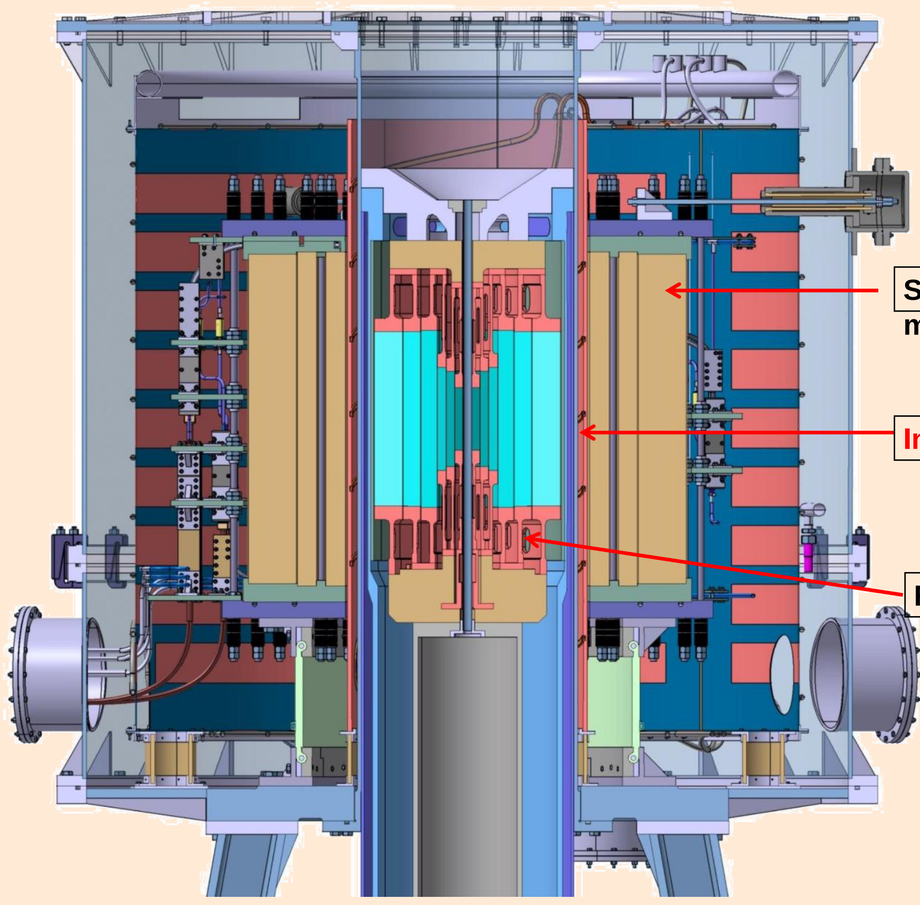
中國科學院強磁場科學中心

High Magnetic Field Laboratory of the Chinese Academy of Sciences

MT 26

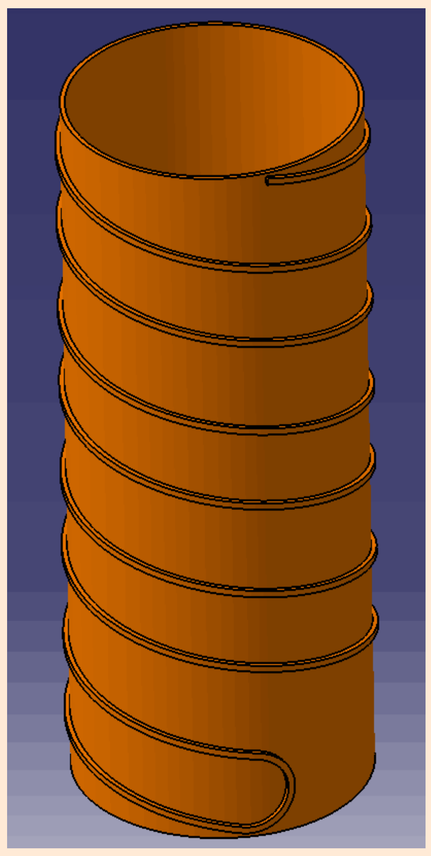
Redesign and Strength Check of 40T Hybrid Magnet Thermal Shield

