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# A structured approach to analyze the influence of channel dimensions on heat extraction via superfluid helium

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When the luminosity of the LHC at CERN is upgraded, the final focusing quadrupole magnets will receive a much higher energy deposition in their coil windings. To better understand the thermal behavior of coil windings at temperatures below -and some kelvin above- the helium lambda transition point, several numerical models have been developed. These models have been partially validated with experimentally obtained results, but none of them have been used to analyze the various designs in a structured way. The main reason for the missing analyses is that setting up and varying the several free parameters is very laborious in the existing models. Here we present a new model, based on an earlier presented FEM model, which makes use of coupling - and integration variables. By making use of coupling variables, a full 3D model can be made 2.5D, which allows changing the insulation width, thickness and angle, as well as the number of layers in a straightforward way, without any loss of generality. The user can easily and quickly change the parameters of interest, giving the possibility to analyze new ideas effectively. By changing boundary conditions, analyses show clearly which thermal paths are favorable over others and where improvements can be made. The thermal path along the wide side of the Rutherford cable is longer than from the small side, but more heat is extracted via here since the contact surface with the cable is larger.

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