1. Based on your proposed topic from HW4, perform a literature search. Identify a dozen of the most relevant journal articles and write a 1-2 sentence synopsis of each as it pertains to your project. Please turn in this problem separately from the rest of the HW.

2. Begin with the nonlinear Schrödinger equation

\[
\left( \frac{\partial}{\partial z} + \frac{1}{v_g} \frac{\partial}{\partial t} \right) \hat{E} - \frac{i}{2v_g^2} v'_g \frac{\partial^2}{\partial t^2} \hat{E} = i\gamma |\hat{E}|^2 \hat{E}
\]

(a) Make the substitution \( \zeta = t - z/v_g \) and obtain a new equation.

(b) Verify that

\[ E(z, \zeta) = E_0 \text{sech}(\zeta/\zeta_0)e^{ikz}, \]

is a valid solution for particular values of \( E_0 \) and \( \kappa \) and find those values. Comment on the role of the second order linear dispersion.

(c) Consider \( E \to E + \Delta \). Find an equation linear in \( \Delta \) and comment

3. [OPTIONAL] A point source gives rise to a field of the form

\[
E = E_0 \frac{e^{ik_0 |r-r_s|}}{|r-r_s|} = E_0 \int d^2k_\parallel \frac{i}{2\pi k_z} e^{ik\cdot(r-r_s)} \quad \text{for } z - z_s > 0 \quad (1)
\]

where \( k = (k_\parallel, k_z) \), and \( k_z = \sqrt{k_0^2 - k_\parallel^2} \). This field falls on a PCM with its face parallel to the \( z = \text{const.} \) plane, located many wavelengths from the source. Up to proportionality, what is the reflected field in the neighborhood of the source? Sketch the intensity on a line in a plane containing the source parallel to the PCM.