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Geometric field errors of Short Models for MQXF, the Nb₃Sn low-beta Quadrupole for the High Luminosity LHC

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In the framework of the High-Luminosity upgrade of the Large Hadron Collider, the US LARP collaboration and CERN are jointly developing a 150 mm aperture Nb₃Sn quadrupole for the LHC interaction regions. Due to the large beam size and orbit displacement in the final focusing triplet, MQXF has challenging targets for field quality at nominal operation conditions. Three short model magnets have been tested and around thirty coils have been built, allowing a first analysis of the reproducibility of the coil size and turns positioning. The impact of the coil shimming on field quality is evaluated, with special emphasis on the warm magnetic measurements and the correlation to magnetic field measurements in operation conditions. The variability of the field harmonics along the magnet axis is studied by means of a Monte-Carlo analysis and the effects of the corrective actions implemented to suppress the low order un-allowed multipoles are discussed.

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