Project Summary / Abstract

Company Name: Particle Beam Lasers, Inc.

Project Title: Development of an accelerator quality high field common coil dipole magnet

Principal Investigator: Ronald M. Scanlan

Topic Number/Subtopic Letter: 27b

Abstract: New high energy physics breakthroughs require particle accelerators of unprecedented energy, requiring dipoles of very high field to bend the particle beam to the desired radius. The proposed Phase II advances a new approach and technology for building high field dipoles based on the common coil design. Because of the inherent simplicity and conductor friendly nature of the design, the common coil magnets are likely to be less expensive and easier to manufacture than the more conventional cosine theta magnets, particularly for high fields that require the use of brittle conductors such as Nb_3Sn. Although several dipoles based on the common coil design have been built, none had the high field quality as required for the accelerator magnets. In Phase I, we developed several designs for 16 Tesla Nb_3Sn dipoles that meet the field quality requirements as specified for the proposed Future Circular Collider with the help of attractive configurations of the pole coils. In Phase II, we will wind the most promising configuration of the pole coil and integrate it with our partner laboratory's existing common coil magnet, for a proof-of-principle demonstration of the design. Such a task is possible within the budget of SBIR/STTR, as we demonstrated in another Phase II project, due to the unique geometry of the existing common coil magnet which allows new coils to be inserted and become an integral part of the magnet with the existing Nb_3Sn coils without requiring expensive and time consuming disassembly and reassembly of the magnet. Based on this experience, another deliverable of Phase II will be a preliminary engineering design of a 16 Tesla common coil dipole that minimizes cost, provides an adequate support structure to withstand the Lorentz forces associated with these high fields, and can be built industrially in large quantities. Our effort will primarily be based on the Low Temperature Superconductor Nb_3Sn.

Commercial Applications and Other Benefits: Not only is the common coil design uniquely suited to building lower cost, reliable high field magnets for colliding beam particle accelerators, the high field technology developed will also be essential for commercial superconducting magnets. The essential technologies include: 1) methods for achieving good field quality; and 2) methods for supporting the superconductor against the large Lorentz forces experienced in high field magnets. High quality, high field magnets will find commercial use in magnetic resonant imaging, proton and ion beam therapy, wind power and superconducting magnet energy storage applications.

Key words: Common coil, high field dipoles, Nb_3Sn superconducting dipole magnets.

Summary for members of Congress: The next generation "atom smashers" will require beam bending magnets that must be stronger, lower in cost, and higher in reliability than those used in previous high energy accelerators. This proposal will explore an alternative design that should be less expensive and easier to build than the present designs.