VERIFICATION OF THE MAGNET ENCLOSURE GEOMETRY AND OF
THE DISPERSION KILLER FOR THE RHIC-PG-12 LATTICE

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(BNL, December 7, 1983)

YCL
16 Dec '83

Geometry magnet enclosure:

$$\begin{aligned}
 R^* &= 590.3298 \text{ m} \\
 l_1 &= 103.772 \text{ m} \\
 l_2 &= 38.0052 \text{ m} \\
 \bar{\theta} &= 0.057394454 \text{ rad} \\
 r &= 239.6523 \text{ m} \\
 p_m &= 381.2325 \text{ m} \\
 R &= r + p = 620.8848 \text{ m}
 \end{aligned}$$

RHIC note 12.

Cells / super period $N_c = 16$
 Dipoles / half super period $N_D = N_c + 1 = 17$
 Deflection angle per dipole $\Theta = \pi / N_D = 0.030799928$
 Half cell length $LHQ = 0.95 \text{ m}$
 $D = 0.995 \text{ m}$
 $LD = 7.85 \text{ m}$
 $D = 0.995 \text{ m}$
 $LHQ = 0.95 \text{ m}$

$$LHC = 11.74 \text{ m}.$$

Average radius $p_m = LHC / \Theta = 381.1697225 \text{ m}$
 Half arc length $LHA = N_c \times LHC = 16 \times 11.74 = 187.84 \text{ m}$
 Dispersion correction $l_2 = 1/2 \times LHC = 17.61$
 Distance from crossing point to bending point Disp. Corr:

$$l_1 = C/12 - l_2 - LHA = \frac{3833.845}{12} - 17.61 - 187.84$$

$$\begin{aligned}
 &= 114.0370833 \\
 l_2 &= 17.61 \\
 \bar{\theta} &= \Theta = 0.030799928
 \end{aligned}$$

$$\begin{aligned}
 R_m^* &= (l_1 + l_2 \cos \bar{\theta} - p_m \sin \bar{\theta}) / \tan \pi/6 + p_m \cos \bar{\theta} + l_2 \sin \bar{\theta} \\
 &= 589.2051513 \text{ m}
 \end{aligned}$$

$$\Delta R^* = R_m^* - R_t^* = -1.1246487$$

$$r_m = (l_1 + l_2 \cos \bar{\theta} - p_m \sin \bar{\theta}) / \sin \pi/6 = 239.8011746$$

$$R_m = r_m + p_m = 620.9708971$$

Inspection shows: $r \sin \frac{\pi}{6} = l_1 + l_2 \cos \bar{\theta} - p \sin \bar{\theta}$

$$R = r + p$$

$$R^* = r \cos \left(\frac{\pi}{6} \right) + p \cos \bar{\theta} + l_2 \sin \bar{\theta}$$

$$C/12 = l_1 + l_2 + \left(\frac{\pi}{6} - \bar{\theta} \right) p$$

$$\Delta R = R_m - R_t = 0.0860971 \text{ m}$$

Consequences for insertion geometry.

Conclusions: tight in tunnel: $\Delta R^* = -1.125 \text{ m}$.

Short changing injection by $l_{1t} + l_{2t} - l_{1m} - l_{2m} =$
 10.1301167 m .

and by $\theta_t - \theta_m = 26.59 \text{ mrad}$.

Dispersion Corrector:

$$\Theta \cdot \frac{1}{2}l \parallel \begin{vmatrix} l & \\ g & -g \end{vmatrix} \begin{pmatrix} x_p \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} x_p \\ x'_p \end{pmatrix}_2 = \begin{pmatrix} 1 & \frac{1}{2}l \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ -g & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ -g & 1 \end{pmatrix} \begin{pmatrix} 1 & l \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ -g & 1 \end{pmatrix} \begin{pmatrix} x_p \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ \epsilon \end{pmatrix}$$

$$= \begin{pmatrix} 1 - \frac{1}{2}lg - (lg)^2 \\ g(1 - 2lg) \end{pmatrix} \begin{pmatrix} x_p \\ 1 \end{pmatrix} + \begin{pmatrix} 0 \\ \epsilon \end{pmatrix}$$

We want $x_{p2} = 0$, $x'_{p2} = 0$ So

$$y = x_{p2} = 0 \rightarrow 1 - \frac{1}{2}lg - (lg)^2 = 0 \rightarrow lg = \frac{1}{4}(-1 + \sqrt{1+16})$$

$$= 0.780776407$$

$$lg = \sin \frac{\Delta\psi}{2} \rightarrow \Delta\psi = 2.2 \sin lg$$

$$= 1.791814963 \text{ rad}$$

$$= 102.6634^\circ$$

$$y' = x'_{p2} = 0 \rightarrow \frac{\Theta l}{x_{p1}} = lg(2lg - 1)$$

$$= 0.438447187$$

$$\frac{x_{p1}}{\Theta l} = 2.280776406$$

Dispersion for regular cell: $\frac{x_{p1}}{l\Theta} = \frac{1 + \frac{1}{2} \sin \frac{\Delta\psi}{2}}{\sin^2 \frac{\Delta\psi}{2}}$

$$= 2.280776407$$

Conclusion: Proposed dispersion corrector

models indeed proposed are structure, provided

that phase advance per cell $\Delta\psi = 1.7918 \text{ rad}$
 $= 102.6634^\circ$