Effect of Longitudinal Variation of Multipoles in the Triplet Magnets

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This note generalizes the result of the previous note[1] (RHIC/AP/37), and estimates the effect of the longitudinal variation of the multipoles harmonics along the triplet magnet body. The results are summarized into three tables of effective strength corresponding to Q1 (QRI), Q2 (QRK), and Q3 (QRJ) magnet.

The effect of the longitudinal variation of the multipoles depends strongly on the variation of the lattice amplitude function (i.e. the variation of the beam size) along the magnet body. Figures 1, 2, and 3 show the variation[2] of the amplitude functions $\beta_{x,y}$ in the Q1, Q2, and Q3 magnet, respectively, in typical IR region operating at $\beta^* = 1$ m. Using the

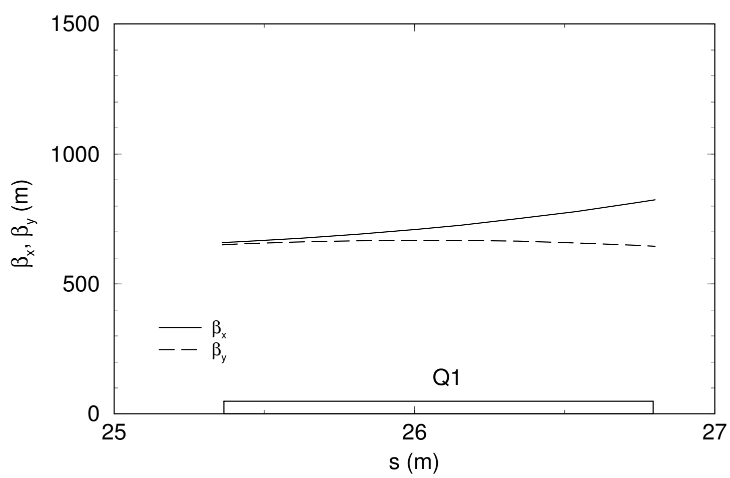

Figure 1: Amplitude function variation in the RHIC Q1 magnet at 6 o'clock outer insertion region during $\beta^* = 1$ m operation.

same definition as that in Ref. 1, Tables 1, 2, and 3 shows the effective values of $a_{n,eff}$ or

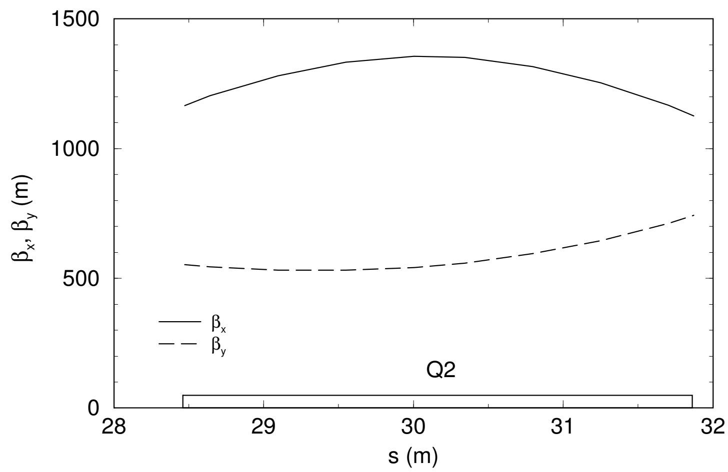

Figure 2: Amplitude function variation in the RHIC Q2 magnet at 6 o'clock outer insertion region during $\beta^* = 1$ m operation.

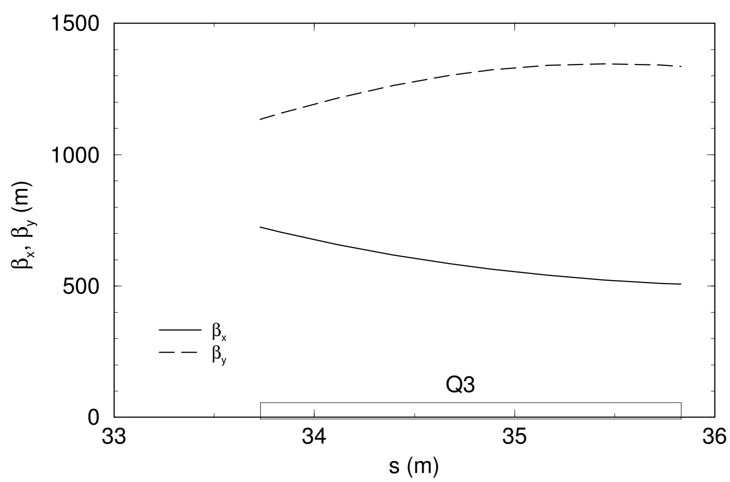

Figure 3: Amplitude function variation in the RHIC Q3 magnet at 6 o'clock outer insertion region during $\beta^* = 1$ m operation.

n	$\lambda = 1$	$\lambda = 2$	$\lambda = 4$
1	0.017	0.012	0.009
2	0.026	0.018	0.014
3	0.035	0.024	0.018
4	0.044	0.031	0.023
5	0.052	0.037	0.027

Table 1: Effective strengths of the longitudinal multipole variations (i.e., the effective $a_{n,eff}$ or $b_{n,eff}$ that correspond to one units of Δa_n or Δb_n, respectively) as functions of the variation cycle λ for various multipole harmonics n for the Q1 magnet.

n	$\lambda = 1$	$\lambda = 2$	$\lambda = 4$
1	0.026	0.018	0.013
2	0.039	0.028	0.021
3	0.052	0.038	0.028
4	0.065	0.048	0.036
5	0.079	0.059	0.045

Table 2: Effective strengths of the longitudinal multipole variations as functions of the variation cycle λ for various multipole harmonics n for the Q2 magnet.

n	$\lambda = 1$	$\lambda = 2$	$\lambda = 4$
1	0.039	0.027	0.020
2	0.059	0.041	0.030
3	0.078	0.054	0.040
4	0.097	0.067	0.050
5	0.12	0.081	0.060

Table 3: Effective strengths of the longitudinal multipole variations as functions of the variation cycle λ for various multipole harmonics n for the Q3 magnet.

$b_{n,eff}$ that correspond to one units of $a_{n,eff}$ or $b_{n,eff}$, respectively, i.e., the relative strength of the multipole variation. Note that with the ideal machine lattice, the effective strength of the magnet multipole variation depends neither upon the focusing property (DFD or FDF) of the triplet, nor (at 1% level) on the value of the β^* (from 1 m to 10 m) of the interaction region.

Acknowledgements

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References

1. J. Wei, RHIC/AP/37 (1994).

2. Ideal MAC94 RHIC storage lattice with two IR at $\beta^* = 1$ m and the rest four at $\beta^* = 10$ m (/usr3/home/mac94/storage/out/store_ideal_twiss), December 1993.