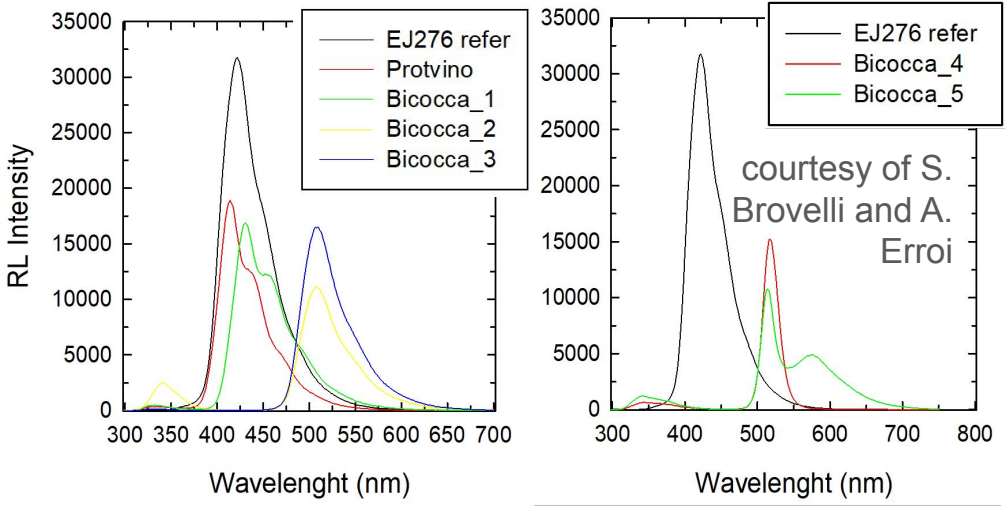
updates on the scintillating sample measurements with cosmic rays @ LNF

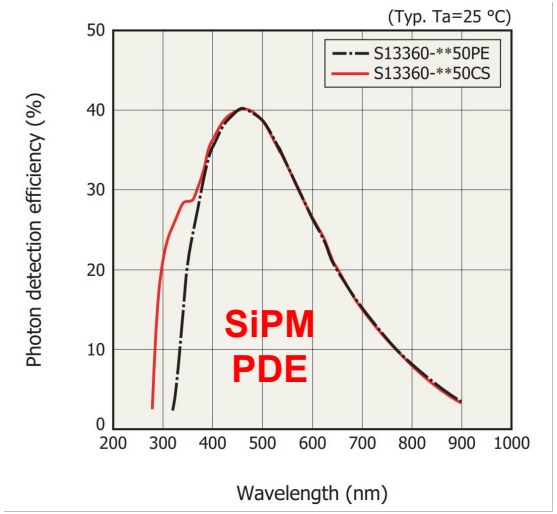
scintillating samples

from latest NA62 Collaboration Meeting, on results of Nov 2023 beamtest @ BTF (see here)

Mattia Soldani

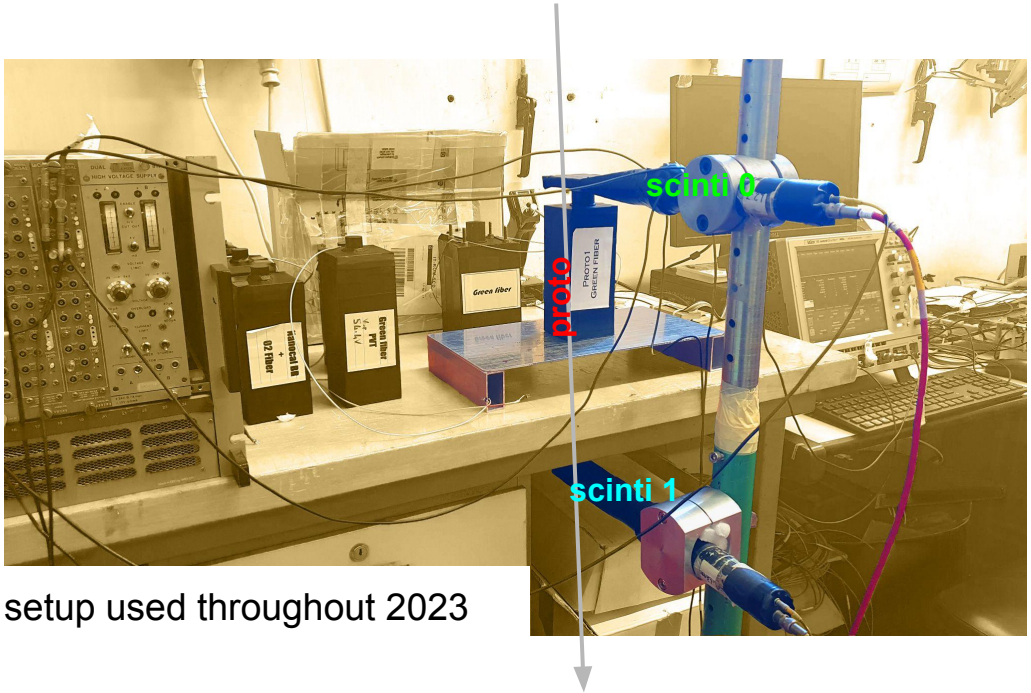
name	recipe	type	colour
Protvino_B	PVT/DVB (90/10 %wt) + 1.5%wt PTP + 0.04%wt POPOP	molecular	blue
Bicocca_1	PVT/DVB (90/10 %wt) + 1.5%wt PTP + 0.04%wt benzothiophene	molecular	blue
Bicocca_2	PVT/DVB (90/10 %wt) + 1.5%wt PTP + 0.04%wt coumarin-6	molecular	green
Bicocca_3	PVT/DVB (90/10 %wt) + 1.5%wt PTP + 0.04%wt benzothiophene + 0.04%wt coumarin-6	molecular	green
Bicocca_4	PVT/DVB (90/10 %wt) + 1.5%wt PTP + 1%wt Yb:CsPbBr3	NC	green
Bicocca_5	PVT/DVB (90/10 %wt) + 1.5%wt PTP + 1%wt Yb:CsPbBr3/perylene dyad	NC	orange





new measurements w/ cosmic rays @ LNF

the setup in brief



setup used throughout 2023

with improvements:

- rebuilt from scratch in a neater environment
- Protvino-based shashlik and Cachex (i.e. the samples + SiPM) installed and read out together – Cachex (amp ch. 1) is on top of the shashlik (amp ch. 2)
- digitiser-based DAQ (instead of an oscilloscope)
  - same software as the beamtest @ BTF, see here
  - reading out a CAEN DT5725 w/ 14 bit, 0.5Vpp/2Vpp range and sampling rate 250MHz (1030 samples) → since ~ Feb 25, using a CAEN V1742 w/ 12 bit, 1Vpp and sampling rate 2.5GHz (1024 samples)

new measurements w/ cosmic rays @ LNF

comparison w/ beamtest data (November 2023 @ BTF)

sample	charge MPV [pC]	corr. for PDE [Protvino_B eq.]	charge MPV [pC Protvino_B eq.]	charge MPV ratio over Protvino_B	cosmic-over-beamtest ratio
Protvino_B	235 (bt)	1	235 (bt)	-	0.73
	172 (cosmic)		172 (cosmic)	-	
Bicocca_3	375 (bt)	0.970	386.60 (bt)	1.64 (bt)	0.58
	219 (cosmic)		225.77 (cosmic)	1.31 (cosmic)	
Bicocca_4	135 (bt)	0.942	143.31 (bt)	0.61 (bt)	0.74
	100 (cosmic)		106.16 (cosmic)	0.62 (cosmic)	

STATUS ON FEBRUARY 19

new measurements w/ cosmic rays @ LNF

reproducibility tests

w/ Bicocca_3

batch	1 (bad) (Jan 24)	2 (bad) (Jan 24-28)	3 (Feb 5-6)	4 (Feb 21)	5 (Feb 22-26)	6 (Feb 26-Mar 4)
evs (total)	616	12787	4150	892	4711	9991
evs (signal)			646	160	854	1503
digitizer	5725 (250 MHz, 2 V)	5725 (250 MHz, 0.5 V)				1742 (2.5 GHz, 1 V)
runs	1706088633	1706116676 1706429272 1706473171	1707146691 1707212879	1708507572 1708522329	1708542927 1708678259 1708710855	1708941129 1708969872 1709026962 1709386300 1709565187
MPV [pC]	46	50	220	169	181	154
width [pC]	38	22	40	21	33	48

new measurements w/ cosmic rays @ LNF

reproducibility tests

w/ Protvino_B

batch	1 (Jan 12-22)	2 (Jan 29-30)	3 (Feb 8-9)	4 (Mar 5-6)
evs (total)	17346	5681	2242	3960
evs (signal)	2243	760	371	561
digitizer	5725 (250 MHz, 2 V)	5725 (250 MHz, 0.5 V)		1742 (2.5 GHz, 1 V)
runs	1705068032 1705076785 1705914682	1706518691 1706549192 1706690659	1707407022 1707410493 1707479196	1709659121 1709746613
MPV [pC]	173	176	166	159
width [pC]	37	36	36	33

new measurements w/ cosmic rays @ LNF

reproducibility tests

→ average MPV (st. dev.),
unweighted:

