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APPLICATION OF THE METHOD OF RELATIVE HELIUM LINE INTENSITY TO DETERMINE THE HELICON LOW-TEMPERATURE PLASMA PARAMETERS *)

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Optical emission spectroscopy (OES) is a passive diagnostic of a helicon plasma source, in which plasma is generated in a magnetic field using radio frequency radiation. Such a source generates high-density plasma (~10^{18} m^3) and operates in a wide range of energy and geometric parameters [1]. The OES of the PN-3 installation makes it possible to study the parameters of the plasma flow in the difficult to observe arreas for other diagnostics - in a transparent quartz tube under the helicon and ICR antennas.

To determine plasma characteristics using OES, the main issue is the choice of the atomic system. The most convenient atomic systems for measuring electron temperature are neutral helium and helium-like ions. The ratio of the dependences of the cross sections of singlet and triplet transitions strongly depends on the energy of the incident electron:

$$R^{int/dip} = \frac{1}{2f_{ji}} \cdot \frac{1}{\frac{E}{\Delta E_{ji}}^2 \cdot \ln \frac{E}{\Delta E_{ji}}} \text{ for } \frac{E}{\Delta E_{ji}} > 1 \quad (1)$$

The electron temperature is determined from the measured intensity ratio values [2].

$$\frac{I_1}{I_2} = \frac{\upsilon_1 \cdot \langle \sigma_1 \cdot \mathrm{v} \rangle_1 \cdot A_1 \cdot \sum A_k^{(2)}}{\upsilon_2 \cdot \langle \sigma_1 \cdot \mathrm{v} \rangle_2 \cdot A_2 \cdot \sum A_k^{(1)}} \quad (2)$$

$\upsilon_1, \upsilon_2 -$ transition frequences, $\langle \sigma_1 \cdot \mathrm{v} \rangle_1$, $\langle \sigma_1 \cdot \mathrm{v} \rangle_1$-effective excitation cross sections averaged over the Maxwellian distribution, A_1, A_2, A_k-transition probabilities.

To determine T_e, we used the dependence of the cross section ratio of the singlet transition 3s 1S and 2p 1P (728.14 nm) to the triplet transition 3s 3S and 2p 3P (706.57 nm) for He I [3, 4].

At the PN-3 facility, this method was used to determine the spatial temperature distribution for helium and argon plasma (using the injection of helium atoms into the plasma in small quantities). The electron temperature profiles determined using OES are in good agreement with the results of processing the results of probe measurements.

The resulting Te profiles make it possible to determine the radial distribution of neutral atoms and the degree of ionization.

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