ASTROPHYSICAL OBSERVATIONS OF MOLECULES IN THE INFRARED REGION WITH HIGH SPECTRAL RESOLUTION

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Our universe is full of molecules. Most molecules have been discovered with the help of radio or MM telescopes based on their rotational spectra in the interstellar medium or in circumstellar envelopes around old stars. But molecules can also be detected unambiguously in the infrared (IR) range, and even those that do not have a permanent electric dipole moment, such as CO_2, C_3 or Al-O-Al. This is an advantage of IR astronomy. Once IR high-resolution laboratory spectra are available, they can be used to identify molecules from astrophysical observational data provided that also these data are available at high spectral resolution. The molecular envelopes around aging stars provide an excellent opportunity to study molecular species. For this purpose, own observations were made at the IRTF telescope on Mauna Kea, Hawaii and with the SOFIA aircraft telescope on selected astronomical objects. Example IR spectra from the hypergiant VY CMa and NML Cyg, as well as observations of variable AGB stars such as Mira (o Cet), Chi Cyg, IK Tau, and R Cas will be presented. With the help of the high-resolution spectra, molecular abundances, ambient temperatures, and dynamical processes can be determined. This will be demonstrated on the molecules silicon monoxid (SiO) and ammonia (NH_3).