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Mechanical design of a superconducting magnet for gravity compensation

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Magnetic compensation of gravity allows for ground-based experiments to be carried out under weightless conditions at reasonable cost and without the time limitation of systems such as zero-g airplanes or drop towers. In this paper a superconducting magnet for gravity compensation is described. The magnet warm bore diameter is 380mm and the center field is 2T. The magnet is comprised by nine solenoid coils wound on two separated mandrels. The magnet is conduction cooled by two GM cryocoolers. Mechanical design and analysis of the cold mass are presented in this paper, especially the effect of different structure material selection, pre-tension force on the wire during winding, and big holes on the mandrel. Cryostat design and analysis are present in this paper, including the heat load analysis, cold mass support design and thermal shield design. Cooling down and charging results show that the magnet can run at its design current very well.

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