



ALICE chamber GIF++ TB July 2021

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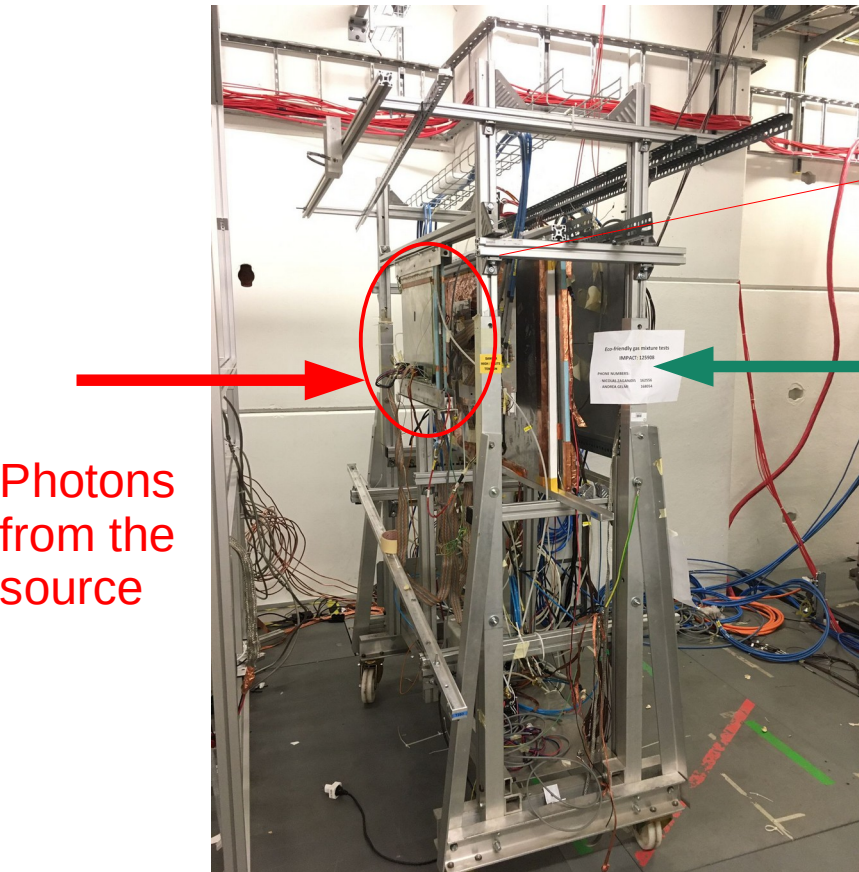
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Overview



- Experimental setup
- Measurements taken
- Results for standard gas mixture
- Results for ECOgas
- “Conclusions”

The setup – trolley 3

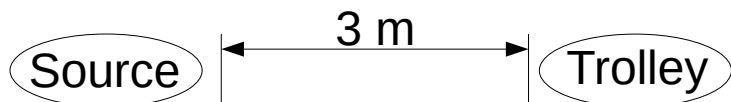


→ ALICE detector

μ beam

Photons
from the
source

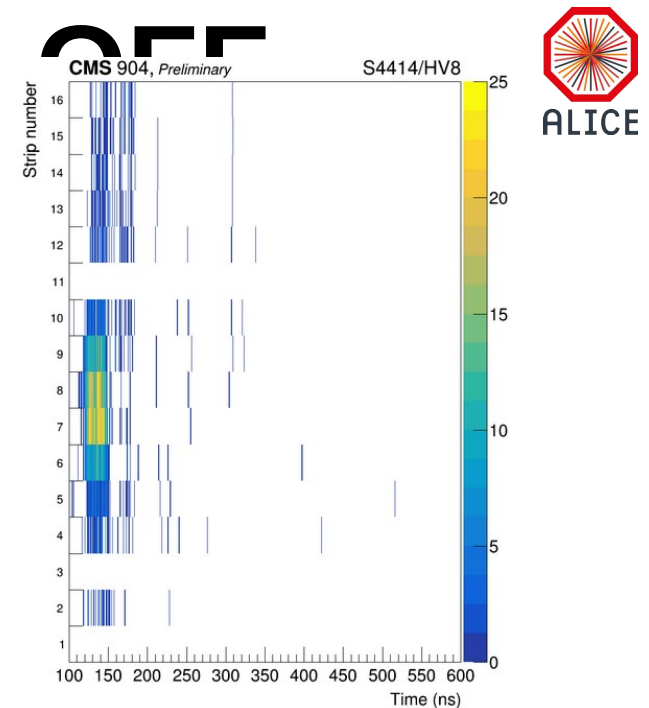
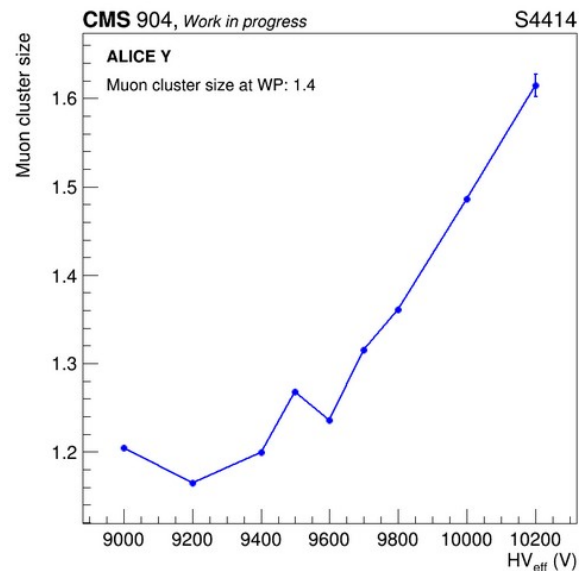
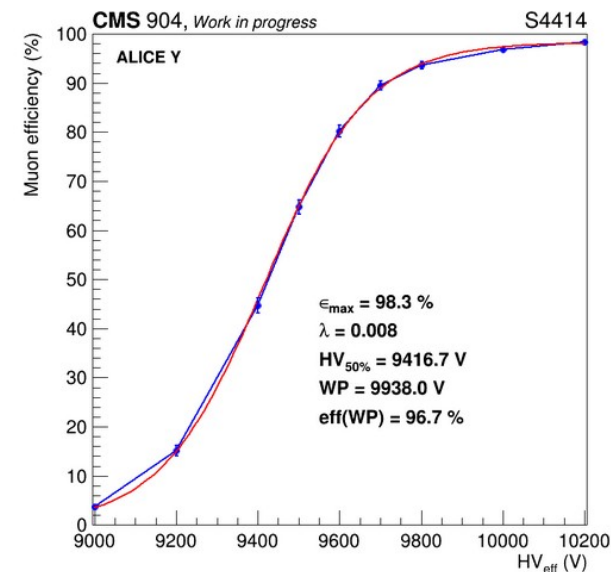
- New gap, never used before (only for an efficiency measurement with cosmics in Torino)
- 2 mm single gap
- 2 mm bakelite electrode
- $50 \times 50 \text{ cm}^2$
- Readout only on one plane, vertical strips with 3 cm pitch (16 strips in total)
- Trigger provided by the coincidence of two PMTs on the trolley and two PMTs out of the GIF++ bunker
- Single gas line for input and output ($\sim 2 \text{ vol/h}$)



