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Title:

Towards more reliable ground state density analysis by solver-assisted line ratio methods cross-checked with two-photon laser absorption

Abstract:

The emission line ratio methods, such as optical actinometry, in many cases suit for determination of the ground state density of emitting particles in plasma. However, these methods rely on electron excitation cross-sections, corona equilibrium and (often) an assumption of a Maxwellian EEDF, neglecting possible deviations of EEDF from a Maxwellian profile.

To tackle these potential deviations, a new method in which EEDF is calculated iteratively using a Boltzmann solver, is proposed and analysed. For validation of this approach the number densities of a few atomic species were measured in an rf-discharge operating with various gas mixtures in wide pressure range (2 - 300 Pa). The apparent agreement between the methods is good at low pressure; however, showing certain deviations when pressure approaches 100 Pa, which may indicate the presence of self-absorption and/or side excitation mechanisms in plasma. The deviations between the classical (Maxwellian) actinometry, iterative actinometry and laser-based diagnostics are discussed.