Atomic vapour dynamics in silicon wafer based cells

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Since the first demonstration of the miniature atomic vapour silicon wafer-based cells in the context of the development of Coherent Population Trapping clocks, a variety of configurations which offer different improvements in performance have been realized. In its generic architecture, the cell volume is enclosed between glass windows which are attached to a silicon wafer via anodic bonding and have been modified to enhance particular aspects of the cell operation, e.g., volume, or symmetry. A plethora of engineering solutions introduced in the field of miniature cells needs to be complemented with a better understanding of the atomic vapour dynamics in these specific contexts. We discuss the details of the spin polarization generation process that combines optical excitation and spin-exchange collisions – indirect pumping. The measurements were performed in a wafer atomic cell with a double-chamber arrangement and integrated heating circuit[1]. Cell design, performance, and optimisation of the pumping performance, in terms of the vapour density and pump beam power will be presented. Implementation of the miniature cell in a portable radio-frequency atomic magnetometer will be demonstrated.

References

[1] J. D. Zipfel, P. Bevington, L. Wright, W. Chalupczak, G. Quick, B. Steele, J. Nicholson, and V. Guarrera. Indirect pumping of alkali-metal gases in a miniature silicon-wafer cell. 2024.

Submitted to Phys Rev Appl., arXiv link