Colloquium

SFB 956

Conditions and Impact of Star Formation

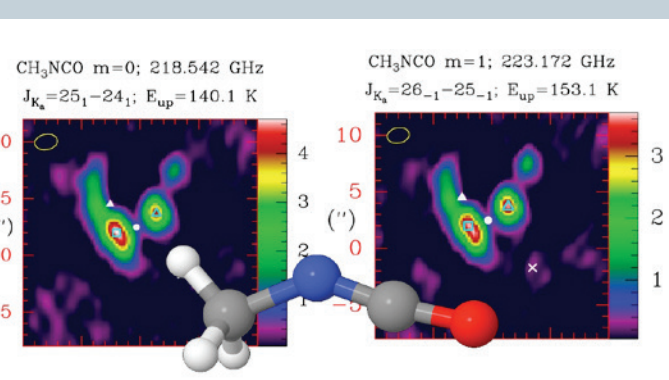
27 November 2017

Monday 3:00 pm

Physikalische Institute Köln

Lecture Hall III

Zülpicher Straße 77 | 50937 Köln



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Intriguing Extraterrestrial Tales of Molecules CH_3NCO and CH_2CHCN

Recently, there have been thought provoking astrophysical developments concerning the molecules methyl isocyanate (CH_3NCO) and acrylonitrile (CH_2CHCN). The associated stories connect in a rather unorthodox manner the spectroscopy of the interstellar medium, of the Solar System and in the laboratory. Two distinct stories will be covered in the talk. The first originates in the Rosetta mission finding that the hitherto astrophysically overlooked CH_3NCO was rather abundant on the 67P/Churyumov-Gerasimenko comet surface. Following this impulse the molecule was readily detected both in Sagittarius B2 and in Orion KL. The hindrance to earlier astrophysical detection of CH_3NCO arose from the inability to fit the mm-wave rotational spectrum to experimental precision, due to complications from a combination of two low-frequency internal motions. Nevertheless, recording of the complete laboratory mmw spectrum allowed unambiguous detection of 399 lines of CH_3NCO in IRAM 30m and ALMA spectra of Orion (Astronomy & Astrophysics 587, L4, 2016). It turns out that CH_3NCO could have been detected even in various legacy spectra if only suitable laboratory data was available, and its addition to astrophysical reaction schemes seems desirable.

The second story concerns the acrylonitrile molecule. This was not expected to hold many astrophysical surprises, since interstellar transitions of its isotopic species and of rather highly excited vibrational states have been detected as a result of extensive laboratory work (also carried out in Köln). However, identification of atmospheric acrylonitrile on Saturn's moon Titan (Science Advances 3, e1700022, 2017) turned out to be rather newsworthy in the context of theoretical predictions that it might be a building block of vesicle structures possible in the liquid methane environment on Titan. Atmospheric modeling suggested that the measured stratospheric abundance would be sufficient to lead to near-saturation of acrylonitrile in the surface methane lakes facilitating the hypothesized more complex, life related chemistry.