

Underground LIME: Run 3

Results from data calibration studies



Rita Roque | CYGNO Reconstruction & Analysis Meeting @ Coimbra | 07/06/2023

Introduction

Data Information

"Daily" scan in z with the ^{55}Fe source:



The data was taken with:

- VGEM = 400 V
- 20 L/h on 24/05, 23/05, 22/05, 16/05
- 10 L/h on 15/05
- 6 L/h on 12/05, 11/05, 10/05

Parking

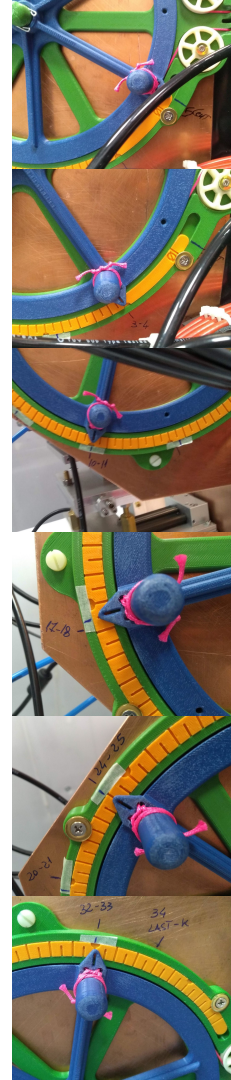
Step 1

Step 2

Step 3

Step 4

Step 5



Introduction

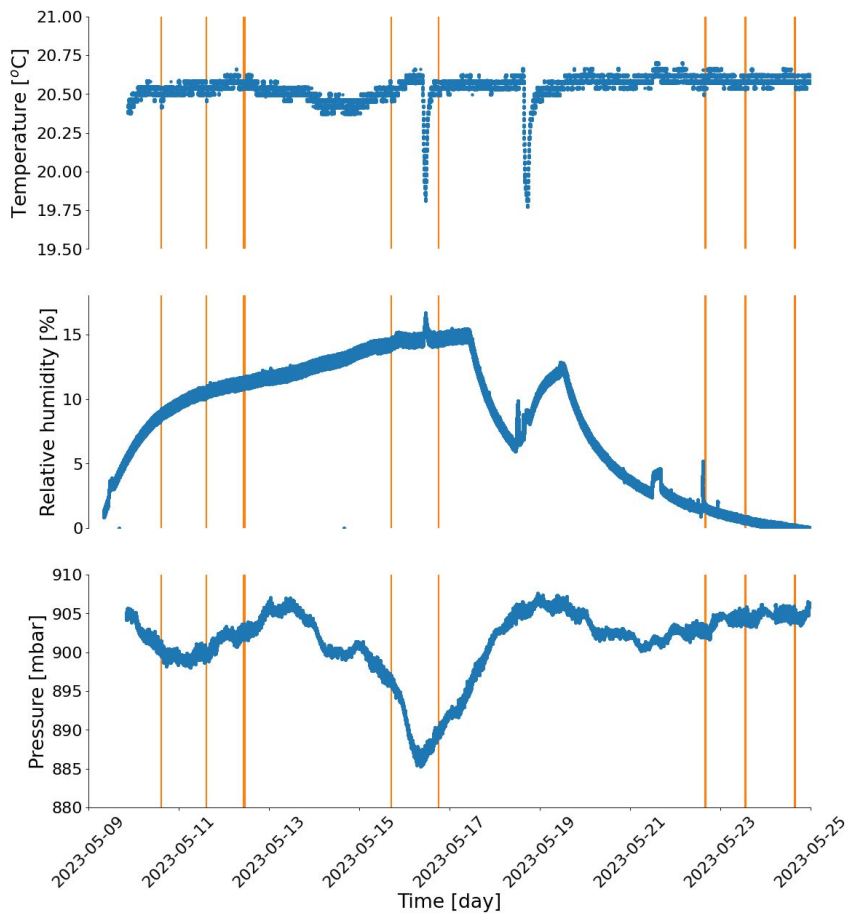
Data Information

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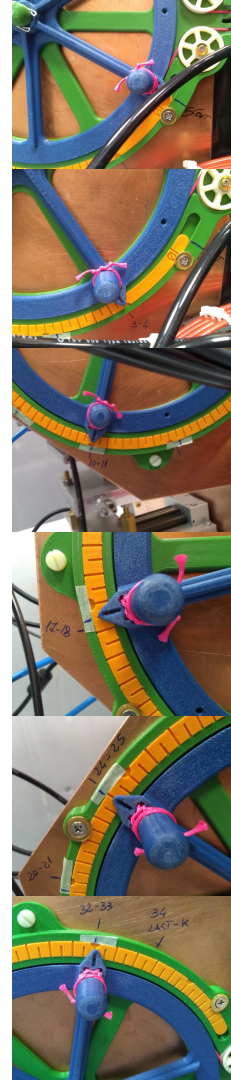


