

Evaluation of Systematic Shifts and Frequency Ratio of $5s^2\ ^1S_0$ - $5s5p\ ^3P_0$ Clock Transition for ^{87}Sr and ^{88}Sr Optical Clock

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We present our new, redesigned optical clock experimental setup in KL FAMO capable of both fermionic ^{87}Sr and bosonic ^{88}Sr clock operation for the purposes of measuring the frequency ratio of $5s^2\ ^1S_0$ - $5s5p\ ^3P_0$ clock transition and an evaluation of systematic shifts for the two isotopes. (*Abstract*)

Keywords—strontium optical atomic clocks; ^{87}Sr ; ^{88}Sr ; systematic shifts; clock frequency ratio; accuracy budget

I. INTRODUCTION

Since their introduction at beginning of the millennia, optical atomic clocks have paved the way for advances in various fields, for instance in- ultra-precise metrology [1,2,3], tests of fundamental physics [4,5], and search for dark matter in astrophysics [6,7,8]. With their ever-increasing precision, strontium-based optical clocks have already reached uncertainty levels of 10^{-18} s. Despite this rapid progress, there exist only a handful of measurements of the absolute frequency of the 1S_0 - 3P_0 clock transition [3,9,10,11,12] for either isotope. Here we present a redesign of our optical clock setup in KL FAMO which is capable of both bosonic ^{88}Sr and fermionic ^{87}Sr clock operation.

II. METHODS/RESULTS

To allow both fermionic and bosonic clock operation, we have redesigned and upgraded the pre-existing experimental setup which previously allowed only for bosonic clock operation. The upgraded setup is shown in Fig.1. We added additional cooling and stirring laser setups required for ^{87}Sr optical clock. We also added optical pumping beams and constructed additional magnetic coils needed for an optical pumping scheme which is required for clock operation due to the hyperfine structure of fermionic strontium. This experimental setup can measure the frequency ratio of $5s^2\ ^1S_0$ - $5s5p\ ^3P_0$ clock transitions in ^{87}Sr and ^{88}Sr , as well as evaluate systematic shifts for the two isotopes.

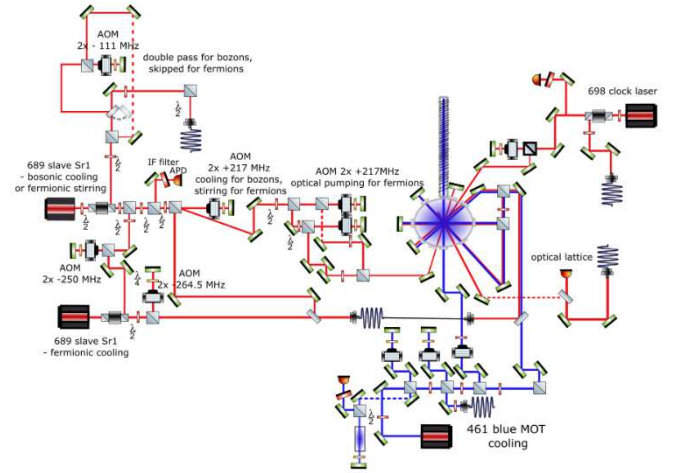


Fig.1. Scheme of new experimental setup in KL FAMO capable for both bosonic and fermionic strontium clock operation.

ACKNOWLEDGMENTS

The “A next-generation worldwide quantum sensor network with optical atomic clocks” project (TEAM/2017-4/42) is carried out within the TEAM IV Programme of the Foundation for Polish Science co-financed by the European Union under the European Regional Development Fund. This project has received funding from the EMPIR Programme co-financed by the Participating States and from the European Union’s Horizon 2020 Research and Innovation Programme (EMPIR JRP-s15 ROCIT). The measurements were performed at the National Laboratory FAMO (KL FAMO) in Toruń, Poland, and were supported by a subsidy from the Polish Ministry of Science and Higher Education.

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