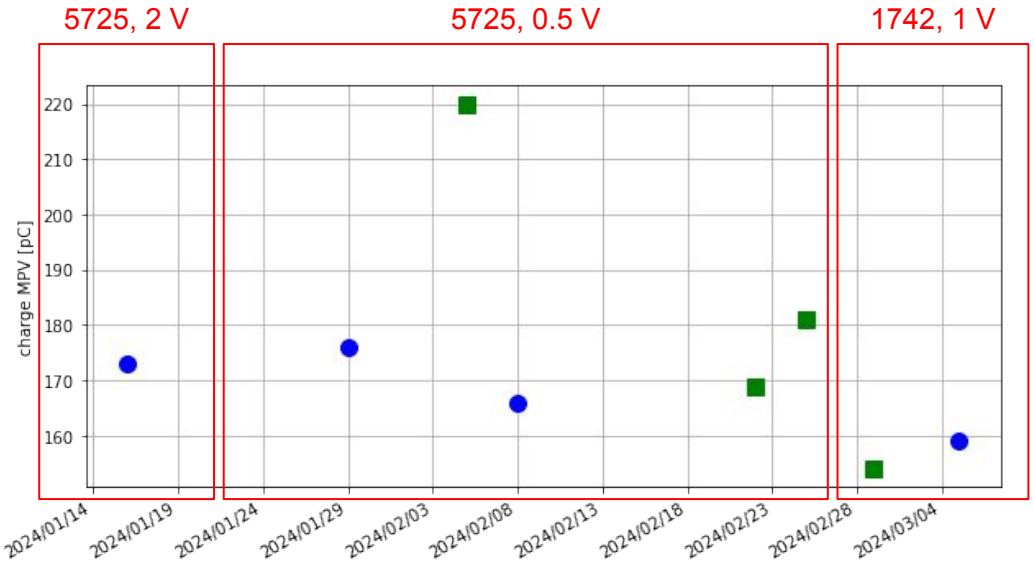
Bicocca_3	181 (24) ⇒ 13%
Protvino_B	168 (7) ⇒ 4%

→ average MPV (st. dev.),
weighted on total population:

Bicocca_3	175 (26) ⇒ 15%
Protvino_B	171 (5) ⇒ 3%

→ average MPV (st. dev.),
weighted on signal population estimate:

Bicocca_3	175 (25) ⇒ 14%
Protvino_B	171 (5) ⇒ 3%

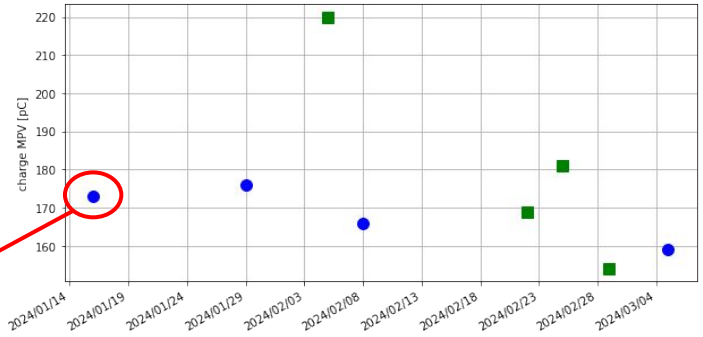


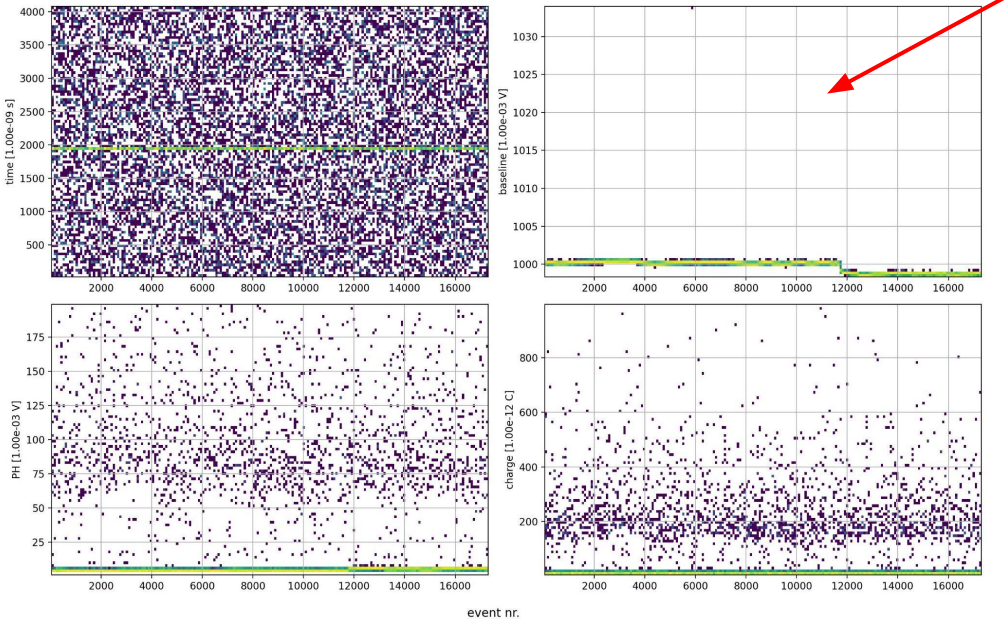
any trends over time?

