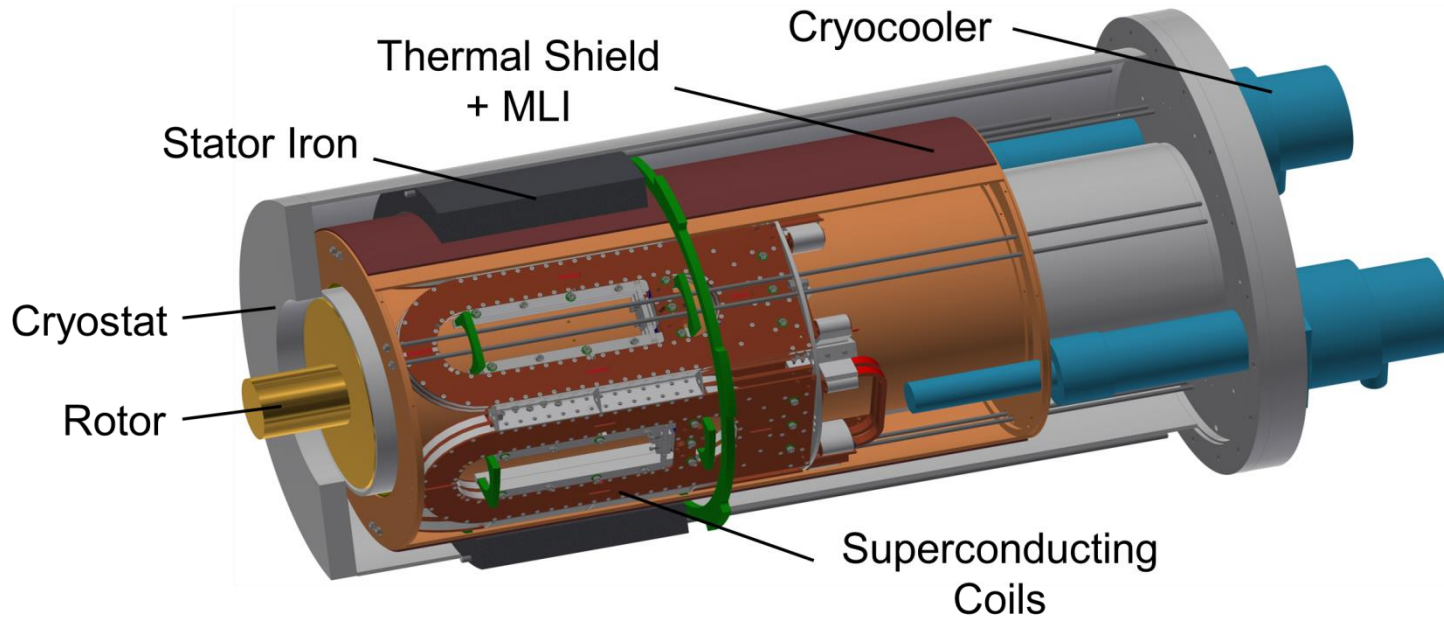


Development of non-insulated racetrack coils wound with 2nd generation HTS tapes for a stator system for wind generators

Fabian Schreiner, Yingzhen Liu, Yuanzhi Zhang, Roland Gyuráki, Mathias Noe and Martin Doppelbauer

