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A THEORETICAL STUDY OF THE INFLUENCE OF ALTERNATING ELECTRIC FIELDS ON THE FORMATION OF LINE PROFILES IN ARGON EMISSION SPECTRA

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Atomic spectroscopy methods are widely used for diagnostics of processes taking place in plasma. The plasma parameters such as the electron density and temperature of atoms can be estimated from profiles of the spectral lines emitted by plasma. The electric field is one of the most important factors that form the line profiles in atomic emission spectra. Calculating the Stark profiles and their convolutions with the Doppler ones for atomic spectral lines in alternating electric fields is very complicated problem in modern physics.

To solve this problem, we propose the unified theoretical approach based on the numerical solution of the non-stationary Schrцdinger equation. This approach is free from limitations of perturbation theory and is valid in wide ranges of the electric field strength and frequency. The algorithm of the suggested method is implemented in a special software package written in FORTRAN and Maple.

Within the framework of this approach, we succeeded in analyzing the influence of changes in the electric field strength and frequency on the spectral line profiles and on the shift direction of the spectral lines of the Ar atom in the electric field. In addition, a computer simulation within the framework of the suggested approach made it possible to estimate the contribution of the electric field to the processes of quenching of spectral lines and increasing their intensity.

As an illustration of potentialities of the proposed approach, Fig. 1 shows the shift of the $6d[1/2]_1$-$4p[1/2]_1$ spectral line of the Ar atom with an increase in the electric field strength and splitting of this line into the Stark components in the electric field (the electric field frequency is 10^5 MHz).

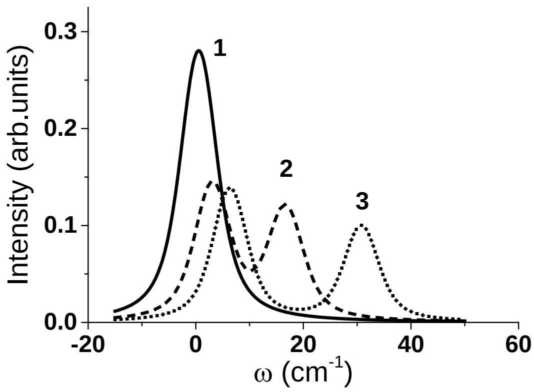

Fig.1. Evolution of the $6d[1/2]_1$–$4p[1/2]_1$ spectral line in the electric field:

1 – F=20 kV/cm,
2 – F=80 kV/cm,
3 – F=120 kV/cm.

These theoretical results are interesting from a theoretical viewpoint, and they have practical applications in plasma spectroscopy, laser physics, and in studying magnetic reconnection. Finally, the results obtained are useful for searching optimal operation modes of existing excitation sources and for constructing new devices.