A Large Ion Collider Experiment

HV STATUS AND X-RAY TEST

24.6.2020

Robert Münzer

PROPOSAL FOR FURTHER SCHEDULE

- Continue x-ray tests at least till Monday morning
- Readout tests in IROC C02 to confirm that one segment is involved
- Continue with insertion test and TPC lifting as planed
- Re-discussion of further irradiation schedule (Re-discuss in 2 weeks)
  - Use time for cooldown
  - Consolidate the operational point
  - Check trip current pattern
  - Think what could be learned from furhter illumination

- Option: Continue RnD in cleanroom with spare IROC in cleanroom after TPC has left the building.

- Vacation constraints:
  - Robert (10.8.-23.08)
  - Christian (5.8-19.8)

X-RAY TESTS

- Continue with X-Ray test of TPC
- X-ray test pointing to A-Side more test
  - 10.6. 17:00-23:00 6h
  - 12/13.6 17:00-6:20 13h 42min
  - 13/14.6 12:00-19:20 31h 20min
  - 15/16.6 18:30-6:00 11h 03min (~30 min break)
  - 16.6/17.6 17:35-6:20 12h 05min
  - 17.6 18:30-20.33 2h 13min (stopped by interlock of door (guard))
  - 18.6/19.6 16:51-6:00 11h 31min
  - 19.6/21.6 17:00-00:05 31h 04min
  - 21.6/22.6 11:42-6:11 18h 29min
- X-ray test pointing to C-Side more test
  - 22.6/23.6 17:12-7:01 13h 49min
  - 23.6/24.6 18:30-7:15 12h 45 min
- Total irradiation with x-rays
  - Pointing to A-Side: 10h (before shutdown) – 137h 28min (after shutdown)
  - Pointing to C-Side: 10h (before shutdown) – 26h 34min (after shutdown)
  - Continue irradiation till Monday morning: >60h extra hours possible

CURRENT ISSUES

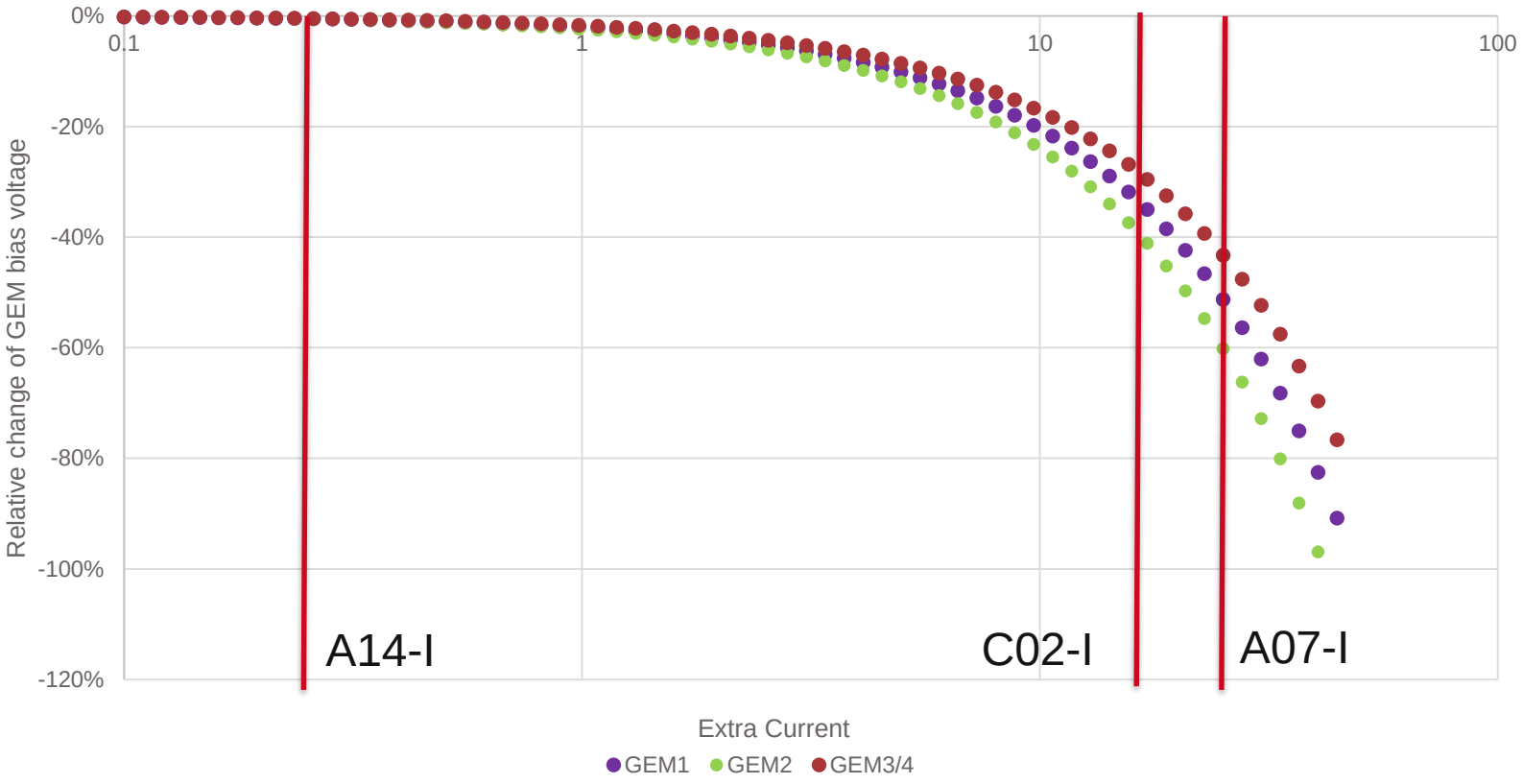
- A07-I :
  - Started within first 10 hours of x-ray irradiation on A-Side
  - High current in GEM2(36 uA / 230 V) after trip.
  - No significant improvement within the last
  - Impact: dead segment

- A14-I:
  - Started within first 10 hours of x-ray irradiation on A-Side (after lockdown)
  - Current in GEM2 increase after rampup after trip (1.5 uA/230 V)
  - Recovered partially during further x-ray irradation (0.6 uA/230 V)
  - Impact: segement with reduced gain (-9%)

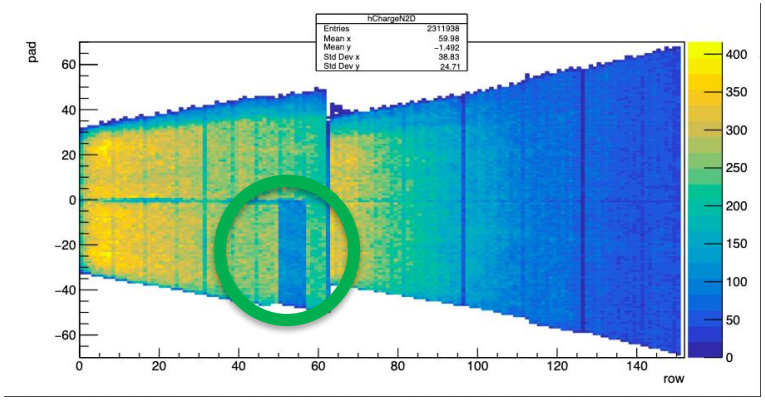
- C02-I:
  - Started after 120h irradiation on A-Side (Load ~ 10x lower on C-Side)
  - High current in GEM2(27 uA / 230 V) after trip.
  - Impact: dead segment

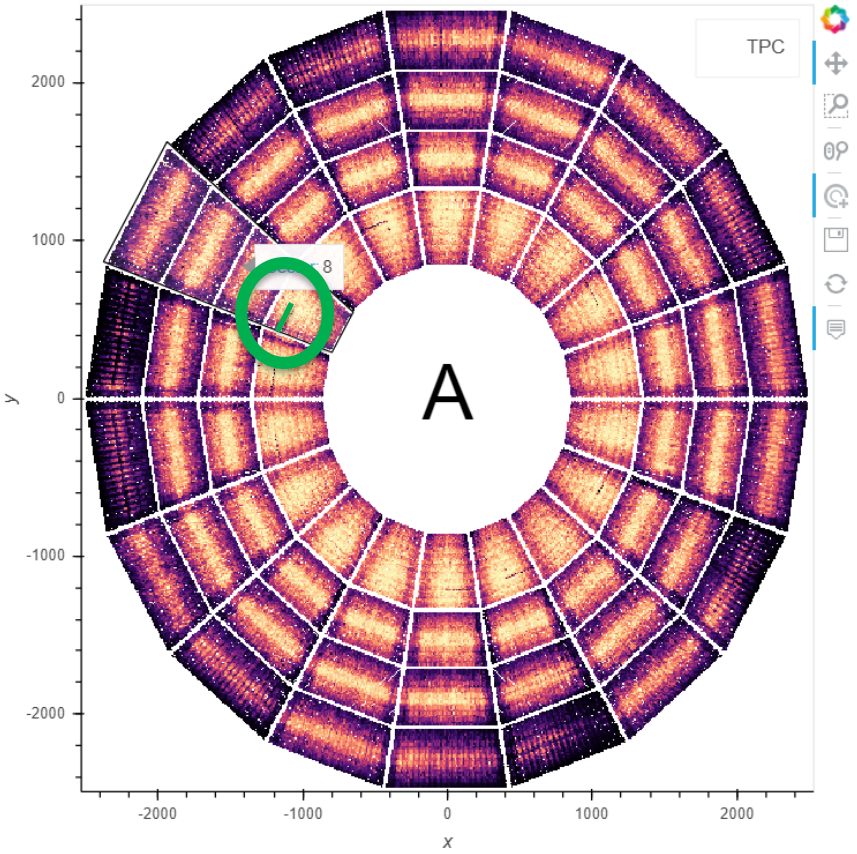
IMPACT OF EXTRA CURRENT

Relative change of effective voltage accross GEM in segment with short



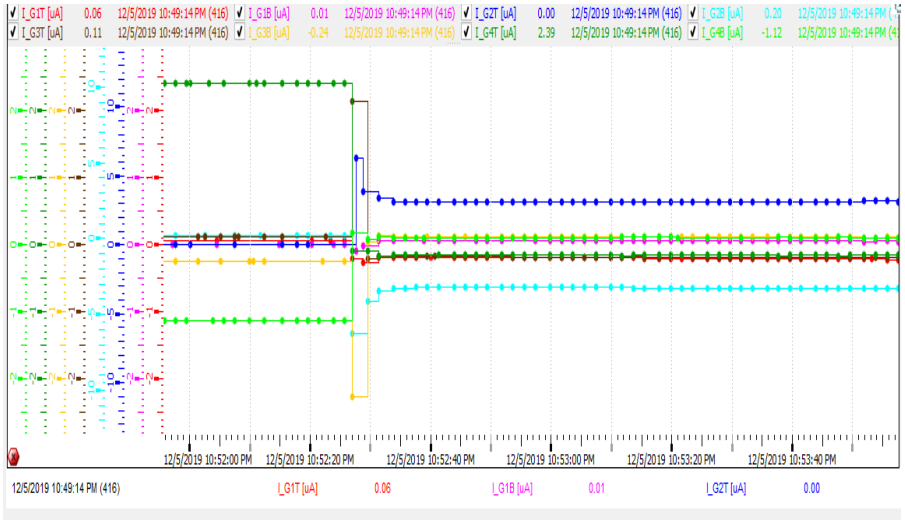
DEAD SEGMENT

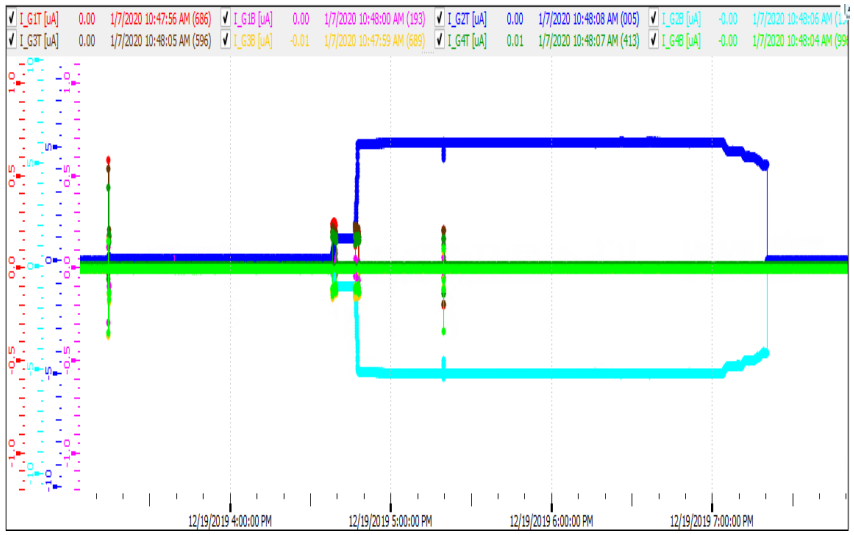




WHAT HAPPEND TO A02 / A17

A02



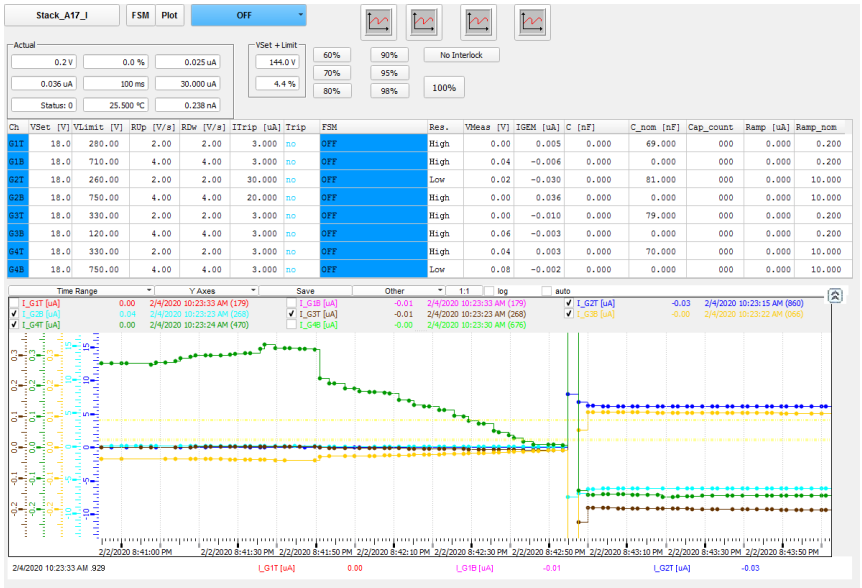


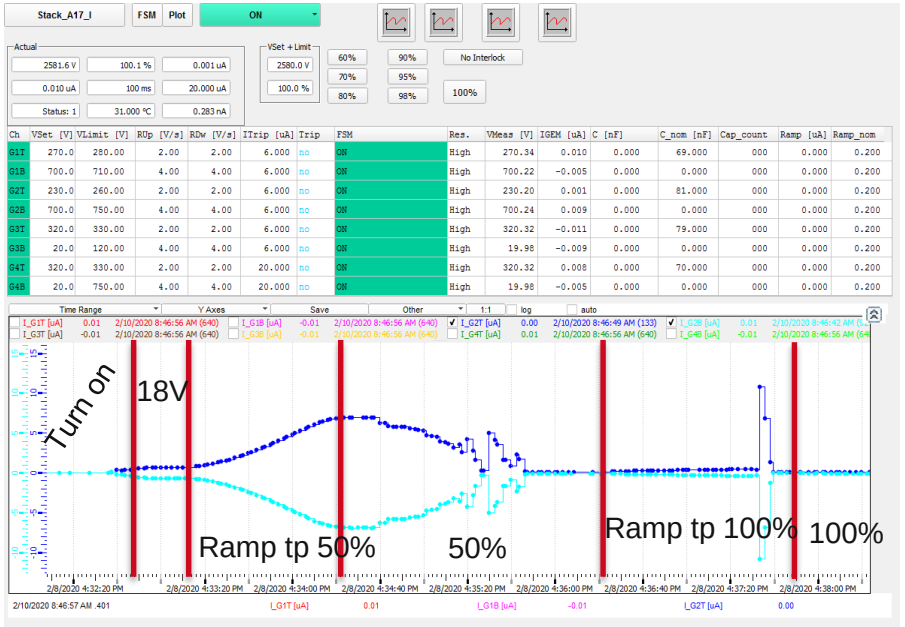
Happend after few hours of irradiation of A-Side
Current ~10uA@230V
No correlatation with external source spotted.

Sudden recovery after 2 weeks

WHAT HAPPEND TO A02 / A17

A17





Happend after trip of FC ramped to 0V.
Irradiation of C-Side
Current ~20uA@ 230V
No proof of correlation.

