Van Hove Singularities in disordered multichannel quantum wires and nanotubes

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We present a theory for the van Hove singularity (VHS) in the tunneling density of states (TDOS) of disordered multichannel quantum wires, with particular focus on multi-wall carbon nanotubes. We assume close-by gates which screen off electron-electron interactions. Diagrammatic perturbation theory within a non-crossing approximation is shown to be valid over a wide parameter region, yielding closed analytical expressions governing the disorder-induced broadening and shift of VHS's as new subbands are opened. This problem is nontrivial because the (lowest-order) Born approximation breaks down close to the VHS. Interestingly, the boundary TDOS shows drastically altered VHS, even in the clean limit. The typical $1/\sqrt{E-E_n}$ dependence of the VHS turns into a $\sqrt{E-E_n}$ behavior close to the boundary, where E_n is the threshold energy.[1]

[1] S. Hügle and R. Egger, cond-mat/0112189