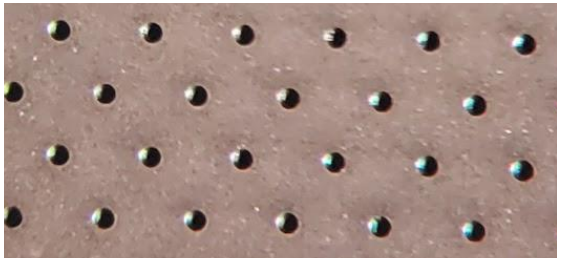
GEOMETRY	GEM	COBRA_125
Hole spacing	140 µm	400 µm
Hole in kapton/ copper	50 µm/ 70 µm	60 µm/ 120 µm
Strip width & separation	–	60 µm



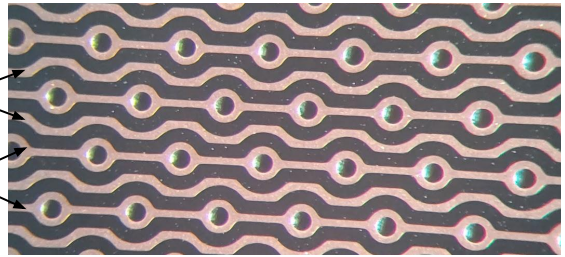
Both features of the COBRA_125 may increase the light yield.

But how much?

