# Abstract

Strong light-atom interactions can be utilized for applications toward quantum information storage and processing. Despite the maturity of research towards trapping of atoms using optical lattices, these laser set-ups tend to be large and complex. In contrast, integrated photonics can be used to provide modular compact platforms. In this work, we propose a waveguide-overlayer system for trapping cold atoms above planar all-dielectric waveguides.

We choose blue and red-detuned laser relative to the D-line of atomic Rb and launch the bi-chromatic light into our waveguide, which is composed of a Si3N4 core placed on a SiO2 substrate. The overlayer is a single silicon subwavelength antenna which enhances the evanescent field of the system. This device can become a method of realizing an improved version of previously-proposed integrated atom chips, as part of a building block for integrated atom optics, with applications such as high-precision sensors and implementations towards quantum information processing. Similar methods have been proposed in literature using plasmons, however, these methods require the use of metals such as gold. Our all-dielectric system aims to produce the same effect while reducing the thermal noise produced by heating metals, absorption due to losses, and at the same time keeping the device low-cost.

We show that the combination of the field confined by the nanoantenna and generates bi-chromatic optical potentials. We also considered the contribution of the atom-surface potentials – the Casimir-Polder and van der Waals potentials. Our numerical simulations show that we can trap atoms along the axis perpendicular to the waveguide, forming an optical trap. These traps are tight enough for single-atom confinement and that provide possibilities for creating arrays of such single-atom traps with controllable lattice constants.