

CHROMATICITY CORRECTION SEXTUPOLES FOR THE AGS

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October 1983

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U.S. Department of Energy

USDOE Office of Science (SC)

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AGS Division Technical Note
No. 190

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October 24, 1983

At present, there are two sets of 12 sextupoles in 7 (vertical) and 13 (horizontal) straight sections. They were originally intended for chromaticity correction.¹ They, however, generate a third integral resonance at the 24th harmonic which is a super structural resonance, and the usefulness of the sextupoles is limited.

In this note, we would like to propose a solution to the problem. Suppose we add four more sets of sextupoles (two each for horizontal and vertical) and eliminate the 24th harmonic components. The other components like 25, 26, and 27 are automatically taken care of.

1. Horizontal

In addition to 13 straight sections, place sextupoles in 2-foot straight sections 1 and 9. The β and α are horizontal maximum at those points. If one goes through mathematics one finds the relationships

$$\left(\begin{smallmatrix} \ell \\ 9 \end{smallmatrix} B''_9 \right) = 1.1 \left(\begin{smallmatrix} \ell \\ 13 \end{smallmatrix} B''_{13} \right)$$

$$\left(\begin{smallmatrix} \ell \\ 1 \end{smallmatrix} B''_1 \right) = -0.57 \left(\begin{smallmatrix} \ell \\ 13 \end{smallmatrix} B''_{13} \right)$$

eliminate the 24th harmonics and

¹Accelerator Department Internal Report EDC-26, 1957.

gives a total integrated sextupole strength of 1.63 ($\int B''_{13}$). The total sextupole strength required is determined from

$$\begin{aligned} \frac{\Delta Q}{Q} &= \left[\frac{1}{4\pi Q} \int \frac{B''(s) \beta(s) \alpha(s) ds}{B\rho} \right] \frac{\Delta P}{P} \\ &= \frac{1}{4\pi Q} \beta(s) \alpha(s) \int \frac{\int B''(s)}{B\rho} \cdot \frac{\Delta P}{P} \end{aligned}$$

Taking $\beta(s) = 22$ m

$$\alpha(s) = 2$$
 m

$$Q = 8.7$$

$$\frac{\Delta Q}{Q} / \frac{\Delta P}{P} \cong 7.87 \frac{\int B''_{13}}{B\rho}$$

If one wants $\frac{\Delta Q}{Q} / \frac{\Delta P}{P} = 1$,

$$\int B''_{13} = \frac{B\rho}{7.87}$$

and at 10 GeV/c ($B\rho \sim 36.4$)

$$\int_{13} B''_{13} = 4.63$$
 T/M.

That means at 9 straight sections

$$\int_9 B''_9 = 5.1$$
 T/M.

Consider making 7" diameter 10 cm long sextupole

$$B''_9 = 51$$
 T/M²

and pole tip field becomes

$$B_T = 0.4$$
 T.

2. Vertical

Consider three sets of sextupoles at 7, 11 and 19 straight sections; required field relations are

$$\left(\begin{matrix} \ell_{11} & B''_{11} \end{matrix} \right) = 0.915 \left(\ell B''_7 \right)$$

$$\left(\begin{matrix} \ell_{19} & B''_{19} \end{matrix} \right) = - 0.55 \left(\ell_7 B''_7 \right)$$

and required strengths are similar to the horizontal sets.

Since the field strength suggests one should have iron core magnets, a careful study of interference with the main magnetic field is required. When the sextupoles are also used for other stopband correction, the relationship should be kept in order not to create stopband at the 24th harmonic.

mvh

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