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CHROMATICITY CORRECTION SEXTUPOLES FOR THE AGS

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CHROMATICITY CORRECTION SEXTUPOLES FOR THE AGS

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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-feet straight sections 1 and 9. The β and α_p are horizontal maximum at those points. If one goes through mathematics one finds the relationships

$$(\ell_9 B''_9) = 1.1\ (\ell_{13} B''_{13})$$

$$(\ell_1 B''_1) = -0.57\ (\ell_{13} B''_{13})$$

eliminate the 24th horminics and

[1] Accelerator Department Internal Report EDC-26, 1957.

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

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

$$= \frac{1}{4\pi Q}\ \beta(s)\ \alpha(s) \sum \frac{\ell\ B''(s)}{B\rho} \cdot \frac{\Delta P}{P}$$

Taking $\beta(s) = 22$ m

$\alpha(s) = 2$ m

$Q = 8.7$

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

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

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

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

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

That means at 9 straight sections

$$\ell_9\ B''_9 = 5.1 \text{ T/M.}$$

Consider making 7" diameter 10 cm long sextupole

$$B''_9 = 51 \text{ T/M}^2$$

and pole tip field becomes

$$B_T = 0.4 \text{ T.}$$

2. Vertical

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

$$(\ell_{11}\ B''_{11}) = 0.915\ (\ell B''_{7})$$

$$(\ell_{19}\ B''_{19}) = -\ 0.55\ (\ell_{7}\ B''_{7})$$

and required strenghts 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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