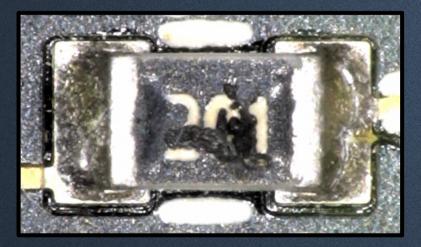


MDC System Status & Beamtime Preparation



19th February 2018

Christian Wendisch

GSI Helmholtzzentrum, Darmstadt





Outline

- SIS18: Hardware & Performance status (this talk)
- SIS100:
 - Performance estimation \rightarrow talk on Friday (C. Müntz)
 - FEE upgrade \rightarrow talk on Tuesday (M. Wiebusch)

MDC system status conclusion from all x-ray tests

MDC I	MDC II	MDC III	MDC IV
Ar/CO ₂ 70/30 + H ₂ O (3000 ppm) <u>Malter currents in</u> <u>I3 & I5</u> \rightarrow H2O recovers stability I3 frequent sparks stay, more conditioning needed?	Ar/CO ₂ 70/30 + H ₂ O (3000 ppm) Malter-currents persistent \rightarrow <u>H₂O recovers stability</u> \rightarrow risk for future runs II4 broken wire repaired	Ar/CO ₂ 70/30 Ar/CO ₂ 80/20 Ar/CO ₂ 90/10 almost no conditioning needed	Ar/CO ₂ 70/30 + H ₂ O (3000 ppm) Ar/CO ₂ 80/20 Ar/CO ₂ 90/10 -3 days conditioning needed before
1x Apr12 load	1.5 x Apr12 load	2x Apr12 load	5x Apr12 load

- Summary:
 - <u>all MDC operating with Ar/CO₂</u>
 - MDC II: H_2O additive allows for stable operation / recovers stability
 - $\ensuremath{\,H_2O}$ also approved for MDC I $\ensuremath{\,\&\/}\,\ensuremath{\mathsf{V}}$
- current gas system status
 - MDC I & II: open system & H_2O additive prepared
 - MDC III + IV: gas reflow system changed to CO_2 , removed iso-butane permanently
 - \rightarrow tested, running since 7.2.2018 with Ar/CO₂ 70/30

counts

Open decisions :

Gas mixture decision needed

30% CO₂

18% CO₂

second electron

0

80/20

Ar/CQ

70/30

2200

HV [V]

MDC IV

2000

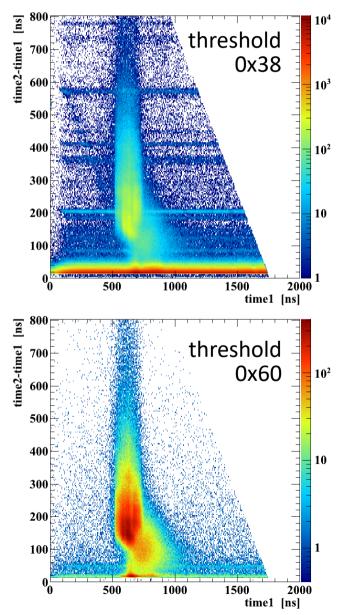
3D Garfiled simulation

time precision (ns) • Does reduction of CO₂ improves data quality ? (reducing disadvantages in fast drift gas) \rightarrow simulations running \rightarrow which priority within HADES? A)data quality B) load / beam intensity -3 -2 \rightarrow decision on gas mixture needed (deadline April) distance to anode wire (mm) working points to be determined ! \rightarrow which priority for tracking? ទ្<u>ខ</u>120 A) conservative (low HV) \rightarrow low thresholds nean ToT 100 B) high gain \rightarrow robust thresholds MDC 1 2.5 80 MDC 2 MDC 3 2 efficiency [binom.] 5.0 MDC 4 1.5 90/10 cosmics track pi+C (aug2014) 0.5 **A**r/iButane 84/16 100 200 300 400 1800 1600 time over threshold (ns)

