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DETERMINATION OF ENERGY OF HYDROGEN ATOMS FLYING IN FROM VACUUM CHAMBER WALL OF THE L-2M STELLARATOR BASED ON DOPPLER BROADENING OF Hα LINE *)

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Neutral Particle Analyzers (NPA) are often used at fusion facilities for determining the plasma ion temperature from data on the energy spectra of neutral particles produced in the course of charge exchange processes. In order to correctly interpret the measurement results of NPA diagnostics, it is necessary to know such parameters as the radial profile of neutrals density and neutral flow out of plasma. These parameters can be obtained by means of simulating the penetration of atoms from the vacuum chamber wall into the plasma. In this case, one of the most important parameters is the energy of hydrogen atoms penetrating into the plasma. The density of atoms penetrating into the central plasma regions exponentially depends on the velocity of primary neutrals flying in to the plasma [1]. Therefore, experimental measurements of the energy of neutrals flying in to the plasma are very important for determining the neutrals density at the plasma axis.

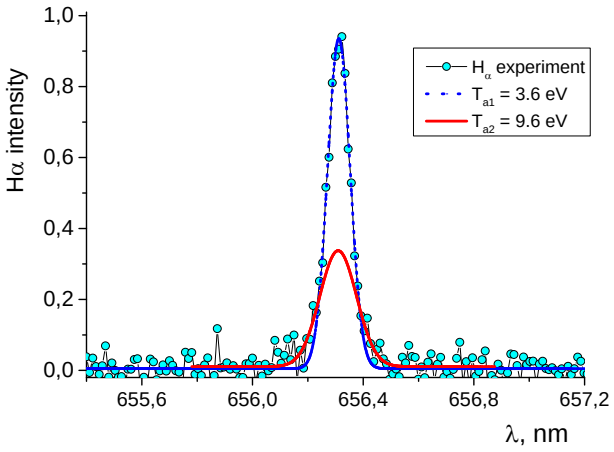

Рис. 1. Форма спектральной линии H_α., измеренная в эксперименте

At the L-2M stellarator, in the ohmic heating regime, the temperature of hydrogen atoms penetrating into the plasma from the wall was measured using the data on the Doppler broadening of the H_α line. Figure 1 shows the shape of the H_α spectral line measured in the experiment. It is evident that the line shape can be approximated by two Gaussian dependences corresponding to the temperatures T_i = 3.6 and 9.6 eV. Analysis of the shape of the measured line makes it possible to estimate the ratio of the numbers of particles with velocities corresponding to the first and second temperatures as ~3:1. When simulating the penetration of neutrals to the plasma center, it is customary to assume the energy of neutrals coming from the wall to be 2 eV [2]. In this work, in simulations, the neutrals flow from the wall was set to be the sum of components with energies of 3.6 and 9.6 eV, the average plasma density was 1.8×10^{19} m^{-3}, and the on-axis electron and ion temperatures were 350 and 80 eV, respectively, which corresponds to the parameters of the ohmic heating regime of the L-2M stellarator. Simulations showed that the density of neutrals at the plasma axis increases by an order of magnitude, as compared to the simulation results for a single-component neutral flow.

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