Geometric phase discussions for counting statistics

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Studies for stochasticity, fluctuations, and non-equilibrium properties could be important in order to understand biological matters. Many theoretical approaches in non-equilibrium physics have been proposed, and one of them is to focus on the statistics of currents in non-equilibrium systems. One can consider various types of currents (e.g., particle currents, entropy productions, and so on) and not only the average current, but also the fluctuations should be investigated because recent developments of experimental techniques enable us to observe such fluctuations.

From theoretical viewpoints, it would be important to construct mathematical frameworks for the statistics of the currents. One of the mathematical frameworks is the counting statistics. In addition, recent researches have clarified that geometric phase discussions, which is similar to Berry phase in quantum physics, are useful to discuss effects of perturbations for non-equilibrium systems.

In this talk, firstly I will review applications of the geometric discussions for a so-called pump current, which is a current caused by cyclic perturbations [1-4]. Secondly, a new proposal for 'excess quantity' in non-equilibrium systems will be given. The excess quantity is considered as a finite contribution from state changes between two non-equilibrium states, and it is expected that the excess quantity plays an important role to construct a theoretical framework for non-equilibrium physics. The new proposal is based on non-cyclic geometric phase discussions [5,6].

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