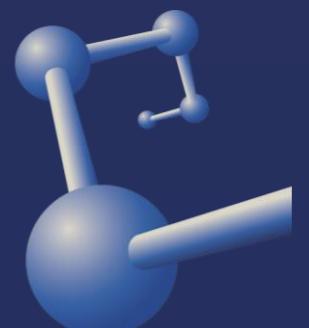


Zeeman Effect in the Forbidden Transition $5P_{3/2} \rightarrow 6P_{3/2}$ in Atomic Rubidium



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Introduction

Electric-quadrupole transitions are frequently used in atomic clocks based on optical lattices [1], and for frequency standards in quantum metrology [2].

The forbidden transition $5P_{3/2} \rightarrow 6P_{3/2}$ in Rb was first observed in [3], and now it is studied under the effect of a homogeneous magnetic field.

Atomic system

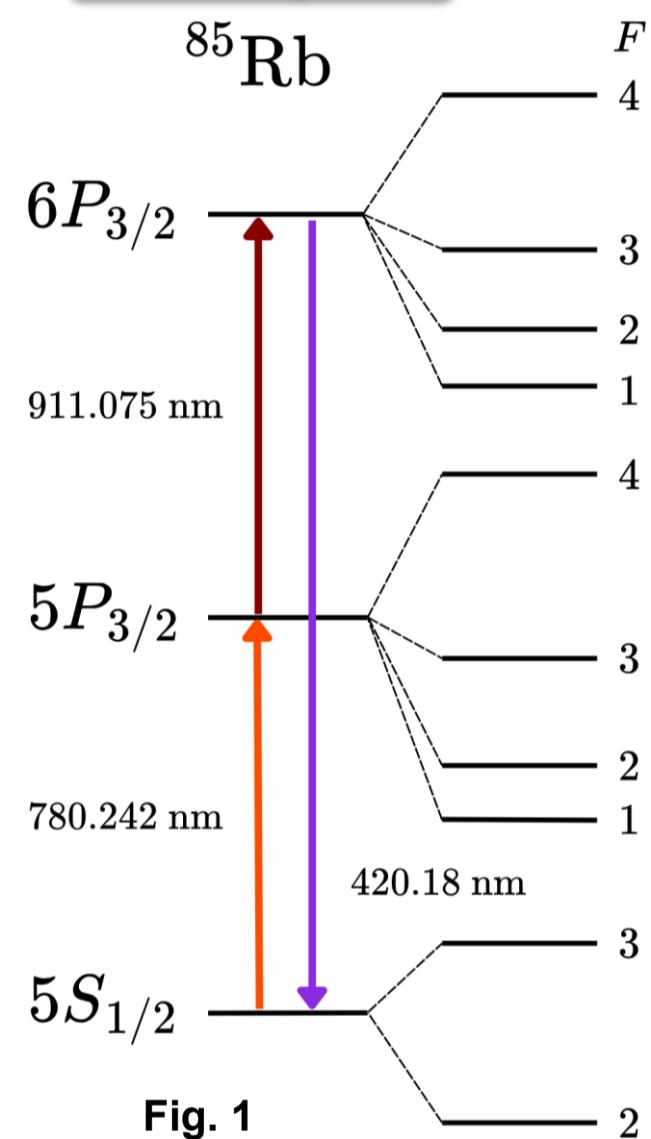


Fig. 1

Electric-dipole
 $\Delta F = 0, \pm 1$
 $\Delta M_F = 0$

Electric-quadrupole
 $\Delta F' = 0, \pm 1, \pm 2$
 $\Delta M_{F'} = \pm 1$

$$\vec{B} = B_0 \hat{z}$$

$$\vec{\epsilon}_{780}, \vec{\epsilon}_{911} \parallel \vec{B}$$

Conclusions

Theoretical prediction of lines positions agreed with the experimental data.

