**How does going from quasi to full dimension affect localization?**

So there seems to be an ambiguity. States in 3D can be either extended or localized, but those in Q1D, or Q2D can only be localized. So how does opening up Q1D or Q2D into fully 3D de-localize some (or all) states? Or conversely, how do de-localized 3D states become localized as we squash one or more of the dimensions?

Well it seems localization is proportional to the probability of an electron to self-intersect. And this can be abetted by both disorder and geometric constrictions. The former plays the dominant role for ‘strong localization’ where W = 1/kFℓ ~ 1, and the latter for ‘weak localization’ where obviously W = 1/kFℓ << 1. So I think that for any given cubic sample size Ld, and any given disorder, there is always localization, or maybe ‘contraction’ would be a better term at this point, i.e. some exponential envelope of the wavefunction ξ(L). But for weak disorder, ξ(L) >> L, and as the cube expands, the probability of self-intersection diminishes, and so ξ expands as well. And so in the thermodynamic limit, ξ(L→∞) = ∞ in the metallic state & critical point, as required. But for strong disorder, I suppose that ξ(L) will also grow with L somewhat, but will reach some finite value, perhaps pretty quickly, in the thermodynamic limit ξ(L→∞) = ξ. But if you stretch out the cube in just one or two dimensions to make it Q2D, or Q1D, then its possible to get localized along those stretched out dimensions, even for weak disorder. Seems that the localization length along the stretched out dimension will be longer than the minimum transverse dimension, at least for weak disorder, and this will be shorter than the stretched out direction, eventually.