Update MBHA-001
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TE-MSC-TF

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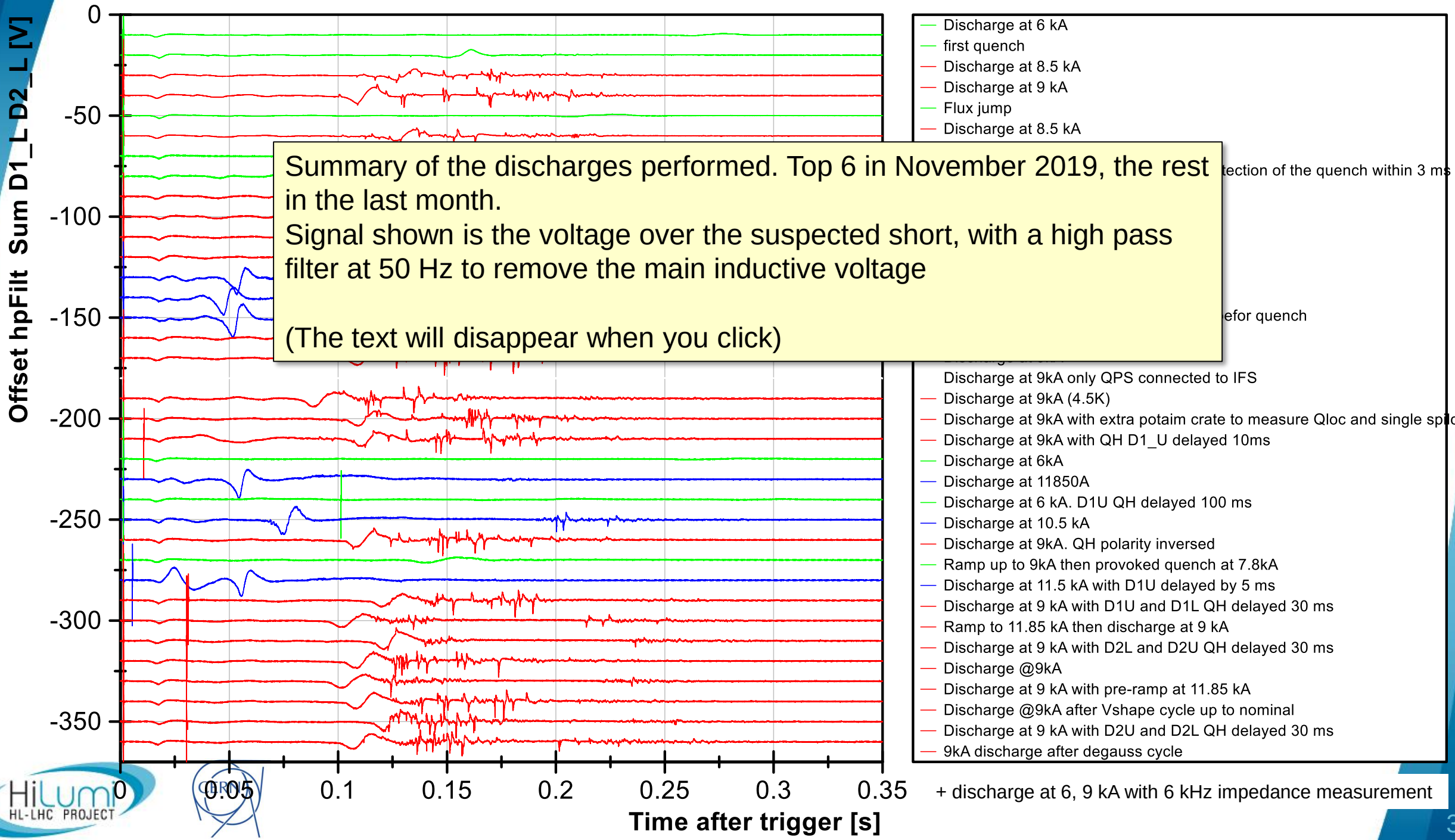
Acknowledgements to all involved.

Tests since last meeting

- RRR during warm up



Summary of the discharges performed. Top 6 in November 2019, the rest in the last month.
Signal shown is the voltage over the suspected short, with a high pass filter at 50 Hz to remove the main inductive voltage

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tection of the quench within 3 ms by

efor quench

+ discharge at 6, 9 kA with 6 kHz impedance measurement

What did we try?

- Discharges at different currents
- Discharges delaying QH:
  - To change voltage across suspected short
  - To delay one aperture quenching vs the other
- Discharges with inverse QH polarity
- Discharges with pre-cycles
  - To check magnetization or other hysteresis effects
- A battery of other tests: HiPot, impedance (with & without current), reflectometry

Spikes during discharges at different currents, voltages

Current [kA] → / Voltage [V] ↓	6	7.1	7.8	8.5	9	9.7	10.5	11.3	11.85
+80	No								
-20					Yes				
-40 – -50	No								
-50 – -70		No	Few		Yes				Few
-70 – -90				Yes	Yes				
-90 – -110					Yes	Yes			
-110 – -150							Few	Few	Few

Current refers to the discharge current
Voltage is the maximum voltage across the suspected short

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Conclusion:

- Current level changes the spikes
- Voltage does not change the spikes

Discharges with one aperture QH delayed

- D1 delayed: no change
- D2 delayed: fewer spikes around 150-200 ms
- D2 delayed repeat: same as D1 delayed

Conclusion: one aperture delayed QH does not change the spikes

Inversed QH polarity test

- Several tests, no changes seen

Conclusion: QH polarity does not affect spikes

Spikes during discharges with pre-cycles

Current [kA] → / Cycle ↓	6	7.1	7.8	8.5	9	9.7	10.5	11.3	11.85
* * / _ / _/ / and /								Few	Few
/\ / * /									
/\ / \ * / \/					Yes				
(degauss)					Yes				

