Progress towards a compact single-ion optical clock

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We report on the ongoing realization of a compact optical Yb^+ clock on a chip. We aim at reaching a stability of 10^{-14} $\tau^{-1/2}$ in a total volume of less than 500 L, including vacuum cell, optics and electronics. We will use the quadrupole transition at 435,5 nm of a single $^{171}Yb^+$ ion. It will be trapped on a chip, by a surface-electrode linear Paul trap which is inspired by technologies developed mainly by the quantum information community [1].
In this poster we detail our current test system, the design of the chip, and our efforts towards compactification. In particular, we use only diode lasers and fiber-coupled frequency doublers. Laser stabilization within a MHz is performed using a commercial wavelength meter. The volume of our current vacuum system is only 54 L and experiment control is essentially made with compact home-built digital electronics.
The current chip is 30x60 mm^2 large and has a mini-SD connector in order to allow fast plug-ang-play replacements. With two RF electrodes driven at 4 MHz and 110 V, it generates a linear Paul trap of 0,2 eV depth and harmonic trapping frequencies of 500 kHz radially and 100 kHz axially. Although the current chip is simply a PCB board, the design of the next version based on silicium on insulator is already ongoing.

References

[1] S. Seidelin *et al.*, “Microfabricated surface-electrode ion trap for scalable quantum information processing.” Phys. Rev. Lett., **96**, 25 (2006).