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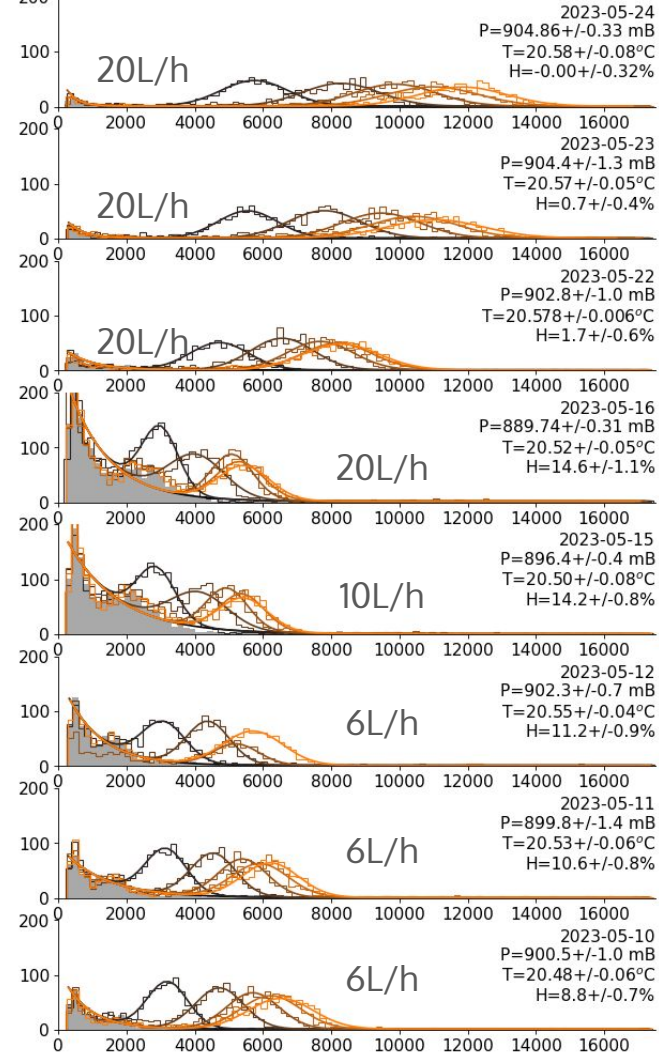
Parking
Step 1
Step 2
Step 3
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Light yield spectra

The background (parking runs) was fitted to an exponential function.

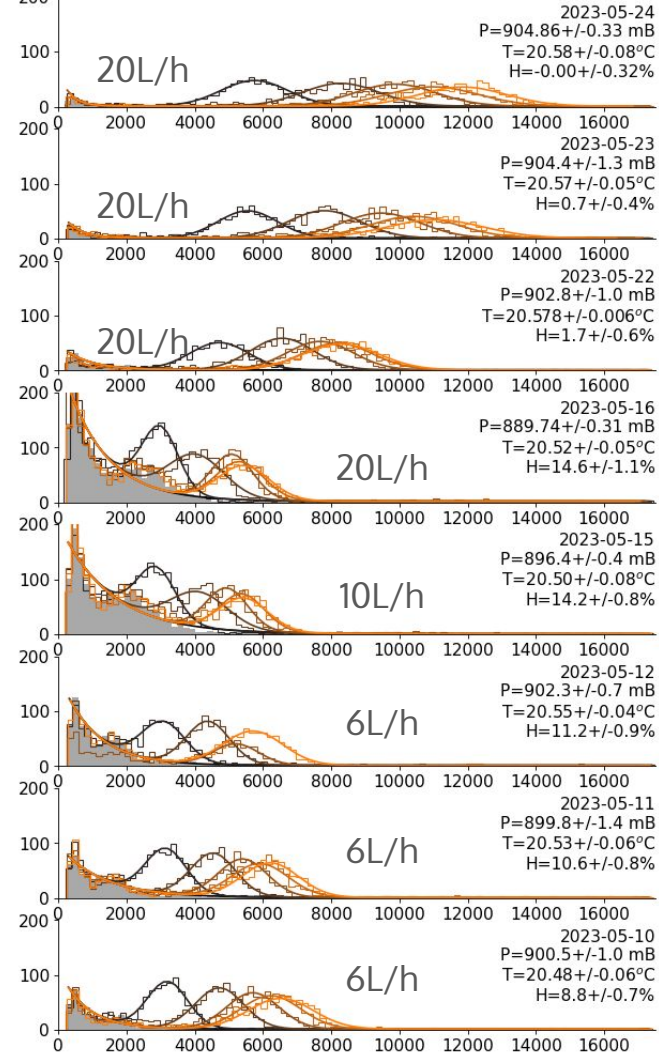
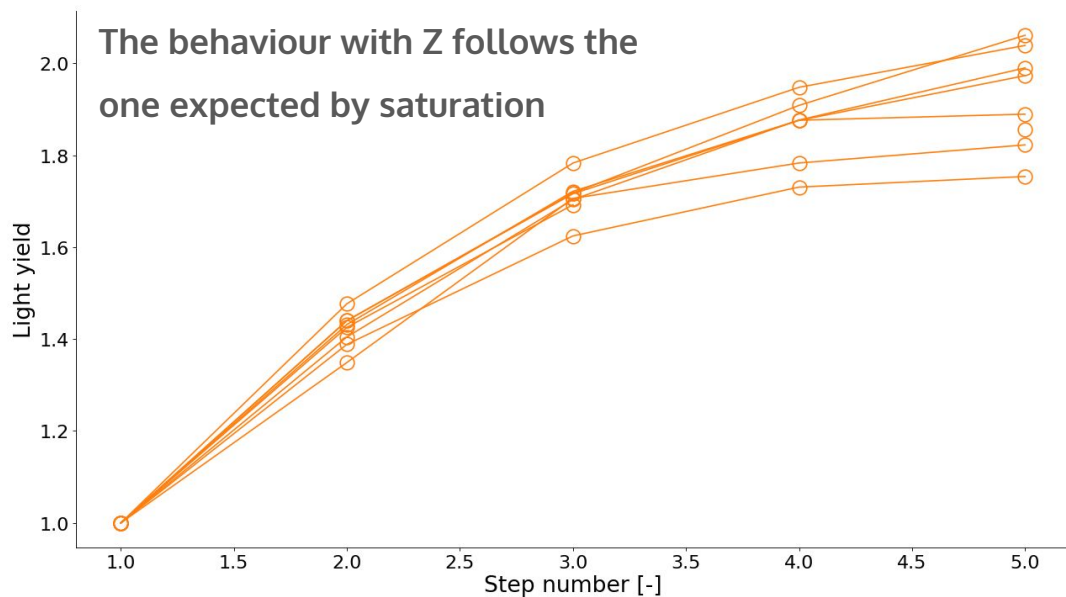
The light yield spectra were then fitted to a gaussian summed to the background exponential profile.