***Abstract*—The 40T hybrid magnet in Hefei consisting of a 10 T superconducting outsert and a 30 T resistive insert magnet has passed the national evaluation in 2017 and has been running steadily up to now. The thermal shield cooled by liquid nitrogen sandwiched by the superconducting magnet and the water-cooled resistive magnet is the important component of the hybrid magnet. During the debugging phase of the hybrid magnet in 2016, a trip of the water-cooled resistive magnet triggered the quench protection of the superconducting magnet, resulting in expansion and rupture of the oxygen-free copper thermal shield. In this paper, we will reveal the reason of damage of the oxygen-free copper thermal shield via the finite element simulation analysis. We also introduce a new design scheme of the thermal shield adopted by the 40 T hybrid magnet which is currently operating steadily.**



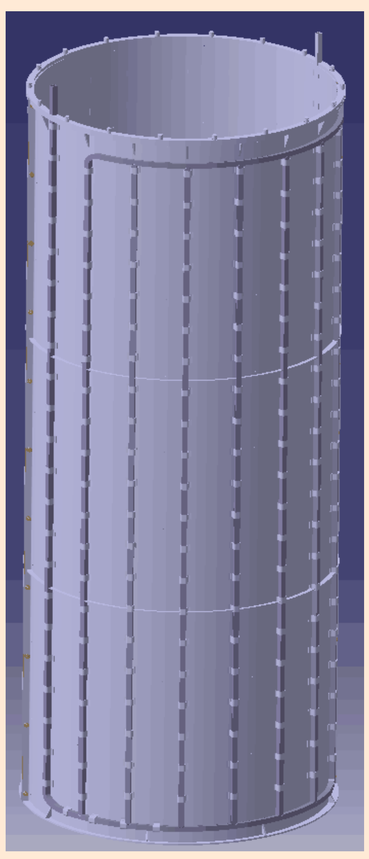
40T hybrid magnet

Previous design



