



Contribution ID: 377

Type: **Poster Presentation of 1h45m**

Parametric Study of Block-coil Dipoles Using Graded Conductors

Wednesday, August 30, 2017 1:15 PM (1h 45m)

In the framework of the Future CERN Collider (FCC) studies, and in order to reach 100 TeV collision energies, 16 T dipoles are under development. To allow for a more compact and cost-effective design, the coils need to be graded. This paper presents a 2D parametric study which explores possible options for an optimal grading. This study uses both analytical formulas and FE analysis. Block coils are considered, using two cable sizes, and therefore two different current densities. Various parameters are also explored, such as cable combinations, current density ratios, or position and size of the blocks. This study shows in particular what are the optimal grading ratio and amount of conductor to reach the 16 T bore field with reasonable margins, while minimizing the conductor area.

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Session Classification: Wed-Af-Po3.01

Track Classification: A1 - Superconducting Accelerator Magnets