HADES MDC

MDC System Status & Beamtime Preparation

19th February 2018

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HADES mDC

Outline

- SIS18: Hardware & Performance status (this talk)
- SIS100:
  - Performance estimation → talk on Friday (C. Müntz)
  - FEE upgrade → 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_2O (3000 ppm)** **Malter currents in I3 & I5** → H2O recovers stability I3 frequent sparks stay, more conditioning needed?	**Ar/CO_2 70/30** **+ H_2O (3000 ppm)** Malter-currents persistent → **H_2O recovers stability** → 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_2O (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:
  - all MDC operating with Ar/CO_2
  - MDC II: H_2O additive allows for stable operation / recovers stability
    - H_2O also approved for MDC I & IV

- 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
    → tested, running since 7.2.2018 with Ar/CO_2 70/30

Gas mixture
decision needed

Open decisions :

- Does reduction of CO_2 improves data quality ?

  (reducing disadvantages in fast drift gas)

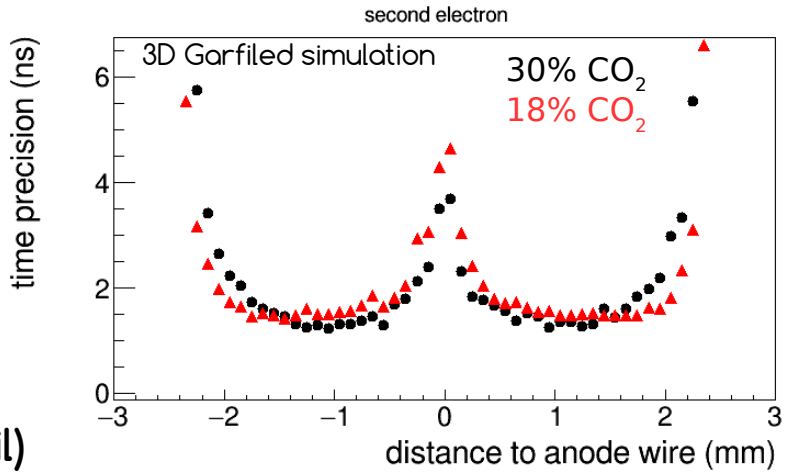
  → simulations running

  → which priority within HADES?

  A) data quality

  B) load / beam intensity

  → **decision on gas mixture needed (deadline April)**

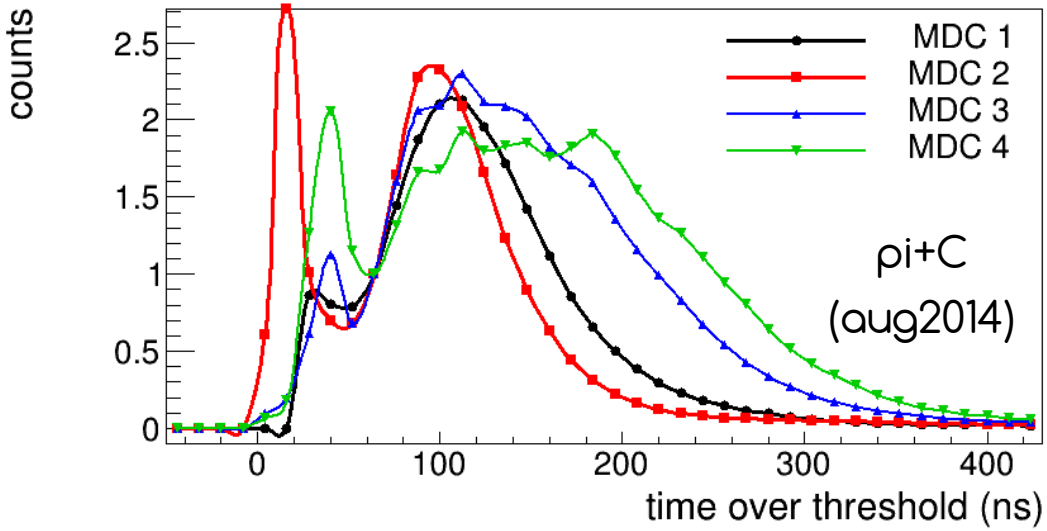


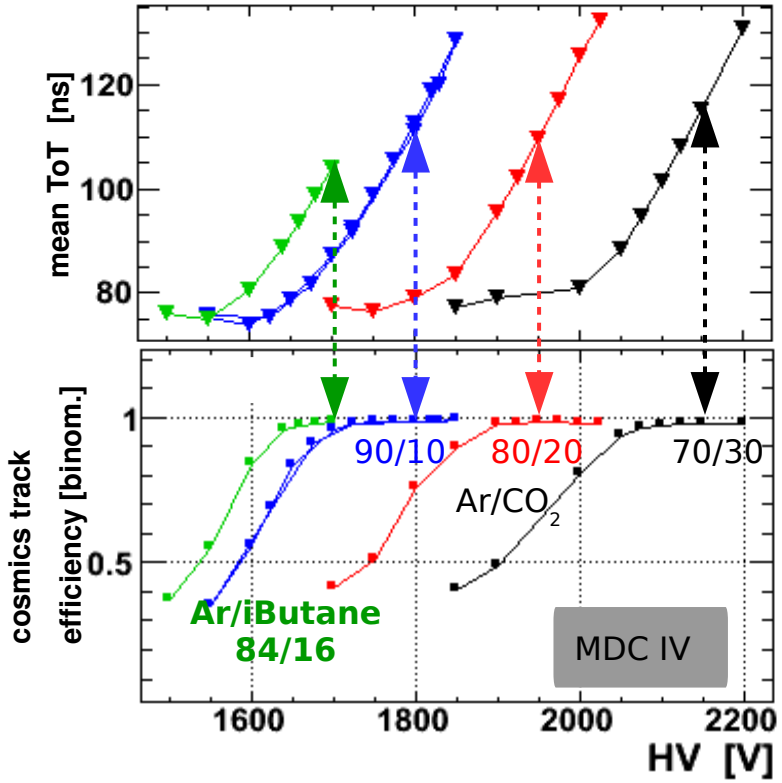
- working points to be determined !

