

Design Optimization of a Compact Quadrupole Electromagnet for CLS 2.0

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Abstract : This paper reports a study on the optimal magnetic design of a compact quadrupole electromagnet for the Canadian Light Source (CLS 2.0). The nature of the design is to determine a quadrupole with low relative higher order harmonics and better field quality. The design problem was formulated as an optimization model, in which the objective function is the higher order harmonics (multipole errors) and the variable to be optimized is the material distribution on the pole. The higher order harmonics arose in the quadrupole due to truncating the ideal hyperbola at a certain point to make the pole. In this project, the arisen harmonics have been optimized both transversely and longitudinally by adjusting material on the poles in a controlled way. For optimization, finite element analysis (FEA) has been conducted. A better higher order harmonics amplitudes and field quality have been achieved through the optimization. On the basis of the optimized magnetic design, electrical and cooling calculation has been performed for the magnet.

Keywords : drift, electrical, and cooling calculation, integrated field, magnetic field gradient, multipole errors, quadrupole

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