SULTAN test of LASSO2 coil

Nikolay Bykovskiy

WPMAG final meeting

16/01/2026

SWISS PLASMA CENTER

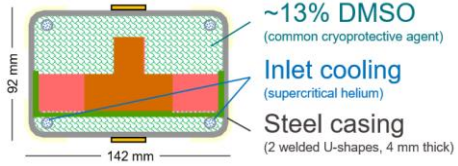
Nikolay Bykovskiy

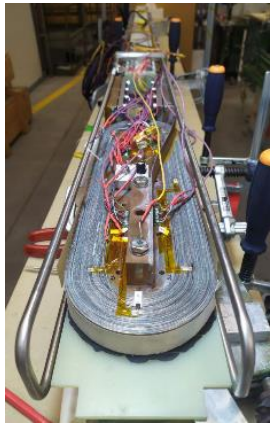
Content

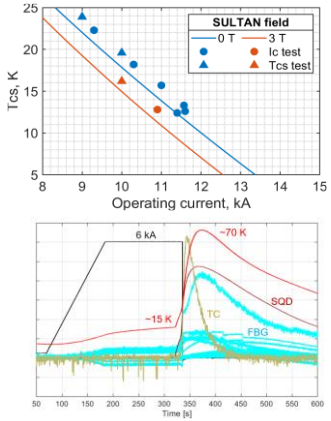
(1) EU-CN - Instrumentation and SULTAN test of LASSO2 sample

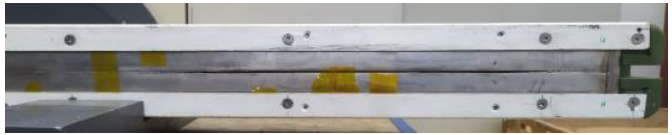
(2) SULTAN test of LASSO2 coil impregnated by water

Motivation









Various issues observed during the LASSO coil testing in SULTAN:

Testing components

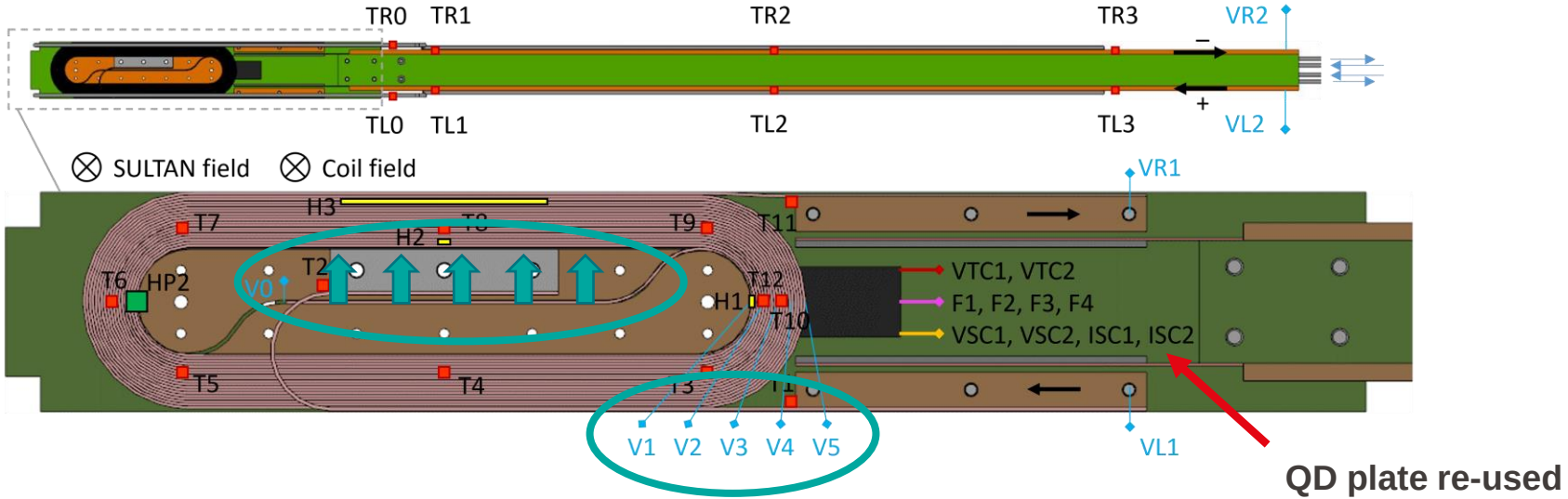
- Fracture of sample steel structure
- High discrepancies between [illegible] sensitives quench triggers in SULTAN and faults to ground in the sample holder

