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. Stephan Kahn
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. Following the progress made in the Phase I SBIR, we propose to design, build and test such a quadrupole for EIC in Phase II based on racetrack coils. We will demonstrate the novel "modular design" concept based on the simple racetrack coils. Magnets based on the racetrack coils are generally less expensive to build because of lower cost of tooling. The modular design, like the Panofsky quadrupole design, allows conductor at the mid-plane to be placed at a radius similar to that in conventional cosine two-theta quadrupoles which is not the case in many other racetrack coil quadrupole designs. This difference in configuration is crucial to creating the 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 a small number of high field magnets with different apertures. The goal of this proposal is to design, build and test a Proof-of-principle quadrupole magnet designed for the EIC based on NbTi racetrack coils within the budget of Phase II. We have chosen to build a short length model of the first IR quadrupole Q1APF, which is closest to the Interaction Point (IP) and is one of the most challenging. The current design requirements of this magnet can be met with NbTi superconductor, even though the modular design is attractive for Nb_3Sn as well.

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 applications, where markets 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.