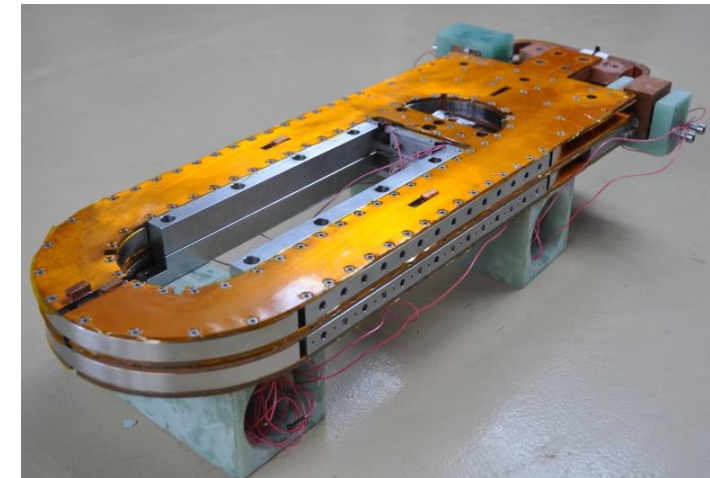
Institute for Technical Physics

GENERATOR LAB DEMONSTRATOR

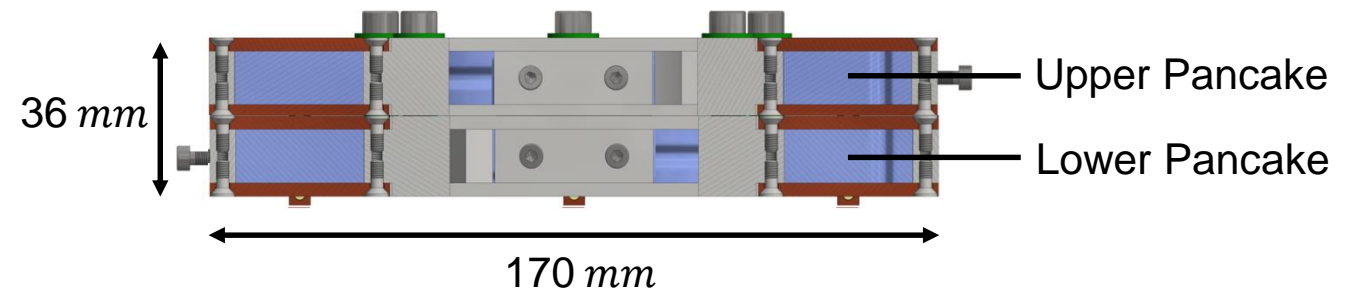
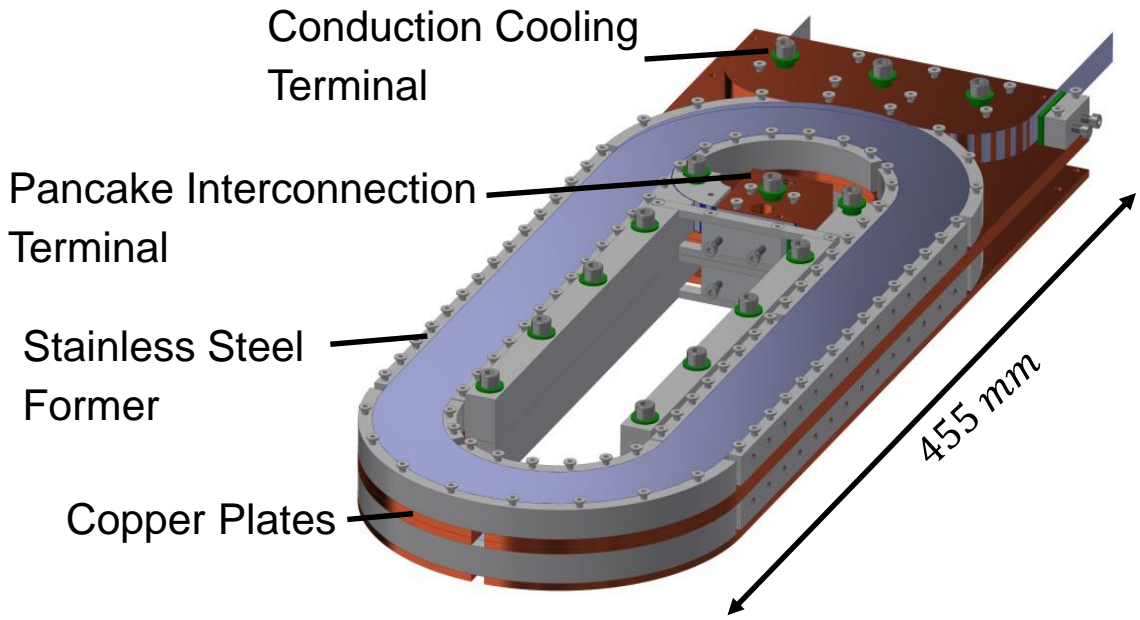


Rated power	10 kW
Stator pole number	6
Thermal shield temperature	80 K
Stator system temperature	30 K
Air gap	5 mm

- 1 double pancake per stator pole
- Pancake measurement under conduction cooled conditions