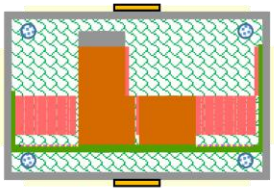
Instrumentation / sample layout

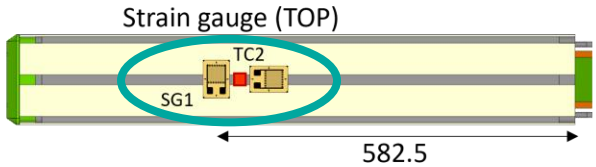
- Considering the sample instrumentation, it is also necessary to increase number of voltage taps along the winding to allow detailed study on quench propagation
- Integration of strain gauges applied on steel structure should be revised given that poor response obtained in the first test
- Only limited number of FBG could be monitored due to feedthrough issues
- The high-field terminal: high resistance of bolted interface and delamination of soldered interface subjected to tensile Lorentz forces.

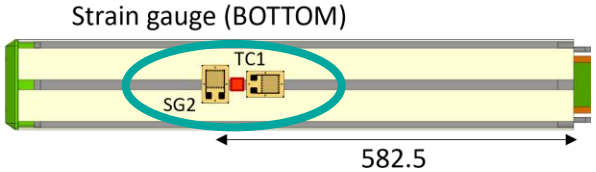
→ **The 'LASSO2' sample aims at addressing these issues…**

Sample instrumentation







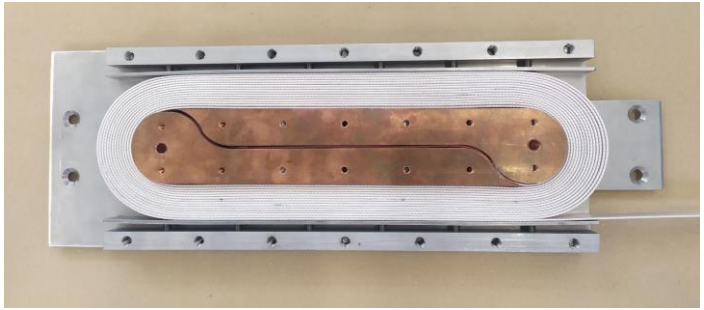


- Strain gauges: 2 sensors per location, along the EM load and along the sample axis, **both rigidly attached**
- New fiberoptics feedthroughs installed allowing to monitor **8 channels**

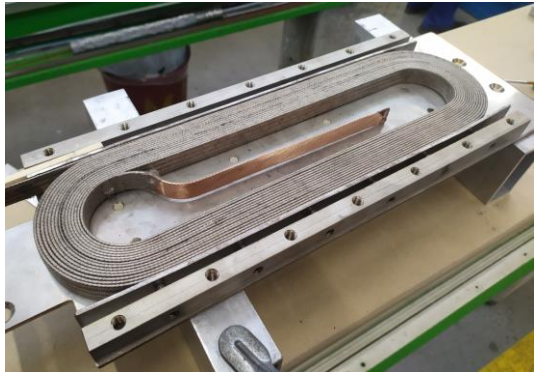
Nikolay Bykovskiy

Sample assembly

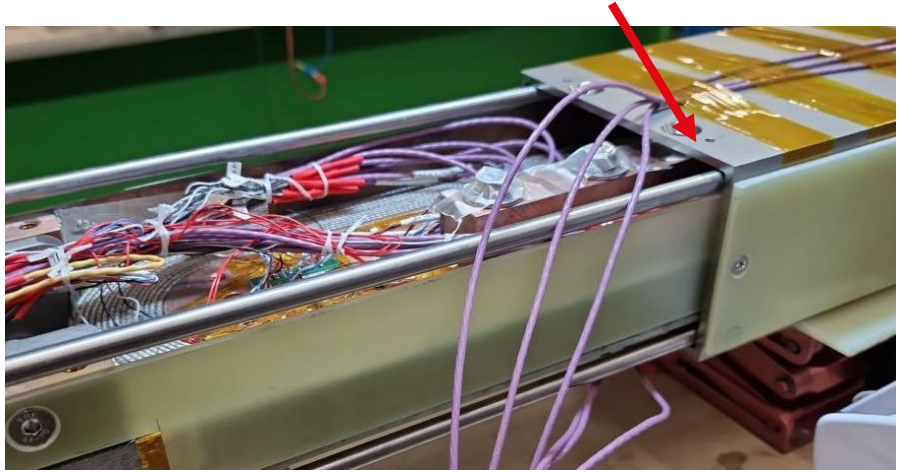
Flat racetrack using Nb3Sn conductor (MQXF)