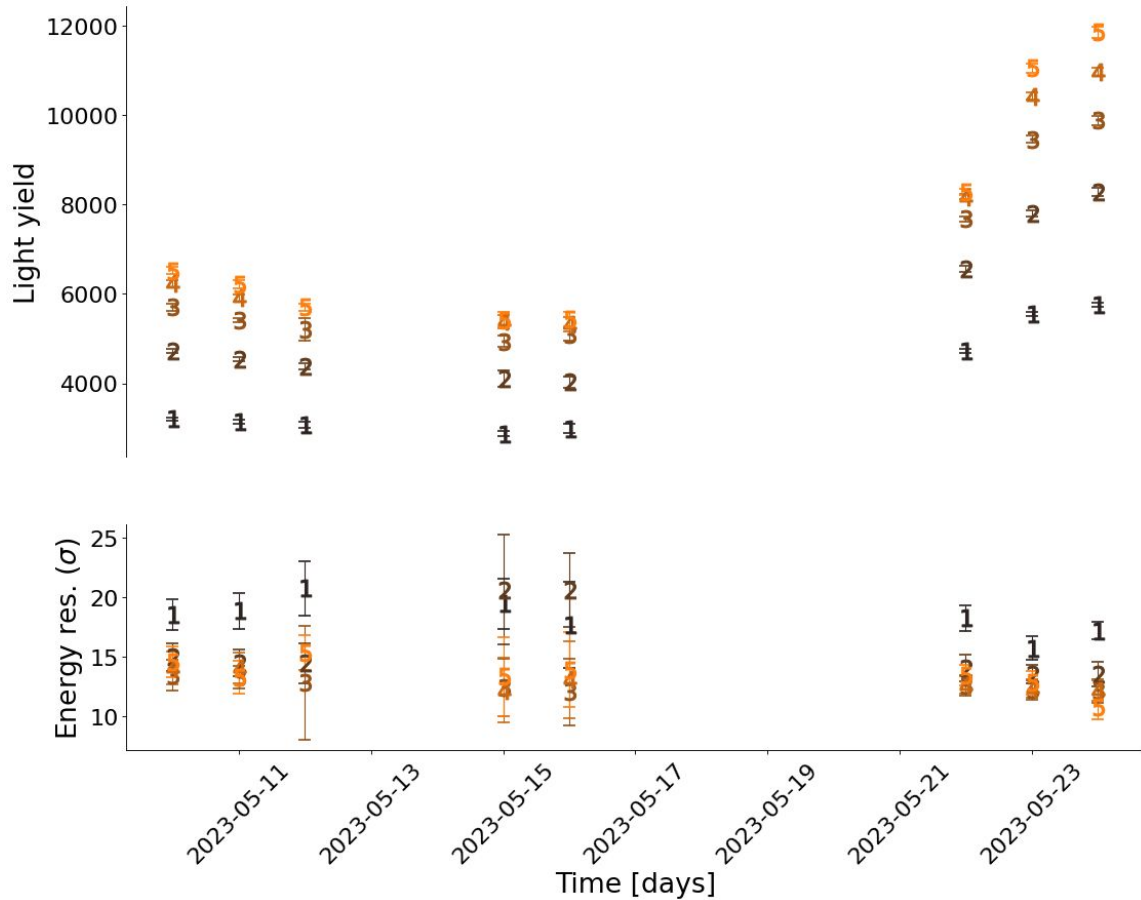
Light yield spectra

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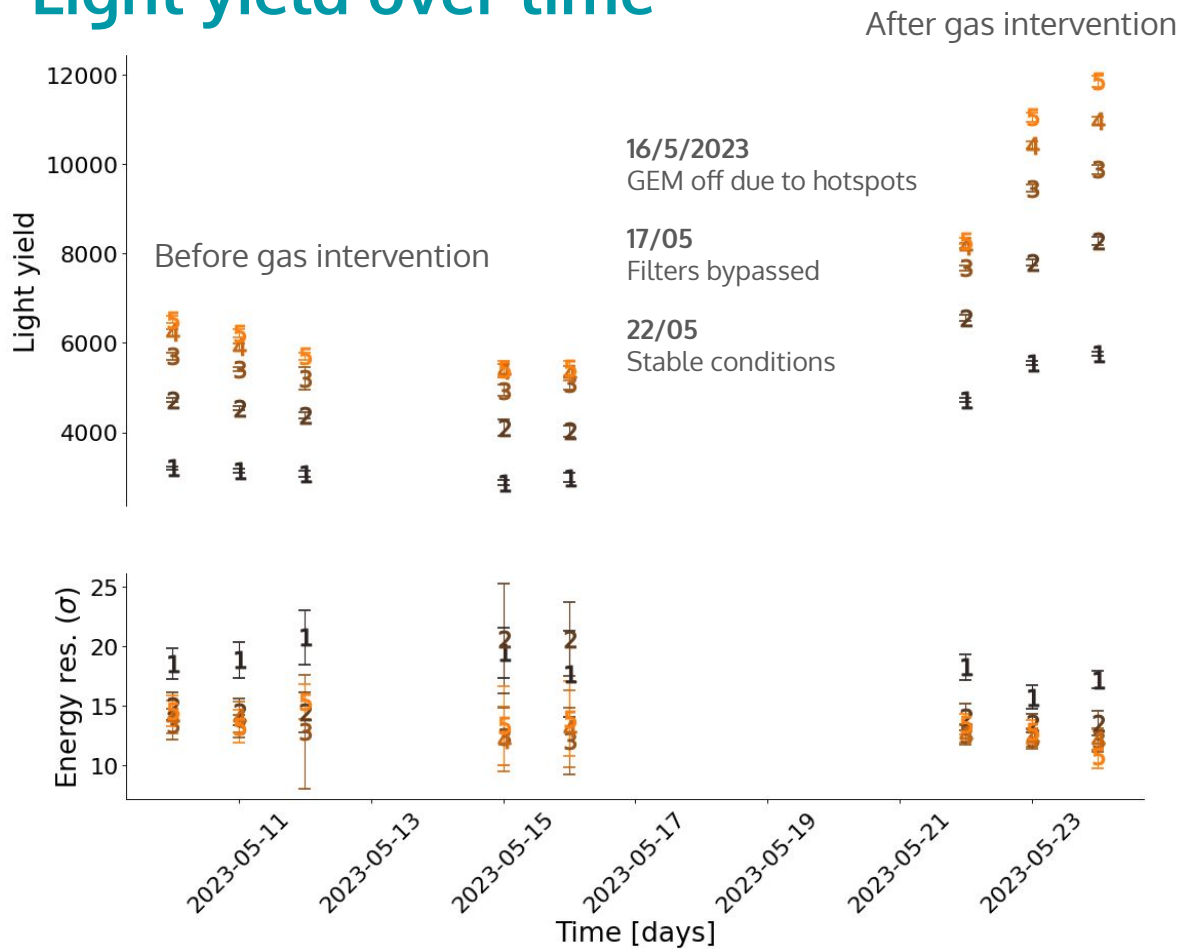
