

Are Haimson Magnets Suitable for Bubble Experiment?

J. Grames
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Haimson provides two stock nested horizontal/vertical steering magnet designs. The steering magnet coils are fabricated from potted #24 AWG copper magnet wire. The coil pairs have different physical size but provide similar deflection (D) at equal power supply current. The deflection of a 100keV electron when by each type of coil powered at 200mA is given provides in Tables 1 and 2.

Table 1. JLAB "BH" mounts on 2.5" ID surface (typ. BPM or spacer)

Model #	Turns	ID (in)	OD (in)	L (in)	R (Ω)	D (mrad)
334	100	2.50	3.25	4.25	2.7	33
335	100	3.25	4.00	4.25	2.9	29

Table 2. JLAB "HB" mounts on 1.5" ID surface (typ. beam pipe)

Model #	Turns	ID (in)	OD (in)	L (in)	R (Ω)	D (mrad)
825	100	1.50	2.25	2.94	1.8	33
826	110	2.25	3.00	2.94	2.3	31

The momentum of a 100keV electron is 0.335 MeV/c. The maximum required energy required for the experiment is 9.50 MeV/c (assumed KE=9.00MeV). The Haimson coils thus provide 3.53% of the specified 200mA deflection at the maximum Bubble chamber energy. We typically limit the current in these coils to 1000mA. The cross-sectional area of #24 AWG wire is 0.205 mm². Assuming 5 A/mm² is safe current for convective cooling the maximum safe current is 1025 mA, thus no additional headroom of any consequence is available. Finally, the maximum deflection at 9.5 MeV/c is 5.82 mrad horizontally (BH or HB) and either 5.12 (BH) or 5.47 mrad (HB) vertically.

The Bubble Demo beam line has 3 alignment elements (two quads + one radiator) each spaced approximately 1.5m. Point corrections from equally spaced correction coils provide 8.7mm (7.7mm) horizontal (vertical) displacement. The inclined Earth's field will add or buck these displacements by 3.6mm (1.4mm) horizontally (vertically). In the latter case, the range of motion is 5.1mm (6.3mm) vertically.

In conclusion, the BH corrections coils are modestly suitable for the Bubble experiment. In addition to the 3 pair of horizontal/vertical steering magnets assigned for the 3 alignment elements it is recommended that a 4th pair be use to improve the control of both position and angle at the radiator.