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An application of the geometrical phase to a biophysical problem: pump current and its fluctuation

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The concept of the geometrical phase is applicable for various phenomena. In this poster presentation, we will discuss a new application of the geometrical phase to a 'biophysical' problem. The problem is not quantum mechanical one, but a classical stochastic one. It has been known that a stochastic system under a periodic perturbation shows a pumping phenomenon; i.e., the periodic perturbation causes a current which is not explained by a simple average of those in the strict static cases. Recently, a current and its fluctuation in an adiabatic case (with very slow periodic perturbation) has been calculated by using the Berry phase interpretation. Because a non-adiabatic case is also important for such classical stochastic systems, we evaluate the current and its fluctuation in the non-adiabatic case. In the non-adiabatic case, the statistics of the pump current is related to the Aharonov-Anandan phase, and the Floquet theory is used to calculate it.

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Modelling the Berezinskii-Kosterlitz-Thouless Transition in the $NiGa_2S_4$

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In the two-dimensional superfluidity, the proliferation of the vortices and the anti-vortices results in a new class of phase transition, Berezinskii-Kosterlitz-Thouless (BKT) transition. This class of the phase transitions is also anticipated in the two-dimensional magnetic systems. However, its existence in the real magnetic systems still remains mysterious. Here we propose a phenomenological model to illustrate that the novel spin-freezing transition recently uncovered in the NMR experiment on the $NiGa_2S_4$ compound is the BKT-type. The novel spin-freezing state observed in the $NiGa_2S_4$ possesses the power-law decayed spin correlation.