Project Summary

Company Name:	Particle Beam Lasers, Inc.
Project Title:	HTS Solenoid for Neutron Scattering
Principal Investigator:	Dr. Stephen A. Kahn
Topic No/Subtopic Letter:	17a

Abstract. Magnets used at US neutron scattering facilities are currently limited to fields of 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 designed, built and tested several high field HTS magnets.

The Phase I project resulted in a magnet design with an innovative geometry that provides generous viewing access radially, axially, and circumferentially for efficient neutron usage. The design exploits outboard coils magnetically attracting inboard coils to overpower the attractive force between the coils on the opposite sides of the magnet midplane. This allows the inboard coils to be placed much closer to each other which significantly increases the efficiency for generating higher fields while also increasing the available viewing port. To increase the efficiency further, conical coils are proposed to match the experimental requirements.

The PBL/BNL team advanced the viability of this concept in Phase I with the help of magnetic and mechanical calculations of several 25 T designs and developing some initial structural concepts. Additionally, a proof-of-principle conical HTS coil was successfully wound and tested.

In Phase II, the PBL/BNL team proposes an ambitious task of designing, building and testing a proof-of-principle ~17 T HTS magnet containing the attractive features developed in Phase I. For that effort, we will leverage existing PBL coils from earlier SBIRs while also winding some new ones. Moreover, a preliminary engineering design of a 25 T magnet will be developed, and the cost (expected to be well beyond the budget of a Phase II SBIR/STTR) will be estimated.

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 and intellectual value, justifying the expenditure of billions of dollars on neutron sources, detectors and magnets. The proposed SBIR/STTR will further the technology to design, fabricate and test proof-of-principle and prototype magnets, thereby further increasing the value of neutron scattering. Such magnets are currently unavailable, and their development and possible commercialization are highly desirable.

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

Summary for Members of Congress: This SBIR/STTR is to develop the high field magnet technology for neutron scattering, which many consider to be one of the most valuable tools for investigating matter.