Recovered during first ramp up with air

TRIPS

X-RAY A-SIDE

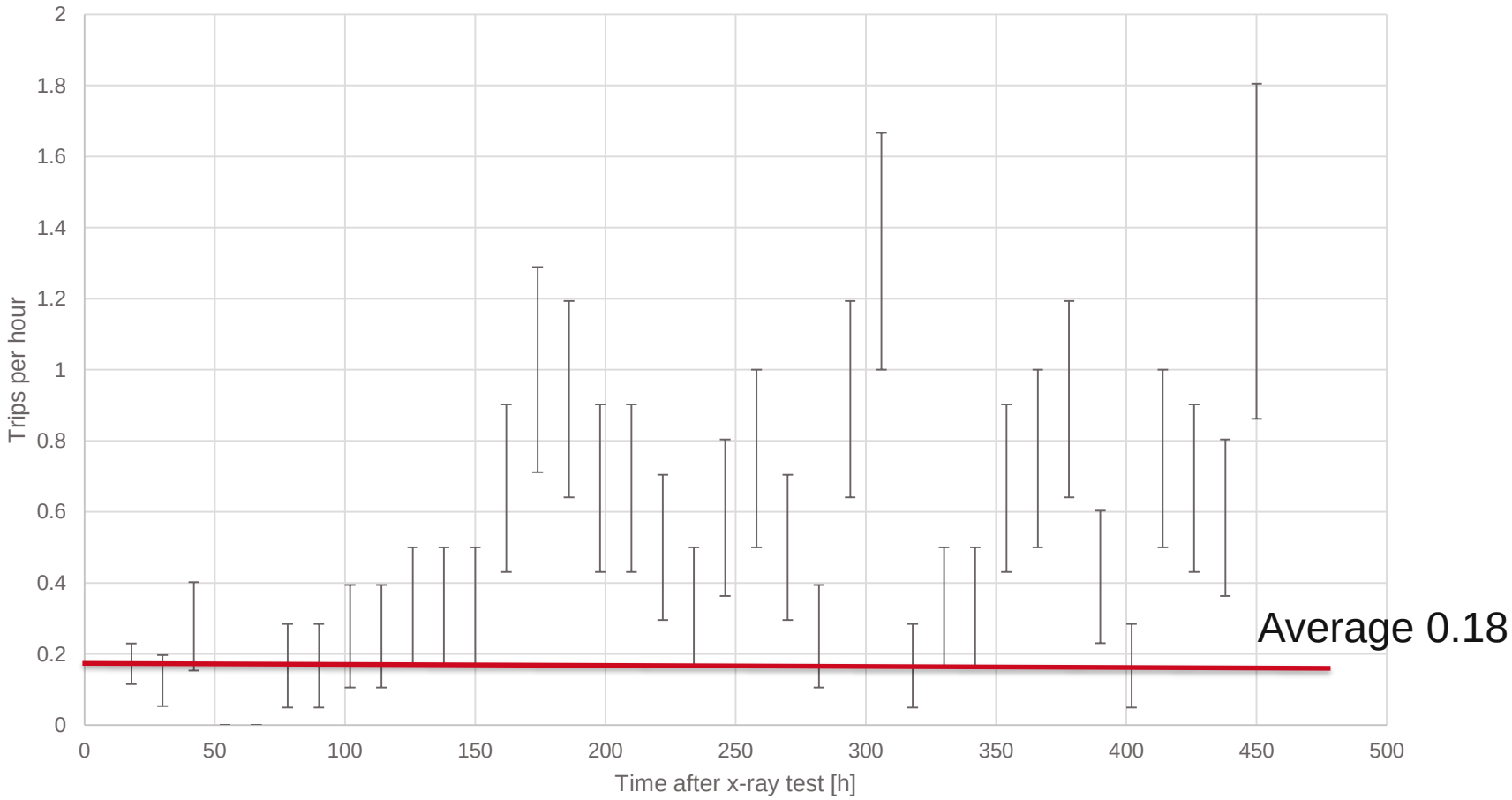
Test	Running time	Cooldown	Trip Rate A-Side	Trip Rate C-Side
1.	3 h	> 3 month	16 (5.3 /h)	3 (1 /h)
2.	6.5 h	2 week	11 (1.69 /h)	5 (0.75 /h)
3.	13h 43min	2 days	7 (0.5 /h)	8 (0.58 /h)
4.	31h 20min	5h 30min	4 (0.12 /h)	8 (0.25 /h)
5.	11h 03min	23h 10min	4 (0.36 /h)	4 (0.36 /h)
6.	12h 05min	11h 35min	2 (0.16 /h)	3 (0.25 /h)
7.	2h 13min	12h	1 (0.5 /h)	0 (0 /h)
8	11h 31min	20h 28min	0 (0 /h)	2 (0.17 /h)
9	31h 04min	11h	5 (0.16 /h)	4 (0.12/h)
10	18h 29min	11h 38min	5 (0.27 /h)	2 (0.10 /h)
Sum	130h 58min		55 (0.41 /h)	39 (0.30 /h)