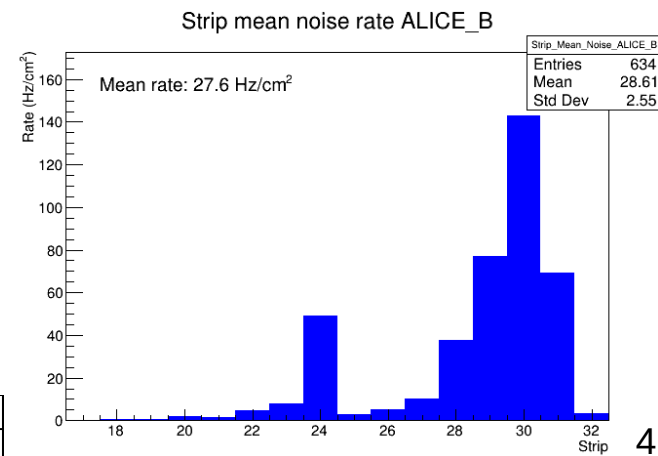
Measurements

- **DAQ setup:**
 - TDC in VME crate for DAQ
 - each TDC channel can host up to 32 inputs (1 TDC channel only for ALICE)
 - DAQ program through CMS webDCS
 - online data analysis also by CMS webDCS
- **Rate scans:**
 - to measure the rate of γ 's on the chamber
 - random trigger provided by a dual timer
 - TDC acquisition window set to 10 μ s
 - with source OFF and source ON and different absorption factors but no beam
- **Efficiency scans:**
 - to measure efficiency as a function of the applied HV
 - trigger provided by the coincidence on 4 scintillators
 - TDC acquisition window set to 600 ns
 - with source OFF and source ON at different ABS and also with beam

STD MIX - SOURCE

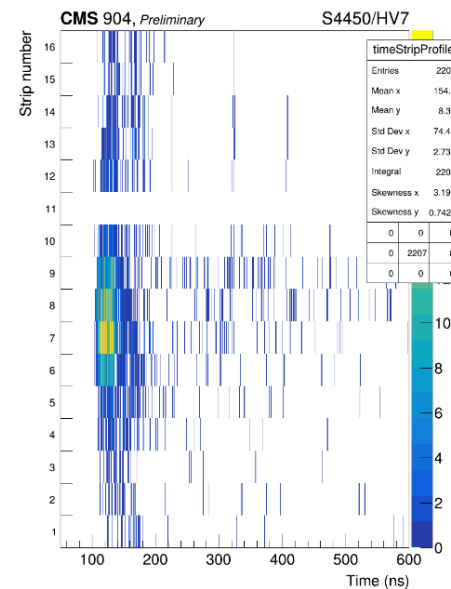
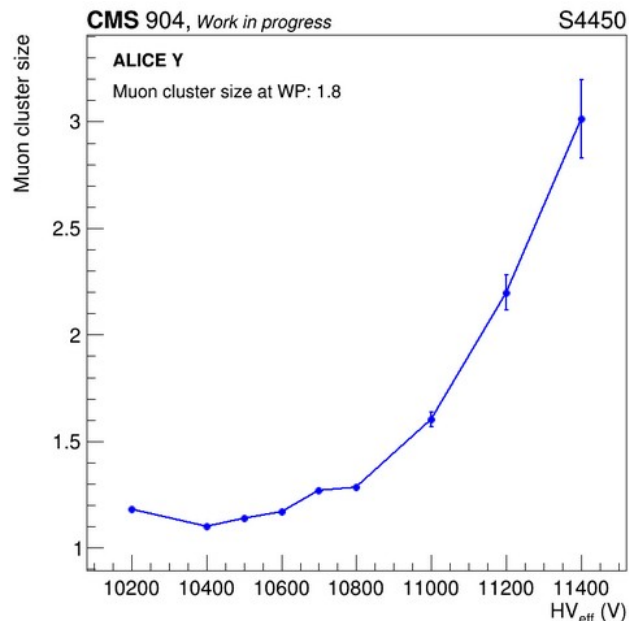
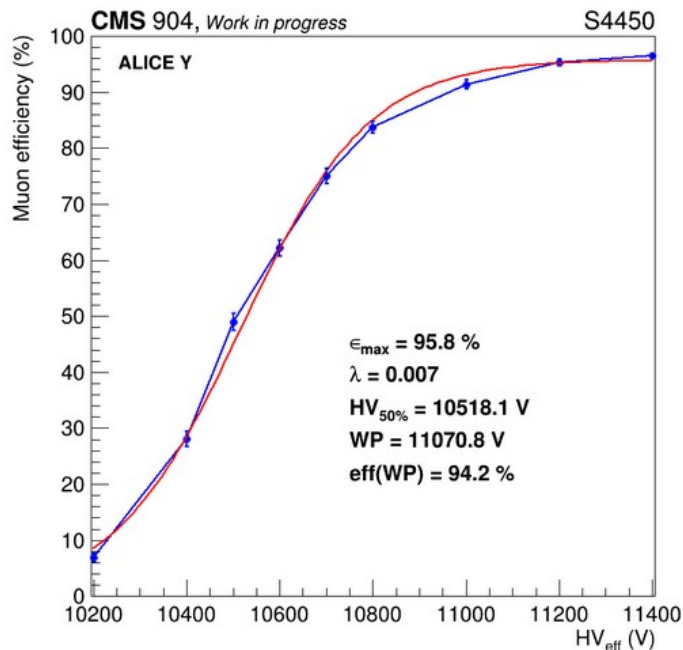


- Everything seems ok for this run



Eff run #	ABS	WP (V)	I (WP)	Eff (WP)	CS (WP)	Rate run #	Rate (WP) Hz/cm2
4414	0	9938	53.32	96.7	1.4	4389	27.6