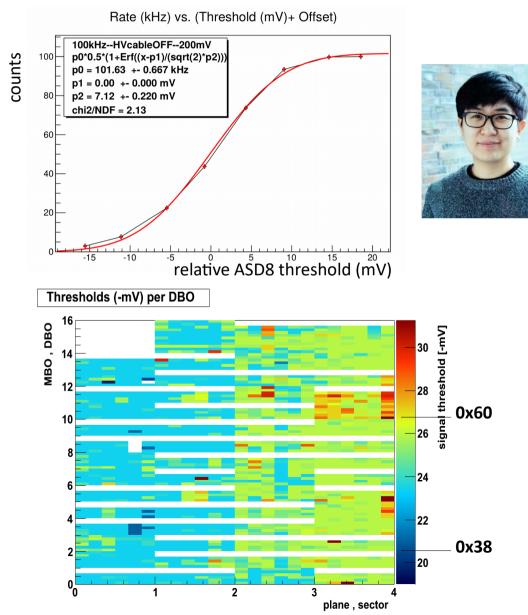
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HADESFront-End Electronics (FEE)MODEpreparation for high occupancy

• thresholds adjustment needs revisit



new threshold optimization (Bachelor thesis Yefei Tang)



5



FEE

Number of Missing Channels per Chamber repair goal single channel failure 0.5 FPC failure **TDC** failure **DBO** failure **MBO** failure working channels 0 2 plane, sector **Q**15 MBO Broken channels

plane, sector

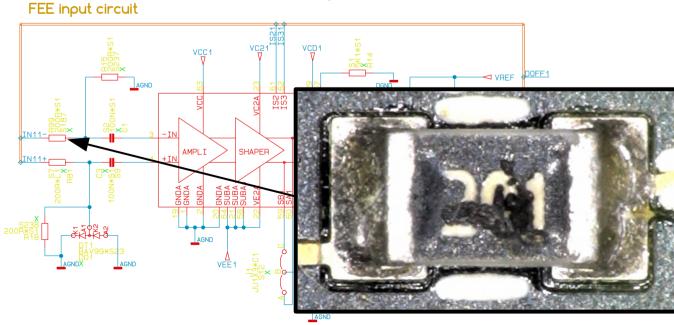
6

5% dead channels, main reason: **broken serial resistor** of input circuit → exchange focused on MDC I & II only (major losses there)

repair goal: < 1 % missing channels

- Status:
 - MDC II 75 % broken channels repaired: (only DBO with number of broken channels > 1) 127 DBOs repaired, each 16 resistors = 2032 exchanged resistors ! (Thanks to Students of GSI Electronics)
 - MDC | repair ongoing (goal 85 % repaired) (only DBO with number of broken channels > 1) 46 DBOs to repair

 \rightarrow To confirm repaired FEE, final full system DAQ test needed soon





Status summary Feb. 2018

• Done tasks

MDC HV pressure interlock 器 Pressure HV Interlock

ON ON ON Enabled

ON

Status

Alarm

ON

ON ON

- FEE repair ongoing (55 % finished)
- gas reflow system changed to CO_2 , removed iso-butane permanently \rightarrow tested, running since 7.2.2018

Gas System Status HV interlock

-reflow oper

ON

ON

OK

reflow Problem

ON

ON

OK

• open system & H₂O additive prepared

Link P3 to P4

YES 🔵

- control system (DCS) running 24/7 with interlocks, constantly improving GUI, adding interlocks for redundancy (Thanks Peter Zumbruch !)
 - chambers being operated since Dec. 2017 (HV at working point and above, under N2)

