Compact Atomics Package and Integration of a Transportable Strontium Lattice Clock

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With the rapidly improving performance of optical clocks, in the future, most applications requiring the highest accuracy will require these systems. The unprecedented accuracy in time promises new applications like relativistic geodesy which might benefit the exploration of oil and minerals, fundamental tests of general relativity and synchronization for long base line astronomical interferometry, deep space navigation. In the framework of the research project SOC2:"Towards Neutral-atom Space Optical Clocks" funded by the EU 7th framework programme (FP7/2007-2013) under grant agreement n. 263500, with the main aim of developing demonstrators of transportable lattice clocks with $5x10^{-17}$ relative frequency accuracy [1], we are reporting on the realization of a very compact, light and energy efficient atomics package for a Sr clock prototype. At the heart of the atomics package is a 3D MOT chamber (Fig.1) which can be loaded either with a permanent magnet Zeeman slower or with a 2D MOT facility. We will also report on the integration of different components (e.g. lasers, FSS unit) of the SOC2 apparatus, which have been developed by other partners of the consortium and have been transported to us at the University of Birmingham from the University of Florence. The total budget of the system will be <10 l, $<10^{-10}$ mbar, < 20 kg [2].

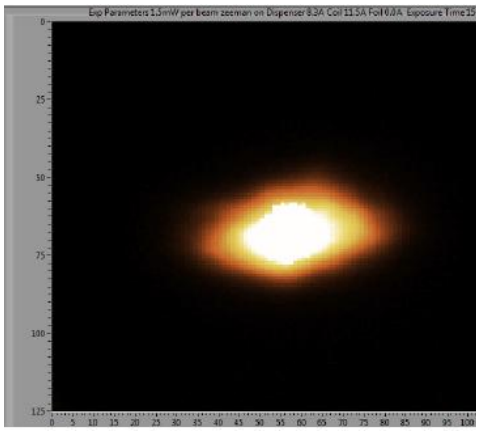

Fig. 1: Trapped Sr atoms in our 3D MOT chamber.

References:

[1] S. Schiller et al. "Towards Neutral-atom Space Optical Clocks (SOC2): Development of high-performance transportable and breadboard optical clocks and advanced subsystems" on "*Let's embrace space, volume II*" **45**, 452-463 (2012). ISBN 978-92-79-22207-8.

[2] www.soc2.eu