

$$\frac{dx}{dz} = \frac{dx}{dt} \cdot \frac{1}{c} = \frac{eB_0 \cosh(K_x x)}{\gamma m c K_y} \left[\frac{-Y_0 K_u K_{ny} \sinh(K_y Y)}{(K_u^2 - K_{ny}^2)} \left(K_u \sin(K_u z) \sin(K_{ny} z) + K_{ny} \cos(K_u z) \cos(K_{ny} z) \right) \right. \\ \left. + \frac{(Y_0' K_u \sinh(K_y Y))}{(K_u^2 - K_{ny}^2)} \left(K_u \sin(K_u z) \cos(K_{ny} z) - K_{ny} \cos(K_u z) \sin(K_{ny} z) \right) \right. \\ \left. + \frac{K_y}{K_u} \cosh(K_y Y) \cos(K_u z) \right]$$

$$X = \int \frac{dx}{dz} dz \Rightarrow K_u \int \sin(K_u z) \sin(K_{ny} z) dz = \frac{K_u K_{ny} \sin(K_u z) \cos(K_{ny} z) - K_u^2 \cos(K_u z) \sin(K_{ny} z)}{K_u^2 - K_{ny}^2}$$

$$K_{ny} \int \cos(K_u z) \cos(K_{ny} z) dz = \frac{-K_{ny} K_u \sin(K_u z) \cos(K_{ny} z) - K_{ny}^2 \cos(K_u z) \sin(K_{ny} z)}{K_u^2 - K_{ny}^2}$$

$$K_u \int \sin(K_u z) \cos(K_{ny} z) dz = \frac{K_u K_{ny} \sin(K_u z) \sin(K_{ny} z) + K_u^2 \cos(K_u z) \cos(K_{ny} z)}{K_u^2 - K_{ny}^2}$$

$$K_{ny} \int \cos(K_u z) \sin(K_{ny} z) dz = \frac{K_{ny} K_u \sin(K_u z) \sin(K_{ny} z) + K_{ny}^2 \cos(K_u z) \cos(K_{ny} z)}{K_u^2 - K_{ny}^2}$$

$$\frac{K_y}{K_u} \int \cos(K_u z) dz = \frac{K_y}{K_u^2} \sin(K_u z)$$

$$X(z) = \frac{eB_0 \cosh(K_x x)}{\gamma m c K_y} \left[\frac{(-Y_0 K_u K_{ny} \sinh(K_y Y))}{(K_u^2 - K_{ny}^2)^2} \left[2 K_u K_{ny} \sin(K_u z) \cos(K_{ny} z) + (K_u^2 - K_{ny}^2) \cos(K_u z) \sin(K_{ny} z) \right] \right. \\ \left. + \frac{(Y_0' K_u \sinh(K_y Y))}{(K_u^2 - K_{ny}^2)^2} \left[(K_u^2 - K_{ny}^2) \cos(K_u z) \cos(K_{ny} z) + \frac{K_y}{K_u^2} \sin(K_u z) \right] \right]$$

$$X(z) = \frac{eB_0 \cosh(K_x x)}{\gamma m c K_y} \left[\frac{(-Y_0 K_u K_{ny} \sinh(K_y Y))}{(K_u^2 - K_{ny}^2)^2} \left[2 K_u K_{ny} \sin(K_u z) \cos(K_{ny} z) + (K_u^2 - K_{ny}^2) \cos(K_u z) \sin(K_{ny} z) \right] \right. \\ \left. + \frac{(Y_0' K_u \sinh(K_y Y))}{(K_u^2 - K_{ny}^2)^2} \left[\cos(K_u z) \cos(K_{ny} z) + \frac{K_y}{K_u^2} \sin(K_u z) \right] \right]$$