

A Ramsey-CPT microcell atomic clock using laser current pulsed modulation

Carlos M. Rivera-Aguilar¹, M. Callejo¹, A. Mursa¹, C. Carlé¹, R. Vicarini¹, M. Abdel Hafiz¹, J-M. Friedt¹, N. Passilly¹, R. Boudot¹

¹FEMTO-ST, CNRS, Université de Franche-Comté, ENSMM, Besançon, France

Email: carlos.rivera@femto-st.fr

Microwave chip scale atomic clocks (CSACs) based on coherent population trapping (CPT) have achieved great success including their commercialization and deployment across a diverse range of applications¹.

A critical feature of CSACs is their long-term stability, known to be notably impacted by light-shifts effects. Several approaches have been proposed to address this problem in standard CSACs employing a continuous-wave (CW) interrogation technique^{2,3}. However, these approaches are subject to some limitations and drawbacks⁴.

An alternative technique used to mitigate light-shift effects in CPT clocks is to use pulsed Ramsey-based interrogation sequences⁵. Such methods have been recently applied in microcell clocks^{6,7}. However, in these experiments, the Ramsey-CPT sequence was generated with an external acousto-optic modulator (AOM). Yet, the AOM is not compatible with a fully-integrated CSAC.

In this work, adapting a two-step pulse optical sequence⁸, implemented with an FPGA-based digital board, we demonstrate a Ramsey-CPT microcell atomic clock using direct pulsed modulation of the laser current. Narrow and high-contrast Ramsey-CPT fringes are detected in a Cs-Ne microcell. The short-term fractional frequency stability is measured at $1.3 \times 10^{-10} \tau^{-1/2}$ until 2000 s. For $\tau > 2000$ s, the stability is degraded. Main suspects are residual light-shifts and Ne permeation through the cell borosilicate glass windows⁶.

The implementation of the symmetric autobalanced Ramsey (SABR) interrogation technique coupled with the use of a cell made of low-permeation glass windows is under progress for improved stability. Latest results will be presented at the conference.

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