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Cryogenic Design and Thermal Stability Analysis of a HTS Magnet for a Radiation Blackout Mitigation Experiment

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Radiation blackout is a communication interruption phenomenon during hypersonic or reentry flight, caused by a plasma layer around a vehicle attenuating or reflecting radio waves. A vehicle in the radiation blackout phase will lose all contact with ground stations or satellites including GPS signals, data telemetry and voice communication. A method proposed to reduce the plasma density around senders and antennas is the use of crossed electric and magnetic fields. The Helmholtz-Russia Joint Research Group COMBIT will demonstrate this method at flight relevant conditions in an arc-heated wind tunnel (L2K facility) at the German Aerospace Center in Cologne. A conduction cooled HTS magnet produced by KIT is applied to generate the required magnetic field in the experiment, which is larger than 2 T outside the cryostat. Meanwhile it must satisfy the very strict space and environment conditions of L2K and will be exposed to the plasma beam with a temperature around 450 K. The special design of COMBIT cryogenic system is presented in detail in this contribution. The thermal stability of COMBIT magnet is analyzed, considering the influences from AC losses during current ramping and the heat exposure of the vacuum vessel due to the plasma beam. At last, this paper presents the test result of the COMBIT HTS magnet, which confirms the design of its cryogenic system and the thermal stability analysis.

Primary author: WU, Hong (Karlsruhe Institute of Technology)

Co-authors: Mrs KLING, Andrea (Karlsruhe Institute of Technology); Mr RINGSDORF, Bernd (Karlsruhe Institute of Technology); Mr FILLINGER, Holger (Karlsruhe Institute of Technology); Mr BRAND, Joerg (Karlsruhe Institute of Technology); Dr SCHLACHTER, Sonja (Karlsruhe Institute of Technology); Dr GOLDACKER, Wilfried (Karlsruhe Institute of Technology)

Presenter: WU, Hong (Karlsruhe Institute of Technology)

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