	Plane 1					Plane 2					I MDC Main 路
Operator	Sector	Status	Voltage 999.25 V	0.00 uA	Trip cnt.	Sector	Status On	Voltage 999.50 V	0.00 uA	Trip cnt.	C C 97% 💌 🔅
Expert	1 [On	999.25 V 999.50 V	0.00 UA	Reset	1 .	On	999.50 V 999.50 V	0.00 uA	Reset	MDC Control
trip OX		On	999.00 V	0.00 uA	0		On	999.75 V	0.00 uA	0	Alarm Interloc
	2 . c	On	999.50 V	0.00 uA	Reset	2 c	On	999.75 V	Au 00.0	Reset	HV ON enabled
all	. F	On	999.50 V	0.00 uA	0	. F	On	1000.25 V	0.00 uA	0	
HV	з. с	On	999.50 V	0.00 uA	Reset	3 . c	On	999.75 V	Au 00.0	Reset	
OFF	4 ^F	On	999.50 V	0.02 uA	0	A . F	On	999.50 V	0.00 uA	0	Gas
	4 c	On	999.50 V	0.00 uA	Reset	4 c	On	999.75 V	0.00 uA	Reset	Warning enabled
	5 ^F	On	999.50 V	0.00 uA	0	5	On	999.50 V	0.00 uA	0	Turustan
	c	On	999.50 V	0.00 uA	Reset	c	On	1000.25 V	Au 00.0	Reset	Temperature
	6 ^F	On On	999.25 V 999.50 V	0.00 uA	0	6 c	On On	999.50 V 999.50 V	Au 00.0	0	LV
	100	Un	999.50 V	0.00 UA	Reset		Un	999.50 V	0.00 UA	Reset	
	Plane 3 Sector	Status	Maltana	Current	Toles and	Plane 4 Sector	Status	Maltana	Current	This such	Trends: HV Currents
	Sector	On	Voltage 1399.00 V	0.00 uA	Trip cnt.	Sector	On	Voltage 1500.25 V	0.00 uA	Trip cnt.	
	1 . c	On	1399.25 V	0.00 uA	Reset	1 . c	On	1499.25 V	0.00 uA	Reset	Individual 1 2 3 4
	- F	On	1399.25 V	0.00 uA	0	- F	On	1499.75 V	Au 00.0	0	Pressure Fresh Gas
	2 c	On	1399.25 V	0.00 uA	Reset	2 c	On	1499.50 V	Au 00.0	Reset	Temperature
	3	On	1399.50 V	0.00 uA	0	- F	On	1499.50 V	0.00 uA	0	
	з _с	On	1399.00 V	0.00 uA	Reset	3 c	On	1499.50 V	0.00 uA	Reset	EMERGENCY HV OFF
	4 ^F	On	1398.75 V	0.00 uA	0	4 F	On	1500.00 V	0.00 uA	0	all MDC_OFF
	c	On	1399.25 V	0.00 uA	Reset	c	On	1499.75 V	0.00 uA	Reset	
	5 ^F	On	1399.25 V 1399.25 V	0.00 uA	0	5 ^F	On	1499.25 V 1499.75 V	Au 00.0	0	🥥 Status
	e F	On	1399.25 V 1399.00 V	0.00 uA	Reset	- F	On	1499.75 V	0.00 uA	Reset	
	6 ⁻	On	1399.00 V 1399.25 V	0.00 uA	Reset	6 c	On	1499.75 V 1499.50 V	0.00 uA	Reset	
								Sector Constraints			
- mdc											
		0 1	2					-			
		•	106	%	CD .	• 🖘	÷			HVс	ontrols GL
				_							
102322			14 16 16		- 25 XX	6					
-N2 p	ress	ure	CO2	conce	entrat	ion	-				
0255											
		12	2.7								
			(personal states)	Enab							

ok Status

Alarm

HV / gas interlocks GUI

Beam Intensities Ag+Ag @ 1.65 AGeV (Aug18)



MDC I	MDC II	MDC III	MDC IV	
Ar/CO ₂ 70/30 + H ₂ O (3000 ppm)	Ar/CO ₂ 70/30 + H ₂ O (3000 ppm)	Ar/CO ₂ 70/30 90/10	Ar/CO ₂ 70/30 80/20	CAUTION X-RAY RADIATION PLEASE LET US KNOW IF
1x Apr12 load	1.5 x Apr12 load	2x Apr12 load	5x Apr12 load	Searchipson + MARCE 2017 + 8.005

heavy ion workload on MDC:

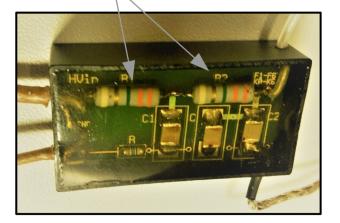
- MDC I, II driven by d-electrons (\neg rate \cdot Z2)
- MDC III, IV driven by reaction products occupancy (~ rate \cdot A)
- HV in-spill voltage drops, due to HV filter resistors

