

Translation

Let K be the translation operators

$$K_1 = \frac{1}{\hbar}P_1, \quad K_2 = \frac{1}{\hbar}P_2, \quad K_3 = \frac{1}{\hbar}P_3$$

Let U be the unitary transformation

$$U = 1 - i\epsilon K_3 - \frac{1}{2}\epsilon^2 K_3^2$$

Show that to order ϵ^2

$$U^{-1}L_1U = L_1 - \epsilon P_2, \quad U^{-1}L_2U = L_2 + \epsilon P_1, \quad U^{-1}L_3U = L_3$$