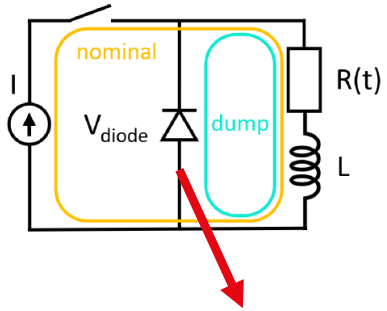
Ready for splicing after heat-treatment



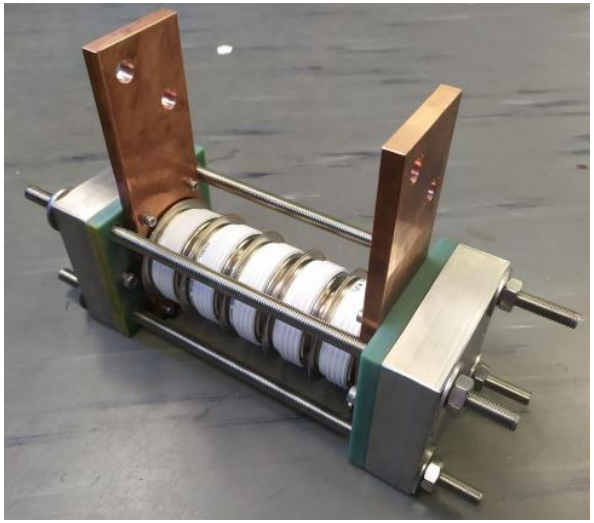
Laser-welded steel structure

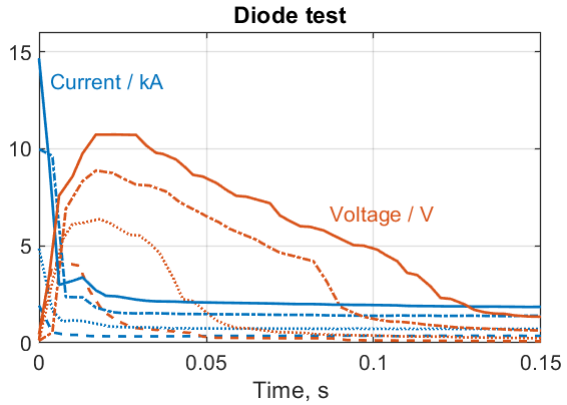


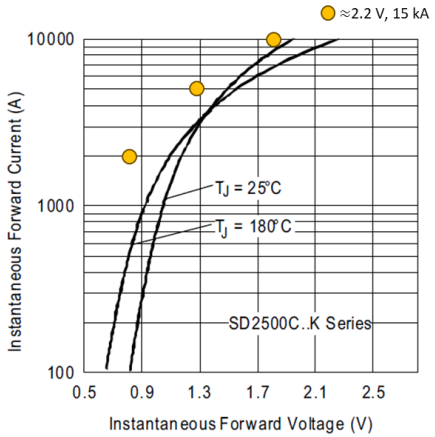
Fast discharge using stack of diodes



Protection circuit

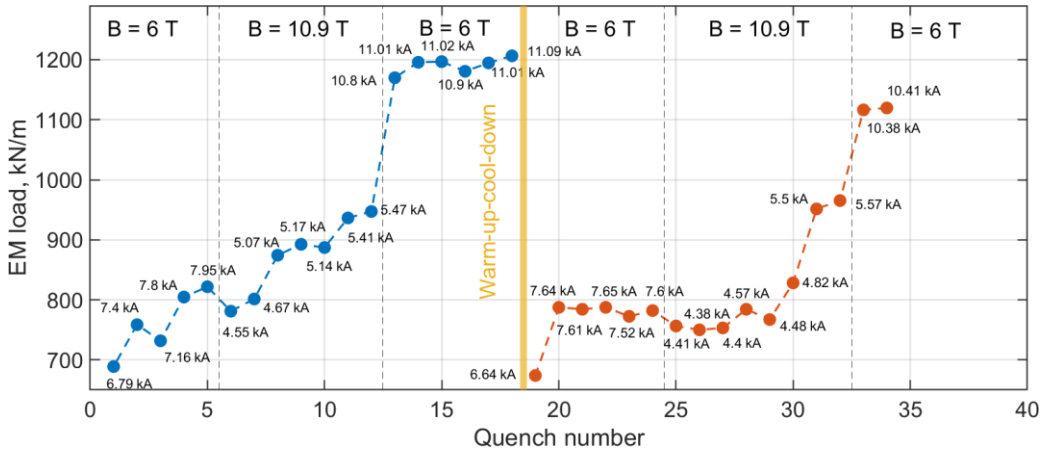


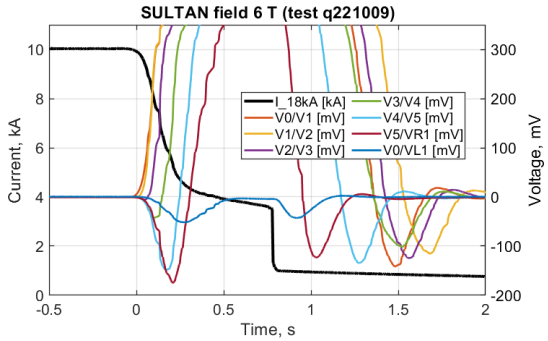


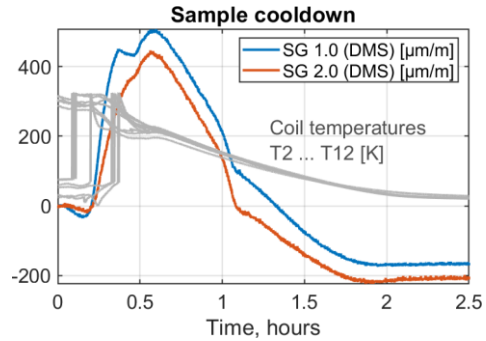


✓ Discharge voltage reduced to ~5 to 10 V, thus arcing and false-positives no longer observed

Sample performance