In low field limit, the $F_1 = 3 \rightarrow F_2 = 4 \rightarrow F_3$ cyclic transition is dominant.

Currently, we are working in the identification of transitions using Breit-Rabi diagrams, and in the calculation of line intensities.

References

- [1] Ludlow, A. D., Boyd, M. M., Ye, J., Peik, E., & Schmidt, P. O. (2015). Optical atomic clocks. *Reviews of Modern Physics*, 87(2), 637-701.
- [2] Roos, C. F., Chwalla, M., Kim, K., Riebe, M., & Blatt, R. (2006). 'Designer atoms' for quantum metrology. *Nature*, 443(7109), 316-319.
- [3] Ponciano-Ojeda, F., et al. (2015). Observation of the $5p_{3/2} \rightarrow 6p_{3/2}$ electric-dipole-forbidden transition in atomic rubidium using optical-optical double-resonance spectroscopy. *Physical Review A*, 92

Experiment

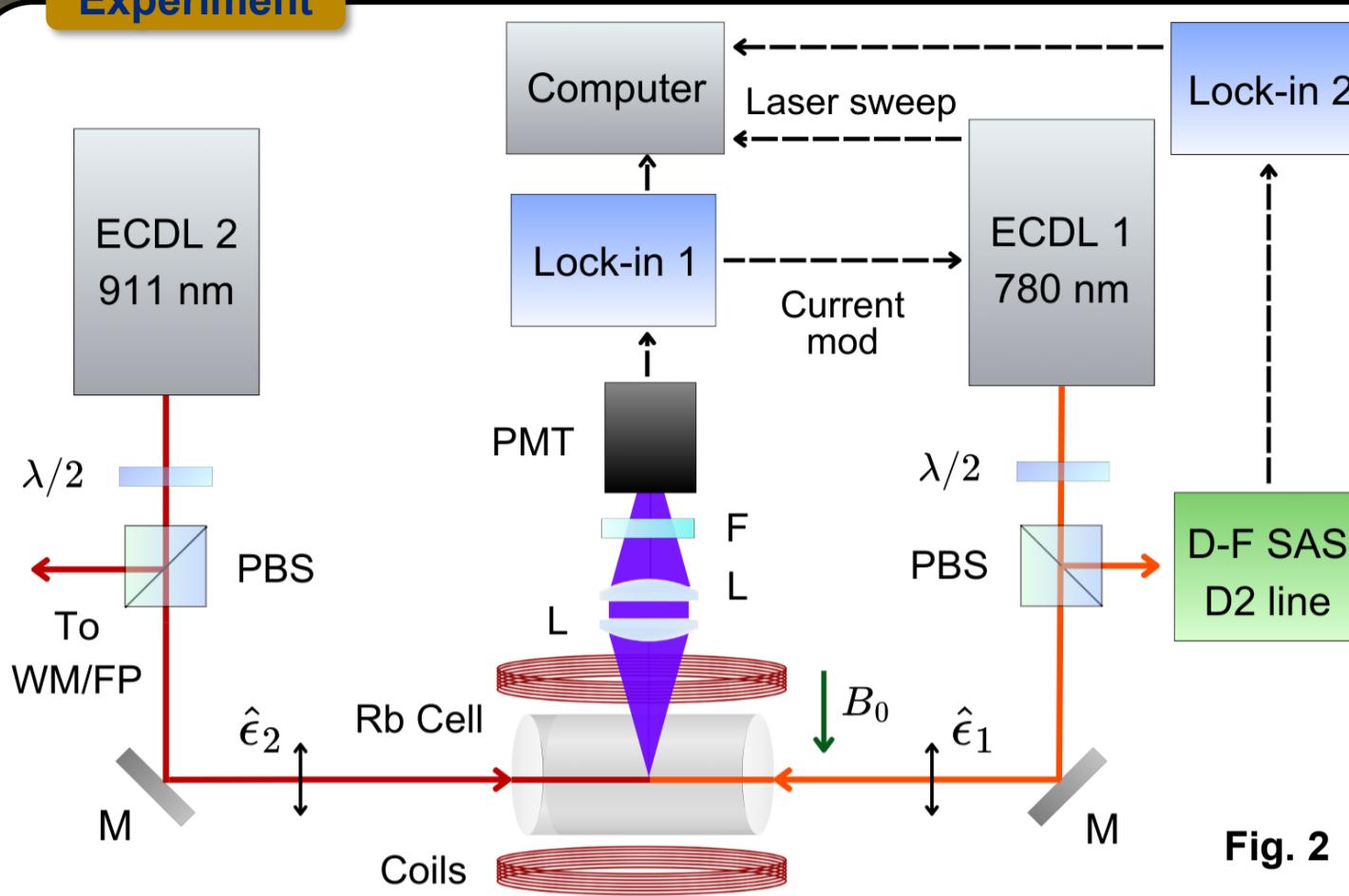


Fig. 2

ECDL: external cavity laser diode, PMT: photomultiplier tube, WM: wavemeter, FP: Fabry-Perot interferometer, PBS: polarized beam splitter, M: mirror, L: lens, F: 420 nm filter.

Results

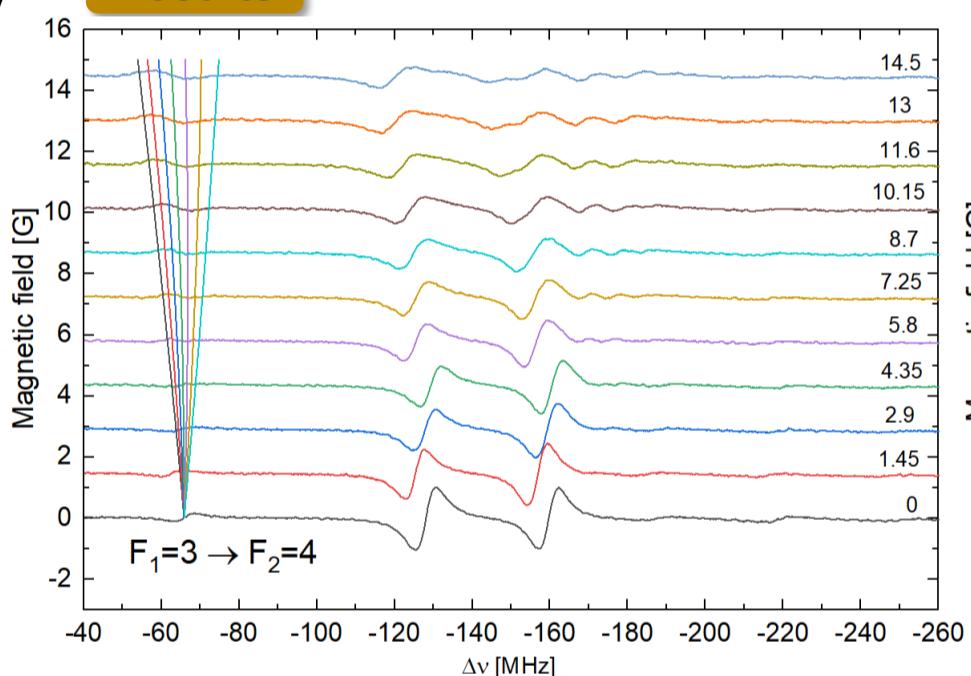


Fig. 3: Breit-Rabi diagram of the cyclic transition $F_1 = 3 \rightarrow F_2 = 4$, which produces the dominant lines of the forbidden transition spectrum.

