Optimisation of Double Resonance Optically pumped Rb Atomic Clocks using a reconfigurable physics package testbed

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We present progress on the development of a new testbed designed to optimise the performance of rubidium vapour cell based double resonance optically pumped (DROP) atomic clocks[1],[2]. The testbed enables easy substitution of core physics package components such as vapour cells, cavities, and optical sources (e.g., laser diodes and lamps) and allows us to assess the atomic clock signals.

Manufactured batches of vapour cells can be assessed to determine their uniformity and consistency. Buffer gas frequency shifts were observed by varying vapour cell temperatures. We have characterised the DROP signal (linewidth, signal contrast and noise) in terms of temperature, optical power, and magnetic field.

There are ongoing studies with different optical sources which can be used in this testbed to generate a DROP signal. We are assessing vertical cavity surface emitting lasers (VCSELs), and a variety of Rb lamps. A commercial external cavity diode laser (ECDL) is used as a baseline against which the VCSELs and lamps are compared.

Various microwave cavities can be tested in this setup. We are assessing the performance of magnetron type- and cylindrical cavities.

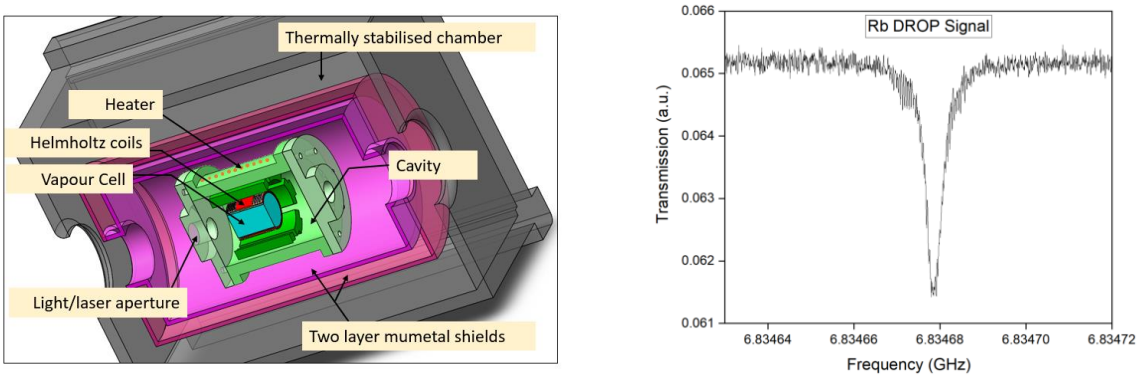

Fig. 1: left: Cross sectional rendered image of the testbed physics package, right: DROP signal.

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[1] J. C. Camparo, Physics Today, 33-39, **60**, 11, (2007).

[2] W. J. Riley, 'A History of the Rubidium Frequency Standard', IEEE UFFC-S History, (2019).