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3D Conceptual Design of R2D2, the Research Racetrack Dipole Demonstrator

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R2D2, the Research Racetrack Dipole Demonstrator, is a short model being developed within a collaboration between CEA Paris-Saclay and CERN aimed at developing key technologies for future high field 16 T Nb_3Sn magnets for particle colliders. In the particular case of block-coil designs, two different cable grades are wound in the same coil layer, in order to maximize the current density, therefore to minimize the size of the magnet and the use of superconductor. One of the most challenging technologies with this grading concept, is the connection between two cables grades. CEA Paris-Saclay has proposed a concept of external joints, for which the cable exits are guided outside of the coil to perform the connections between the cable grades. The R2D2 project is aimed at demonstrating this technology in a representative demonstrator magnet, while simplifying and reducing the risks when possible, as an intermediate step towards 16 T magnets. In particular, the magnet is composed of single-layer racetrack coils, mainly to reduce the use of conductor and simplify some fabrication steps. However, the complexity inherent to the external joints requires a special focus in the design of the coil ends. To do so, the design of the magnet has been performed using a combination of CAD (Computer Aided Design), magnetic and mechanical 3D FEM (Finite-Elements Models). This paper will explain the design choices leading to a safe operation of the magnet in terms of peak fields and peak stresses. In particular, different strategies for the mechanical support of the coil-ends will be presented.

Primary authors: Dr ROCHEPAULT, Etienne (Université Paris-Saclay (FR)); DURANTE, Maria; Dr RONDEAUX, Françoise (CEA PAris-Saclay); CALVELLI, Valerio; PERRAUD, Simon (Université Paris-Saclay (FR)); MANIL, Pierre (Université Paris-Saclay (FR)); Mr MINIER, Gilles (CEA Paris-Saclay); PEREZ, Juan Carlos (CERN); FELICE, Helene (CERN)

Presenter: Dr ROCHEPAULT, Etienne (Université Paris-Saclay (FR))

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