

# Summary of ELQA measurements on LMBHA001 in SM18

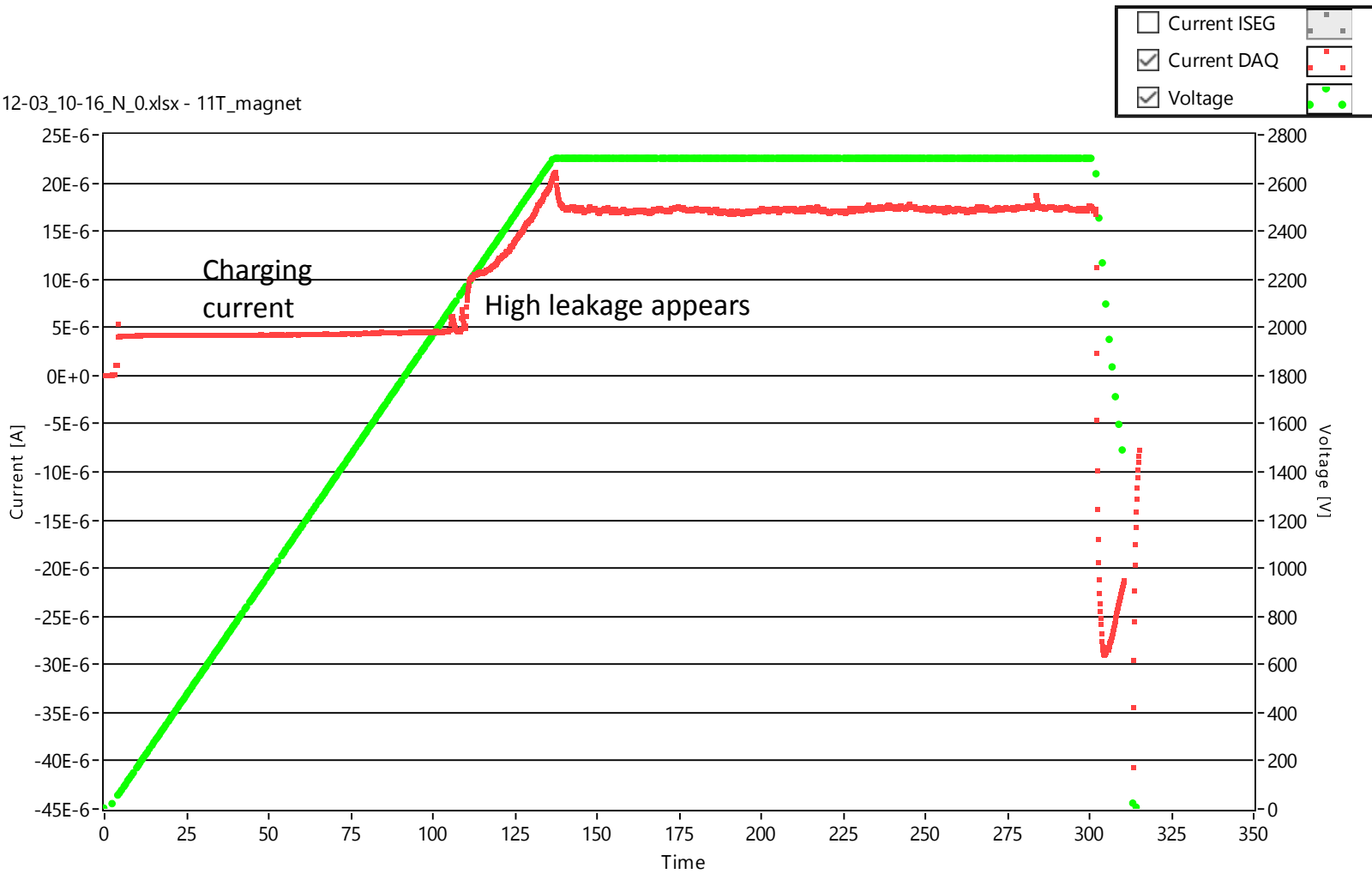
Mateusz Bednarek, Jaromir Ludwin,  
Tiago Catalão da Rosa

With important input from Felix Rodriguez Mateos and Jan Petřík

- **2019-11-27:** First tests with the ELQA hardware up to 2.6 kV,
  - The insulation was perfect up to 2.6 kV (leakage current of 200 nA)
  - The test at 2.8 kV was interrupted by a power-cut, during the voltage ramp.
  - DC precision voltage measurements
- **2019-11-28:** Magnet tested up to 2.7 kV,
  - High leakage current first appeared at about 2.74 kV, then the on-set voltage varied
  - DC precision voltage measurements continued
- **2019-11-29:** Magnet tested up to 2.6 kV
  - HV tests mostly below the high leakage current on-set, observation of partial discharges
  - Differential measurements across magnet coils with an oscilloscope
- **2019-12-03:** Magnet tested up to 2.7 kV
  - HV tests mostly below and at the high leakage current on-set, observation of partial discharges
  - Oscilloscope fast measurements of leakage current and voltage to ground between all magnet coils

