





Purity Monitor Update

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CALCI Consortium Meeting

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Purity monitors in PD-HD

the middle PrM is new with longer drift distance.

	□ Purity N	Nonitor Operation	-		0.00	1 101/1 101/
Purity Monitor Contro	ol 🕴	Photon Detector Status		PrM Temperatures	PrM Power	and +12V/-12V
		Purity Monitor Status			tue	
Lact Run Timostamn			PrM DAC	1 00 310		raye
			DAQ H	leartBeat 373		DrM T
2024.03.21 09:45:54.029	DCS	HeartBeat 95529 STATUS OK	DAQ S	Status: Ready to Run PrM DAQ System	PTMIP	DC PIM_I
Automatic Puns	(*********			Run type : REAL RUN		
Scheduler	Ru	n Purity Monitor		Mode : EXPERT		
Run status: 📕 No run.		pchoose a bigitizer coning :		HV State : OFF		
Bottom (Prl	<u>VI 0)</u>	Middle (PrM 1	1)	<u>Top (PrM 2)</u>		
Electron Lifetime		Electron Lifetime		Electron Lifetime		
Electron lifetime	-nan(ind) ms	Electron lifetime	0.30 ms	Electron lifetime	0.21 ms	
		LL				
Expert variables		Expert variables		Expert variables		
Anode HV status		Anode HV status		Anode HV status		
Anode Setting	1000.0 V	Anode Setting	2400.0 V	Anode Setting	1000.0 V	
Anode Applied Voltage	1000.0 V	Anode Applied Voltage	2400.0 V	Anode Applied Voltage	1000.0 V	
Anode Current Flow	3.00000 uA	Anode Current Flow	6.00000 uA	Anode Current Flow	3.00000 uA	
Anode peak voltage	-nan(ind) mV	Anode peak voltage	13.81 mV	Anode peak voltage	130.10 mV	
Corrected anode peak voltage	-nan(ind) mV	Corrected anode peak voltage	14.87 mV	Corrected anode peak voltage	137.40 mV	
Anode peak time	18.5 us	Anode peak time	477.0 us	Anode peak time	137.5 us	
Anode baseline voltage	-nan(ind) mV	Anode baseline voltage	-1.20 mV	Anode baseline voltage	-0.36 mV	
		Cathada INV status				
Cathode Set Voltage	50.0.1/	Cathode HV status	40.0.1	Cathode Av status	50.0.1	
	50.0 V		40.0 V		50.0 V	
	V 0.0C-		-40.0 V		- 1 00000A	
Cathode Current How	-0.00000A	Cathode Current How	-0.0000 04	Cathode Current How	-1.00000 uA	
Catnode peak voltage	2.16 mV	Cathode peak voltage	57.65 mV	Cathode peak voitage	206.83 mV	
Corrected Cathode peak voitag	je 3.20 mv	Corrected cathode peak voltage	64.69 MV	Corrected cathode peak voltage	231.10 MV	
Cathode peak to					28.0 us	
Cathode baselin	Iritv	Monit	nr (ontrol	1.43 mV	
Transparency co					1	
Corrected charge ratio	-nan(ind)	Corrected charge ratio	0.230	Corrected charge ratio	0.595	

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• 3 purity monitors installed. 2 of them (top and bottom) from the SP run, and

Temperature sensors installed above and below each purity monitor, 6 in total.



Purity Monitors

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Purity monitors status

- 3 purity monitors are working properly
 - From the reading in argon gas, there might be a gradient of purity from bottom to top (getting worse)
 - Keep taking data while purity monitors are in gas
 - Keep monitoring the purity of liquid once they're immersed, during filling and recirculation







First look in the argon gas before cooldown



3/6/2024 ~9am, Temperature: 304 K

- Middle PrM has smaller cathode signal when the voltage setting are the same
- Middle PrM has smaller anode signal because of the long drift distance

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Va = 0, Vary Vc: top PrM (temp. = ~221 K)



Va = 0, Vary Vc: bottom PrM (temp. = ~207 K)



Va = 0, Vary Vc: middle PrM (temp. = ~213 K)



Va = 0, Vary Vc: middle PrM (temp. = ~213 K) Voltage (mV) Voltage (mV -50 -50 middle middle -100 -100 Vc: -150 Vc: -180 -150 Va: 0 Va: 0 -150 -200 -200**೬** -0.5 -0.5 0 0.5 0.5 Time (ms)

Middle PrM has smaller signal strength when the voltage setting for all PrMs are the same

- We tried moving around the optical fibers, and switching the electronic readout channels. It's getting the same behavior
- It might be the difference of the photocathode

- The signals were all very large in the vacuum thus not shown up until it's in argon gas We can still get decent signals from the long PrM with high voltage applied







Raw Cathode Voltage

Top - (Vc: -50, Va: 1000) Middle - (Vc: -20, Va: 2400) Bottom - (Vc: -50, Va: 1000)







Drift time

Top - (Vc: -50, Va: 1000) Middle - (Vc: -20, Va: 2400) Bottom - (Vc: -50, Va: 1000)







PrM signals on Mar. 21

Liquid argon is getting to the cathode of the bottom PrM (anode is still in argon gas)



Purity Monitors

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Summary

- Purity monitors are working properly
 - Bottom PrM is about to be immersed very soon

Next steps:

- Trying to analyze the data with the full waveform model
 - Rising edge :
 - Observed maximum voltage :
 - Falling edge :
- not good

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$$V(t) = V_0 \frac{1 - \exp(-t/RC)}{t_{\text{rise}}/RC},$$

$$V_{\text{max}} = V(t_{\text{rise}}) = V_0 \frac{1 - \exp(-t_{\text{rise}}/RC)}{t_{\text{rise}}/RC},$$

$$V(t) = V_{\text{max}} \exp(-\frac{t - t_{\text{rise}}}{RC}),$$

Trying to analyze the lifetime using only the cathode signal, when the purity is

