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Magnetic Design of the EIC IR Cable Magnets

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We will summarize the initial magnetic designs of the Interaction Region (IR) magnets for the Electron Ion Collider (EIC) that has been proposed to be built at the Brookhaven National Laboratory. This paper will be limited to the magnet designs based on the Rutherford cable (magnets based on the Direct Wind technology will be discussed elsewhere). The magnets to be discussed are: (a) 1.46 meter long quadrupole Q1ApF with a coil aperture of 141 mm, and a design field gradient 72.6 T/m, (b) 1.61 meter long quadrupole Q1BpF with a coil aperture of 186 mm, and a design field gradient of 66.2 T/m, (c) 3.8 meter long quadrupole Q2pF with a coil aperture of 280 mm, and a design field gradient of 36 T/m, (d) 3 meter long dipole B1pF with a coil aperture of 300 mm, and a design field of 3.4 T, and (e) 1.5 meter long dipole B1apF with a coil aperture of 270 mm, and a design field of 2.7 T. The goal was to develop magnetic designs that can be made using NbTi technology and can operate at ˜4.5 K with a sufficient margin. A combination of large aperture and high field create high stresses and will require stainless steel collar with sufficient width. Another major challenge was to develop magnetic designs with a low leakage field from the high field superconducting quadrupole for the proton/ion beam on the superconducting quadrupole (or a hole in the iron for beam passage) for the electron beam. The crosstalk from the superconducting electron quadrupole on the proton quadrupole should also be low. This is particularly challenging since the two beams are in close proximity to each other with the separation between the two changing along the length. This paper will present a novel strategy to overcome this challenge.

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