Crossed Beams Studies on the Formation of Aromatic Molecules in Extreme Environments. Brant M. Jones,[1,2] Fangtong Zhang,[1] Pavlo Maksyutenko,[1] Christopher J. Bennet,[1,2] Xibin Gu,[1] Alexander M. Mebel,[3] and Ralf I. Kaiser[1,2], [1]Department of Chemistry, University of Hawai`i at Manoa, Honolulu, HI 96822, [2]Nasa Astrobiology Institue, University of Hawai`i at Manoa, Honolulu, HI 96822, [3]Department of Chemistry and Biochemistry, Florida International University, Miami, FL 33199.

Introduction: During the last decades, polycyclic aromatic hydrocarbons (PAHs) and related compounds such as their anions, cations, partially hydrogenated systems, and hetero-atom substituted molecules have received considerable attention in astrochemistry, astrobiology, and in combustion chemistry. However, as of to date, no experiment has been conducted under true single collision conditions in which the simplest building blocks of PAHs, were probed experimentally. We have investigated the formation of benzene, the phenyl radical and phenylacetylene under single collision conditions utilizing a crossed molecular beams instrument with supersonic sources of ethynyl (CCH), dicarbon (CC), 1,3-butadiene and benzene molecules together with their partially deuterated counterparts. The data are combined with electronic structure calculations to verify the experimentally derived reaction mechanisms.

This talk presents an overview of how molecules can be formed in extraterrestrial environments both in the gas phase and in interstellar ices. First, an overview of the crossed molecular beams apparatus will be presented; we will show how this instrument can be used to help elucidate the formation of the molecular species, observed within the gas phase of the interstellar medium and Saturn's satellite Titan as a case study. PAHs are thought to be linked to the formation of carbonaceous, interstellar grains. In cold molecular clouds, these grains can hold temperatures as low as 10 K thus acting as natural cold traps for molecular species to be condensed upon. The second part of the talk expands on these grains and presents how astrobiologically important molecules can be formed in these ices as condensed on interstellar grains via ionizing radiation. Finally, we present an overview of our newly designed surface scattering machine simulating the space environment of the carbonaceous grains and the molecules deposited upon them and the effects that the galactic radiation has on these compounds. The coupling of these instruments will allow an unprecedented understanding of how complex molecular species such as sugars, amino acids, and even polypeptides can be produced within the interstellar medium.