  → **which priority for tracking?**

  A) **conservative** (low HV) → low thresholds

  B) high gain → **robust thresholds**

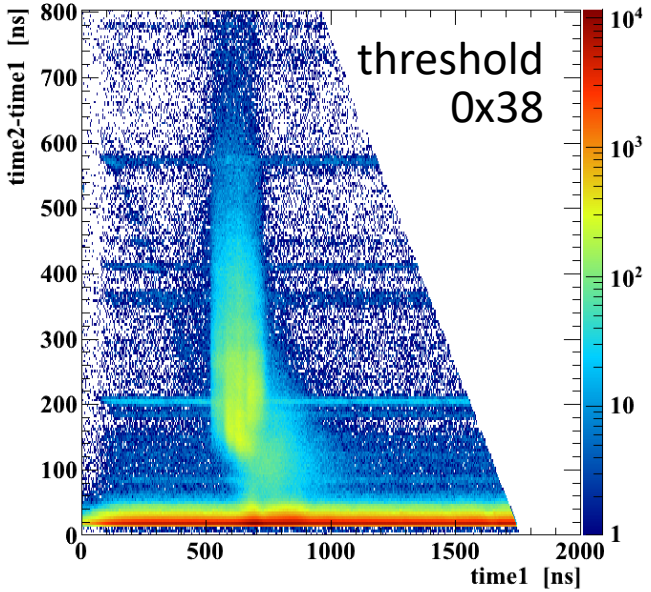


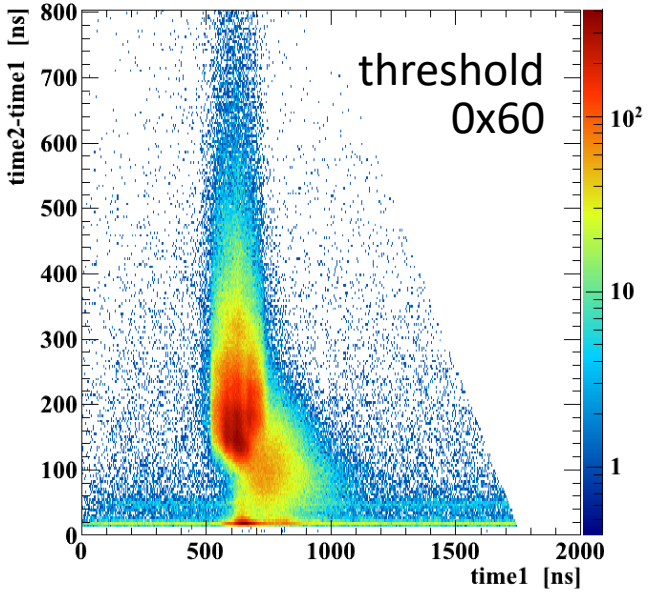


Front-End Electronics (FEE)

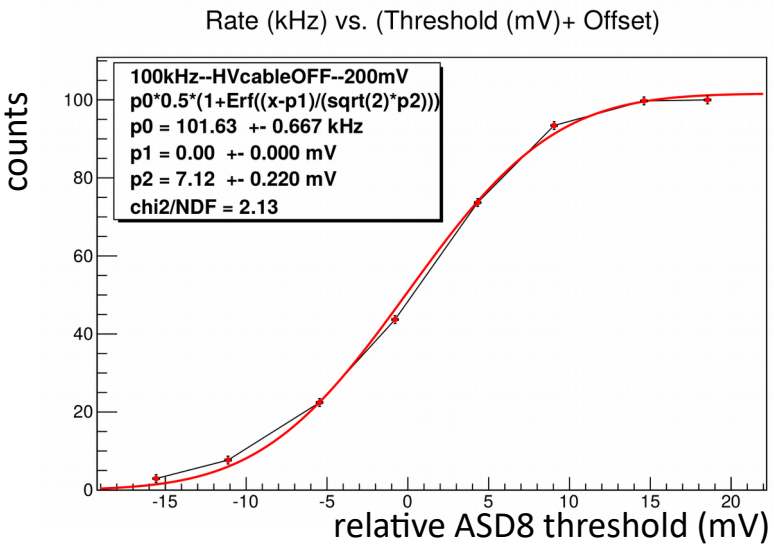
preparation for high occupancy

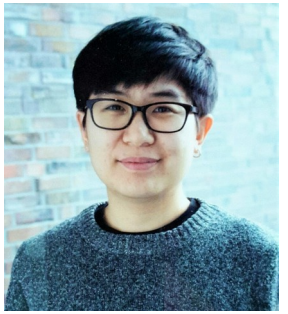
- thresholds adjustment needs revisit

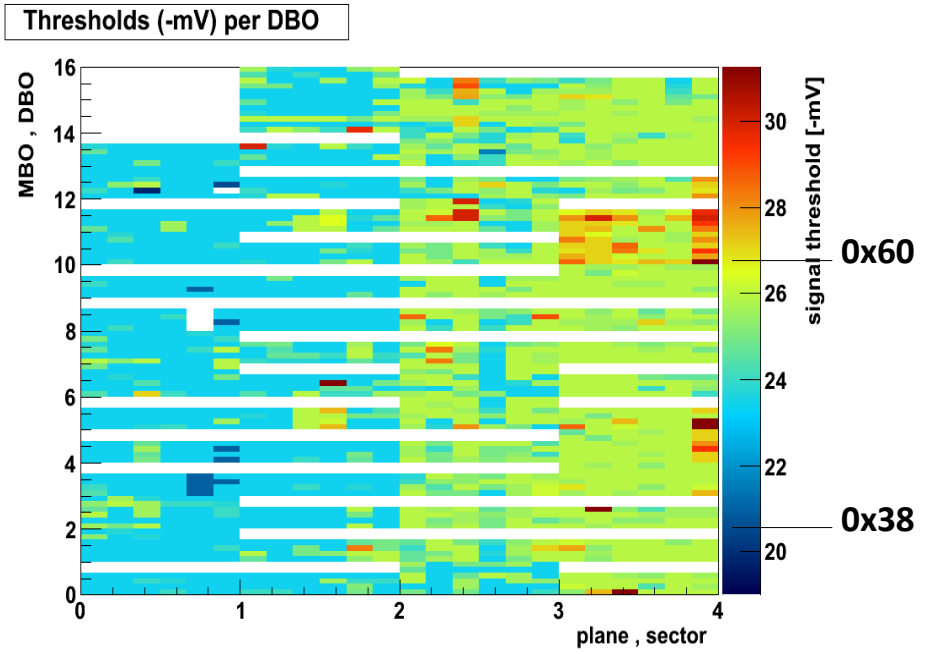




- new threshold optimization (Bachelor thesis Yefei Tang)







