LABORATORY INFRARED SPECTROSCOPY AND ITS APPLICATION FOR ASTRONOMICAL OBSERVATIONS

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When the nuclear fuel of a star is exhausted and the temperature of the stellar surface drops to a few thousand Kelvin, small molecules containing refractory elements such as silicon, carbon, titanium or aluminum can be formed. In the outer regions of the stellar atmosphere and at decreasing temperatures, these molecules can build dust grains, which are partially destroyed by atmospheric shocks and the strong radiation field outside the stellar envelope. The shells of late-type stars, such as the carbon-rich star IRC+10216 or the oxygen-rich star VY Canis Majoris, contain a large variety of these small molecules. Most molecular detections and observations were made at mm- and submm-wavelengths, while some molecules, especially the centro-symmetric species, lacking a permanent electrical dipole moment, were observed through ro-vibrational transitions in the mid- and far-infrared range. The spectroscopic data for astronomical observations stem from laboratory groups worldwide, whose results are made available in the form of spectral line lists via molecular databases.

The talk presents techniques to produce and spectroscopically investigate short-lived reactive molecules, like Si$_2$C, $^{13}$CCC, TiO and AlO. Recent results of the laboratory astrophysics group in Kassel and astronomical observations will be presented.