The effects of ion dynamics on Stark-Zeeman spectra in plasma

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The analysis of the neutral hygrogen spectral line-shapes is often used for divertor plasma diagnostics [1]. However, it is necessary to deal with two fundamental difficulties to perform correct calculation of the spectral line profiles of hydrogen and its isotopes in tokamak divertor. Firstly, due to the simultaneous presence of the magnetic field created by the experimental set up and the electric plasma microfield, to diagonalize the atom Hamiltonian it is necessary to solve three-dimensional problem. Secondly, the plasma density in a divertor is relatively low: $N_e \approx 10^{13} - 10^{17}$ cm^{-3}. Under such conditions, it is necessary to take into account the effects of ion thermal motion on the spectral line formation in plasma. It is non-trivial problem to carry out numerical calculations taking into account both effects mentioned above. Nevertheless, in the present work the simple approach for performing such calculations is presented. The effect of ion thermal motion on Stark broadening is taken into account via Frequency Fluctuation Model (FFM) [2]. It is shown that the last modification of the FFM, performed by the authors of this work [3], leads the good agreement with molecular dynamics data.

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[3] Letunov A, Lisitsa V, Loboda P and Novikov A 2024 *JETP Letters* **120** 115–120