

Séminaire de matrices, cordes et géométries aléatoires

Vendredi 08/03/2019, 14h15-15h15

Orme des Merisiers Salle Claude Itzykson, Bât. 774

Emergence of Space-Time in the SYK Model

Kenta Suzuki

CPHT, Ecole Polytechnique

The Sachdev-Ye-Kitaev (SYK) model is a quantum mechanical many-body system with random all-to-all interactions on fermionic N sites (N large). This model is shown to saturate the known maximal chaos bound of many-body system and then based on this observation it is conjectured to be dual to a quantum black hole in the sense of the AdS/CFT correspondence. In this talk, we start from reviewing basic aspects of the SYK model in the large N limit, which is systematically described by a single bi-local field. We show that a propagator of the bi-local field, which is understood as a four-point function of the original fermions, predicts an infinite spectrum of the dual AdS_2 theory, but it has a divergent contribution from the zero mode at the critical IR fixed point of the model. Next, we show that the spectrum of the four-point integration SYK model can be interpreted as that of a single scalar field coupled to gravity in 3 space-time dimension. The scalar field lives on $AdS_2 \times I$, where I is a finite interval, and subject to a delta function potential at the center of the interval. Through Kaluza-Klein procedure on the third direction, this scalar generates the spectrum predicted by the SYK bi-local propagator at strong coupling. Finally, we consider the question of identifying the bulk space-time of the SYK model. Focusing on the signature of emergent space-time of the (Euclidean) model, we explain the need for non-local (Radon-type) transformations on external legs of n -point Green's functions. This results in a dual theory with Euclidean AdS signature with additional leg-factors. We speculate that these factors incorporate the coupling of additional bulk states similar to the discrete states of 2D string theory.
