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Designing a Large-gap Superferric Dipole Magnet for CEE

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The CSR external-target experiment (CEE) will be China's first self-developed nuclear research experimental facility operating in the GeV regime based on the large-scale scientific facilities HIRFL-CSR. One of its core components is a dipole magnet with a large gap and wide acceptance. Unlike traditional large spectrometer magnets, the physical target of the CEE requires a highly stable, large-scale, uniform magnetic field. To achieve this design goal, the study introduces a 9-parameter model of the iron yoke structure. Multiple methods are employed to optimize both the air trim slot structure and the shimming structure. After several rounds of optimization, a design which can provides field uniformity less than $\pm 0.6\%$ within a region of $0.9 \times 1.0 \times 0.8$ m (length \times width \times height) is proposed. The overall size of the magnet will be around 3.2 m long, 4.4m width and 2.9 m high. The aperture in the beam direction measures 2×1.2 m. The gap of the magnet is 1.3 m, and the yoke weighs 185 t in total.

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