Time-Independent SEQ

What does the time-independent SEQ represent?

It's actually not so puzzling…it's just an expression of a familiar result:

Kinetic Energy (KE) + Potential Energy (PE) = Total Energy (E)

$$-\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{dx^2} + U(x)\psi(x) = E\psi(x)$$

KE term PE term Total E term

Can we understand the KE term? Consider a particle with a definite momentum. Its wave function is: $\psi(x) \propto \cos(kx)$, where $p = h/\lambda = \hbar k$.

$$\frac{d\psi}{dx} = -k\sin(kx) \quad \Rightarrow \quad \frac{d^2\psi}{dx^2} = -k^2\cos(kx) = -\frac{p^2}{\hbar^2}\psi(x)$$

So, the first term in the SEQ is $(p^2/2m)\psi$.

Note that the KE of the particle depends on the curvature ($d^2\psi/dx^2$) of the wave function. This is sometimes useful when analyzing a problem.