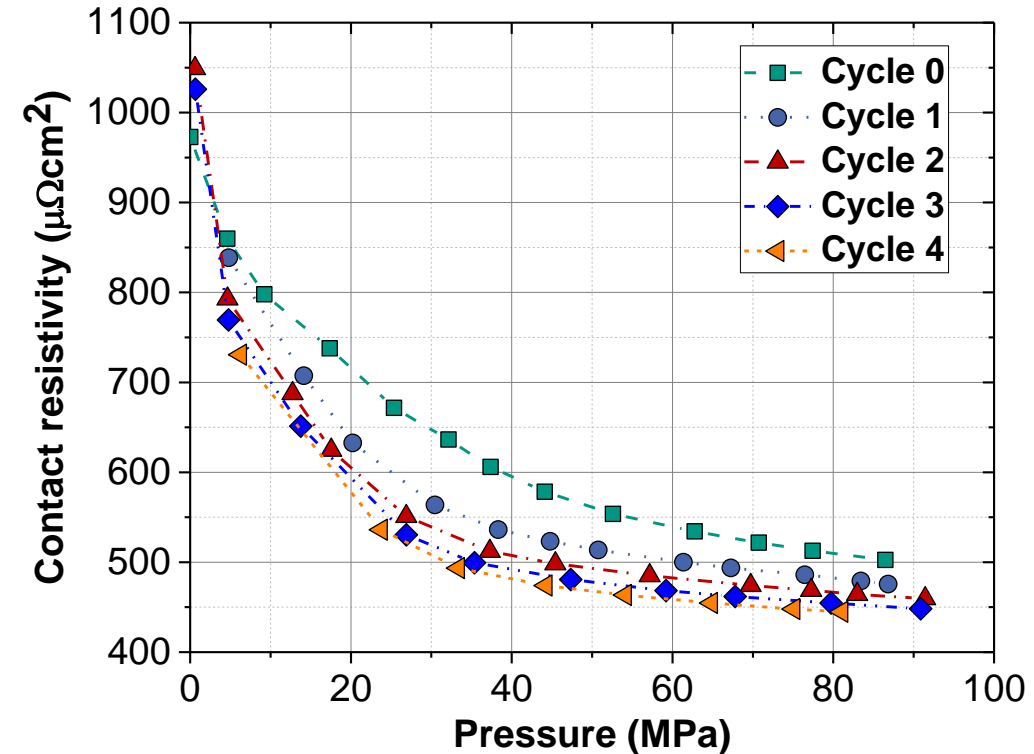
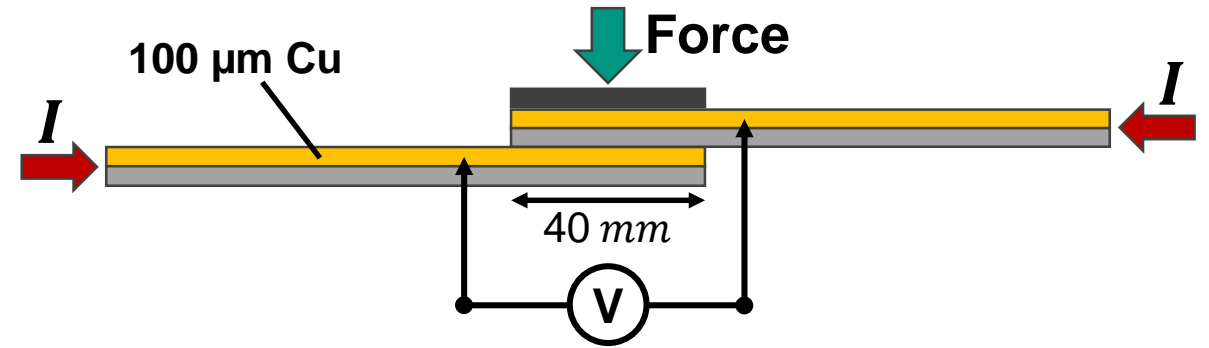
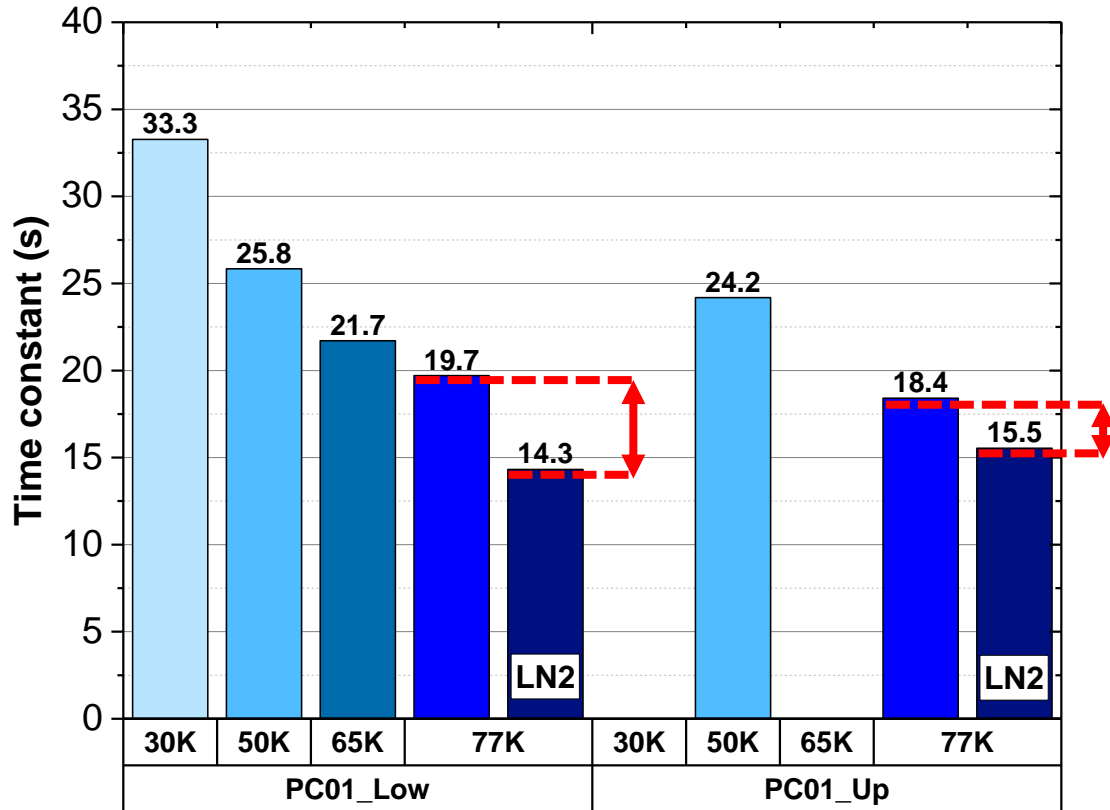


