

# Numerical Model and Experiment of Quench Process in HTS Racetrack Coil

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## Introduction

- 1) An numerical model is built to simulate the quenching process of the racetrack coil. This model couple circuit model and heat transfer model.
- 2) The quenching process of a racetrack coil is measured using voltage profiles in a conduction cooling system which is immersed in liquid nitrogen.
- 3) The simulated results and measured results are compared, including the voltage curve during quenching process, minimum quench energy (MQE) and normal zone propagation velocity (NZPV).

## Numerical model

Circuit model

Thermal model

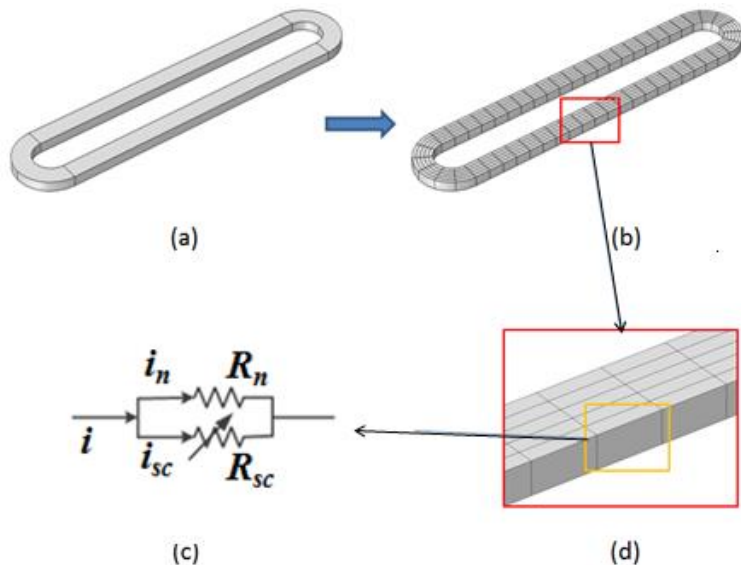
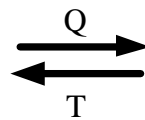


Fig. 1 schematic illustration of circuit model

Circuit equation

$$\begin{cases} E_0 l \left( \frac{i_{sc}}{I_c} \right) - (i - i_{sc}) R_n = 0 \\ I_c = I_{c0} \cdot I_c(B) \cdot I_c(T) \end{cases}$$

