Fluctuation -Dissipation-Dispersion Relation for Slow Processes and Quality Factor for Oscillation Systems

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Abstract— We have generalized the Fluctuation-Dissipation Theorem to the systems with slowly varying parameters [1]. The important conclusion of this analysis is to reveal that the spectral function of the fluctuations is determined not only by dissipation but also by the derivatives of the dispersion. The non-Joule dispersion contribution is characterized by a new non-local effect originating from an additional phase shift between the force and the response of the system. That phase shift results from the parametric control to the system. Finally, an electrical oscillation circuit is considered as a concrete example. In that system, it is shown that the dispersive contributions strongly affect the Q factor.

Keywords—non-equilibrium fluctuations, FDT, Q-factor