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O(^1D) Relaxation by O(^3P)

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We report laboratory investigations on the relaxation of O(^1D) by O(^3P) atoms. The literature values for the rate coefficient of this process deduced from atmospheric observations and theoretical calculations differ by more than an order of magnitude. No previous laboratory measurement of this rate coefficient is available, despite its importance in determining the energy flow in the upper atmosphere and controlling the intensity of atomic oxygen emissions.

In the experiments, the 157-nm output of a fluorine laser photodissociates molecular oxygen to produce O(^1D) and O(^3P) atoms. The temporal evolution of the O(^1D) concentration is monitored by detection of the 630-nm atomic oxygen red line emission. Our experiments show that O(^1D) relaxation by O(^3P) atoms is a rapid process and needs to be accounted for in atmospheric models. We discuss the relevance of our results to atmospheric observations and ionospheric heating experiments.