Project Summary / Abstract

Company Name:	Particle Beam Lasers, Inc.
Project Title:	Field Compensation in Electron-Ion Collider Magnets with Passive Superconducting Shield
Principle Investigator:	Dr. Shailendra Chouhan
Topic Number/Subtopic Letter:	29h

Abstract: The proposed Electron-Ion Collider (EIC) could unravel the mysteries of the atomic nucleus by using high energy electron beams colliding with ion or proton beams. One of the key elements in the proposal is the Interaction Region (IR) magnets which satisfy unique requirements since the electron beams must travel very close to the proton or ion beam. Whereas the ion or proton beams need high field magnets, the beams of lighter electrons must be magnetically shielded from the fringe fields of the ion beamline magnets. Topic 29(h)(3) calls for "*techniques for efficient compensation of the external field generated by a quadrupole*". This proposal is for developing a "*passive superconducting shield*" as an alternate to the present design of an active shield with superconducting coils. In fact, the recent NP Community Panel Report on Electron Ion Collider (EIC) Accelerator R&D in Feb 2017 encouraged this technique with the following mention: "*An open question for a study, common to the dipole and quadrupole sweet spot work, is the use of mu metal or a **'Meissner shield'** (superconducting shield) for passive magnetic shielding. The geometric advantage for cold shielding is much less radial space required. However, shield geometries can be tested inside existing BNL magnets*." If successfully developed, demonstrated and incorporated with the magnet designs, then not only will this technique provide a technically good solution, it will also simplify the design of challenging magnets in the interaction regions, remove certain constraints and allow higher field options for increasing the luminosity of the proposed Electron-Ion Collider. In Phase I, design studies will be performed for providing and integrating this shielding with the magnets. In addition, proof-of-principle shielding made with HTS tape will be demonstrated at 77 K in liquid nitrogen.

Commercial Applications and Other Benefits: The investigation of magnetic shielding 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 superconducting magnets for other research applications such as and similar to the g-2 experiment, cloak experiment and commercial applications such as MRI.

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

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