

Chem. 542
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Time Evolution Models – Problem 1

In class we calculated the time-dependent Green function or propagator for a free particle of mass m moving in one dimension.

Calculate the time evolution of a wave packet moving in free one-dimensional space given that at $t = 0$ its wavefunction has the form

$$\Psi(x;0) = \left(\frac{\alpha}{\pi}\right)^{\frac{1}{4}} e^{-\frac{\alpha}{2}(x-x_0)^2 + ip_0x/\hbar}.$$

Check your answer by directly substituting in the time-dependent Schrödinger equation. Examine how the probability density spreads with time by calculating the “uncertainty in position”

$$\Delta x(t) = \left(\langle \Psi(t) | x^2 | \Psi(t) \rangle - \langle \Psi(t) | x | \Psi(t) \rangle^2 \right)^{\frac{1}{2}}.$$