Abstract Submitted
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Optical diagnostics of Ar plasmas using $3p^5 5p \rightarrow 3p^5 4s$ emissions with consideration of excitation out of metastable levels[1] R.O. JUNG, JOHN B. BOFFARD, CHUN C. LIN, A.E. WENDT, University of Wisconsin-Madison — For argon plasmas, optical emissions corresponding to $3p^5 4p \rightarrow 3p^5 4s$ (668-1150 nm) are often exploited for diagnostic purposes. Metastable atoms, having large electron-impact excitation cross sections and potentially high densities in a plasma can contribute significantly to these emissions. At high densities however, $3p^5 4p \rightarrow 3p^5 4s$ emissions can be strongly reabsorbed by metastable atoms, misleading results. In a 600 W, 1 mTorr ICP, our white light absorption measurements give a metastable density of $\sim 2 \times 10^{10}$ cm^{-3}. Here the observed $2p_6 \rightarrow 1s_5$ branching fraction is 0.24 in contrast to the expected value of 0.71 in the absence of radiation trapping. This discrepancy is resolved by accounting for radiation trapping. Emissions from $3p^5 5p \rightarrow 3p^5 4s$ (395-470 nm) however, are less affected by radiation trapping, making them favorable candidates for optical diagnostics. We have combined our $3p^5 5p \rightarrow 3p^5 4s$ optical emission, metastable density, and Langmuir probe measurements for a series of ICP conditions (1-25 mTorr, 10-800 W) with previously measured cross sections in order to develop a self-consistent model.

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