Top electrode



Bottom electrode

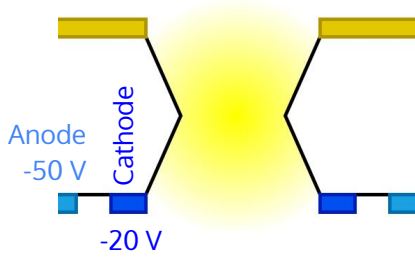


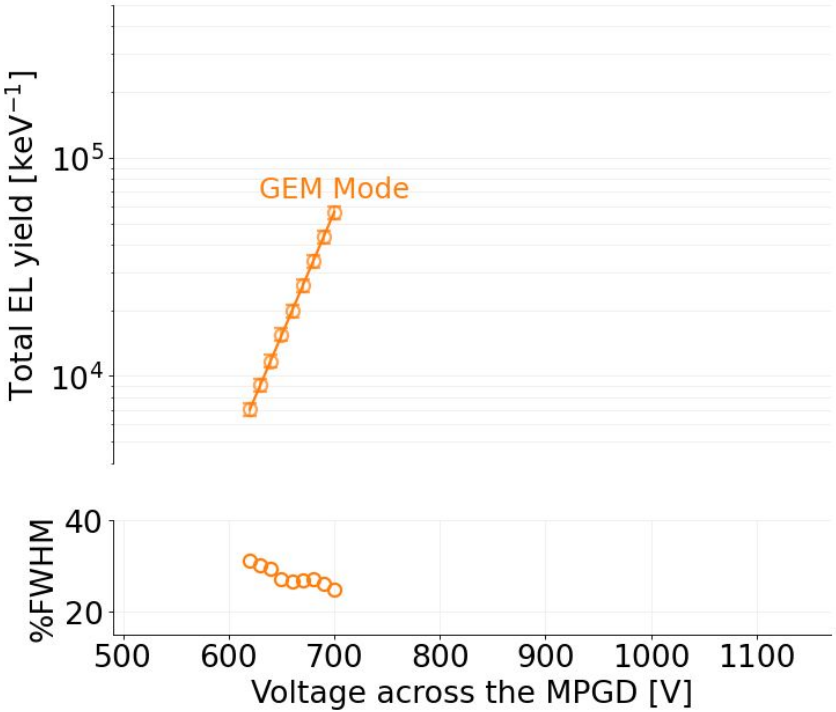
He-40%CF_4: GEM Mode

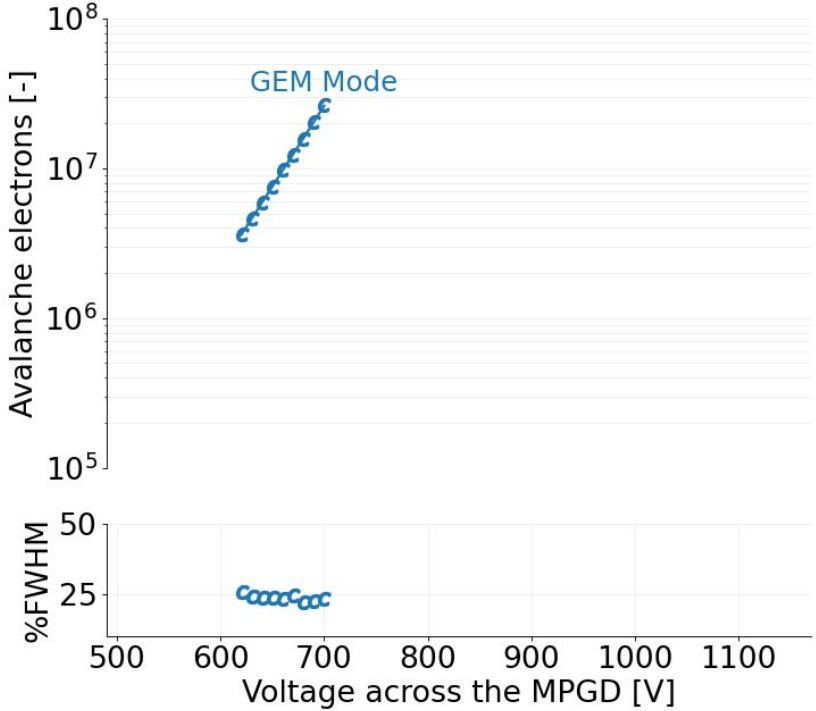
Light and Charge increases with increasing bias.
Minimum energy resolution (FWHM) is 22% for charge and 24% for light signals.

Light is only produced within the holes:

- Hole bias is increased.
- Strip bias is constant.

