Project Summary / Abstract

Company Name:	Particle Beam Lasers, Inc.
Project Title:	Novel Design for High Field, Large Aperture Quadrupoles for Electron-Ion Collider
Principle Investigator:	Dr. Shailendra Chouhan
Topic Number/Subtopic Letter:	29h

Abstract: The proposed Electron-Ion Collider (EIC) needs several high-field, large-aperture quadrupole magnets in the interaction region for the ion or proton beams. These magnets should (a) be able to tolerate high radiation loads, (b) be compact in size, with limited space for iron shielding, and (c) have a field-free region along the length of the magnet for the passage of electron beams. We propose to develop designs for EIC quadrupoles in Phase I based on racetrack coils satisfying the above requirements. In particular, we will examine a novel "modular design" concept. The modular design is based on simple racetrack coils, which require less expensive tooling to build the magnets. However, unlike in many racetrack coil quadrupole designs, the modular design is similar to the Panofsky quadrupole design, which allows conductor at the mid-plane to be placed at a radius similar to that in conventional cosine two-theta quadrupoles. This difference in configuration is crucial to creating high field gradient. Moreover, the "modular design" also enables a "modular R&D program" in which the same coils can be used in "proof-of-principle" magnets of different aperture. Such a "modular program" should significantly reduce the cost of R&D, which is a significant part of the overall cost of developing the small number of Nb_3Sn magnets with different apertures. We propose to build a Proof-of-Principle demonstration magnet in Phase II.

Commercial Applications and Other Benefits: The investigation of the modular quadrupole design to be done in this project will have an immediate market for use in the EIC, and it is also foreseen to enable additional intellectual property that may prove valuable in the development of high quality, high field gradient quadrupole magnets. It is also expected that the design will facilitate a cost-effective, rapid-turn-around quadrupole R&D program when the parameters and technologies cannot be frozen without feedback from proof-of principal magnets. High quality, high field magnets will find commercial use in proton and ion beam therapy and wind power applications; markets that are significant and growing.

Key words: superconducting quadrupoles, electron-ion collider, superconducting magnets

Summary for members of Congress: The proposed electron-ion-collider will require special high field quadrupole magnets for ion beams so that the electron beams can operate under the needed low field conditions. This proposal will explore alternative designs that are flexible and should be less expensive and easier to build than the present designs.