**Magnetic Susceptibiliy**

So yeah.

**Example: Magnetic susceptibility in the RPA limit**

Let’s calculate the paramagnetic susceptibility in the constant field, 0 frequency limit.



And from the Collective Excitation (spin) file, we found,



So in the RPA approximation, we’ve got:



and then going to q = 0, ω = 0 (meaning constant field in space and time), we have:



where we acknowledge that the small q, and ω = 0 limit is just the classical regime, which, in the RPA, is given by the Thomas-Fermi approximation. We have, from the Collective Excitations file,



So, recalling the density of states at the Fermi surface (see Free Day / Electrons / Excitation / Properties), we can say:



And filling this in we have:



We can go to SI by basically converting 4π → μ0, and well I guess we’ll have to add in factors of ℏ too. Anyway, we can see that this is precisely what we found in the thermal equilibrium case. And in the Free Day folder. Might point out that this formula suggests we could get some strongly magnetic behavior if ρF is large enough. And it is often large for transition metals, and especially the f’s, as there are many overlapping bands near the Fermi surface, and so a large density of states.