NON-INSULATED PANCAKE COILS



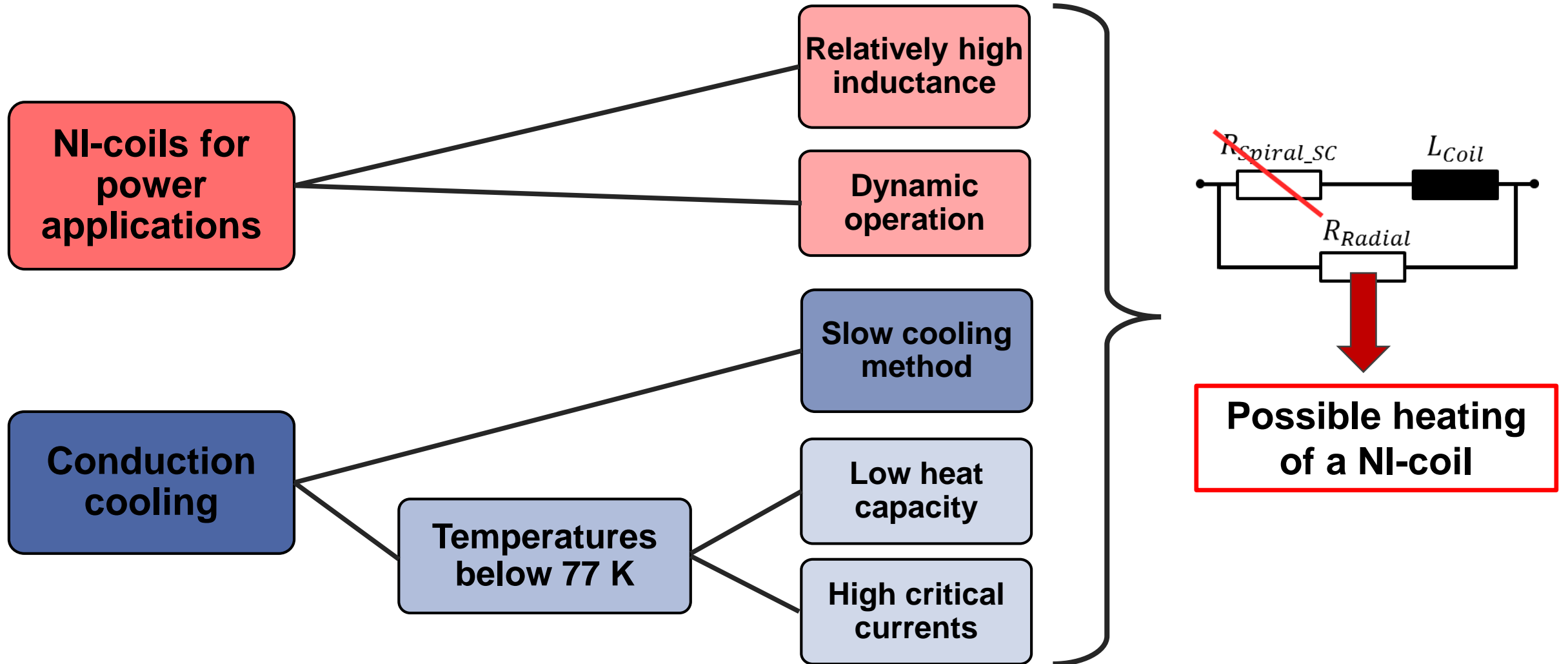
Tape	GdBaCuO, 12 mm, 100 μ m Cu laminated
Number of turns	2 x 115 in series connection