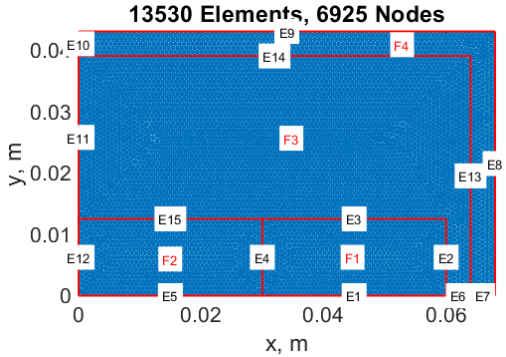


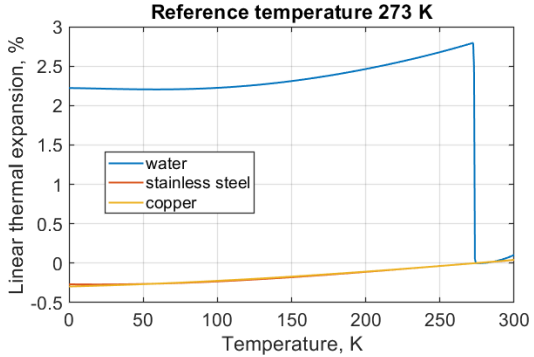


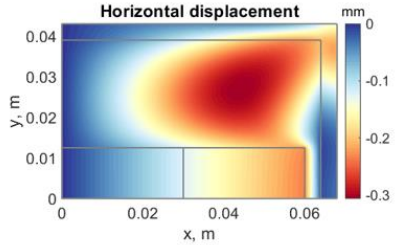
- After some training EM load increased up to ~1200 kN/m at 11 kA, 6 T (74% expected value). In the previous sample steel structure fractured at this load.
- No ‘memory’ upon WUCD as DMSO impregnation is liquid at RT
- Fast quench propagation (up to ~60 m/s) leads to decrease of operating current before discharge
- 13% DMSO impregnation expands initially during cooldown but then contracts (no pre-compression).

