SYML 1: From First Molecules to Life

Time: Wednesday 11:00–13:00 Location: e415

Invited Talk SYML 1.1 Wed 11:00 e415

Laboratory studies of interstellar molecules: from the first molecules to complex organics in space — •Holger Kreckel — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Modern telescopes have detected more than 180 different molecules, bearing witness to a surprisingly rich interstellar chemistry network that operates efficiently at extremely low densities and temperatures. The key to the molecular complexity in the gas phase are reactions between molecular ions and neutral atoms and molecules, as this class of reaction is often exothermic and barrier-less and therefore proceeds even in low-temperature environments. However, many of the key interstellar species are highly reactive under terrestrial conditions and thus difficult to study in the laboratory.

I will report on laboratory studies that simulate the formation of molecular hydrogen in the early universe and describe the merged beams technique that allows for the determination of energy-resolved rate coefficients for interstellar applications. Furthermore, I will introduce the planned neutral-ion collision setup at the Cryogenic Storage Ring (CSR) of the Max Planck Institute for Nuclear Physics (Heidelberg). This new experimental development aims at the study of ion-neutral collisions relevant for the formation of key species like water and complex organic molecules, under true interstellar conditions.

Invited Talk SYML 1.2 Wed 11:30 e415

Detecting astrophysically relevant ions in laboratory and space — •Stephan Schlemmer — 1. Physikalisches Institut, Universität zu Köln

Ions play a pivotal role in the astrophysics of the interstellar medium as they are readily formed by cosmic ray ionisation. They are also key species to understand the physics and chemistry of many other environments. Todays radio telescopes like the Atacama Large Millimeter Array (ALMA) and the airborne observatory SOFIA are sensitive enough to detect those species in space. In fact, many molecules and in particular some ions are first detected in space. However, laboratory spectra are missing as they are difficult to record due to their transient, i.e. highly reactive, nature. In recent years various methods of action spectroscopy have been developed in our group to overcome these limitations. In all cases changes in the rate of chemical reactions are imposed by excitation of the parent, mass selected ion. Recording the product formation in ion traps as a function of the excitation frequency results in the respective molecular spectra. Examples include mid-resolution vibrational, as well as high-resolution ro-vibrational and pure rotational spectra. In this presentation the methods are introduced and recent examples related to astrophysical searches in the radio frequency range will be discussed.

Invited Talk SYML 1.3 Wed 12:00 e415

Interstellar ice - a hot topic — •Harold Linnartz — Leiden Observatory, University Leiden

The talk reviews laboratory based studies of interstellar ice analogues. The physical and chemical processes at play upon UV irradiation and atom bombardment are discussed. It is shown how water and complex organics - building blocks of life - form in the solid state and how photodesorption rates help to understand the formation of planets.

Invited Talk SYML 1.4 Wed 12:30 e415

Exoplanets: The Thorny Path to Habitable Conditions — •Manuel Güdel — Dept. Astrophysics, University of Vienna

Habitable conditions on planetary surfaces evolve as a consequence of complex interactions between the host star, the planet itself, and a variety of solid bodies in interplanetary space. The long journey toward habitability begins in the protoplanetary disk, the birthplace of planets; here, important molecules such as water and organics form, but also protoplanetary bodies grow and eventually accrete gas envelopes from the disk. At later stages, outgassing and colliding smaller bodies begin to form a secondary atmosphere with important molecular ingredients such as nitrogen, carbon dioxide and water. Meanwhile, the evolving stellar conditions, in particular stellar high-energy radiation and ionized winds, influence the evolution of the atmosphere, potentially leading to its severe erosion. In this presentation, I will describe the intricate interplay between these factors and discuss conditions that need to be met before a planet can become habitable.