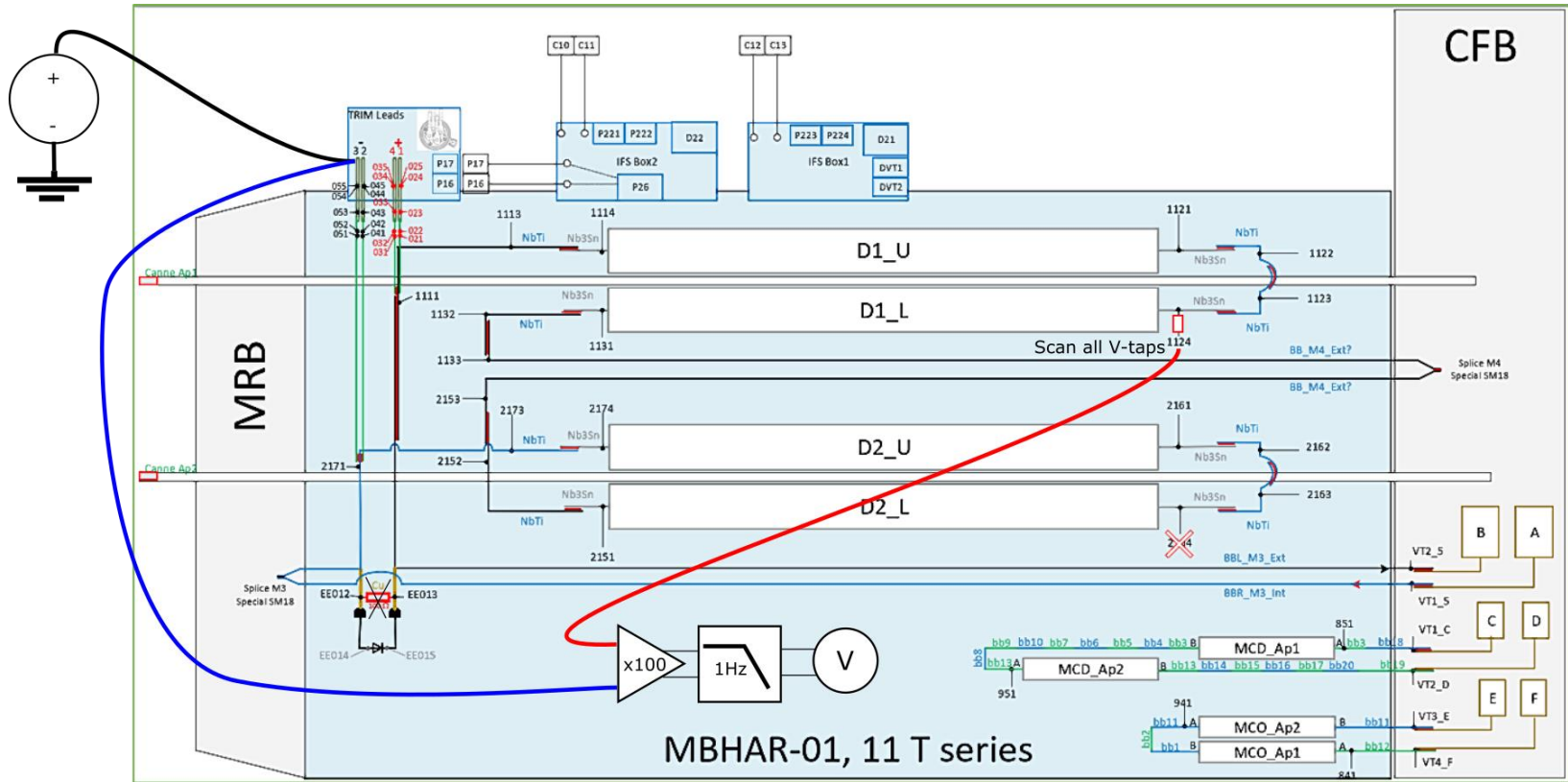
- Voltage ramp rate 20 V/s
- Increased leakage current appeared at 2170 V

