



BNL-101557-2014-TECH

RHIC/PG/14;BNL-101557-2013-IR

Verification Of The Magnet Enclosure Geometry And Of The Dispersion Killer For The RHIC-PG-12 Lattice

J. Claus

December 1983

Collider Accelerator Department
Brookhaven National Laboratory

U.S. Department of Energy

USDOE Office of Science (SC)

Notice: This technical note has been authored by employees of Brookhaven Science Associates, LLC under Contract No.DE-AC02-76CH00016 with the U.S. Department of Energy. The publisher by accepting the technical note for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this technical note, or allow others to do so, for United States Government purposes.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

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

J. CLAUS

(BNL, December 7, 1983)

YLL
6 Dec '83

Geometry magnet enclosure:

$$R^* = 590.3298 \text{ m}$$

$$l_1 = 103.772 \text{ m}$$

$$l_2 = 38.0052 \text{ m}$$

$$\bar{\theta} = 0.057394454 \text{ rad}$$

$$r = 239.6523 \text{ m}$$

$$p_m^* = 381.2325 \text{ m}$$

$$R = r + p = 620.8848 \text{ m}$$

R.H.C. with 12.

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

LHC = 11.74 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:

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

$$= 114.0370833$$

$$l_2 = 17.61$$

$$\bar{\theta} = \theta = 0.030799928$$

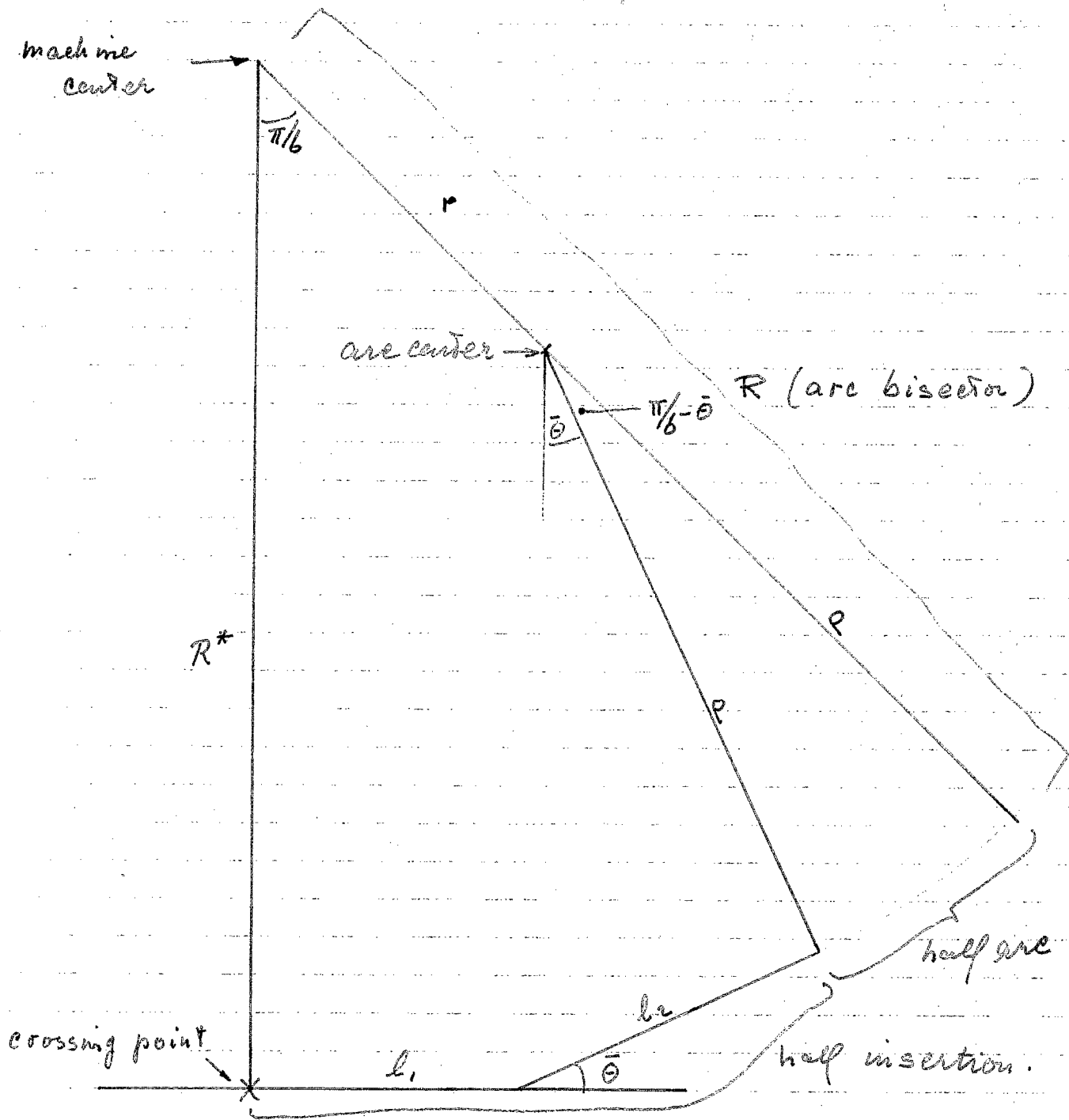
$$R_m^* = (l_1 + l_2 \cos \bar{\theta} - p_m \sin \bar{\theta}) / \tan \pi/6 + p_m \cos \bar{\theta} + l_2 \sin \bar{\theta}$$