new measurements w/ cosmic rays @ LNF

most lasting batches

Protvino_B, batch 1, overall ~11 days

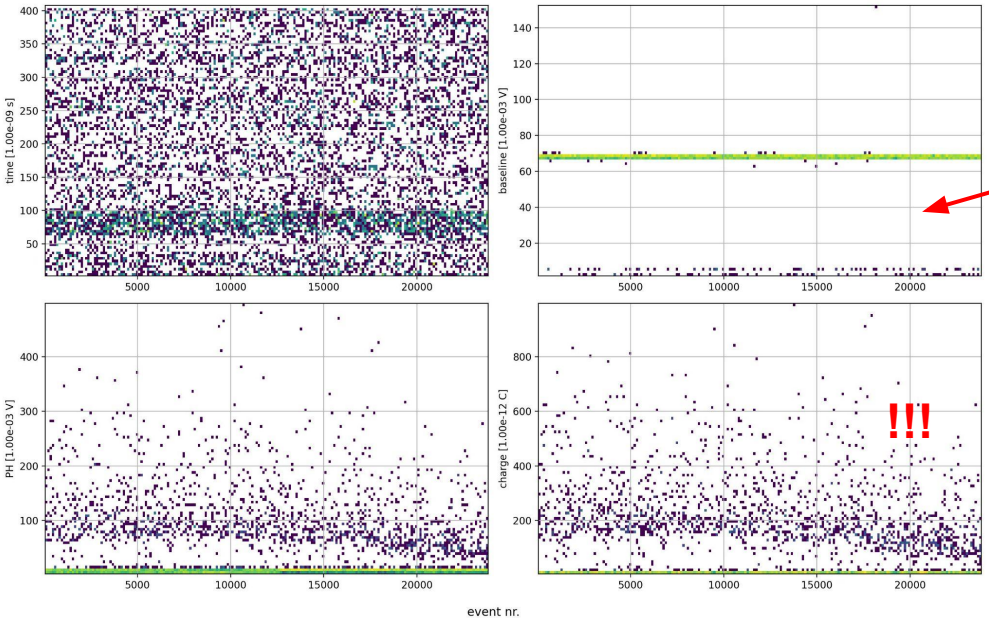


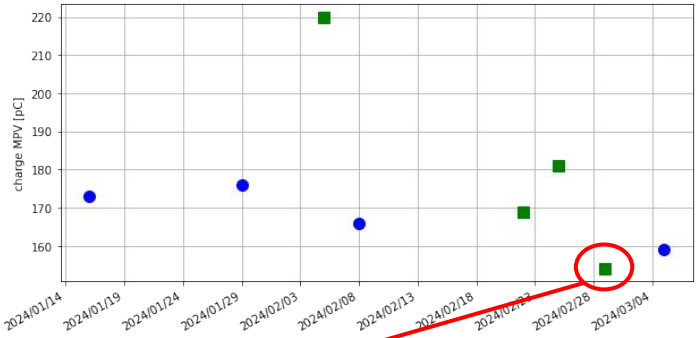


new measurements w/ cosmic rays @ LNF

most lasting batches

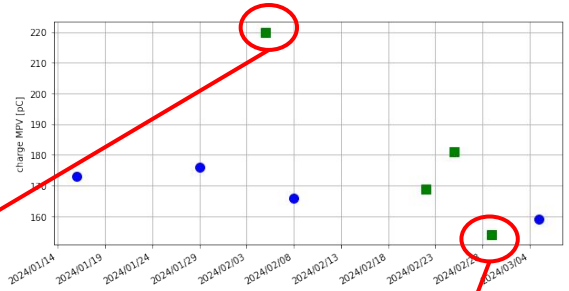
Bicocca_3, batch 6, overall ~8 days

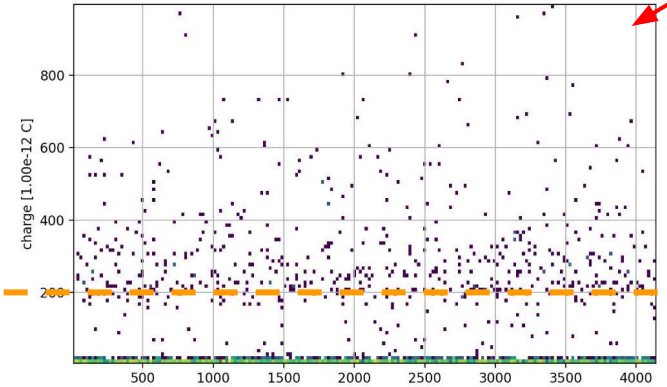




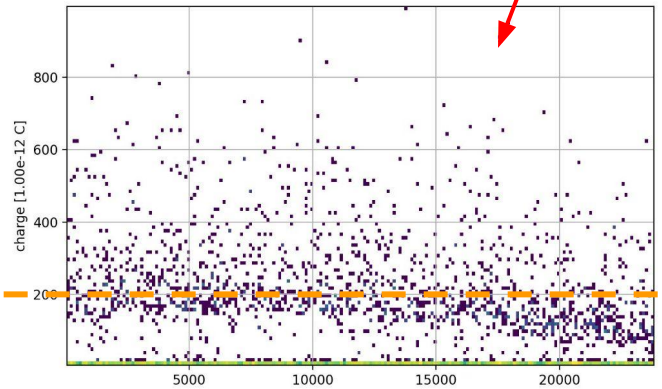
new measurements w/ cosmic rays @ LNF

trend over time?





Bicocca_3, batch 3, overall ~2 days
the highest-MPV set

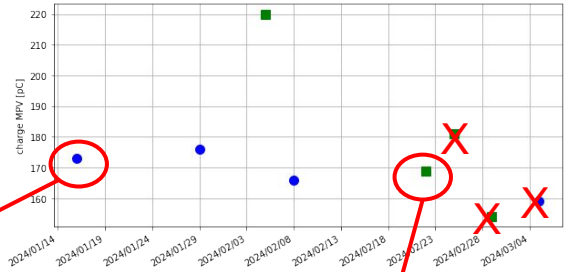


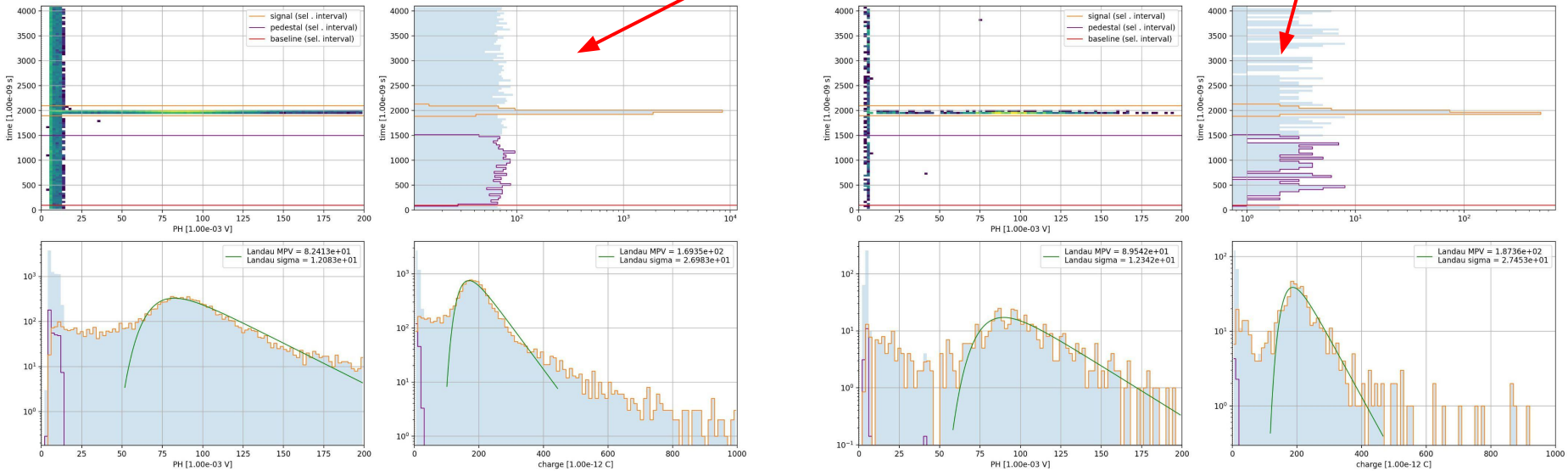
Bicocca_3, batch 6, overall ~8 days
the lowest-MPV set

new measurements w/ cosmic rays @ LNF

the shashlik prototype

response was stable throughout the whole data taking session

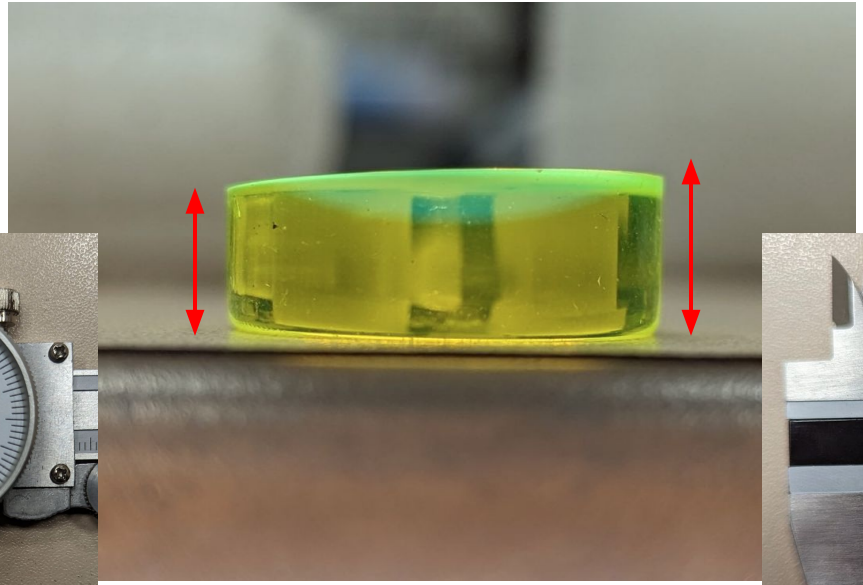


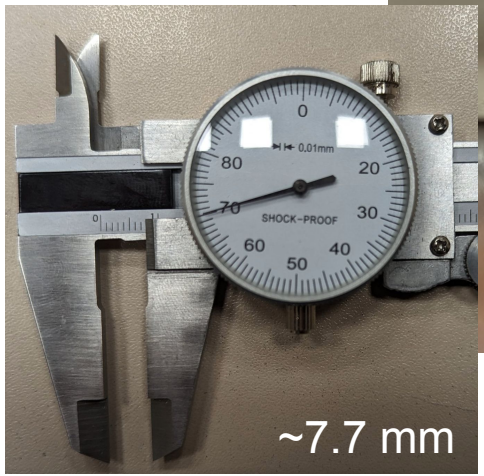


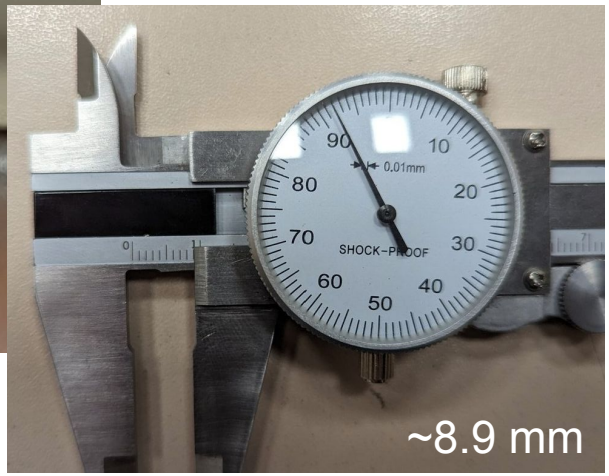
new measurements w/ cosmic rays @ LNF

dependence on sample orientation wrt. the SiPM?

