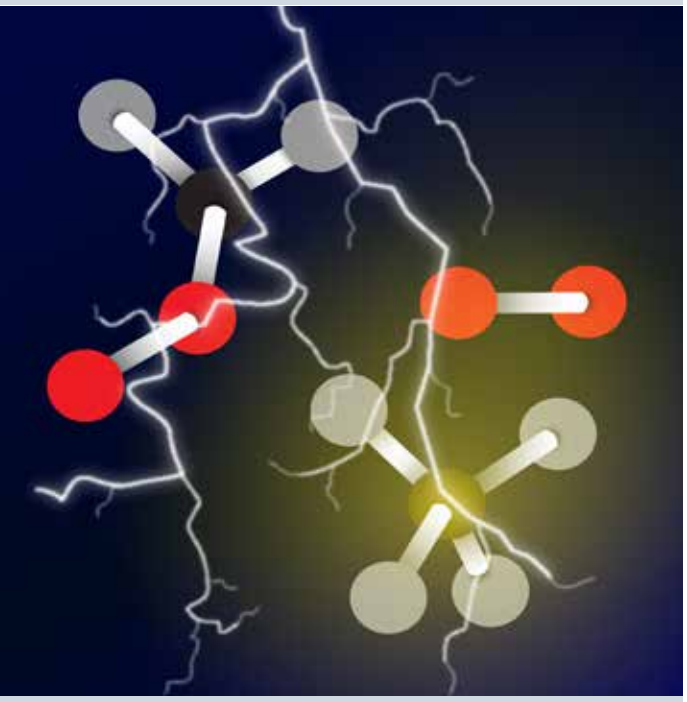
Colloquium

SFB 956

Conditions and Impact of Star Formation

17.11.2014
Monday 10:30 am

I Physikalisches Institut Köln
KOSMA room
Zülpicher Straße 77 | 50937 Köln



Michael C. McCarthy
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Strange Bonds and Odd Angles: Exploring the Fascinating World of High-energy Isomers using Rotational Spectroscopy

Fourier transform (FT) microwave spectroscopy of supersonic molecular beams has developed into a remarkably sensitive technique for detecting and structurally characterizing transient species such as radicals, carbenes, highly-energetic isomers, and both positively- and negatively-charged molecular ions, which, once formed, often react at the gas-kinetic or Langevin rate. Although laboratory detection remains challenging, the rotational spectra of several hundred entirely new carbon, silicon, sulfur, and oxygen-bearing molecules have been detected by these means in our laboratory with collaborators and colleagues. Precise molecular geometries have been determined by means of isotopic substitution for nearly one-half of the newly found molecules.

This talk will provide a broad overview of our recent work, illustrating with a few specific examples the power of our laboratory techniques, and how these techniques can be applied to detect and characterize key reactive intermediates that are believed to play important roles in combustion, atmospheric, and interstellar chemistries. Many of the results are of general interest to the chemical physics community; they contribute to comparative studies of bonding between different elements in the Periodic Table, providing further evidence of the rich architecture of the chemical bond; and establish important benchmarks for theoretical chemistry. Recent work on reactive oxygen molecules such as HOON, dihydroxycarbene (HOCOH), and the simplest Criegee intermediate (CH_2OO), will be highlighted.

Technological innovation is also an implicit part of our work. The feasibility of using chirped and cavity FT microwave spectroscopies to rapidly detect and automatically group spectral lines to entirely new species based on chemical and other assays, elemental composition, and exhaustive spectral cross-correlations using double resonance techniques will be discussed. Such methodologies may have important practical implications for analytical chemistry and ‘library-free’ detection.