**Meisner Effect**

So now we want to add impurities to the mix, for Type I’s. These plots are for dirty (i.e., they have impurities) superconductors I’d imagine.

Chart

Description automatically generated with medium confidence

So should say that Meisner effect has to do with the magnetic susceptibility, plotted above for both Type I’s and Type II’s. From the plot we see that for Type I’s, the susceptibility is χm = -1 up to a critical field. Thus they are perfect diamagnets up to that point. And as we calculate the supercurrents below, keep in mind that one could say that we’re simply calculating the magnetization, as **M** = (1/2)∫d3r **r**×**J** (see EM folder).

**Meisner Effect via BCS theory of Superconductors**

Now we’ll do a quantum calculation, with impurities added to the mix. So our H is:



where,



and where A is the vector potential, and jp the paramagnetic current density,



So from the Metals/Impurities/Nonequilibrium/Conduction/Quantum file, we derived the relationship.



Guess I’ll call the thing in brackets, **K**(q,ω).



So we’ll start with the current-current correlation function (maybe see the absorbtivity+conductivity tensor file in non-equilibrium properties folder).



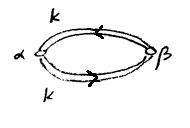
And then the retarded correlation function is,



And now our discussion of the Meisner effect, in the previous file, centered on slowly increasing a uniform magnetic field. So we’ll take the q = ω = 0 limit in this Π equation, and that gives us,



The simplest approximation to this would be this guy,



which is the product of the two disorder averaged GF’s. So our expression would be:



and from GF excitations file,



and also from the GF excitation file, I’m going to use the simple Born approximation to the disorder averaged GF,



where,



In the previous file, we evaluated the Trace and did the Matsubara sum. The trace is:



So then we have:



To evaluate S, we have to do that Matsubara sum over the frequencies. So recall the general technique elaborated on in the Stat Mech Math Appendix,



So now have to evaluate:



I don’t want to work this out, but I think we still get:



where we define the super current electron density, ns(T), which goes from 0 at T = Tc to n at T = 0.

