Bell inequalities and waiting times

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We propose a Bell test based on waiting time distributions for spin entangled electron pairs, which are generated and split in mesoscopic Coulomb blockade structures, denoted as entanglers. These systems have the advantage that quantum point contacts enable a time resolved observation of the electrons occupying the system, which gives access to quantities such as full counting statistics and waiting time distributions. We use the partial waiting times to define a CHSH-Bell test [1], which is a purely electronic analogue of the test used in quantum optics. After the introduction of the Bell inequality we discuss the findings on the two examples of a double quantum dot [2] and a triple quantum dot [3]. This Bell test allows the exclusion of irrelevant tunnel processes from the statistics normally used for the Bell correlations. This can improve the parameter range for which a violation of the Bell inequality can be measured significantly.

[1] See e.g.: J. F. Clauser, M. A. Horne, A. Shimony, and R. A. Holt, Phys. Rev. Lett. **23**, 880 (1969), J. F. Clauser and A. Shimony, Reports on Progress in Physics **41**, 1881 (1978).

[2] O. Sauret, T. Martin, and D. Feinberg, Phys. Rev. B **72**, 024544 (2005).

[3] D. S. Saraga and D. Loss, Phys. Rev. Lett. **90**, 166803 (2003).