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Understanding Plasma Optical Emission Diagnostics using Ar Excitation Cross Sections[1] JOHN B. BOFFARD, R.O. JUNG, CHUN C. LIN, AMY WENDT, University of Wisconsin-Madison — Electron-atom collisions are the primary excitation mechanism of low-temperature plasmas. Nevertheless, the emissions of most lines are the result of many excitation channels: direct excitation from the ground state, excitation into higher levels that radiatively cascade into the level of interest, and excitation from long-lived metastable atoms in the plasma. Incorporating these processes into a radiative model, we have used Ar emissions to determine the electron energy distribution functions of inductively coupled plasmas[1]. Emissions from the Ar($3p_5$) and Ar($3p_9$) levels, at 419.8 nm and 420.1 nm respectively, are found to exhibit a particularly interesting intensity ratio that is very sensitive to plasma conditions. The 420.1/419.8 line ratio varies from ~ 1 at high electron temperatures (T_e), to ~ 3 at low T_e. These variations can be explained in terms of the nearly equal ground state optical emission cross sections, and the vastly different cross sections out of the metastable levels[2]. We explore the atomic physics that drives this particular line ratio and how it can be used to non-invasively measure the electron temperature of argon containing plasmas.

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[2] Phys. Rev. A **75**, 052707 (2007).

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