Optimized micro-machined vapor cell geometries for optical atomic clocks

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In recent years, there has been a real drive towards miniaturization for the development of the next generation of chip-scale optical atomic clocks. A promising approach in this pursuit involves exploiting a simple sub-Doppler spectroscopy scheme within micro-machined alkali-metal vapor cells [1] [2] [3]. To address the growing demand, it is crucial to establish a fabrication process that not only remains cost-effective but also preserves the collection efficiencies demonstrated using larger glass-blown cells [4] [5]. A sensible route towards achieving this goal is leveraging our MEMS fabrication capabilities, which facilitates mass production at scale together with customizable enhanced vapor cell geometries.

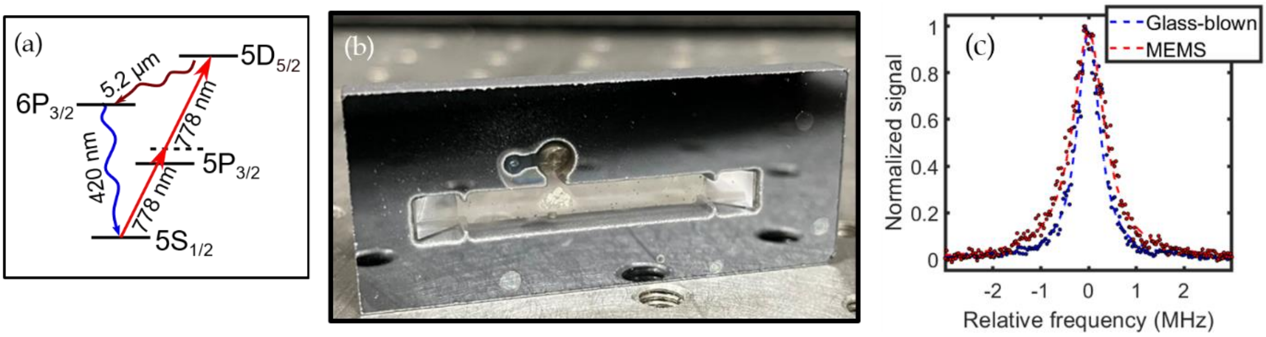

Fig.1: (a) Incorporating the two-photon transition in Rb using enhanced micro-fabricated vapor cell designs as pictured in (b) provides a route towards an economical and adaptable cell design, which maintains a narrow linewidth, and yields improved detection of the 420 nm fluorescence signal (c), compared to conventional MEMS cells, ultimately increasing the SNR and performance.

In this presentation, we will discuss our recent developments in clean alkali deposition and improved collection efficiencies in a next-generation, elongated micro-machined vapor cell package. We highlight integrated optics and compare the results from our design to traditional glass-blown and conventional MEMS cells.

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