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COMPUTER SIMULATION OF ATOMIC EMISSION SPECTRA IN ALTERNATING ELECTRIC FIELDS

E.V. KORYUKINA

National Research Tomsk State University, Tomsk, Russia

The interest in studying the influence of alternating electric fields on atomic emission spectra results from the necessity of solving many theoretical and practical problems of atomic spectroscopy, gas discharge physics and plasma diagnostics.

Theoretical methods based on non-stationary perturbation theory were developed for calculating atomic emission spectra in laser fields at the end of previous century. By the present time, a lot of other excitation sources (in particular, electrodeless high-frequency discharge lamps, light-emitting diodes, superpower lasers, and so on) have appeared. These sources generate electric fields with parameters essentially different from those of optical lasers. Perturbation theory, by virtue of its limitations, is not always suitable for calculating atomic spectra excited by electric fields of the above-mentioned sources.

In the present work, a theoretical approach is suggested for calculating the emission spectra of atoms in an alternating electric field. This approach, based on the numerical solution of the non-stationary Schrцdinger equation, is free from limitations of perturbation theory and suitable for calculations of atomic emission spectra in alternating electric fields with the parameters changing in wide ranges. The algorithm of the suggested method is implemented in a special software package written in FORTRAN and Maple [1].

The results of computer simulations obtained in the framework of the suggested approach have allowed us: (1) to study the dependences of the AC Stark effect on the electric field strength and frequency; (2) to reveal regularities in the behavior of the transition probabilities in the electric field; (3) to analyze the reasons for an increase in the intensity of spectral lines and their quenching in the electric field; (4) to investigate the mechanisms of the formation of the spectral line profiles in the electric field.

The theoretical regularities established in this work have been obtained for the first time. They are of interest both from a theoretical point of view and in solving practical problems of plasma diagnostics, magnetic reconnection, and other branches of physics where spectroscopic methods are used to study the influence of alternating electric fields on the properties of the object under study. In addition, the established regularities can be used to develop new excitation sources with required characteristics and to search for the optimal operating mode of existing sources.

REFERENCES

[1] E.V. Koryukina, "Software package StarkD for calculating atomic emission spectra in an alternating electric field," J. Phys.: Conf. Series, vol. 1141, Article Number 012053, 2018.