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A passively shielded HTS magnet for polarized neutron scattering

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The use of spin-polarized neutrons in neutron scattering experiments provides fundamental information on magnetic properties. One of the key issues is to maintain the polarization of a neutron beam on its way through the large magnetic fringe fields produced by a high field superconducting magnet. Up to now, most Low Temperature Superconducting (LTS) magnets for neutron scattering use active shielding coils to reduce the fringe fields around the neutron spin flippers and an asymmetric mode to guide polarized neutrons through the region of the zero-field node. By exploiting the use of iron in the magnetic circuits, High Temperature Superconducting (HTS) magnets offer an easier solution to maintain neutron polarization. Recently a passively shielded 3T HTS magnet for polarized neutron scattering experiments was designed, constructed and tested by HTS-110. This split-pair magnet provides a maximum horizontal magnetic field of 3 tesla while the fringe field is less than 1 mT at 0.5 m from the magnetic center in the magnet axial direction and the fringe field is less than 0.1 mT at 1 m from the magnetic center in the magnet radial direction. Furthermore the zero-field nodes are located outside the magnet cryostat easing the control of neutron polarization at entry to the magnet. The magnet has a vertical room temperature bore of 80 mm in diameter for sample access and 4 horizontal bores with an opening angel of 32° for neutron access, allowing high flexibility without any material in the beam to cause a scattering background. In this paper we report the test results of this magnet. Aspects of HTS magnet design specific to the combined requirements of neutron scattering including magnetic field, fringe field and sample and neutron access are discussed.

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