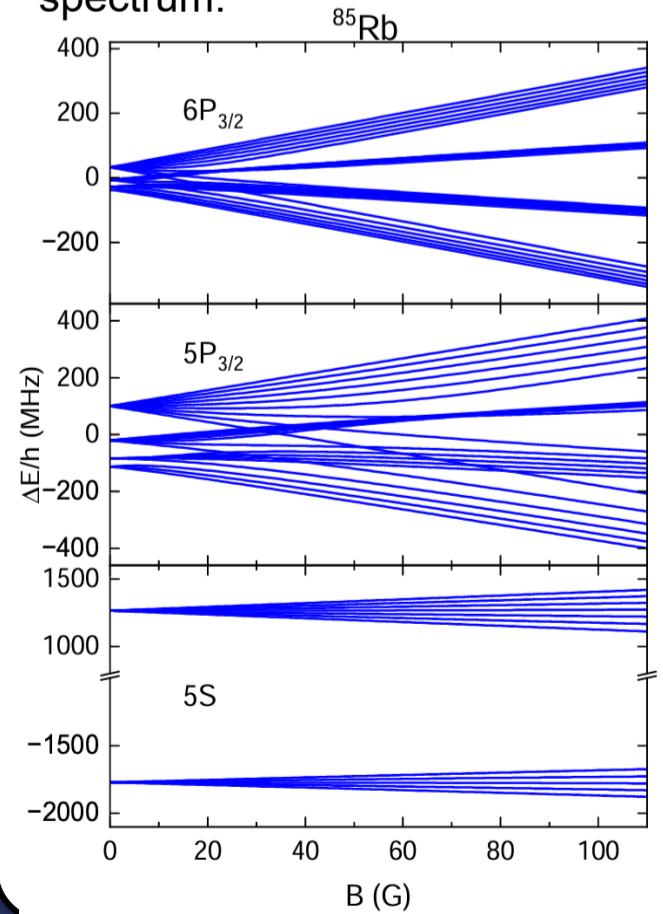


Fig. 5: Breit-Rabi diagrams of the involved states. $5S_{1/2}$, $5P_{3/2}$ and $6P_{3/2}$ frequency splittings are in low field limit, intermediate regime, and Paschen-Back limit at 100 G, respectively.

