BEAM COUPLING IMPEDANCE OF THE NEW BEAM SCREEN OF THE LHC INJECTION KICKER MAGNETS

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Abstract

The LHC injection kicker magnets experienced significant beam induced heating of the ferrite yoke, with high intensity beam circulating for many hours, during operation of the LHC in 2011 and 2012. The causes of this beam coupling impedance were studied in depth and an improved beam screen implemented to reduce the impedance. Results of measurements and simulations of the new beam screen design are presented in this paper: these are used to predict power loss and temperature of the ferrite yoke for operation after long shutdown 1 and for proposed HL-LHC operational parameters.

INTRODUCTION

NEW DESIGN

IMPEDANCE MEASUREMENTS

POWER LOSS AND FUTURE IMPROVEMENTS

INTRODUCTION

During the 2011 and 2012 runs of the LHC, high temperatures were observed in several devices in the LHC [1], a critical piece being the LHC injection kicker magnets (MKIs, Fig. 1), which were attributed to beam-induced heating due to high power loss from the interaction of the circulating beam with the longitudinal beam coupling impedance. This heating was observed to raise the temperature of the ferrite yoke of one of the MKIs above its Curie point during fills, thereby necessitating waiting times of several hours for the ferrite to cool before safe injection could be carried out [2].

In response to this an extensive study to reduce the temperature of the ferrite yoke was carried out, aimed at reducing the power loss into the kicker magnet and increasing the transfer of thermal energy from the ferrite yoke to the surroundings [3]. A new beam screen was implemented in MKI8D in technical stop 3 (TS3) (23/09/12-27/09/12) with improved screening of the ferrite from the beam and some modifications to reduce the likelihood of electrical breakdown during magnet pulsing: this was observed to greatly reduce the temperature of the ferrite yoke [3]. Building on this success, further modifications to the beam screen have been proposed to further reduce the beam coupling impedance. In addition, the reasons for the resulting impedance in a well screened magnet (i.e. where the beam does not see the ferrite yoke) are discussed.

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