Project Summary / Abstract

Company Name:	Particle Beam Lasers, Inc.
Project Title:	Development of an accelerator quality high field common coil dipole magnet
Principle Investigator:	Ronald M. Scanlan
Topic Number/Subtopic Letter:	27b

Abstract: To search beyond the Higgs requires particle accelerators of unprecedented energy, requiring dipoles of very high field to bend the particle beam to the desired radius. This proposal explores a new approach to these high field dipoles – a common coil magnet. A common coil magnet may be less expensive and easier to manufacture than the more conventional cosine theta magnets that have been used in most high energy colliders such as the Large Hadron Collider at CERN. Although several proof-of-principle common coil magnets have been built, none had the high field quality required for accelerator magnets. This proposal seeks to demonstrate the technology of high field quality common coil dipoles suitable for use in particle accelerators through the use of pole coils. These pole coils have not been built and integrated with the proof-of-principle main coils before. In Phase I, analytical tools will be used to (a) design a number of geometries of pole coils that can provide accelerator field quality and (b) design the mechanical support structure necessary to hold the pole coils and to withstand the large Lorentz forces. At least two types of pole coils such as those designed in Phase I will then be built in Phase II and integrated with the existing common coil dipole at Brookhaven National Lab to demonstrate that the coils perform as predicted. Based on this experience, another deliverable of Phase II will be an engineering design of a high field (~16 Teslas) common coil dipole that minimizes cost, provides an adequate support structure to withstand the large Lorentz forces associated with the high field magnets, and is able to be built industrially in large quantities. Our effort will primarily be based on Low Temperature Superconductors (Nb_3Sn and perhaps also NbTi); however, use of High Temperature Superconductors will also be examined.

Commercial Applications and Other Benefits: Not only is the common coil design uniquely suited to the case of colliding beam particle accelerators, the technology developed during Phase I and Phase II 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.