indeed, it can happen that the SiPM is not exactly at the center of the sample…







perhaps the observed instability can be ascribed to a lack of reproducibility of the SiPM-sample coupling, at the level of ~15% according to Bicocca_3 data

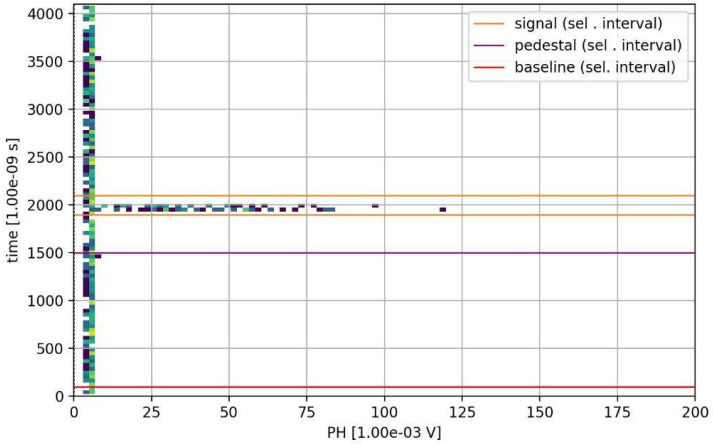
why is it significantly different wrt. Protvino_B?

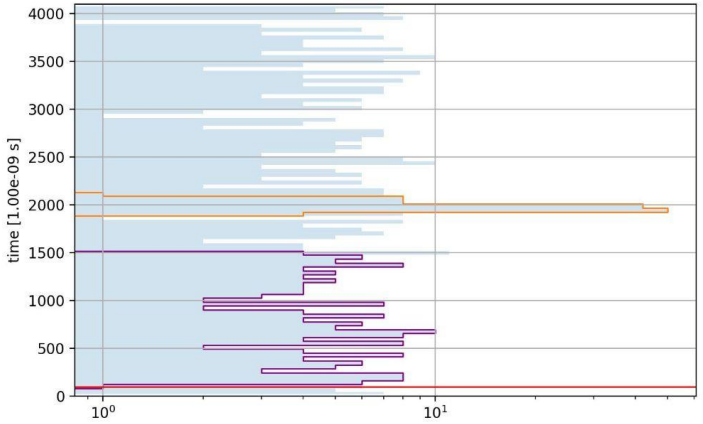
anyway, Bicocca_3 is still appealing

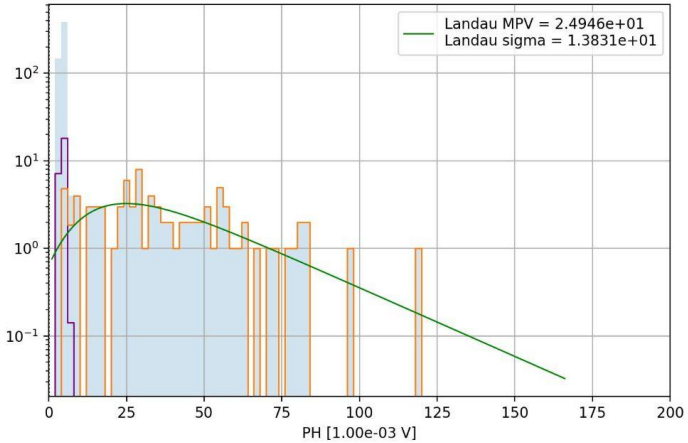
time to think about an improved device (**Cachex 3**) in view of the next beamtest (April 22-28) in BTF?

