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Record High Ramping Rates in HTS Based Superconducting Accelerator Magnet

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We report on power test of a rapid-cycling superconducting accelerator magnet. The dual-bore magnetic core of 0.5 m length and two 10 mm (vertical x 100 mm (horizontal) beam gaps arranged in vertical plane is energized with HTS-based power cable. The 3-turn magnet cable is placed within magnetic core space where core descending magnetic field is strongly suppressed minimizing ramping B-field induced eddy and hysteresis losses for the cable. The conductor cable is formed of 2 sub-cables each using 2 HTS strands (2.5 mm x 0.1 mm) helically wound on the supporting SS pipe (8 mm x 0.1 mm) which also serves as liquid helium conduit. The strands are firmly secured on the pipe surface with a single wrap of 12.5 mm x 0.1 mm Cu tape. Conventional current leads are used to connect power supply to magnet conductor coil. Magnet coil and leads are separately cooled with flow of supercritical helium (6 K, 2.5 bar). The current discharge capacitor bank is used to energize magnet. The sine -wave-like conductor current of 1 kA at 14 Hz generated 0.52 T B-field variation in magnet beam gaps with maximum ramping rate of 289 T/s. The liquid helium temperature does not show increase between the off/on power cycles within +/- 0.003 K measurement error indicating cryogenic power loss possibly less than 0.1 W. An upgrade of magnet design to higher B- fields in the 20 mm beam gaps, as considered for the muon collider accelerator, is discussed.

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