GENERALIZATION OF BALLISTIC MODEL TO TWO-DIMENSIONAL VELOCITY DISTRIBUTION OF ATOMS DURING RECYCLING OF HYDROGEN ISOTOPES IN TOKAMAK [[1]](#footnote-1)\*)

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A generalization of the ballistic model (BM) [1-3] of the velocity distribution function (VDF) of neutral hydrogen atoms, one-dimensional in velocity and their coordinate, for the case of a two-dimensional velocity distribution has been developed. Such a generalization is necessary for the use of BM for the interpretation of measurements of tokamak plasma radiation in the spectral lines of hydrogen isotopes along the lines of sight observing the first wall at oblique angles (not perpendicular), and for the development of synthetic H-alpha diagnostics in ITER.

BM [1-3] was developed as a simple, computationally efficient model that allows calculating the VDF of atoms and molecules of hydrogen isotopes in tokamak scrape-off layer (SOL) plasma by iteratively solving the kinetic equation for the VDF of atoms on top of a simplified solution of the kinetic equation for the VDF of molecules. BM takes into account the penetration of slow neutrals from the wall into the plasma, taking into account the dissociation of molecules into atoms and ionization of atoms and molecules, the charge exchange of slow neutral atoms on fast plasma ions, elastic and inelastic reflection of atoms from the wall, reflection of ions from the wall with their neutralization, and influx of molecules from the wall. Using the density and temperature profiles of ions and electrons in the SOL and the wall temperature as input data, the BM in the flat-layer approximation makes it possible to obtain the VDF of neutral molecules and atoms in the SOL. The BM was verified in [1, 3] by comparison with the results of the Monte-Carlo simulations with the EIRENE code [4] for the ITER SOL plasma conditions modeled by the SOLPS4.3 code [5].

The use of BM will make it possible to replace EIRENE simulations [4] in the H-alpha diagnostics, which will greatly speed up solving the inverse problem of recovering the flux density of atoms and molecules from the wall by fitting high-resolution spectra of Balmer-alpha lines in synthetic H-alpha diagnostics for ITER [6] and interpretation of experiments, for example, when improving the method used in [7] for JET. However, BM [1-3] is applicable only for lines of sight directed orthogonally to the first wall. In the BM, sought-for two-dimensional VDF is assumed to be symmetric in the polar angle and depends on projections of the velocity onto the directions parallel and perpendicular to the wall.

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