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Non-destructive detection in 87Sr optical lattice clocks

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Optical clocks have reached an impressive level of stability and accuracy.
Many of the systematic uncertainties can now be measured and controlled at the
fractional level of 10 −18 , with stability in the low 10 −16 at 1 s integration time.
The stability of the clocks is technically limited by the Dick effect, which is an
aliasing of high frequency noise projected in the low frequency range, hence
degrading the long term stability. In order to minimize this technical limitation, here we present a non–destructive detection of trapped strontium atom clock as opposed to the usual flourescence–based destructive detection system. Because the loading and atomic preparation time are less significant with respect to the duty cycle in this scheme, the result can lower the dead time and provide better stability. In addition, we will discuss how spin squeeze states can be used in this non-destrucitve detection setup to overcome the fundamental quantum limit. Here we also present a discussion about the accuracy budget in the 87Sr clocks at SYRTE with a special attention to the frequency shift on the clock transition due to the hot background gas collision with the cold atom clock.

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