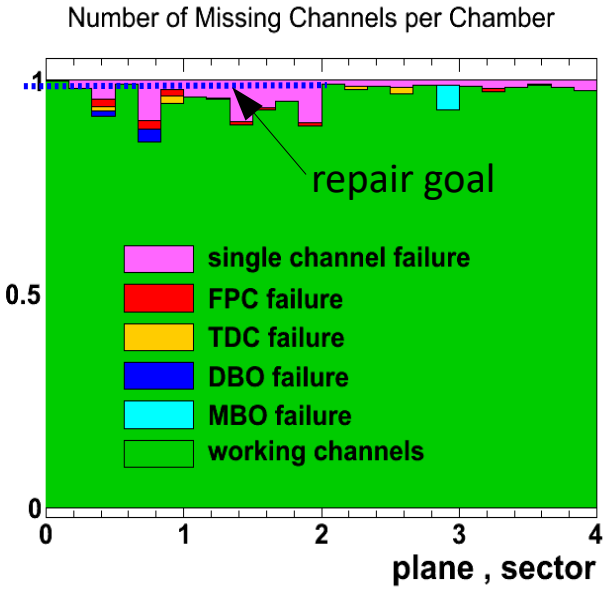
FEE
status Feb 2018

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

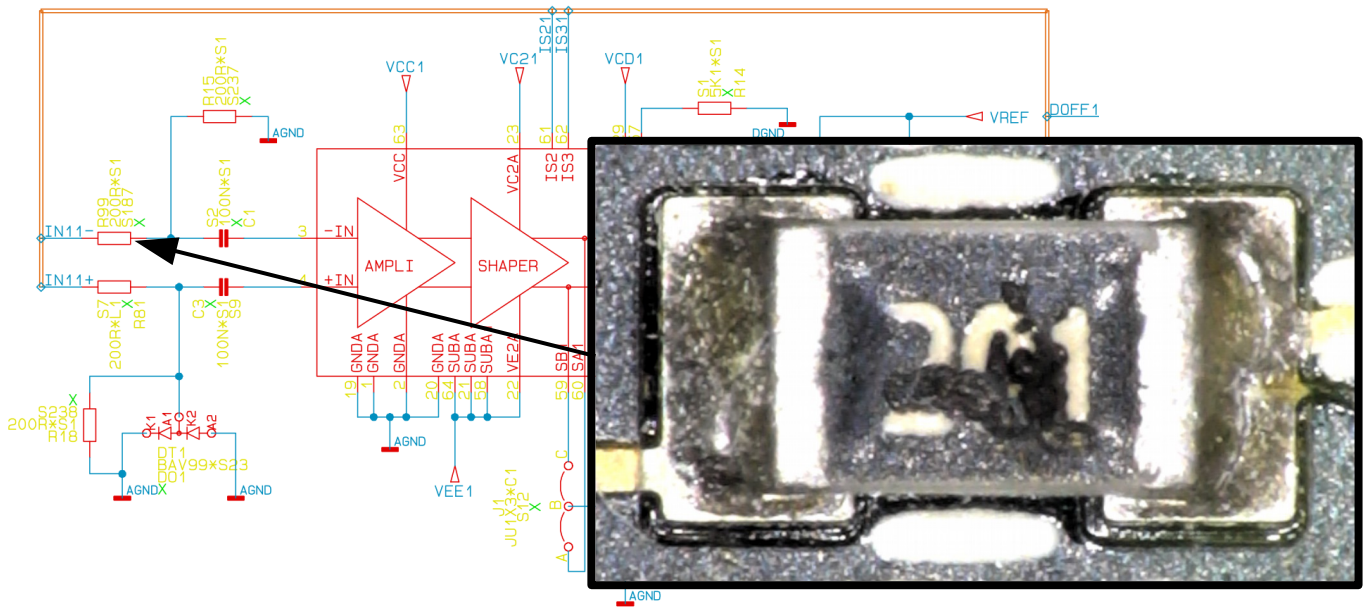
repair goal: < 1 % missing channels

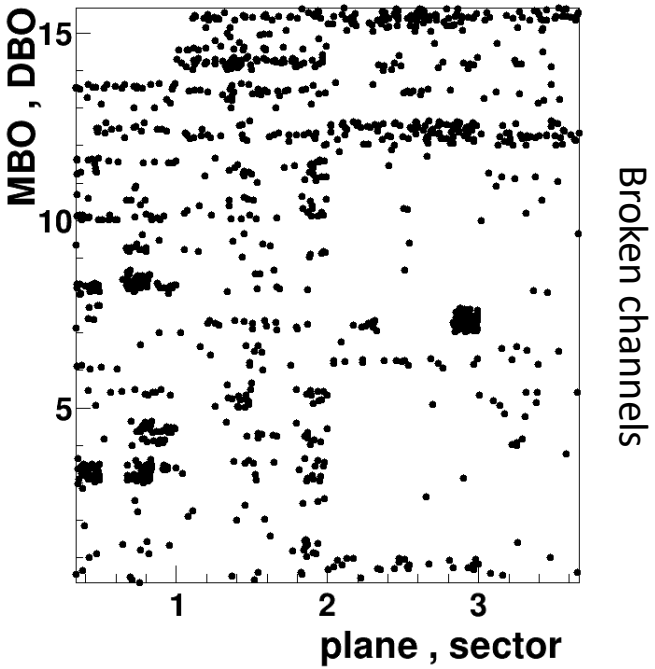
- Status:
  - MDC II 75 % broken channels repaired: (only DBO with number of broken channels > 1)
    127 DBOs repaired, each 16 resistors = 2032 exchanged resistors !
    (Thanks to Students of GSI Electronics)
  - MDC I repair ongoing (goal 85 % repaired) (only DBO with number of broken channels >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