Inductance	19 mH
Tape length	2 x 99.5 m

TIME CONSTANT AT DIFFERENT TEMPERATURES

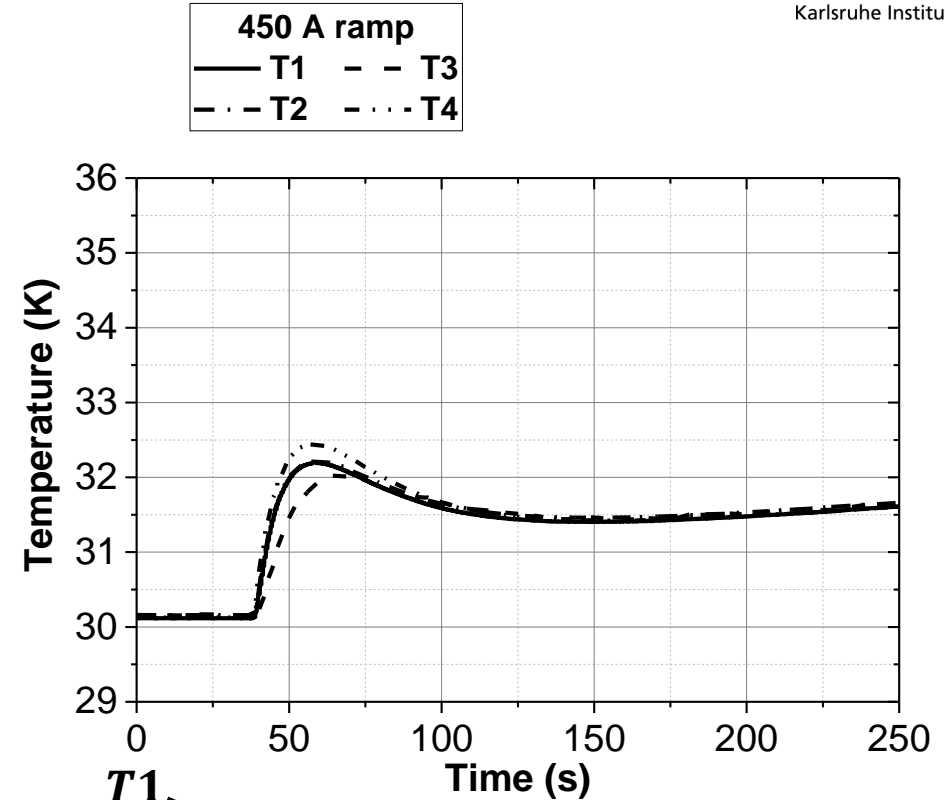
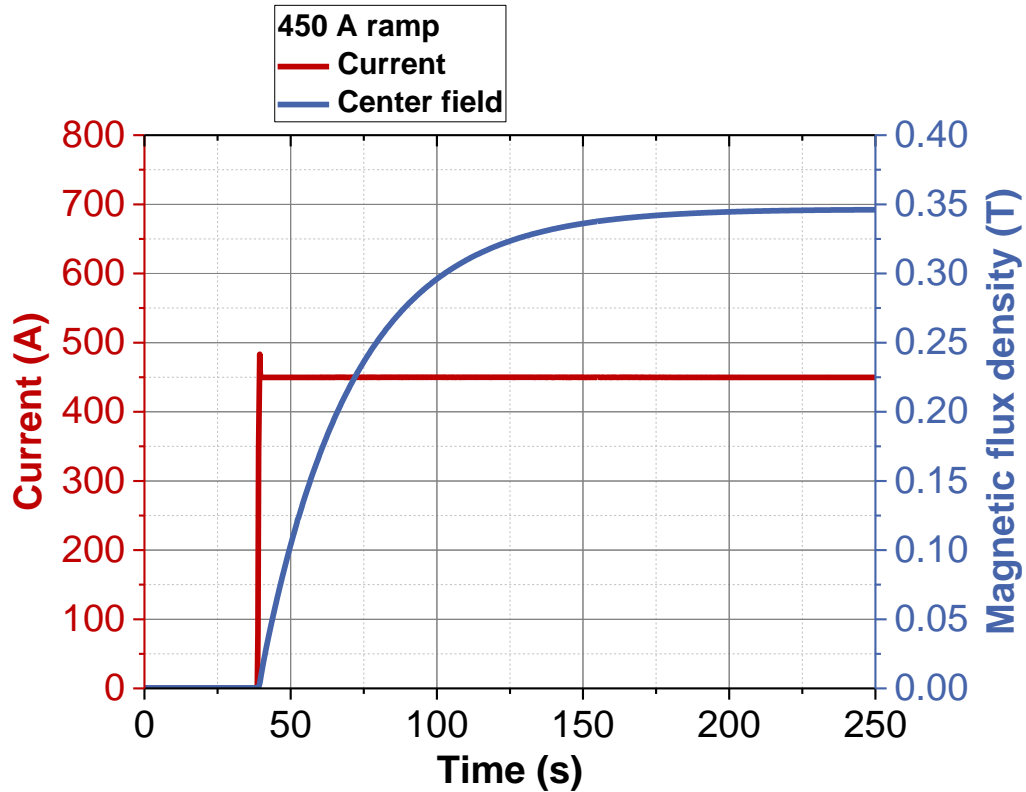