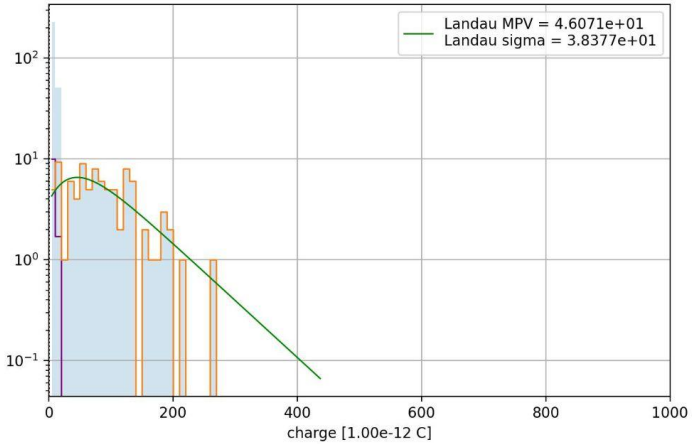
backup

new measurements w/ cosmic rays @ LNF Bicocca_3, batch 1

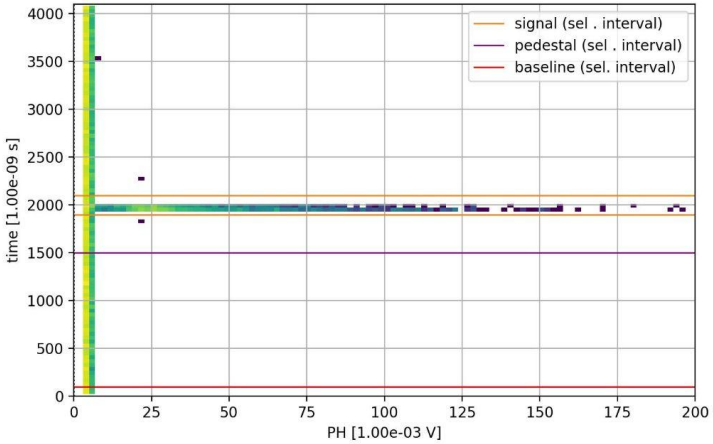


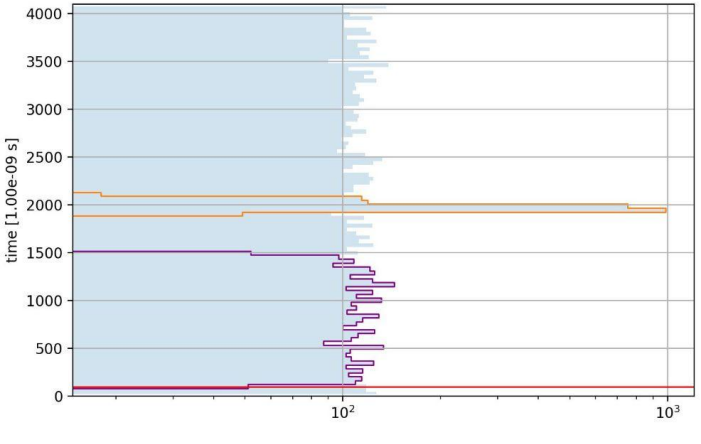


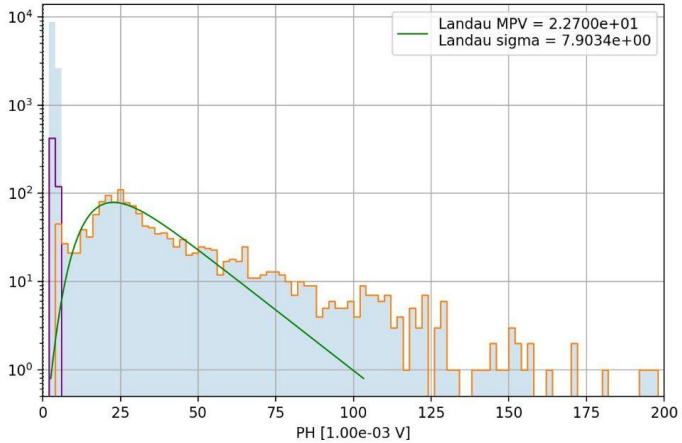


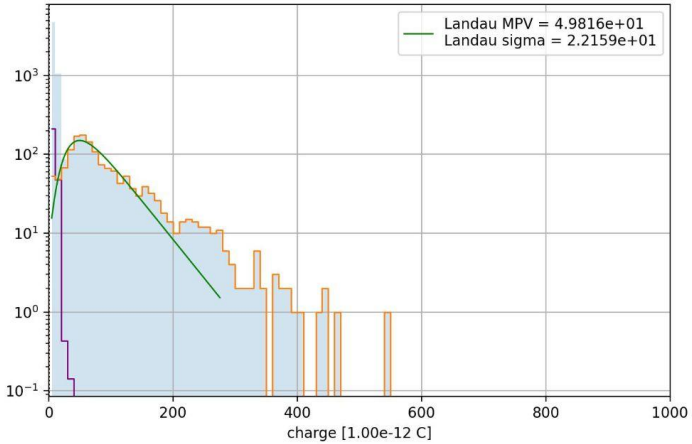


new measurements w/ cosmic rays @ LNF Bicocca_3, batch 2

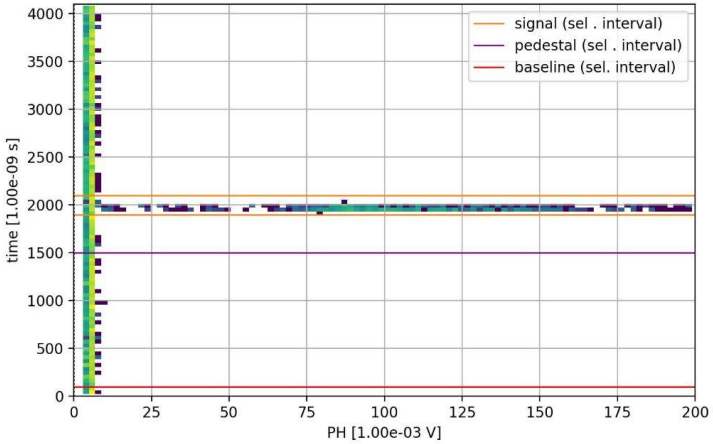


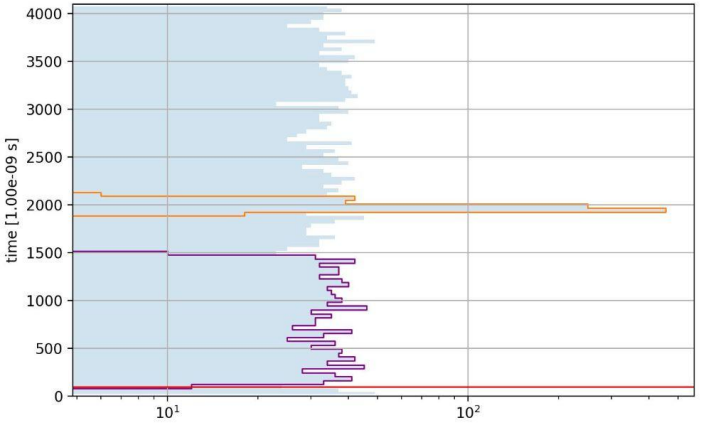


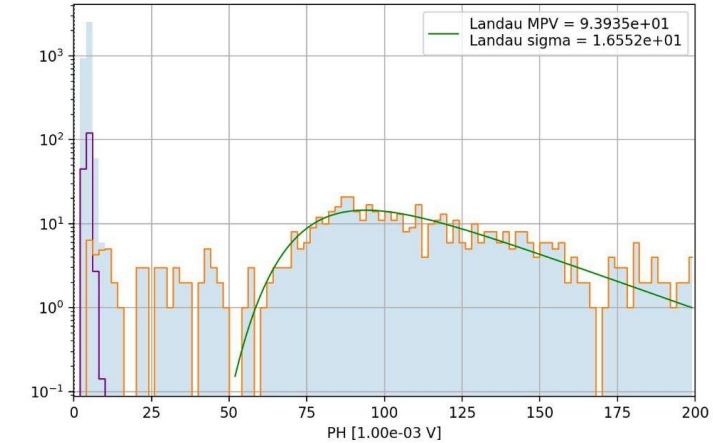


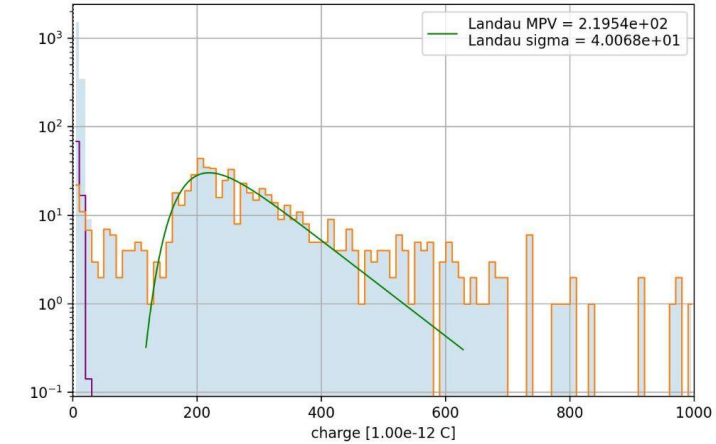


new measurements w/ cosmic rays @ LNF Bicocca_3, batch 3

