**Self-Energy**

Gonna do a short sweet example,

**Example**

Let’s consider the thermal self-energy of single particle HO in a cuartic perturbation.



What is the self-energy to first order in this interaction?



(factor of 1/2 comes from coincident propagator) and so,



And so,



To evaluate the frequency sum we use (see Math Appendix)



and so,



So we have:



Might note that in the limit β → ∞ (T → 0) our result reduces to the ΣC we found for the ground state in the QM file. So that makes sense. On the other hand, when T → ∞, ΣC\* → 0. I would think that ΣC\*(T large) is measuring in some sense the energy correction for higher energy states. And evidently the correction is nill the higher we go. Wonder why? Even if kinetic energy were to dominate, still don’t see why the potential energy contribution should go to zero, absolutely. Anyway, so our GF would be:



And new (thermally averaged) excitations are:



**Example**

We have, from the formal properties file, that:



Now in the limit of infinite lifetime, our spectral function ought to go to a δ function.



where fk(ω) is some small smooth background – the background must be there to ensure that ∫dω A(**k**,ω) = 1. Now consider how this would affect the momentum distribution function. We have, from the formal properties file, that:



Plugging our A in here we get:



Only thing wanted to mention is that the first term tells us the discontinuity at the Fermi surface will be reduced from 1 to ZkF, as the last term just gives us a smooth background. So we may expect something like this (interacting = blue, non-interacting = pink).

