Evaluation of the Beam Coupling Impedance of New Beam Screen Designs for the LHC Injection Kicker Magnets

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Abstract

The LHC injection kicker magnets (MKIs) have experienced a significant degree of beam induced heating since the beginning of the 2011 due to the increasing intensity stored in the LHC, for long periods of time, and the relatively large broadband impedance of the installed kicker magnets. In this paper we show the sources of impedance in the MKIs, especially the effect that the beam screen dimensions have on the impedance. We show how these alter the power loss, and present an improved beam screen design that improves shielding on the magnet, whilst further improving electrical breakdown.

INTRODUCTION

During the 2011 and 2012 runs of the LHC, high temperatures were observed in several devices in the LHC [6], a critical piece being the LHC injection kicker magnets (MKIs), which were attributed to beam-induced heating due to high power loss from the interaction of the circulating beam with the beam coupling impedance of the MKI. This heating was observed to raise the temperature of the ferrite yoke of the kickers above their Curie point during fills, thereby necessitating long waiting times for the ferrite to cool before safe injection could be carried out [1].

In response to this an extensive study in reducing 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. A new beam screen was implemented in MKI8d in technical stop 3 (23/09/12-27/09/12) with improved screening of the ferrite from the beam and some modifications to reduce the liklihood of electrical breakdown during magnet pulsing was installed, and was observed to greatly reduce the temperature of the ferrite yoke [2]. Building on this success, more

CAUSES OF THE IMPEDANCE

NEW BEAM SCREEN DESIGN

POWER LOSS FOR FUTURE OPERATION

SUMMARY

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