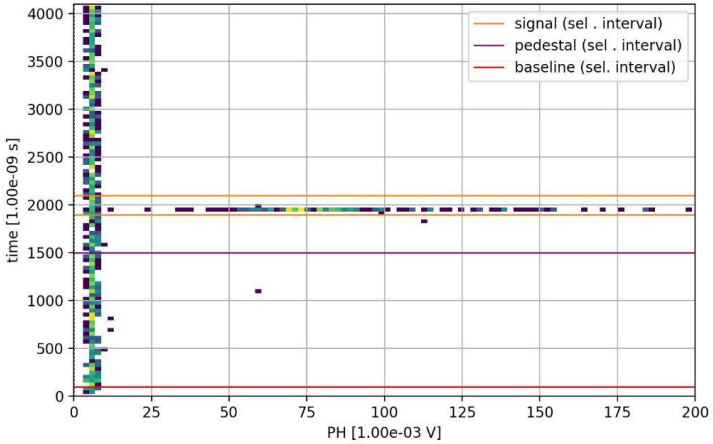


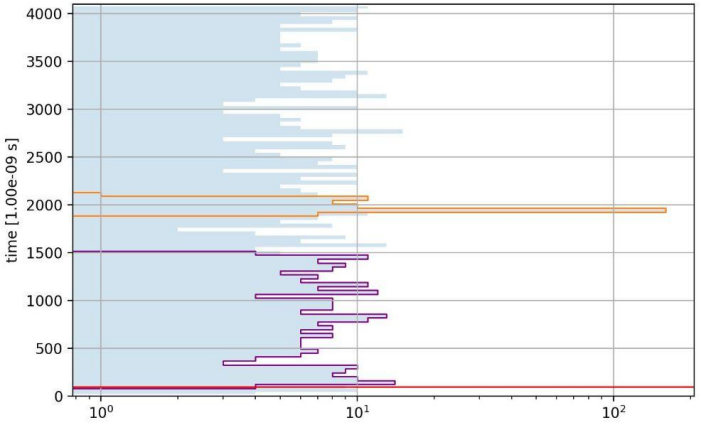


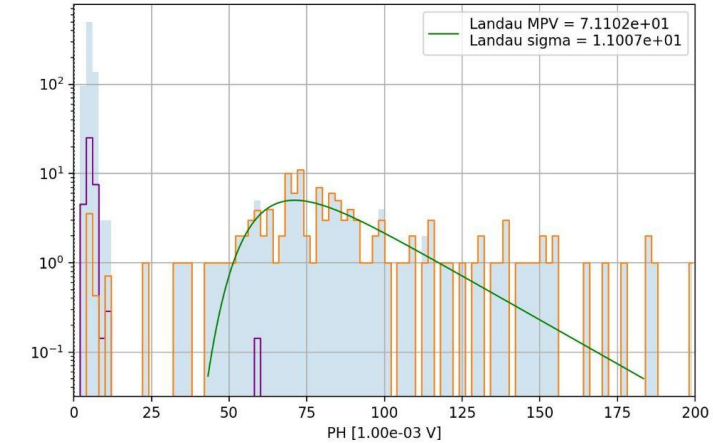


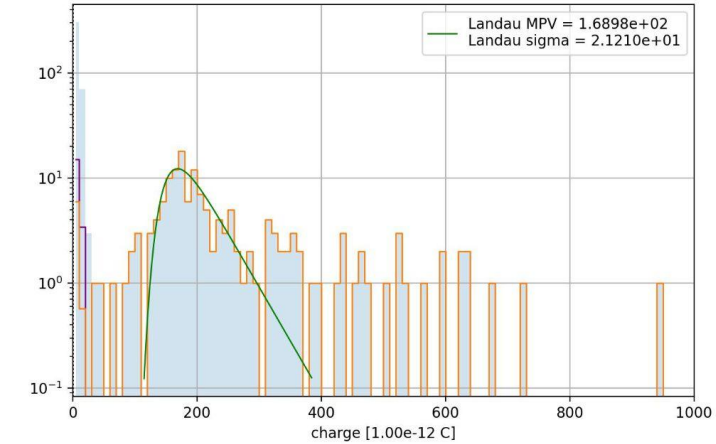


new measurements w/ cosmic rays @ LNF Bicocca_3, batch 4

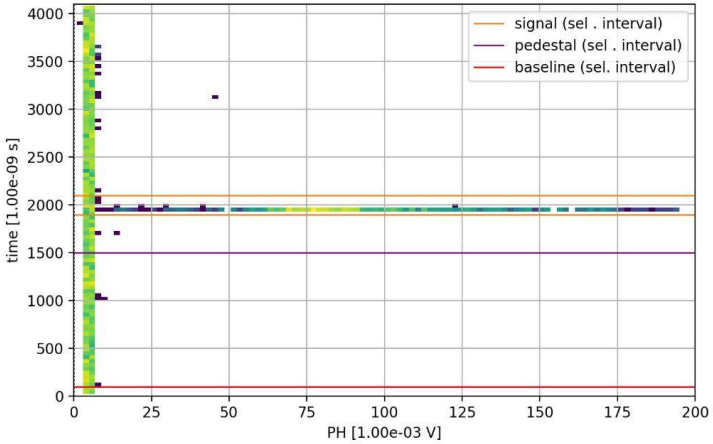


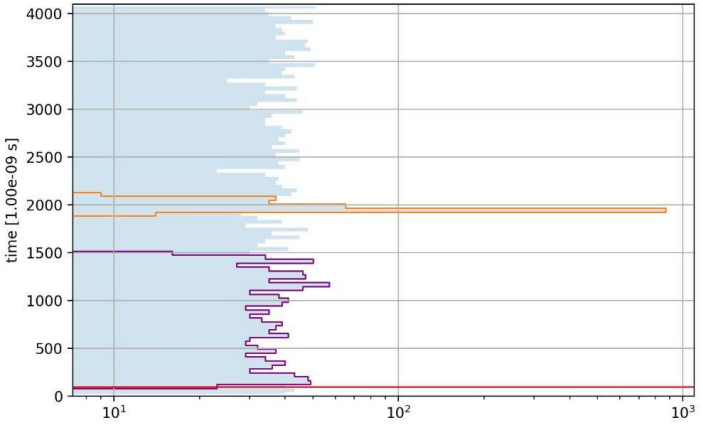


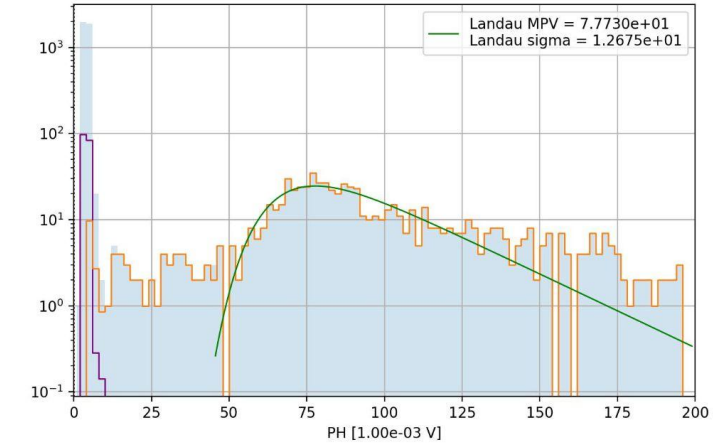


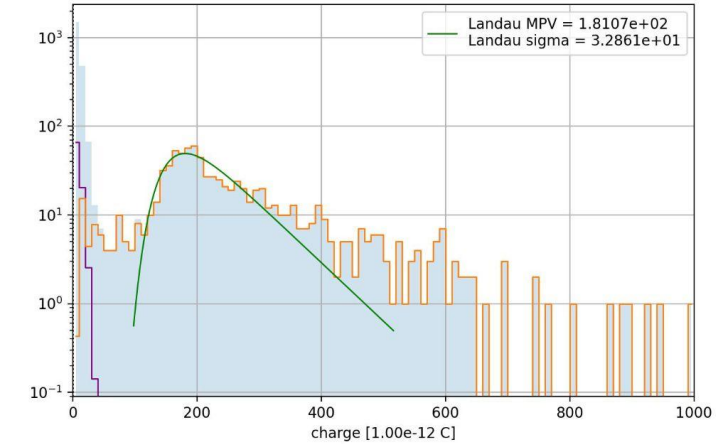


new measurements w/ cosmic rays @ LNF Bicocca_3, batch 5

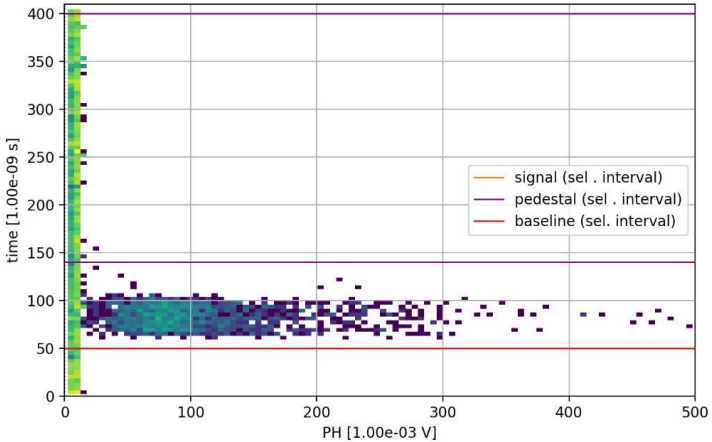


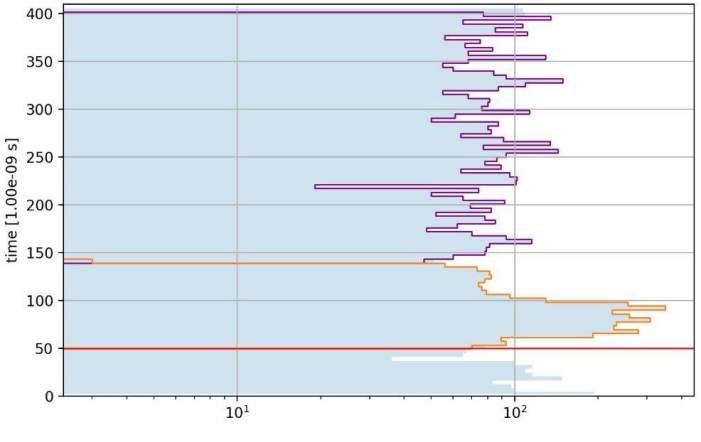