X-RAY C-SIDE

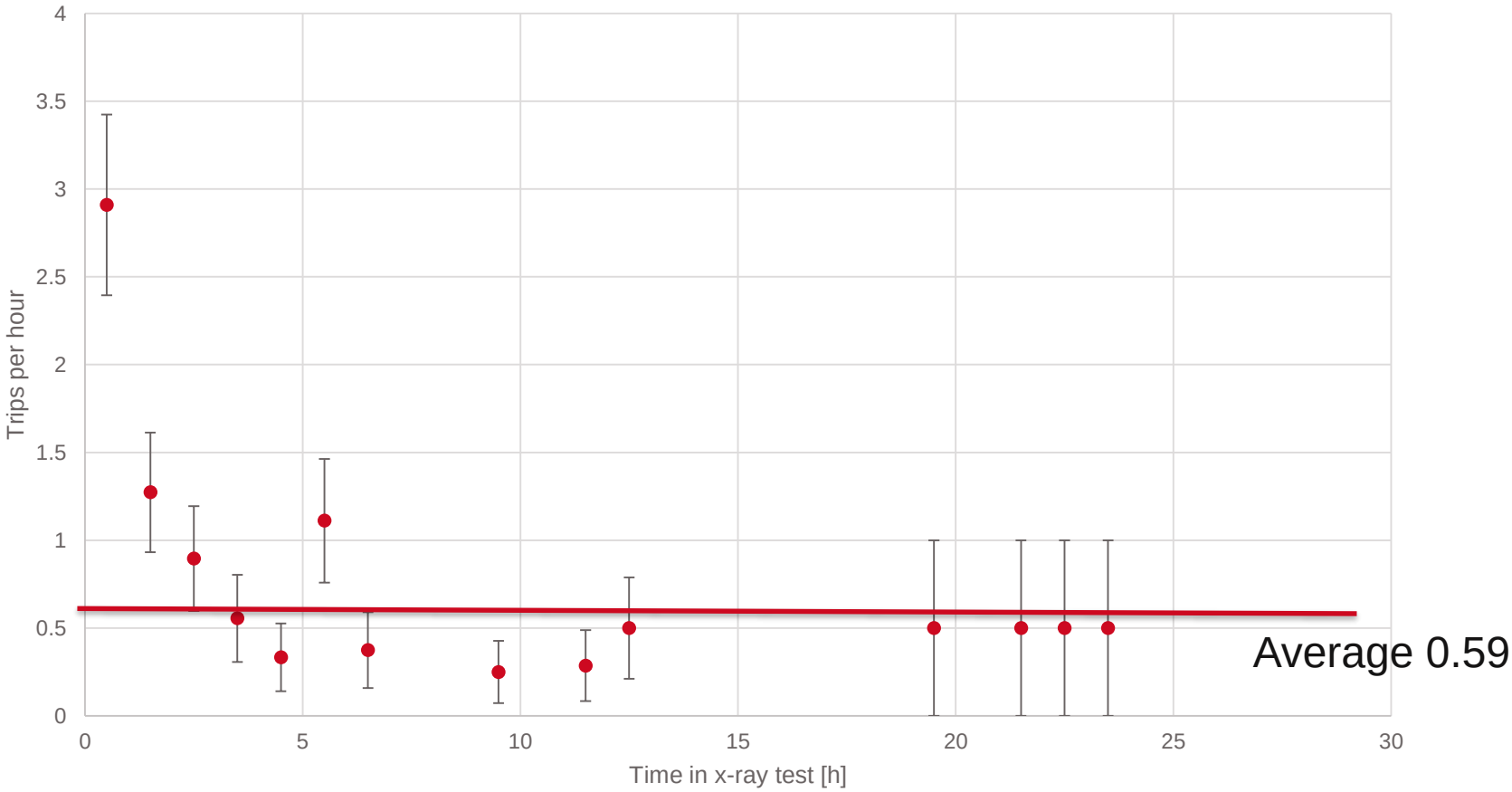
Test	Running time	Cooldown	Trip Rate A-Side	Trip Rate C-Side
1.	13 h 49 min	8h 55min	0 (0 /h)	3 (0.2 /h)
2.	12h 45min	11h 30min	1 (0.07 h)	3 (0.23 /h)
Sum	26h 34min		1 (0.04 /h)	6 (0.25 /h)