ECOGAS - SOURCE OFF

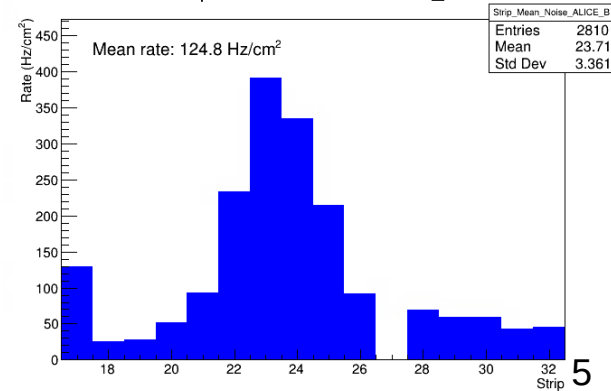


$$I_{\text{std}}(WP) = 53.32 \mu\text{A}$$

$$I_{\text{eco}}(WP) = 118.88 \mu\text{A}$$

Very noisy even at source OFF

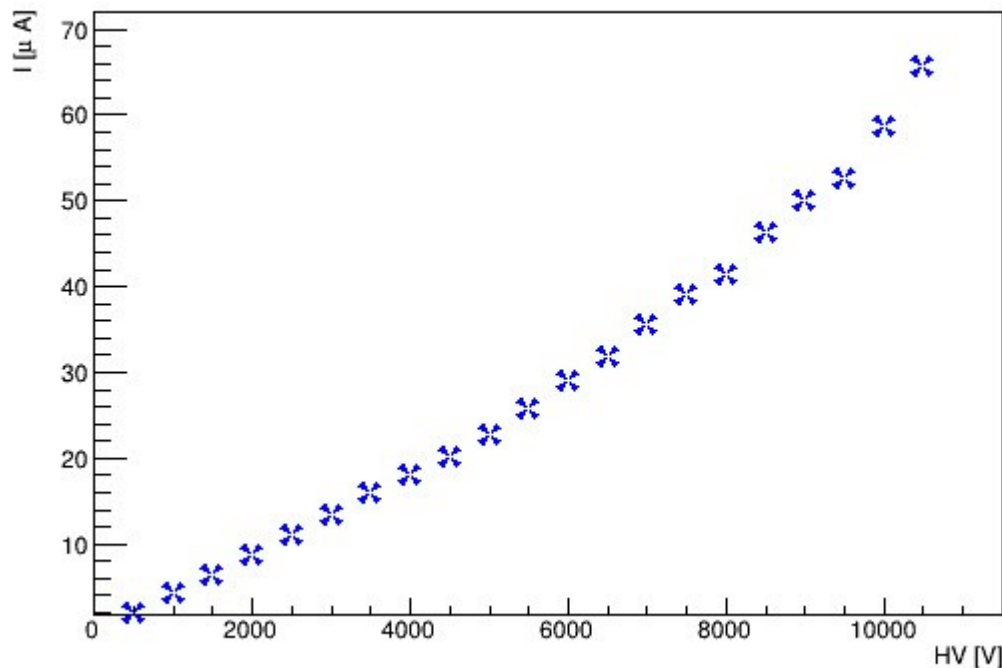
Strip mean noise rate ALICE_B



Eff run #	ABS	WP (V)	I (WP)	Eff (WP)	CS (WP)	Rate run #	Rate (WP) Hz/cm2
4450	0	11070.8	118.88	94.2	1.8	4452	124.8

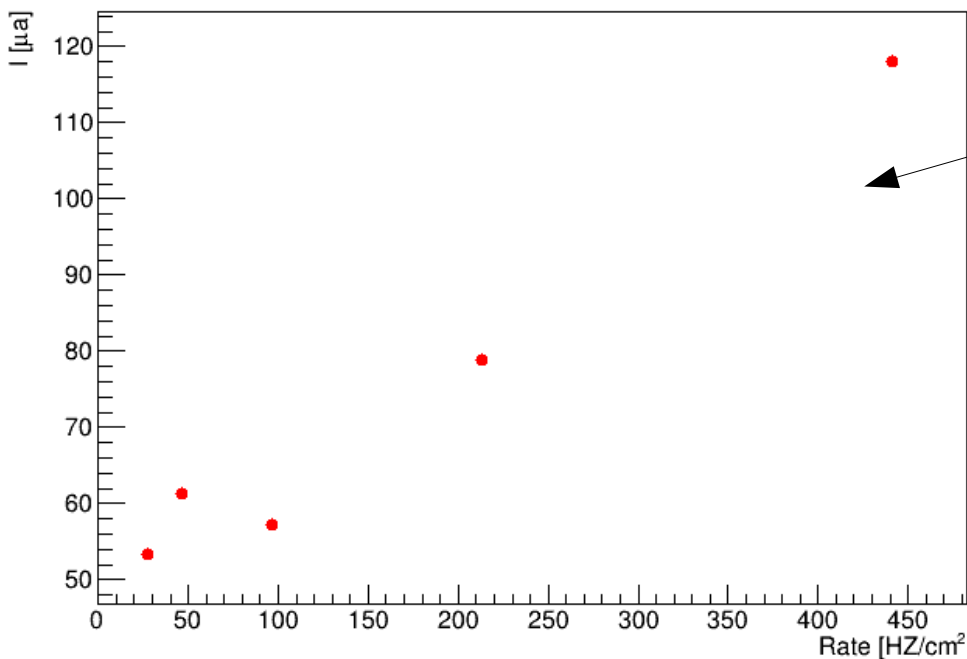
Standard gas mixture (1)

- Really high current absorbed even at source OFF
→ probably due to damages in the transport since in Torino this was not observed
- In any case the efficiency reached acceptable values



- Source OFF
- Beam OFF
- Important Ohmic component

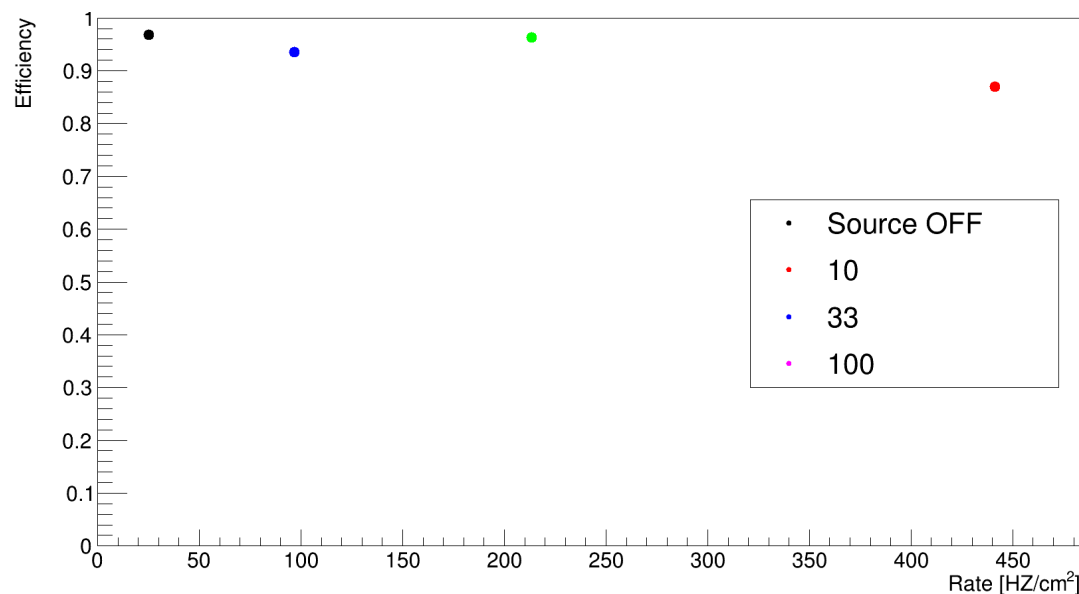
Standard gas mixture (2)



