Project 1

Use Fourier spectral method to solve the following nonlinear Schrödinger equation:

$$i\frac{\partial\psi(\boldsymbol{x},t)}{\partial t} = -\frac{1}{2}\Delta_{\boldsymbol{x}}\psi(\boldsymbol{x},t) + V(\boldsymbol{x})\psi(\boldsymbol{x},t) + \frac{1}{10}|\psi(\boldsymbol{x},t)|^2\psi(\boldsymbol{x},t),$$

$$\psi(\boldsymbol{x},0) = \frac{(\gamma_2\gamma_3)^{1/4}}{(\pi\varepsilon)^{3/4}}\exp\left(-\frac{x_1^2 + \gamma_2 x_2^2 + \gamma_3 x_3^2}{2\varepsilon}\right),$$

where

$$V(\boldsymbol{x}) = \frac{1}{2}(x_1^2 + \gamma_2^2 x_2^2 + \gamma_3^2 x_3^2), \quad \gamma_2 = 2, \quad \gamma_3 = 4, \quad \varepsilon = 1/4.$$

Present the numerial solutions at $t = 5k$ for $k = 0, 1, \cdots, 8$. Submit the following to Canvas when finishing your project:

- The source code;

- A simple report including a description of the numerical method and the figures showing the numerical results.

Please complete your submission no later than 19 March, 2023.