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Field Measurement to evaluate iron saturation and coil end effects in the 2-m Model Magnet of Beam Separation Dipole for the HL-LHC Upgrade

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We have been developing the beam separation dipole magnet for the High Luminosity LHC (HL-LHC) upgrade. The magnet has a coil aperture of 150 mm using NbTi superconducting cable and dipole magnetic field of 5.6 T will be generated at 12 kA at 1.9 K to provide the field integral of 35 Tm. We have started development of the first 2-m-long model magnet (MBXFS01) to evaluate the design and the performance. In the first cold test in 2016, quench performance was not satisfactory because the coil stress at pole was completely released during excitation. It was decided that the model magnet was reassembled with increasing the coil stress to improve the quench performance. The excitation test of the modified model magnet (MBXFS01b) was performed at 1.9 K from February 2017 at KEK. The magnet showed much better quench performance and succeeded to reach the ultimate current of 13 kA as acceptance criteria. After the train campaign, magnetic field measurement was performed by a rotating coil method. The coil systems with an internal compensation of main dipole field were superior to simple coils in measuring the high-order multipole components and eliminating a variety of measurement errors. Due to the large coil aperture and limited outer diameter of the iron yoke, the control of iron saturation effects on the field quality has been a design issue. Regarding the magnetic performance, field saturation effects on the transfer function and the multipole field variation along the excitation, and coil end effects to the straight section need to be evaluated by the field measurement. In this work, field measurement results will be presented and the comparison with the 3D field calculation will be discussed.

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JAPAN

Primary author: Mr ENOMOTO, Shun (KEK)

Co-authors: SASAKI, Kenichi (KEK); KIMURA, Nobuhiro (HIGH ENERGY ACCELERATOR RESEARCH ORGANIZATION, KEK); OGITSU, Toru; NAKAMOTO, Tatsushi; Mr TAKAHASHI, Naoto (KEK); SUZUKI, Kento (High Energy Accelerator Research Organization); IKEMOTO, Yukiko (KEK); Mr IIDA, Masahisa (KEK); SUGANO, Michinaka; Mr SUGAWARA, Shigekatsu (KEK); MUSSO, Andrea (CERN); TANAKA, Ken-ichi (KEK); Mr OHATA, Hirokatsu (KEK); Mr OKADA, Ryutaro (KEK); OKADA, Naoki (KEK); Mr KAWAMATA, Hiroshi (KEK); TODESCO, Ezio (CERN); Mr HIGASHI, Norio (KEK)

Presenter: Mr ENOMOTO, Shun (KEK)

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