

Homework 20

1. (10 points) Show that for $\hat{C} \ll 1$, the eigenvalue of the growing mode for the 1-D FEL (cold beam) can be approximated as

$$\lambda = a_0 + a_1 \hat{C} + a_2 \hat{C}^2$$

with

$$a_0 = \frac{\sqrt{3}}{2} + i \frac{1}{2},$$

$$a_1 = -i \frac{2}{3},$$

and

$$a_2 = -\frac{1}{9} \left(\frac{\sqrt{3}}{2} - i \frac{1}{2} \right).$$

Hint: Insert the expansion, $\lambda = a_0 + a_1 \hat{C} + a_2 \hat{C}^2$, into the polynomial equation for the eigenvalues in a cold beam (lecture slide # 10) and request coefficients of \hat{C}^0 , \hat{C}^1 and \hat{C}^2 to vanish.