Feasibility toward a compact high performance coherent population trapping clock

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***Abstract*—Atomic clock based on the constructive polarization modulation coherent population trapping, demonstrated a promising performance with frequency stability at the level of 3.2 x 10^{-13} $\tau^{-1/2}$ up to the averaging time of 100 seconds. The feasibility to implement a compact and high performance CPT clock is discussed.**

Keywords—CPT; atomic clock; miniaturization;

Here we demonstrated a high performance coherent population trapping atomic clock based on the constructive polarization modulation configuration [1,2]. In this method, a phase modulation is applied to the two optical components of a bichromatic laser field, synchronously with the polarization modulation, we then defined it as double-modulation (DM) CPT. With careful work parameters investigation and noise suppression, a promising frequency stability at the level of 3.2 x 10-13 τ-1/2 up to the averaging time of 100 seconds is observed [3]. Currently, the short-term stability is mainly limited by the microwave power fluctuation which coupled to the fiber electro-optic phase modulator.

Thanks to DM CPT, in which the polarization modulation frequency for the maximum CPT signal contrast is in the range of several kHz [4], allowing employing a liquid crystal device as the polarization switch. This low voltage driving and negligible size liquid crystal device is an ideal choice to build a very compact and robust setup while maintaining its high performance. The possibility to directly modulate a DFB laser diode with half of Cs ground states hyperfine splitting (~4.6GHz) and miniaturization by micro-optical integration technology are discussed, with the aim to implement an even more compact and high performance CPT clock.

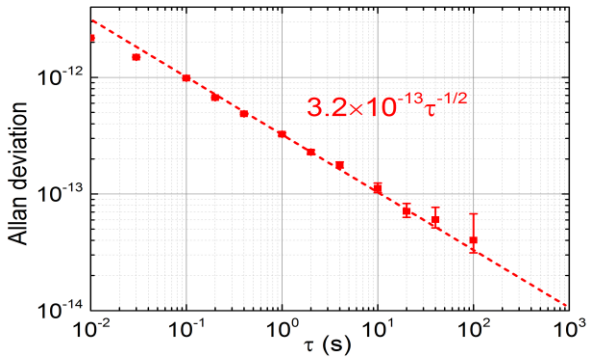

Fig. 1. Allan deviation of the DM-CPT clock.

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