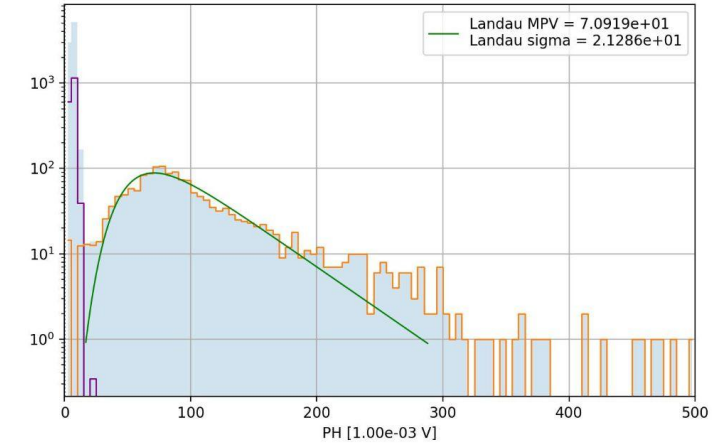


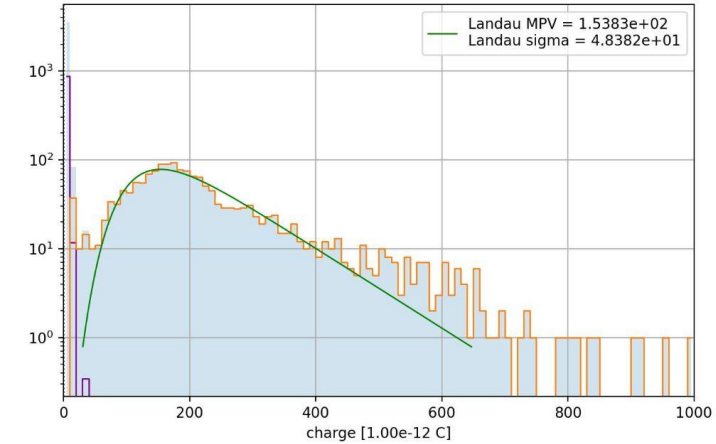


new measurements w/ cosmic rays @ LNF Bicocca_3, batch 6

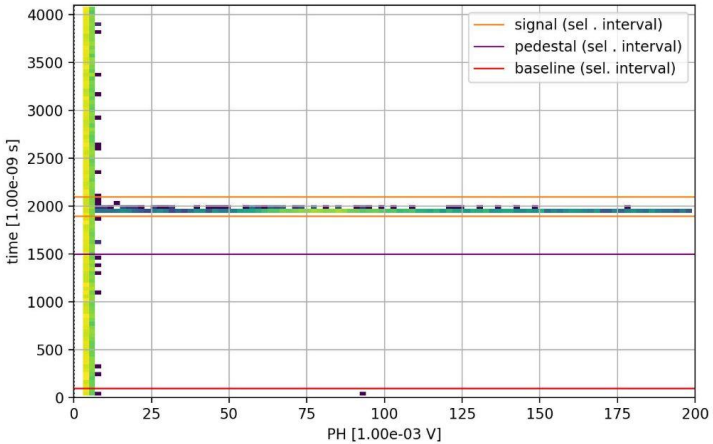


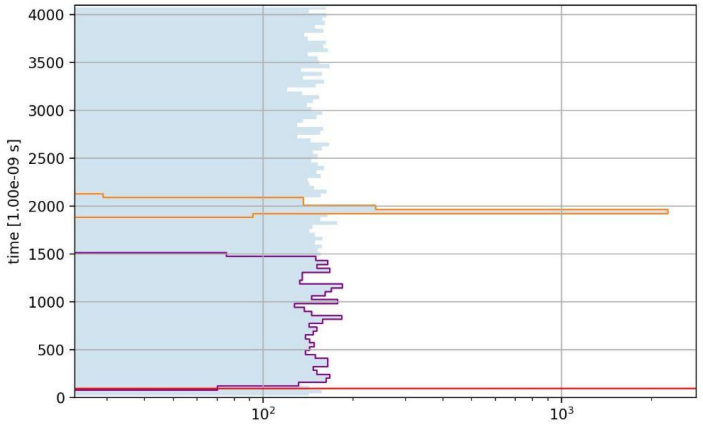


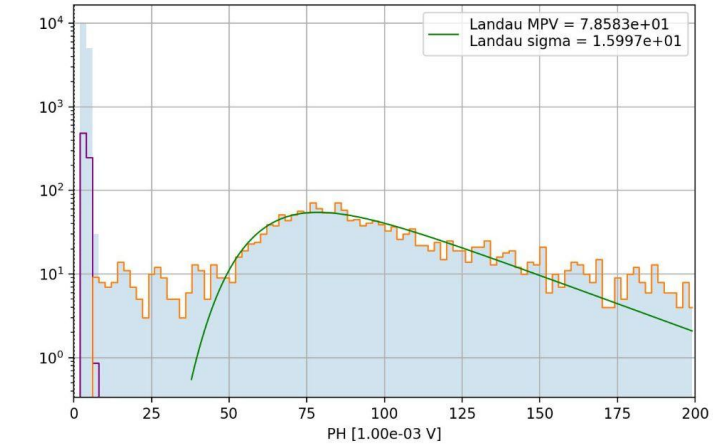


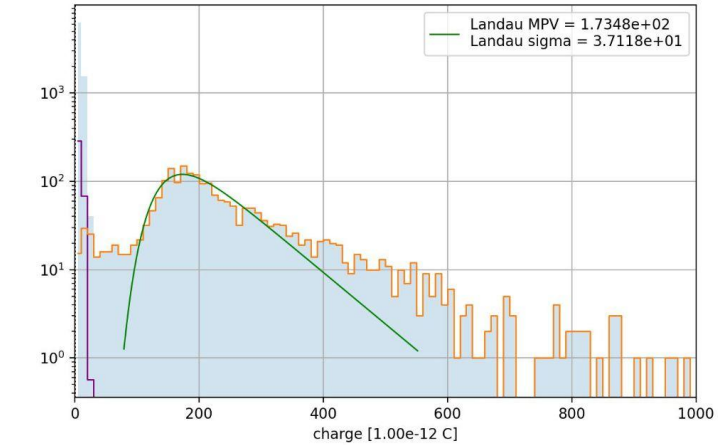


new measurements w/ cosmic rays @ LNF Protvino_B, batch 1

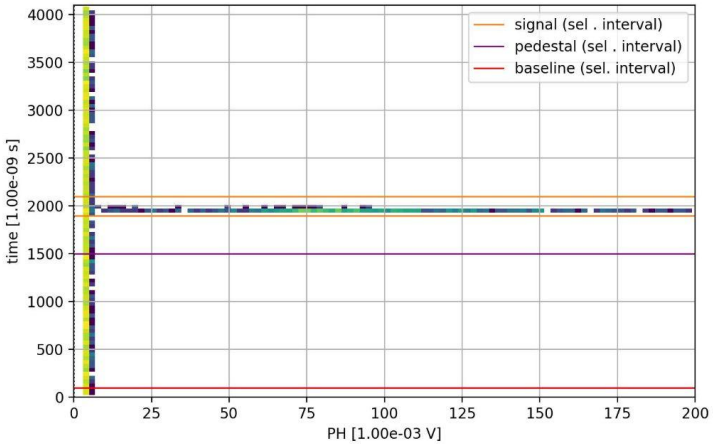


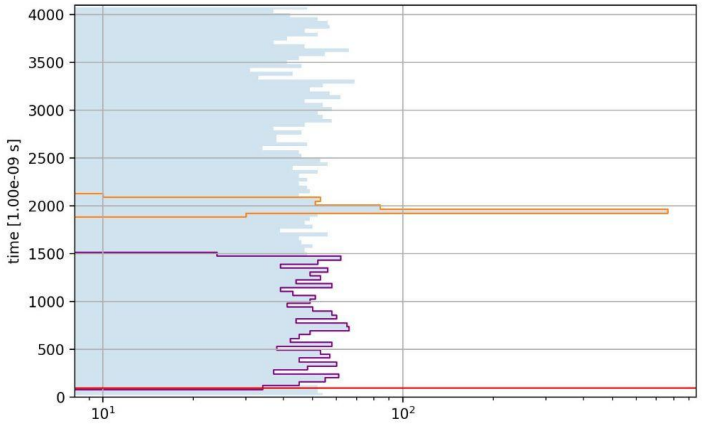


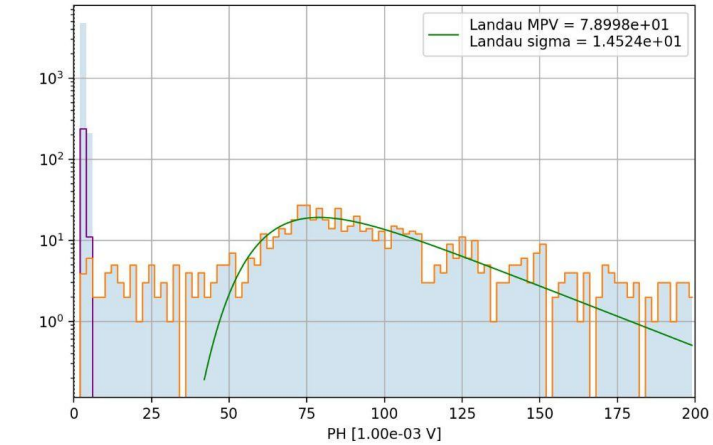


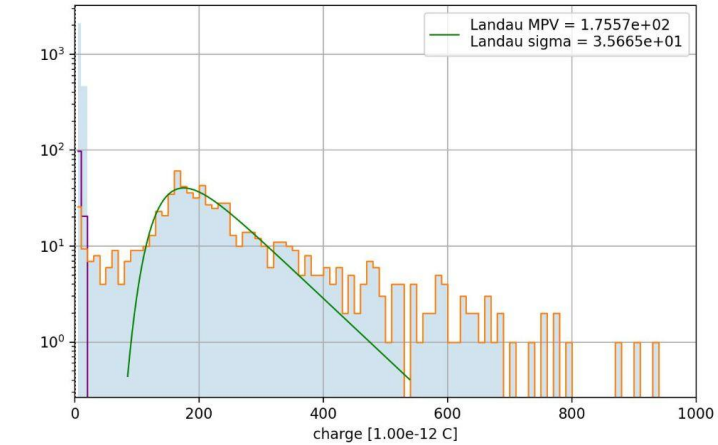


