**Electric Susceptibility**

Now let’s examine the electric susceptibility. Starting with [note we’ll be using fake Gaussian units again]:



where,



Now we’re immersing the sample in an electric field. We can just use the gauge where **A** = 0, and φ = -**E**(Rj,t)·**P**(Rj), so that:



Now we want the thermal average of the polarization. This requires knowledge of the statistical evolution operator, which, to first order in the perturbation VI = P·E, is:



Filling in our perturbation,



where in the last step we take t0 → -∞ so that we just extract the steady-state response. This is obviously,



where the polarization-polarization GF is:



Presuming homogeneity, **F** should be a function only of the difference of the arguments **R**i, **R**j. Then taking the Fourier transform of both sides,



where,



and,



[where in 4th line, we use fact that < > must enforce **k**´ = -**k**, if **F** is to be a function purely of Δ**R**] Now recall from Electrodynamics (upgrading χe to a tensor and switching to Gaussian units)



So clearly, F = -χe, and since ε = 1 + 4πχe, we’ve got:



Well, we already have our result basically, since we already calculated F.



Need to convert that to tensor **F**R though, and so we use:



which implies,



and therefore