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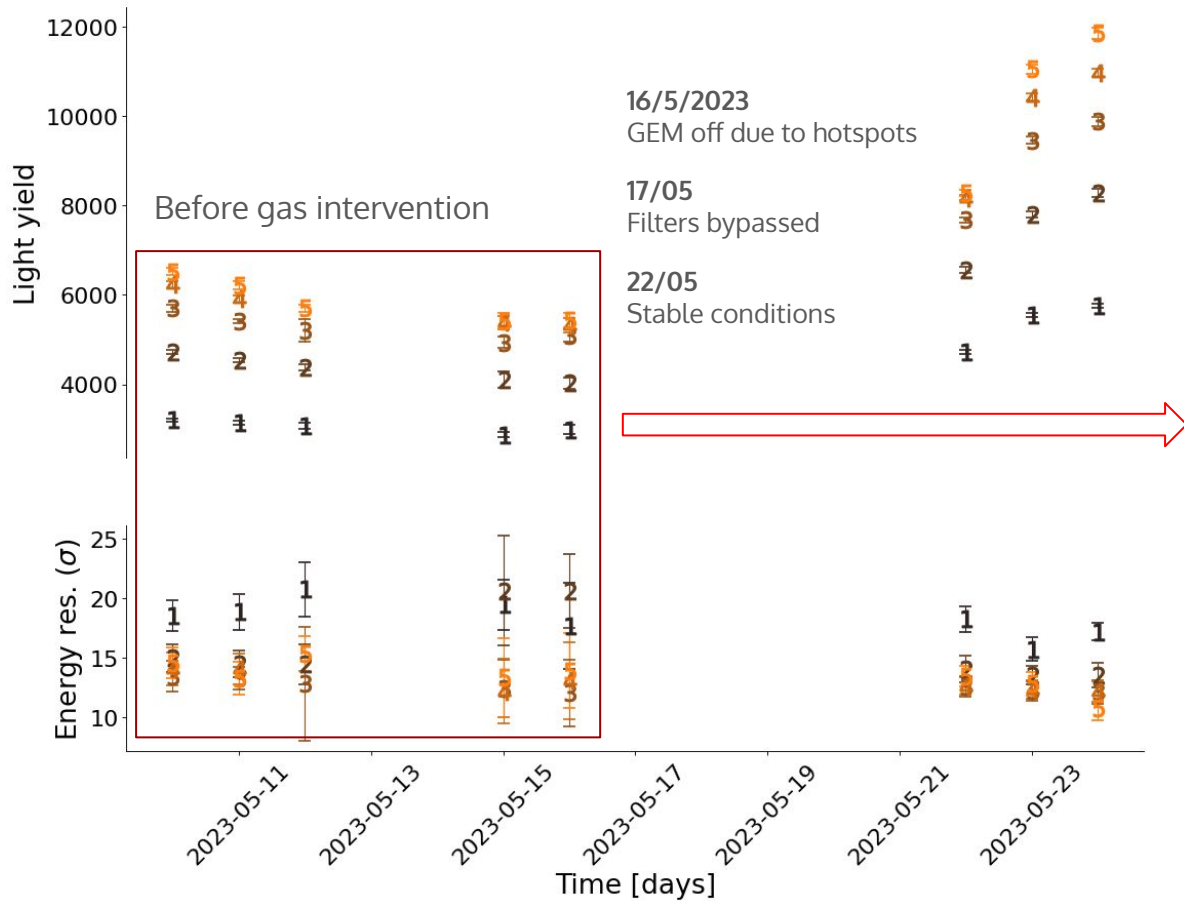
Light yield over time



