Finite temperature spectral functions using the time-dependent DMRG

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Exotic quantum many-body behavior such as spin-charge separation is unavoidable when electrons (or other quantum particles with an internal "spin" degree of freedom) are confined to one spatial dimension. While the basic theoretical understanding of spin-charge separation in one-dimension, known as "Luttinger liquid theory", has existed for some time, recently a previously unidentified regime of strongly interacting one-dimensional systems at finite temperature came to light: The "spin-incoherent Luttinger liquid". The key to establishing both Luttinger liquid behavior and spin-incoherent Luttinger liquid behavior in experiment is detailed knowledge of the spectral properties.

I will introduce a framework based on the thermo-field formalism, that allows one to describe a thermally mixed state as a pure state in an enlarged Hilbert space. In this language a thermal average reduces to a regular quantum mechanical one. I will show that the spin-incoherent state can be described as a generalization of Ogata and Shiba's factorized wave function in an enlarged Hilbert space. I will study the crossover from the spin-incoherent to the spin-coherent regime by using the time-dependent Density Matrix Renormalization Group method, combining simulations in imaginary time and real time.

Finally, I will discuss the possibility of realizing spin-incoherent behavior in the *ground-state* of model Hamiltonians, such as ladders, and the Kondo lattice.