# Thermoelectric properties of an interacting QD-based heat engine

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We study the thermoelectric properties and heat-to-work conversion performance of an interacting, multi-level quantum dot (QD) weakly coupled to the leads. We focus on the sequential tunneling regime. The dynamics of the charge in the dot is studied by means of master equation for the probabilities of occupation. From here we compute the charge and heat currents in the linear response regime. Assuming a generic multi-terminal setup, and for low temperatures (quantum limit), we obtain analytical expressions for the transport coefficients which account for the interplay between interactions (charging energy) and level quantization. In the case of systems with two and three terminals we derive formulae for the power factor Q and the figure of merit ZT for a QD-based heat engine, identifying optimal working conditions which maximize output power and efficiency of heat-to-work conversion. Beyond the linear response we concentrate on the two-terminal setup. We first study the thermoelectric non-linear coefficients assessing the consequences of large temperature and voltage biases, focusing on the breakdown of the Onsager reciprocal relation between thermopower and Peltier coefficient. We then investigate the conditions which optimize the performance of a heat engine, finding that in the quantum limit output power and efficiency at maximum power can almost be simultaneously maximized by choosing appropriate values of electrochemical potential and bias voltage. At last we study how energy level degeneracy can increase the output power.