1D FERMIONS AND BOSONS BEYOND THE LUTTINGER LIQUID PICTURE

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We consider the effect of a generic nonlinear dispersion relation on the dynamics of one-dimensional fermions or bosons. The dispersion nonlinearity restores the main feature of the Fermi liquid : In a striking departure from the Luttinger liquid theory, the spectral function acquires a finite-width Lorentzian peak at the particle mass-shell. The nonlinear dispersion leads also to broadening of the dynamic structure factor peak. The resulting peak shapes for bosons or fermions are manifestly non-Lorentzian, with newly-discovered power-law singularities. The origin of this new non-analytical behavior of 1D fermions and bosons is related to the familiar physics of the Fermi-edge singularity. The spectral function and dynamic structure factor are accessible, respectively, in the measurements of particle tunneling and of AC field absorption. The constructed theory relates results of such measurements to the nature of quasiparticles and collective modes in 1D quantum systems.