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Evanescent light-matter Interactions in Atomic Cladding Wave Guides

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Alkali vapors, and in particular rubidium, are being used extensively in several important fields of research such as slow and stored light non-linear optics3 and quantum computation. Additionally, the technology of alkali vapors plays a major role in realizing myriad industrial applications including for example atomic clocks magentometers8 and optical frequency stabilization. Lately, there is a growing effort towards miniaturizing traditional centimeter-size alkali vapor cells. Owing to the significant reduction in device dimensions, light matter interactions are greatly enhanced, enabling new functionalities due to the low power threshold needed for non-linear interactions. Here, taking advantage of the mature Complimentary Metal-Oxide-Semiconductor (CMOS) compatible platform of silicon photonics, we construct an efficient and flexible platform for tailored light vapor interactions on a chip. Specifically, we demonstrate light matter interactions in an atomic cladding wave guide (ACWG), consisting of CMOS compatible silicon nitride nano wave-guide core with a Rubidium (Rb) vapor cladding. We observe the highly efficient interaction of the electromagnetic guided mode with the thermal Rb cladding. The nature of such interactions is explained by a model which predicts the transmission spectrum of the system taking into account Doppler and transit time broadening. We show, that due to the high confinement of the optical mode (with a mode area of 0.3{\lambda}2), the Rb absorption saturates at powers in the nW regime.

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