**Noninteracting Green’s Functions**

Now we’ll examine some non-interacting GF’s. Most are of the same form as those obtained before/only difference being a thermal averaged expectation replacing a single state expectation. Note I’m going to be presuming time-development starts at t = 0: So U0(t) = e-iH0·t. But if we used U0(t,t0) = e-iH0(t-t0) instead, this wouldn’t change G(t,t´) because it is, as you’ll see, a function only of the difference of the arguments. Also, for the most part, I won’t bother with the exponential convergence factors that we should have on the real space GF’s. Might want to check out QFT folder for more work on these.

**Free Photon Green’s Functions**

And now we’ll do a field GF, but we’ll stick with the non- (manifestly) relativistic Coulomb gauge formalism – using ‘Natural Gaussian’ units. We’re starting with,



(ωk would be ℏkc, were we to go to SI units) And we’ll recall we have, from the photon field file in the QFT folder, that using the CMT phase convention for a, a† as we have for phonons, we can write the free field expansion as:



just as we did for the phonon. Then let’s examine,



Now for a homogeneous, isotropic medium, we expect that < > to enforce λ´ = λ, and k´ = -k, as it did for the phonon case. So then we’ll have:



Now we define,



[the QFT phase convention would gives us the same result for both D and G] Just like we got in the phonon case, we will get:



and taking the FT we will likewise have:



So then the position/time space GF will be:



and the momentum, energy/frequency space GF will be:



and recalling what the sum over the polarization vectors equals,



(basically the two polarization vectors are an orthonormal set perpendicular to the photon’s velocity – because EM waves are transverse of course) this could be written as:



The others we can obtain from analytic continuation, just like we did for the phonon GF. The QFT phase convention would give us the same result.