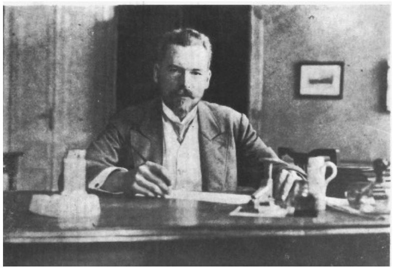

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Quantum law for partition of kinetic energy

Monday, 3 September 2018 14:30 (45 minutes)

One of the fundamental laws of classical statistical physics is the energy equipartition theorem which states that for each degree of freedom the average kinetic energy equals $E_k = k_B T/2$, where k_B is the Boltzmann constant and T is temperature of the system. Despite the fact that quantum mechanics has already been developed for more than 100 years still there is no quantum counterpart of this theorem. We attempt to fill this far-reaching gap and formulate the \emph{quantum law for equipartition of energy} in the appealing form $E_k = \langle \mathcal{E}_k \rangle$, where $\mathcal{E}_k$ is thermal kinetic energy per one degree of freedom of the thermostat consisting of harmonic oscillators and $\langle ... \rangle$ denotes averaging over frequencies ω of those thermostat oscillators which contribute to E_k according to the probability distribution $\mathbb{P}(\omega)$.
%It is valid for an arbitrary strength of the system-thermostat coupling.
We derive it for two paradigmatic and exactly solvable models of quantum open systems: a free Brownian particle and a harmonic oscillator. We formulate conditions for validity of the relation $E_k = \langle \mathcal{E}_k \rangle$ for other quantum systems.

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