

# Electroluminescence studies in He-CF<sub>4</sub>-isobutane mixtures

R.C. Roque, R.D.P. Mano, F.D. Amaro, C.M.B. Monteiro, J.M.F. dos Santos

LIBPhys-UC Department of Physics, University of Coimbra, Portugal

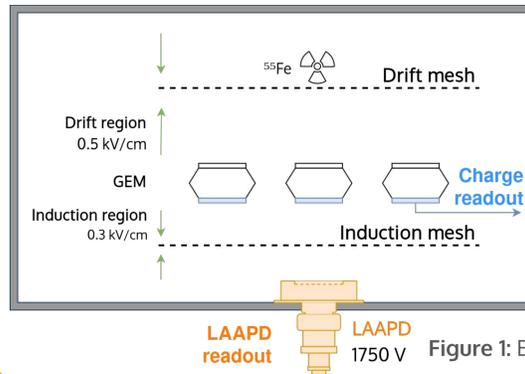
## Summary

CYGN0 is part of the CYGNUS international proto-collaboration for the development of a distributed Galactic Nuclear Recoil Observatory for directional Dark Matter search at low WIMP masses (1-10 GeV/c<sup>2</sup>) and coherent neutrino scattering measurement. CYGN0 is developing a gaseous Time Projection Chamber (TPC), which will be hosted at Laboratori Nazionali del Gran Sasso, Italy [1]. The base mixture of the CYGN0 TPC will consist on He-CF<sub>4</sub> (60/40) [2] and the addition of isobutane and other gases with high H-content is currently under consideration.

This work aims at determining how the addition of small percentages of isobutane to the He-CF<sub>4</sub> (60/40) base mixture influences the Electroluminescence (EL) yield, charge multiplication and corresponding energy resolution.

## Experimental Setup

The detector was irradiated with low-energy x-rays (5.9-keV) and a Large Area Avalanche Photodiode (LAAPD) was used to readout the EL produced in the avalanches of a single GEM [3].



Increasing concentrations of isobutane, from 1% to 5%, were added to the base mixture of He-CF<sub>4</sub> (60/40), continuously flowing at 4 L/h.

## Results

The charge signals were collected at the bottom of the GEM.

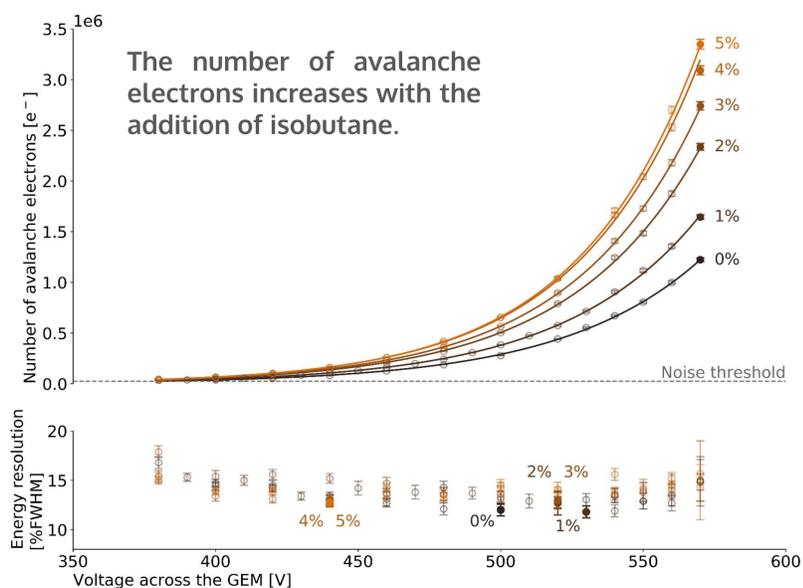


Figure 2: Number of avalanche electrons in function of the voltage across the GEM.