TRIP DISTRIBUTION

Without load



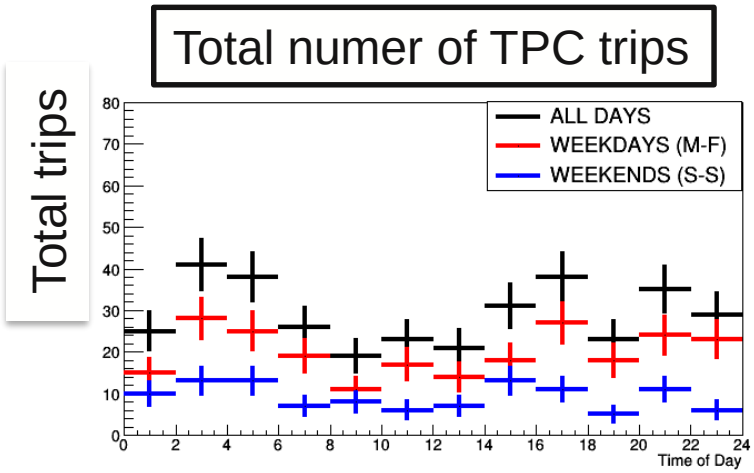
TRIP DISTRIBUTION

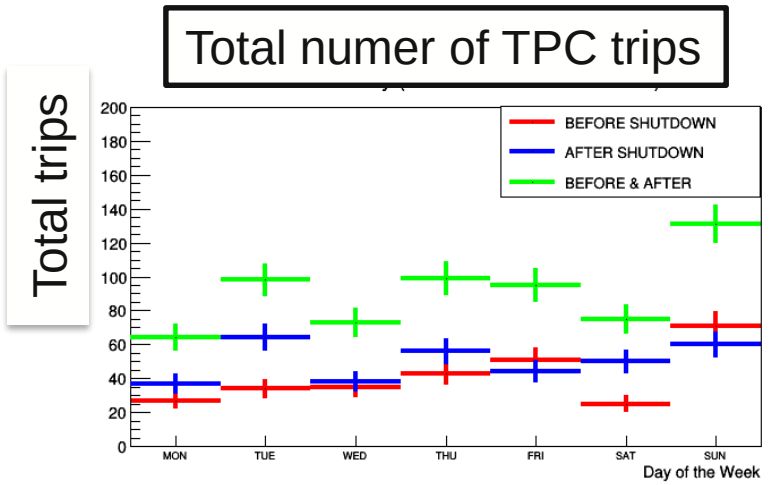


TRIP FREQUENCY

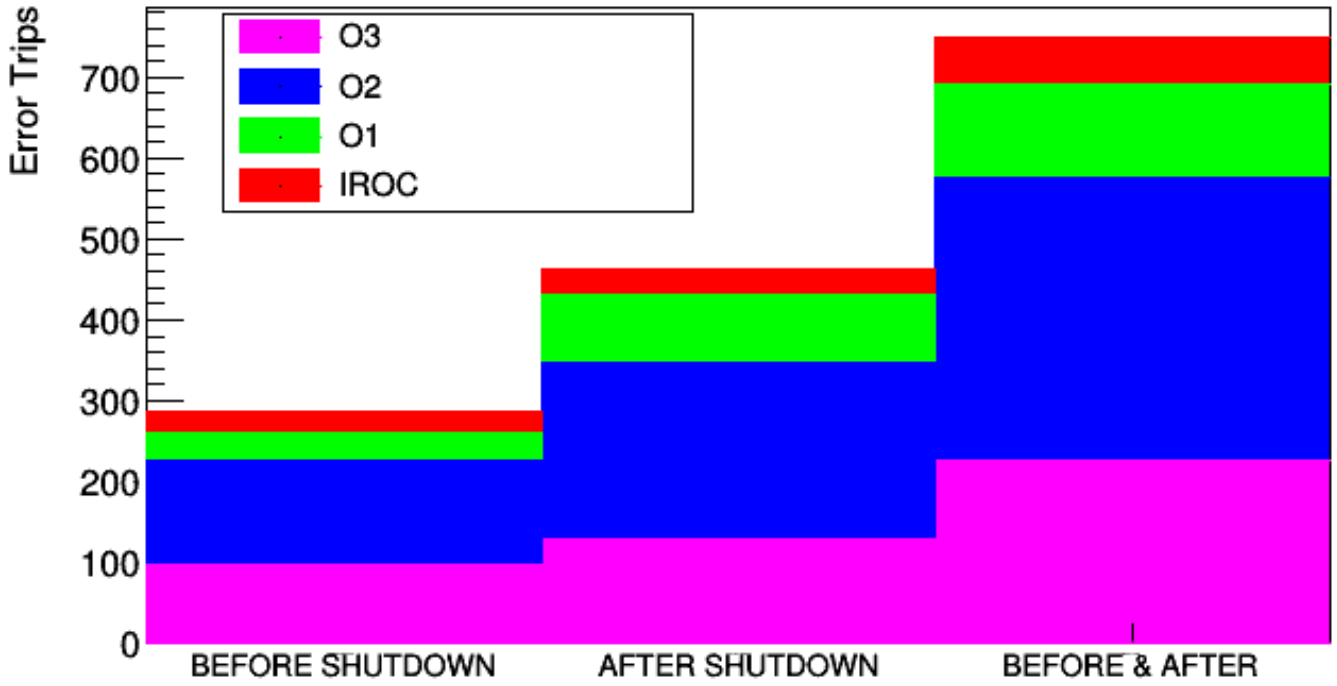
Without load

- Frequent trips (~0.2 / h) without load observed
- Enhanced trip rate in evenings and early mornings
- No flat distribution during week