Light yield over time



Light yield over time

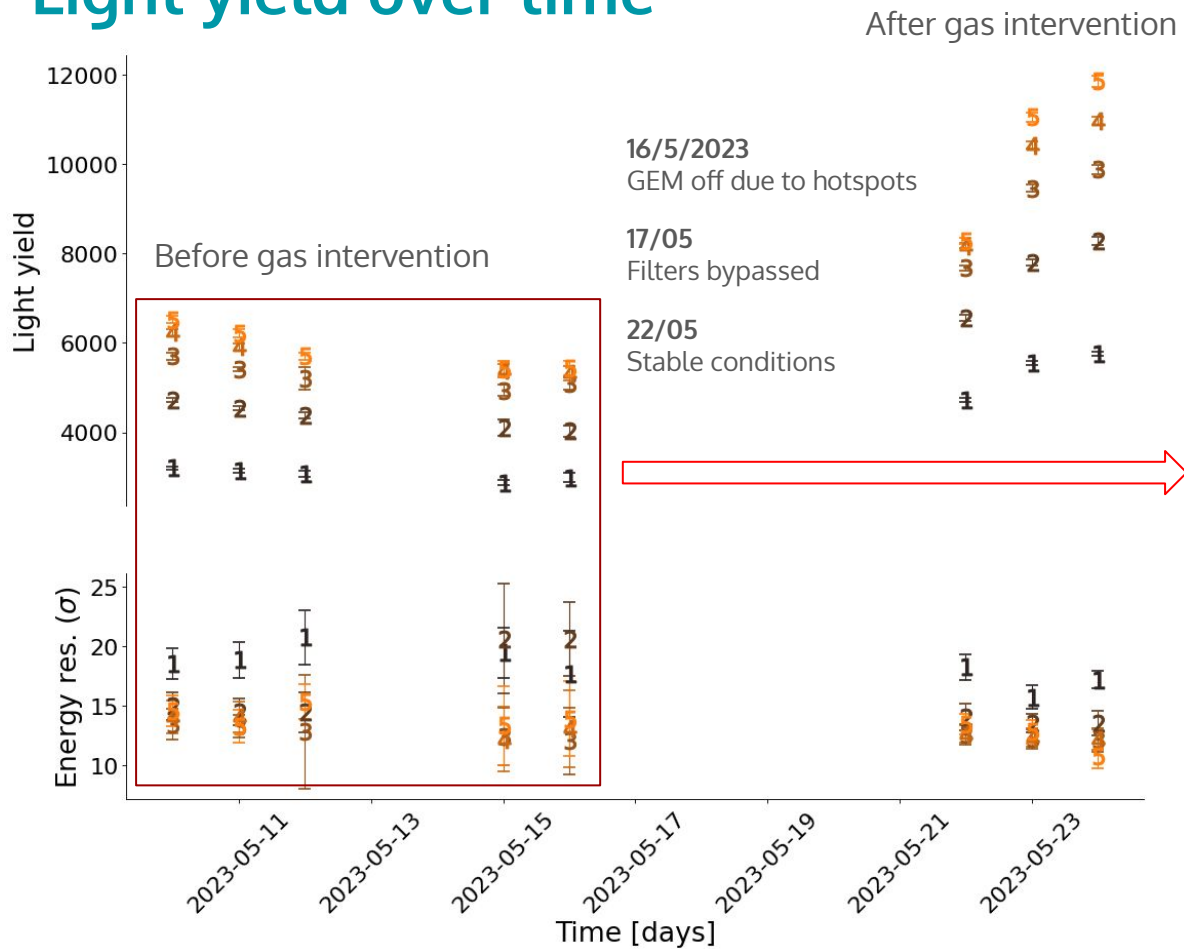


Even for the same detector conditions, the light yield fluctuates over time:

$$\text{Fluctuation} = \frac{\sigma}{\mu} \times 100\%$$

Step →		1	2	3	4	5
Run 3	LY	4.3	6.7	5.6	7.6	8.4
	σ	6.0	19.3	4.6	6.8	6.3

Light yield over time



Even for the same detector conditions, the light yield fluctuates over time:

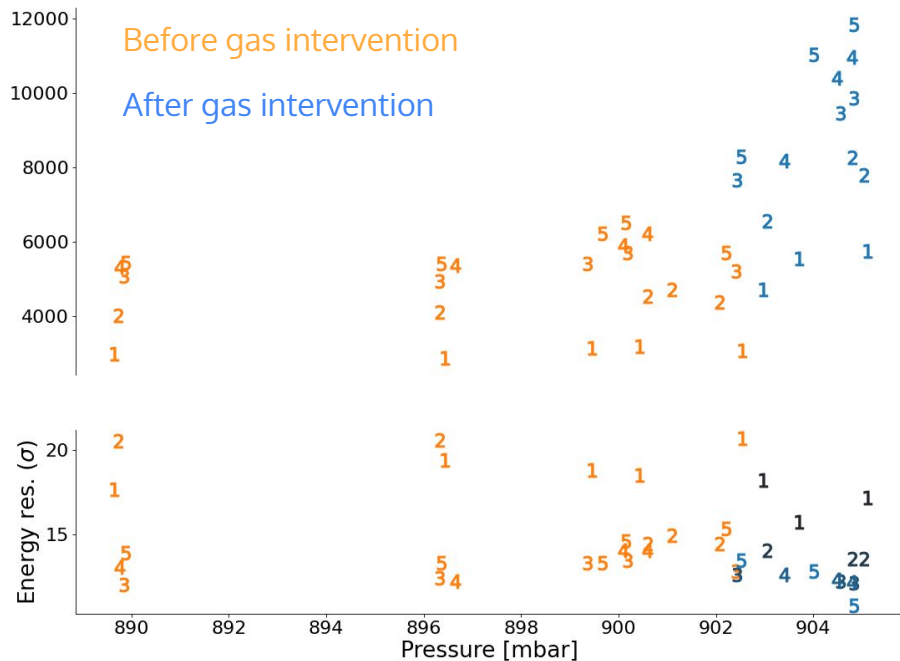
$$\text{Fluctuation} = \frac{\sigma}{\mu} \times 100\%$$

