

Effects of Planar Insertions on the Ring^{Ho1,Ka2,Wi1}

1. No Net Deflection or Displacement of e^- Beam Requires:

$$\int_{-L/2}^{L/2} B_y(s) ds = 0, \quad B_y(-z) = B_y(z)$$

2. Betatron Tune Shift, $\Delta\nu$:

$$\Delta\nu_x \approx 0, \quad \Delta\nu_y \approx \frac{\pi L \langle \beta_y \rangle K^2}{2\lambda_u^2 \gamma^2}$$

3. Maximum Distortion of the β Functions, $\Delta\beta/\beta$:

$$\frac{\Delta\beta_x}{\beta_x} \approx 0, \quad \frac{\Delta\beta_y}{\beta_y} \approx \frac{2\pi\Delta\nu_y}{\sin(2\pi\nu_y)}$$

4. Effect of Wigglers & Undulators on the Energy Spread, σ_ε :

$$\frac{\sigma_{\varepsilon w}^2}{\sigma_{\varepsilon 0}^2} = \frac{1 + \frac{\sqrt{2}\pi^2 N \rho_0^2 K^3}{\lambda_w^2 \gamma^3}}{1 + \frac{\pi N \rho_0 K^2}{\lambda_w \gamma^2}}, \quad \frac{\sigma_{\varepsilon u}^2}{\sigma_{\varepsilon 0}^2} = \frac{1 + \frac{112\sqrt{3}\pi^2 N \rho_0^2 K^2}{275\lambda_u^2 \gamma^3}}{1 + \frac{\pi N \rho_0 K^2}{\lambda_u \gamma^2}}$$

5. Effect of Damping Wigglers on the Emittance, ε :

$$\frac{\varepsilon_w}{\varepsilon_0} = \frac{1 + \frac{2\sqrt{2}\pi^3 \rho_0^3 K^3 \langle H_w \rangle}{\lambda_w^3 \gamma^3 \langle H_0 \rangle}}{1 + \frac{\pi N \rho_0 K^2}{\lambda_w \gamma^2}}$$

where $\langle H_{w,o} \rangle = \frac{1}{C} \int \frac{ds}{\beta} \left[\eta^2 + \left(\beta \eta' - \frac{1}{2} \beta' \eta \right)^2 \right]$, subscripts 'w, u, 0'

denote wigglers, undulators & dipoles respectively and C is the ring circumference.