- Data with source ON and beam
- ABS 220 removed because it was not a good run
- Decrease of efficiency if the radiation is increased

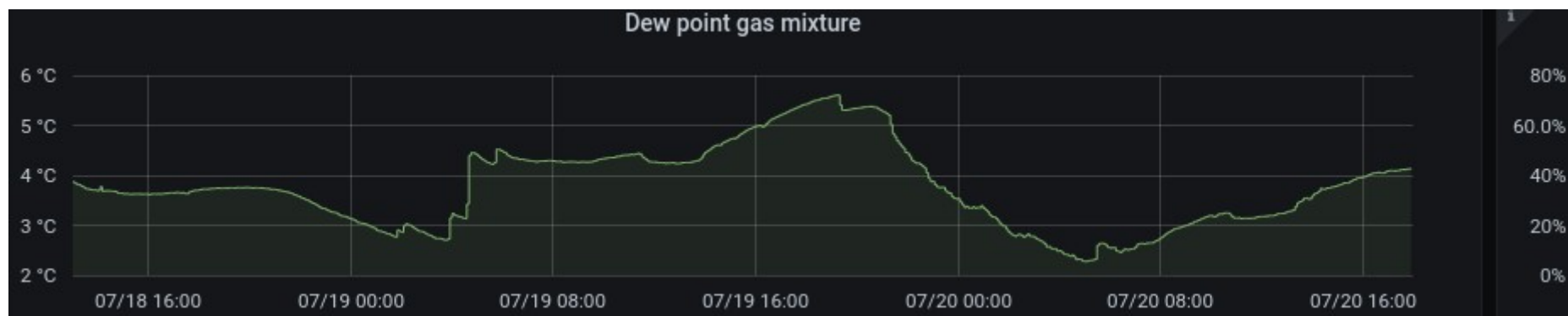
ABS	Current WP (uA)	Rate (WP) Hz/cm2
0	53.32	27.6
10	118.07	441.1
33	78.91	213.4
100	57.2	96.6
220	61.37	46.2

- Data with source ON but no beam
- Trend should be linear
→ fluctuations due to ALICE chamber instability

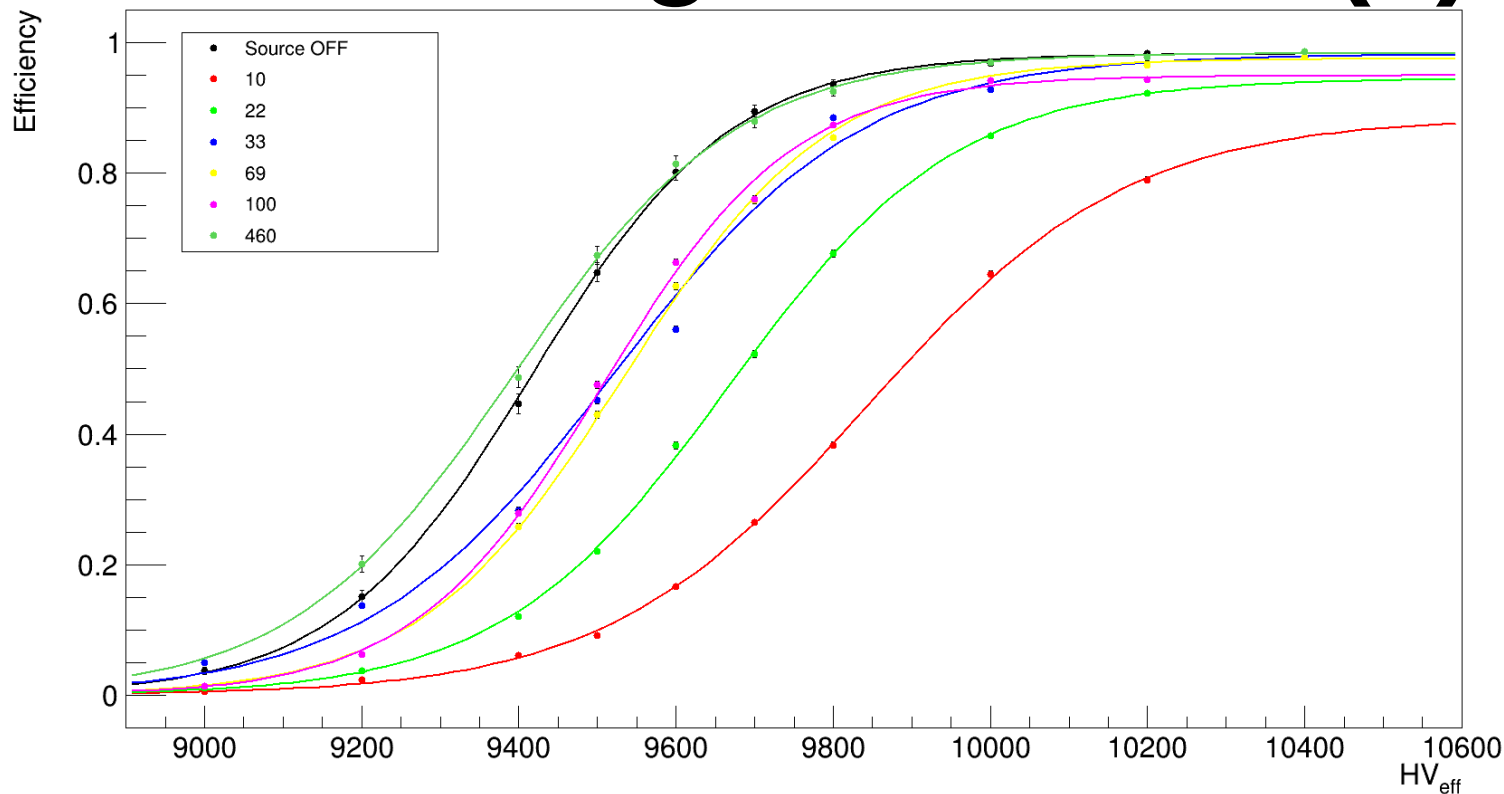


ECO mix 2 (1)