Step →		1	2	3	4	5
Run 3	LY	4.3	6.7	5.6	7.6	8.4
	σ	6.0	19.3	4.6	6.8	6.3
Run 2	LY	1.6	0.6	0.7	0.5	0.6
	σ	5.3	5.2	6.9	2.6	3.9

The fluctuations are higher than for the last days of Run 2.

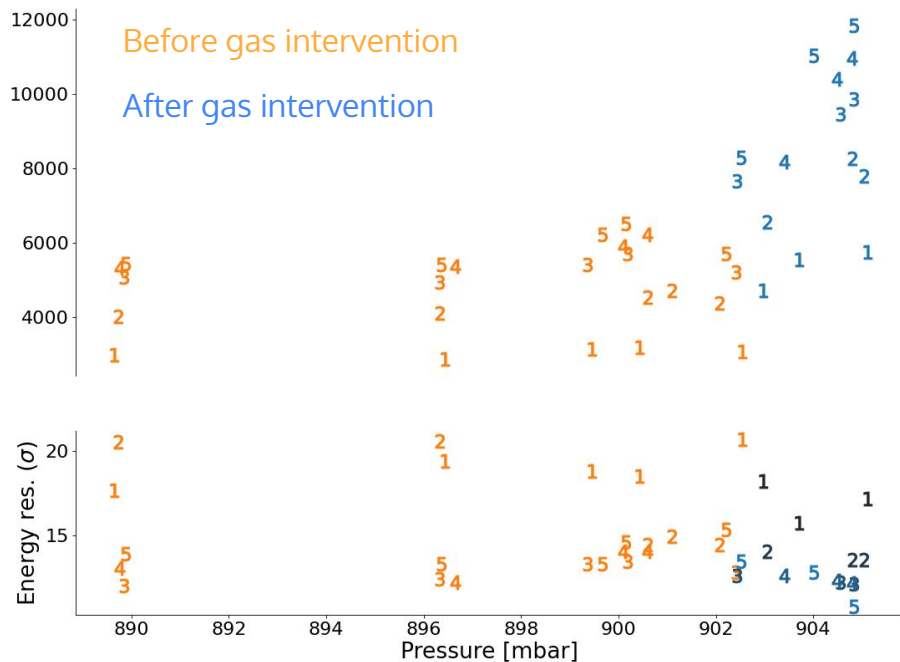
Light yield and ambient conditions

The LY seems to increase with pressure

