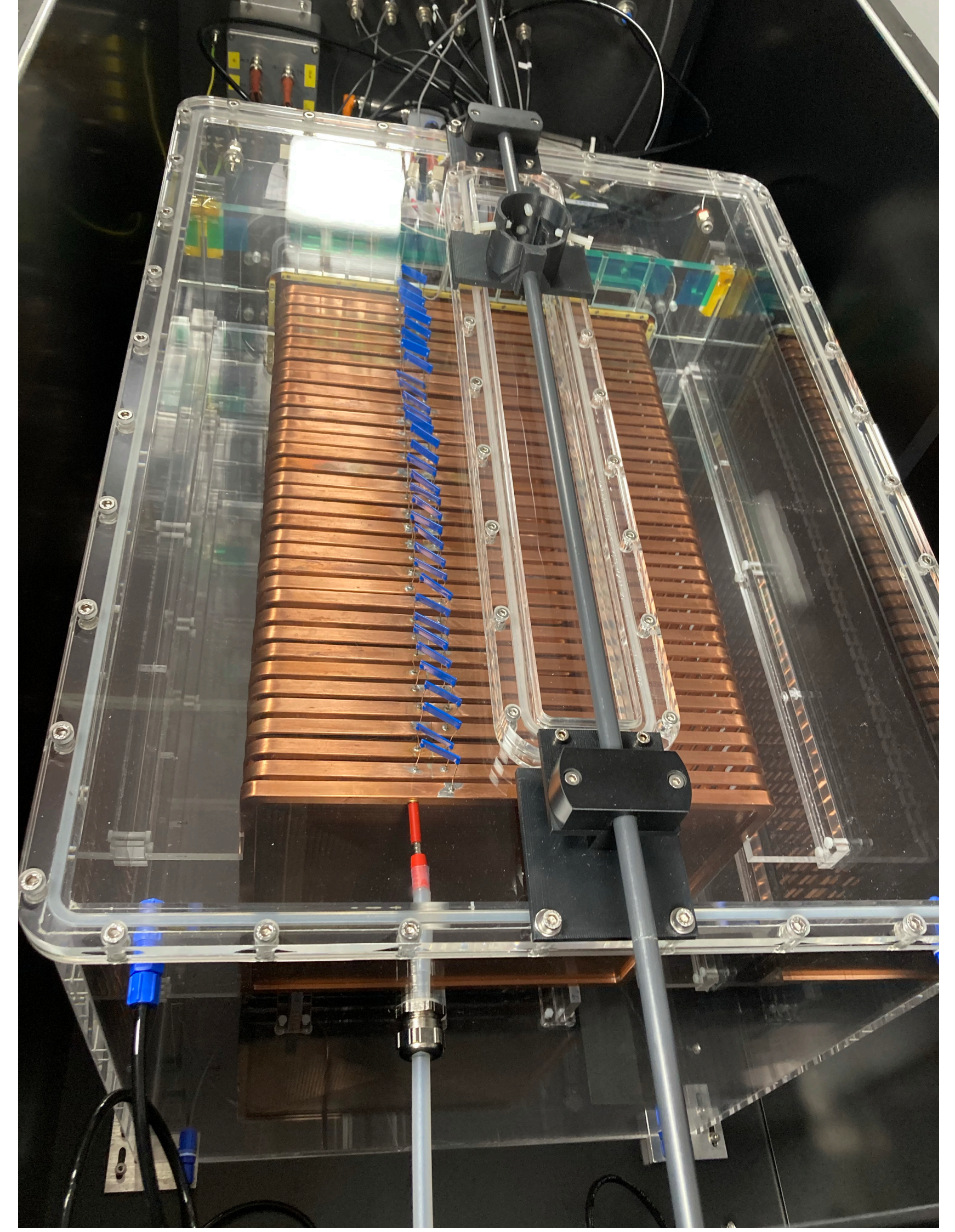


Summary and plans of LIME operations

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CYGNO Collaboration Meeting

Cagli, 27/11/2024



Outlook

- In this contribution we present the evolution and the plans of the **LIME underground operation** in **2024** and **until the end of LIME's** lifespan.
- With respect to Dec 2023, there were the following **improvements**:
 - **Stepper motor** completely controlled by remote
 - **Calibration procedure is now automatic** by means of a MIDAS sequencer script
 - **New** (successful) **regime for shifters**, capable of giving coverage throughout the entire year (including August)
 - **Renewed** efficient **alarm system** integrated with MIDAS
- We collected huge amount of data in **different configurations**
- We completed **RUN4**, and moved to the longer data taking phase **RUN5**
- RUN5 is ending on the 4th of Dec, 2024, when the **AmBe source** will be installed for a new neutron calibration campaign.

