**How we’d expect the conductance to fluctuate**

Boltzman’s equation gives us the impurity averaged conductance in 3D. But when we change the impurity distribution we do get a different value of g. This is because changing the impurity arrangements will change the interference pattern the electron sets up with the impurities. We also find a different value when we change the magnetic field because this changes the phase of the electrons and thereby changing the interference pattern. Finally, you can find them as a function of an applied gate voltage, which changes the Fermi energy. But a question would be, ‘how broad is the conductance distribution pertaining to different impurity arrangements, and these other effects?’. Also, I wonder if any other observables average in this fashion.

For a typical (non-mesoscopic as it turns out) material, we would expect the following behavior of the variance. For a typical material, you can divide the sample up into little pieces, and measure the conductance for each piece. Then the conductance for the entire sample will typicaly be the average of the material constants of each little piece. Assuming such, we would expect that the distribution of the observable would, according to the central limit theorem, approach a guassian distribution. And the st.dev. of the of material constant would go like 1/√N, where N is the number of pieces. So this would look like,



where V0 is the volume over which the the material constant is uncorrelated, typically about an atomic volume, so that the variance of the quantity drops as V increases. When this ratio decreases the quantity is said to self-average.