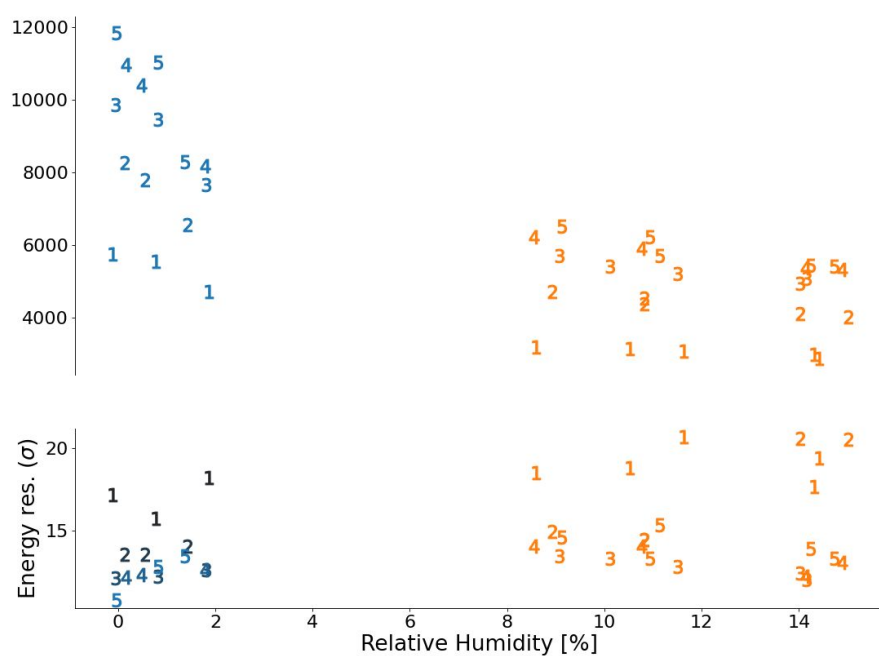


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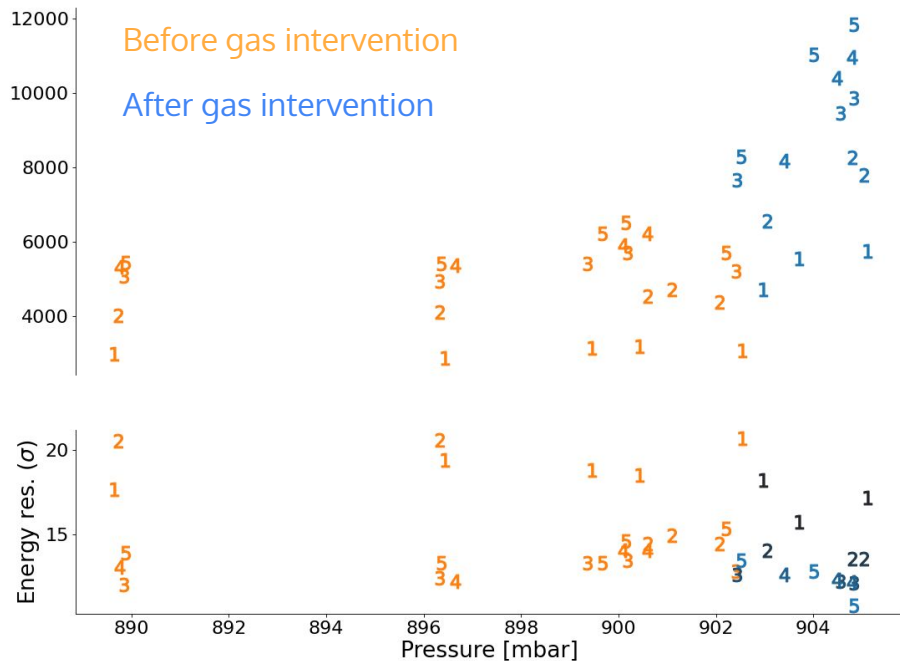


LY seems to decrease with humidity

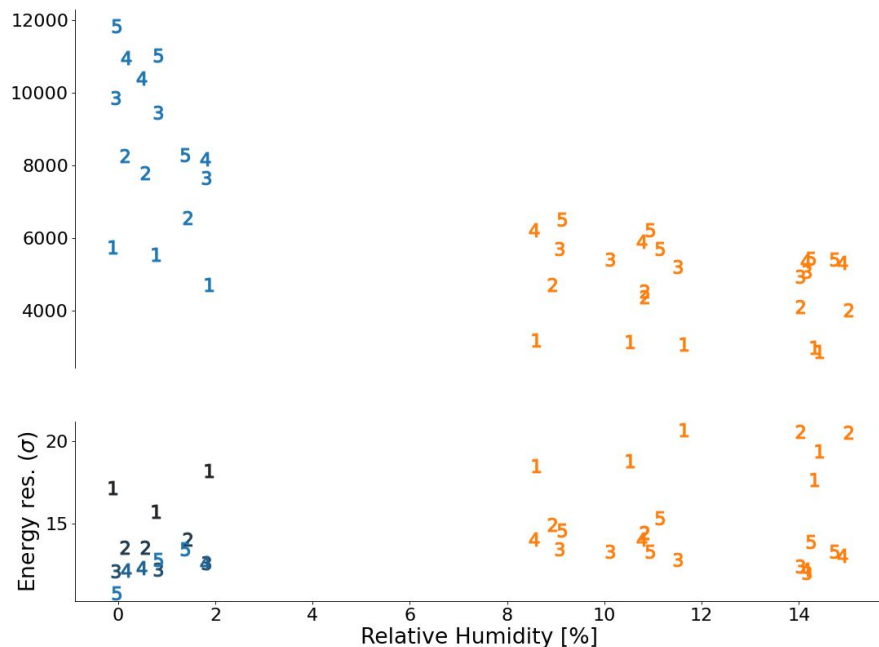


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The LY seems to increase with pressure