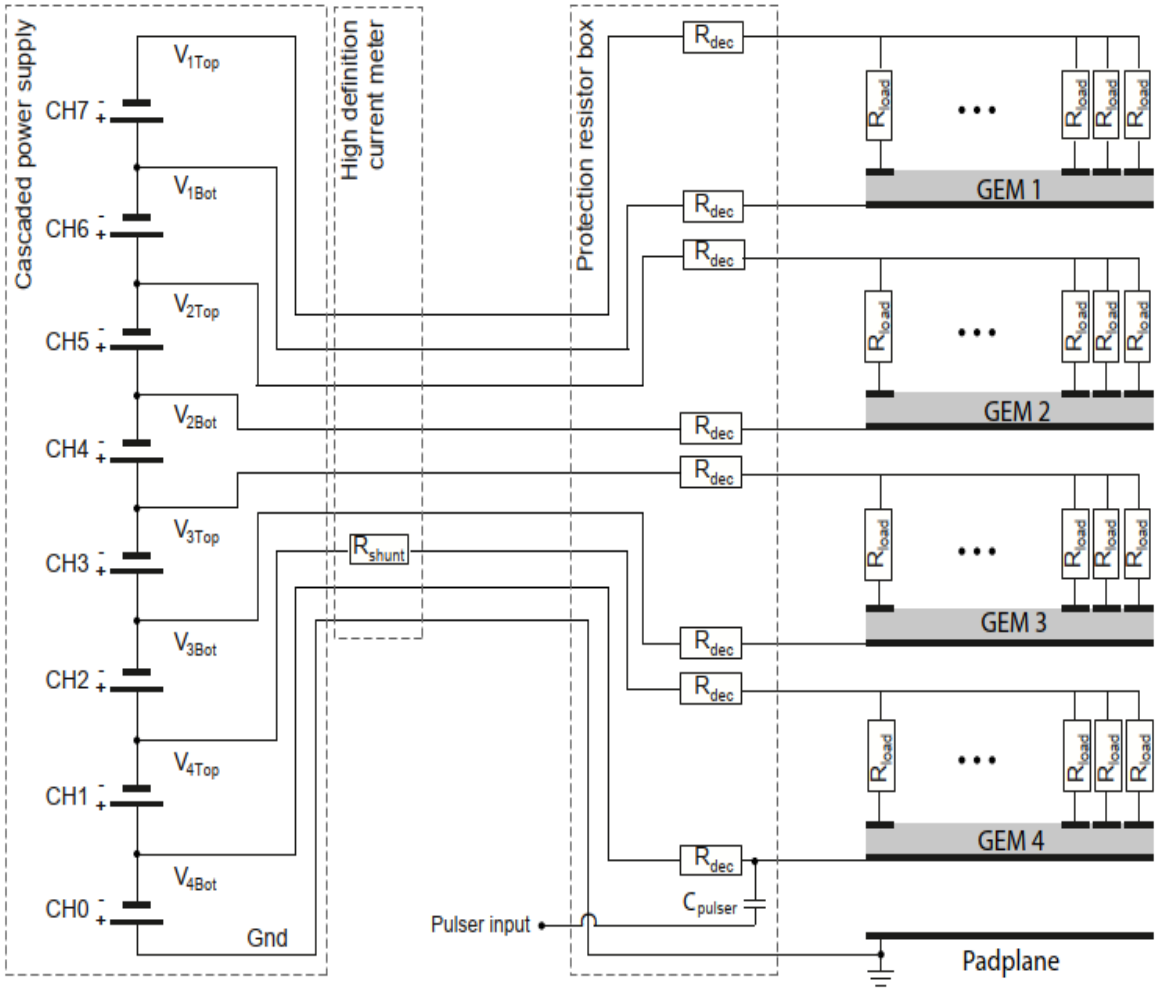


WHICH STACK TRIPPED



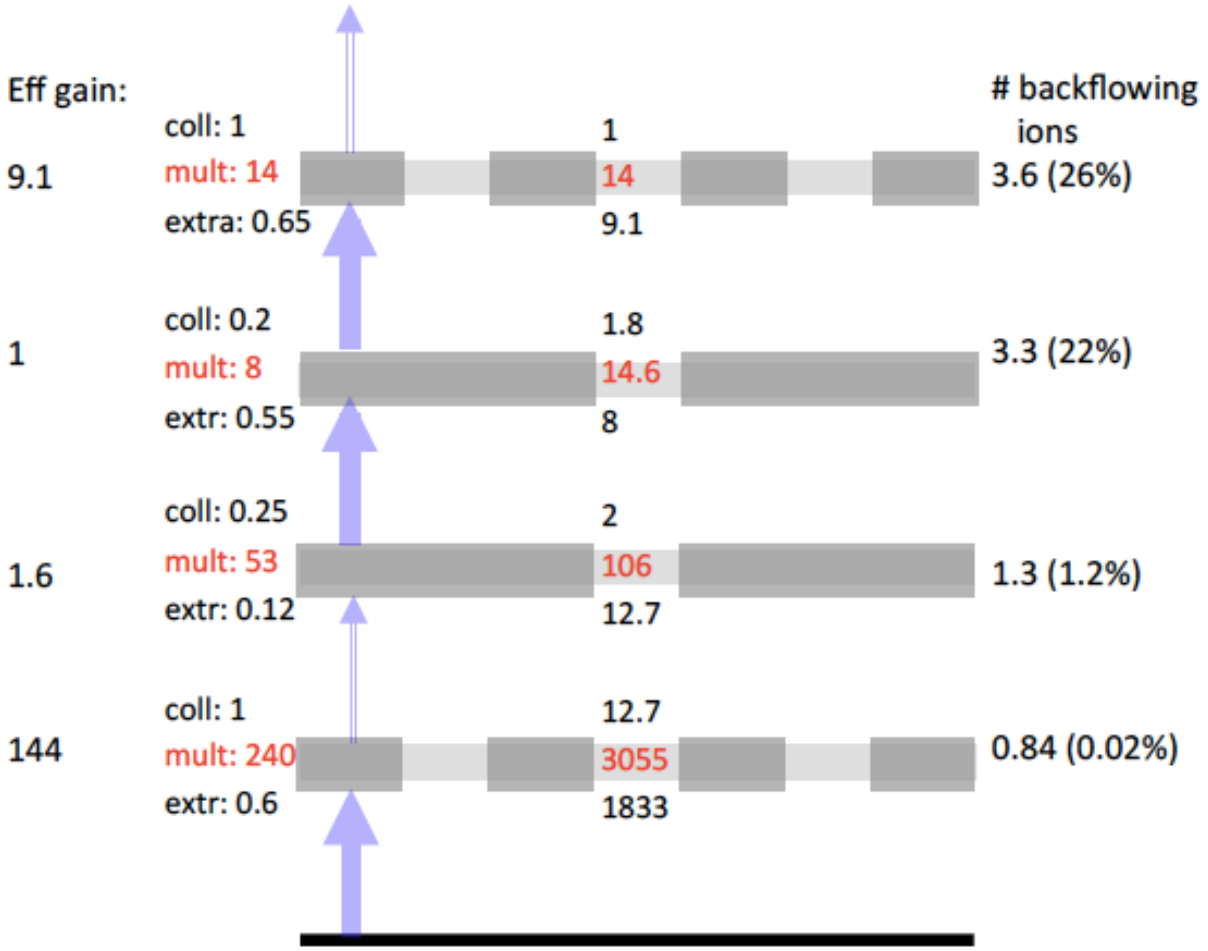
HV SYSTEM

GEM POWERING



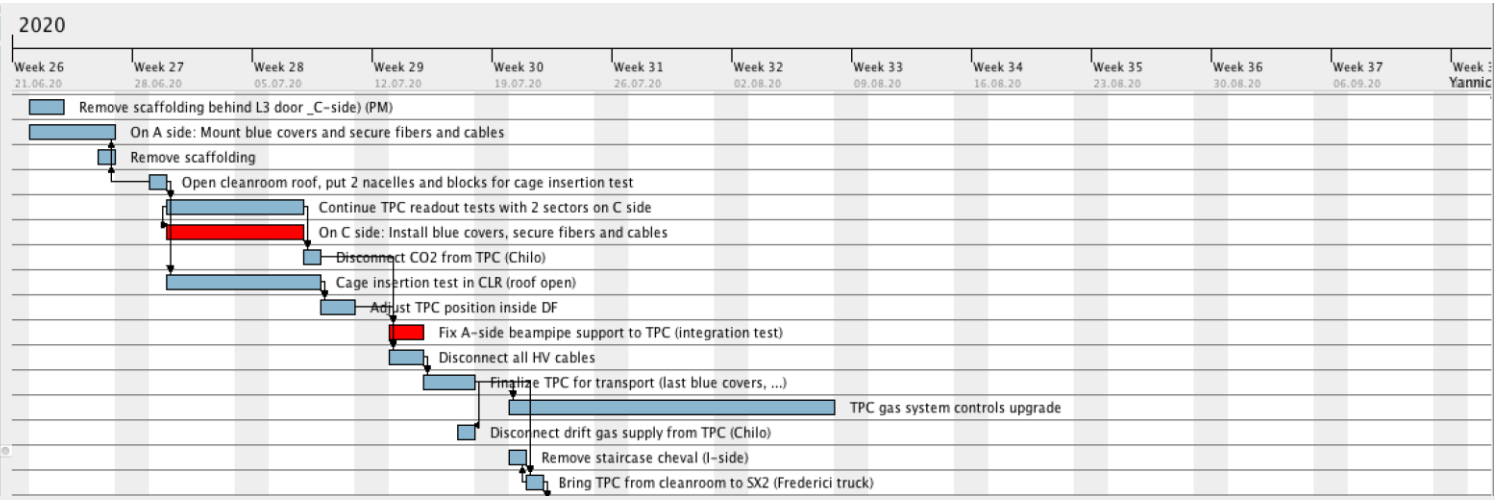
BACKUP

EFFECTIVE GAIN

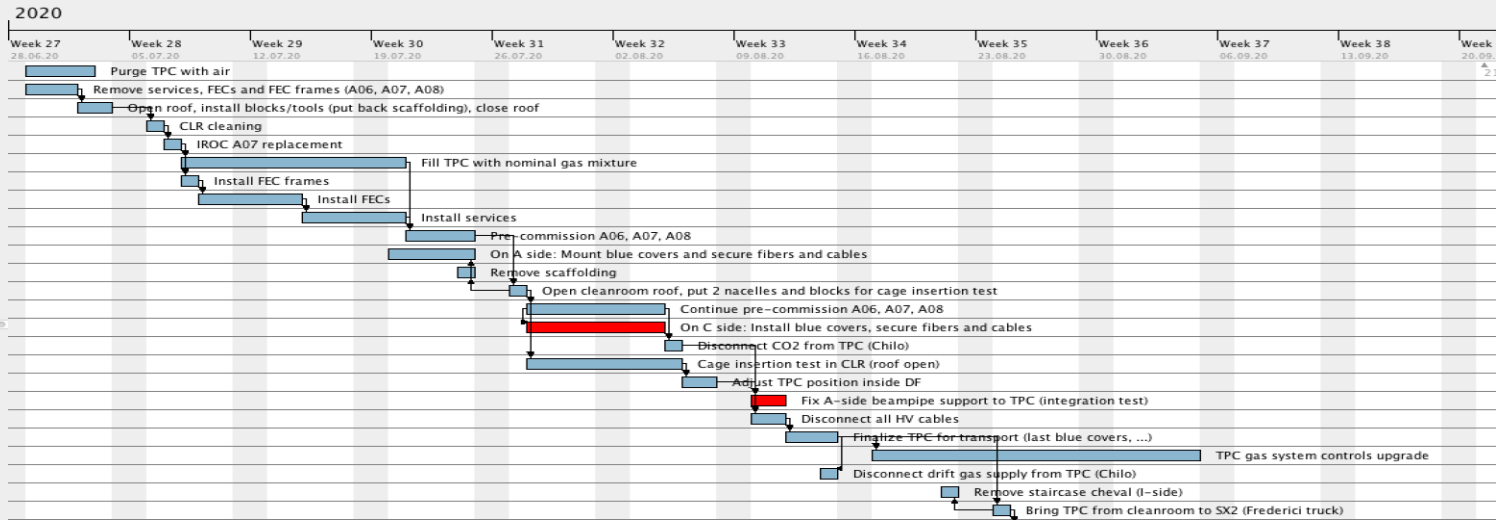


SCHEDULE (V39 VS. V40)

Name	Begin date	End date	Duration
R...	22.06.20	23.06.20	2
O...	22.06.20	26.06.20	5
R...	26.06.20	26.06.20	1
O...	29.06.20	29.06.20	1
C...	30.06.20	07.07.20	6
O...	30.06.20	07.07.20	6
D...	08.07.20	08.07.20	1
C...	30.06.20	08.07.20	7
A...	09.07.20	10.07.20	2
Fi...	13.07.20	14.07.20	2
D...	13.07.20	14.07.20	2
Fi...	15.07.20	17.07.20	3
T...	20.07.20	07.08.20	15
D...	17.07.20	17.07.20	1
R...	20.07.20	20.07.20	1
B...	21.07.20	21.07.20	1

