MOLECULAR SPECTROSCOPY IN SPACE: DISCOVERING NEW MOLECULES FROM LINE SURVEYS AND LABORATORY SPECTROSCOPY

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The increasing sensitivity offered by the new generation of radio astronomical receivers and radio telescopes (single dishes and radio interferometers) has provided an enormous impact in our capacity to study the molecular content of interstellar and circumstellar clouds. Astronomers face now the challenging problem of interpreting the thousands of lines detected in hot cores which arise from isotopologues and vibrationally excited states of most known molecules. Although all strong features have been already assigned to abundant species, many of the lines still pending to be assigned could arise from very abundant molecular species having low dipole moment and/or very large partition functions.

The only way to address this problem in astrophysics is through a close collaboration between astrophysicists and laboratory spectroscopists. In this talk I am going to present the results obtained over the last 10 years in interpreting the line surveys of Orion gathered with the 30m IRAM radio telescope and with ALMA. The most recent molecule found in this cloud is methyl isocyanate, CH$_3$NCO, for which near 400 lines have been found in Orion in the 80-280 GHz domain. This molecule has an abundance only a factor 5-20 below that of the well-known species HNCO and CH$_3$CN. The molecule has been also found towards the giant cloud SgrB2 in the galactic center.

Finally, I will present the case of the submillimeter spectrum of the carbon-rich evolved star IRC+10216 in which we have recently found Si$_2$C with an abundance similar to SiC$_2$. Our recent ALMA observations in a narrow band of 20 GHz around 265 GHz show near 200 features corresponding to the J=3-2 transition of hot HCN (vibrational levels up to 11000 cm$^{-1}$). In addition to HCN lines, a forest of several hundreds of U lines dominates the spectrum. Most of these lines arise from molecules that condensate very quickly into dust grains.

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