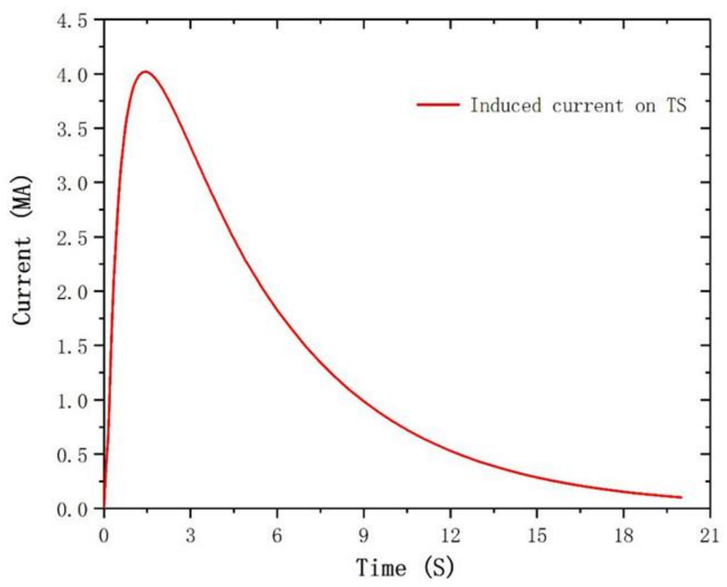
Material：Oxygen Free Copper

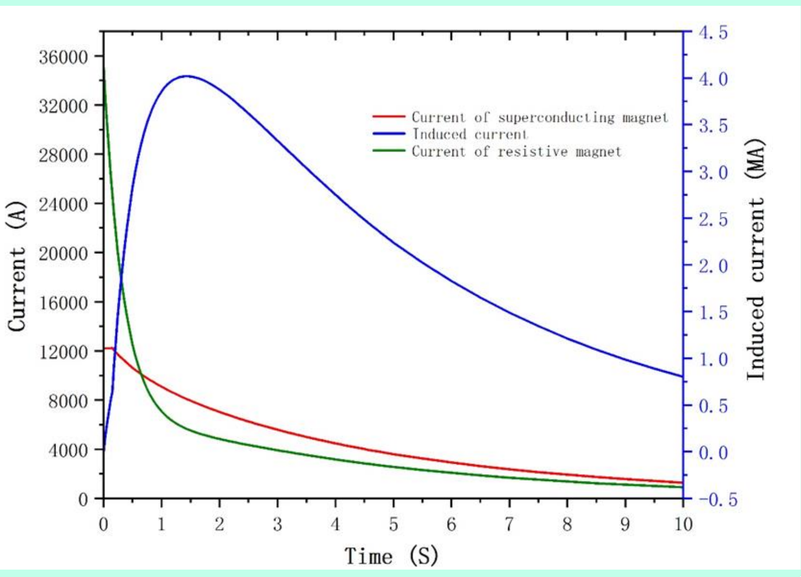
New design



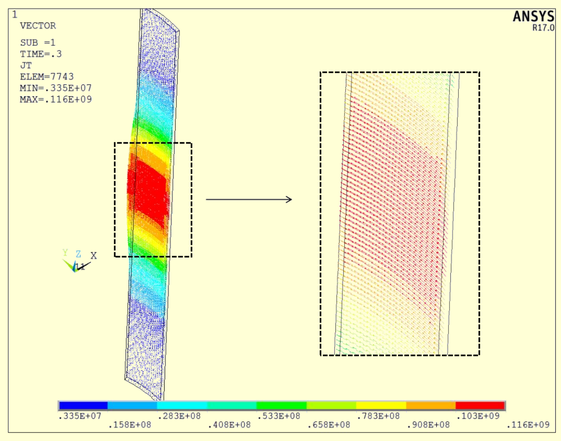
Material：Stainless Steel 304

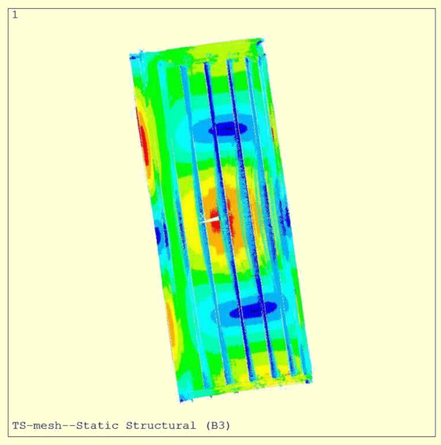
EDDY CURRENT ANALYSIS

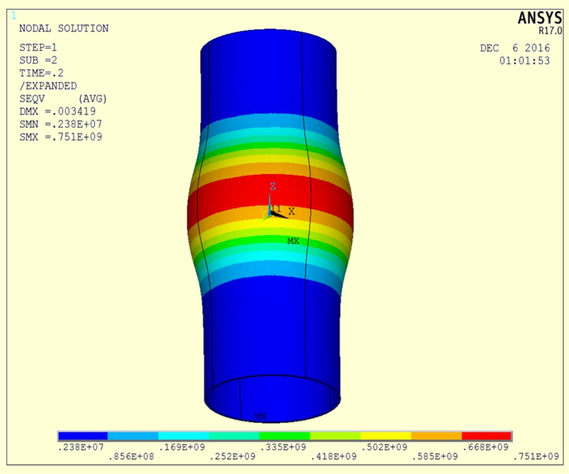


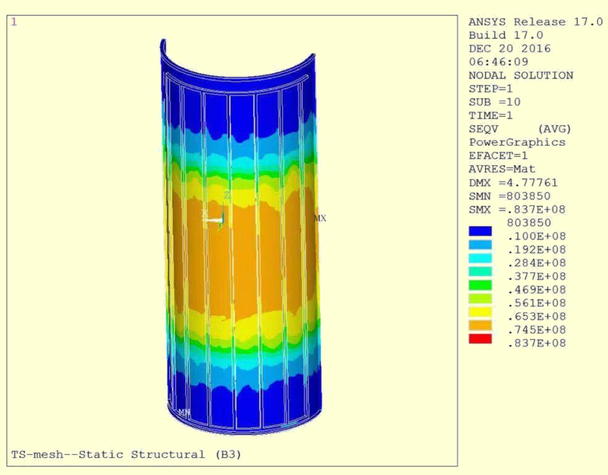


FINITE ELEMENT ANALYSIS









Component	Maximum current density	Maximum Stress
TS （copper）	1.16e8 A/m^2	751Mpa
TS（Stainless Steel 304）	5.27e5 A/m^2	83.7Mpa

***Conclusion*—By using the newly designed stainless steel 304 thermal shield instead of the oxygen-free copper thermal shield, the induced current on the thermal shield can be effectively reduced in the case of superconducting magnet quenching, thus ensuring the stability of the thermal shield under extreme conditions. At present, the new thermal shield is in good condition in the hybird magnet, and can effectively reduce the thermal radiation of the external environment to the superconducting magnet.**