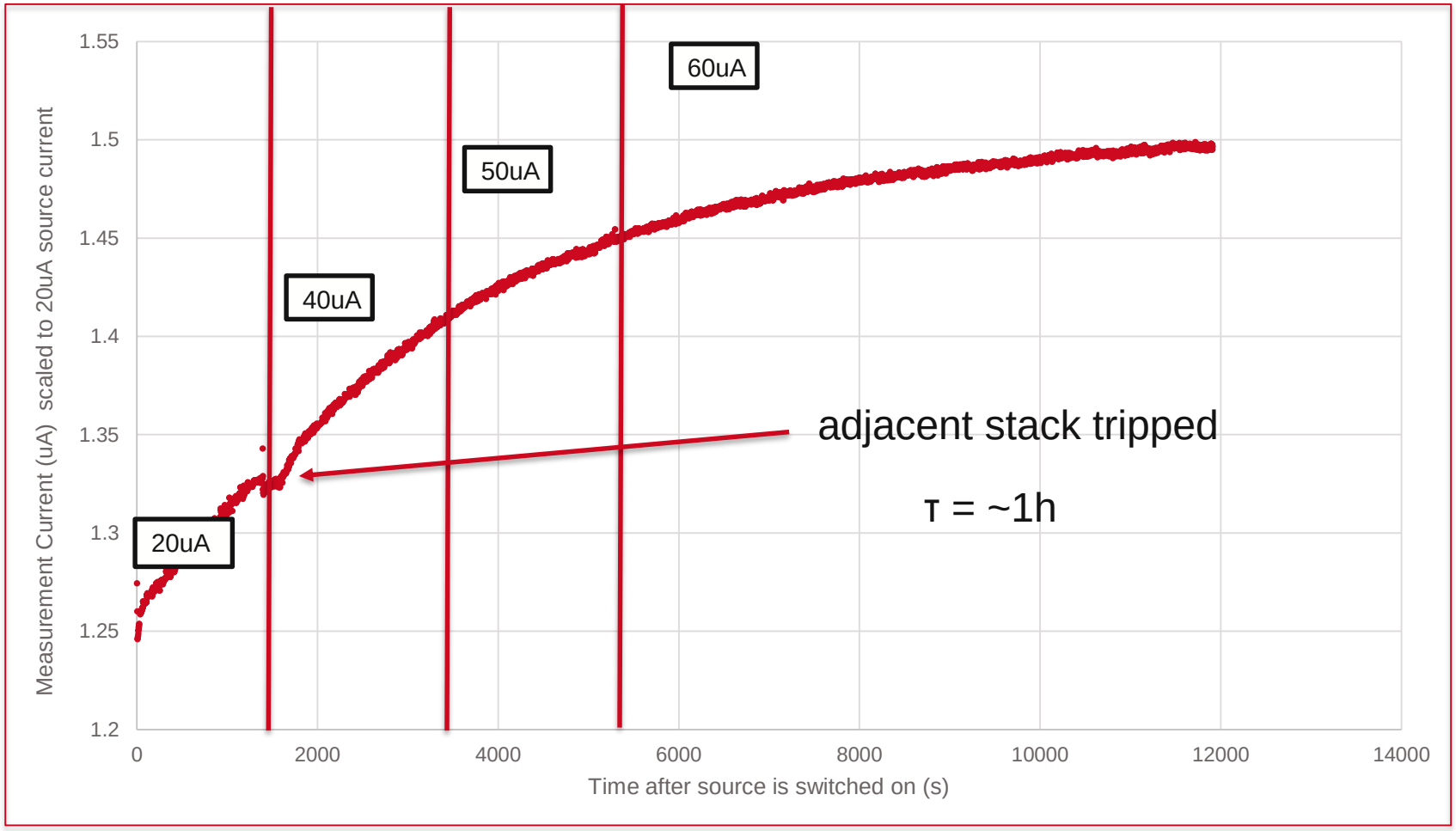


Name	Begin date	End date	Duration
P...	29.06.20	02.07.20	4
R...	29.06.20	01.07.20	3
O...	02.07.20	03.07.20	2
C...	06.07.20	06.07.20	1
I...	07.07.20	07.07.20	1
Fi...	08.07.20	20.07.20	9
In...	08.07.20	08.07.20	1
In...	09.07.20	14.07.20	4
In...	15.07.20	20.07.20	4
P...	21.07.20	24.07.20	4
O...	20.07.20	24.07.20	5
R...	24.07.20	24.07.20	1
O...	27.07.20	27.07.20	1
C...	28.07.20	04.08.20	6
O...	28.07.20	04.08.20	6
D...	05.08.20	05.08.20	1
C...	28.07.20	05.08.20	7
A...	06.08.20	07.08.20	2
Fi...	10.08.20	11.08.20	2
D...	10.08.20	11.08.20	2
Fi...	12.08.20	14.08.20	3
T...	17.08.20	04.09.20	15
D...	14.08.20	14.08.20	1
R...	21.08.20	21.08.20	1
B...	24.08.20	24.08.20	1