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



FEE input circuit

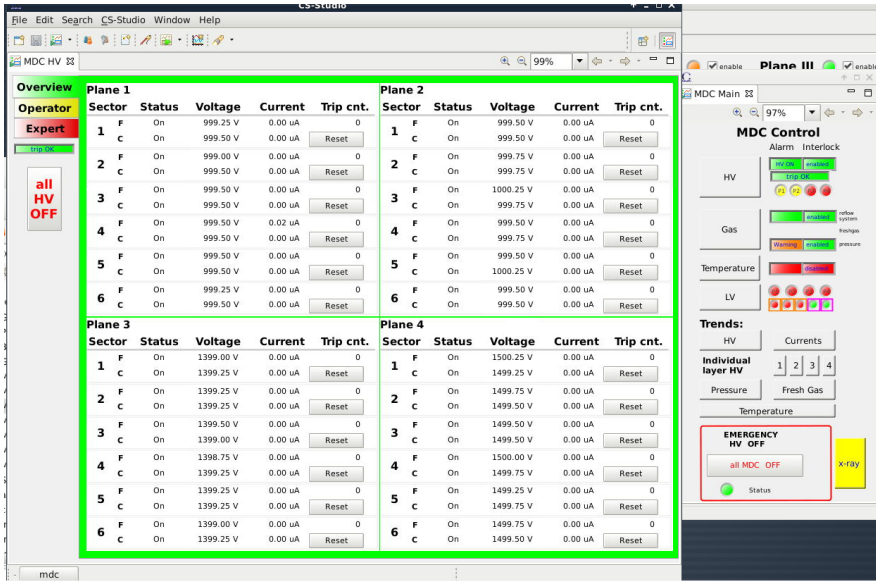




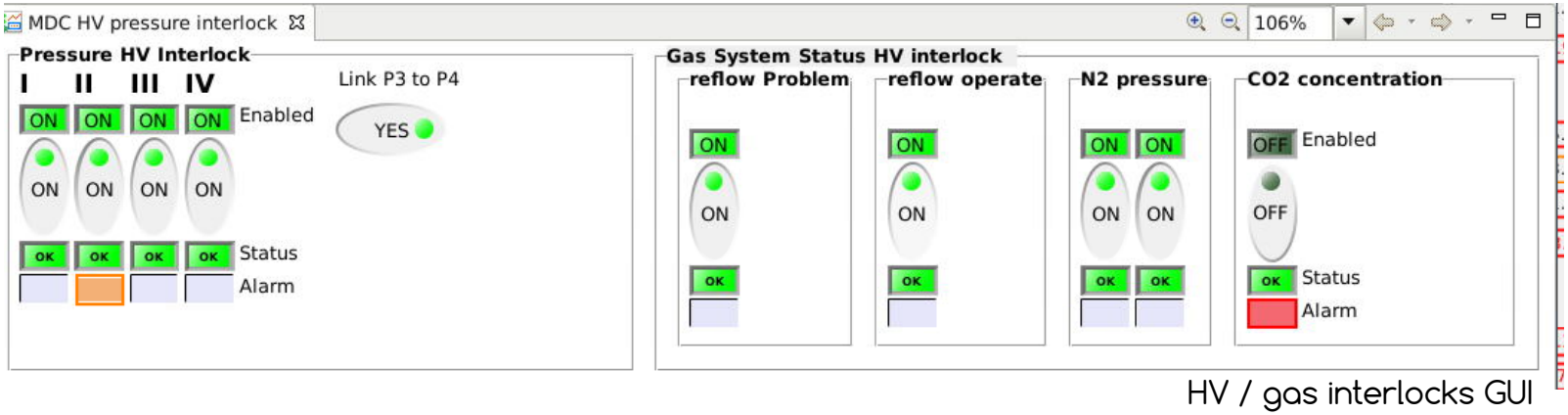
Status summary

Feb. 2018

- Done tasks
  - FEE repair ongoing (55 % finished)
  - gas reflow system changed to CO_2, removed iso-butane permanently
    → tested, running since 7.2.2018
  - open system & H_2O additive prepared
  - 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)



HV controls GUI



HV / gas interlocks GUI

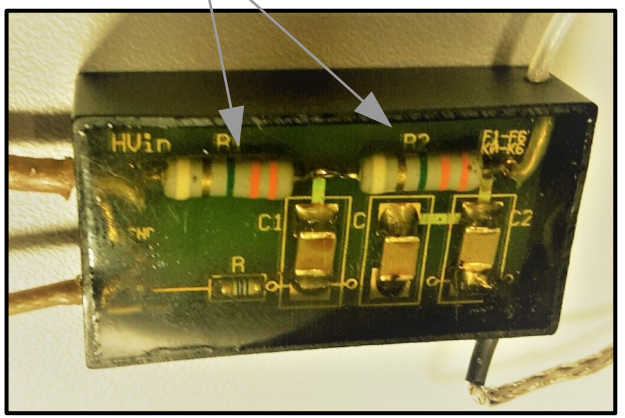
Beam Intensities

Ag+Ag @ 1.65 AGeV (Aug18)

MDC I	MDC II	MDC III	MDC IV
Ar/CO_2 70/30 + H_2O (3000 ppm)	Ar/CO_2 70/30 + H_2O (3000 ppm)	Ar/CO_2 70/30 ... 90/10	Ar/CO_2 70/30 ... 80/20
1x Apr12 load	1.5 x Apr12 load	2x Apr12 load	5x Apr12 load

heavy ion workload on MDC:

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



Result for Aug18, max in-spill beam intensity:

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

Possible improvements:

- Exchange serial resistor in HV filter of MDC I from 1 + 1 MΩ → 0.2 + 1 MΩ
- for > 4.5×10^6 → Increase load benchmark of MDC I : 1 → 1.5x Apr12

Conclusion

ToDo

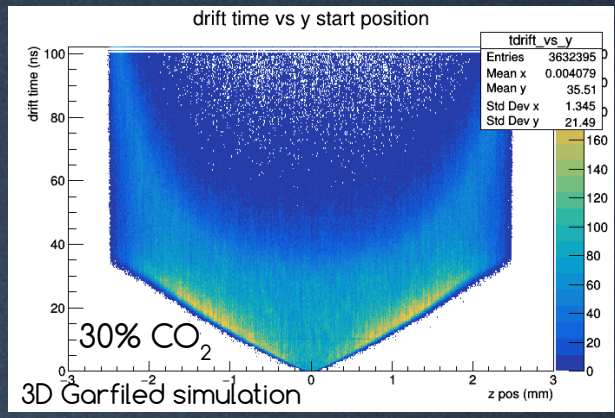
FEE tasks:

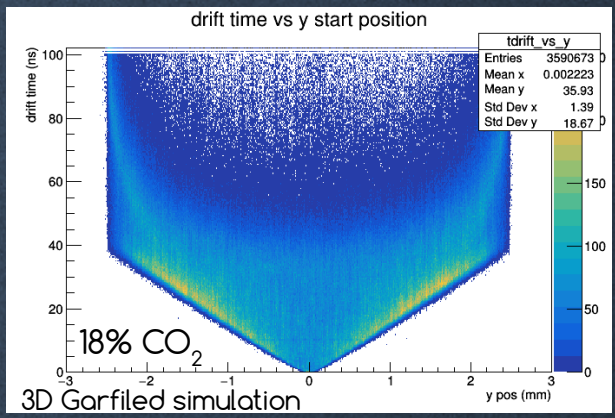
- full system test → running DAQ needed soon
- adjust power voltages
- define robust thresholds for high occupancy
  (max. efficiency / low noise, robustness?)

Decisions to take:

- **counting gas mixture** (optimize CO_2 fraction)
  → which priority within HADES (data quality vs. stability) ?
- MDC I - **HV filter modification** for higher intensities?

  <u>decision needed now!</u>
- MDC I - benchmark to higher load with x-ray requested?