2019-12-03\_10-16\_N\_0.xlsx - 11T\_magnet



- No degradation
- Random behaviour, always between 2 kV and 2.75 kV

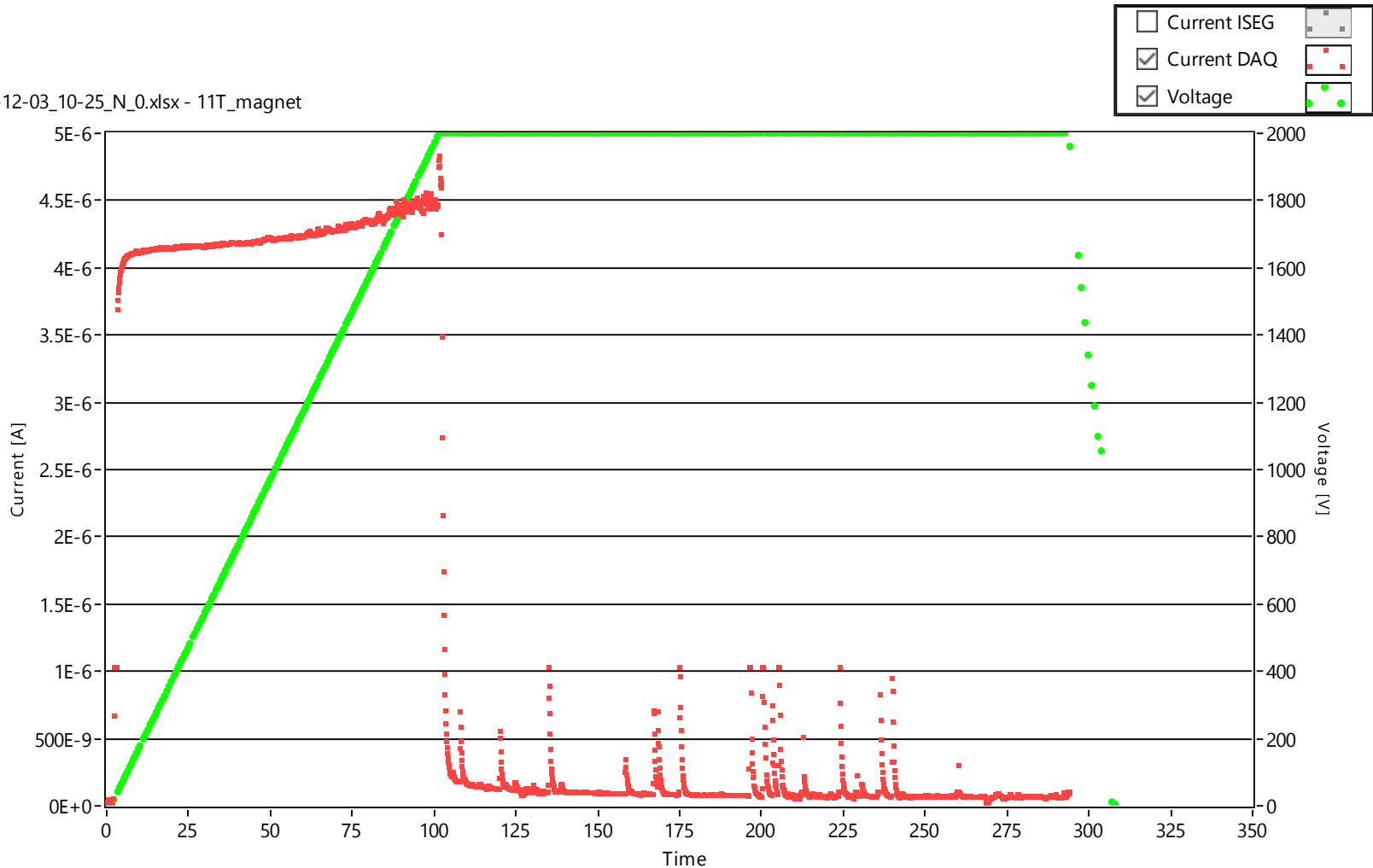
| Test             | start of increased leakage<br>V |
|------------------|---------------------------------|
| 2019-11-28_10-37 | 2741                            |
| 2019-11-28_11-29 | 2150                            |
| 2019-11-28_17-29 | 2440                            |
| 2019-11-28_17-39 | 2140                            |
| 2019-12-29_16-07 | 2596                            |
| 2019-11-29_16-23 | 2200                            |
| 2019-11-29_16-37 | 2200                            |
| 2019-12-03_09-52 | 2700                            |
| 2019-12-03_10-16 | 2160                            |
| 2019-12-03_10-52 | 2140                            |



- Not completely conclusive
- Not fully understood
- Grouping of V-taps observed

- Partial discharge activity during the ramp and the plateau

2019-12-03\_10-25\_N\_0.xlsx - 11T\_magnet



- High leakage current that appears at about 2 kV during the HV test was observed with both instruments (SM18 and ELQA)
- Multiple measurements were performed testing various scenarios
- Very difficult to localise this kind of fault, especially in a superconducting magnet
- The fault location was not identified
- The fault did not persist at warm