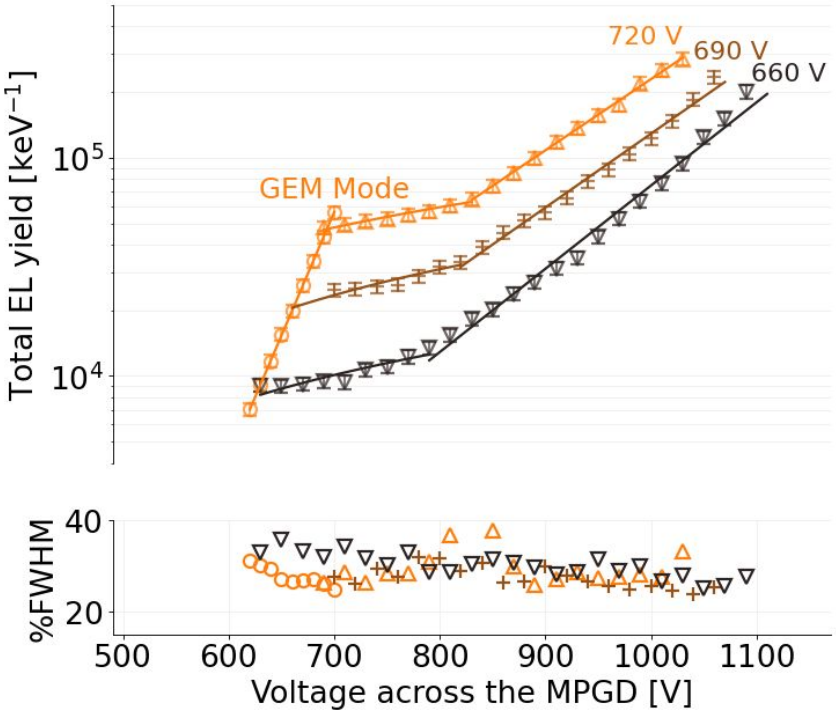






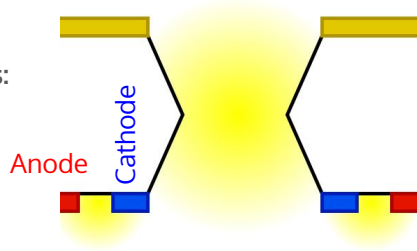
He-40%CF_4: Full-COBRA

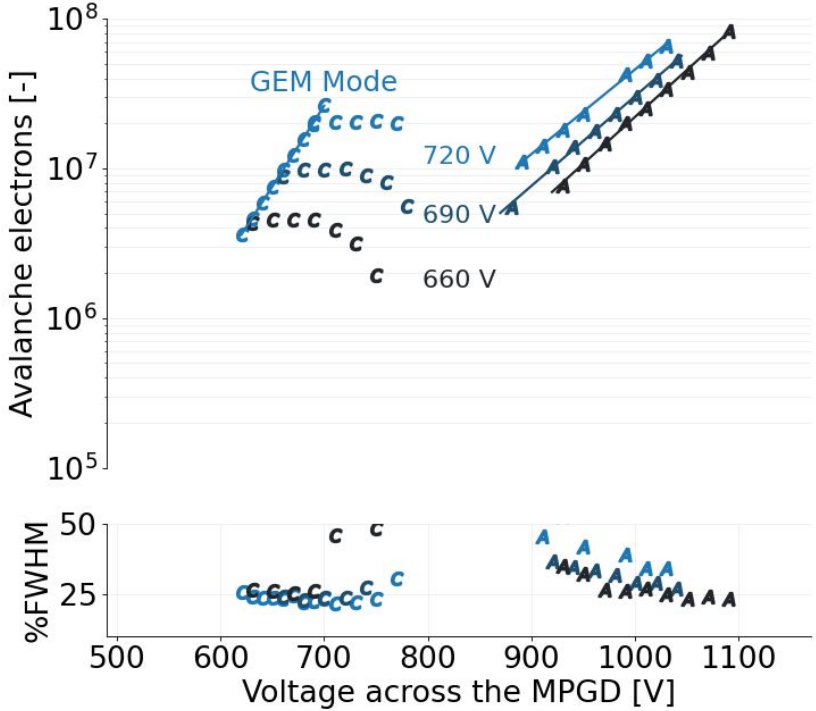
Light first increases linearly and then exponentially.
At first, charge is transferred to the anode and then increases exponentially with increasing bias.



Light is produced in the holes and strips:

- Hole bias is constant.
- Strip bias is increased.

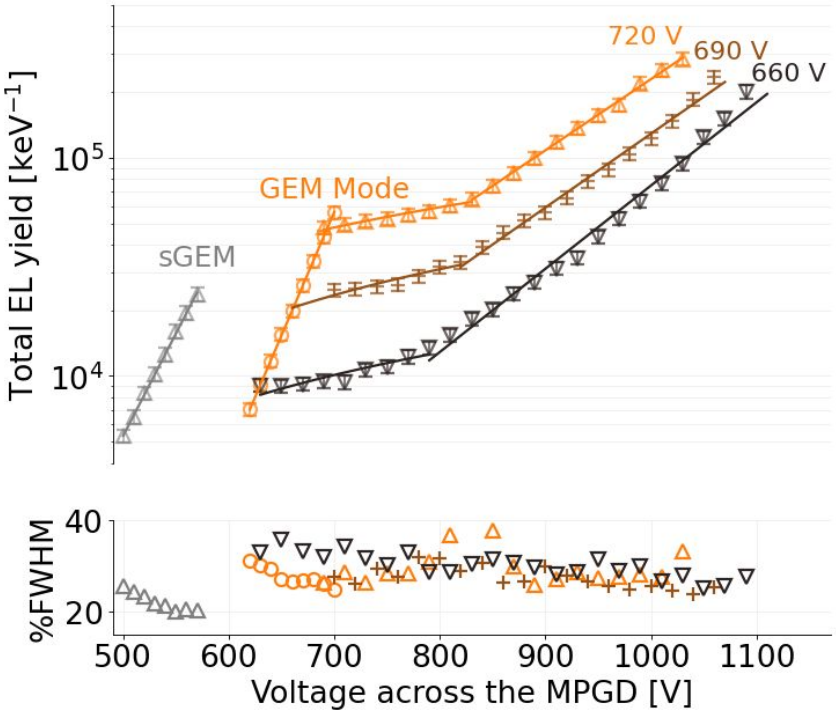




He-40%CF_4: Comparison with a standard GEM (sGEM)

