**Path Integral Formulation of Propagator**

Let’s say we have the following boson Hamiltonian, for example,



Then let’s get the propagator:



Now we use our result that for small times (see single particle QM propagator stuff), we are able to separate the free π part from φ part, and so we have, with implicit summation over the φ’s…



Now we’ll throw in some |π> state resolutions of identity:



In the last line eiπ·φ is meant to stand for the field momentum wavefunction in field configuration space:



And we can put these back together, now to write:



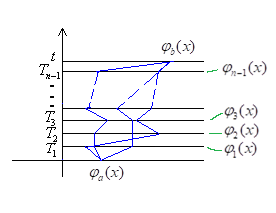
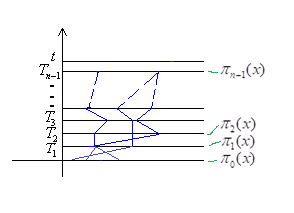
And so finally,



where,



where the paths look like this:

Of course, with an H quadratic in π, we can do the D[π(x)] integral. And we’ll find:



where,



And of course, mindful of the restriction of time to (0,t) interval, and of the boundary conditions φa(x), φb(x) on the time-development, we may write this in 4-vector notation:



Explicitly, for our scenario, the action is:



where ∂2 = ∂μ∂μ = (∂t, ∇)·(∂t, -∇).