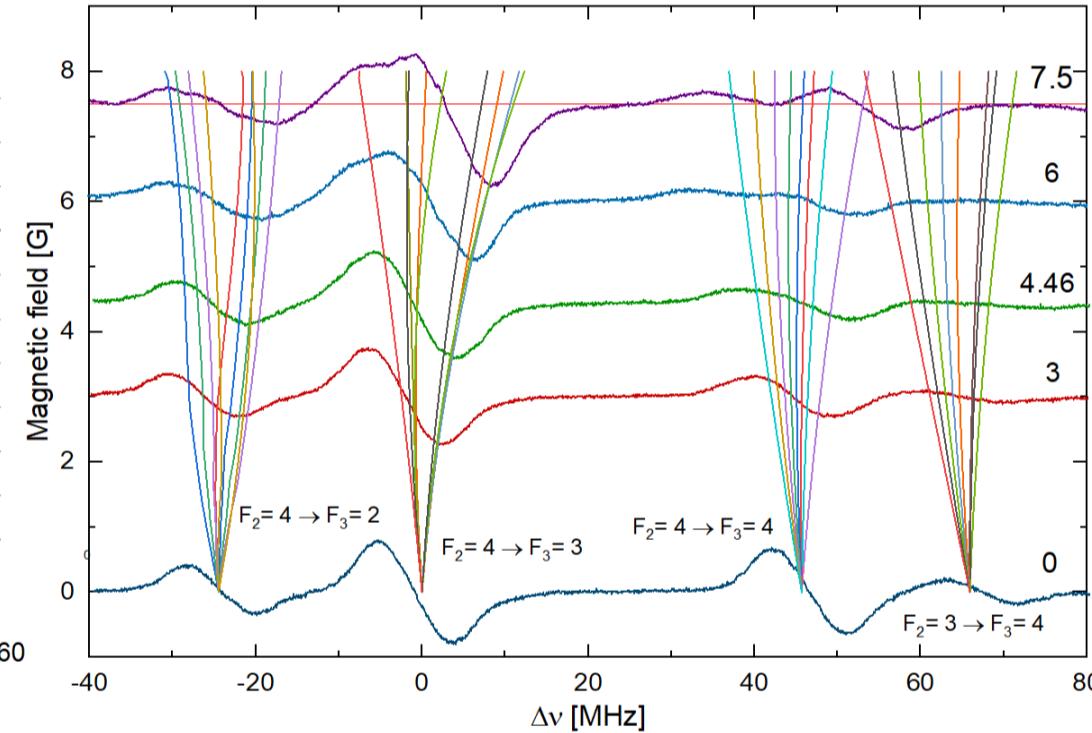


Fig. 4: Forbidden transition $5P_{3/2} \rightarrow 6P_{3/2}$ spectra in the low field limit. At zero field, the $F_2 = 4 \rightarrow F_3 = 2, 3, 4$ lines and the $F_2 = 3 \rightarrow F_3 = 4$ velocity-selected line due to ECDL 1 sweep are observed.

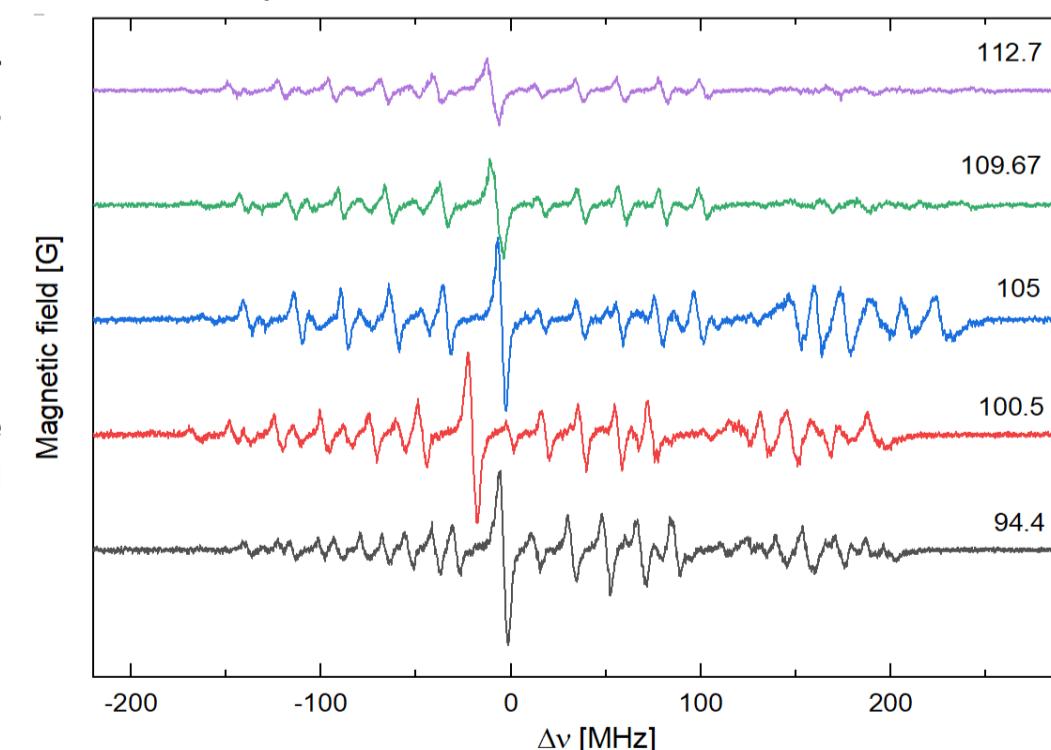


Fig. 6: Forbidden transition $5P_{3/2} \rightarrow 6P_{3/2}$ spectra in the Paschen-Back limit.

Acknowledgements

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