Permanent Magnet Accelerator Arcs with Linear Fields

Dr Stephen Brooks

Brookhaven National Laboratory (USA) and Cornell University (USA)

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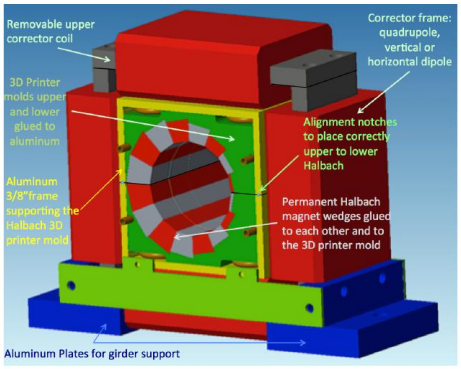

In 2017, a linear-field permanent magnet arc was tested at the Accelerator Test Facility (ATF-1) at BNL. It has a 6-cell approximately FODO lattice and bends through a total angle of 40 degrees. It transmitted beam through a kinetic energy range from 18 to 70.5MeV, demonstrating a ratio of 3.8x in momentum. Scans of the input beam position show transfer function from the beginning to the end of the arc are in line with predicted optics.

In 2018, 214 neodymium permanent magnets were manufactured for the return loop of the CBETA multi-turn ERL being built at Cornell University. There are 5 types of quadrupole and combined-function gradient magnets using a variant of the circular Halbach design. These are made out of NdFeB material and glued into an aluminium housing with water channels for temperature stabilisation. The NdFeB wedges and magnet construction were done by outside companies, while the final "tuning" using inserts containing 64 iron wires per magnet was done at BNL over a period of about 6 months. Average relative field errors of 2.3e-4 were achieved on the beam region. The magnet strengths vary by type but are of order 10T/m for quadrupole component and up to 0.3T for the dipole. This paper reports on the field quality and timeline achieved in this production process.

Stephen Brooks is an Accelerator Physicist at Brookhaven National Laboratory working on fixed-field accelerators, magnets and the CBETA project at Cornell University. He has a DPhil from Oxford Particle Physics department (2010) on the design of particle capture for a neutrino factory. He worked on particle tracking and proton accelerators at Rutherford Appleton Laboratory from 2003 until 2013 when he joined BNL.