

Non-commutative kinematics for a point-like particle

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I will present a toy model which exhibit interesting properties from the point of view of the foundations of quantum mechanics and probability theory.

The model describes a point-like particle which moves by random jumps on a discrete random space, that is described by a collection of random walks. The particle at a certain time t is assumed to be completely described by two quantities: its position and its velocity, which are represented by two random variables. Another random variable is the configuration of the space at the same time t . The model is not deterministic, as such its description is done in terms of the probability distributions of these random variables.

It is possible to prove that the position and the velocity of the particle at the time t fulfil an entropic uncertainty relation, after conditioning with respect to the configuration space at the same time (operation that in some sense "removes the space from the model"). Entropic uncertainty relations are additive uncertainty relations between the Shannon's entropies of two non-commuting operators. This implies that, if we want to describe the position and the velocity random variables in this model, without any reference on the space, we have to use non-commuting operators over some Hilbert space. During the talk an intuitive proof of these facts will be provided.

Presenter: CURCURACI, Luca (T)