Result for Aug18, max in-spill beam intensity:

- 4.5 x 10⁶ ions / s (limited by d-electrons in MDC I)
- 3×10^6 ions / s (keeping HV drop < 20V)
- 1.5 x 10° ions / s (10 kHz DAQ) Aug18 proposal

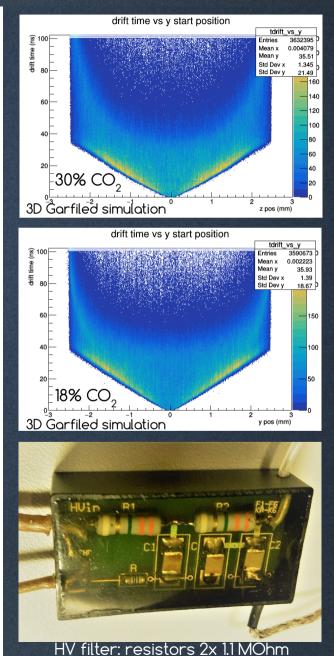
Possible improvements:

- Exchange serial resistor in HV filter of MDC I from 1+1MQ \rightarrow 0.2 +1MQ
- for > 4.5 x 10° \rightarrow Increase load benchmark of MDC I : 1 \rightarrow 1.5x Apr12





Conclusion ToDo



FEE tasks:

- full system test \rightarrow running DAQ needed soon
- adjust power voltages
- define robust thresholds for high occupancy (max. efficiency / low noise, robustness?)

Decisions to take:

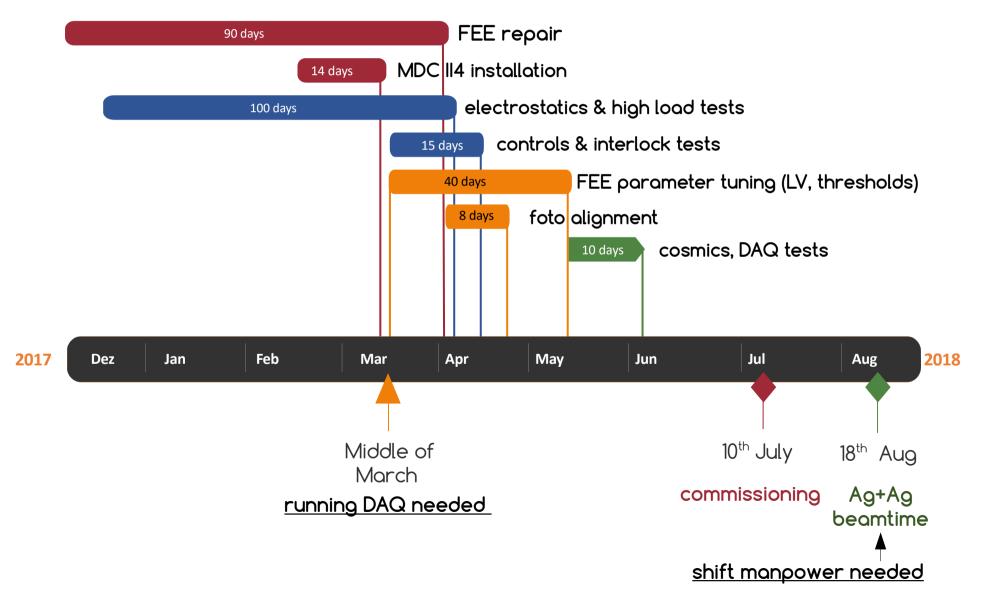
- counting gas mixture (optimize CO₂ fraction)
 → which priority within HADES (data quality vs. stability) ?
- MDC I HV filter modification for higher intensities?

decision needed now!

• MDC I - benchmark to higher load with x-ray requested?