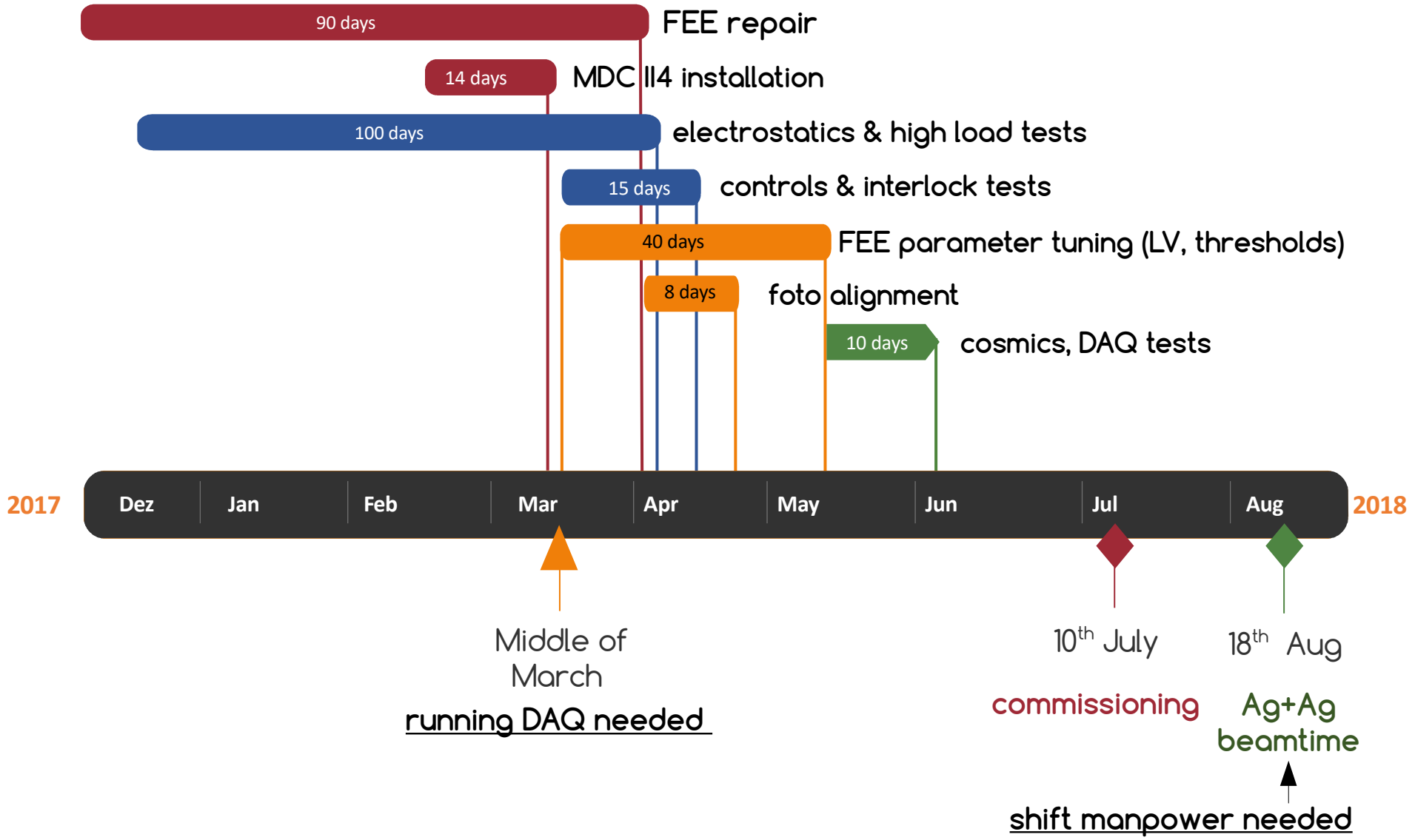




HV filter: resistors 2x 1.1 MOhm

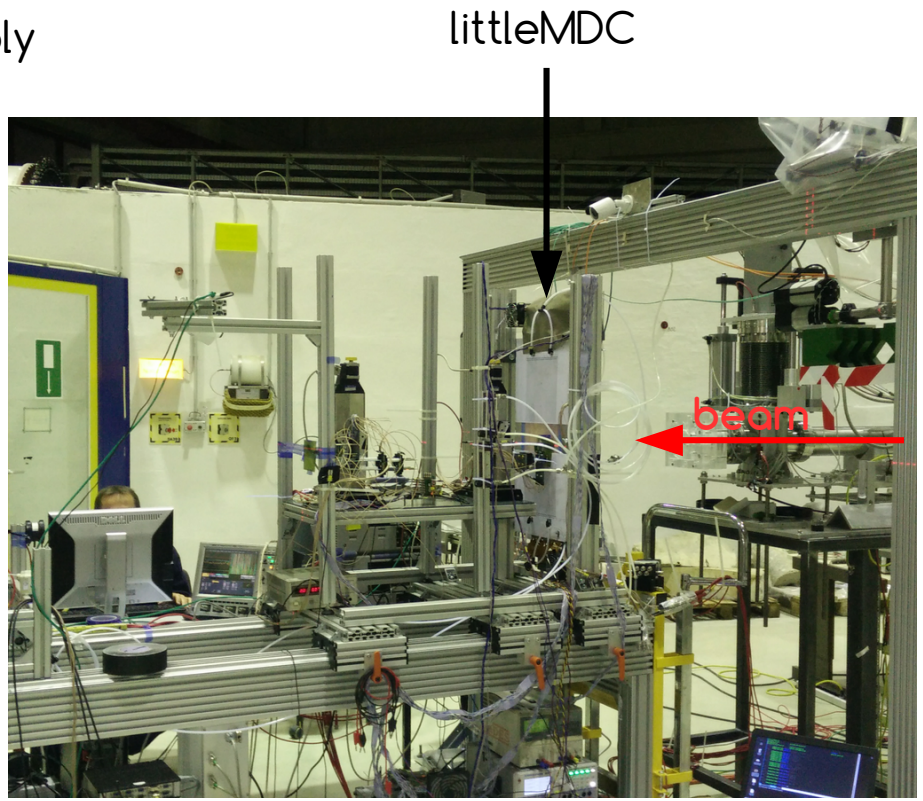
Summary

preparation schedule



Summary
additional projects

- **littleMDC** by Luis Lopes
  - steep learning curve in drift chamber assembly
  - stable operation in COSY proton beam



