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Inferring argon plasma properties from optical emission: the role of metastable atoms[1] R.O. JUNG, JOHN B. BOFFARD, CHUN C. LIN, R. DING, Y.-H. TING, Y. YANG, A.E. WENDT, University of Wisconsin-Madison —
Collisions between electrons and Ar atoms are primarily responsible for the characteristic plasma glow of Ar discharges. The intensity of a given emission line depends upon both the electron energy distribution (EED) and the excitation cross sections for populating the excited levels. Since the EED also drives the plasma chemistry, there is a need for non-invasive diagnostics of the EED in plasmas for industrial processing. One obstacle in using optical emission spectroscopy (OES) of the plasma glow as a diagnostic is that only electrons in the highest energy range of the EED have enough energy to excite atoms directly from the Ar $3p^6$ ground state. Due to the much lower energy threshold, and much larger cross sections, excitation from atoms in $3p^4 4s$ metastable levels can contribute substantially to plasma emissions. Recent measurements of excitation cross sections into $3p^5 5p$ levels (λ: 395-470 nm) from the Ar metastable levels [1] allow us to exploit the role of metastable atoms to probe the low energy range of the EED. Verification of this OES technique with simultaneous Langmuir probe (for the EED) and optical absorption (for the metastable density) measurements is underway.
[1] R. O. Jung, et al, Phys. Rev. A **75**, 052707 (2007).

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