Contribution ID: **866** Type: **Poster**

4P77 - Simplified Radiation Model for Atmospheric Plasmas

Thursday 27 June 2019 16:00 (1h 30m)

The use of stark broadening in plasma diagnostics is a common tool to derive information about electron density and temperature distributions. In contrast, only limited theoretical work is available, which can be used to interpret experimentally acquired spectra. Current ab initio models do not give a sufficient explanation on the driving effect of radiation interaction with the plasma particles especially in gas mixtures, which are of great importance for technical applications. This work seizes the concept of a radiation model, which calculates the net energy emission intensity within a given spectral window for a specific gas mixture. The line profile in this case derives from a quantum physical description of the dominant effect on spectral lines for thermal plasma –Stark Broadening.
The model is built on a simplified geometry. Here a plasma cylinder is situated between two electrodes. However, it incorporates radiative emission and absorption phenomena of spectral lines depending on the underlying electron density distribution and influencing the same vice versa. The model generates information on the spectrally resolved net emission intensity and calculates the resulting electron density and temperature profile for a given input current and a given distance to a cooling wall.
The method proposed has been calculated for pure Argon and Argon-Helium gas mixtures and compared to experimental spectra as well as plasma parameters acquired from Thomson scattering measurements. As a next step calculation of gas mixtures including metal vapor such as Argon Aluminum are planned.

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Session Classification: Poster - Charged Particle Beams and Accelerators and High Energy Density Plasmas and Applications

Track Classification: 1.2 Computational Plasma Physics;