Observations of Fast-Flux Transients and Instability in Nb_3Sn Magnets

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The Superconducting Magnet Group at Lawrence Berkeley National Laboratory has been developing high-field, brittle-superconductor, accelerator magnet technology for several years. Recent dramatic increases in Nb_3Sn superconducting current density, (J_c = 3000 A/mm^2, at 12 Tesla, 4.2 K) have facilitated the achievement of record peak dipole bore-fields (16 Tesla). However, the number and size of fast coil-flux adjustments of the "flux-jump" variety have increased with the current density. In 2000, with state-of-theart Nb3Sn Jc = 2000 A/mm^2, the associated voltage transients were large enough to cause occasional nuisance "quench-detector" magnet-protection false-alarms. Subsequent J_c increases have resulted in flux-jumps large enough to quench some magnets well below the current predicted by their strand's superconducting "short-sample" measurements.

This paper will show representative examples of "flux-jump" signals, and summarize the latest techniques for observing them in high-field magnets, as well as, distinguishing them from "slip-stick" flux-adjustments (both of which can become large enough to negatively impact a magnet's reliability). Recent efforts to localize an unstable coil's "flux-jumps", especially performance-limiting ones, will be presented and discussed. Some implications for future magnet and/or conductor design and development will be examined.

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