Summary preparation schedule





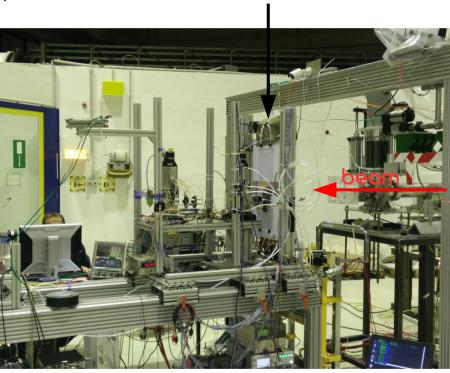


Summary additional projects

littleMDC

- littleMDC by Luis Lopes
 - steep learning curve in drift chamber assembly
 - stable operation in COSY proton beam
- MDC II rebuild:
 - preparatory work started
 - production site GSI detector lab
 - prototyping with new materials ongoing (MDC I spare & littleMDC)
 - MDC I spare wiring in progress (~ 40% finished)
 - time scale = 2-2.5 years
 - team needed ! → search for manpower
- new FEE for higher rates
 - \rightarrow talk by M. Wiebusch

BigKarl cave @ COSY, Nov. 2017 – CBM test beam time



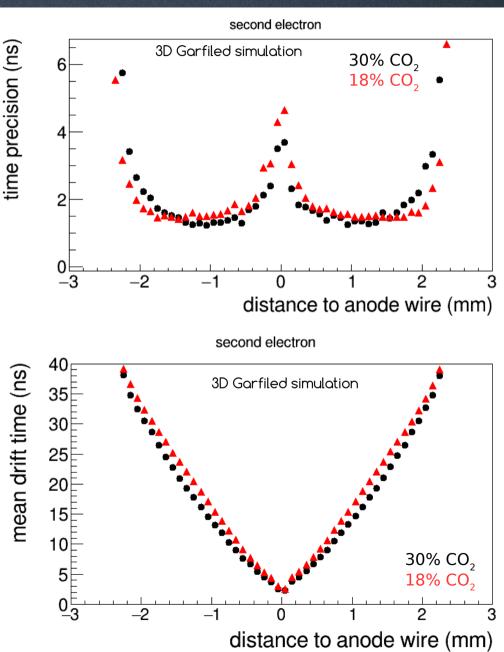






Open decisions :

- Does reduction of CO₂ improves
 - data quality / spatial resolution ?
 - \rightarrow simulations running
 - → which priority within HADES?
 A)data quality
 B) load / beam intensity
- → decision on gas mixture needed (deadline April)

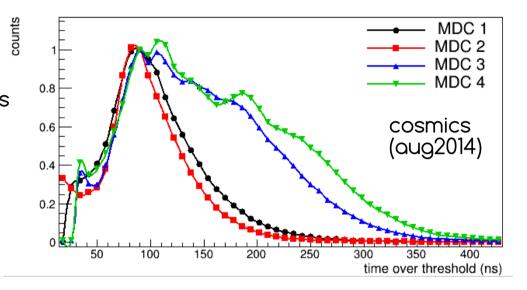




Gas mixture decision needed

Open decisions :

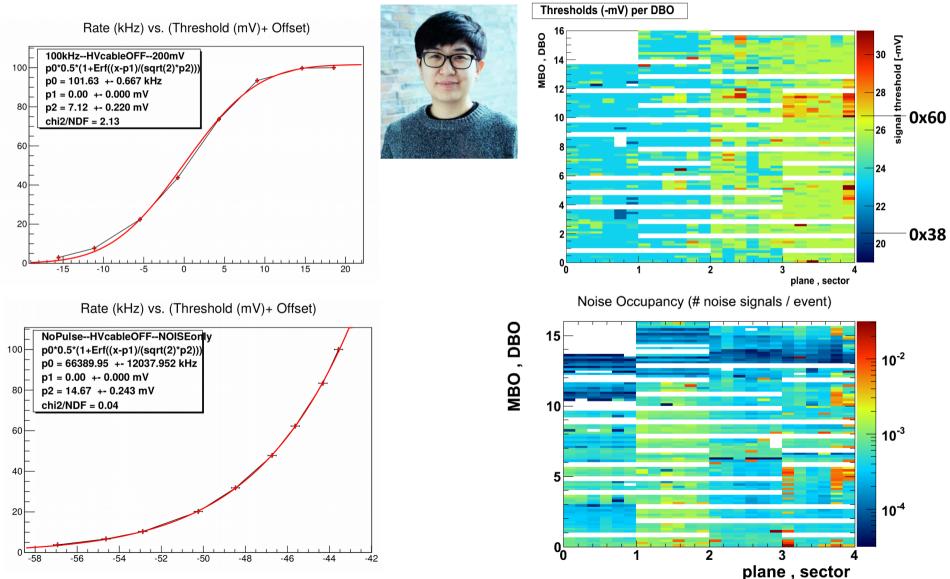
 working points to be determined ! \rightarrow which priority within HADES? A) conservative (low HV) \rightarrow low thresholds B) high gain \rightarrow robust thresholds



