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Laboratory Studies of Vibrational Relaxation: Important Insights for Mesospheric OH

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The hydroxyl radical has a key role in the chemistry and energetics of the Earth's middle atmosphere. A detailed knowledge of the rate constants and relevant pathways for OH(high v) vibrational relaxation by atomic and molecular oxygen and their temperature dependence is absolutely critical for understanding mesospheric OH and extracting reliable chemical heating rates from atmospheric observations.

We have developed laser-based experimental approaches to study the complex collisional energy transfer processes involving the OH radical and other relevant atmospheric species. Previous work in our laboratory indicated that the total removal rate constant for OH(v = 9) + O at room temperature is more than one order of magnitude larger than that for removal by O_2. Thus, O atoms are expected to significantly influence the intensity and vibrational distribution extracted from the Meinel OH(v) emissions. We will report our most recent laboratory experiments that corroborate the aforementioned result for OH(v = 9) + O and provide important new insights on the mechanistic pathways involved. We will also highlight relevant atmospheric implications, including warranted revisions of current mesospheric OH models.

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