Unification of electromagnetic noise and Luttinger liquid via quantum-dot resonant level

KARYN LE HUR, MEI-RONG LI, Département de Physique, Université de Sherbrooke, Sherbrooke, Québec, Canada J1K 2R1 — We investigate the effect of dissipation on a small quantum dot (resonant level) tunnel-coupled to a chiral Luttinger liquid (LL) with the LL parameter $K$. The dissipation stems from the coupling of the dot to an electric environment, being characterized by the resistance $R$, via Coulomb interactions. We show that this problem can be mapped onto a Caldeira-Leggett model where the (ohmic) bath of harmonic oscillators is characterized by the effective dissipation strength $\alpha = (2\tilde{K})^{-1}$ with $\tilde{K}^{-1} = K^{-1} + 2R/R_K$ and $R_K = \hbar/e^2$ the quantum of resistance. A quantum phase transition emerges at $\tilde{K} = 1/2$ and its consequences on the occupation of the level are addressed. The special limit $K = 1/2^+$ is thoroughly studied at small $R/R_K$ via a link to the spin-boson-fermion model. Our result can be detected by measuring the occupation of the quantum dot or by carrying out resonant tunneling transport measurement.