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Benchmarking the Resonances in Photoionization of O II

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Synopsis Study of accurate resonant features of O II is crucial in predicting its abundances in nebular plasmas and for its diagnostic role. A well known large discrency exists in the predicted abundance of the ion depending on the radiative or collisional processes taken in to consideration. We will report new calculations for resonant structures in photoionization of O II where we have noted important features not seen before, especially in the low-energy region of the three fine structure components of $2s^22p^2\ ^3P$ of core O III. These are expected to make considerable differences in the low temperature recombination. Preliminary comparison of the new results with experiments shows improved agreement.

A recent advancement has been made [1] in inclusion of relativistic two-body interactions to the existing Breit-Pauli R-matrix (BPRM) method [2] that includes one-body correction terms. This provides an important scope to reexamine more accurately the atomic physics of the long-standing discrepancy of predicted O II abundances in low temperature astrophysical plasmas when calculated from collisional excitations or recombinations. Our calculations reveal sharp and high-peak resonant structures, not seen before, very close to the ionization threshold of the ground state and in between the fine structure levels $^3P_{0,1,2}$ of the residual ion O III. These could be of importance in the recombination of O III to O II at low energies and temperatures and narrowing down the discrepancy in the abundances.

The new calculated structures are being compared with the three sets of experimental measurements carried out for the ion, two at Advanced Light Source in Berkeley [3, 4] and one using the synchrotron radiation source with an improved modulator by Aarhüs University [5]. The comparison of the new calculation with experiment shows the presence of O II ions in the ground state $2s^22p^3(^4S^o_{3/2})$, and excited levels $^2D^o_{3/2,5/2}$ and $^2P^o_{1/2,3/2}$ of the ground complex. In addition, we identify some observed resonances corresponding to much higher levels of ^4P, that is, of $2s2p^4(^4P_J)$. These additional resonances were missing in the earlier comparison [6].

References

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