THE QUANTUM SPACETIME SEMINAR SERIES

Out of Time Ordered Quantum Dissipation

Bidisha Chakrabarty
(ICTS-TIFR, Bangalore)

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Recently the connection of Out of Time Ordered Correlators (OTOCs) to scrambling, quantum chaos, thermalisation etc has been realised. With the increasing interest in OTOCs, it will be useful to develop a systematic prescription to compute them. In this talk I will discuss techniques of effective theory to compute OTOCs in open quantum systems. In particular, I will focus on the problem of a quantum Brownian particle interacting with a dissipative bath composed of two sets of harmonic oscillators. Besides the linear coupling between the particle and each set of oscillators, we add a small 3-body interaction, between the particle and the oscillators. This cubic coupling induces non-linear dissipation and noise terms in the effective theory of the particle. For appropriate choice of distributions of bath oscillators, all the bath correlators decay exponentially fast at late times. Hence after the decay of the bath correlators has set in, one can write down a suitable 1-PI effective action of the particle which is local in time. The correlators computed from the microscopic theory evolve the same way as the correlators computed from this 1-PI effective action. If the bath has microscopic time-reversal invariance and thermality, it imposes constraints on the 1-PI effective action. These constraint relations between the effective couplings of 1-PI action are OTO generalisations of the well-known Onsager-Casimir reciprocal relations and fluctuation-dissipation relations. Combining these relations, the non-Gaussianity of the thermal noise gets related to the thermal jitter in the damping constant of the Brownian particle.

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