PHOTOELECTRICAL DETECTION OF SINGLE SPINS: HOW CAN THEORY HELP?

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In recent years the advance in diamond-based quantum technologies has been impressive. Most technology-ready applications have been in the field of quantum sensing, but progress in quantum communication and quantum computing [1] has also been eminent. One key achievement that improves the sensitivity of diamond-based quantum sensors and enables a better scalability of quantum computers is the photoelectrical detection of a single spin qubit in diamond [2]. These qubits are based on nitrogen-vacancy (NV) center defects and their photoelectrical read-out relies on the photoionization process. However, despite impressive technological achievements, this process is still poorly understood. In this work we present a methodology to determine defect photoionization cross sections from density functional theory calculations [3, 4]. In particular, our analysis reveals how spin polarization of the negatively charged NV center translates into spin polarization of the neutral NV, explaining electron spin resonances experiments of neutral NVs [5]. Finally, our calculations provide a consistent explanation of recent experiments regarding ionization of NV centers upon dual-beam excitation and provide guidelines for the most effective photoelectrical detection of single spins in diamond.

Work done together with L. Razinkovas, M. Maciaszek, F. Reinhard, and M.W. Doherty.

References

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