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Thermoelectric Transport Coefficients in Correlated Condensed Matter[1]

SRIRAM SHASTRY, University of California Santa Cruz

We present a recently developed formalism for computing thermoelectric transport coefficients for standard models of correlated matter, such as the Hubbard and the $t-J$ model. Successful predictions of this method in the context of the Hall constant are noted. This success helps to motivate the extension to the Seebeck coefficient, the Lorentz number L, and the figure of merit ZT, in terms of novel equal time correlation functions of two new fundamental operators, the thermal operator Θ^{xx} and the thermoelectric operator Φ^{xx}. Along the way, we uncover a new sum rule for the dynamical thermal conductivity for many standard models, precisely analogous to the f-sum rule for the electrical conductivity. Also along the way, we throw light on Lord Kelvin's early ideas on reciprocity, worked out within the context of equilibrium thermodynamics. The precise connection between Kelvin's formulation, and the later and more rigorous formulation of Onsager is commented upon. The new formalism is tested in simple settings and recent computational results are displayed for testing the frequency dependence of these variables in certain standard models. Close agreement with existing transport experiments on sodium cobaltates $Na_{.68}CoO_2$ in the Curie Weiss phase is found. Finally some new predictions are made regarding triangular lattice systems, motivated by the sodium cobaltate system.

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