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

- 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

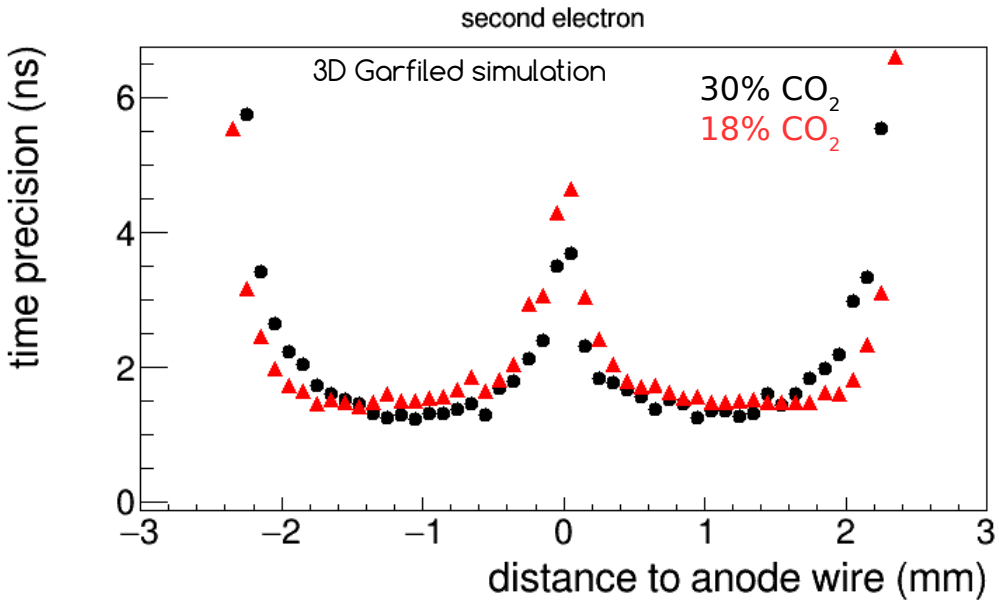
  → talk by M. Wiebusch

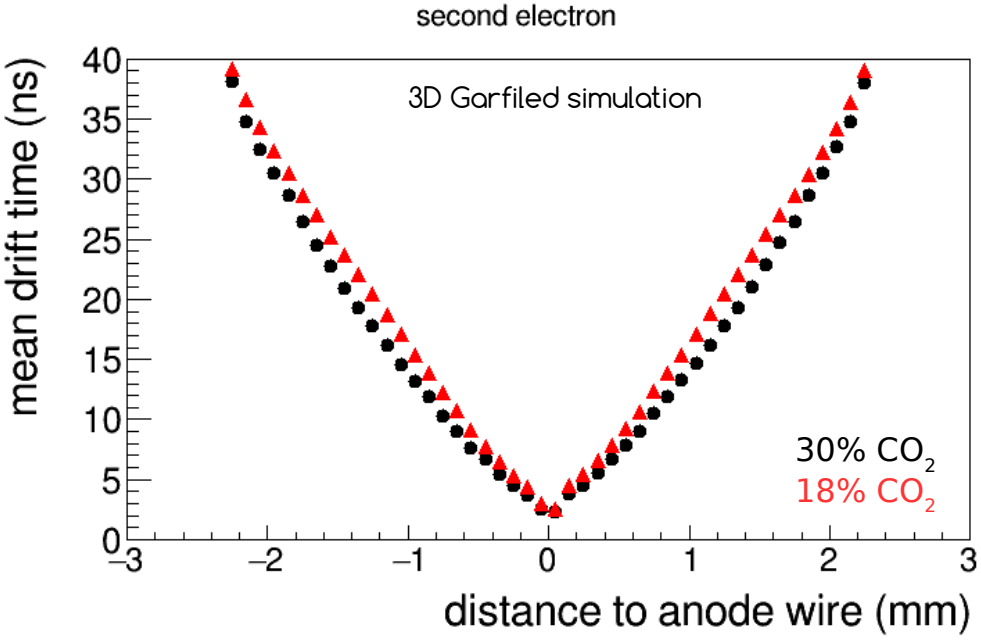
Backup

Gas mixture decision needed

Open decisions :

- Does **reduction of CO_2** improves data quality / spatial resolution ?
  → simulations running
  → which priority within HADES?
  A) data quality
  B) load / beam intensity
- → decision on gas mixture needed (deadline April)

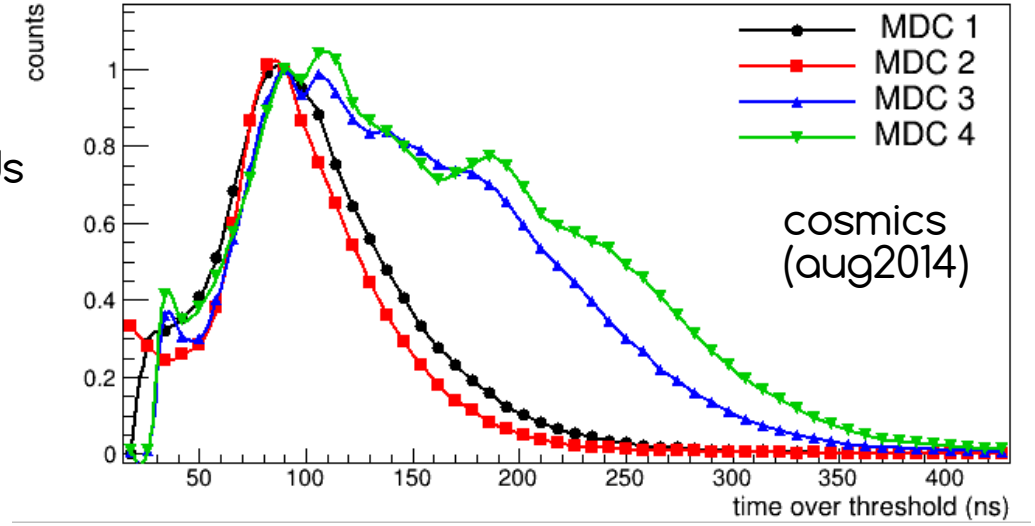




Gas mixture
decision needed

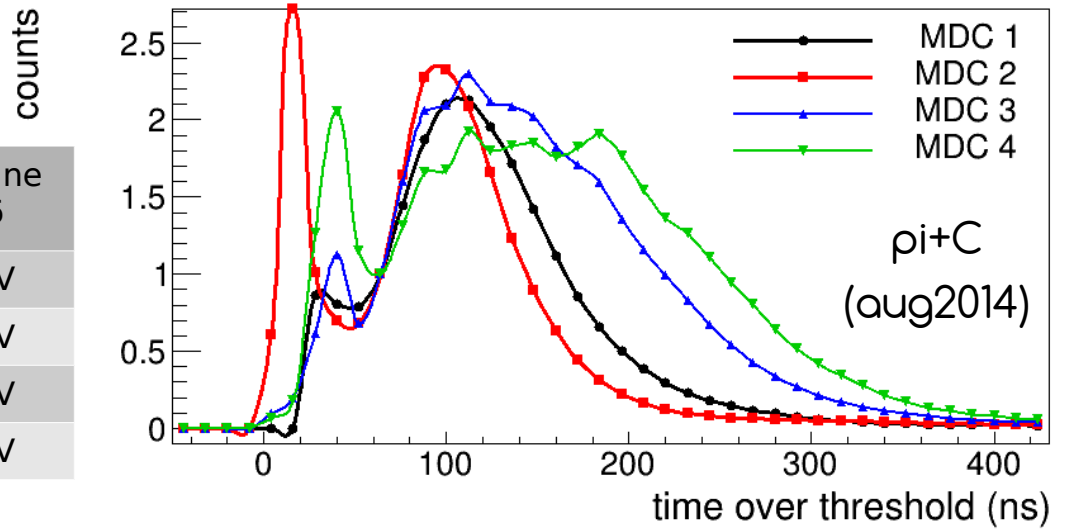
Open decisions :