Thermal Equation

$$dC_p \frac{\partial T}{\partial t} + \nabla \cdot (-k \nabla T) = Q$$

## Experiment setup

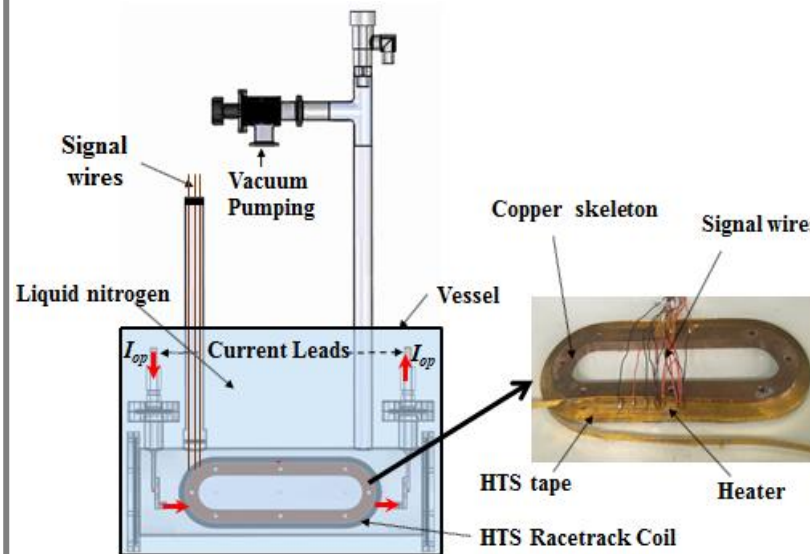


Fig. 2 schematic illustration of experiment system

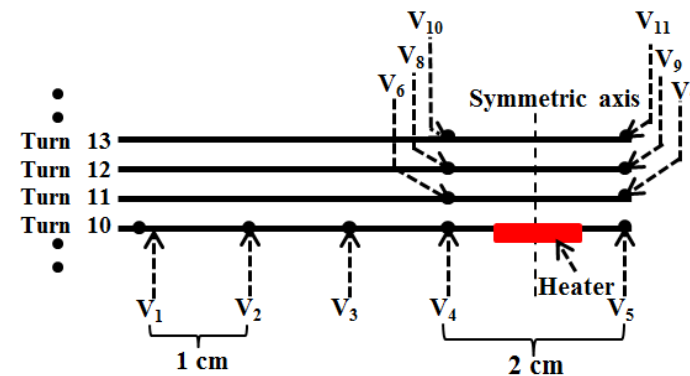


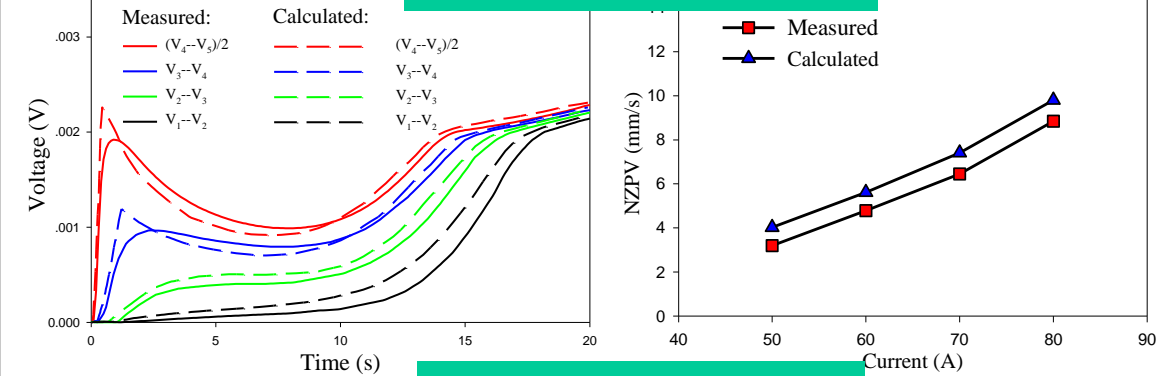
Fig. 3 schematic illustration the arrangement of voltage profiles

Turns	23
Inner radius	3.5 cm
Outer radius	4.7 cm
Straight line length	15 cm
Tape thickness	0.33 mm
Tape width	4.8 mm
Insulation thickness	0.19 mm
Tape $I_c$ @77 K	120 A
Coil $I_c$ @77 K	95 A
n value	31

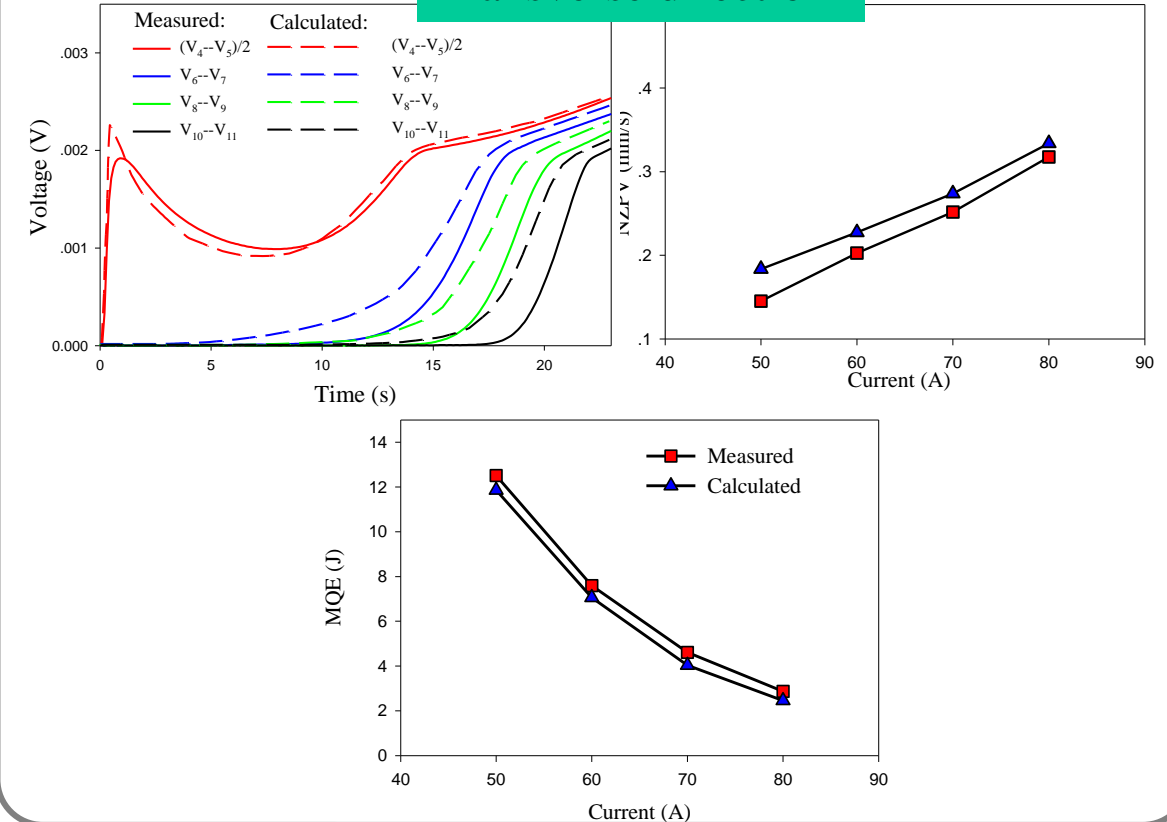
Table . I specification of the racetrack coil

## Results

### Longitudinal direction



### Transverse direction



## Conclusion

- 1) The numerical model is validated by comparing the simulated results with the measured results.
- 2) The MQE of the racetrack coil ranges from 2J to 12J, which is larger than the MQE of typical HTS tapes.
- 3) The longitudinal NZPV is about one order of magnitude larger than that in transverse direction.