- Higher time constant with lower temperatures
- Saturation of contact resistivity

NI-COILS UNDER CONDUCTION COOLING

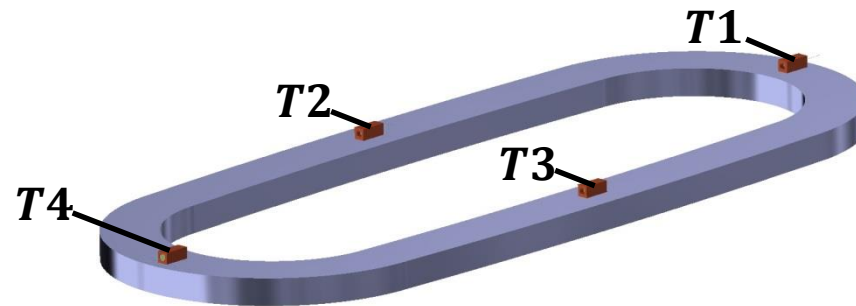


HEATING OF NI-COILS MEASUREMENT



- 450 A/s ramp
- End current: 450 A

■ Start temperature: 30 K

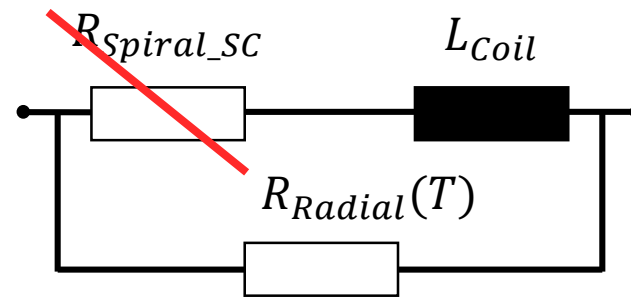


1D ELECTRO-THERMAL MODEL

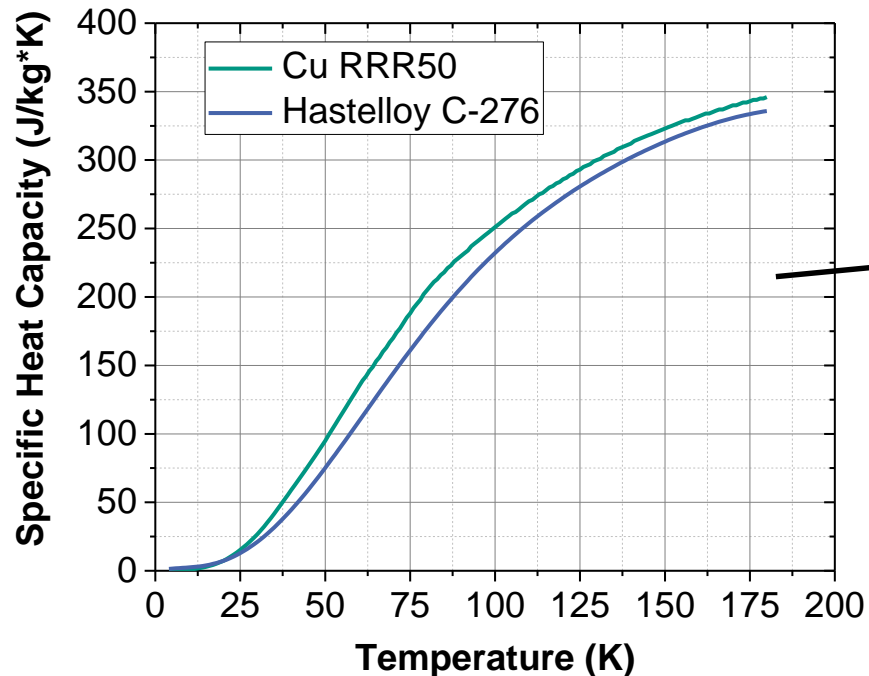
- Temperature depending

$$R_{Radial}(T)$$

- Thermal mass: 6.41 kg



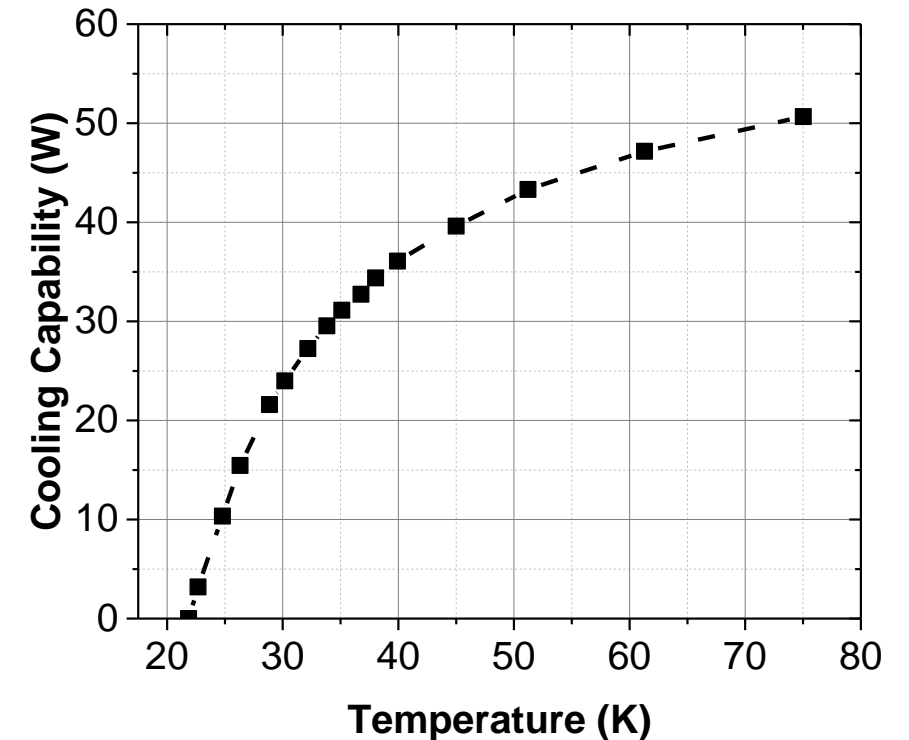
- Measured cooling curve from set-up under steady-state conditions