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



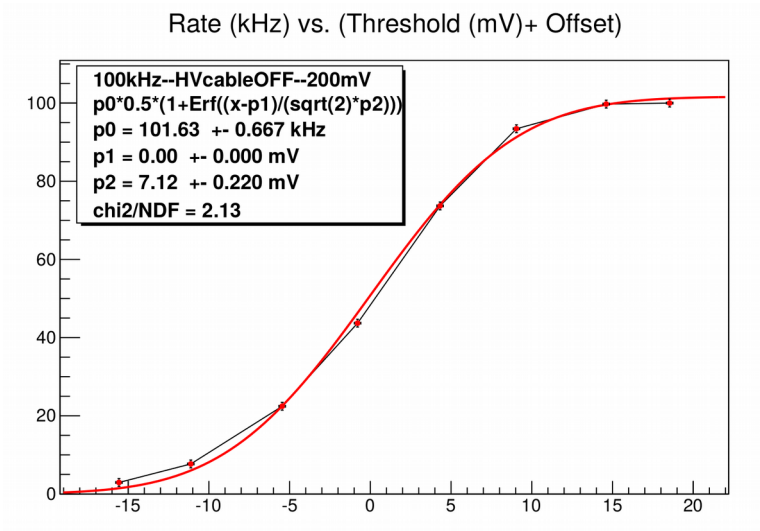
MDC working points

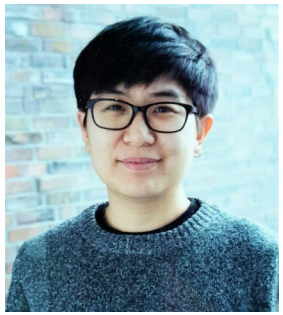
plane	Ar/CO_2 70/30	Ar/CO_2 80/20	Ar/CO_2 90/10	Ar/iButane 84/16
I	1750 V	-	-	1300 V
II	1770 V	-	-	1375 V
III	1900 V	1700 V	1600 V	1500 V
IV	2150 V	1950 V	1800 V	1700 V

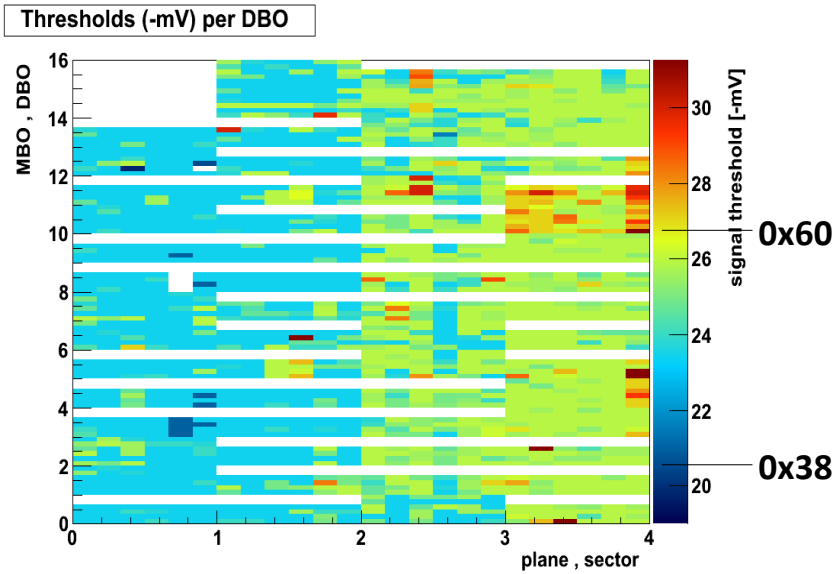


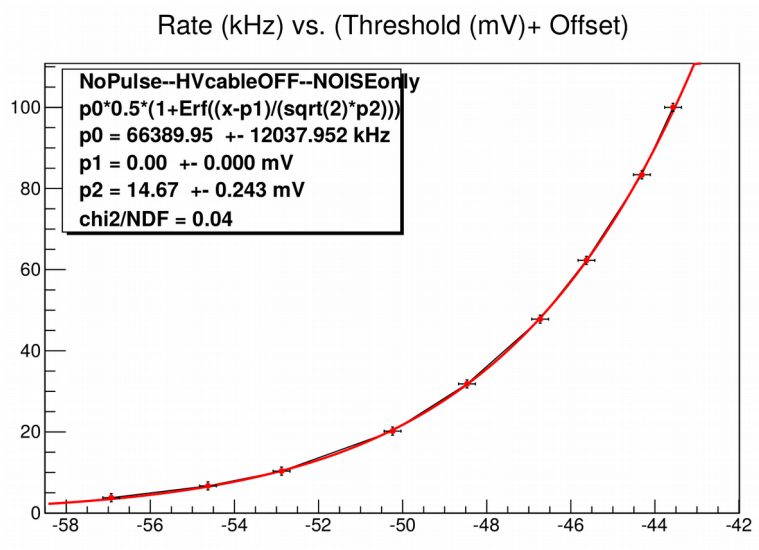
FEE optimization

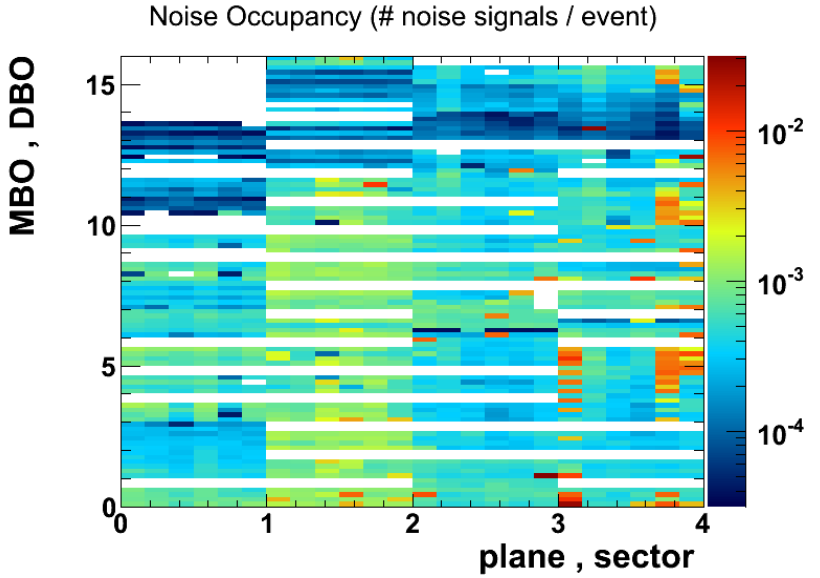
- new optimization of thresholds (Bachelor thesis Yefei Tang)