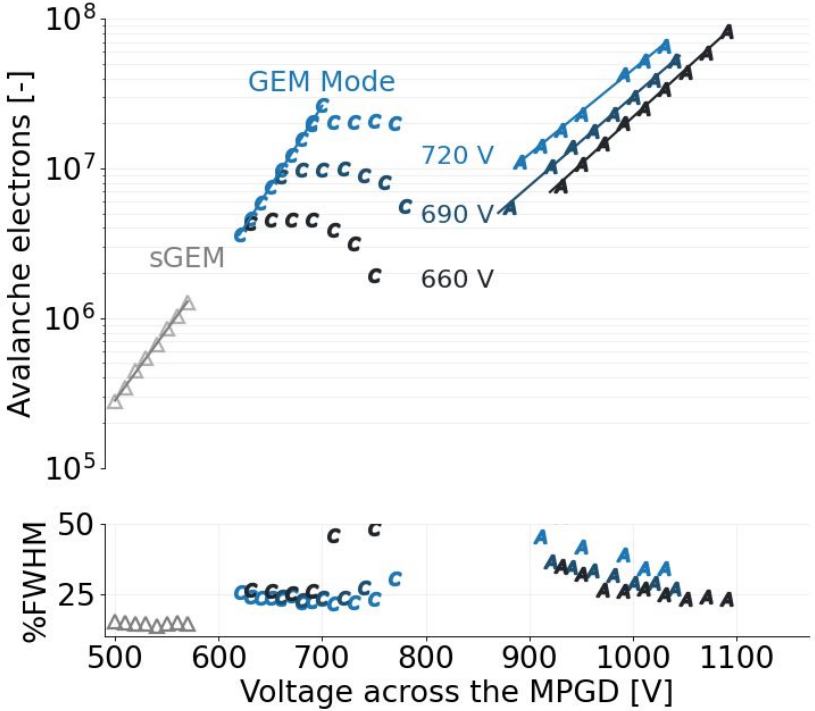
The Maximum Light Yield can be increased by

- **2.3-fold** (GEM Mode)
- **11.8-fold** (full-COBRA Mode)



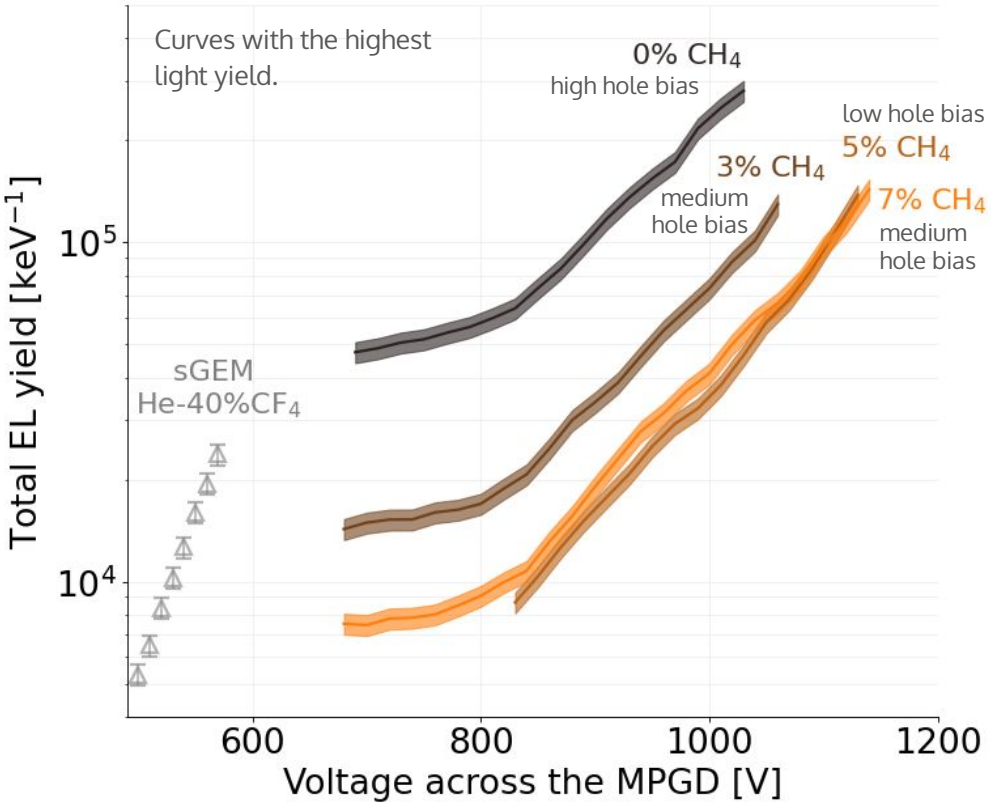
The Maximum Charge can be increased by

- **21.0-fold** (GEM Mode)
- **65.4-fold** (full-COBRA Mode)



