EXAMINING ANOMALOUS PHOTOCHEMISTRY IN THE DENSE INNER WIND OF IRC+10216 THROUGH ALMA OBSERVATIONS OF HC_3N

MARK A. SIEBERT, *Department of Astronomy, University of Virginia, Charlottesville, VA, USA*; MARIE VAN DE SANDE, *School of Physics and Astronomy, University of Leeds, Leeds, UK*; THOMAS J. MILLAR, *School of Mathematics and Physics, Queen's University Belfast, Belfast, United Kingdom*; ANTHONY REMIJAN, *NAASC, National Radio Astronomy Observatory, Charlottesville, VA, USA*.

In recent years, many questions have arisen regarding the chemistry of CN-bearing molecules in the carbon-rich winds of evolved stars. To address them, it is imperative to constrain the distributions of such species through high angular resolution interferometric observations of multiple rotational transitions. To that end, we used several archival ALMA observations to image high energy rotational transitions of cyanide-bearing molecules in the inner envelope (< 8") of the carbon star IRC+10216. The observed lines include the J = 38 - 37 and J = 28 - 27 transitions of cyanoacetylene (HC_3N), and the J = 18 - 17 (K = 0 - 9) transition of methyl cyanide (CH_3CN). In contrast to previous observations of photochemical products in the same source, the maps of these molecular lines show spatially coincident, compact morphologies comprising various arcs and loops, with significant enhancement in dense clumps at an angular distance of $\sim$3" (350 AU) from the central AGB star. Considering the known gas phase formation mechanisms of these molecules, our results are consistent with photochemistry occurring in warm ($\sim$200 K) knots present in the inner regions of this circumstellar envelope. Using visibility sampled LIME radiative transfer models accompanied by the results of a specialized photochemical model, we explore the possibility that the enhanced HC_3N abundances in the inner wind are due to a binary companion supplying UV photons to this region. In this talk, I will discuss the results of this analysis, and demonstrate how they may impact our understanding of circumstellar carbon chemistry at the final stages of stellar evolution.