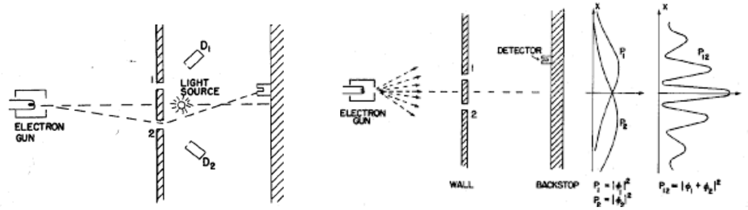
Quantum Mechanics Overview

- Quantum Physics - for very short length scales $< 10^{-8}$m.
- Matter has both particle and wave properties. Depends on what is measured and how.



- Free particles: kinetic energy, $E = \frac{1}{2}mv^2 = \frac{p^2}{2m}$;
  Waves: amplitude $\Psi(x,t) = Ae^{i(kx-\omega t)}$,
  $\lambda = \frac{h}{p}$ i.e. $p = mv = \hbar k$ and $E = \hbar\omega$.
- Transform physics intuition with help of mathematical concepts and build a predictive theory.

Waves and particles

- Context for Schrodinger Equation

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\Psi(x,t)+V(x)\Psi(x,t)=i\hbar\frac{\partial}{\partial t}\Psi(x,t).$$

- Works - e.g. for $V=0$, Wave $\Psi(x,t)=Ae^{i(kx-\omega t)}$, is a solution, $\frac{\hbar^2k^2}{2m}=\hbar\omega$, i.e. $\frac{p^2}{2m}=E$.
- Probability distribution (particle counting) $\rightarrow|\Psi(x,t)|^2$.
- Standing waves $\Psi(x,t)=\Phi_n(x)e^{-iE_nt/\hbar}$ and energy levels, E_n,

$$-\frac{\hbar^2}{2m}\frac{d^2}{dx^2}\Phi_n(x)+V(x)\Phi(x)=E_n\Phi_n(x).$$