

# Spin Correlation and Entanglement Detection in Cooper Pair Splitters by Current Measurements Using Magnetic Detectors

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Recently, there are significant breakthrough in experimental demonstrations of Cooper pair splitting (CPS) using the double quantum dot system [1-2]. The next important step, after successful splitting of Cooper pairs, would be experimental demonstration that the split electrons remain entangled. It occurs significantly more challenging since eight years after the first demonstration of the splitting there is still lack of the entanglement detection in this system. Therefore, we explore a general model of the CPS coupled to two ferromagnetic detectors converting spin information into charge information. We use perturbation theory taking into account of the spin dynamics and the exchange interaction between quantum dots and the ferromagnetic detectors. Despite of the complex spin precession in quantum dots [3] it is still possible to determine spin correlation by dc current measurements in this system. We propose an entanglement test based on the Bell inequalities and the entanglement witness approach.

## References:

- [1] L. Hofstetter et al., Nature **461**, 960 (2009)
- [2] Z. B. Tan et al., Phys. Rev. Lett **114**, 096602 (2015)
- [3] A. D. Crisan et al., Nature Communications **7**, 10451 (2016)