EFFECT OF SPACE CHARGE WAVES ON THE ELECTRON ENERGY DISTRIBUTION FUNCTIONS IN A LOW PRESSURE NITROGEN-OXYGEN PLASMA

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The effect of resonance space charge waves on the electron energy distribution function (EEDF) has been an unresolved issue for determining the enhancements in radio frequency (RF) induced photo-emission in the ionosphere. Comparisons of experiment, Particle-In-Cell (PIC) Monte Carlo Collision (PIC-MCC) and Boltzmann Transport models have shown good agreement in EEDF for an equilibrium high frequency RF breakdown in various molecular gases. However, an equilibrium EEDF greatly underestimates the photo-emission intensities observed in High Frequency (HF) induced ionosphere photo-emission[1]. In this work, we investigate the effect of induced resonance waves on the EEDF of an ionospheric plasma using a PIC-MCC model. We compare the relative impact of the vibrational and electronic excitations versus the effect of resonance waves on the non-thermalized EEDF. The resulting changes in photo-emission intensity from the simulated ionospheric plasma in the infra-red and visible wavelengths are determined. In addition, the effect of variations in measured gas reaction rates and cross-sections gathered from multiple experiments are examined. This investigation provides a possible range of photo-emission intensities that may be observed in experiment and helps differentiate from the enhancement to photo-emission due to resonance waves.

1. Gustavsson, B., and B. Eliasson, HF radio wave acceleration of ionospheric electrons: Analysis of HF induced optical enhancements, J. Geophys. Res., 113, 2008 p. A08319.

* Work supported by Air Force Research Laboratory