

Simple optimized stellarator construction using permanent magnets.

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Stellarators can be constructed simply and inexpensively using permanent magnets combined with toroidal field coils. This strategy is being demonstrated in the quasi-axisymmetric optimized stellarator ‘MUSE’ which is being constructed using commercial rare-earth permanent magnets to generate the 3D magnetic field structure combined with simple planar coils. The magnet support structures are precisely fabricated by additive manufacturing, simplifying metrology and the assembly process. The resulting free-boundary stellarator equilibrium is highly optimized for good neoclassical confinement with the effective helical ripple $\epsilon_{eff}^{3/2} < 10^{-6}$ for $0.3 < \rho < 0.7$. This is significantly lower than in any previous stellarator experiment. This degree of quasi-symmetry is calculated to be insensitive to expected construction tolerances. The experiment is designed to be table-top scale with $R = 0.30$ m, $B = 0.15$ T, and two field periods, suitable for basic physics experiments. The construction status and operating plans will be presented. Related methods suitable for larger stellarators with higher magnetic fields will be discussed.