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Zeeman and Stark effects of Ba highly-excited states

Yuki Nojiri, Cheng Li, Hiroumi Ito, Masayuki Kawamura, Tatsuya Minowa and Wei-Guo Jin
Toho University, Japan

Zeeman and Stark effects, the interactions between the atom and magnetic or electric fields are very important for understanding the atomic structure. The fundamental spectroscopic data of the g factor and the electric polarizability are directly related to the atomic wave function and therefore, provide sensitive tests of theoretical calculations. As a heavy two-electron atom, Ba has rather complicated atomic structure together with strong configuration mixing in highly excited states and shows repeated interest to spectroscopists up to now. For the $5d6p$ configuration, the electric polarizabilities of 3D_1 and 3P_1 have been reported and found to have large different values. However, there are no data determined for 3F_1 . Data for 3F_1 are indispensable for checking the systematic behavior of the $5d6p$ configuration. Recently we have measured Zeeman and Stark effects for 3F_2 . In this paper we report measurements for 3F_3 and 3F_4 . The high-resolution atomic-beam laser spectroscopy was performed to measure Zeeman and Stark spectra. A tunable diode laser with an external cavity system together with a highly collimated atomic beam was used in this experiment. Laser-induced fluorescence was measured and magnetic or electric field was applied to atomic beam. Transitions from the metastable states $6s5d\ ^3D_1$ populated by an electric discharge were used. Figure 1 shows the measured spectrum at the zero field for the Ba $6s5d\ ^3D_3-5d6p\ ^3F_4$ transition at 705.9 nm; the peaks of ^{136}Ba and ^{138}Ba are marked and other peaks are the hyperfine structure of the odd-isotopes ^{135}Ba and ^{137}Ba . The insert in Fig. 1 is the measured Zeeman spectrum at the magnetic field 186.1 G which shows splittings by the magnetic field for ^{136}Ba and ^{138}Ba . Zeeman and Stark spectra were measured at various magnetic and electric fields and their shifts and splittings were derived. Therefore, the g factor and scalar and tensor polarizabilities were determined for $5d6p\ ^3F_3$ and 3F_4 . Together with the previously reported values on 3F_2 , systematic behaviors of the g factor and scalar and tensor polarizabilities for 3F_1 are discussed.

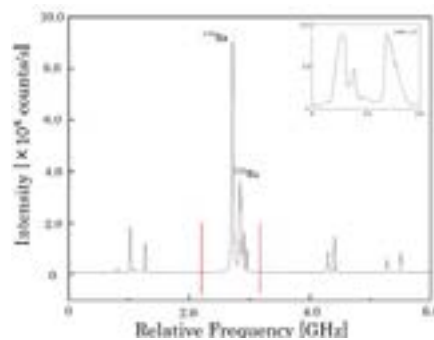


Fig 1. The observed spectrum of Ba $6s5d\ ^3D_3-5d6p\ ^3F_4$ transition at 705.9 nm at the zero field. The insert is the Zeeman spectrum observed at the magnetic field 186.1 G for ^{136}Ba and ^{138}Ba .

Biography

Yuki Nojiri after graduating from department of physics, Toho University, now he was a graduate student at Toho University. He is interested in atomic physics and currently doing high-resolution laser spectroscopy to study Zeeman and Stark effects.

6417006n@st.toho-u.ac.jp

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