Summary of Lecture 7

- 1D scattering from symmetric potential

$$\Psi_k(x) = c_{\text{even}} \cos(k|x| + \delta_{\text{even}}) + c_{\text{odd}} \text{sgn}(x) \cos(k|x| + \delta_{\text{odd}})$$

- Lippmann-Schwinger Equation

$$\Psi_k(x) = \exp\left(\mathrm{i}kx\right) + \int \mathrm{d}x'\, G_k^+(x, x') V(x') \Psi_k(x')$$

- Scattering in 3D

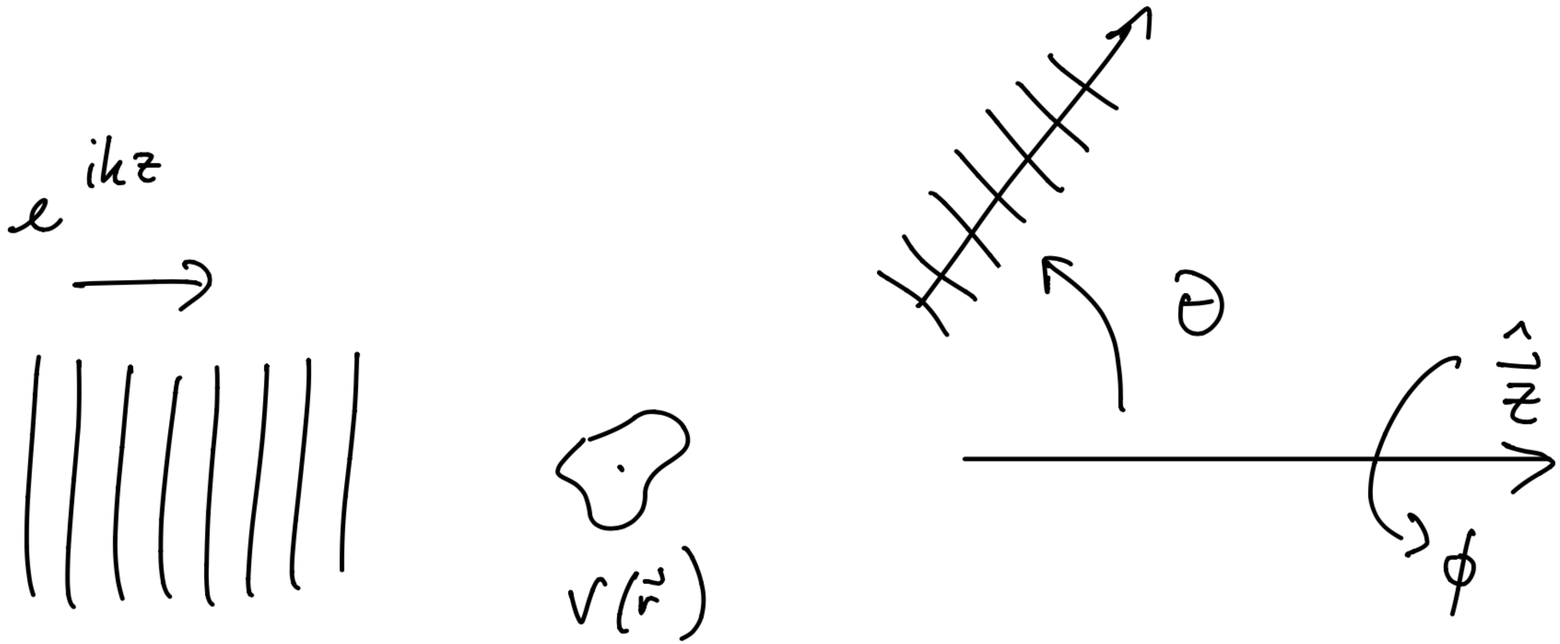
$$\Psi_k(\vec{r}) \underset{r\to\infty}{\longrightarrow} \exp\left(\mathrm{i}kz\right) + \frac{f(\theta, \phi)}{r} \exp\left(\mathrm{i}kr\right)$$

Differential cross section $\quad \dfrac{\mathrm{d}\sigma}{\mathrm{d}\Omega} = |f(\theta, \phi)|^2$

This Lecture (8)

- First Born Approximation
- Partial Wave Analysis
- Optical Theorem

Scattering in 3D



$$\Psi_k(\vec{r}) \underset{r\to\infty}{\longrightarrow} \exp\left(\mathrm{i}kz\right) + \frac{f(\theta,\phi)}{r}\exp\left(\mathrm{i}kr\right)$$

Differential cross section $$\frac{\mathrm{d}\sigma}{\mathrm{d}\Omega} = |f(\theta,\phi)|^2$$

Optical Theorem $$\sigma_{\text{tot}} = \frac{4\pi}{k}\mathrm{Im}\left[f(\theta=0)\right]$$

Summary of Lecture 8

- First Born approximation

$$\left.\frac{\mathrm{d}\sigma}{\mathrm{d}\Omega}\right|_{\mathrm{Born}} = \left| \frac{m}{2\pi\hbar^2} \int \mathrm{d}\vec{r}' \exp\left(-\mathrm{i}\vec{q}\cdot\vec{r}'\right) V(\vec{r}') \right|^2$$

- Partial wave analysis: conserved angular momentum

$$f(\theta,\phi) = \frac{1}{k} \sum_{l=0}^{\infty} (2l+1)\, \mathrm{e}^{\mathrm{i}\delta_l} \sin\delta_l\, P_l(\cos\theta)$$

$$\sigma_{\mathrm{tot}} = \frac{4\pi}{k^2} \sum_{l=0}^{\infty} (2l+1) \sin^2\delta_l = \frac{4\pi}{k} \mathrm{Im}\left[f(0)\right]$$

[Optical Theorem]

Next Lecture (9)

- Low-energy scattering, Resonances and Bound States