Spin transport via gauge/gravity duality

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Recent development of the technology manipulating electron spins arouses a great deal of interest in spintronics, instead of conventional electronics, which mainly focuses on the electric charge degree of freedom. The most important ingredient of spintronics is transport of the electron spin, namely a spin current. However, it is difficult to define the spin current naively because, unlike the ordinary electric current, it is not conserved by itself, but only in the form of the total angular momentum, due to the spin-orbit interaction.

We show that the spin connection, associated with the local Lorentz transformation, plays an important role in the definition of the spin current as a conserved one in relativistic quantum field theory. We also provide an analysis of the spin transport phenomena in the strongly correlated system, applying the gauge/gravity duality with a simple setup. We demonstrate a holographic treatment of the spin current by calculating the thermal spin Hall conductivity and so on.

This presentation is based on arXiv:1304:3126 [hep-th] as a collaboration with K. Hashimoto (Osaka/RIKEN) and N. Iizuka (YITP).