MT25 Conference 2017 - Timetable, Abstracts, Orals and Posters



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Real-time functional diagnostics of superconducting magnets using acoustic techniques

Monday 28 August 2017 11:45 (15 minutes)

Functional diagnostics of superconducting magnets is essential for ensuring their safe and reliable operation and understanding performance limitations. Among various known diagnostic approaches, acoustic techniques being non-invasive and inexpensive carry a significant potential that is not yet fully explored. Firstly, acoustic emissions provide direct access to magnet mechanical disturbance spectra, allowing localization, and in some cases identification of the type of disturbances leading to premature quenching, training and memory phenomena. Next, they allow for real-time structural monitoring of mechanical integrity, contact stiffness and coupling between magnet structural parts. Finally, early detection of heat release in coil windings during current ramping and quench development can be accomplished using active acoustic sensing of local variation of the Young's modulus. Acoustic detection of hot spots using this principle is complementary to the conventional voltage-based quench detection, and can be especially useful for high-temperature superconductor magnets exhibiting slow quench propagation. We demonstrate how the described range of diagnostic capabilities can be achieved with in-house developed package of passive and active acoustic analysis and sensor hardware. We present a novel "acoustic heartbeat"monitoring tool, allowing for in-depth real-time analysis of disturbance types, structural integrity and heat release in the magnet. Validation of our tool during testing of the canted-cosine-theta Nb3Sn dipole and ReBCO tape stacks will be discussed.

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