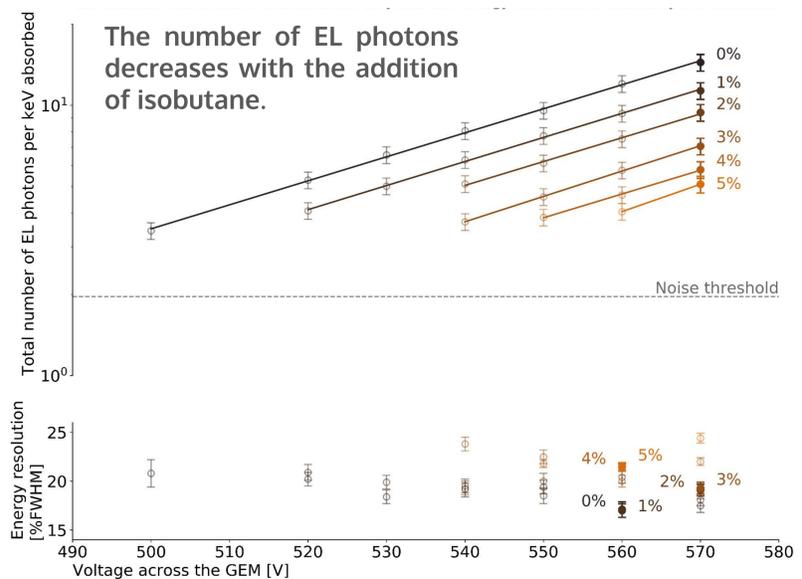


Figure 3: Total number of EL photons per keV absorbed in function of the voltage across the GEM.

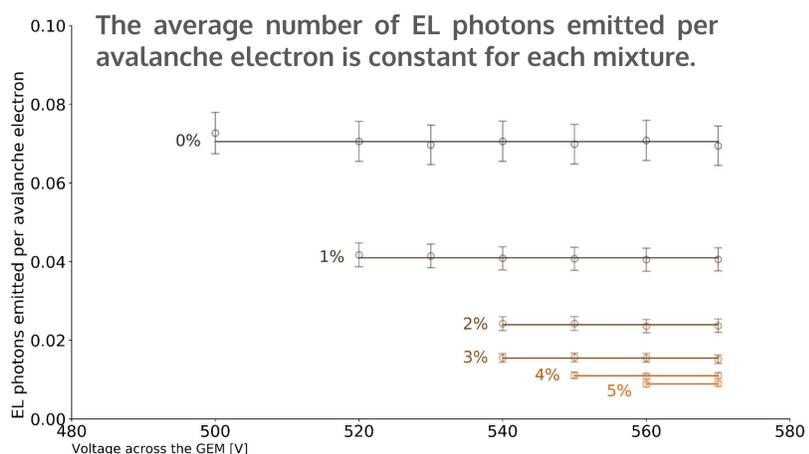


Figure 3: Average number of EL photons emitted per avalanche electron in function of the voltage across the GEM.

## Conclusions

The results obtained show that adding isobutane to the He-CF<sub>4</sub> (60/40) base mixture decreases the amount of EL photons but does not compromise the EL readout and is therefore a good option to study for possible applications in the CYGN0-TPC.

## References

- [1] Baracchini, E. *et al.* "CYGN0: a gaseous TPC with optical readout for dark matter directional search." *Journal of Instrumentation* 15, no. 07 (2020): C07036. DOI: 10.1088/1748-0221/15/07/C07036.
- [2] Fraga, M. M. F. R., *et al.* "The GEM scintillation in He-CF<sub>4</sub>, Ar-CF<sub>4</sub>, Ar-TEA and Xe-TEA mixtures." *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 504, no. 1-3 (2003): 88-92. DOI: 10.1016/S0168-9002(03)00758-7.
- [3] Monteiro, Cristina. "Determination of argon and xenon absolute electroluminescence yields in Gas Proportional Scintillation Counters". PhD diss., Universidade de Coimbra, 2010.