Laboratory Studies of O$_2$ Excited States Relevant to the CO$_2$ Planets: The O$_2$ c-a Emission in the Nightglow of Venus

Konstantinos S. Kalogerakis, Oleg Kostko, and Kate Storey-Fisher
SRI International, Molecular Physics Laboratory, Menlo Park California, United States (ksk@sri.com)

Knowledge of the details relevant to the production of excited O$_2$ is critical for the study and modeling of composition, energy transfer, airglow, and transport dynamics in CO$_2$ planetary atmospheres. Significant gaps and uncertainties exist in our understanding of the above processes, and often the relevant input from laboratory measurements is missing or outdated.

We are performing laser-based laboratory experiments to investigate the O-atom three-body recombination responsible for the generation of oxygen airglow in the upper atmosphere of Venus and Mars. In the laboratory, an ultraviolet light pulse from a laser photoinitiates O-atom recombination in a CO$_2$ environment. Spectroscopic techniques are used to probe the excited O$_2$ molecules produced following recombination and subsequent relaxation in CO$_2$. Our recent results indicate that the O$_2$ c-a emission is strongly enhanced by collisions with CO$_2$ and can even exceed the O$_2$ c-X Herzberg II emission intensity at sufficiently high CO$_2$ pressures.

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