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The quantum first detection problem

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Streszczenie:

We investigate a quantum system with Hamiltonian $\hat{H}$ initially prepared in state $|\psi_{in}\rangle$, that evolves unitarily. Every τ time units the unitary evolution is interrupted by a strong measurement that probes whether the system is in some target state $|\psi_d\rangle$. A non-vanishing value of τ avoids the complications of the quantum Zeno effect. This is repeated until the detection was successful for the first time. The probability that the first successful detection attempt is the n-th one is called the first detection probability F_n, that generalizes the first passage problem of random walks to the quantum realm. This setup gives an operational definition to the quantum time-of-arrival, is potentially important for obtaining the output of general quantum computers, and allows us to better understand the measurement process in quantum physics.

We show how F_n and other first detection statistics can be determined from properties of the system's energy spectrum and review some of the recent results. In particular, we report how the spectral dimension controls the asymptotic decay of F_n in systems with a continuous spectrum. Furthermore, we report on the total probability of detection, the mean first detection time, and the Zeno ($\tau \to 0$) limit of F_n in systems with a point spectrum.

Przed referatem (15.45) zapraszamy na kawę.