THE ALMA SPECTRUM OF IRC+10216

JOSE CERNICHARO, MARCELINO AGÚNDEZ, FABIEN DANIEL, *Departamento de Astrofísica, Centro de Astrobiología CAB, CSIC-INTA, Madrid, Spain*; ARANCHA CASTRO-CARRIZO, *IRAM, IRAM, Grenoble, France*; NURIA MARCELINO, *ALMA, National Radio Astronomy Observatory, Charlottesville, VA, USA*; CHRISTINE JOBLIN, *IRAP, Université de Toulouse 3 - CNRS, Toulouse, France*; MICHEL GUÉLIN, *Institut de Radioastronomie Millimétrique, Observatoire de Paris, Paris, France*; JAVIER GOICOECHEA, *Departamento de Astrofísica, Centro de Astrobiología CAB, CSIC-INTA, Madrid, Spain*.

We report the detection in IRC+10216 of lines of HNC J = 3-2 pertaining to nine excited vibrational states with energies up to $\sim$5300 K. The spectrum, observed with ALMA, also shows a surprising large number of narrow, unidentified lines that arise in the vicinity of the star. The HNC data are interpreted through a 1D-spherical non-local radiative transfer model, coupled to a chemical model that includes chemistry at thermochemical equilibrium for the innermost regions and reaction kinetics for the external envelope. Although unresolved by the current early ALMA data, the radius inferred for the emitting region is $\sim$0.06 (i.e., 3 stellar radii), similar to the size of the dusty clumps reported by IR studies of the innermost region ($r < 0.3$). The derived abundance of HNC relative to H_2 is $10^{-8} < X(HNC) < 10^{-6}$, and drops quickly where the gas density decreases and the gas chemistry is dominated by reaction kinetics. Merging HNC data with that of molecular species present throughout the inner envelope, such as vibrationally excited HCN, SiS, CS, or SiO, should allow us to characterize the physical and chemical conditions in the dust formation zone.

The interpretation of ALMA observations of C-rich evolved stars will require spectroscopic studies of highly excited states of HCN and HNC including accurate determination of l-doubling frequencies for all combination vibrational levels involving the bending mode. Several l-doubling transitions for which laboratory data allow the determination of their frequencies have been identified in the spectrum of IRC+10216.