



Istituto Nazionale di Fisica Nucleare



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# LIME: summary of all data

Roma - Joint WP meeting

17 / 06 / 2025

# RUN0 & RUN1

- **Run0:** commissioning [not usable, not relevant]

	Time slot	Number of pictures	Event rate	Number of events
<b>RUN 1: No-shielding</b>	3 Nov 2022 - 15 Dec 2022	$4 \cdot 10^5$	35 Hz	$4 \cdot 10^6$
<b>RUN 2: 4 cm Cu shielding</b>	15 Feb 2023 - 15 March 2023	$4.5 \cdot 10^5$	3.5 Hz	$5 \cdot 10^5$
<b>RUN 3: 10 cm Cu shielding</b>	5 May 2023 - 16 Nov 2023	$1.6 \cdot 10^6$	1.5 Hz	$7.3 \cdot 10^5$
<b>RUN 4: 10 cm Cu + 40 cm water shielding</b>	30 Nov 2023 - 31 March 2024	$2 \cdot 10^6$	1.0 Hz	$6 \cdot 10^5$
<b>RUN 5: 10 cm Cu shielding (neutron flux measurements)</b>	17 May 2024 - 1 Dec 2024	$12 \cdot 10^6$	1.5 Hz	$5.4 \cdot 10^6$

- **Run1**, no shielding: 3000 → 6744
  - ➡ DAQ was still not fully developed and data taking was not stable
  - ➡ No recirculation
  - ➡ Scans in z (manual movement of the Fe source) and drift field
  - ➡ Stability studies
  - ➡ Test with 100 ms exposure
  - ➡ PMT studies (rate vs disc. threshold)
  - ➡ Golden datasets (GEMs at 420 V, DF at 800 V /cm) at different gas flows:

4475-4492 / 4782-4935 / 5001-5106 / 5741-5908 / 5922-6287 / 6288 - 6744

# RUN2

- **Run2**, 4 cm Cu shielding:  
7792 → 11279

	Time slot	Number of pictures	Event rate	Number of events
<b>RUN 1: No-shielding</b>	3 Nov 2022 - 15 Dec 2022	$4 \cdot 10^5$	35 Hz	$4 \cdot 10^6$
<b>RUN 2: 4 cm Cu shielding</b>	15 Feb 2023 - 15 March 2023	$4.5 \cdot 10^5$	3.5 Hz	$5 \cdot 10^5$
<b>RUN 3: 10 cm Cu shielding</b>	5 May 2023 - 16 Nov 2023	$1.6 \cdot 10^6$	1.5 Hz	$7.3 \cdot 10^5$
<b>RUN 4: 10 cm Cu + 40 cm water shielding</b>	30 Nov 2023 - 31 March 2024	$2 \cdot 10^6$	1.0 Hz	$6 \cdot 10^5$
<b>RUN 5: 10 cm Cu shielding (neutron flux measurements)</b>	17 May 2024 - 1 Dec 2024	$12 \cdot 10^6$	1.5 Hz	$5.4 \cdot 10^6$

- ➡ More stable DAQ but still incomplete
- ➡ No recirculation
- ➡ Scans in z (manual movement of the Fe source)
- ➡ Scan in VGEM1, scan in VGEMall, scan in pressure
- ➡ Stability studies
- ➡ Golden datasets (GEMs at 440 and 420 V, DF at 800 V /cm) at 20 l/h:

9888-10131 / 11175-11279

# RUN3

- **Run3**, 10 cm Cu shielding:  
17362 → 39638

	Time slot	Number of pictures	Event rate	Number of events
<b>RUN 1: No-shielding</b>	3 Nov 2022 - 15 Dec 2022	4 10 <sup>5</sup>	35 Hz	4 10 <sup>6</sup>
<b>RUN 2: 4 cm Cu shielding</b>	15 Feb 2023 - 15 March 2023	4.5 10 <sup>5</sup>	3.5 Hz	5 10 <sup>5</sup>
<b>RUN 3: 10 cm Cu shielding</b>	5 May 2023 - 16 Nov 2023	1.6 10 <sup>6</sup>	1.5 Hz	7.3 10 <sup>5</sup>
<b>RUN 4: 10 cm Cu + 40 cm water shielding</b>	30 Nov 2023 - 31 March 2024	2 10 <sup>6</sup>	1.0 Hz	6 10 <sup>5</sup>
<b>RUN 5: 10 cm Cu shielding (neutron flux measurements)</b>	17 May 2024 - 1 Dec 2024	12 10 <sup>6</sup>	1.5 Hz	5.4 10 <sup>6</sup>

