**EM Susceptibilities**

**Electric Susceptibility**

Don’t know. So I’ll presume it’s as before, from the Thomas Fermi or Linhardt approximation. One would think that, as localization sets in, it would take on a more insulator like form, perhaps with resonant frequencies? Dunno.

**Magnetic Susceptibility**

Would also tend to think that the diamagnetic response would be supressed since the electrons can’t form a large current, and so the metal would be more paramagnetic? So it would seem that:



Well I think this can be further substantiated by looking at the conductivity calculation in the non-equilibrium properties folder. There, we implicitly presumed a spin-independent electromagnetic perturbation (since we didn’t have it coupling to the spins per se´, which would definitely be the case apropos electric fields). And we found the current density to be related to the vector potential via:



And we said the conductivity tensor was:



so that we could say



Well we can already see that in the ω → 0 limit, since remains finite and **A** is proportional to **B**, the induced current would go to zero, and with it, the magnetization **M** = -(1/2)∫dτ(**r**×**J**). So as long as there is finite resistance, we get no steady-state diamagnetic response really. But it seems odd that we’d get no diamagnetic response for *any* impurity concentration. Would it depend on the impurity concentration in such a way that only if ℓ were smaller than the magnetic orbital radius the diamagnetism would be suppressed? This makes more sense from the perspective of the Excitations folder in that it did not seem that putting an impurity potential into the metal prohibited the electrons from still circling around the magnetic field lines (which is part of how they get the ωB(n+1/2) contribution to their energy). Can think of having a lot of impurities as destroying the diamagnetic current in two different perspectives: one is that it just scatters the diamagnetic current that would be formed, and two is that the random impurity potential wells cause the electron drift currents to circulate in random directions corresponding to the whether the potential has a local minimum or maximum, perhaps leading to a canceling out the diamagnetic current.