第二课：波函数ψ和S方程

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1. 约化普朗克常量：$\hbar = \frac{h}{2\pi}$;
2. 薛定谔方程：
   a. 能量：$E = \frac{1}{2}mv^2 + v(x) = \frac{1}{2} \cdot \frac{P^2}{m} + v(x)$;
   b. 德布罗意波：$\psi = A \cdot \cos\left[\vec{k} \cdot \vec{r} - \omega t\right] = A \cdot e^{\left[i(\vec{k} \cdot \vec{r} - \omega t)\right]}$;
   c. 由：
      i. $\omega = 2\pi r$;
      ii. $k = \frac{2\pi}{\lambda}$;
      iii. $E = h\nu$;
      iv. $P = \frac{h}{\lambda}$;
   d. 得到物质的德布罗意波：$\psi = A \cdot e^{\frac{i}{\hbar} \cdot (\vec{p} \cdot \vec{r} - Et)}$;
   e. 两边对时间微分：$\frac{\partial \psi}{\partial t} = -\frac{iE}{\hbar} \cdot \psi \Rightarrow i\hbar \cdot \frac{\partial \psi}{\partial t} = E\psi$;
   f. $\frac{\partial \psi}{\partial x} = \frac{\partial}{\partial x}\left(A \cdot e^{\frac{i}{\hbar}(p_x x + p_y y + p_z z - Et)}\right) = \frac{ip_x}{\hbar} \cdot \psi \Rightarrow \frac{\partial^2 \psi}{\partial x^2} = \left(\frac{ip_x}{\hbar}\right)^2 \cdot \psi = -\frac{p_x^2}{\hbar^2} \cdot \psi$;
   g. $\Rightarrow \frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} + \frac{\partial^2 \psi}{\partial z^2} = -\frac{1}{\hbar^2} \cdot \left(p_x^2 + p_y^2 + p_z^2\right)\psi$;
   h. $\Rightarrow \nabla^2 \psi = -\frac{1}{\hbar^2} p^2 \psi \Rightarrow -\frac{\hbar^2}{2m} \nabla^2 \psi = \frac{p^2}{2m} \cdot \psi$
   i. $-\frac{\hbar^2}{2m} \nabla^2 \psi + \mathrm{U(r)}\psi = \mathrm{E}\psi$;
3.