

$$i \frac{\partial}{\partial t} \begin{pmatrix} \Phi_0(t) \\ \Phi_1(t) \\ \Phi_2(t) \\ \vdots \\ \vdots \\ \Phi_{L-1}(t) \end{pmatrix} = \Delta^{-2} \underbrace{\begin{pmatrix} 1 + \Delta^2 V_0 & -1/2 & 0 & & 0 \\ -1/2 & 1 + \Delta^2 V_1 & -1/2 & & 0 \\ 0 & -1/2 & 1 + \Delta^2 V_2 & & 0 \\ & & \ddots & \ddots & \\ & & & 1 + \Delta^2 V_{L-2} & -1/2 \\ 0 & & 0 & -1/2 & 1 + \Delta^2 V_{L-1} \end{pmatrix}}_H \begin{pmatrix} \Phi_0(t) \\ \Phi_1(t) \\ \Phi_2(t) \\ \vdots \\ \vdots \\ \Phi_{L-1}(t) \end{pmatrix}$$