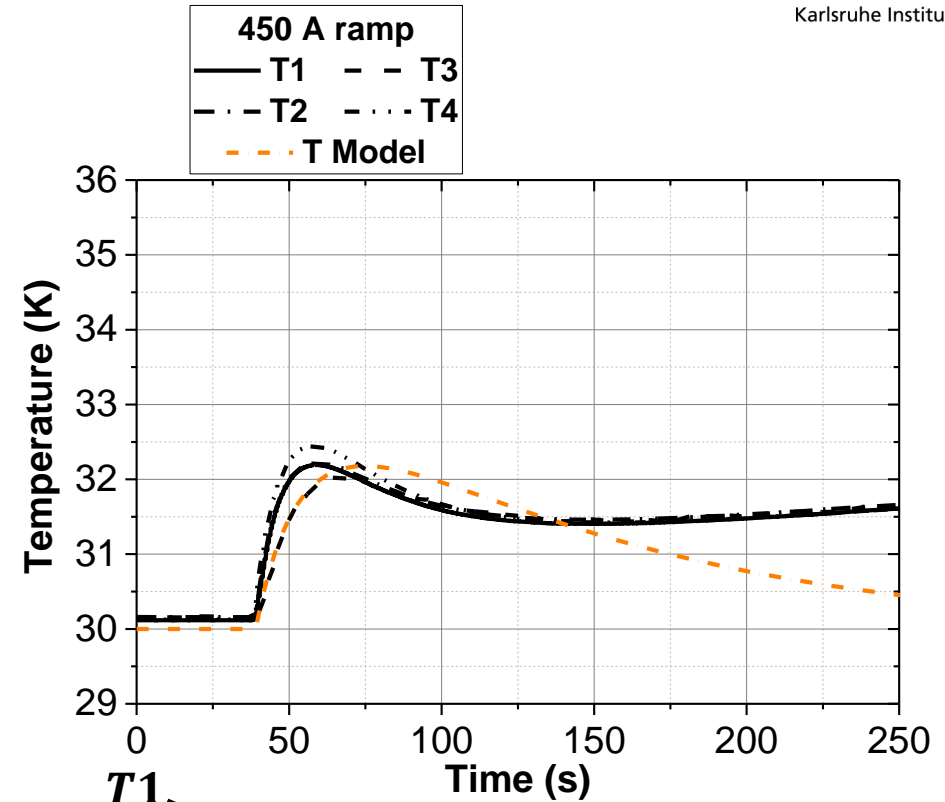
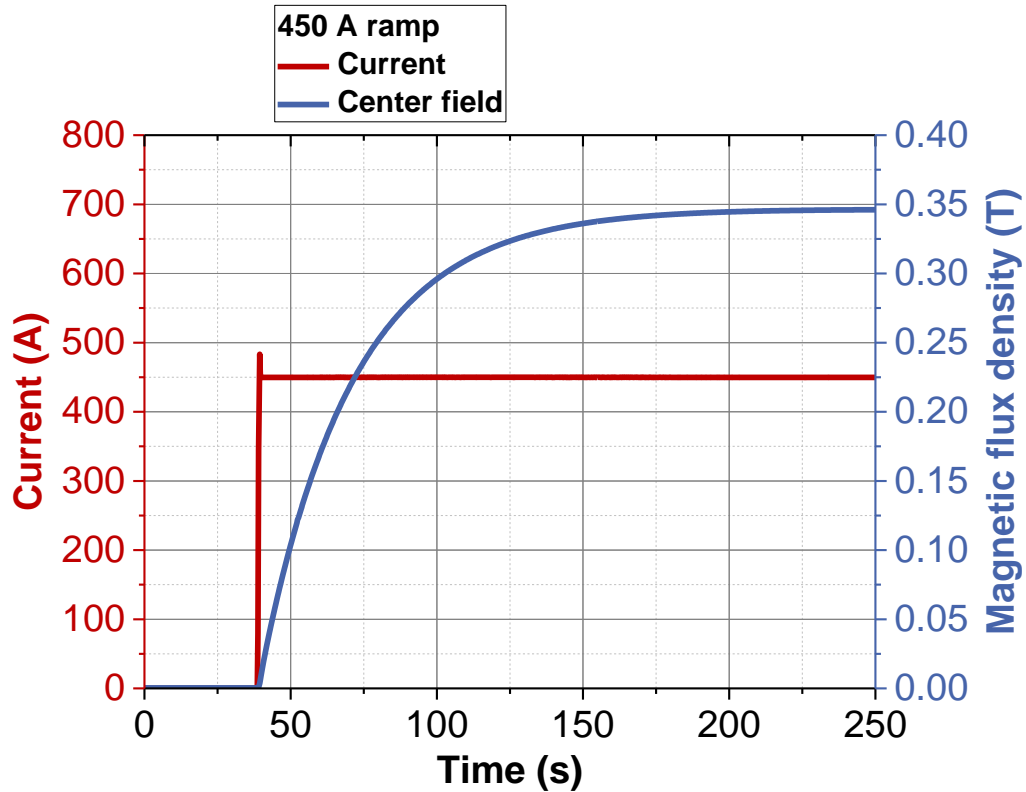
$$\dot{Q}_{Radial}$$

