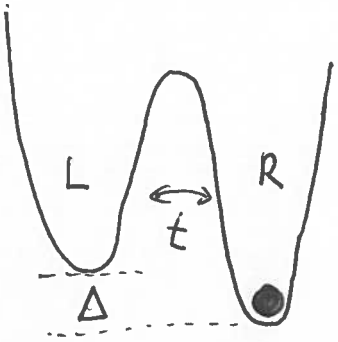
Phys 402: Applications of Quantum Mechanics

Homework III (due 930am, Thursday, Jan 28, 2016)

Quantum Bouncing in a double-well potential

A tilted double-well. Assume a particle initially is at the right hand side or the lower site of potential. Can the particle appear at the left hand site of the potential at time t? What is the probability? What happens when the tilt is very large and very small? Construct a reasonable Hamiltonian matrix to describe the phenomenon here. Assume that the tilt and tunneling amplitude are known parameters.



We are interested in the limit when t is independent of Δ, tilt and t, Δ are treated as independent parameters.

Spin-1/2 electron

Spin projection Operators along direction $\vec{\Omega}$ is defined as

$S_\Omega = \vec{S} \cdot \hat{\Omega}$, $S_\alpha = \frac{\hbar}{2}\sigma_\alpha$, $\alpha = x, y, z$; $\hat{\Omega}$ is a unit Vector.

$\sigma_{x,y,z}$ are Pauli matrices introduced in Chapter 4.

1) Find the eigenspinors and eigenvalues of spin projection operators along x, y, z direction.

2) Prob. 4.30 (page 178).

3) A polarized electron beam with spins pointing along the z-direction and momentum p enters a region with uniform magnetic fields pointing along the direction of x. Find out the outgoing spin states and the probability of finding a spin pointing along the downward direction. Assume the width of the region is L. Plot it as a function of L. (Translational motion can be treated classically.)