Universal Approach for Quantum Interfaces with Atomic Arrays

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We develop a general approach for the characterization of ordered arrays of atoms as efficient atom-photon interfaces. Our approach is based on the mapping of complex atom-array systems to a generic one-dimensional (1D) model of light that is scattered off of a collective dipole. We show that the amount of reflected light — the reflectivity — quantifies the efficiency of the atom-photon interface and subsequent quantum tasks, such as a quantum memory or photonic entanglement generation. We consider several realistic atom-array systems and show how they can be mapped to our 1D model, thus highlighting how their efficiencies are determined by their reflectivity. Our results establish a unified framework for the analysis of various timely atom-photon platforms.

References

[1] Y Solomons, R Ben-Maimon and E Shahmoon, arXiv:2302.04913 (2023)