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A Collisional Radiative Model of Hydrogen Plasmas Developed for Diagnostic Purposes of Negative Ion Sources

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A collisional radiative model of low-pressure hydrogen plasmas is elaborated and applied in optical emission spectroscopy diagnostics of a single element of the matrix source of negative hydrogen ions [1]. The planar-coil inductive discharge studied is sustained at a frequency of 27 MHz by rf power varied in the range P = (90 – 160) W. The collisional radiative model accounts for the main processes determining both the population densities of the first ten states of the hydrogen atom and the densities of the positive hydrogen ions H^+, H_2^+ and H_3^+. In the calculations the electron density and electron temperature are varied whereas the gas temperature is included as an external parameter experimentally obtained [2]. The ratio of the H_α to H_β line intensities is calculated from the numerical results for the excited state population densities, obtained as a solution of the set of the steady-state rate balance equations. The comparison of measured and theoretically obtained ratios of line intensities yields the values of the electron density and temperature as well as of the degree of dissociation, i.e. of the parameters which have a crucial role for the negative ion production.

References

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