PHYC - 505: Statistical Mechanics
Homework Assignment 7

Due May 8, 2014

1. Present, compare and contrast the standard textbook derivation of the Fermi Golden Rule with the Zwanzig derivation via projection operators and critique both. Be as precise as you can.

2. Given a time-dependent complex number $z(t) = x(t) + iy(t)$ which evolves via the equation

$$\frac{dz(t)}{dt} = -\gamma z(t)$$

   where $\gamma = \alpha + i\beta$ is a complex constant (x, y, α, β are all real),

   (i) define a projection operator to extract the real part of any number on which it acts;

   (ii) apply the operator via Zwanzig projection techniques to the above evolution equation to derive the counterpart here of the Zwanzig projected equation for x in terms of x alone for the initial condition that $y(0) = 0$

   (iii) evaluate in detail EXACTLY the operator expressions that you got in (ii) to obtain a simple closed equation for $x(t)$

   (iv) obtain the exact evolution equation of $x(t)$ without using projections and show its equivalence with what you get in (iii) and show a connection, if any, to the damped harmonic oscillator.