

## 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. Ramesh Gupta  
**Topic Number/Subtopic Letter:** 29h

**Abstract:** The proposed Electron-Ion Collider (EIC) could unravel mysteries of atomic nuclei by means of high energy electron beams colliding with beams of ions or protons. One of the key tasks in the proposal involves the Interaction Region (IR) magnets, which must satisfy challenging requirements posed by the electron beam traveling very close to the proton or ion beam. The electron beam must be magnetically shielded from the fringe fields of the high field magnets which guide the proton or ion beam. This proposal is for developing a “*passive superconducting shield*” as an alternative to the present design of an active shield using additional superconducting coils. The Nuclear Physics Community Panel Report on Electron Ion Collider Accelerator R&D in February 2017 encouraged evaluation of this technique.

Proof-of-principle shielding provided by High Temperature Superconducting (HTS) tape and HTS bulk material were demonstrated at 77 K in Phase I. In addition, we performed shielding tests at 4 K (beyond the original scope of the Phase I proposal), thanks to an ongoing project that could accommodate such tests. This is highly valuable to the EIC, because EIC magnets will operate at 4 K. We demonstrated shielding not only with HTS tube, but also with a Low Temperature Superconducting (LTS) NbTi tube. These additional contributions have made the Phase II proposal stronger than what was foreseen a year ago.

In Phase II, apart from performing extensive superconducting shielding tests at 77 K (for HTS), we also plan to demonstrate four different techniques at 4 K. Two of them will be based on HTS and two on LTS. These demonstrations will attempt to simulate the EIC interaction region environment and respond to the statement listed in the topic of interest, “*a region of about 3 cm in radius outside the quadrupole along its length for passage of the electron beam*”.

We will also perform an overall magnetic, mechanical and engineering design of a shielding system and its integration with the then current design of an EIC IR magnet.

In addition, we propose to demonstrate an invention that, if successful, may be much more effective.

**Commercial Applications and Other Benefits:** The superconducting shielding will have an immediate market for use in the EIC, and it is also foreseen to enable additional intellectual property (including the invention discussed in the proposal) that may prove valuable in the development of superconducting magnets for other research applications, such as a g-2 experiment, a 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 requires magnetically shielding the electron beams from the high field magnets for the ion beam. This proposal will explore alternative designs that should be less expensive and simpler than the present designs. A promising invention will be further developed and demonstrated.