Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

Spectroscopy Measurements of Air Breakdown Initiated with a Focused 110 GHz, MW-Level Quasioptical Gyrotron Beam[1] JASON HUMMELT, SAM SCHAUB, MICHAEL SHAPIRO, RICHARD TEMKIN, Plasma Science and Fusion Center, Massachusetts Institute of Technology — We present spectroscopic measurements of air breakdown that is created with a focused 110 GHz gyrotron beam at fluxes exceeding 1 MW/cm^2. Excitation, rotational, and vibrational temperature measurements are made over the pressure range of 1-100 Torr. The gyrotron power is varied to measure the behavior of these plasma temperatures as the field is raised above the threshold field required for breakdown. Rotational temperature measurements of the plasma show minimal gas heating, with gas temperatures in the range of 300-500 K. The vibrational and excitation temperatures were measured to be on the same order and vary between 4200-6200 K and 0.4-0.65 eV, respectively. In order to calculate the excitation temperature it was necessary to include the deviation from Local Thermodynamic Equilibrium (LTE) in the analysis because the electron density of the discharge is not high enough to satisfy the conditions for LTE. The excitation temperature is observed to vary little with applied field, while the vibrational and rotational temperatures increase as the field is increased above threshold. The temperature measurements indicate that the plasma is in a state of thermal non-equilibrium, with heavy ions and neutrals heated by collisions with much hotter electrons.

[1]This work was supported by AFOSR grant FA9550-09-1-0363 on the Basic Physics of Distributed Plasma Discharges.

David Tax
Massachusetts Institute of Technology

Date submitted: 13 Jul 2012 Electronic form version 1.4