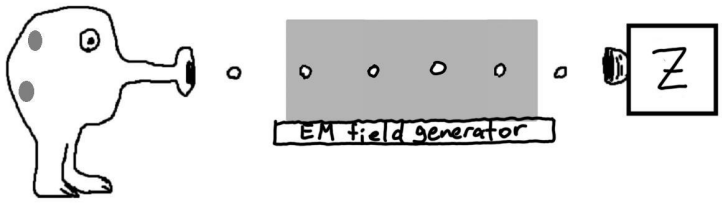
Physics 402 worksheet

Please work in groups of ~ 3 people, but write on your own worksheet since this will be part of your homework.



Particles in the state $|Z = 1\rangle$ are produced and travel through an electromagnetic field such that their state evolves via a Hamiltonian which is represented in the basis of Z eigenstates as

$$\hat{H} = E_0 \begin{pmatrix} 3 & 1 \\ 1 & 3 \end{pmatrix} . \tag{1}$$

After traveling through the electromagnetic field for a time T, the particle enters a Z detector. What is the probability that the particle will be measured in the state $Z = 1$?

Hint: you have seen this matrix before.

Homework Problem

The internal states of a particle of spin 1 are described by a three-dimensional Hilbert space. We can choose a basis of eigenstates of and operator S_z with eigenvalues (in units of $\hbar$) -1, 0, and 1. Suppose the Hamiltonian for this system (perhaps coming from the interaction of this spin with a magnetic field) is represented in this basis by

$$H = E_0 \begin{pmatrix} 9 & 0 & 0 \\ 0 & 10 & -4i \\ 0 & 4i & 4 \end{pmatrix} . \tag{2}$$

where $E_0 = 10^7 s^{-1} \cdot \hbar$. So for example, $\hat{H}|-1\rangle = 9E_0|-1\rangle$. If the state at $t = 0$ is $\frac{1}{\sqrt{2}}(|-1\rangle + |1\rangle)$ what is the probability that the spin S_z will be measured to be 0 at some later time $T = 10^{-8}s$?