Methane Admixtures to He-40%CF_4

We also evaluated the light yield of 3%, 5% and 7%CH_4.

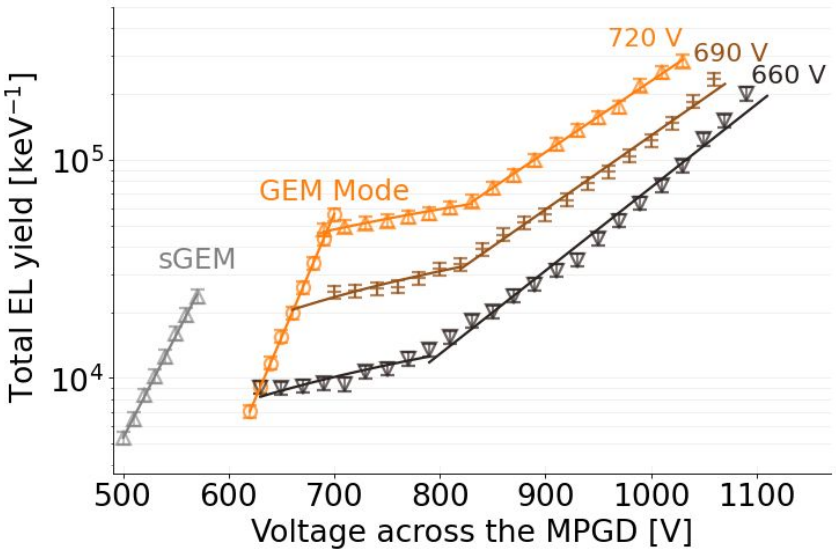


Maximum Light Yield for each mixture

He-40%CF_4	GEM	COBRA
0% CH_4	2.37(17)x10^4	2.80(20)x10^5
3% CH_4	3.90(28)x10^4	1.30(9)x10^5
5% CH4	3.09(22)x10^4	1.38(10)x10^5
7% CH_4	2.41(17)x10^4	1.43(10)x10^5

The light yield of CH_4 admixtures with a COBRA_125 is about ***6 times higher*** than the light yield of He-40%CF4 with a sGEM.

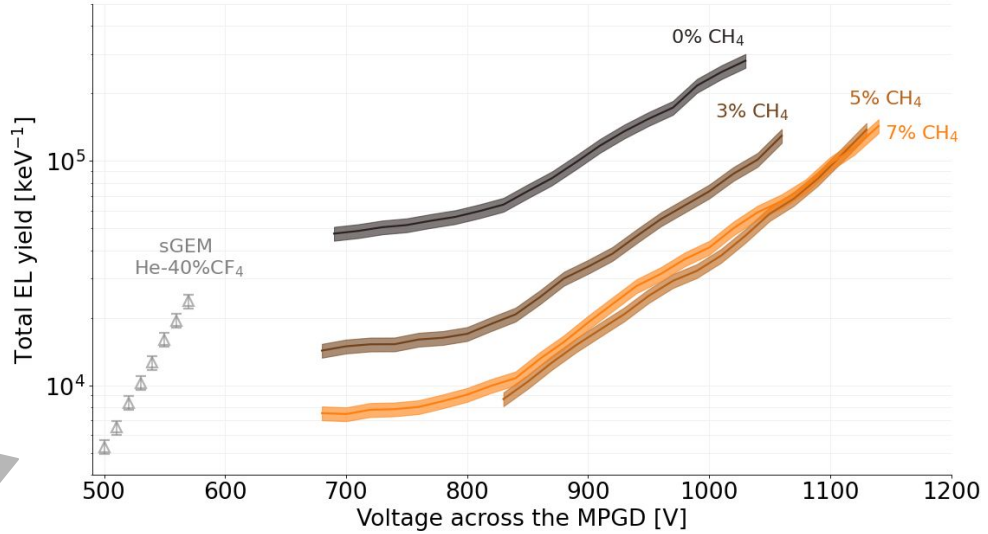
Conclusions



With a COBRA_125, the light yield of methane admixtures is 6 times higher than the light yield of He-40%CF_4 produced with a standard GEM.