- ECO2: 60% CO₂, 35% HFO, 4% i-C₄H₁₀ and 1% SF₆
- RH humidity set to around 40%
- Gas mixture monitored through Grafana
- 1 vol/h in CMS-GT, CMS-KODEL and EP-DT
- 2 vol/h in ALICE

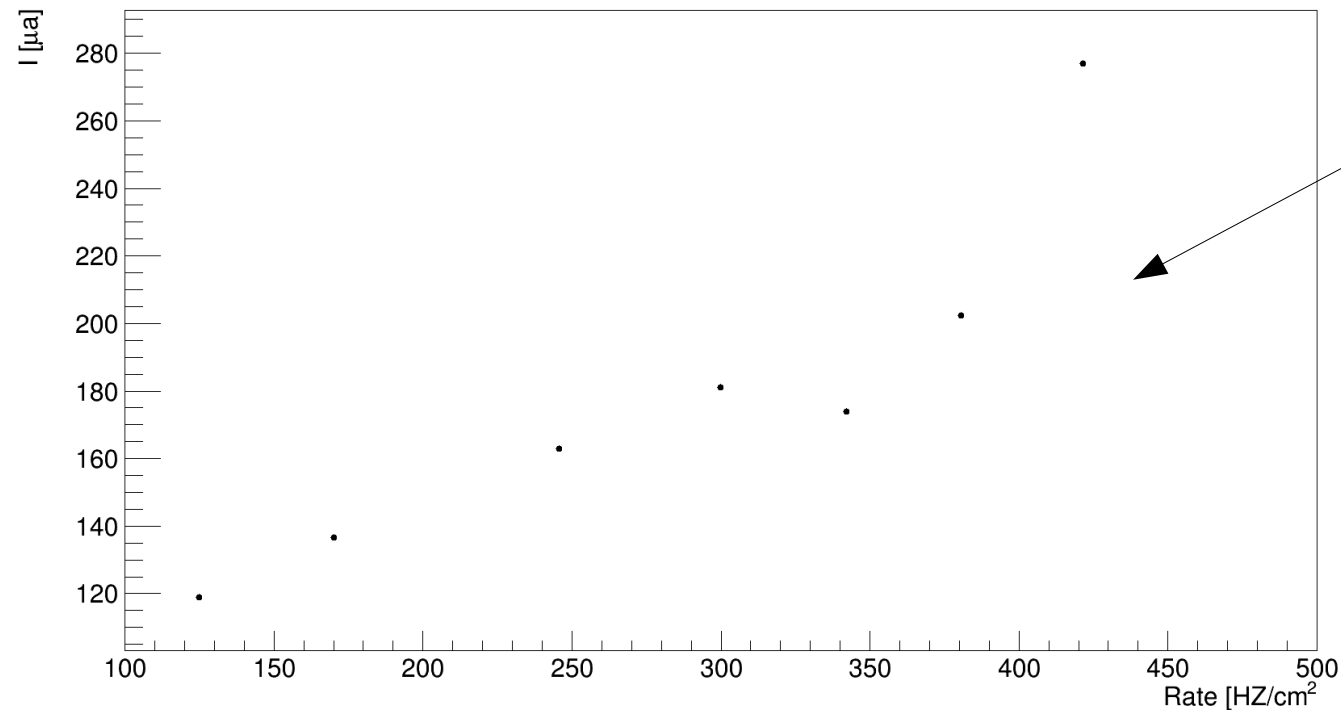


Standard gas mixture (3)



- Removed the curve at abs 220
→ not a good run
- Efficiency curve is shifted to higher voltages only for low filter values (high rates)

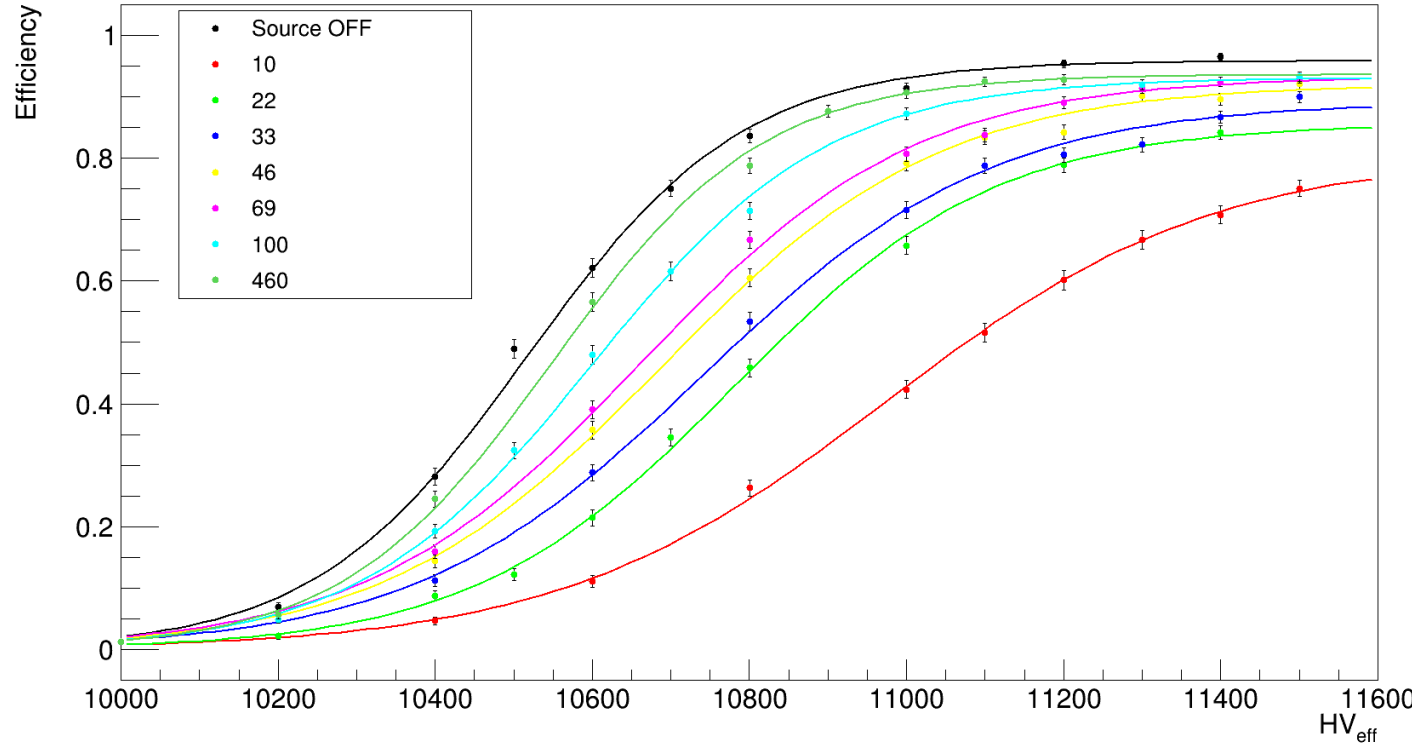
ECO mix 2 (1)



