PRESS RELEASE

EEC Awarded DoE SBIR/STTR Program!

Landisville, PA (October 31, 2016) – Electron Energy Corporation (EEC), an expert developer and leading producer of rare earth magnet solutions, was awarded a new DoE SBIR/STTR Program focused on the technical topic of Nuclear Physics Accelerator Technology! EEC continues our commitment to the advancement of magnetic solutions technology.

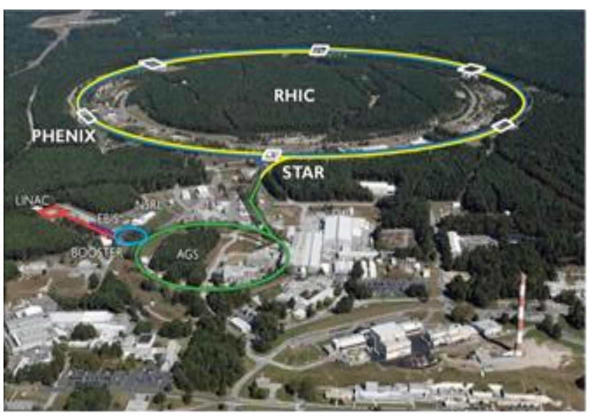
EEC has been awarded a Fast Track project under the DoE SBIR/STTR Program (DE-FOA-0001366), technical topic Nuclear Physics Accelerator Technology, subtopic Magnet Development for Future Electron-Ion Colliders (EIC). The period of performance is 02/22/2016 to 11/21/2016 for Phase I, with the possibility of continuation based on accomplishments, to Phase II, with the period of performance 11/21/2016 to 11/21/2018.

DoE's EIC program focuses on the long-term vision for advancing the fundamental theory of the strong interaction that binds the atomic nucleus, as well as forming new states of matter which have not existed since the first moments after the birth of the Universe. This can be achieved with the construction of an electron relativistic heavy ion collider based on an Energy Recovery Linac (ERL) architecture for the electron beam. The ERL requires return-passes beam lines for electrons to be brought back to the linac during acceleration and deceleration. After collisions with ions, the highest energy electrons are decelerated by going through the linac with an opposite RF voltage. The beam lines could be built using permanent magnets instead of electromagnets. High-performance, low-cost magnets and systems are of great importance for feasibility of future accelerator facilities.

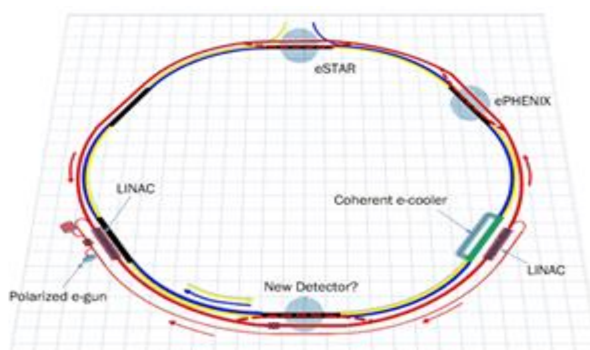
EEC's engineering research team, with Dr. Heeju Choi as principal investigator, is working under this project to provide the optimum design of the magnet modules for the beam focusing and defocusing functions. The optimization criteria include: (1) magnetic circuit parameters such as field gradient, field gradient error, field harmonics, field correction, etc, (2) mechanical stress analysis, (3) ease of manufacture. EEC will then build magnet assembly prototypes for experimental testing. In the past experience, EEC recently worked with Loma Linda University to design a Halbach oriented quadrupole magnet with finite element analysis and produced more than a dozen of focusing quadrupole magnet assemblies using Sm-Co permanent magnet materials for testing of a potential proton radiosurgery application. Results showed highly symmetric 186 MeV focused proton beam cross sections indicating high quality quadrupole fields, and dose distributions with superior properties compared to unfocused beams, which indicates the high quality of magnet materials and suggests that rare earth magnet assemblies are feasible and promising for the proton radiosurgery applications.

The use of permanent magnets will result in a significant construction, operation and maintenance cost reduction for the future EIC. If the magnets are designed for use in a Non-scaling Fixed-Field Alternating Gradient (NS-FFAG) structure, they can transfer multiple energies within the same aperture. Brookhaven National Lab plans to construct an electron relativistic heavy ion collider (eRHIC) on the existing relativistic heavy ion collider facility, which will collide polarized electron beams with the full array of RHIC hadron beams. Modifications of the present RHIC machine for the eRHIC version include new quadrupole and dipole permanent magnets in two interaction regions. NS-FFAG optics will be used making the system more space- and cost- effective. eRHIC is anticipated to be operational in the second part of the 2020 decade.

NS-FFAG accelerators have the potential to bring a paradigm change in accelerator technology for many existing applications in science, and allowing the development of applications in completely new areas. Due to the compact design and low cost enabled by the permanent magnet based system, these potential applications include: X-ray sources, industrial high power Free Electron Laser as a source for EUV lithography, detection of special nuclear materials, astrophysical measurements, important physics experiments including dark matter and dark energy searches. Similar NS-FFAG systems could be also used for hadron therapy in cancer treatment.



The RHIC accelerator complex at Brookhaven National Lab (source: https://www.bnl.gov/rhic/news2/news.asp?a=3758&t=today)



A schematic of the design for adding an electron ring (red), and possible future detector, to RHIC to create eRHIC, which would be the world's first electron-ion collider (EIC) (source: https://www.bnl.gov/rhic/news2/news.asp?a=3145&t=today)

For more information please contact Dr. Heeju Choi (PI), hchoi@electronenergy.com, Dr. Melania Jasinski (Mgr. of Process Engineering), melania@electronenergy.com, or Scott Murr (Dir. Business Development), smurr@electronenergy.com.

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