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Design of a Magnet Bore Field Mapper Consisting of a Cylindrically Fixed Array of Inexpensive Hall Elements to Probe Low-Order Spherical Harmonics in Real Time

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Demand continues to be high for high-temperature superconducting (HTS) wires and tapes to wind coils of high field quality for NMR or MRI applications. A magnet bore field mapper of relatively simple design and operation is needed to confirm the low-order spherical harmonics during testing after construction of such coils, irrespective of compensation. Presented here is one probe design of a compact, cylindrically fixed array of inexpensive Hall elements normally used in consumer, industrial, and automotive electronics. At most, the probe is only 50.8 mm in diameter and 124 mm in height. The several (i.e., 20) gallium arsenide (GaAs) Hall elements required are incorporated into this probe only after careful and systematic calibration of each at room and low temperatures (i.e., at 298 K and 4.22 K), and moderate magnetic fields (i.e., from 0.0 T to 9.0 T by 0.25 T), in this case, using a Physical Property Measurement System (PPMS) manufactured by Quantum Design. Furthermore, because the array is fixed rather than rotating, the low-order spherical harmonics from the magnet bore may be probed in real time. Thus, the severe magnetic distortions generated by induced screening currents in anisotropic (RE)BCO coated conductors (e.g., in no-insulation pancake windings) may be followed with respect to time.
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