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Dragon Segments in Electron Transport through Nanostructures[1]

MARK NOVOTNY, Mississippi State Univ — In transport through nanostructures connected to two semi-infinite leads, the transmission probability $\mathcal{T}(E)$ as a function of the energy E of the incoming electron enters the Landauer calculation of the electrical conductance. Ballistic propagation occurs in pure materials due to the lack of scattering, and consequently $\mathcal{T}(E) = 1$. It is shown that there is a large class of strongly disordered quasi-1D segments that also have $\mathcal{T}(E) = 1$. Such segments are called quantum dragon segments. Quantum dragon segments have a serpentine quasi-1D structure, and if present cannot be observed by electron transport since $\mathcal{T}(E) = 1$. Dragon segments are only possible when there is correlated disorder, thereby overcoming the Anderson localization that is present in 1D systems with random disorder. Dragon segments are found by using an exact mapping for $\mathcal{T}(E)$ at the level of the single-band tight-binding model. The mapping is from the quasi-1D model of the nanostructure onto a 1D model. Presented examples of dragon segments will include: select single-walled carbon nanotubes, Bethe lattices, conjoined Bethe lattices with random hopping within each ring, and quasi-1D systems formed from rectangular or orthorhombic lattice slices.

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Mark Novotny
Mississippi State Univ

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