Project Summary / Abstract

Company Name and Address:	Particle Beam Lasers, Inc. 18925 Dearborn Street Northridge, CA 91324-2807
Principal Investigator:	Robert J. Weggel

Project Title:	HTS Solenoid for Neutron Scattering
Topic No: 17	Instrumentation and Tools for Materials Research using Neutron Scattering
Subtopic: (a)	Advanced Sample Environments

US neutron scattering facilities are currently limited to 16 T, which is insufficient to study the structure and dynamics of ultra-high magnetic field states of quantum matter and materials processed in high magnetic fields. To remedy this, proposals have been requested for very high field magnets suitable for neutron-scattering applications.

Particle Beam Lasers, Inc. (PBL) and the Superconducting Magnet Division of Brookhaven National Laboratory (BNL) propose to advance magnet technology for neutron-scattering experiments by capitalizing upon their expertise and equipment, some of which was developed during several SBIR/STTR collaborations, including one that designed, built and tested a solenoid that generated nearly 16 T, a world record in 2013 for a magnet exclusively of high temperature superconductor (HTS). BNL also has built and tested an HTS magnet for superconducting magnetic energy storage, and is building a 25 T solenoid for Axion research.

Proposed is a magnet design of a revolutionary geometry that provides generous viewing access radially, axially, and circumferentially. The design exploits outboard coils to magnetically attract inboard coils so strongly as to overpower the attractive force from coils on the opposite side of the magnet midplane. These inner coils therefore need no midplane-straddling structure for mechanical support. Support of the outboard coils is at a radius so large as to block little of the circumference of the midplane viewing port.

Phase I will benefit from the participation of BNL scientists involved in neutron-scattering experiments to generate a preliminary design of a 25 T magnet that satisfies their challenging requirements. A major computational task is to optimize the magnet design to reduce cost in materials and fabrication and to limit the strain on conductors. An experimental task is to utilize HTS tape on hand to wind coils of conical shape and to test them at 77 K. Phase II would extend the theoretical and experimental studies of Phase I to a Proof-of-Principle demonstration magnet.

Commercial Applications and Other Benefits: Many consider neutron scattering to be the most valuable of all tools for investigating matter, employing many thousands of researchers. Their research is of great commercial as well as intellectual value, justifying the expenditure of billions of dollars on neutron sources, detectors and magnets. The R&D proposed by this SBIR/STTR is to further the technology to design, fabricate and test proof-of-principle and prototype magnets, and thereby to increase even further the value of neutron scattering.

Key Words: Magnet, solenoid, high-temperature superconductor, HTS, neutron scattering

Summary for Members of Congress: This SBIR/STTR is to develop the technology for a 25 T magnet for neutron scattering, which many consider to be the most valuable—commercially as well as academically—of all tools for investigating matter.