

Regular Cell And Dispersion Killer For The 120 degree Phase Advance Case

A. G. Ruggiero

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.

REGULAR CELL AND DISPERSION KILLER
FOR THE 120° PHASSE ADVANCE CASE

A. G. RUGGIERO

(BNL, December 9, 1983)

19

RTIC- PG- ~~19~~

Regular Cell and Diffusion Killer
for the 120° phase advance Case

A. G. Ruggiero

BNL , December 9, 1983

①

Lattice for a Regular Cell

(Thin lenses approximation)

$$\begin{cases} L, & \text{length of half-cell} \\ \theta, & \text{bending for half-cell} \\ \varphi, & \text{phase advance per half-cell} \end{cases}$$

$$\frac{B' l_2}{B \varphi} = \frac{2 \sin \varphi}{L}$$

$$\begin{cases} \beta_{\max} &= \frac{L}{\sin \varphi} \left(\frac{1 + \sin \varphi}{1 - \sin \varphi} \right)^{1/2} \\ \beta_{\min} &= \frac{L}{\sin \varphi} \left(\frac{1 - \sin \varphi}{1 + \sin \varphi} \right)^{1/2} \end{cases}$$

$$\begin{cases} \eta_{\max} &= \frac{L \theta}{\sin \varphi} \left(\frac{1}{\sin \varphi} + \frac{1}{2} \right) \\ \eta_{\min} &= \frac{L \theta}{\sin \varphi} \left(\frac{1}{\sin \varphi} - \frac{1}{2} \right) \end{cases}$$

$$\left\{ \begin{array}{l} \bar{\beta} = \frac{\beta_{\max} + \beta_{\min}}{2} = \frac{2L}{\sin 2\varphi} \\ \bar{\eta} = \frac{\eta_{\max} + \eta_{\min}}{2} = \frac{L\theta}{\sin^2 \varphi} \end{array} \right.$$

$$\delta_T = \sqrt{R/\bar{\eta}}$$

R , average radius

For $\varphi = 60^\circ$

$$\frac{B'l_2}{B\varphi} = \frac{1.732}{L}$$

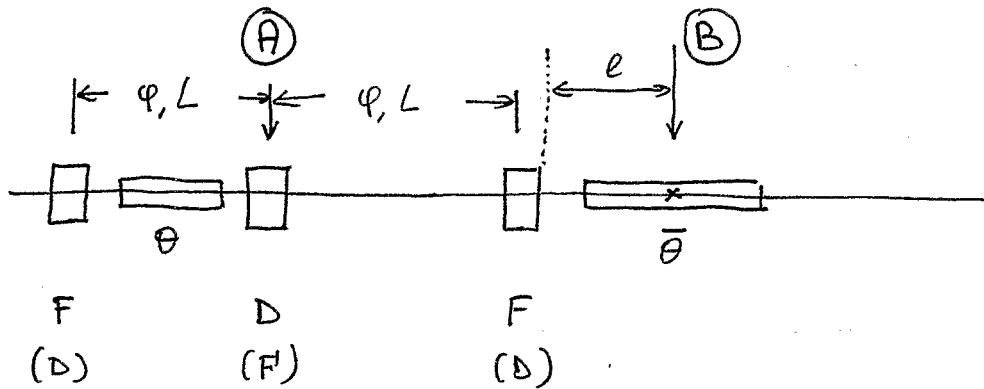
$$\left\{ \begin{array}{l} \beta_{\max} = 4.3094 \quad L \\ \beta_{\min} = 0.3094 \quad L \end{array} \right.$$

$$\bar{\beta} = 2.3094 \quad L$$

$$\left\{ \begin{array}{l} \eta_{\max} = 1.9107 \quad L\theta \\ \eta_{\min} = 0.7560 \quad L\theta \end{array} \right.$$

$$\bar{\eta} = 1.3333 \quad L\theta$$

Dispersion Killer (thin lenses)



Transfer matrix from A to B

$$M = \begin{pmatrix} 1 & l \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ -p & 1 \end{pmatrix} \begin{pmatrix} 1 & L \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ p/2 & 1 \end{pmatrix}$$

$$= \begin{bmatrix} (1 - lp)(1 + L \frac{p}{2}) + \frac{lp}{2} & L(1 - lp) + l \\ p/2 - p(1 + \frac{Lp}{2}) & 1 - Lp \end{bmatrix}$$

$$p = \frac{B'l_2}{B_f} \quad , \quad \frac{Lp}{2} = \sin \varphi$$

$$\text{At (A)} \quad \eta = \eta_A, \quad \eta' = 0$$

$$\text{At (B)} \quad \eta = 0, \quad \eta' = 0$$

For the condition $\eta_B = 0$

$$(1 - lp)(1 + L \frac{p}{2}) + \frac{lp}{2} = 0$$

from which

$$\frac{l}{L} = \frac{1 + \sin \varphi}{\sin \varphi \cdot (1 + 2 \sin \varphi)}$$

For $\varphi = 60^\circ$

$$l = 0.788675 L$$

$$\eta_B' = \left[\frac{p}{2} - p \left(1 + \frac{Lp}{2} \right) \right] \eta_A$$

$$= - \frac{\sin \varphi}{L} (1 + 2 \sin \varphi) \eta_A$$

$$\eta_A = \frac{L\theta}{\sin \varphi} \left(\frac{1}{\sin \varphi} \pm \frac{1}{2} \right)$$

upper sign if QF at (A)
lower sign if QD at (A)

$$\eta_B' = - \theta \frac{(1 + 2 \sin \varphi) (2 \pm \sin \varphi)}{2 \sin \varphi}$$

For $\varphi = 60^\circ$

$$\eta_B' = - \theta \times \begin{cases} 4.520726 & \text{with QF at (A)} \\ 1.788675 & \text{with QD at (A)} \end{cases}$$

Clearly the solution with QD at (A) is preferred.

6

$\bar{\theta}$, bending angle of the dispersion corrector dipole

$$\bar{\theta} = 1.788675 \times \theta$$