Umeå University
Department of Physics
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Växelverkan
Quantum Optics
Spring 2010

Assignment 6

To be submitted on June 7, 2010
(if you want it to be graded before the exam, please submit before May 28)

Consider a quantum particle that undergoes the time evolution described by the density matrix $\rho_{ij}(t)$, where $i, j = 1, 2$. At time $t = 0$ the particle is in state 1, and therefore $\rho_{11}(0) = 1$.

As we learnt in the lecture, a measurement at time Δt has the effect of restarting the time evolution from time $t = 0$, but the density matrix is now multiplied by the probability that the system was found in state 1, $\rho_{11}(\Delta t)$.

(The probability to be found in state 2 gives a small contribution that can in fact be neglected in this problem.)

Calculate the probability that the system is still in state 1 after n measurements are done at intervals Δt, if

(a) $\rho_{11}(t) = 1 - \alpha t^2$,

(b) $\rho_{11}(t) = 1 - \beta t$,

where α and β are real-valued constants. In which case do you get a quantum Zeno effect?

The solution should be submitted to Emil Lundh (`lundh@tp.umu.se`) no later than June 7, 08:00. If you want to have the problem graded before the exam, please submit it before May 28 at 08:00. If the solution is submitted electronically, I will only accept platform independent formats (pdf strongly recommended!). Answers on paper are of course also accepted.