Exercise Set 5

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Monday

Exercise 1

$$\begin{aligned}\langle Jm_J|S_z|Jm_J\rangle &= \frac{\langle Jm_J|\vec{J}\cdot\vec{S}|Jm_J\rangle}{\hbar^2 J(J+1)}\langle Jm_J|J_z|Jm_J\rangle \\ &= \frac{\langle Jm_J|J^2+S^2-L^2|Jm_J\rangle}{2\hbar J(J+1)}m_J \\ &= \frac{J(J+1)+S(S+1)-L(L+1)}{2J(J+1)}\hbar m_J\end{aligned}$$

Tuesday

Exercise 1

$$\begin{aligned}\partial_t A_I &= \partial_t\left[e^{iH_0t/\hbar}A_s e^{-iH_0t/\hbar}\right] \\ &= \frac{i}{\hbar}H_0A_I - \frac{i}{\hbar}A_IH_0 \\ &= -\frac{i}{\hbar}[A_I,H_0]\end{aligned}$$

$$\begin{aligned}\partial_t|\psi\rangle_I &= \partial_t\left[e^{iH_0t/\hbar}|\psi\rangle_S\right] \\ &= \frac{i}{\hbar}H_0e^{iH_0t/\hbar}|\psi\rangle_S - \frac{i}{\hbar}e^{iH_0t/\hbar}|\psi\rangle_S \\ &= -\frac{i}{\hbar}\left[e^{iH_0t/\hbar}(H_0+V) - H_0e^{iH_0t/\hbar}\right]|\psi\rangle_S \\ &= -\frac{i}{\hbar}e^{iH_0t/\hbar}V|\psi\rangle_S \\ &= -\frac{i}{\hbar}e^{iH_0t/\hbar}Ve^{-iH_0t/\hbar}e^{iH_0t/\hbar}|\psi\rangle_S \\ &= -\frac{i}{\hbar}V_I(t)|\psi\rangle_I\end{aligned}$$