

# Frequency comb for $^{88}\text{Sr}^+$ clock frequency comparison with Cs fountain clock at the NRC

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The redefinition of the SI second in terms of optical atomic transitions is expected to happen within the next few years. The CIPM has issued requirements for candidate clocks to be considered in the redefinition [1-3]. Among these requirements is continuity: the candidate clock frequencies need to be measured against current primary frequency standards and the measurements need to be mainly limited by the systematic uncertainty of the Cs clock. NRC has recently commissioned its Cs fountain clock NRC-FCs2 [4]. NRC also has a candidate clock for the redefinition, the  $^{88}\text{Sr}^+$  single ion clock, which was used to make an absolute frequency measurement with an uncertainty of  $4.3 \times 10^{-16}$  [5].

In this work, we present the portable saturable absorber-based fibre combs made for this clock comparison [6-7]. We also present the setup that we intend to use for the  $^{88}\text{Sr}^+$  single ion clock measurement campaign against NRC-FCs2. The ultrastable probe laser [8] of the  $^{88}\text{Sr}^+$  clock at 674 nm will serve as the local oscillator of both clocks. The stability of the Cs fountain clock operating with two different local oscillators can be seen in Fig.1. The fractional frequency uncertainty averages down as  $\sigma_y = 2.9 \times 10^{-14} / \sqrt{\tau}$  when using the ultrastable laser as its local oscillator through the comb, while it is averaging as  $\sigma_y = 10.5 \times 10^{-14} / \sqrt{\tau}$  using NRC's best active hydrogen maser. The departure from a  $\sigma_y \propto \tau^{-1/2}$  dependence fails at  $\tau \sim 100$  s due to the drift of the ultrastable probe laser not being perfectly removed. As soon as the slow laser drift correction is properly implemented, we should see nearly a factor ten reduction in averaging time, essentially reaching the systematic uncertainty of NRC-FCs2 in one day. This scheme will also be used to facilitate the re-evaluation of the systematic biases of NRC-FCs2.

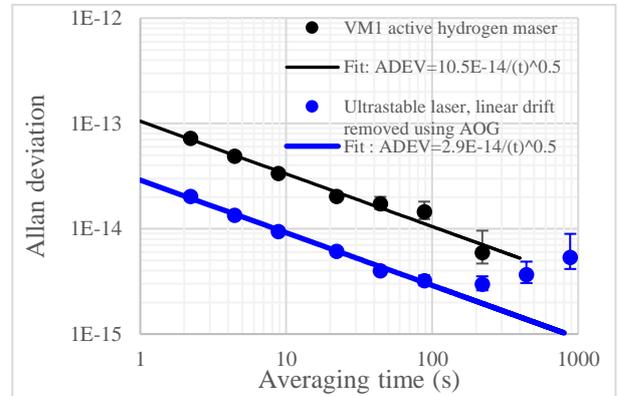


Fig.1. Stability of the NRC-FCs2 fountain clock using two different local oscillators. Black: active hydrogen maser. Blue: ultrastable laser through comb. Fit for  $\tau < 100$  s.

## References

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