Controlling atom-like systems in diamond: from quantum optics to life science

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Abstract

We will discuss recent advances in quantum optical control of individual atom-like systems in diamond and their novel applications. Specifically, new methods for controlling of electronic spin states associated with Nitrogen Vacancy (NV) centers in diamond will be discussed. For example, we will show that Coherent Population Trapping can be used for laser cooling and real time observation of nuclear environment of the NV centers. Similar techniques are used to implement a room-temperature quantum bit memory with coherence lifetime exceeding one second. In addition, realization of quantum optical interfaces for the NV centers using nanoscale diamond photonic cavities and nanomechanical resonators will be described. Finally, novel applications of these techniques will be discussed. They include, in particular, nanoscale magnetic resonance imaging inside living cells using quantum systems.