MT 26
International Conference on Magnet Technology
Vancouver, Canada | 2019

Contribution ID: **1616** Type: **Contributed Oral Presentation**

Fri-Mo-Or25-07: Analysis of the transient mechanics behind superconducting accelerator magnet training

Friday, 27 September 2019 09:30 (15 minutes)

Training is a long-standing problem hindering performance of high-field superconducting accelerator magnets. Proliferation of cracks in the epoxy impregnation and mechanical motion of the conductor in a stick-slip fashion are known to be the most common factors causing premature magnet quenching, and are also responsible for the training. Identifying and understanding those processes is thus essential for solving the training problem. By acquiring acoustic emissions and voltages continuously at a rate of 1 MHz during magnet ramping to quench, we have collected a large dataset of transient mechanical events in the recently tested canted-cosine-theta Nb3Sn dipole magnets CCT4 and CCT5 developed by the U.S. Magnet Development Program. Energy release in these events and their spatial localization were estimated and compared to the superconducting margin. Acoustic signals were further analyzed by creating their wavelet-based spectrogram representations and applying unsupervised machine learning techniques to learn a representation that allows for further downstream analysis, e.g. clustering, to identify events of different kind. We followed evolution of these clusters from one current ramp to another, and developed a qualitative picture of how the underlying mechanical processes define the training rate. After the test, the magnets were disassembled, coils cut and crack formations imaged, allowing for making a direct connection between the distribution of physical epoxy cracks and the acoustic data. The results will be used towards developing a neural network model capable of recognizing different types of transient mechanics in magnets, and providing a real-time feedback to magnet designers and operators on the expected course of training and its causes.

This work was supported by the Director, Office of Science, High Energy Physics, and U.S. Department of Energy under contract No. DE-AC02-05CH11231.

Primary authors: MARCHEVSKY, Maxim (Lawrence Berkeley National Laboratory); ARBELAEZ, Diego (Lawrence Berkeley National Lab); BROUWER, Lucas (Lawrence Berkeley National Laboratory); PRESTEMON, Soren (LBNL); Dr STEPHEY, Laurie (Lawrence Berkeley National Laboratory); Dr MUSTAFA, Mustafa (Lawrence Berkeley National Laboratory); Dr FARRELL, Steve (Lawrence Berkeley National Laboratory); Dr PRABHAT (Lawrence Berkeley National Laboratory)

Presenter: MARCHEVSKY, Maxim (Lawrence Berkeley National Laboratory)

Session Classification: Fri-Mo-Or25 - Accelerator Magnets - Miscellaneous