Data taking campaigns

Program from last year's CM presentation:

- **RUN2:**

2023

- 4 cm Cu shielding
- 15th Feb 2023 → 9th March 2023

- **RUN3:**

- 10 cm Cu shielding
- 5th May 2023 → 16th November 2023

- **RUN4:**

- 10 cm Cu + 40 cm water shielding
- 30th November 2023 → 15th December 2023

Data taking campaigns

LIME data taking in 2024

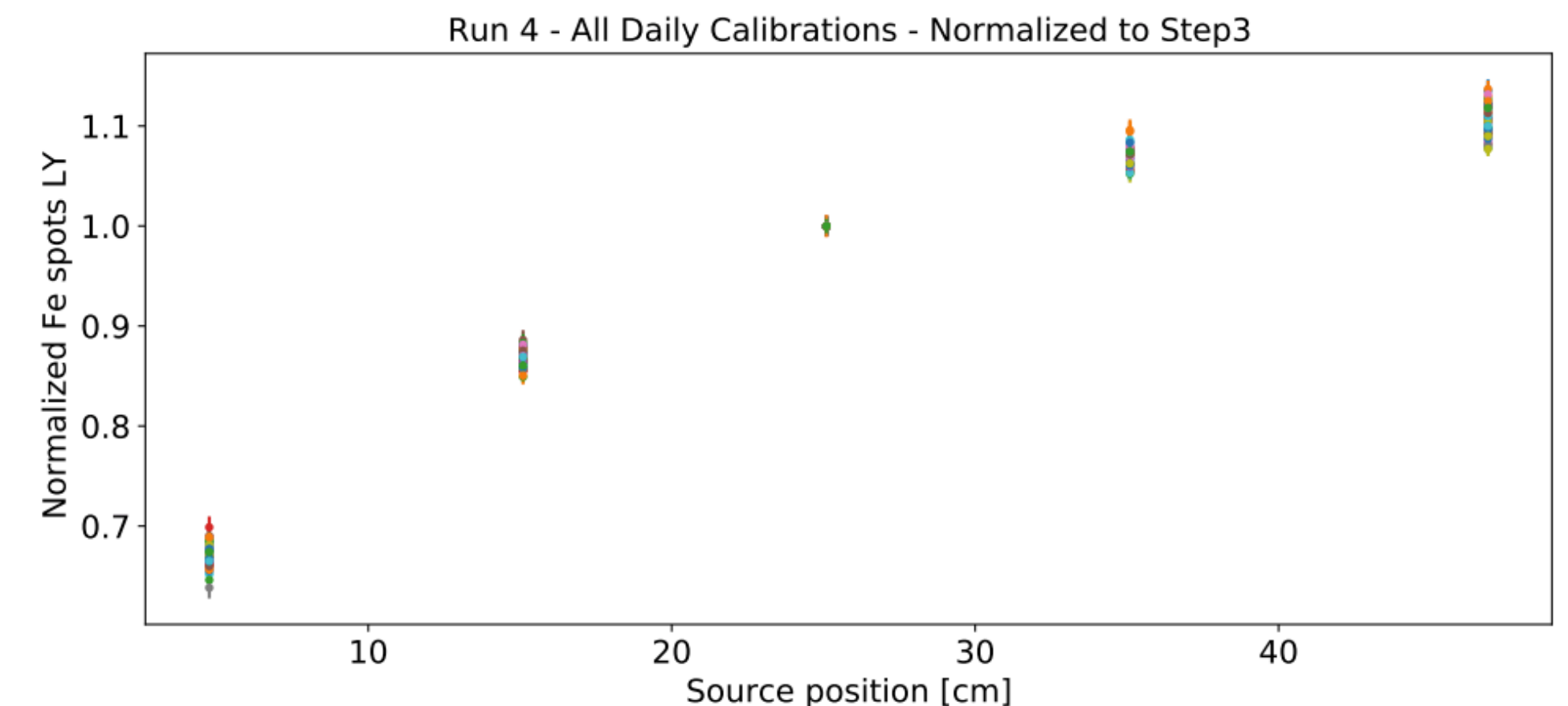
2024

Program from last year's CM presentation:

- **RUN2:** 2023
 - 4 cm Cu shielding
 - 15th Feb 2023 → 9th March 2023
- **RUN3:**
 - 10 cm Cu shielding
 - 5th May 2023 → 16th November 2023
- **RUN4:**
 - 10 cm Cu + 40 cm water shielding
 - 30th November 2023 → 15th December 2023
- **RUN4:**
 - 10 cm Cu + 40 cm water shielding
 - 30th November 2023 → 15th December 2023
 - 15th Jan 2024 → 22nd April 2024
 - Optimization of parameters for low gain campaign of RUN5
- **RUN5:**
 - 10 cm Cu shielding, **low gain**
 - 17th May 2025 → **4th Dec 2024**
- **AmBe:**
 - 10 cm Cu shielding, **low gain**
 - 4th Dec 2025 → 17th/18th December 2024
- **Latest tests (dedicated shifters?):**
 - Gas purity filters;
 - Other?

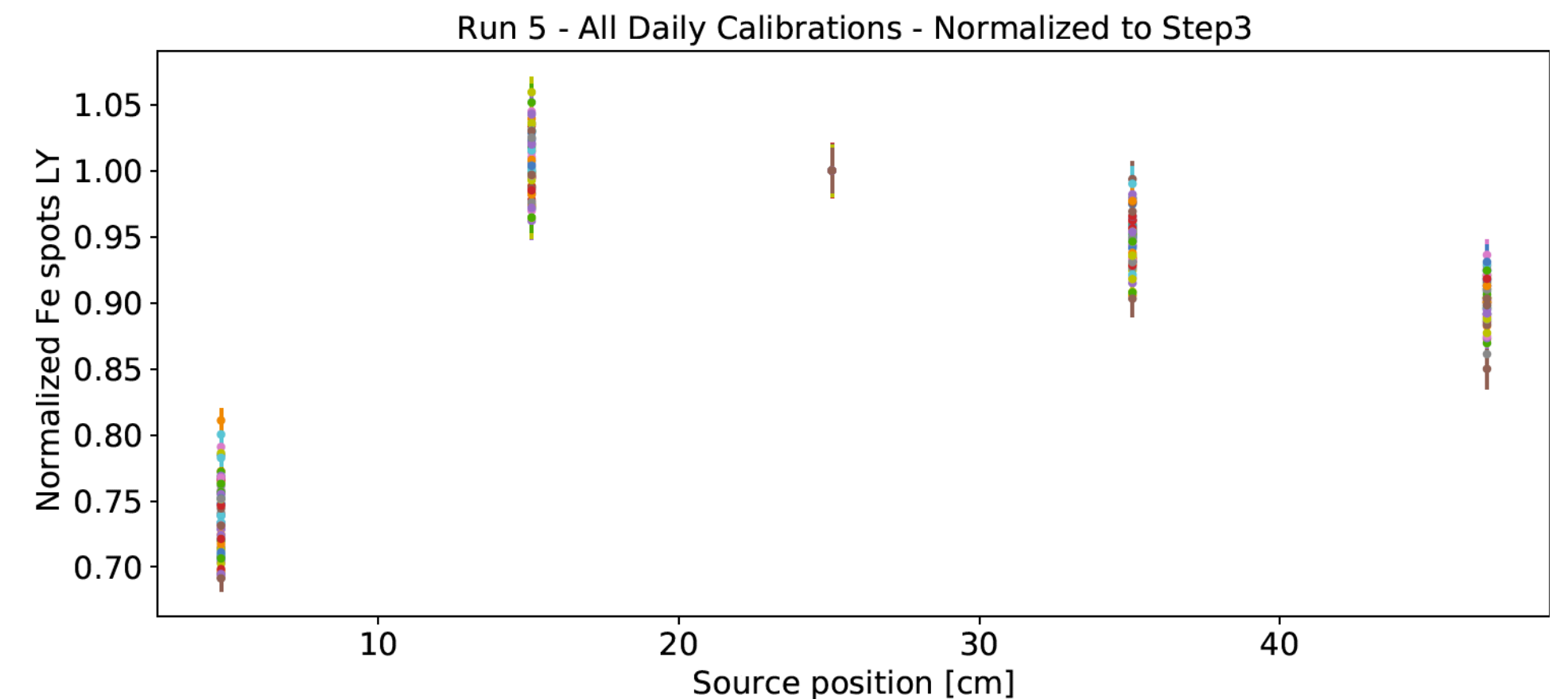
RUN4 Summary

- **Shielding** configuration:
 - 10 cm of copper
 - 40 cm of pure water
- **Data taking** details:
 - 30/11/23 → 15/12/23: high Radon concentration due to presence of just oxygen filter
 - 15/01/24 → 22/04/23: lower Radon concentration (two filters in series)
 - Background measurements
 - Scan in Vdrift and VGEM for the determination of the best configuration for RUN5
- **Golden Runs conditions:**
 - VGEM configuration: 440 V - 440 V - 440 V
 - Drift field: 0.83 kV / cm
 - Fresh (Recirculated) Gas flow: 5 l/h (20 l/h)



RUN5 Summary

- **Shielding** configuration:
 - 10 cm of copper
- Physics **goal**:
 - Characterization of the external neutron background in LIME
- **Data taking** details:
 - 7 months of continuous data acquisition
 - Radon kept under control by the use of the two filters in series
 - Background measurements
- **Golden Runs conditions**:
 - VGEM configuration: 420 V - 420 V - 420 V
 - Drift field: 0.50 kV / cm
 - Fresh (Recirculated) Gas flow: 4.8 l/h (20 l/h)



Stability and continuity of the operations

- Very **stable operation** with very few and short interruptions.
- **All the interruptions were due to:**
 - Interruption of **compressed air LNGS service**: 0(4-5 days/year) lost
 - **Bad behavior of the filters**, requiring maintenance: 0(4-5 days week/year) lost
 - A few crashes of the **DAQ** and failures in the **motor remote control**: 0(2-3 days/year) lost
 - Two **human errors** during the maintenance operations: 0(2 weeks/year) lost
- **Thanks to the shifters** (regular and experts) **all the time lost was really minimized** as we always reacted promptly to any difficulty happening at the detector level