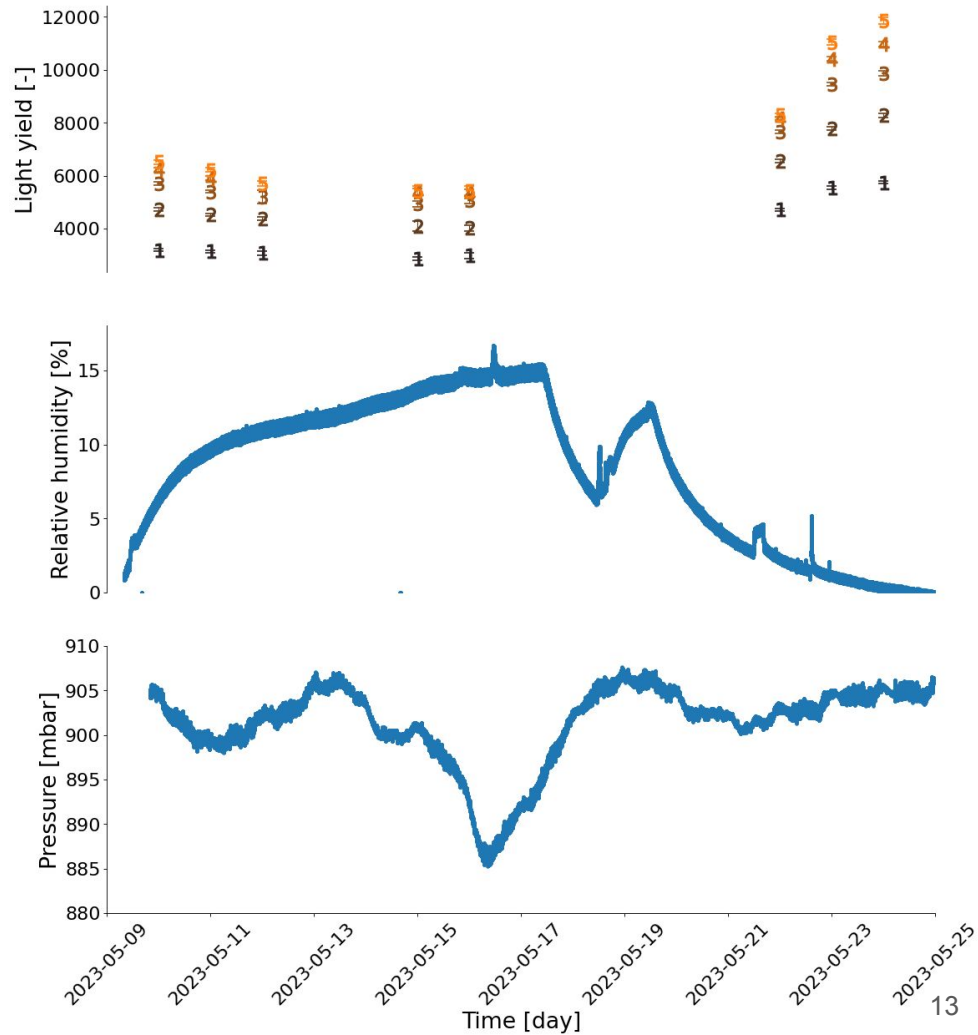
LY seems to decrease with humidity



The LY changes for daily calibrations performed in the final week: 22/05 - 24/05, but there was also a pressure and humidity drop.

(Very) Preliminary model

Step	1	2	3	4	5	All
P	0.68	0.72	0.71	0.79	0.71	0.56
T	0.68	0.77	0.84	0.81	0.43	0.41
P/T	0.68	0.71	0.70	0.78	0.70	0.56
H	-0.95	-0.96	-0.96	-0.94	-0.93	-0.76



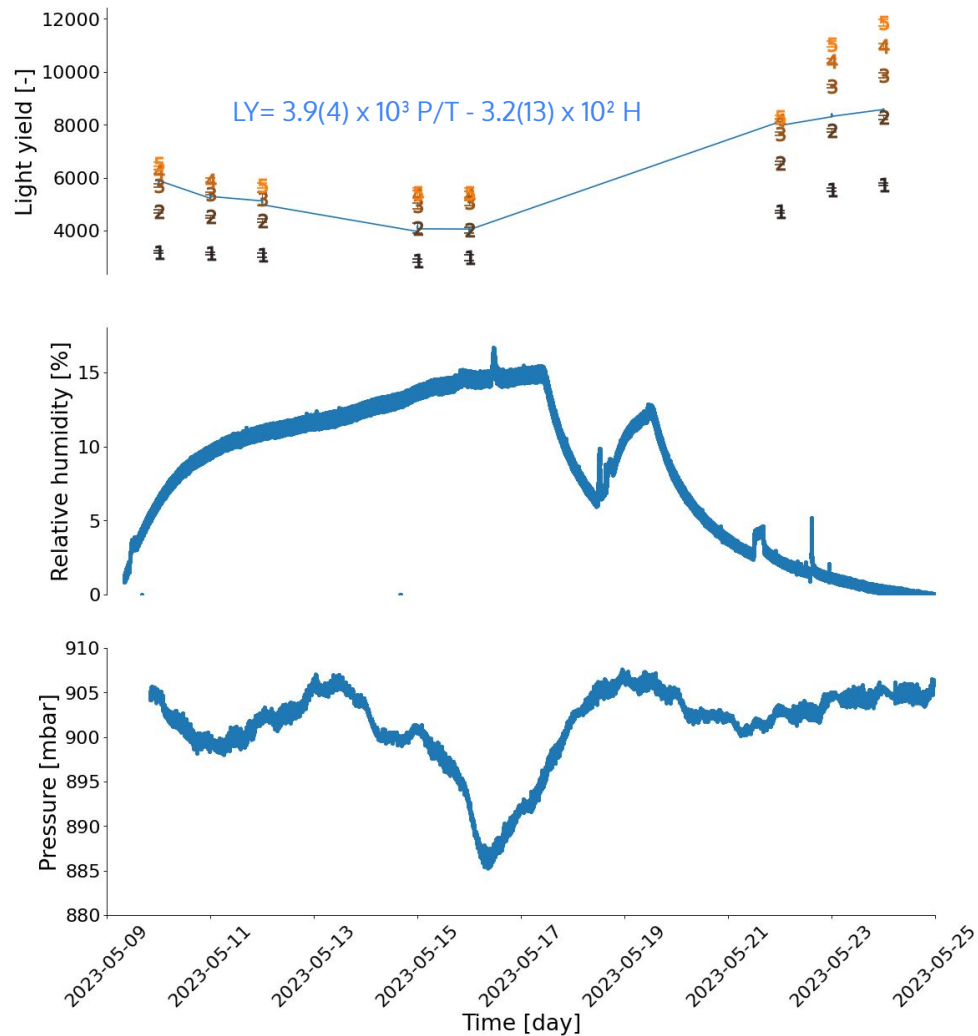
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Step	1	2	3	4	5	All
P	0.68	0.72	0.71	0.79	0.71	0.56
T	0.68	0.77	0.84	0.81	0.43	0.41
P/T	0.68	0.71	0.70	0.78	0.70	0.56
H	-0.95	-0.96	-0.96	-0.94	-0.93	-0.76

Overall fit to the Light Yield:

$$LY = 3.9(4) \times 10^3 P/T - 3.2(13) \times 10^2 H$$

$$r^2 = 0.991$$



Conclusions

- The light yield changed in the last week of daily calibrations

This is probably due to the humidity drop after the gas system intervention.

- The light yield changes over time for stable detector conditions, but with more fluctuations than in Run 2

The light yield fluctuates between 4.3% - 8.4%, and the energy resolution between 4.6% - 19.3% (first two weeks).

- We have a very preliminary model to predict the LY from the humidity and P/T

But we need more data to validate it. So, at least for now, the daily calibration procedure remains fundamental!

