**General Behavior in all Regimes**

Is this how it works?

**Quasi Dimension**

Based on the foregoing, we can identify the following quasi-dimensional (i.e. Q1D, Q2D) regimes, where we extend z longitudinally from 0 to past the localization length ξ. We can presume that ξ remains fixed I think, as it’s mainly set by the minimum fixed transverse dimension(s). I think that as a function of z, we can identify the following regimes,

**Ballistic: z << ℓ**

Maybe scattering picture is inapplicable here, and so our calculations might be too. Might expect σ to be infinite here, or something like ~ exp(ℓ/z).

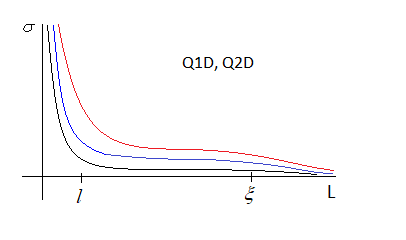
**Metallic: ℓ << z << ξ**

This is the Ohmic regime, where should find σ obeys its namesake, with increasingly dominant weak localization corrections.

**Insulating: ξ << z**

This is where weak localization dominates the transport behavior. The conductivity must exponentially damp to zero as something like exp(-z/ξ).

Graphically it would look like this:



Same shape always prevails, but as disorder increases, we can expect ℓ and ξ to decrease (not really illustrated in diagram). Technically we only know this for weak disorder, but one presumes it’s all the same in these dimensions?

**Full Dimension D > 2**

And in pure d>2 dimensions, we have the finite L localization length increasing as L increases. I think we should still have all of those regimes, at least for weak localization.

**Ballistic: L << ℓ**

Maybe scattering picture is inapplicable here, and so our calculations might be too. Might expect σ to be infinite here, or something like ~ exp(ℓ/L).

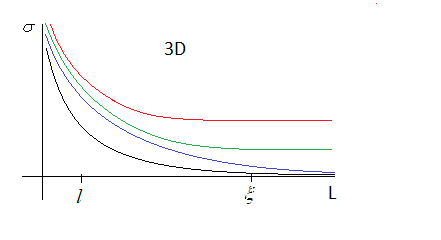
**Metallic: ℓ << L << ξ**

Here is where our previous calculations are predominantly valid; called the Ohmic regime. σ is constant, and scattering is a perturbation on free crystalline transport. I’m not sure there is a true metallic *regime* for 3D metals when they’re in localized state, as our perturbative calculations do not give us access to the localized state in 3D.

**Insulating: ξ << L**

This is where localization dominates the transport behavior. The conductivity must exponentially damp to zero as something like exp(-z/ξ).

Graphically it would look like this:



* σ will asymptote to constant for weak disorder (ξ →∞ of course)
* σ will asymptote to smaller constant, ultimately zero, as disorder increases, and ℓ will decrease as well (ξ →∞ of course)
* σ will obey power law decay, 1/L2 presumably, at critical point (no ξ!)
* σ exponentially decay past critical point, with decay rate 1/ξ, and as disorder further decreases, ξ would decrease.

In metallic state, how does limiting asymptotic conductivity decrease to zero with disorder? One may presume a power law with an associated critical constant.



In insulating state, how does the localization length decrease with disorder? Can also presume a power law.



Evidently these are related via known relationshp:

