MAR16-2015-020072

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Reaction Product Identification in Extreme Chemical Environments by Broadband Rotational Spectroscopy[1]

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Molecular rotational spectroscopy has several advantages for detection of reaction intermediates and products under extreme laboratory conditions. Rotational spectroscopy has high sensitivity to the molecular structure and provides high spectral resolution in low pressure environments. Furthermore, quantum chemistry provides accurate estimates of the spectroscopic parameters. As a result, rotational spectroscopy can identify molecular species in complex reaction mixtures without the need for chromatographic separation and without the need for a previously recorded "library spectrum" of the molecule. The application of chirped pulse Fourier transform rotational spectroscopy methods for the identification of molecules of astrochemical interest formed in pulsed discharge sources will be described including recent advances for high-throughput mm-wave spectroscopy. The set of reaction products created in the experiment can provide insight into the reaction mechanism. Reactions involving the CN radical will be discussed. These reactions can be barrierless making them candidates for interstellar gas reactions. The possibility that interstellar cyanomethanimine is produced by gas phase radical-neutral reactions instead of surface chemistry on grain-supported ices will be discussed using recent spatially resolved chemical images in Sagittarius B2 observed with the Jansky Very Large Array.

[1]This work supported by NSF CHE 1213200