Energy transport in a chain of oscillators with magnetic field

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The chain of oscillators is a typical and important model of heat transport. It is generally believed that heat conduction in low-dimensional nonlinear systems is anomalous from many theoretical and experimental studies. Recently, it was rigorously shown that chain of harmonic oscillators perturbed by a stochastic dynamics conserving momentum and energy has diverging thermal conductivity, which implies the anomalous behavior of the heat conduction. After this pioneering work, the role of conserved quantities for the anomalous behavior has been intensively studied.

In this talk, we consider a system of harmonic oscillators in a magnetic field perturbed by a stochastic dynamics conserving generalized momentum and energy. The magnetic field destroys the conservation of the momentum, but we have found that the thermal conductivity still diverges in dimension 1 and 2, while it remains finite in dimension 3. In particular, we obtain a new exponent of the divergence. Also, we derive a linear Boltzmann equation as the weak noise limit of our model and show that the long-time, large-scale limit of its solution converges to the fractional diffusion equation with index $\frac{5}{6}$. This talk is based on joint works with Keiji Saito, Shuji Tamaki and Hayate Suda.