Current refers to the discharge current
Cycles are, in order:

- Ramp or VI-ramp and then quench or discharge
- Ramp up to higher current, down to target current and discharge
- Full pre-cycle up and down, then ramp again to target current and discharge
- Degauss cycle, with several “oscillations” of reducing amplitude around target current, and then discharge

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Conclusion:

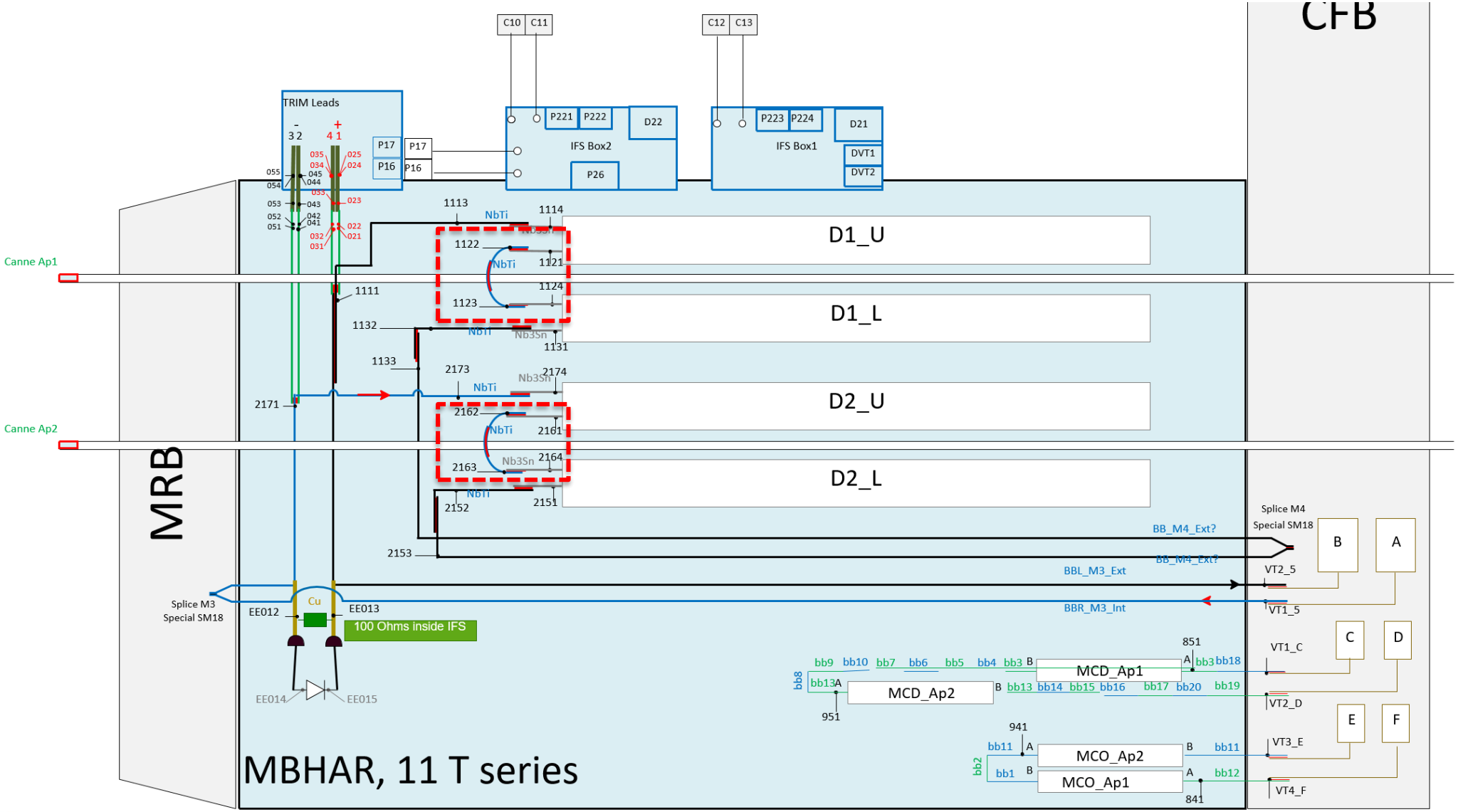
- Pre-cycle changed something at 9 kA

What are the main hypotheses?

- Coil-coil short
- Coil-QH-QH-coil short
- Flux jumps
- Magnetization

What are the main hypotheses?

	Evidence +	Evidence -	Other comments
Coil-coil short	• Symmetry • Reproducible by models	• Unaffected by voltage • Current pre-cycles	• Current pre-cycle: maybe force hysteresis?
Coil-QH-QH-Coil short		• HV test passed • Inverse QH polarity did not affect	
Flux jump		• Symmetry • Coils resistive when spikes happen	
Magnetization	• Current pre-cycles	• Symmetry	• Symmetry: maybe in splice?


CFB
MRB
TRIM Leads
C10
C11
C12
C13
P221
P222
D22
IFS Box2
P223
P224
D21
IFS Box1
DVT1
DVT2
P26
P17
P16
Canne Ap1
Canne Ap2
D1_U
D1_L
D2_U
D2_L
NbTi
Nb3Sn
Splice M3
Special SM18
EE012
EE013
Cu
100 Ohms inside IFS
EE014
EE015
Splice M4
Special SM18
BB_M4_Ext?
BBL_M3_Ext
BBR_M3_Int
VT2_5
VT1_5
VT1_C
VT2_D
VT3_E
VT4_F
MCD_Ap1
MCD_Ap2
MCO_Ap2
MCO_Ap1
MBHAR, 11 T series