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Magnetic Design Update of Large Aperture Beam Separation Dipole for the HL-LHC Upgrade

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High-luminosity Large Hadron Collider (HL-LHC) upgrade aims increase of peak luminosity by a factor of five and integrated luminosity by a factor of ten over the life of the upgraded machine in comparison with the current LHC. Large aperture final focusing quadruple magnets play a major role to obtain a smaller \beta*at an interaction point and they are being developed by CERN and US-LARP. Large beam separation dipole magnets (D1) are also needed for the new beam optics and KEK has been in charge of development of D1 in the framework of CERN-KEK collaboration. This magnet is based on Nb-Ti technology and generates field integral of 35 T·m at 12.0 kA and 1.9 K in a coil aperture of 150 mm. One of the difficulties in magnetic design of D1 is management of severe iron saturation due to a large coil aperture and limitation of an outer diameter of iron yoke. Main design parameters were once fixed after a series of design studies and the first 2 m model was fabricated and tested at cold in 2015 – 2016. However, it was recently decided by CERN that heat exchanger holes have to be in line with those of the inner triplets and modification of cross section of D1 magnet was requested. This was a very large impact on field quality and re-optimization of coil and iron yoke should be performed. In this paper, we will report magnetic design with new cross section of the coil and the iron yoke with four heat exchanger holes. Optimal conditions of the field tuning holes to reduce variation of multipole coefficients from the injection to the nominal current will be discussed. Optimization of coil end shape will be also mentioned considering minimization of cable strain and integrated multipoles over 7 m long magnet.

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