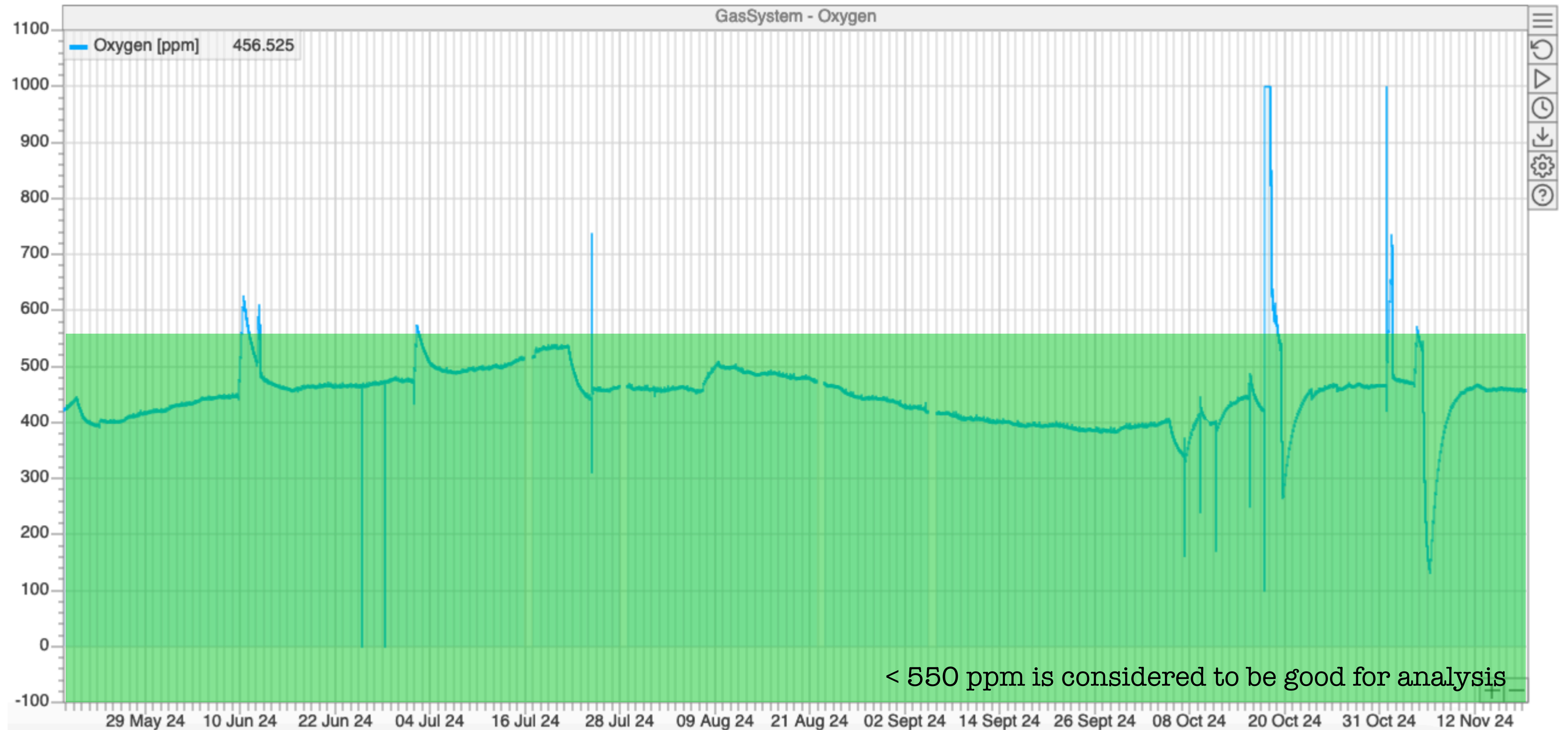
Humidity (RUN5 period)



Gas Density (RUN5 period)



Oxygen level (RUN5 period)



New shifters regime and coverage

- In the last 5 months **we covered 86% of the shift duties** including:
 - Daily Calibrations
 - Remote/In person shifts
 - Expert shifts
- Most of the **uncovered** SEUs were:
 - weekend expert shifts
 - weekend remote shifts

Institution	Shift type						Daily Calibration	SEU
	IP	R [mon-fri]	R [sat-sun]	E [Type A-1]	E [Type A-2]	E [Type B]		
RM1	0	7	7	0	0	68	10	76.9
UC	0	22	34	0	0	0	14	80
GSSI	22	77	18	98	0	50	43	237.7
UFJF	0	94	0	0	0	0	0	94
RM3	0	14	13	0	0	0	13	40
UK	0	0	0	0	0	0	0	0
LNF	0	1	0	99	99	0	0	100
UNICAMP	0	6	0	0	0	0	0	6

Statistics for t<=TODAY	
TOT. TIME [d]	152
TOT. SEUs	620.3
MAX. SEUs	719.8
SEUs Covered [%]	86.2

Plans: AmBe

- **Polyethylene bars** (borrowed from DarkSide) will be installed to shield the neutron source inside LIME room on the 3rd of Dec 2024
- **AmBe** Source will be provided for at least 2 weeks
- **Dates:** 4th Dec 2024 → 17th or 18th* Dec 2024
- **2 weeks** period of low gain data taking.

Plans: latest tests

- **Assumption:** since I did not receive any date for the official closure of LIME life, I will assume we have at least another month of time after the AmBe campaign.
- We are planning to have some **other tests until LIME decommissioning** after AmBe campaign:
 - Tests with and without the Fe source to study the behavior, in time, of **the gas filters** in sight of the CYGNO-04 operation
 - **Other** tests:
 - Proposed by any group, but let me know asap. Shifters can be asked for these tests but are not mandatory for the entire collaboration I would say.
 - Data with Quest (Betta's proposal)?
 - Water cooled pedestals with Quest (needed for Basilian codes)?
 - **Other?**

**A huge thanks to
all the people
contributing to the
success of LIME!!!**