The light yield can be increased 11.8-fold in He-40%CF_4 with a COBRA_125 due to:

- **The thickness of the COBRA (125 µm):** increases the threshold for self-sustained micro-discharges.
- **The second multiplication region:** additional light is created in the strips.



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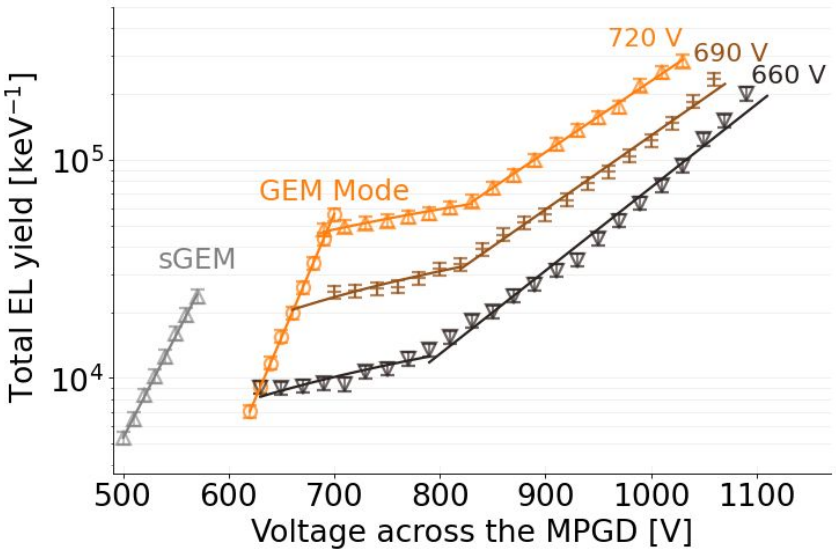

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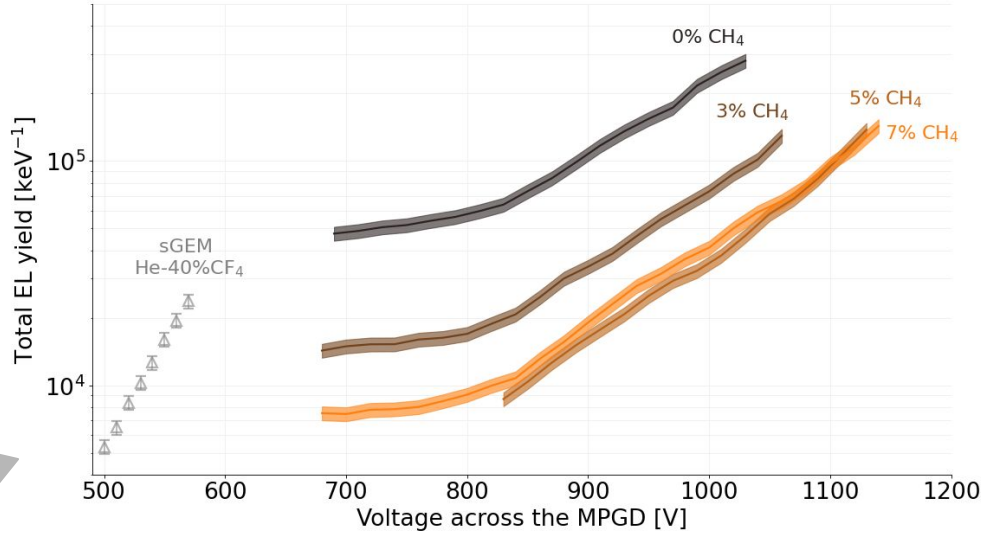

Grazie per l'attenzione
Any questions or suggestions?

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