Abstract Submitted for the GEC17 Meeting of The American Physical Society

Non-invasive plasma diagnostics using oxygen optical emissions<sup>1</sup> JOHN BOFFARD, NATHANIEL LY, CHUN C. LIN, AMY WENDT, University of Wisconsin - Madison — The optimization and control of technological plasmas is facilitated by measurements of plasma properties. Non-invasive diagnostics based on optical emission spectroscopy (OES) rely on the prediction of recorded spectral features, using an emission model accounting for processes related to the excitation and de-excitation of photon-emitting species. Here we implement an emission model for low-pressure oxygen plasmas. We have measured the emission spectra of low pressure oxygen inductively coupled plasmas in the 350-900 nm wavelength range, yielding both atomic O lines and a few  $O_2^+$  molecular ion bands. The model takes the intensities as inputs, returning values of dissociation fraction, and electron density and temperature, which we benchmark against  $O_2/Ar$  actinometry and Langmuir probe measurements, respectively. Trends (pressure: 1-30 mTorr, RF power: 100-2000 W) reveal that the  $O_2^+$  emissions have a complicated dependence on the electron density. The dominant excitation mechanism shifts from simultaneous ionizationexcitation of  $O_2$  molecules at very low plasma densities to excitation of ground state  $O_2^+$  ions at higher densities, for which it is also found that electron-induced quenching suppresses emissions from long-lived radiative levels.

<sup>1</sup>Supported by NSF Grants PHY-1617602 and PHY-1068670

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Date submitted: 01 Jun 2017

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