DECIPHERING HIGH-RESOLUTION INFRARED MOLECULAR SPECTRA ONE BY ONE

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High-resolution infrared (IR) spectroscopy is a valuable tool to identify astrophysical relevant molecules in space via their characteristic transition line pattern. Opposed to radio and mm- observations, at IR wavelengths, also molecules with no permanent dipole moment, like CO_2 and C_3, can be detected. Furthermore, to obtain a comprehensive view on the physical and chemical processes in the gaseous envelopes of aging stars, observations at various wavelengths are necessary, i.e., beside microwave, and optical observations also IR contributions are important. The downside of IR is the limited transparency of the terrestrial atmosphere which required telescopes to be situated at high altitude, like the IRTF on Mauna Kea/Hawaii, or until recently, the SOFIA airborne observatory.

In contrast, the space telescope JWST has an unrestricted view on the sky. With the MIRI spectrometer, it also has a broad spectral range, from $5-28\ \mu$m. This opens up the possibility of discovering new small molecules in the infrared spectra of late-type stars or other environments. Here, MIRI′s spectral resolution of R=2000−3000 allows the detection of rotational vibrational transitions of small diatomic and triatomic molecules as well as characteristic vibrational bands of larger molecules. However, in order to obtain such a detection, the spectral signature of these molecules need to be known beforehand from precise laboratory studies.

This poster will show how molecules such as Si_2C[1], C_3, TiO[2], Al_2O[3] and VO are experimentally produced in cold supersonic jets by laser ablation processes and how these species are analyzed using quantum cascade lasers and high-resolution infrared spectroscopy.

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