The role of UV photolysis and thermal processing in interstellar ice chemistry

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It has been shown through both laboratory and observational studies that direct and cosmic-ray induced UV photodissociation drives a complex network of chemistry in interstellar ices. Astrochemical models have demonstrated that gradual heating of these UV-processed ices during star formation can lead to a wide variety of complex organic molecules. Additional modeling and observational studies have shown that these molecules are likely incorporated into protoplanetary disks and participate in the chemistry of planet formation. These processes could therefore serve as molecular starting points for prebiotic chemistry in the universe. Our observations of the chemistry of star-forming regions have shown that there is wide variation in the chemical compositions of hot cores, and that methanol photodissociation on icy grains may be the key process feeding the formation of larger prebiotic molecules. To test possible chemical routes in interstellar ices, we have built a novel laboratory experiment that couples the traditional tools of ice studies – FTIR spectroscopy and mass spectrometry – with the structure specificity of rotational spectroscopy. Such measurements can provide the "ground truth" to guide observations of star- and planet-forming zones. In this talk I will present both the observational and laboratory studies and discuss these results in the context of prebiotic astrochemistry.