

# 1 Frequency

Consider a two-state quantum system (i.e., a system with a two-dimensional Hilbert space) with a Hamiltonian

$$\hat{H} \doteq \begin{pmatrix} E_1 & 0 \\ 0 & E_2 \end{pmatrix} \quad (1)$$

Another physical observable  $M$  is represented by the operator

$$\hat{M} \doteq \begin{pmatrix} 0 & c \\ c & 0 \end{pmatrix} \quad (2)$$

where  $c$  is real and positive. Note: Both matrices are written in the same basis.

The initial state of the system is  $|\psi(t=0)\rangle = |m_1\rangle$ , where  $|m_1\rangle$  is the eigenstate of  $\hat{M}$  corresponding to the larger of the two eigenvalues of  $\hat{M}$ .

- (a) What is the expectation value of  $M$  as a function of time?
- (b) What is the frequency of oscillation of the expectation value of  $M$ ?