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Multi-photon processes in a waveguide-confined ensemble of laser-cooled atoms[1] PAUL ANDERSON, TAEHYUN YOON, BRIAN DUONG, MICHAL BAJCSY, University of Waterloo — We report the results and analysis of spectroscopy measurements of a ladder-scheme implemented using laser-cooled atomic cesium confined to a hollow-core photonic-bandgap fiber with mode diameter of the guided light ˜7um. This fiber allows us to both confine a large number of atoms (˜10,000) into a quasi-1D geometry and guide light along the atom confining region. The setup grants us access to an atomic system with a large optical depth in excess of 100, as well as to high intensities of light at low power levels. Our goal is to demonstrate optical nonlinearities, such as wavelength conversion of single photons through four-wave mixing. As a precursor, we studied two-photon absorption of a weak probe in the presence of a strong pump coupling the excited states, expecting to see a single transparency window. Instead, we observed two and eventually three transparency windows for certain combinations of experimental parameters. We successfully modelled these phenomena by using additional atomic levels that the pump couples into as its power increases, resulting in multi-photon absorption.

[1]NSERC, Transformative Quantum Technologies

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