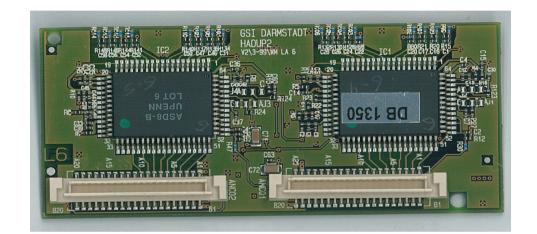
MDC wa	orking poi	nts		counts	2.5	MDC 1 MDC 2 MDC 3 MDC 4
plane	Ar/CO ₂ 70/30	Ar/CO ₂ 80/20	Ar/CO ₂ 90/10	Ar/iButane 84/16	1.5	
I	1750 V	-	-	1300 V	1	pi+C (aug2014)
Ш	1770 V	-	-	1375 V	0.5	
III	1900 V	1700 V	1600 V	1500 V		
IV	2150 V	1950 V	1800 V	1700 V	0	100 200 300 400
						time over threshold (ns)

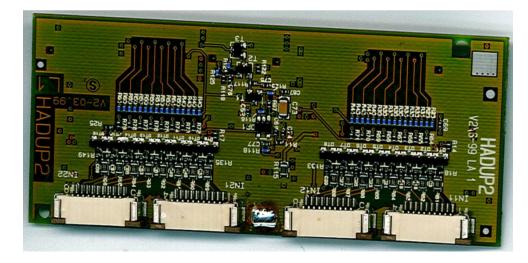
FEE optimization

new optimization of thresholds (Bachelor thesis Yefei Tang)

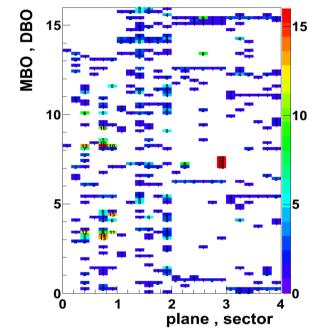


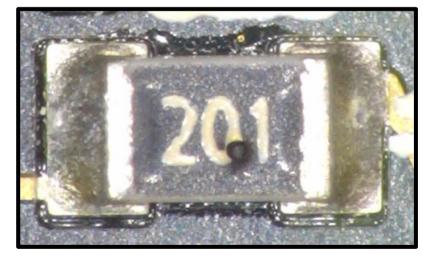
FEE broken channels





Number of Missing Channels per DBO





Beam Intensities Ag+Ag @ 1.65 AGeV (Aug18)



