8.321 Recitation 11-12

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1 Solving 1D Schrodinger Equation

1.1 Bound State

- Single Dirac delta: $V(x) = -\alpha\delta(x)$

- One bound state: $E = -\frac{m\alpha^2}{2\hbar^2}$

- Single Dirac delta with spin: $V(x) = -c\sigma_z - \alpha\delta(x)\sigma_x$

- One bound state: $E = -\sqrt{c^2 + \left(\frac{m\alpha^2}{2\hbar^2}\right)^2}$

1.2 Scattering State

- Single barrier: $V(x) = V_0$ when $0 < x < a$

- Tunneling when $E < V_0$: $T = \left(1 + \frac{V_0^2}{4E(V_0-E)}\sinh^2\sqrt{\frac{2m(V_0-E)a^2}{\hbar^2}}\right)^{-1} > 0$

- Double barrier: $V(x) = V_0$ when $0 < x < a$ and $a + b < x < 2a + b$

- Transfer matrix method

- Resonant tunneling: $T_{max} = 1$! (See resonanttunneling.nb)