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## Designing and Manufacturing of the Fully Configured Multiplet for the Super-FRS at FAIR

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The Superconducting FRagment Separator (Super-FRS) is a key experimental facility for FAIR (Facility for Antiproton and Ion Research) in Darmstadt, Germany. It consists of 24 superconducting dipole magnets and 30 multiplets. Three branches (a low energy, a high energy and a ring branch) allow to carry out a wide variety of nuclear physics experiments. Quadrupole magnets and corrector magnets are assembled as one cold mass column and they will be cooled in a common He bath with design pressure of 20 bars. There are 23 types of cryogenic modules depending on how a cold mass column is configured upon requirements of beam optics. This paper focuses on various aspects of the most complicated multiplet (FHF1YMQ11). The cold mass is fully configured with nine magnets and its weight and length are 45 tons and 6.5 m respectively. Two types of quadrupole magnets sharing the same 2D design but having a different yoke length and sextupole magnets are superferic magnets. Their warm bore radius is 192 mm and coils are vacuum impregnated racetrack coils made of Nb-Ti conductor. Two octupole and one steering dipole magnet are cos-theta magnet. Extensive design studies were performed for homogeneous cooling down of such a large cold mass in a reasonable time as well as for achieving required magnetic field quality. The construction was completed in Q4, 2020. The cold test of the long multiplet is now underway at a CERN cryogenic magnet test facility in the frame of a GSI/CERN collaboration work.

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