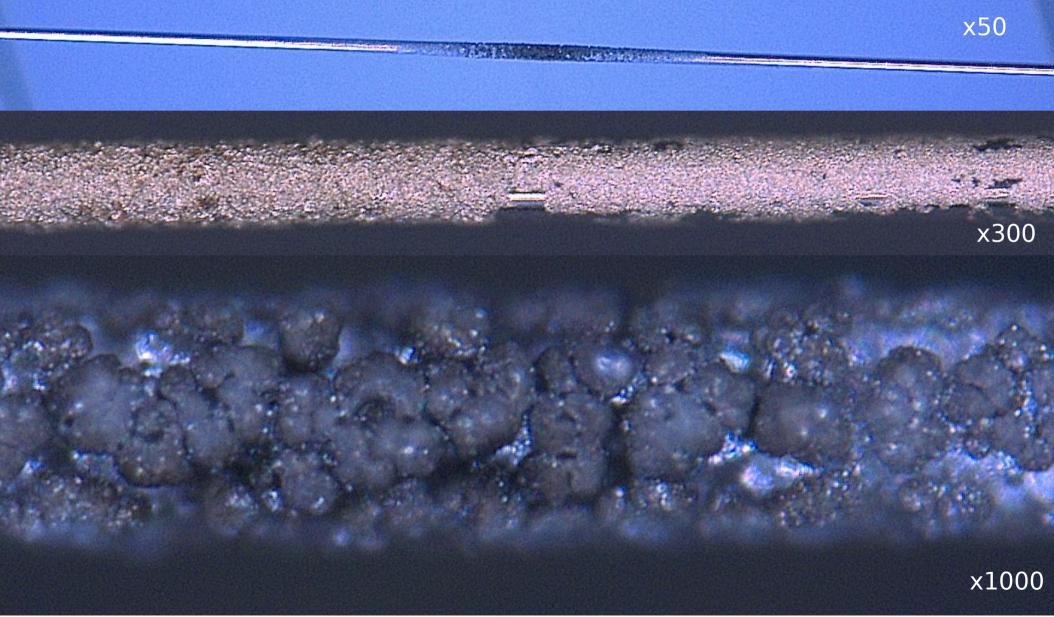
MDC I	MDC II	MDC III		MDC IV			
Ar/CO ₂ 70/30	Ar/CO ₂ 70/30	Ar/CO	2	Ar/CO ₂	CA	UTION	
+ H ₂ O (3000 ρρm)	+ H ₂ O (3000 ρρm)	70/30 90/10		70/30 80/20	RADIA	X-RAY RADIATION PLEASE LET US KNOW IF YOU ARE PREGNANT	
1x Apr12 load	1.5 x Apr12 load	d 2x Apr12 load		5x Apr12 load		SmartSign.com + 800-902 1457 + 5-8154	, ,
•	load in MDC I, II dri load in MDC III, IV dri	•	•		HV in-spill vo (due to HV fil		
Result for Aug18:		Particle load e	stimation	ı (based on apr12):			
Result for Aug18: max in-spill beam int	tensity:		stimation	n (based on apr12): max. Intensity	@max Int.	max. int. (N	/Hz)
Ũ	· · ·	Particle load e max (MHz) Ag ane	estimation constrair	max. Intensity	@max Int. Delta V	max. int. (N for DV max	
max in-spill beam in 2.5-3 x10° ions ,	/ s	max (MHz) Ag		max. Intensity			
max in-spill beam inf 2.5-3 x10⁶ ions (limited by δ-electr	/ s rons in MDC I, II	max (MHz) Ag	constrair	max. Intensity nt MHz	Delta V	for DV max	
max in-spill beam in 2.5-3 x10° ions ,	/ s rons in MDC I, II	max (MHz) Ag	constrair deltas	max. Intensity nt MHz 4,53	Delta V 30,0	for DV max 3,02	
max in-spill beam inf 2.5-3 x10⁶ ions (limited by δ-electr keeping HV dro	/ s rons in MDC I, op < 20V)	max (MHz) Ag	constrair deltas deltas	max. Intensity nt MHz 4,53 6,79	Delta V 30,0 12,0	for DV max 3,02 6,79	
max in-spill beam inf 2.5-3 x10⁶ ions (limited by δ-electr keeping HV dro compare to propos	/ s rons in MDC I, op < 20V) sol:	max (MHz) Ag	constrair deltas deltas occ	max. Intensity nt MHz 4,53 6,79 5,25	Delta V 30,0 12,0 22,8	for DV max 3,02 6,79 4,62	-
max in-spill beam inf 2.5-3 x10⁶ ions (limited by δ-electr keeping HV dro	/ s rons in MDC I, op < 20V) sol:	max (MHz) Ag ane	constrair deltas deltas occ occ	max. Intensity nt MHz 4,53 6,79 5,25 13,13	Delta V 30,0 12,0 22,8	for DV max 3,02 6,79 4,62 11,55	

1) Exchange serial resistor in HV filter of MDC I from 1 + 1 M $\Omega \rightarrow$ 0.2 + 1 M $\Omega = ->$ 4.5 x10° ions / s

2) Increase load benchmark of MDC I : 1 \rightarrow 1.5x Apr12

(limited by MDC III HV drop)

MDCII4 wire inspection cathode Al wire (80 µm), opt. microscope



ADES

InG