

**PHY 554. Homework 4.**

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1 (10 point): localized orbit correction

The closed orbit can be locally corrected by using steering dipoles. A commonly used algorithm is based on the “three-bumps” method, where three steering dipoles are used to adjust local-orbit distortion.

Let  $\theta_1$ ,  $\theta_2$  and  $\theta_3$  be the three bump angles. For the orbit distortion to be localized between first and third dipoles, show that these angles must be related by

$$\theta_2 = -\theta_1 \sqrt{\frac{\beta_1}{\beta_2}} \frac{\sin \psi_{31}}{\sin \psi_{32}}, \quad \theta_3 = \theta_1 \sqrt{\frac{\beta_1}{\beta_3}} \frac{\sin \psi_{21}}{\sin \psi_{32}},$$

where  $\beta_1$ ,  $\beta_2$  and  $\beta_3$  are the beta functions at local bumps and  $\psi_{ij}$  is the phase advance between  $i$ th and  $j$ th steering dipoles.

Show under what condition, the “three-bumps” method can become “two-bumps” method, i.e., only two steering dipoles are used for local orbit distortion.