$$= 589.2051513 \text{ m}$$

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

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

$$R_m = r_m + p_m = 620.9708971$$



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

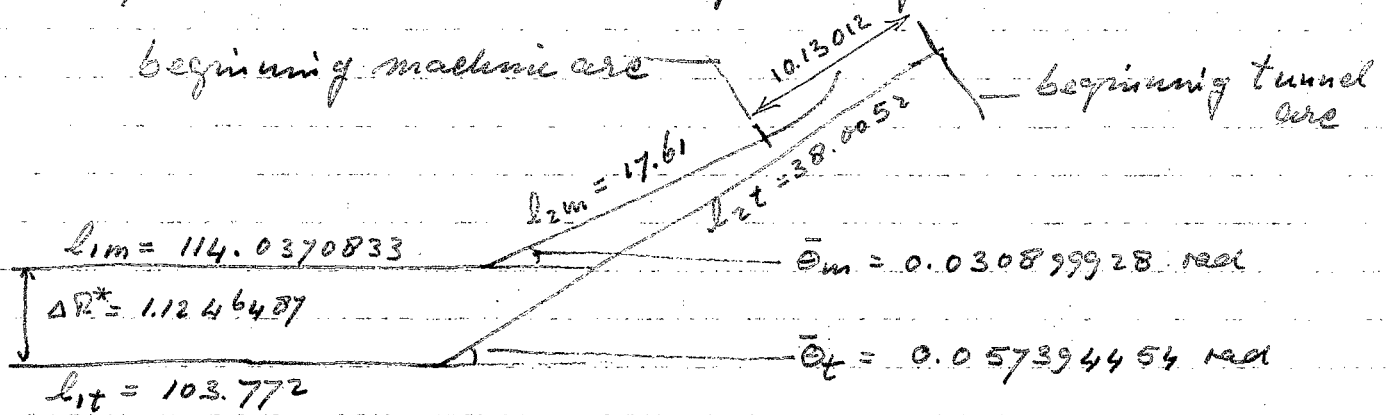
$$R = r + p$$

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

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

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

Consequences for insertion geometry.



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

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

and by $\bar{\theta}_t - \bar{\theta}_m = 26.59 \text{ mrad}$.

Dispersion Corrector:

$$\Theta \cdot \frac{1}{2} l \left\| \begin{array}{c} l \\ g \end{array} \right\| \left\| \begin{array}{c} l \\ -g \end{array} \right\| \begin{pmatrix} x_p \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} x_p \\ x_p' \end{pmatrix}_2 = \begin{pmatrix} 1 & \frac{1}{2} l \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ g & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ g & 1 \end{pmatrix} \begin{pmatrix} 1 & l \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ -g & 1 \end{pmatrix} \begin{pmatrix} x_p \\ 0 \end{pmatrix}_1 + \begin{pmatrix} 0 \\ \epsilon \end{pmatrix}$$

$$= \begin{pmatrix} 1 - \frac{1}{2} l g - (l g)^2 \\ g(1 - 2 l g) \end{pmatrix} \begin{pmatrix} x_p \\ x_p' \end{pmatrix}_1 + \begin{pmatrix} 0 \\ \epsilon \end{pmatrix}$$

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

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

$$= 0.780776407$$

$$l g = g \sin \frac{\Delta \psi}{2} \rightarrow \Delta \psi = 2 \alpha \sin l g$$

$$= 1.791814963 \text{ rad}$$

$$= 102.6634^\circ$$

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

$$= 0.438447187$$

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

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

$$= 2.280776407$$

Conclusion: Proposed dispersion corrector

models indeed proposed are structure, provided

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