ABS	Current WP (uA)	Rate (WP) Hz/cm2
0	118.88	124.8
10 (69)	277	421.5
22 (46k)	202.32	380.5
33 (4.6)	173.97	342
46(22)	180.98	299.9
69 (6.9)	162.83	245.6
100 (46)	136.55	170.2

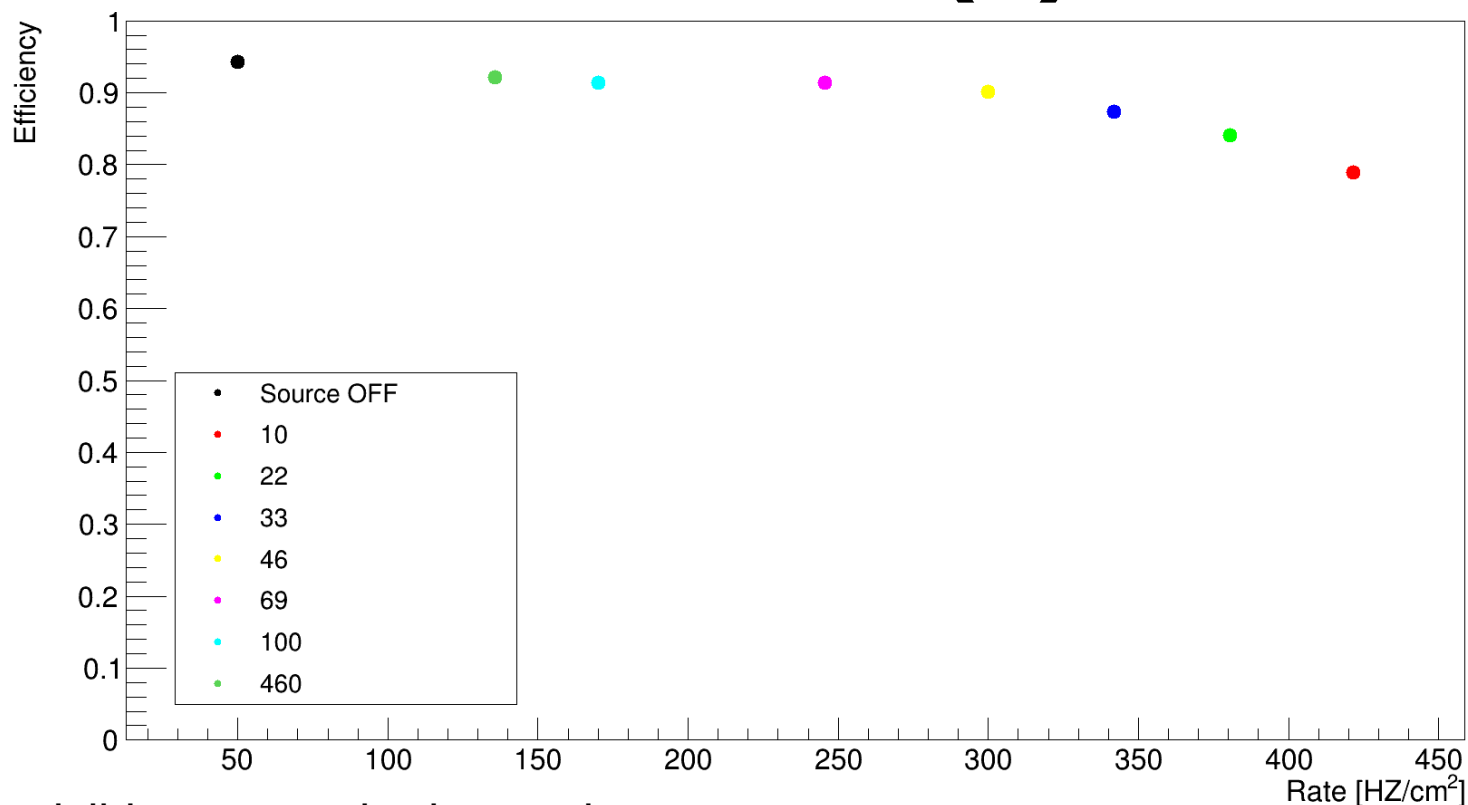
- Trend is linear
- Only exception is ABS 460
→ when we did that scan the current absorbed by ALICE had increased a lot
- The current absorbed by the detector increased during the irradiation
→ due to bad quality of ALICE chamber

ECO mix 2 (2)



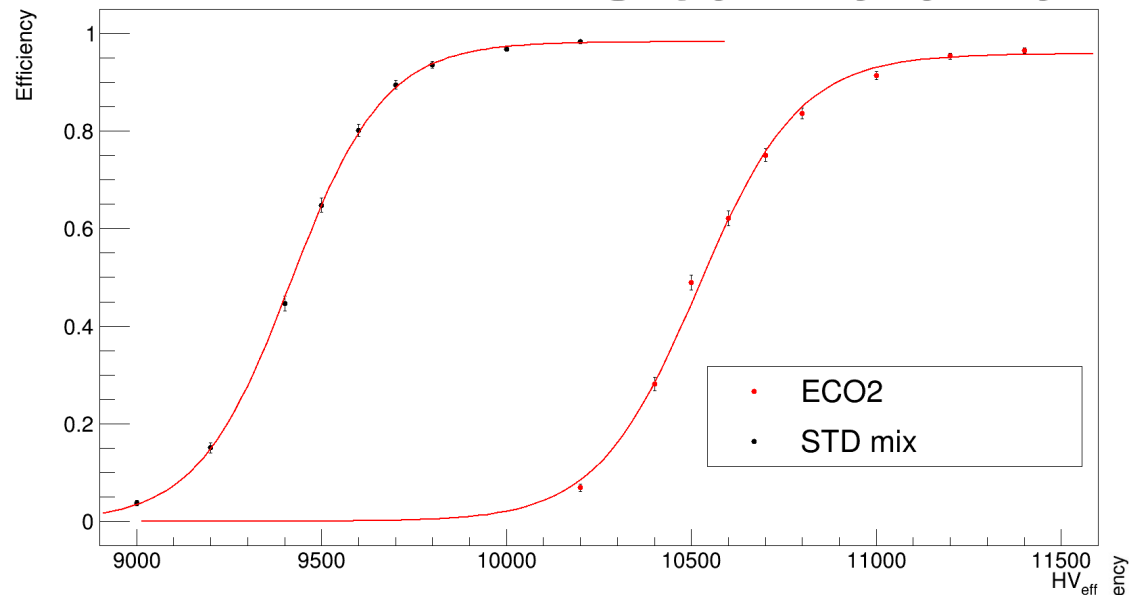
- Efficiency curve is shifted of around 1000 V to higher values
- Effect of the shift to higher voltages is visible when the abs factor decreases
- The plateau moves to lower efficiency values when the abs decreases

