Hall C Raster

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Abstract

Short explanation of Hall C raster's effect on the beam.

1 Deflection of beam by the Hall C raster

The integrated magnetic field,$\int B \cdot dl$ (units are kG·m), needed to give an electron with momentum, p (units are GeV), a deflection , Δx, at the target which is a distance, L, from the target is :

$$\int B \cdot dl = 33.356 \times p \frac{\Delta x}{L} \tag{1}$$

The integrated magnetic field produced by a Hall C raster coil has been measured as a function of the current, I (units of A), running through the coil as:

$$\int B \cdot dl = 81 \times 10^{-5} \frac{kG \cdot m}{A} \times I \tag{2}$$

Therefore the current needed to to give a particle of momentum, p, a deflection, Δx, at the target which is a distance, L, from the target is :

$$I = 33.356 \times p \frac{\Delta x}{81 \times 10^{-5} \times L} \tag{3}$$

The Hall C raster has two sets of X-X and Y-Y coils. The X-X raster coils are located at 1375 cm from the target and the Y-Y raster coils are 1337 cm from the target. For the demonstration purpose, $L = 1356$ cm is taken as the average of the two positions. Using $L = 1356$ cm, then the relationship between current (A), momentum (GeV) and beam deflection (mm) is :

$$I = 3.04 \times p \times \Delta x \tag{4}$$

Typically, the raster size,R, is quoted as the length of a side of the square raster pattern which would be twice the deflection or $2 \times \Delta x$. The current to give a certain raster size is

$$I = 3.04 \times p \times \frac{R}{2} \tag{5}$$

Each coil gives an equal deflection, so having two coils will double the deflection. Therefore, to set a certain raster size, the current for each coil, I_{coil}, needs to be set to $I/2$. If current is quoted as the peak-to-peak current, then I is half of the peak-to-peak current,I_{pp}. From a report that Bill Gunning produced, the maximum $I_{pp} \approx 100A$ for voltage of 350V. Assume that running at 80% of the maximum voltage is best for long term lifetime of the power supply, then the maximum current for one coil is $I_{pp} = 80$A or $I_{coil} = 40$A. The following table gives the I_{coil} needed for two raster sizes for a given beam energy. The maximum raster size is 5mm for beam energy of 10.6 GeV given the current limitations of the power supplies.

Energy	Raster size R	I_{coil} (each coil)
10.6	2mm	16.1
10.6	5mm	40