5.74 Introductory Quantum Mechanics II
Spring 2009

Resonant driving of two-level system

Input energy splitting and coupling $\qquad \omega_{kl} := 0 \qquad V := 1$

Rabi frequency:

$$\Omega(\omega) := \frac{1}{2}\cdot\left[\sqrt{V^2 + \left(\omega_{kl} - \omega\right)^2}\right]$$

Probability of transfer from intial state (l) to final state (k)

$$P(t,\omega) := \frac{V^2}{V^2 + \left(\omega_{kl} - \omega\right)^2}\cdot\sin(\Omega(\omega)\cdot t)^2$$

Time axis: $\qquad i := 0..500 \qquad \tau_i := \dfrac{i}{50}$

Evalulate time-dependence for four values of the detuning ω_{kl}-ω.

$n := 0..3$ $\qquad\qquad\qquad\qquad \omega_n :=$

Detuning : $\qquad \Delta_n := \omega_n - \omega_{kl}$

0
0.5
1
3

$$\Delta = \begin{pmatrix} 0 \\ 0.5 \\ 1 \\ 3 \end{pmatrix}$$

Here the units of detuning should be measured with respect to the coupling:
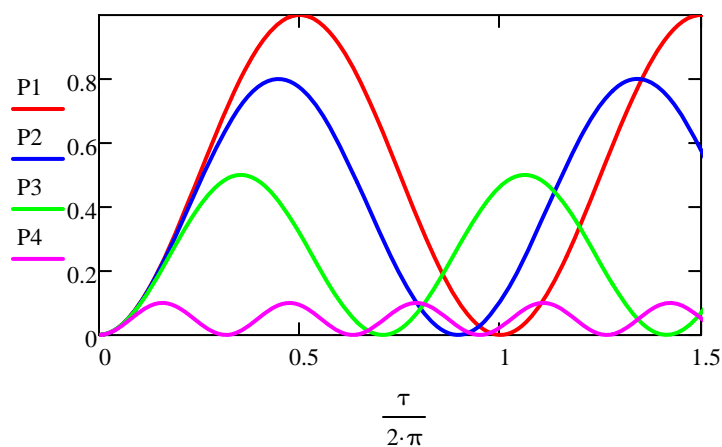
$$\frac{\Delta}{V} = \begin{pmatrix} 0 \\ 0.5 \\ 1 \\ 3 \end{pmatrix}$$

$$P1_i := P\left(\tau_i, \omega_0\right) \qquad P2_i := P\left(\tau_i, \omega_1\right) \qquad P3_i := P\left(\tau_i, \omega_2\right) \qquad P4_i := P\left(\tau_i, \omega_3\right)$$

1

Now investigate the detuning dependence of the transfer probability as a function of time.

$j := 0 .. 200$

$$\omega_j := \frac{100 - j}{10}$$

$t_n :=$

1
2.5
5
7.5

$$P_{max}(\omega) := \left[\frac{v^2}{\left[v^2 + \left(\omega_{kl} - \omega \right)^2 \right]} \right]$$

$$P1_j := P\left(t_0, \omega_j \right) \qquad P2_j := P\left(t_1, \omega_j \right) \qquad P3_j := P\left(t_2, \omega_j \right) \qquad P4_j := P\left(t_3, \omega_j \right)$$