ECO mix 2 (3)



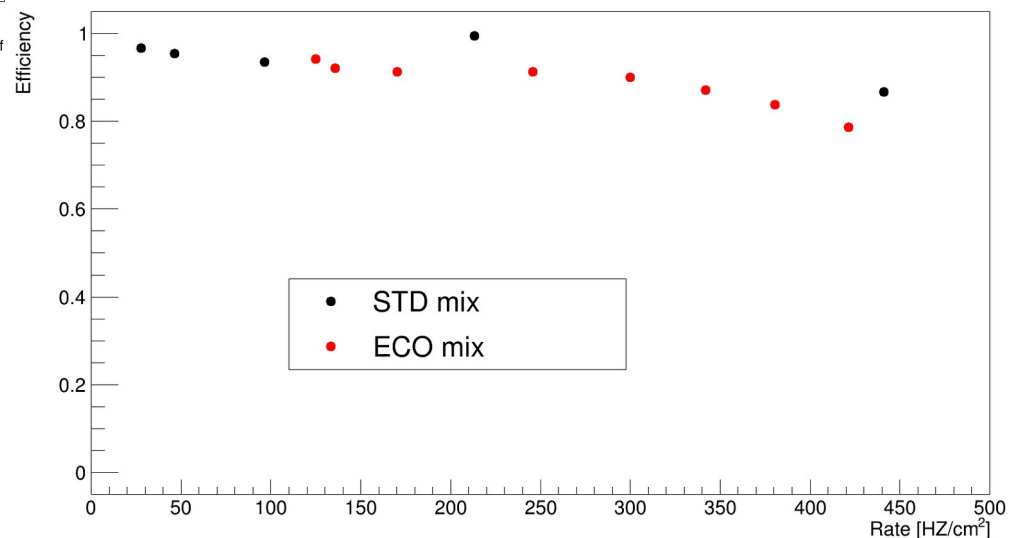
- Drop is more visible wrt standard gas mixture
→ around 15% from source OFF to abs 10
- To be kept in mind: during the ECO gas measurements the abs downstream was also changed

Standard vs ECO

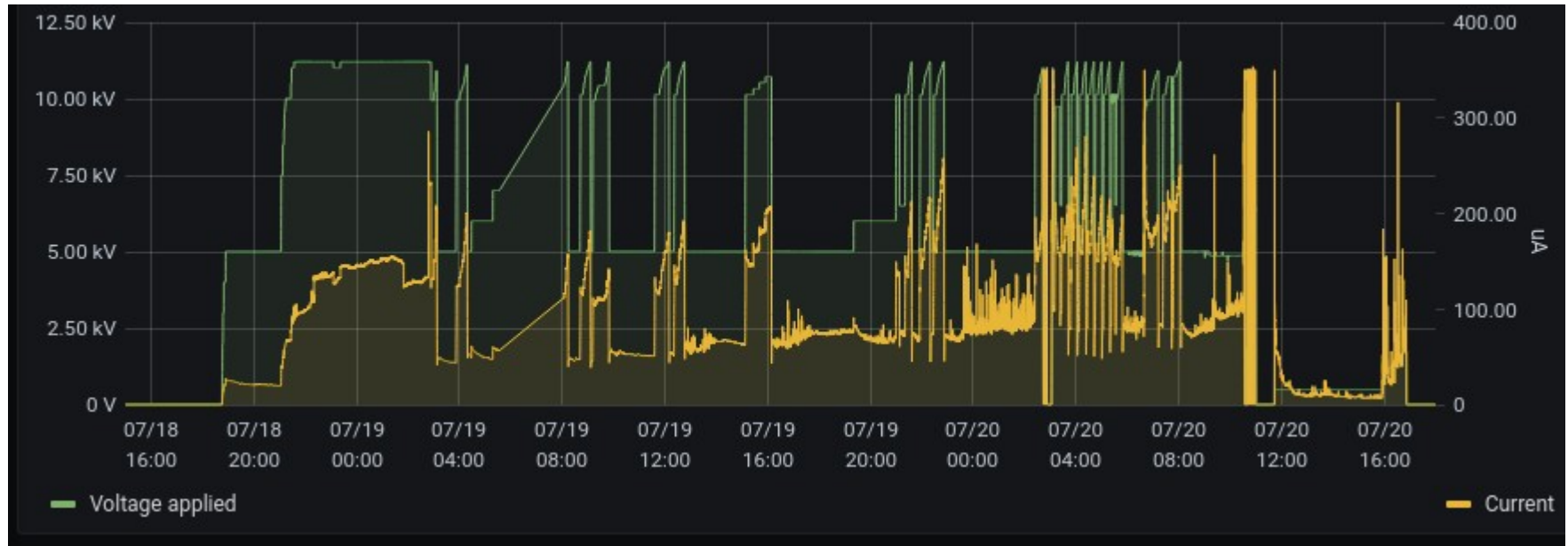


Efficiency at working point
drop vs rate for standard
and eco gas mixtures

Efficiency curves at
source OFF with beam for
standard vs eco gas
mixtures



Current absorbed with ECOgas



- Trend of current shows an increase with time
- I do not believe it is due to the gas mixture but to some problems with the chamber

Conclusions

- ALICE detector showed very high currents both with standard gas mixture and ecogas
→ I believe it might be due to damages of the RPC and not to the mixtures themselves
- Since it had high currents from the beginning we operated with even higher currents and eventually we damaged the chamber
- Now this gap is not usable anymore
- Efficiency reached with standard gas mixture is compatible with what we had in tests in Turin
- Efficiency with ecogas reached acceptable values but had a very evident drop when the rate of photons on the chamber increased
- Further studies are needed and have to be performed with a newer chamber that draws less current

