Loop measures for space-time random walks.

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Loop measures have become important in the analysis of random walks and their applications in mathematical physics and are currently actively worked on. Such measures go back to Symanzik in the late 1960s in the context of Euclidean field theory. We introduce a novel class of such measures - namely loop measures on graphs with countable infinite different time horizons. The loops are generated by space-time random walks where we add an additional dimension - called 'time'- to the integer lattice in d dimension, $d \geq 3$. These measures are connected to the cycle representation of partition functions in quantum systems (Boson systems). We derive corresponding Dynkin isomorphism theorems for space-time random walks which are complex Gaussian measures and we show the onset of the so-called Bose-Einstein condensation for some examples using the Green function analysis for space-time random walks. Complex Gaussian measure are a novel concept, in our case we are able to show that these measure take real values.

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