BNL-101752-2014-TECH

RHIC/AP/97;BNL-101752-2013-IR

Effects of Random b1 Errors in the High Beta Quadrupoles

G. Parzen

February 1992

Collider Accelerator Department

Brookhaven National Laboratory

U.S. Department of Energy

USDOE Office of Science (SC)

DISCLAIMER

AD/RHIC/AP-97

RHIC PROJECT

Brookhaven National Laboratory

Effects of Random b_1 Errors in the High Beta Quadrupoles

G. Parzen

February 1992

Effects of Random b_1 Errors in the High Beta Quadrupoles

G. Parzen

Brookhaven National Laboratory
February 1992

1. Introduction

The random b_1 error in the high beta quadrupoles in the insertions can produce large distortions[1] in the beta functions, β_x, β_y. A maximum shift of the beta functions of about 90% may occur for a lattice with 6 $\beta^* = 2$ insertions. The b_1 error in the high beta quads contribute about 85% of this beta function shift. If the b_1 errors in the high beta quads are corrected locally, then a maximum beta function shift of about 20% will remain due to the b_1 errors in the dipoles and arc quadrupoles.

2. $\Delta\beta/\beta$ Results

The largest source of the b_1 error in the high beta quadrupoles is the random error in the effective length. This was assumed to be $\Delta L/L = 2 \times 10^{-3}$ rms.

Table 1 shows the rms contribution to $\Delta\beta_x/\beta_x$ due to various magnets in the lattice. These results are analytical results. Computer simulation have been done, and agree with the analytical results. The results are shown for two lattices; one with 6 $\beta^* = 6$ insertions and one with 6 $\beta^* = 2$ insertions. For computing the 90% probability maximum $\Delta\beta_x/\beta_x$, from the rms $\Delta\beta/\beta$

$$(\Delta\beta_x/\beta_x)_{\max} \cong 3 \quad (\Delta\beta_x/\beta_x)_{\text{rms}}$$

was used. Table 1 shows the breakdown for $\Delta\beta_x/\beta_x$. The results for $\Delta\beta_y/\beta_y$ are similar, except that certain magnets like Q3 and Q2, and QF and QD interchange roles.

1 G. Parzen, Linear Random Quadrupole Effects, AD/RHIC-AP-71, (1988).

Table 1 shows that a maximum $\Delta\beta_x/\beta_x$ of 90% may occur for the $\beta^* = 2$ lattice. If the b_1 error in the high beta quadrupoles is corrected locally, then a maximum $\Delta\beta_x/\beta_x$ will remain of about $\Delta\beta_x/\beta_x \simeq 20\%$ due to the b_1 errors in the quadrupoles and dipoles. The maximum $\Delta\beta_x/\beta_x \simeq 20\%$ result came from simulation studies, and is somewhat higher than that suggested by Table 1.

Table 1: Contributions to $(\Delta\beta_x/\beta_x)_{\text{rms}}$ due to the b_1 errors in various magnets for two lattices.

	$(\Delta\beta_x/\beta_x)_{\text{rms}}$	
	$\beta^* = 6$	$\beta^* = 2$
B	0.036	0.035
QF	0.036	0.036
QD	0.007	0.007
Q3I	0.032	0.109
Q2I	0.026	0.079
Q1I	0.023	0.063
Q10	0.024	0.067
Q20	0.080	0.227
Q30	0.014	0.039
Total		
$\frac{\Delta\beta}{\beta}_{\text{rms}}$	0.116	0.29
$\frac{\Delta\beta}{\beta}_{\text{max}}$	0.36	0.90