For submission to EPAC 2006

Investigations of the parameter space for the LHC Luminosity Upgrade*

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Abstract :

Increasing the LHC luminosity by a factor of ten is a major challenge, not so much for the beam optics but certainly for the beam-beam long-range interactions and even more for the technology and layout: the quadrupole gradient, its physical aperture and tolerance to the energy deposition shall be significantly increased; its distance to the crossing point shall be reduced if the particle detectors can allow it. To help identifying consistent solutions in this multi-dimensional constrained space, a algorithmic model of an LHC insertion was prepared, based on the present LHC layout, i.e. “quadrupole first” and small crossing angle. The model deals with the layout, the beam optics, the beam-beam effect, the superconductor field margins and the peak heat deposition in the coils. The approach is simplified to allow a large gain in the design/computation time for optimization. First results have shown the need to use the Nb_3Sn technology (or a material of equivalent performance) to reach the performance goal. In this paper, the model is refined to take into account the quench levels and temperature margins. The optimal insertions within the framework of this approach are identified.

*Work supported by the European Community-Research Infrastructure Activity under the FP6 “Structuring the European Research Area” programme (CARE, contract number RII3-CT-2003-506395)

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