THREE BUMP (LOCAL BUMP)

MJS

11/18/03

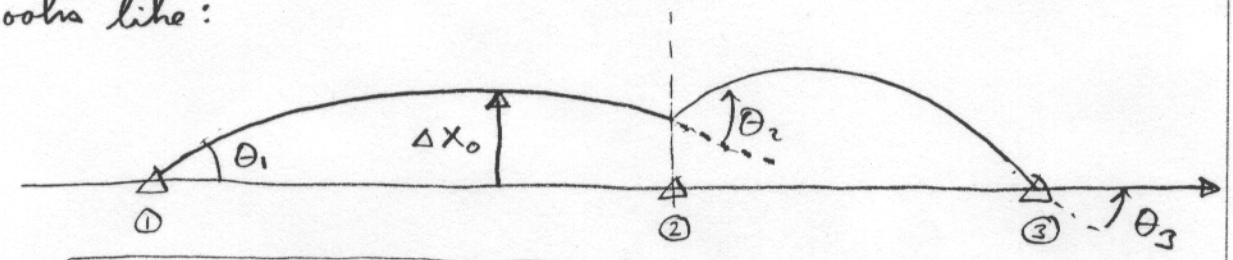
local Transverse change o

Suppose wish to make a *local* change to the closed orbit...

Use 3 correctors: 1st -- generate desired displacement

2nd, 3rd -- restore the trajectory (x, x')

Looks like:



$$\Delta X_0 = \theta_1 \sqrt{\beta_1 \beta_0}\, \sin \psi_{10} \qquad (\psi_{10} = \psi_0 - \psi_1)$$ 1 to 2

Follow the trajectory... (matrix goes from)

$$\begin{pmatrix} 0 \\ \theta_3 \end{pmatrix} + M_{23}\left[\begin{pmatrix} 0 \\ \theta_2 \end{pmatrix} + M_{12}\begin{pmatrix} 0 \\ \theta_1 \end{pmatrix}\right] = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

or,

$$M_{13}\begin{pmatrix} 0 \\ \theta_1 \end{pmatrix} + M_{23}\begin{pmatrix} 0 \\ \theta_2 \end{pmatrix} = -\begin{pmatrix} 0 \\ \theta_3 \end{pmatrix}$$

a) $$\sqrt{\beta_1 \beta_3}\, \sin\psi_{13}\, \theta_1 + \sqrt{\beta_2 \beta_3}\, \sin\psi_{23}\, \theta_2 = 0$$

$$\therefore \quad \theta_2 = -\theta_1 \sqrt{\frac{\beta_1}{\beta_2}}\, \frac{\sin\psi_{13}}{\sin\psi_{23}}$$

b) $$\sqrt{\frac{\beta_1}{\beta_3}}\left(\cos\psi_{13} - \alpha_3 \sin\psi_{13}\right)\theta_1 + \sqrt{\frac{\beta_2}{\beta_3}}\left(\cos\psi_{23} - \alpha_3 \sin\psi_{23}\right)\theta_2 = -\theta_3$$

$$\sqrt{\frac{\beta_1}{\beta_3}}\left(\cos\psi_{13} - \alpha_3 \sin\psi_{13}\right)\theta_1 - \sqrt{\frac{\beta_1}{\beta_3}}\left(\cos\psi_{23}\, \frac{\sin\psi_{13}}{\sin\psi_{23}} - \alpha_3 \sin\psi_{13}\right)\theta_1 = -\theta_3$$

$$\sqrt{\frac{\beta_1}{\beta_3}}\left[\frac{\cos\psi_{13}\sin\psi_{23} - \cos\psi_{23}\sin\psi_{13}}{\sin\psi_{23}}\right]\theta_1 = -\theta_3$$

$$-\sqrt{\frac{\beta_1}{\beta_3}}\, \frac{\sin[\psi_{13} - \psi_{23}]}{\sin\psi_{23}}\, \theta_1 = -\theta_3$$

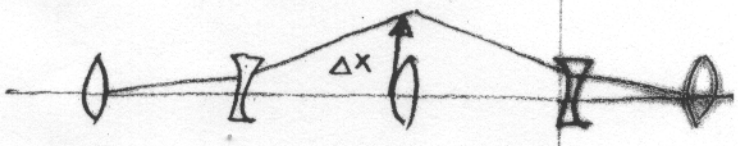
2 →

$$\theta_3 = \theta_1 \sqrt{\frac{\beta_1}{\beta_3}}\, \frac{\sin\psi_{12}}{\sin\psi_{23}}$$

FODO cells: correctors, BPM's @ "F" quads ...

$\psi_{13} = 2\psi_{12} = 2\psi_{23} = 2\mu$

$\beta_1 = \beta_2 = \beta_3 = \hat{\beta}$



$$\Rightarrow \quad \boxed{\theta_1 = \frac{\Delta x}{\hat{\beta} \sin\mu}}$$

$$\theta_2 = -\theta_1 \frac{\sin 2\mu}{\sin\mu} \Rightarrow \boxed{\theta_2 = -2\theta_1 \cos\mu}$$

$$\boxed{\theta_3 = \theta_1}$$