GEC14-2014-000096

Abstract for an Invited Paper
for the GEC14 Meeting of
the American Physical Society

Optical emission spectroscopy at different timescales: nanoseconds, microseconds, milliseconds[1]

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Analysis of plasma optical emissions can provide a simple, non-invasive way of measuring key plasma parameters such as the electron temperature and electron density. Due to the short radiative lifetimes of excited states, the plasma emissions can be used to track the near-instantaneous state of time-varying plasmas. Using a small set of argon emission lines along with a low-resolution spectrometer we have monitored the effective electron temperature, electron density, and number densities of long-lived excited Ar($3p^5 4s$) atoms in near real-time (update rate 10 Hz, T=100 ms) for an inductively-coupled plasma (ICP) under a wide variety of plasma conditions.[2] When this same set of Ar emission lines are measured with a faster time-response by using a monochromator/PMT, the plasma conditions on a microsecond timescale can be monitored in pulsed plasmas. Time-resolved measurements of neon emission lines at an even higher time resolution ($\sim$ 5 ns) have been used as a probe for the presence of high energy electrons which occur during only select portions of the 13.56 MHz rf cycle in Ne/Ar ICP discharges.[3]

[1]This work was supported by NSF grants CBET 0714600 and PHY-1068670.

[2]J. Vac. Sci. Technol. A **31** (2013) 021303.

[3]J. Phys. D: Appl. Phys. **45** (2012) 382001.