Universal description of the spectral line shape in magnetized plasmas [[1]](#footnote-1)\*)

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The measurement of the temperature and density of the plasma in the ITER divertor can be carried out using the analysis of the spectral line shape [1]. The problem of calculating the line profile is significantly complicated by the fact that, in order to analyze the ionic component, it is necessary to work with transitions between highly excited levels. As the principal quantum number grows, the number of radiative transitions grows rapidly. A new method for calculating the shape of spectral lines in a magnetized plasma is presented. With the help of it, it became possible to solve two serious problems in the theory of broadening of spectral lines 1) Description of the array of radiative transitions between excited atomic levels 2) Taking into account the influence of the thermal motion of ions on the shape of the spectral line. However, using the semiclassical approximation [2] and the frequency fluctuation model [3], these two problems can be solved. Using the symmetry of the Coulomb field for the diagonalization of the Hamiltonian [4], and the specific properties of the Wigner d-functions, one can obtain simple expressions for the intensity of the Stark-Zeeman components [5,6]. Thus, a universal description of the shape of spectral lines in plasma has been obtained, which takes into account the motion of ions, the presence of a magnetic field, as well as the electronic and Doppler mechanisms of broadening. Calculations for the Balmer series showed that the presented method is in agreement with precise quantum calculations. The universality of the method lies in the fact that the obtained quadrature formulas have the same form for arbitrarily large principal quantum numbers.

References

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/E/ru/HK-Letunov.docx) [↑](#footnote-ref-1)