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Precision Magnetic Fields for Fundamental Neutron Symmetries

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Because the neutron has only a single static moment–the magnetic dipole, virtually every fundamental neutron physics experiment relies on static and/or oscillating magnetic fields to manipulate the neutron spin and/or kinematics. The level of precision required for modern experiments places stringent constraints on field uniformity, fringes, geometry, magnetic materials, and shielding, which impose formidable challenges on magnet coil design. We describe new techniques being developed to design precision coils and construct them with an industrial robotic arm. These techniques allow direct calculation of coil windings subject to geometric and field constraints. The techniques are based on a new physical interpretation of the magnetic scalar potential, which lends itself to elegant illustrations of the mixed symmetry between electric and magnetic fields.

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