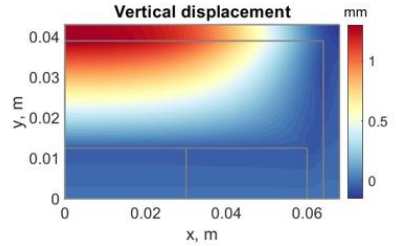
➢ Would impregnation by pure water improve sample performance due to pre-compression and high k?...

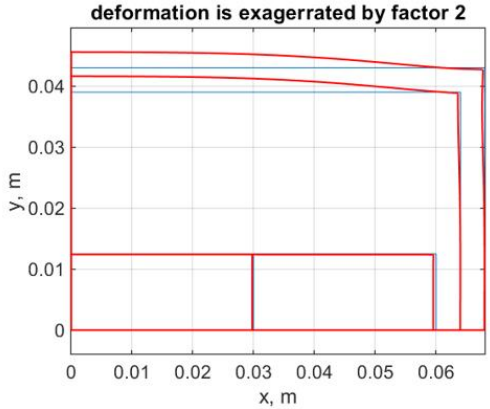
Impregnation by water





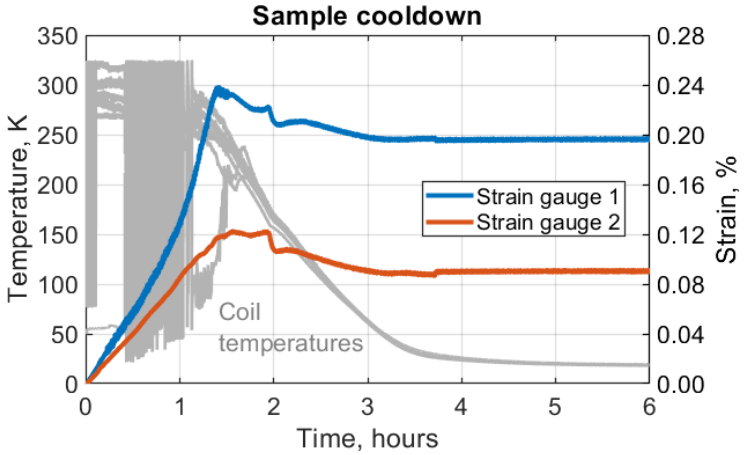


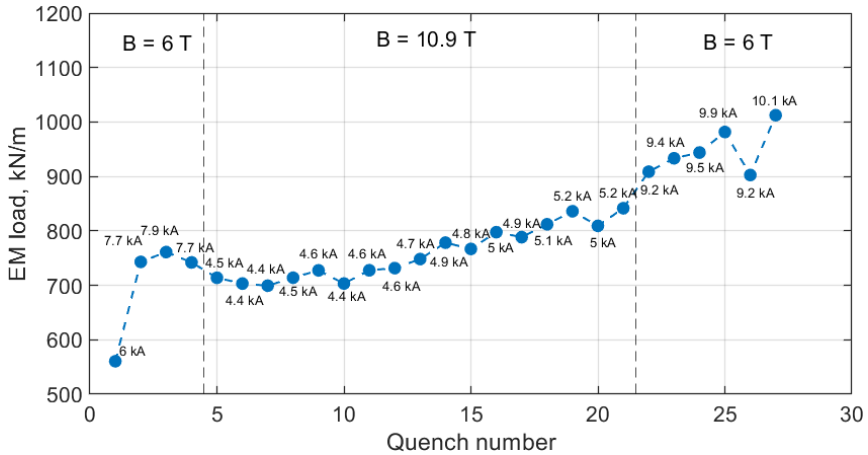




- Thermoelastic model of 1st quadrant: u=0 at E10-E12; v=0 at E1, E5-E7
- Linear thermal expansion from 273 K to 0 K: -0.3% for copper (F2) and steel (F4), 2.2% for water (F3)
- Relatively weak horizontal displacement (u), but strong in vertical direction (v), **up to ~1.3 mm**
- As a result, sample dimensions were reduced by 1.5 mm each side using thinner outer insulation, which is further validated in LN2.

Impregnation by water





- Steel structure in tension after cool-down → coil is pre-compressed ✔
- Lower T rise in AC loss testing → impregnation has higher thermal conductivity ✔
- However, coil training is nearly unchanged □

Thank you for your attention!