$$C_{Coil}(T)$$

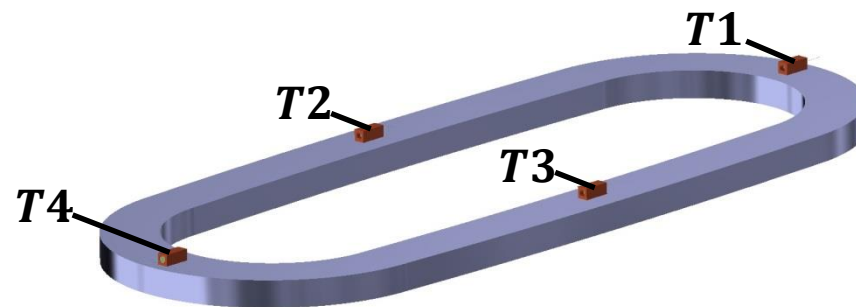
$$\dot{Q}_{Cooling}$$



HEATING OF NI-COILS MODEL

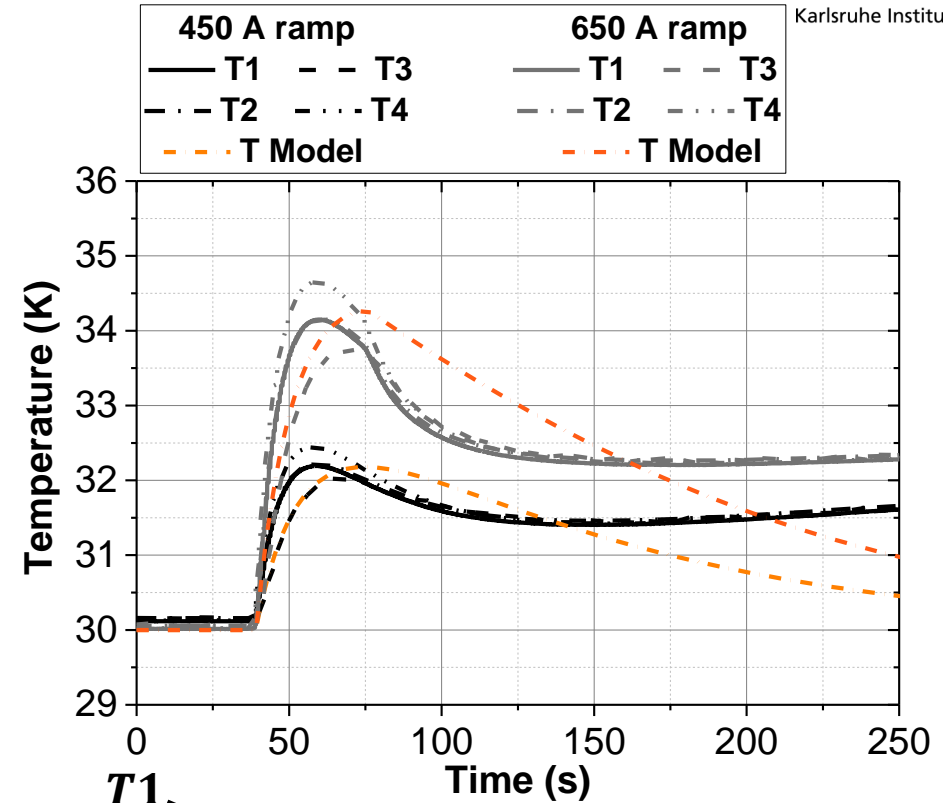
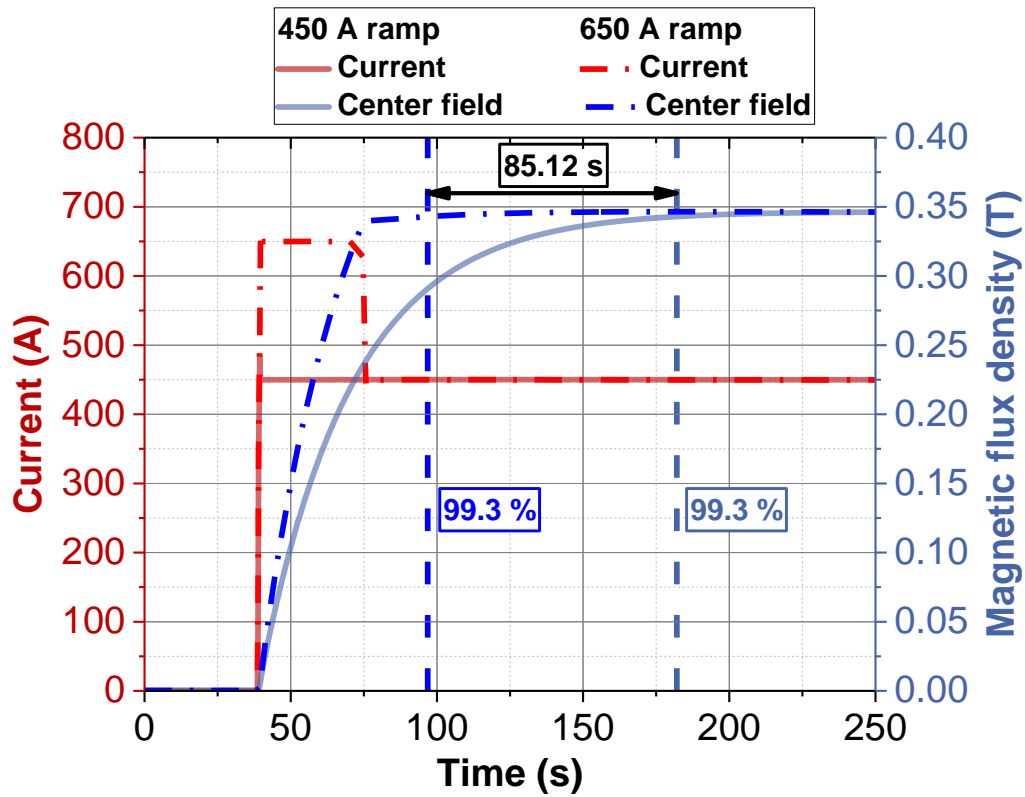


- 450 A/s ramp
- End current: 450 A



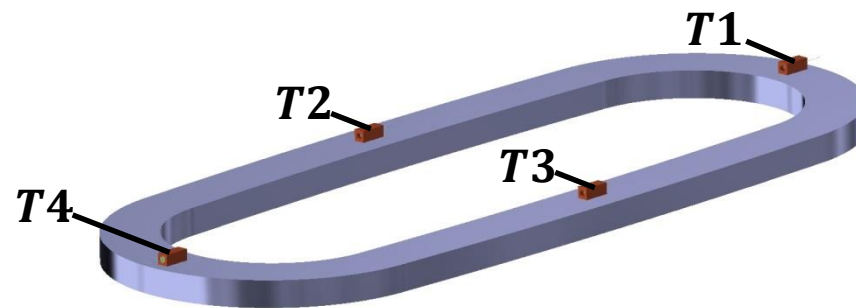
- Start temperature: 30 K
- Dissipated energy: 561.2 J
- $\Delta T = 2.06 \text{ K}$

OVERSHOOTING CURRENT RAMP



■ 650 A/s ramp for 37 s

■ End current: 450 A



■ Start temperature: 30 K

■ Dissipated energy: 1058 J

■ $\Delta T = 4.38 \text{ K}$

[1] S. Kim, S. Hahn, K. Kim and D. Larbalestier: „Method for generating linear current-field characteristics and eliminating charging delay in no-insulation superconducting magnets,“ Supercond. Sci. Technol. 30 (2017) 035020

CONCLUSION

- Successful test of 2 NI-HTS pancakes for a 6 pole stator system
- **Higher time constant** of the pancakes at **lower temperatures**
- **Saturation of contact resistivity** for HTS-tape samples
- **Saturation of time constant** for both pancakes
- **Heating** under **dynamic load** and **conduction cooled** conditions at 30 K
- Validation of heating with 1D electro-thermal model