Quantum Friction in Different Regimes

JULIANE KLATT, STEFAN BUHMANN, Albert-Ludwig University, Freiburg, Germany — Quantum friction is the velocity-dependent force between two polarizable objects in relative motion, resulting from field-fluctuation mediated transfer of energy and momentum between them. Due to its short-ranged nature it has proven difficult to observe experimentally. Theoretical attempts to determine the precise velocity-dependence of the quantum drag experienced by a polarizable atom moving parallel to a surface arrive at contradicting results. Scheel\textsuperscript{2} and Barton\textsuperscript{3} predict a force linear in relative velocity $v$ – the former using the quantum regression theorem and the latter employing time-dependent perturbation theory. Intravaia,\textsuperscript{4} however, predicts a $v^3$ power-law starting from a non-equilibrium fluctuation-dissipation theorem. In order to learn where exactly the above approaches part, we set out to perform all three calculations within one and the same framework: macroscopic QED. In addition, we include contributions to quantum friction from Doppler shift and Röntgen interaction, which play a role for perpendicular motion and retarded distances, respectively, and consider non-stationary states of atom and field.

\textsuperscript{1}DFG Emmy-Noether Program