Summary of the runs

STD MIX

	Eff run #	ABS	WP (V)	I (WP)	Eff (WP)	CS (WP)	Rate run #	Rate (WP) Hz/cm2
	4417	460	9958.4	66.52	98.4	1.5	//	//
Check fit again	4416	220	9969.8	61.37	95.4	1.5	4428	46.2
	4407	100	10011.9	57.2	93.5	1.3	4427	96.6
wrong HV → Fit offline	4411	69	10065.7	69.22	95.9	//	//	//
	4410	33	10202.2	78.91	94.3	1.3	4426	213.4
Not reached plateau	4408	22	10242.7	85.77	94.5	1.2	//	//
Not reached plateau	4405	10	10483.6	118.07	86.7	1.1	4432	441.1
	//	6.9	//	//	//	//	4431	571.8
	4414	0	9938	53.32	96.7	1.4	4387	25

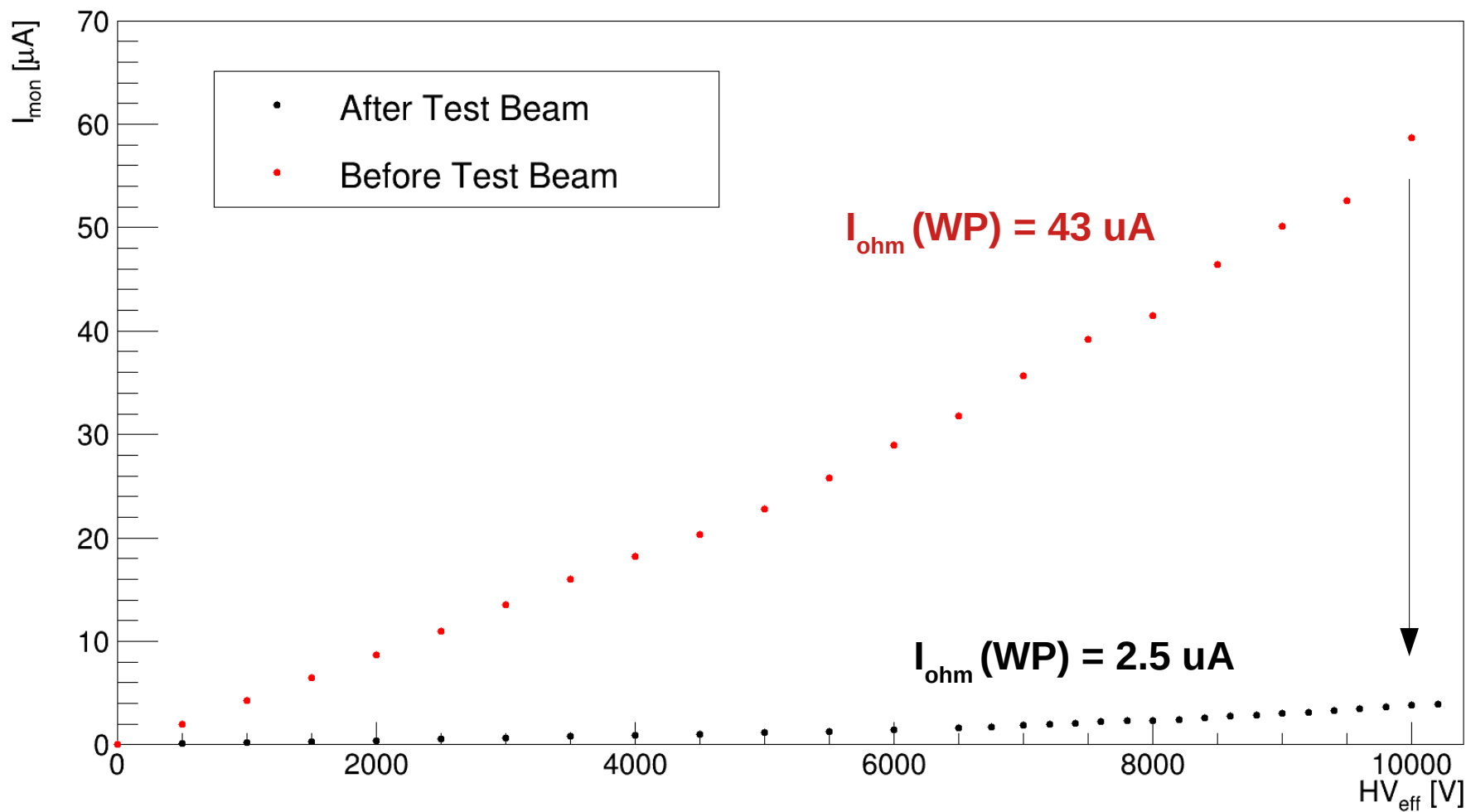
ECOGAS

Eff run #	ABS	WP (V)	I (WP)	Eff (WP)	CS (WP)	Rate run #	Rate (WP) Hz/cm2
4472	460 (22)	11092.7	189.53	92	1.9	4473 (22)	135.7
4471	220 (46)	trip	//	//	//	4479 (22)	//
4453	100 (46)	11188.3	136.55	91.3	1.5	4478 (22)	170.2
4456	69 (6.9)	11327.1	162.83	91.3	1.5	4477 (22)	245.6
4457	46 (22)	11361.1	180.98	90	1.5	4466 (46)	299.9
4454	33 (4.6)	11433.4	173.97	87.1	1.4	4476 (22)	342
4447	22 (46k)	11422	202.32	83.8	1.3	4475 (22)	380.5
4467	10 (6.9)	11740.5	277	78.6	1.2	4474 (22)	421.5
//	6.9	//	//	//	//	//	//
4450	0	11070.8	118.88	94.2	1.8		
4455	0	11120	120.82	94.9	2		

Investigation on ALICE (1)

- At the end of the TB period ALICE chamber showed very high currents
→ We brought it to 904 to investigate the issue
- We installed a resistor + capacitor on the return line of the HV to measure the presence of leakage current
- Chamber flushed for 2 days at 2 l/h with STD gas mixture
- When switched ON the current went up to 10's of μA
→ we investigated
- The mechanical frame was opened and it was observed that the gap without frame did not have such high currents
→ current leak somewhere in the frame
- Eventually the frame was slightly modified and now the issue is not seen anymore

Investigation on ALICE (2)



Next steps

- We are building a twiki page with information about:
 - Detectors and setup
 - Trigger and trigger logic
 - Code used now for data analysis
 - Approved plots
- Calculate the “effective” high voltage in the gap
 - Subtract the voltage drop due to the resistivity of the electrodes
- Re-calculate the efficiency subtracting the residual background due to photons
 - At the moment there is a slight over estimation ($\sim 1-2\%$)
- Eventually re-calculate efficiency using the tracking chambers
 - At the moment we use only the PMTs

**Thank you for your
attention!**