new measurements w/ cosmic rays @ LNF Protvino_B, batch 2

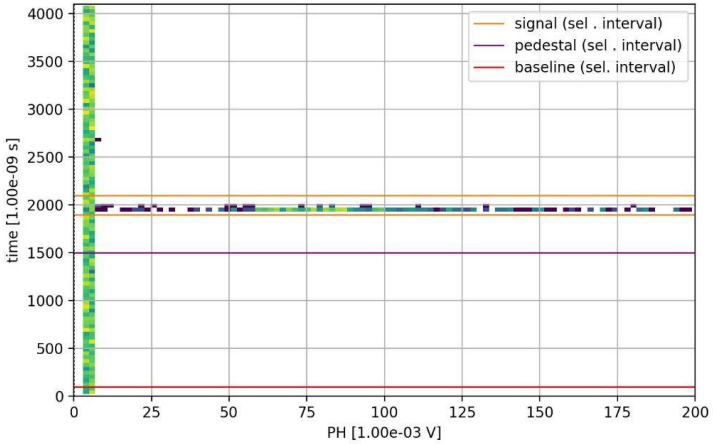


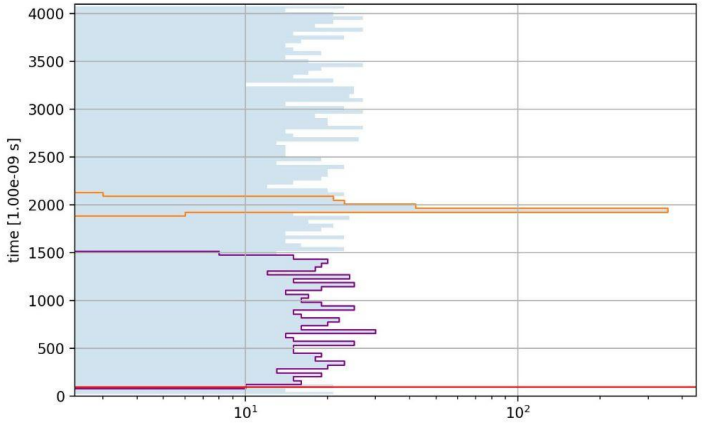


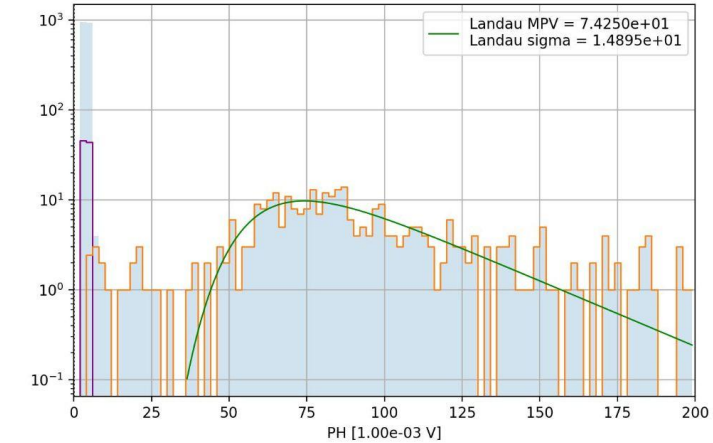


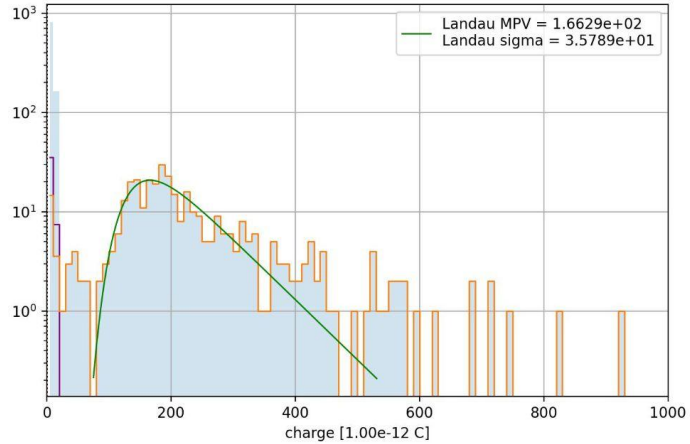


new measurements w/ cosmic rays @ LNF Protvino_B, batch 3

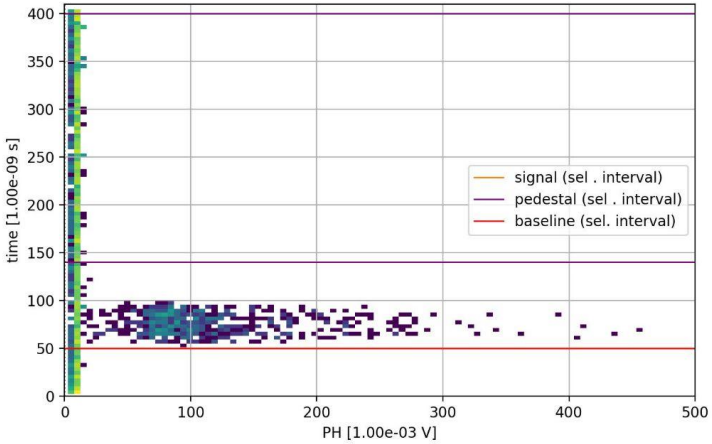


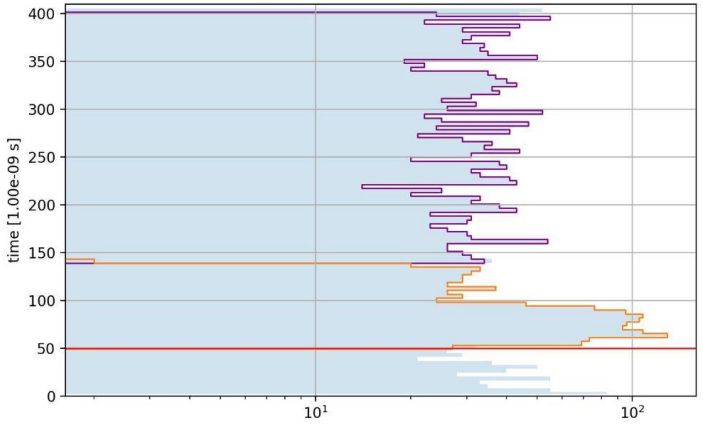


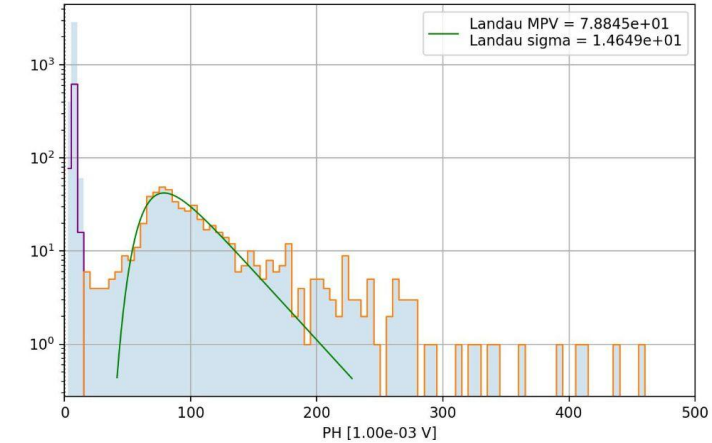


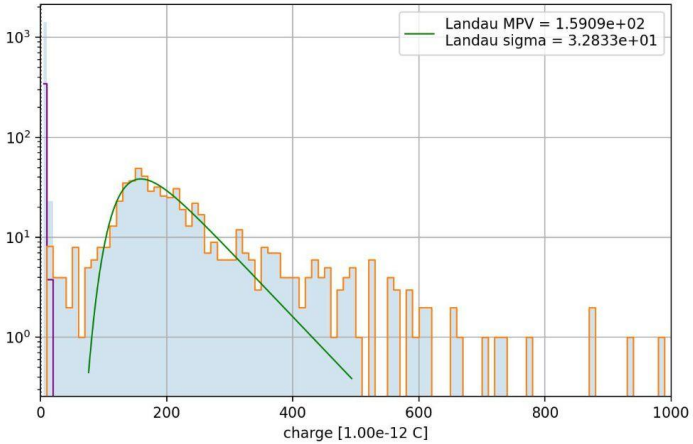


new measurements w/ cosmic rays @ LNF Protvino_B, batch 4









new measurements w/ cosmic rays @ LNF

reproducibility tests