Contribution ID: **10** Type: **not specified**

Outcomes of repeated measurements on non-replicable Unruh-De Witt detectors (C)

Thursday, 27 October 2022 14:25 (25 minutes)

The Born rule describes the probability of obtaining a specific outcome when measuring an observable of a given quantum system. As it has an intrinsic frequentist meaning, the Born rule only holds when it is possible to consider, at least in principle, many replicas of the system under examination. Hence, its use becomes delicate when dealing with systems for which having any copy is impossible, including cosmological models and many scenarios involving quantum mechanics and gravity.

In this talk, we introduce an effective Born rule, which, under reasonable conditions, allows one to use the outputs of (many) previous measurements to make previsions on the outcomes of future observations for non-replicable quantum systems. Then, we study the dynamics of a repeatedly measured Unruh-De Witt detector interacting with a scalar quantum field, for which using such an approximate Born rule is necessary. Specifically, we analyse the detector's dynamics under the assumption that the state of the field collapses after each measurement and investigate the statistics learned by observers measuring the detector, i.e. how they can use acquired outcomes to make educated guesses about the results of later measurements. We perform this analysis within the framework of the theory of Unruh-De Witt detectors in flat and curved spacetime, modified to include the measurement-induced collapse of the quantum field's state. Finally, we give explicit results for detectors moving along inertial and accelerated trajectories.

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Session Classification: COSMOLOGY - Talks on specific topics

Track Classification: Cosmology