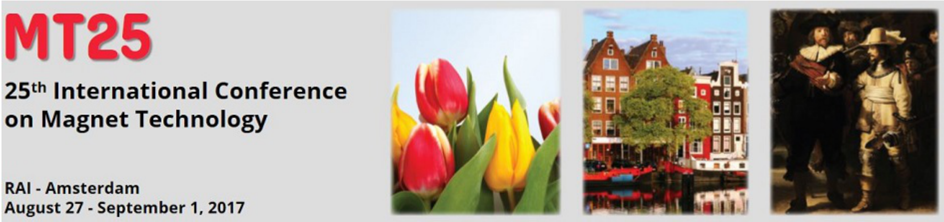

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Influence of 3D effects on field quality in the straight part of accelerator magnets for the High Luminosity Large Hadron Collider

Tuesday 29 August 2017 13:15 (1h 45m)

The new D1 beam separation dipole is currently developed at KEK for the Large Hadron Collider Luminosity upgrade (HL-LHC). Four 150 mm aperture, 5.6 T magnetic field and 6.7 m long Nb-Ti magnets will replace resistive D1 magnets in the insertion regions of the LHC. The development includes fabrication and testing of 2.2 m model magnets. The magnet has single layer coil and thin spacers between coil and iron, giving a non negligible impact of saturation on field quality at nominal field. The magnetic design of the straight section coil cross section is based on 2D optimization by means of the ROXIE code, and a separate optimization of the coil ends. However, magnetic measurements of the short model showed a large difference (tens of units) between the sextupole harmonic in the straight part and the 2D calculation. This difference is correctly modelled only by a 3D analysis: 3D calculation performed with Opera-3D and ROXIE show that the magnetic field quality in the straight part is influenced by the coil ends, even for the 6.7 m long magnets. The effect is even more remarkable in the short model. In this paper we investigate similar 3D-effects for other magnets, namely the 11 T dipole for the HL-LHC for which the effect is clearly visible for the single aperture model. On the other hand in the double aperture configuration with field in opposite direction the effect is negligible. We also consider the case of the 4.5 T recombination magnets for HL-LHC (D2), where the lower field and the larger space between coil and iron makes this effect less important, but still visible. We conclude the paper by outlining the different classes of accelerator magnets where this coupling between 3D effects and iron saturation can be relevant.

Submitters Country

Switzerland

Author: NILSSON, Emelie (CERN)

Co-authors: IZQUIERDO BERMUDEZ, Susana (CERN); TODESCO, Ezio (CERN); Mr ENOMOTO, Shun (KEK); FARINON, Stefania (Universita e INFN Genova (IT)); FABBRICATORE, Pasquale (Universita e INFN Genova (IT)); NAKAMOTO, Tatsushi; SUGANO, Michinaka; SAVARY, Frederic (CERN)

Presenter: NILSSON, Emelie (CERN)

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