MILLIMETER AND SUBMILLIMETER STUDIES OF $O(^1D)$ INSERTION REACTIONS TO FORM MOLECULES OF ASTROPHYSICAL INTEREST

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While both the number of detected interstellar molecules and their chemical complexity continue to increase, understanding of the processes leading to their formation is lacking. Our research group combines laboratory spectroscopy, observational astronomy, and astrochemical modeling for an interdisciplinary examination of the chemistry of star and planet formation. This talk will focus on our laboratory studies of $O(^1D)$ insertion reactions with organic molecules to produce molecules of astrophysical interest. By employing these reactions in a supersonic expansion, we are able to produce interstellar organic reaction intermediates that are unstable under terrestrial conditions; we then probe the products using millimeter and submillimeter spectroscopy. We benchmarked this setup using the well-studied $O(^1D)$ + methane reaction to form methanol. After optimizing methanol production, we moved on to study the $O(^1D)$ + ethylene reaction to form vinyl alcohol (CH_2CHOH), and the $O(^1D)$ + methyl amine reaction to form aminomethanol (NH_2CH_2OH). Vinyl alcohol measurements have now been extended up to 450 GHz, and the associated spectral analysis is complete. A possible detection of aminomethanol has also been made, and continued spectral studies and analysis are underway. We will present the results from these experiments and discuss future applications of these molecular and spectroscopic techniques.