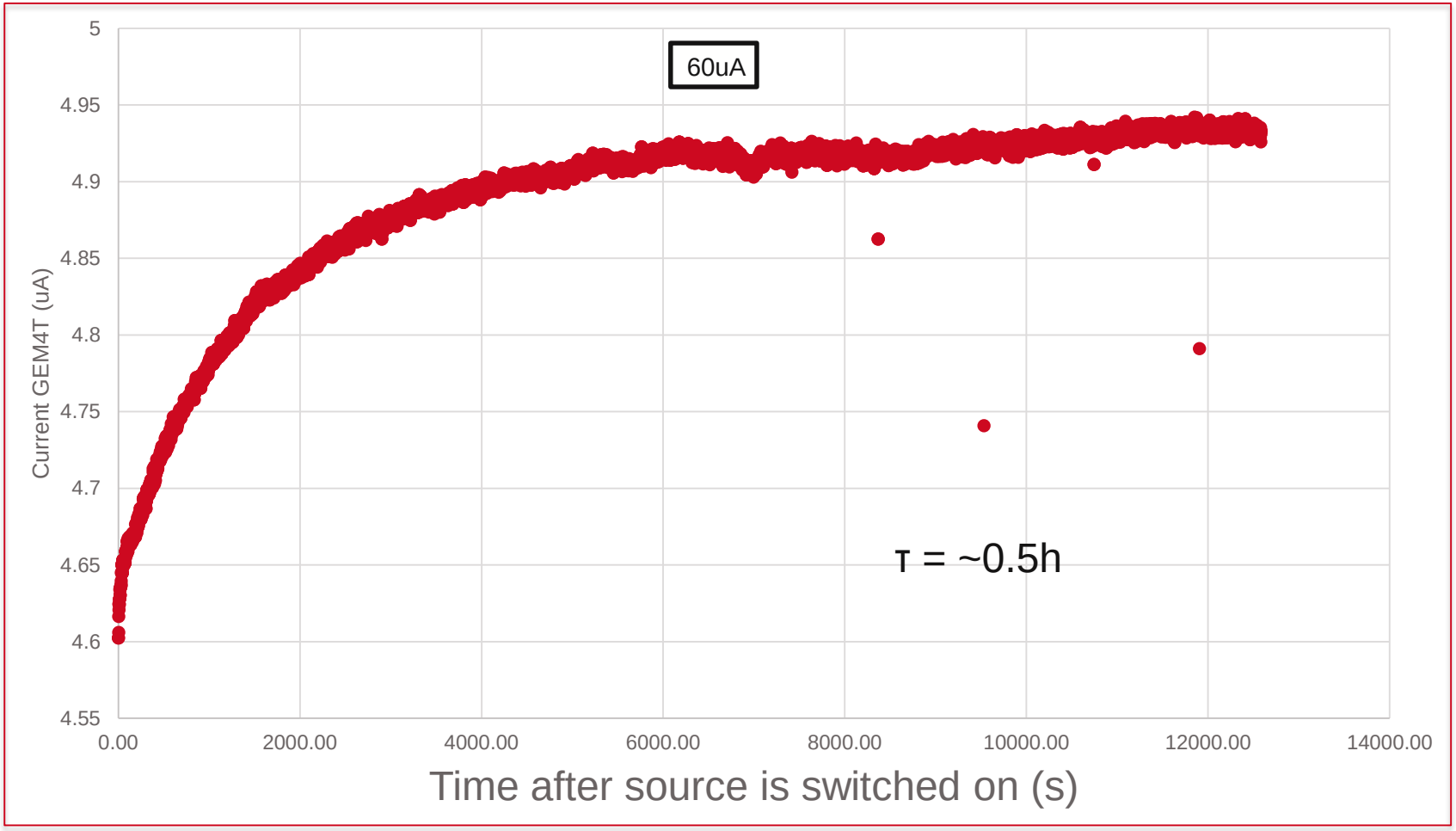
GAIN CHANGE IN GEM

Normalized Current of GEM4T during X-ray scan to 20uA Source current



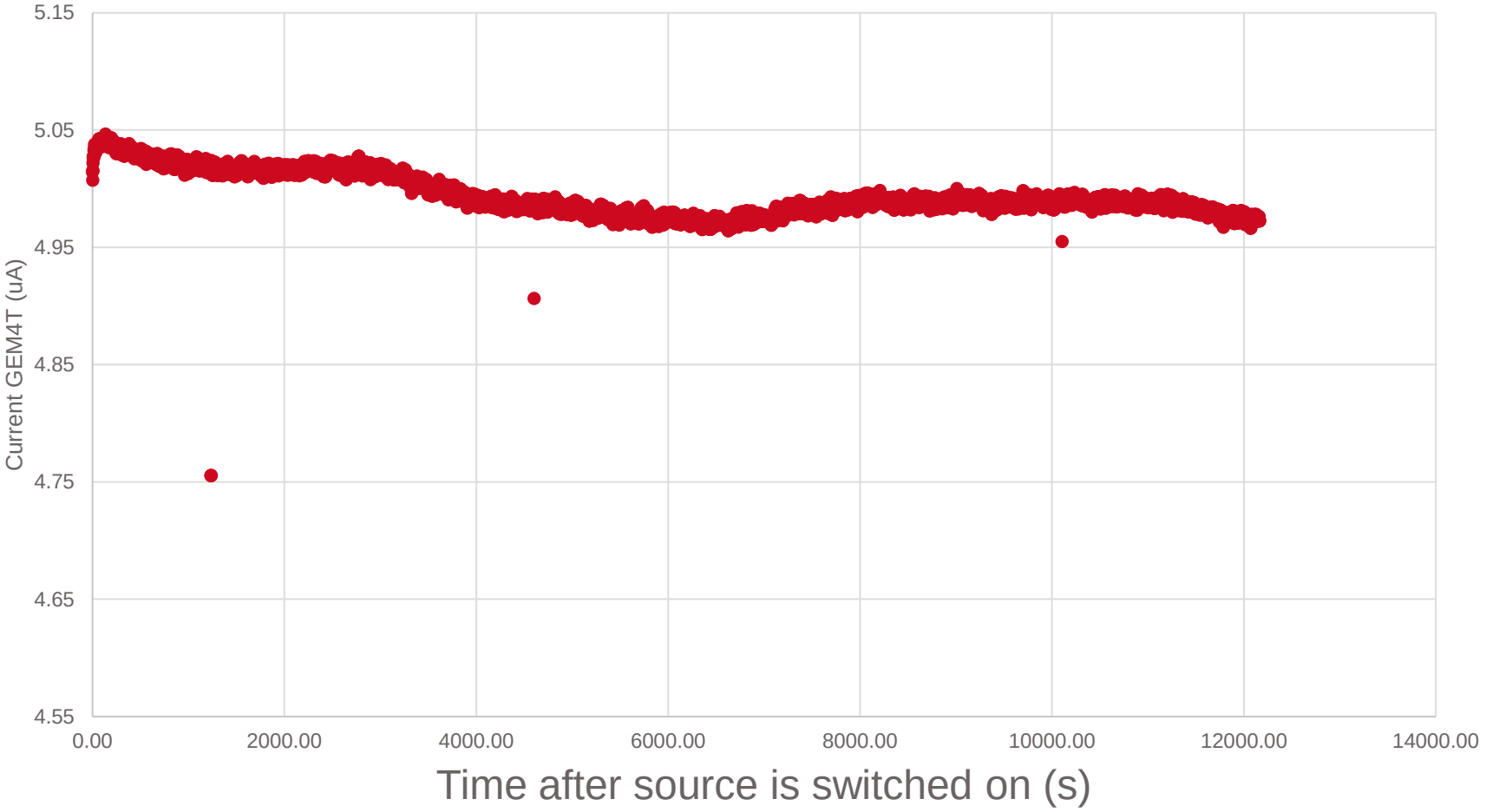
GAIN CHANGE IN GEM

Second X-Ray scan (60uA only) – 2 weeks cooldown



GAIN CHANGE IN GEM

Fours X-Ray scan (60uA only) – 5.5 hours cooldown

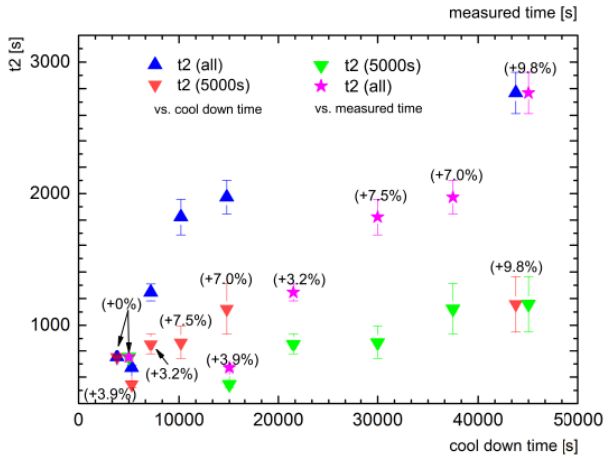


X-RAY SUMMARY

Test	Cooldown	Running time	Charge up t	Gain increase (~1h)	Trip Rate A-Side	Trip Rate C-Side
1.	> 3 month	3 h	1h	11%	16 (5.3 /h)	3 (1 /h)
2.	2 week	6.5 h	0.5h	6.2%	11 (1.69 /h)	**5 (0.75 /h)**
3.	2 days	13h 43min	0.1h	2%	7 (0.5 /h)	8 (0.58 /h)
4.	5.5 hours	31h 20min	~1-2min	<0.5%	4 (0.12 /h)	8 (0.25 /h)

Charge up effect reduced with lower cooldown time

Lower trip rate with charged up GEMs



Y. Vetter – Bachelor Thesis 2015 (Heidelberg)

X-RAY A-SIDE

Test	Running time	Cooldown	Charge up t	Gain increase (~1h)	Trip Rate A-Side	Trip Rate C-Side
1.	3 h	> 3 month	1h	11%	16 (5.3 /h)	3 (1 /h)
2.	6.5 h	2 week	0.5h	6.2%	11 (1.69 /h)	5 (0.75 /h)
3.	13h 43min	2 days	0.1h	2%	7 (0.5 /h)	8 (0.58 /h)
4.	31h 20min	5.5 hours	~1-2min	<0.5%	4 (0.12 /h)	8 (0.25 /h)
5.	11h 03min					
6.	12h 05min					
7.	2h 13min					
8	11h 31min					
9	31h 04min					
10	18h 29min					