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Progress Towards Hall Sensor-Based Quench Detection in CORC® Cables

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ReBCO-based CORC® superconducting cables [1] can enable compact fusion reactors and high-field accelerator magnets. However, additional research is required to develop sensitive and robust quench detection methods. One potential technique utilizes Hall probe arrays in CORC® cable terminations to monitor inter-tape current redistribution [2] as a proxy for quench detection. In short-sample quench experiments done at 77 K, this method yielded detection sensitivities equivalent to or better than voltage-based detection [3-4]. Present work addresses a scale-up of the technique to longer 4-10-meter CORC® samples, and to 4.2 K. We are using large-scale Hall probe arrays to monitor variations of the axial and radial field caused by quench-driven current redistribution. We will discuss static and dynamic phenomena occurring during fast ramps and normal zone development, as well as new methods to improve understanding of current sharing. Finally, recent progress on a rotary cryogenic Hall probe scanner for CORC® cables is presented along with algorithms for current reconstruction based on an inverse Biot-Savart algorithm.

[1] D C van der Laan et al., 2019 Supercond. Sci. Technol. 32 033001
[2] M. Marchevsky et al., 2010 Supercond. Sci. Technol. 23 034016
[3] R. Teyber et al., 2020 Supercond. Sci. Technol. 33 095009
[4] J D Weiss et al. 2020 Supercond. Sci. Technol. 33 105011

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