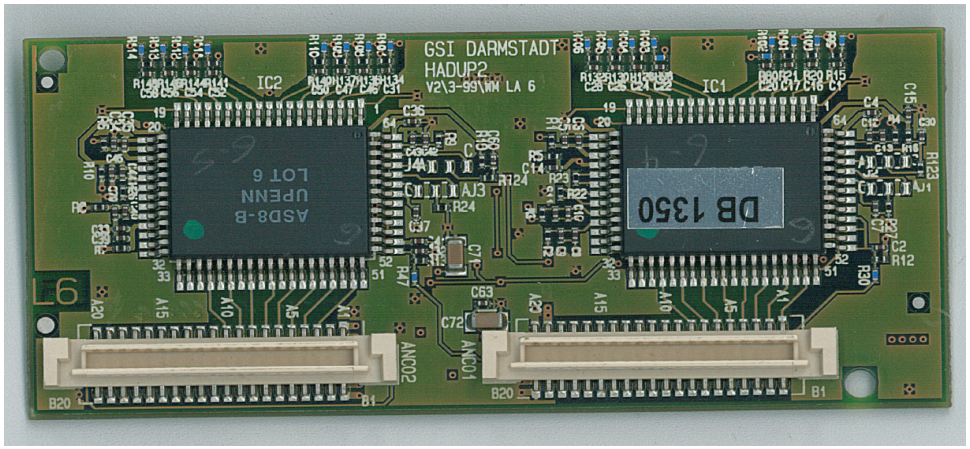


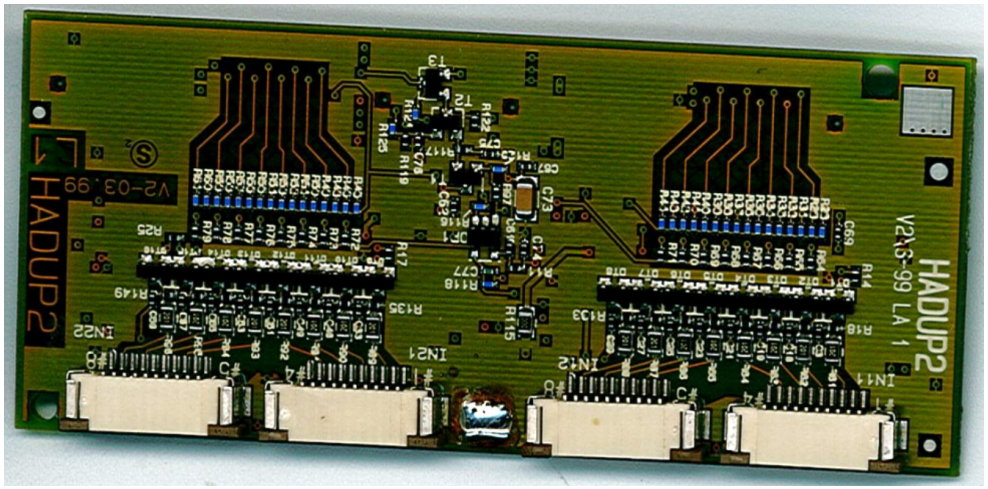


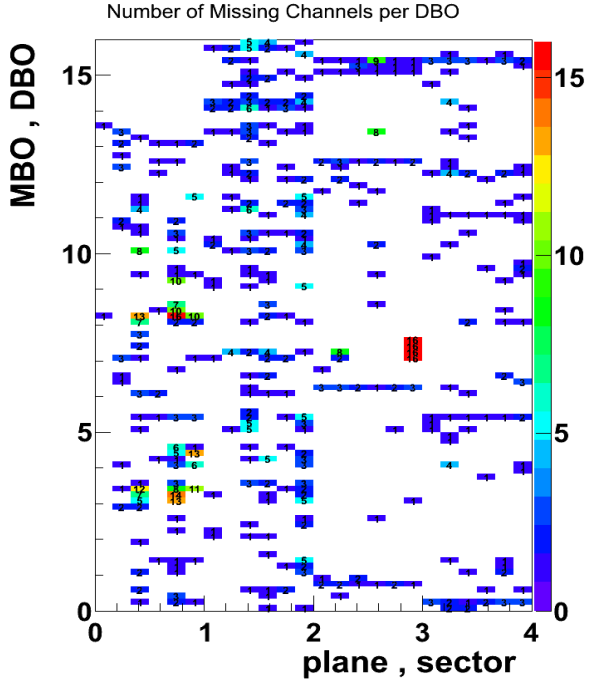


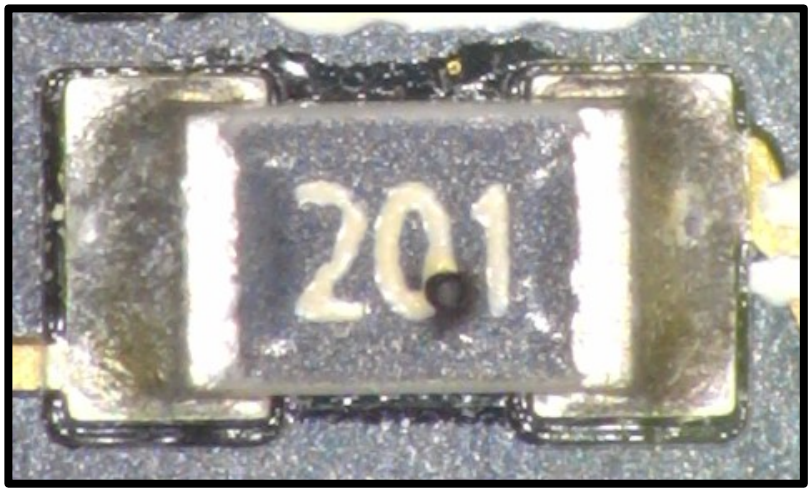


FEE
broken channels









Beam Intensities
Ag+Ag @ 1.65 AGeV (Aug18)

MDC I	MDC II	MDC III	MDC IV
Ar/CO_2 70/30 + H_2O (3000 ppm)	Ar/CO_2 70/30 + H_2O (3000 ppm)	Ar/CO_2 70/30 ... 90/10	Ar/CO_2 70/30 ... 80/20
1x Apr12 load	1.5 x Apr12 load	2x Apr12 load	5x Apr12 load

Heavy Ion mode: load in MDC I, II driven by δ-electrons (~ rate · (1-ρ) · Z^2)
load in MDC III, IV driven by occupancy (~ rate · ρ · A)

HV in-spill **voltage drops** (due to HV filter resistors)

Result for Aug18:
max in-spill beam intensity:

2.5-3 x10^6 ions / s

(limited by δ-electrons in MDC I, keeping HV drop < 20V)

compare to proposal:
1.5 x10^6 ions / s (10 kHz DAQ)

Particle load estimation (based on apr12):

r_max (MHz) Ag		max. Intensity	@max Int.	max. int. (MHz)
plane	constraint	MHz	Delta V	for DV max
I	deltas	4,53	30,0	3,02
II	deltas	6,79	12,0	6,79
III	occ	5,25	22,8	4,62
IV	occ	13,13	22,8	11,55
max beam int.	**MHz**	**4,53**		**3,02**
max DAQ rate	kHz	29,88		19,92

Possible improvements:

1) Exchange serial resistor in HV filter of MDC I from 1 + 1 MΩ → 0.2 + 1 MΩ --> **4.5 x10^6 ions / s**
(limited by MDC III HV drop)

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

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