- ➡ Final version of the DAQ → stable and continuous data stream to cloud
- ➡ Recirculation in use for the first time
- ➡ Several background and stability data-taking, but countless technical issues (DAQ, gas system, etc.)
- ➡ Very long pedestal studies
- ➡ Neutron source: AmBe campaign
- ➡ Other radioactive sources:
  - ⦿ Eu (low and high activity)
  - ⦿ Ba
  - ⦿ Am
  - ⦿ Fe without collimation
- ➡ Golden datasets (GEMs at 440 V, DF at 800 V /cm) at 5 l/h

Radioactive Sources	
source_type	Description
0	No source
1	Fe
2	AmBe
3	AmBe + Fe
4	Ba
5	Eu
6	Eu (less active)
7	Am
8	Rb83
9	Rb83 + Fe



# RUN4

- **Run4**, 10 cm Cu shielding + 40 cm water:  
40784 → 56883

	Time slot	Number of pictures	Event rate	Number of events
<b>RUN 1: No-shielding</b>	3 Nov 2022 - 15 Dec 2022	$4 \cdot 10^5$	35 Hz	$4 \cdot 10^6$
<b>RUN 2: 4 cm Cu shielding</b>	15 Feb 2023 - 15 March 2023	$4.5 \cdot 10^5$	3.5 Hz	$5 \cdot 10^5$
<b>RUN 3: 10 cm Cu shielding</b>	5 May 2023 - 16 Nov 2023	$1.6 \cdot 10^6$	1.5 Hz	$7.3 \cdot 10^5$
<b>RUN 4: 10 cm Cu + 40 cm water shielding</b>	30 Nov 2023 - 31 March 2024	$2 \cdot 10^6$	1.0 Hz	$6 \cdot 10^5$
<b>RUN 5: 10 cm Cu shielding (neutron flux measurements)</b>	17 May 2024 - 1 Dec 2024	$12 \cdot 10^6$	1.5 Hz	$5.4 \cdot 10^6$

- ➡ Several background and stability data-taking, very few technical issues
- ➡ Automation of daily calibration movement, installation of Trigger Module and full integration with MIDAS
- ➡ Mostly dedicated to background studies
- ➡ Tests of stability at low gas flows (2 l/h and 1 l/h)
- ➡ Deadtime measurement dedicated datataking
- ➡ Radon filter
- ➡ VGEM1 scan and final parte dedicated to optimization of low gain configuration for RUN5
- ➡ Golden datasets (GEMs at 440 V, DF at 800 V /cm) at 5 l/h

# RUN5

- **Run5**, 10 cm Cu shielding:  
56894 → 102210

	Time slot	Number of pictures	Event rate	Number of events
<b>RUN 1: No-shielding</b>	3 Nov 2022 - 15 Dec 2022	$4 \cdot 10^5$	35 Hz	$4 \cdot 10^6$
<b>RUN 2: 4 cm Cu shielding</b>	15 Feb 2023 - 15 March 2023	$4.5 \cdot 10^5$	3.5 Hz	$5 \cdot 10^5$
<b>RUN 3: 10 cm Cu shielding</b>	5 May 2023 - 16 Nov 2023	$1.6 \cdot 10^6$	1.5 Hz	$7.3 \cdot 10^5$
<b>RUN 4: 10 cm Cu + 40 cm water shielding</b>	30 Nov 2023 - 31 March 2024	$2 \cdot 10^6$	1.0 Hz	$6 \cdot 10^5$
<b>RUN 5: 10 cm Cu shielding (neutron flux measurements)</b>	17 May 2024 - 1 Dec 2024	$12 \cdot 10^6$	1.5 Hz	$5.4 \cdot 10^6$

- ➡ 7 months of continuous data taking with very few interruptions ( $\sim$  weeks)
- ➡ Low gain: GEMs at 420 V, DF at 500 V /cm
- ➡ A new AmBe campaign:
  - ⦿ Low gain 96373 → 99255
  - ⦿ High gain 99258 → 100023
  - ⦿ Background for high gain 100024 → 102210
- ➡ Golden datasets (GEMs at 420 V, DF at 500 V /cm) at 3-5 l/h

# Technical Runs

- **Technical Runs**, 10 cm Cu shielding: 102211 → 105715
  - ➡ Pedestals
  - ➡ VGEM1, VGEMALL, VDRIIFT scans
  - ➡ DGTZ at 2.5 GS/s
  - ➡ QUEST 1 + EHD lens (bkg, daily scans, VGEM1, VGEMALL, VDRIIFT scans)
  - ➡ Filters tests
  - ➡ Rubidium source installation and test
  - ➡ SF6 installation: NID
    - ◎ 1.6% SF6: GEMs from 540 V to 580 V (above very unstable GEMs)
    - ◎ 1.2% SF6: GEMs from 550 V to 580 V (above very unstable GEMs)



# LIME: What's next?

- Parts of LIME environment to be inherited by CYGNO-04:

## ➡DAQ:

- NIM crate
- VME crate (digitizers, bridge)
- DAQ server
- HV modules

## ➡Gas system

- Is LIME going to be used somewhere else? And what about LIME\_2?

