**Dielectric Susceptibility**

Want to consider the RTA model approximation for working out some time-dependent things we proferred in the EM folder, like the conductivity and dielectric susceptibility. So,

**Metals**

Let’s examine the susceptibility from the perspective the MFT solution to the RTA equation, which we developed in a different file – see Stat Mech Folder. So we found these two self-consistent equations:



where D was given by:



The susceptibility, χirr, is defined as the charge density response to an electric field perturbation.



But in the faux-Gaussian units we’ll be working in, where ε0 → 1/4π, we’d have:



But…then it’s customary to redefine the susceptibility by absorbing the 1/4π into it. So we’ll say,



We can work χ out from our equation. Setting B to zero for simplicity, we have (j is synonymous with jind, and ρ is synonymous with ρind; we’re assuming no free charge):



Well we need to relate jind and ρind. We have the continuity equation,



So let’s take the divergence of both sides of our RTA equation,



Then we can say,



Now fill in our expressions for ρind and φ,



So we have:



Filling in D = 2τscεF/3m again, we’ll get:



and so we end up with,



Not calculating the dielectric function, because technically, with no e-e interactions, the dielectric function would be just ε = ε0 or whatever.