Abstract

In a series of nine articles submitted as a doctoral thesis presented are results of precision spectroscopic measurements of atomic constants, such as *A* hyperfine structure constants, Lande g_J-factors, energies of previously unknown energy levels and isotope shifts in atomic lines. These measurements were performed for the following group of metal atoms: bismuth, antimony, thallium, lanthanum and praseodymium. The measurements were performed using high resolution emission spectroscopy (the radiation source was a discharge cell) and laser spectroscopy techniques. Two laser spectroscopy methods were used: optogalvanic spectroscopy (OG) and laser induced fluorescence (LIF) method. The source of free atoms was a hollow cathode discharge lamp filled with a buffer gas.

The set of publications presents the following experimental and theoretical results:

- The *A* hyperfine structure constants were determined for 10 atomic levels of bismuth (3 new constants) and 18 atomic levels of isotope ^{123}Sb (7 new constants). The results of measurements for antimony were used to reanalyse and revise the structure of Sb I.
- 14 new previously unknown energy levels were found in the lanthanum atomic structure.
- For 8 lines of antimony, measurements of the isotope shifts were made. The results of these measurements were used in the calculation to find the contributions from the field and mass effects.
- The Zeeman structure study was performed using the emission technique on atomic lines of bismuth, antimony and thallium. In the case of bismuth 10 Lande g_J - factors (5 new) were determined, in the case of antimony 18 g_J - factors (7 new) were determined, and in the case of thallium 18 new factors were determined. The results of measurements of Lande factors for antimony and thallium were used for theoretical analysis of the structure of these atoms.
- In the case of lanthanum, measurements of the Zeeman structure (presented in 4 publications) were performed for a total of 98 atomic lines and 78 new Lande g_J -factors were determined. These measurements were carried out using optogalvanic spectroscopy and LIF technique in the spectral range 562-668 nm using a ring dye laser operating on DCM and R6G dyes.
- In the case of praseodymium, the Zeeman structure measurements were made for 52 atomic lines using only the LIF technique with a dye laser working on R6G and as a result of the experiment 87 g_J -factors were determined, including 78 new ones.

In studies of the Zeeman structure a new experimental technique, which had previously been used in the measurement of the hyperfine structure, was used. Two methods of the laser absorption spectroscopy were used i. e. optogalvanic spectroscopy and the laser induced fluorescence method. The magnetic field was produced by a strong neodymium magnet generating a magnetic field of hundreds of Gauss in the observation region.