Improvement of $^{171}Yb^{+}$ Optical Qubit Readout Using Microwave Pulse

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Qubit readout is a crucial operation for any quantum algorithm. The readout fidelity defines how many shots are required to achieve the desired computational accuracy. More than that, fault-tolerant quantum computations require high-fidelity mid-circuit measurements. ^{171}Yb is one of main workhorses of quantum computations, however, readout procedure for this element is not perfect due to non-resonant transitions. We work with optical qubits, in which readout fidelity is less susceptible to non-resonant errors than in other types of qubits. Still, systematic errors occur during the optical pumping of population from level $^2S_{1/2}(F=0)$ to levels $^2S_{1/2}(F=1)$ and $^2P_{1/2}(F=0)$ in the beginning of the readout procedure. In this work, we demonstrate an improvement in the readout fidelity of a $^{171}Yb^{+}$ qubit using a microwave π-pulse at 12.6 GHz to couple the hyperfine levels of the ground state as you can see in Fig. 1. The setup configuration was optimized using a theoretical model. The readout fidelity was enhanced by modifying the readout algorithm: probability of spontaneous decays outside the luminescence cycle was decreased.

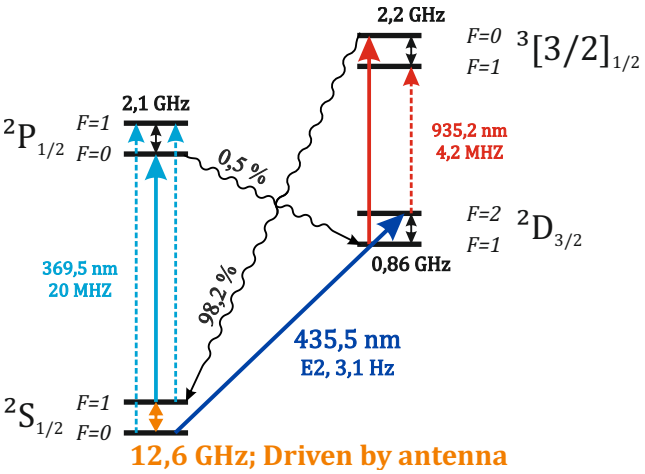

Figure 1: $^{171}Yb^{+}$ level scheme